$\mu$Analyst 2000
MODEL 2200

# INTERACTIVE TIMING ANALYZER

# User's Manual

NORTHWEST INSTRUMENT SYSTEMS, INC.

Manual Package No: 00965
Manual Text No: 00843

## WARRANTY

Northwest Instrument Systems, Inc., warrants this product against defective material and workmanship, under normal use, for a period of one year from the date of sale. At the option of Northwest Instrument Systems, Inc., proven defects covered by this warranty will be corrected either by repair or replacement.

This warranty applies only to products manufactured by Northwest Instrument Systems, Inc. This warranty does not apply if the product has been modified, altered, or serviced by other than Northwest Instrument Systems, Inc., or its authorized service representative. Furthermore, this warranty does not apply if the product has been damaged by misuse, abuse of any kind, misapplication, or accident.

If warranty repair is required, call one of the authorized service representatives listed in the *User Update Policy* at the front of this manual. Or, call Northwest Instrument Systems, Inc., (1-800-547-4445) for assistance in locating the authorized service center nearest you.

Service will not be performed without proof of purchase showing purchase date. All instruments must be securely packaged in their original packing material, or the equivalent, to prevent damage during shipment.

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SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

## Electromagnetic Emissions

The μAnalyst™ 2000 system has been designed to minimize emitted and conducted electromagnetic energy. Tests have shown that when properly installed with an IBM® or IBM-compatible personal computer that meets FCC Class B emission standards, the μAnalyst system meets or exceeds applicable standards.

Each owner is subject to the non-interference requirements of Section 15.803 of the FCC Rules. In effect, Section 15.803 states that the operator of a computing device may be required to stop operating his device if it is found that the device is causing harmful interference and it is in the public interest to stop operation. Operation may not resume until the interference problem is corrected.

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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 2200 Interactive Timing Analyzer, as part of the μAnalyst 2000™ instrumentation system.

The manual explains the features of the Interactive Timing Analyzer and describes all operating menus, displays, and hardware connections. It also shows how to use the Interactive Timing Analyzer in time-aligned acquisitions with the Model 2100 Interactive State Analyzer.

A special feature of the manual is the demonstration session in Section 7. This session gives you the opportunity to operate the Interactive Timing 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 Timing Analyzer and its key features. It also lists the analyzer's components and specifications. |
| Installation | Section 2 shows how to install the Interactive Timing 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 Timing Analyzer's key features and their modes of operation. |
| Menus | Section 5 covers all operational and mechanical aspects of the Interactive Timing Analyzer menus. |

| | |
|---|---|
| State & Timing Together | Section 6 describes how to use the Interactive Timing Analyzer in time- aligned acquisition with the Model 2100 Interactive State Analyzer. |
| Demonstration | Section 7 provides hands-on exercises that use the Interactive Timing Analyzer to acquire data from a demo circuit board. |
| Appendices | Appendices at the back of the manual provide reference information, such as conversion charts and data file formats. |

Each section in the manual is preceded by a tabbed page so that information can be referenced easily.

# PRODUCTS COVERED BY THIS MANUAL

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

μAnalyst 2000 Mainframe

Model 2200 Interactive Timing Analyzer (ITA)

ITA Memory Board

ITA Trigger Board

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 Interactive 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 may be operated in conjunction with the Model 2200 Interactive Timing Analyzer.

**Model 2100(2100E) Interactive State Analyzer**

The Model 2100(2100E) can be configured with up to 80 channels of acquisition at speeds up to 10 MHz. It provides five sample clocks and two hold clocks that can be used to acquire data from virtually any type of microprocessor system. You can operate this product independently within the mainframe, or you can use it in time-aligned acquisition with the Interactive Timing Analyzer.

The Model 2100(2100E) comes equipped with its own user's manual.

**Time Stamp Board**

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 disassemblers are currently under development. Contact Northwest Instrument Systems, Inc., for additional information.

# 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

# CONTENTS

## Section 3: Getting Started



## Section 4: Modes of Operation

**Section 5: Menus**

**Section 5: Menus (continued)**

**Section 5: Menus (continued)**



**Section 6: State & Timing Together**

## Section 6: State & Timing Together (continued)



## Section 7: Demonstration

## LIST OF ILLUSTRATIONS

# LIST OF TABLES

**Using this section.** This section introduces you to the μAnalyst 2000 and its Model 2200 Interactive Timing Analyzer (ITA). It describes the key product features, components, and specifications.

## SECTION CONTENTS

## DESCRIPTION

The Model 2200 Interactive Timing Analyzer (ITA) is a high-speed hardware analysis and troubleshooting tool. It features up to 16 channels of acquisition with sampling rates as fast as 100 MHz. It also features 5 ns glitch detection, transition timing, and sophisticated edge and level triggering.

The timing analyzer's hardware consists of a memory board, a trigger board, and three data acquisition probes. This hardware installs in the expansion slots located within the μAnalyst 2000 Mainframe.

Once installed, the timing analyzer is controlled by menu-driven operating software that runs on your IBM-compatible personal computer. This software is contained on the μAnalyst'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, and data display. They also control linked operations between the timing analyzer and other μAnalyst products, such as the Model 2100 Interactive State Analyzer.

The rest of this section discusses the timing 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 Timing Analyzer include:

- **100 MHz Clocking**—A high-resolution timebase allows you to sample data at speeds up to 100 MHz. You can set this timebase to the analyzer's internal clock for asynchronous acquisition at intervals ranging from 10 ns to 10 ms, or you can use the rising or falling edges of two ORed synchronous external clocks. These external clocks are derived via the analyzer's middle and lower data probes.
- **Glitch Detection**—Glitch detection as narrow as 5 ns is available during asynchronous or synchronous acquisitions. You can focus in on intermittent problems by latching transient pulses that occur between the clocked events. The analyzer displays these glitches as narrow pulses on the timing waveforms.
- **Transition Timing**—A special acquisition mode allows you store data only when a transition is detected on one or more of the incoming channels. This way, you can extend the analyzer's effective memory depth by storing data only when transitions occur.
- **Edge and Level Triggering**—Up to seven trigger recognition modes are available for defining a trigger. You can specify a trigger on a level or edge pattern, on the start or end of a pattern, or on the duration of a pattern. You can also specify that a trigger occurs if any of the channels exceeds predefined setup and hold boundaries.
- **Multi-Triggers Mode**—The timing analyzer features a unique multi-triggers mode that lets you capture 15 occurrences of the same trigger event. Each occurrence of the trigger event is centered within a 32-sample memory segment. You see up to 15 events preceding each trigger occurrence, and up to 16 events following.
- **Waveform and List Displays**—Two displays are available for viewing the acquired data. One display lets you view the data as logic waveforms, while the other lets you view the data in a numerical list. The radix selections for the numerical list include hexadecimal, octal, binary, and ASCII.

- **Reference Memory Comparisons**—The timing analyzer's acquisition and reference memories are both 508 words deep. At any time, you can transfer acquisition data to the reference memory, then compare new acquisitions with old. These comparisons are shown in both the Waveform and List Displays.
- **Time-Aligned Displays with State Analzyer**—The timing analyzer can share the μAnalyst mainframe with the Model 2100 Interactive State 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 same display screen, using a common cursor.
- **I/O Utilities**—Mass storage is available through the timing analyzer's interface to the personal computer. You can save menu setups and 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 2200 Interactive Timing 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.

### Timing Analyzer Boards and Probes

The timing analyzer boards plug into the expansion slots located within the μAnalyst 2000 Mainframe. These boards include:

- Trigger Board—which provides the triggering, clocking, and acquisition control logic.
- Memory Board—which provides 16 bits by 508 words of acquisition and reference memory.

The timing analyzer also comes equipped with three data probes. These probes are attached to the trigger board through slot openings located on the mainframe's back panel.

### $\mu$Analyst 2000 Mainframe

The $\mu$Analyst 2000 Mainframe houses the timing analyzer boards, and provides the hardware interface to the personal computer. This interface includes:

- $\mu$Analyst Interface Board
- PC Interface Board
- 48-inch Interface Cable

**NOTE**
The mainframe can house other $\mu$Analyst products simultaneously with the timing analyzer. Refer to *Related Products and Options* at the front of this manual.

### $\mu$Analyst Software

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

### PC Compatibility

An IBM or IBM-compatible personal computer and DOS operating software (version 2.00 or higher) are essential to the timing analyzer and all $\mu$Analyst products. A list of compatible personal computers and their memory requirements are provided at the front of this manual under *PC Compatibility Requirements*.

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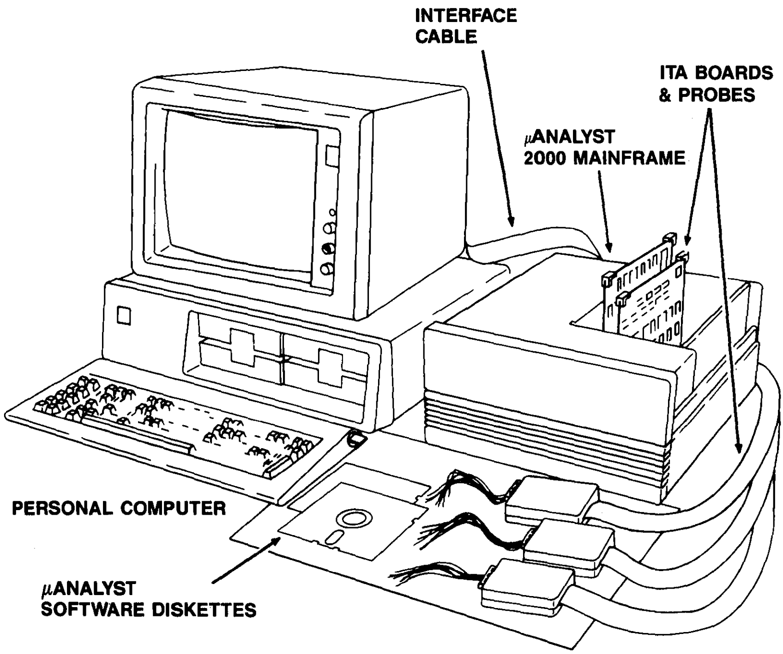


**Figure 1-1. System Components.**

# SPECIFICATIONS

The specifications for the μAnalyst 2000 Mainframe operating the Model 2200 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

### μANALYST 2000 MAINFRAME

Power: 105-125 Vac, 50-60 Hz (or 210-250 Vac, 50-60 Hz with Option V1). 220 VA max.

Operating Environment Temperature: 25° C ± 10° C.

Dimensions: See Figure 1-2.

**TIMING ANALYZER BOARDS AND PROBES** (Measured at 25° C after a 30 minute warm-up period.)

The following specifications apply to the Timing Analyzer Memory Board, Trigger Board, and three data probes.

### Sampling

- Sample Rate: 100 MHz, internal or external clock (asynchronous or synchronous)
- Internal Clock Range: 10 ns to 10 ms; 10 steps per decade.
- Clock Accuracy: Crystal controlled (± 0.005% at 25° C).
- Data Acquisition Channels: 16 channel sampling mode; 10 channel transition timing mode.
- Memory Depth: 508 samples per channel. (Effective memory depth increases when the transition timing mode is used.)

### Probes

- Input Z: 1 MΩ; 7 pF, typical, at probe body.
- Threshold Range: ± 5.5 V
- Threshold Resolution: 50 mV.
- Threshold Accuracy (at probe tip): ± 50 mV, ± 3% of threshold voltage setting.
- Threshold Compensation: The ground is sensed in the system under test; threshold value is automatically compensated.
- Maximum Input Voltage: ± 6.0 V.
- Non-Destructive Voltage: < ± 25 V.
- Output Crosslink (CL): 50 Ω line driver.
- Square-Pin Connector Dimension: 0.025 in. pins.

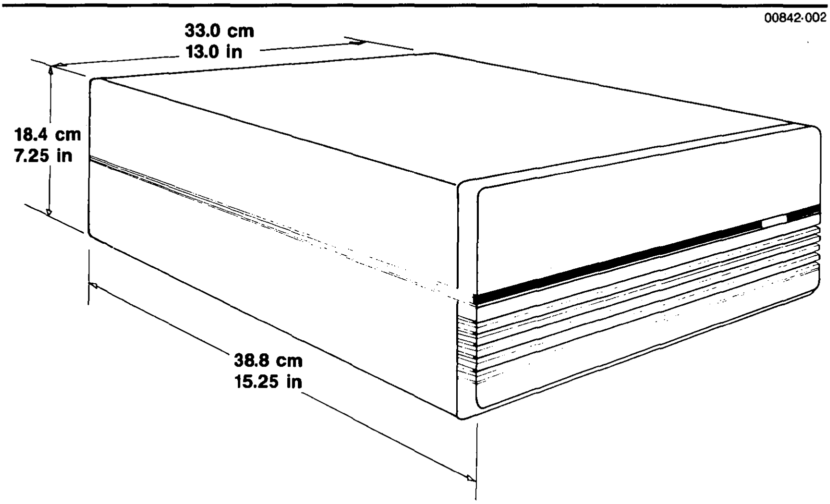


**Figure 1-2. Dimensions of the $\mu$Analyst 2000 Mainframe.**

## ■ Table 1-2: Software Characteristics

**Acquisition Memory**

16 channels with 508 bits-per-channel memory depth.

**Reference Memory**

Dynamically allocated at runtime using personal computer RAM.

**Trigger Modes**

- Occurrence of pattern.
- Occurrence of pattern of duration greater than time.
- Occurrence of pattern of duration less than time.
- Start of pattern.
- End of pattern.
- Setup time violation.
- Hold time violation.

**Menus**

- Format Menu: standard or transition timing modes; immediate, full-memory, or multi-triggers; probe threshold settings; list display groupings, radices, and polarities; timebase selection; trigger setup.
- Waveform Display: logic waveform format with magnification control; active and reference cursors; time readouts between cursors and trigger; threshold and timebase adjustments; window scrolling; data display of acquisition, reference or both.
- List Display: hexadecimal, octal, binary and ASCII display formats; absolute or relative times between acquired events; active and reference cursors; time readouts between cursors and trigger; threshold and timebase adjustments; scroll by line or page; data display of acquisition, reference, or both.
- Trigger_find(vertical) Menu: vertical trigger setup, based on waveforms; find pattern in memory.
- Timing Environment Submenu: Run (Go) mode selection; acquisition and reference memory comparison parameters, with masking and offset; list display controls; split-screen display controls.
- I/O Menu: save and load setup and data to and from disk; path name setup; disk directory display; print waveforms or list data.

Continued

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

- Configuration Menu: $\mu$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.

**Using this section.** This section shows you how to install the $\mu$Analyst 2000 Mainframe and the Model 2200 Interactive Timing 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

Before unpacking the μAnalyst 2000 Mainframe or the Interactive Timing 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 μANALYST

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

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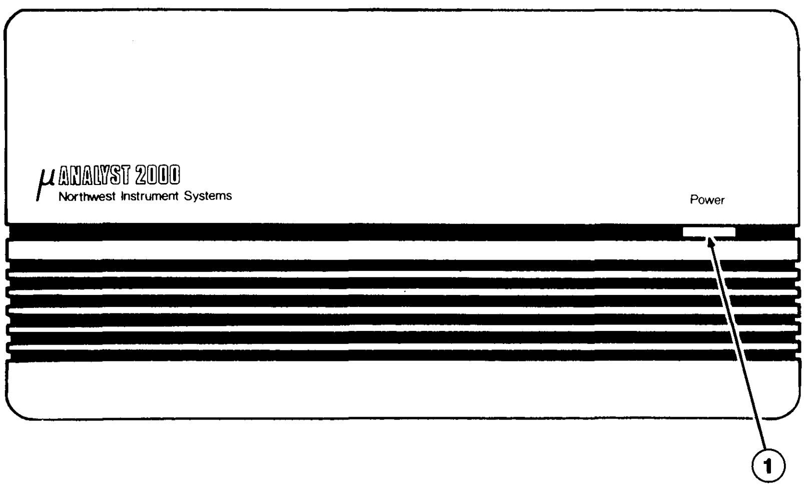
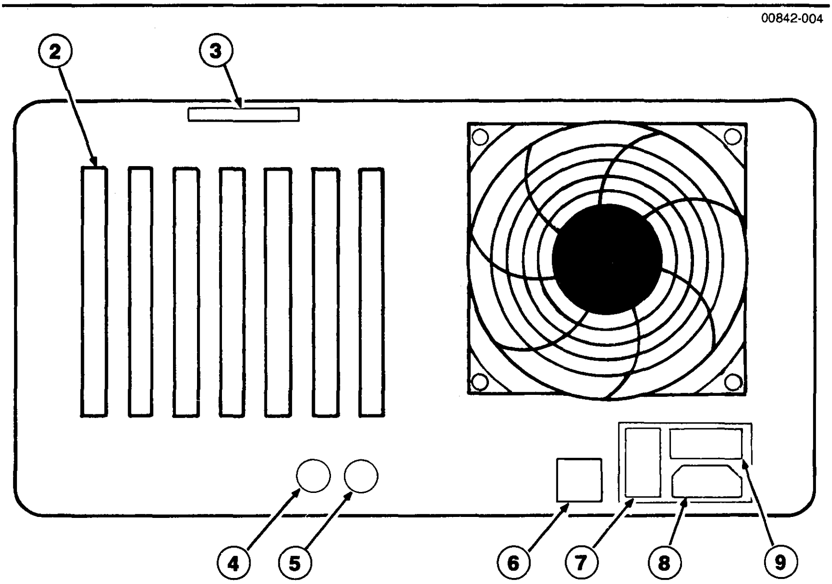



■ **Figure 2-1. The front panel of the μAnalyst mainframe.**




■ **Figure 2-2. The back panel of the μAnalyst 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 ($lin_{low}$ = 1.6 mA). You can use this line when setting up word-recognizer/trigger conditions (see Section 5's *Format Menu* subsection).

(5) **Crosslink (CL) Output**—this BNC connector outputs a TTL-level signal through a 74128 (50 Ω line driver). You can assert this low-level signal from the timing analyzer's Format Menu when you are using the Timing Arms State or Non-Aligned mode (see Section 6 of this manual).

(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 $\mu$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 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 $\mu$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).
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 and damage to mainframe circuitry, 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.

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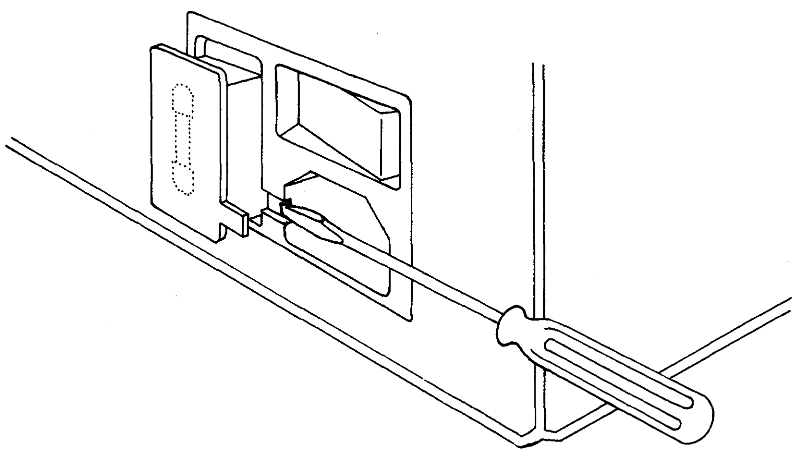

**Figure 2-3. Removing the fuse holder.**

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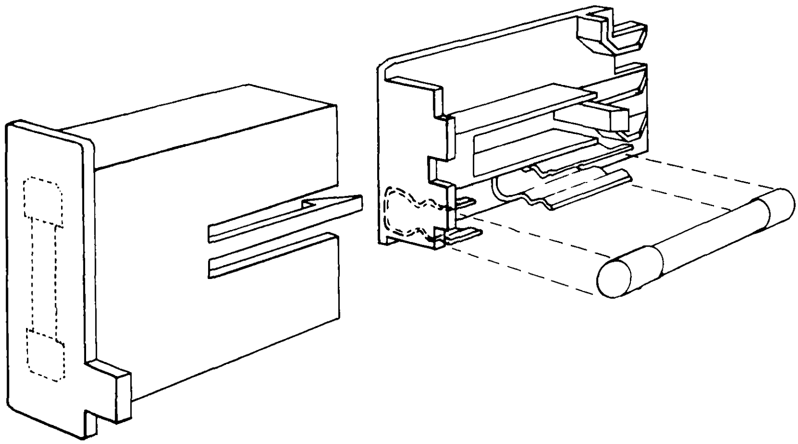

■ **Figure 2-4. Detaching the fuse-holder circuit board.**

### Power Cords

If your µAnalyst 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.

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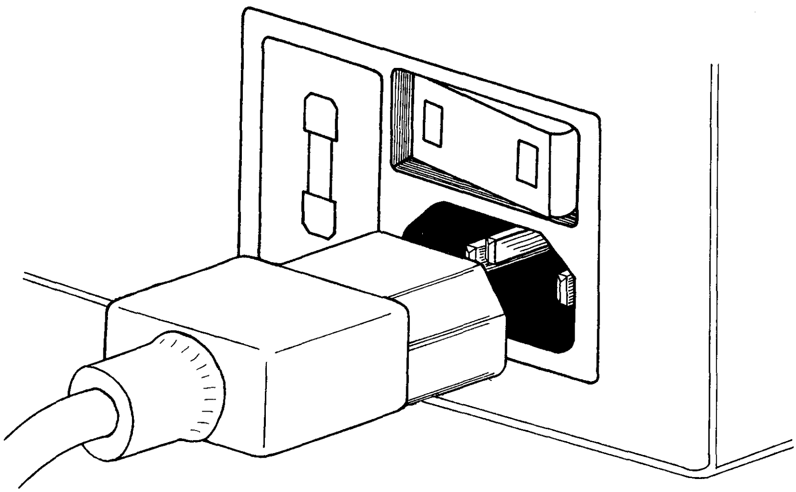

■ **Figure 2-5. Connecting the power cord.**

# CONNECTING THE PC INTERFACE

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

- μAnalyst 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 may also need to refer to your personal computer manual.

### Installing the μAnalyst Interface Board

The μAnalyst interface board is installed in the μAnalyst 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 μAnalyst interface board, simply follow the procedures contained later in this section under *Installing the Timing 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 μANALYST-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 μAnalyst 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.

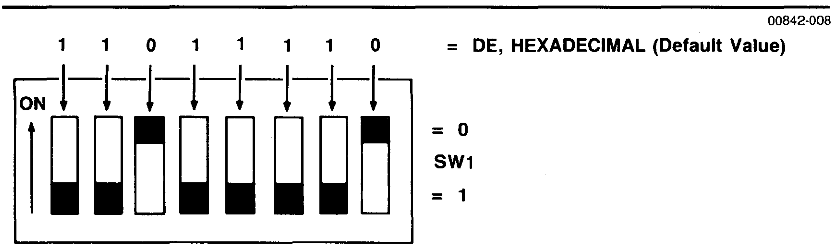


**Figure 2-6. Address switches on the PC interface board.**
These switches are factory-set to the address range DE000—DEFFF, hexadecimal. The polarity of the switches is inverted so that ON=0 and OFF=1.

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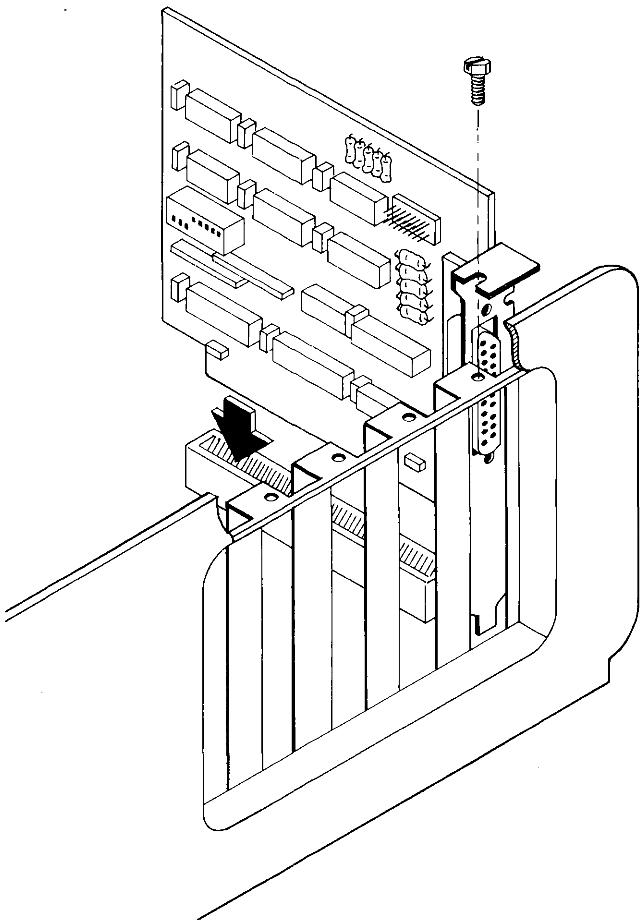
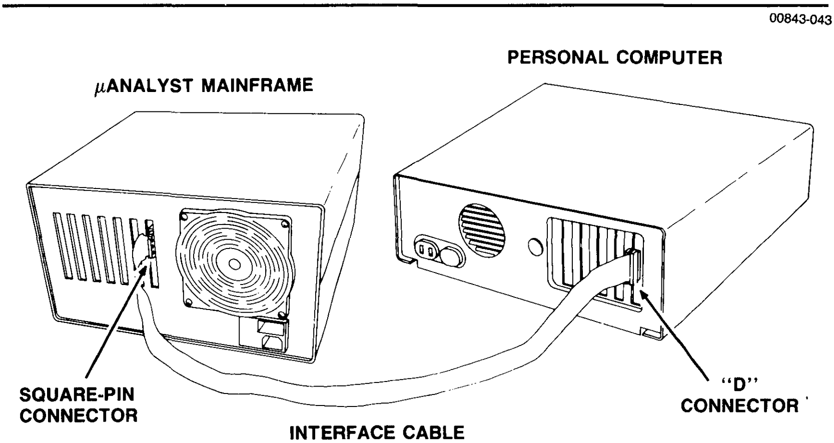


■ **Figure 2-7. Installing the PC interface board.**

### Connecting the Interface Cable

Once the μAnalyst 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 μAnalyst interface board.

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




■ **Figure 2-8. Connecting the interface cable.**

# INSTALLING THE TIMING ANALYZER BOARDS

If you order the Interactive Timing Analyzer separately from the $\mu$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 may gain access to the mainframe's card cage only. Other compartments within the mainframe contain hazardous voltages and may only be accessed by qualified service personnel.**

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.

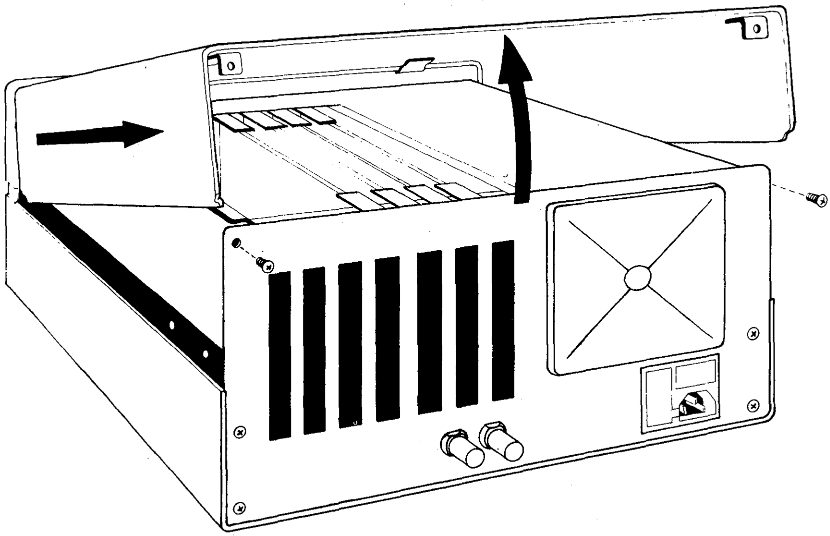
**CAUTION**

**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 this 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.**

### Setting the Upper Probe's Threshold Jumper

The threshold levels for the timing analyzer's lower and middle data probes are set independently in the Format and Waveform Display Menus (see Section 5). The threshold level for the upper probe, however, is not independent. It is slaved internally to either the lower or middle probe threshold value.

The upper probe's slaved threshold is determined by the square-pin jumper located on the trigger board. Figure 2-10 shows the positioning of this jumper.

To set the upper probe's threshold, gently slide the square-pin jumper over one set of pins or the other. The set of pins nearest the top of the board are used to slave the upper probe to the middle probe's threshold value, while the pins on the bottom are used to slave the probe to the lower probe's threshold value.

Once you have set the upper probe's threshold, continue with the procedures for installing the boards.

00843-002

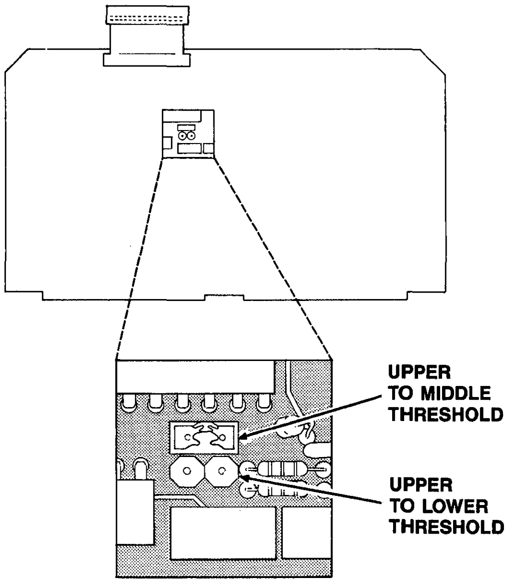


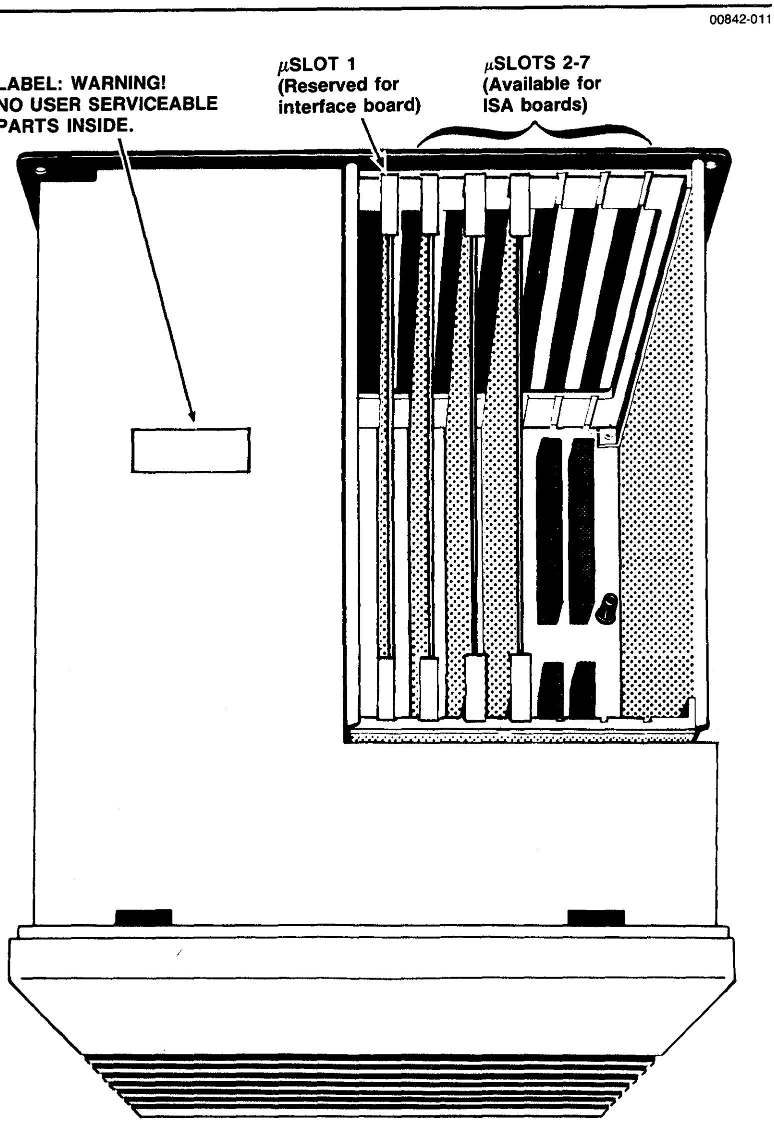

**Figure 2-10. Setting the upper probe's threshold jumper.**

### Installing and Removing Boards

Figure 2-11 illustrates the mainframe's card cage and expansion slots. These expansion slots are labeled 1—7. 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 $\mu$Analyst interface board. Slots 2—7 are available for housing the timing analyzer and other $\mu$Analyst products.

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

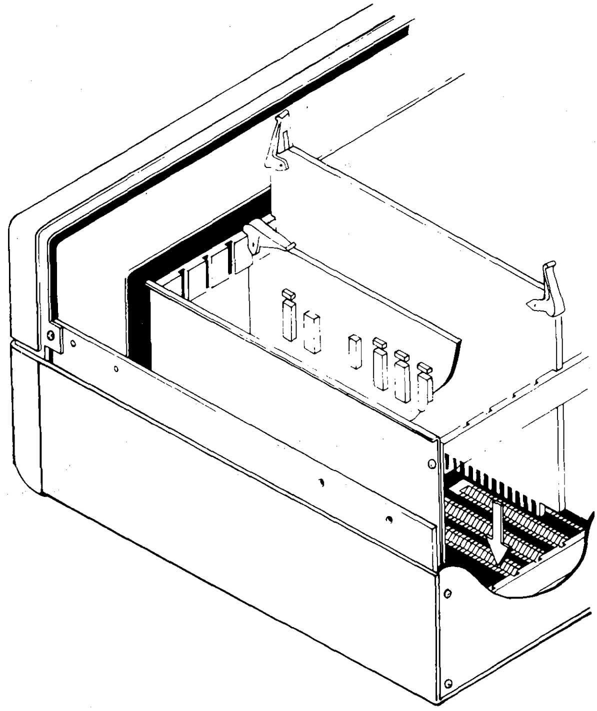



■ **Figure 2-11. The mainframe's card cage.**

To install a board (refer to Figure 2-12):

1. Position the board over the chosen slot, with the board's probe connectors, if any, facing toward the back of the mainframe, and the board's component side facing toward higher numbered slots.
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.

Once both boards are installed, insert the jumper from the trigger board into the adjacent connector on the top of the memory board. (Do not attempt to reach the second memory board connector that is offset from the trigger board jumper. The second memory connector is reserved for future expansion.)




■ **Figure 2-12. Installing a circuit board into the $\mu$Analyst mainframe.**

When you are removing the timing analyzer boards from the mainframe, extra caution is needed due to the jumper that runs between the trigger and memory boards. This jumper should not be removed until both boards are out of the mainframe.

To remove the timing analyzer boards:

1. With two fingers from each hand, lift the ejector tabs on the ends of both boards simultaneously, so that the boards are freed from their edge connectors at the same time.
2. Slide both boards up and out of the mainframe. While doing this, keep the tops of the boards level with each other so that their jumper connection is not stressed.

3. Once the boards are out of the mainframe, use a fine-bladed screwdriver to gently pry the jumper out of the connector on the memory board. Work from each end of the jumper, prying a little bit up at time. If you have two screwdrivers available, pry from each end of the jumper at the same time.

**CAUTION**

**Do not attempt to disconnect the jumper by pulling on its ribbon cable. You may damage the conductors in the cable.**

### 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.

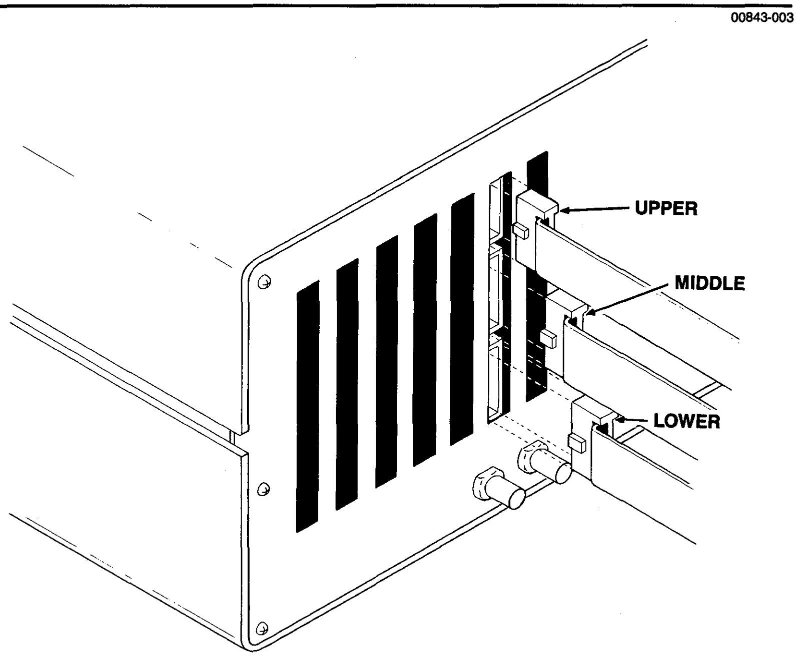
## CONNECTING THE PROBES

The timing analyzer comes equipped with three data probes:

- P2903 Lower Data Probe—which provides five data input channels and one external clock line.
- P2904 Middle Data Probe—which provides five data input channels and one external clock line.
- P2905 Upper Data Probe—which provides six data input channels.

These three probes are connected to the timing analyzer's trigger board. Slot openings on the mainframe's back panel let you access the probe connectors located on the back edge of the board.

Figure 2-13 illustrates how you connect the probes to the board. 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.




■ **Figure 2-13. Connecting the probes to the trigger board.**

### Installing Lead Sets

The standard accessories for the data probes include: a square-pin flying lead set; grabber clips; and five user-configurable probe labels with a plastic overlay.

Figures 2-14 and 2-15 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.

00842-014

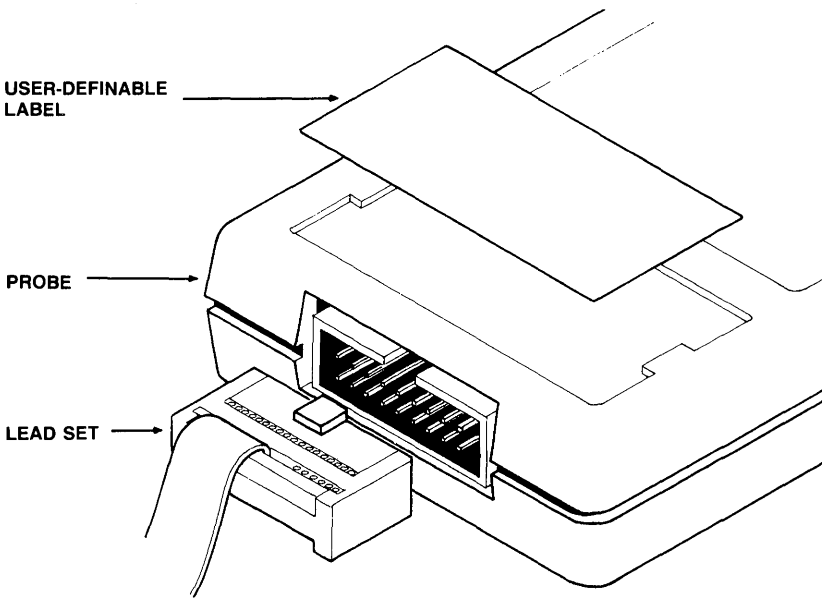



**Figure 2-14. Installing a lead set on a probe.**

00842-015

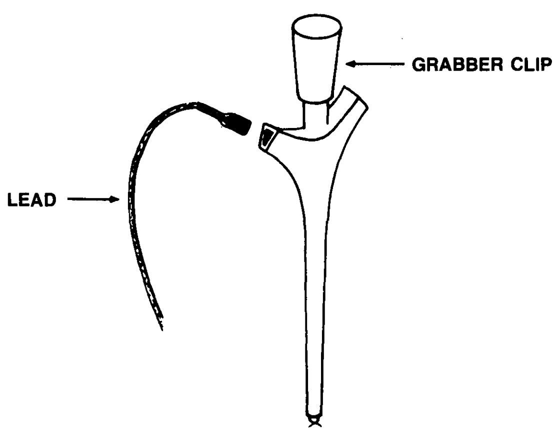



**Figure 2-15. Installing a grabber clip.**

### Grounding

One ground line is provided for every two data lines. (In the lower and middle probes, the clock and one data line ground are combined.) While each probe will operate with only one ground connected, cross-talk will increase, and frequency response will be degraded. In addition, sensitive nodes in the system under test may be adversely affected by inadequate grounding.

Be sure to connect all the ground leads. If possible, the grounds should be connected near the node that is being measured. For example, if you are connecting data lines to a DIP clip, try to connect the associated ground leads to the DIP clip's ground. Avoid connecting to a ground that is far away, such as the metal chassis case of the device under test.

The timing analyzer's data input circuitry is equipped with ground sensors. If the ground potential in the system under test does not match that of the timing analyzer, the analyzer will automatically vary the thresholds of the probes to compensate. This usually occurs when there is a heavy current flow in the system under test.

### Customizing Probe Interfaces

The pinouts from the three data 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 timing analyzer system. You can design a connector using any of the pins, except pin 1 +5 V. Pin 1 is not user accessible.

**CAUTION**

**Probe circuitry may be damaged if a signal is applied to pin 1 +5 V.**

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.

**P2903 Lower Probe**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | +5 V | |
| n/c | Gnd | Gnd | Gnd | Gnd | Gnd | Gnd | (not-user-accessible) | |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| 15 | 13 | 11 | 9 | 7 | 5 | 3 | 1 | pins |
| 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | pins |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| Gnd | Ch0 | Ch1 | Ch2 | Ch3 | Ch4 | C1kL | n/c | |

**P2094 Middle Probe**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | +5 | |
| n/c | Gnd | Gnd | Gnd | Gnd | Gnd | Gnd | (not user-accessible) | |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| 15 | 13 | 11 | 9 | 7 | 5 | 3 | 1 | pins |
| 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | pins |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| Gnd | Ch5 | Ch6 | Ch7 | Ch8 | Ch9 | C1kM | n/c | |

**P2905 Upper Probe**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | +5 V | |
| n/c | Gnd | Gnd | Gnd | Gnd | Gnd | Gnd | (not user-accessible) | |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| 15 | 13 | 11 | 9 | 7 | 5 | 3 | 1 | pins |
| 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | pins |
| \| | \| | \| | \| | \| | \| | \| | \| | |
| Gnd | ChA | ChB | ChC | ChD | ChE | ChF | n/c | |

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

## SECTION CONTENTS

## THE $\mu$ANALYST SOFTWARE

The $\mu$Analyst 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 $\mu$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 $\mu$Analyst, but it is recommended. It provides a Help Information System that is comprehensive and extremely useful.

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 electric motors.

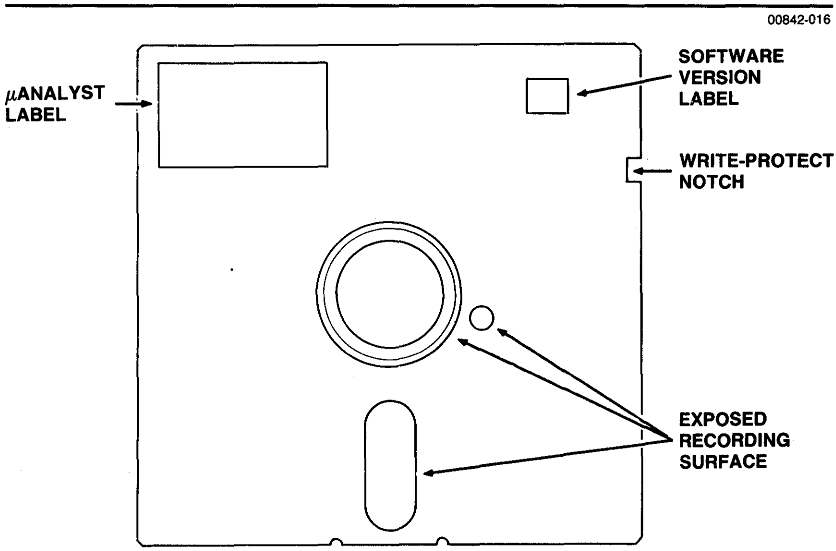



**Figure 3-1. A μAnalyst diskette.**

## COPYING DISKETTES FOR BACKUP

When you first unpack the μAnalyst 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 μAnalyst's SYSTEM DISK (source diskette) to a new, blank diskette (target diskette).
3. Finally, use the DISKCOPY command to copy the files from the μAnalyst's HELP DISK (source diskette) to 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 μAnalyst.

## USING A FIXED DISK

As an alternative to using diskettes, you can install the μAnalyst 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 μAnalyst software in a fixed disk by executing the FINSTALL batch file as described below. This batch file is contained in the μAnalyst'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 μAnalyst 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 μAnalyst'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 and insert the HELP DISK when directed to do so. A message on the screen will tell you when the copying procedure is complete.

## STARTING THE μANALYST

**NOTE**
The following procedures assume that you have installed the μAnalyst 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 μAnalyst: one for diskettes and one for fixed disks. These two methods are described in the following paragraphs.

**Starting the μAnalyst 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 μAnalyst mainframe.
3. Remove the DOS diskette from drive A and replace it with the μAnalyst's HELP DISK.
4. Now, insert the μAnalyst'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 $\mu$Analyst Using a Fixed Disk

**NOTE**
The following procedures assume you have transferred the $\mu$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 $\mu$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.

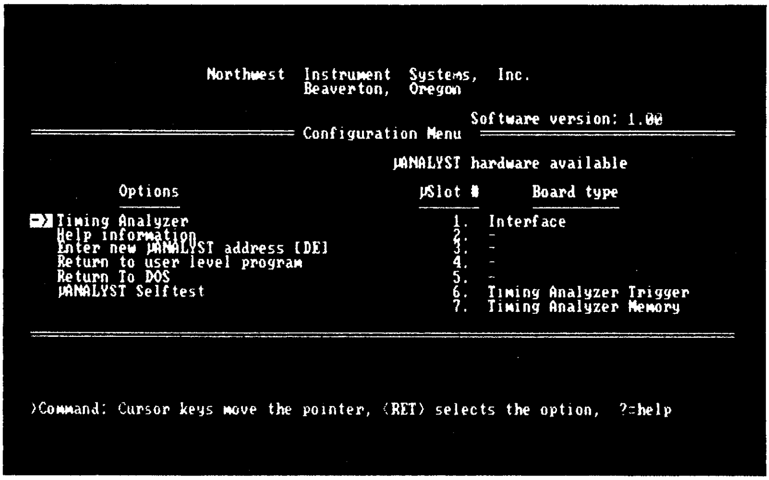
### A Successful Start-Up Display

The Configuration Menu is the first menu displayed by the $\mu$Analyst. This menu tells you the status of the $\mu$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 $\mu$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 $\mu$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.)*

00843-004




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

### Start-Up Error Conditions

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

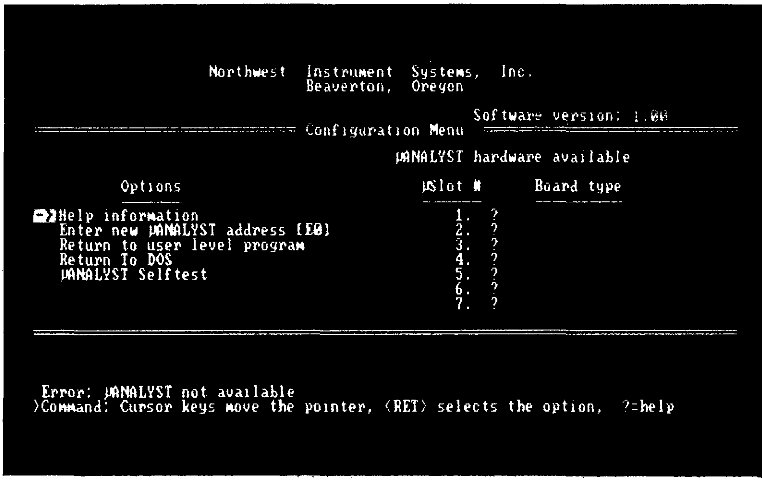
**Error Condition: The Configuration Menu does not appear on start-up.**

This error indicates a problem with your personal computer or with the µAnalyst SYSTEM DISK. First, check your personal computer to see if it is working properly. Then, check the label on your µAnalyst 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 µAnalyst 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).**

00843-005




■ **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 µAnalyst and the personal computer is not securely connected.
2. The power to the µAnalyst mainframe is not on.
3. The µAnalyst 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 $\mu$Analyst or the conflicting product. Procedures for changing the $\mu$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*.

If the error is caused by the fifth problem, you can rectify the condition by entering the new address range into the Configuration Menu. If you do not know the new address range, look at the address switches on the PC interface board and compare them to the settings shown in Figure 2-6 in Section 2 of this manual.

To enter the new address in the Configuration Menu, move the blinking screen pointer to the menu's Enter New $\mu$Analyst Address option 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.

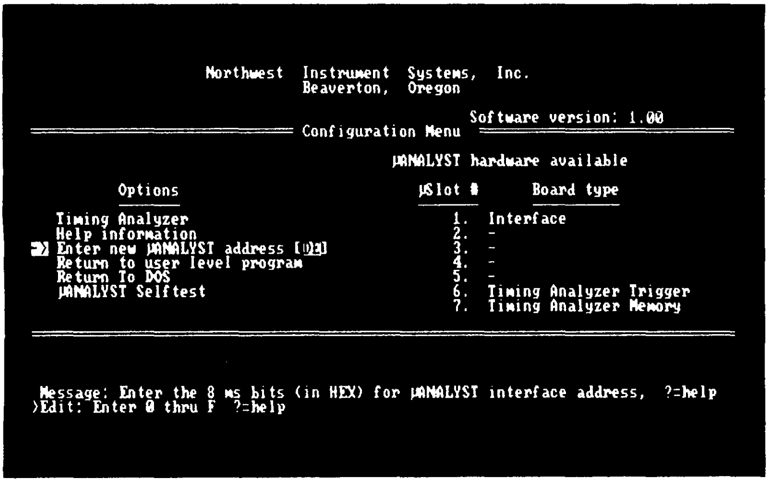
The Configuration Menu will check the newly entered address location, and if it finds the $\mu$Analyst hardware, it will immediately replace the question marks with the appropriate hardware list.

**NOTE**

If the SYSTEM DISK is not write-protected, and if you are using the SYSTEM DISK drive as the default drive, the Configuration Menu will remember the newly entered $\mu$Analyst address and will automatically search that location whenever the $\mu$Analyst software is restarted.

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

00843-006




■ **Figure 3-4. Entering a new µAnalyst address.**

**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 provides an overview of the Interactive Timing Analyzer and its 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 desired results will be easier to define and achieve.

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

## SECTION CONTENTS

## DATA ACQUISITION MODES

The Interactive Timing Analyzer differs from most conventional analyzers by offering you not one but two basic acquisition modes: standard or transition timing. You can select either of these modes in the Format Menu.

### 16-Channel Standard Timing

In the standard mode, the analyzer samples data on all 16 input channels. This sampling occurs with each tick of the selected sample clock. The logic levels of the sample channels are determined by the probe threshold voltages.

Data is loaded into memory in a first-in, first-out basis. When all available memory locations have been written once, the first-in (first-used) location is over-written. Then the next location is over-written, and the next, and so on. This circular filling of memory continues until a trigger is received.

Once the trigger is received, the acquisition continues until a preset storage condition—such as the placement of the trigger sample in the middle of the stored data—has been met. Once the condition has been met, the acquisition stops.

### 10-Channel Transition Timing

In the transition timing mode, the analyzer acquires data using the lower ten channels (channels 0—9) only. The upper six channels (channels A—F) are not available.

When operated in this mode, the analyzer does not automatically store data on each tick of the sampling clock. Instead, it asks a fundamental question: has the logic level of any channel changed since the last sample?

If no logic level has changed, the analyzer does not store a redundant sample. Instead, it increments a counter so that when a change in one of the channels finally occurs, the system will know the elapsed time from the last stored sample to the new stored sample.

The timing analyzer stores the current counter value when it stores a sample. This way, when data is displayed, the timing analyzer is able to reconstruct a proper picture of the timing transitions.

The counter size is 8 bits, which means that if there have been no transitions in any of the incoming data lines, the analyzer can run for 256 sample clocks without storing any samples. Once the counter has reached 256, which is the overflow condition, a sample is automatically stored along with the counter value, and the counter is reset. With room in memory for storing up to 508 events, and with no transitions occurring on any data line, an acquisition window of more than 130,000 sample clock periods (256 × 508) could be captured.

Now consider the other extreme: a transition occurring at least once every sample clock period. This type of data activity usually occurs in bursts centered around a major event such as a memory read or write strobe, sync pulse, or some other control signal. Typically, you use a timing analyzer to see what happens around these events. With transition timing, you can run a very fast sample clock (10 ns), get the highest resolution, and not pay for that high resolution with small, and perhaps useless, acquisition windows. The analyzer is not wasting any memory space while the system under test is doing nothing.

**Extending Acquisition Window Sizes in Transition Timing.**

You can optimize memory depth for a given application by selectively storing channels. Remember, one of the conditions for storing a sample is that a change must occur in one of the 10 input channels (an OR situation). If you are looking for a problem that involves only a few channels, you can reduce memory use by storing only the channels you are interested in.

**NOTE**
The capability for selectively storing channels is only provided in the transition timing mode. All 16 channels are always stored in the standard mode.

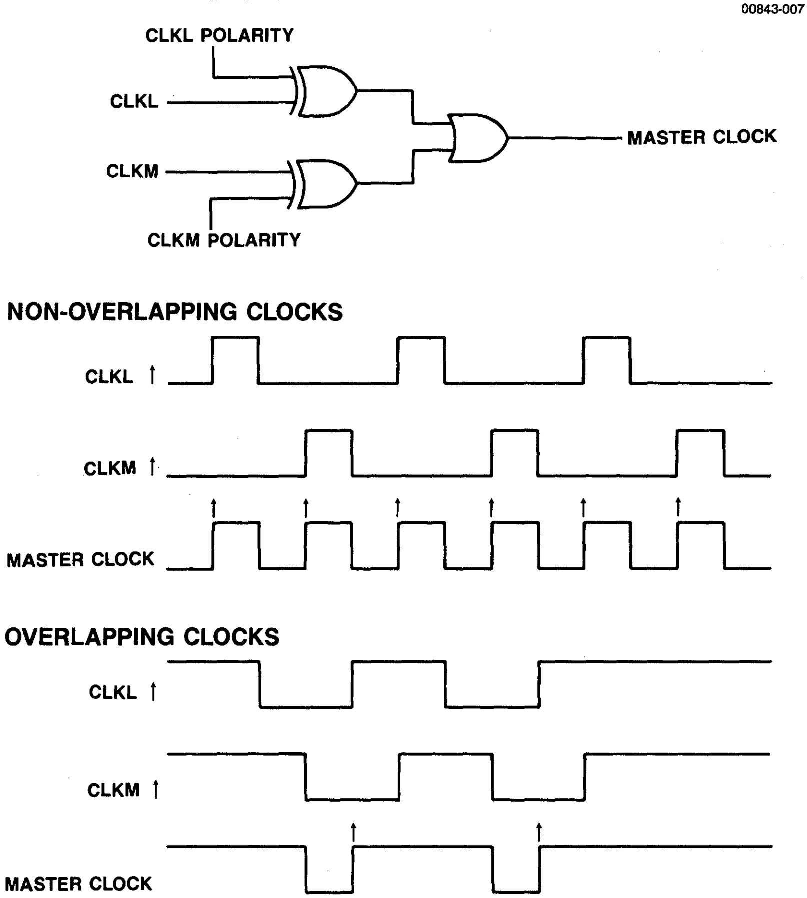
## CLOCKING

The timing analyzer acquires data at speeds up to 100 MHz, using either an internal (asynchronous) or external (synchronous) clock source. You specify the clock source and speed in the Format Menu.

The internal clock has a timebase range of 10 ns to 10 ms. Rather than the traditional 1-2-5 steps per decade, a full 1-2-3-4-5-6-7-8-9 sequence range is provided. For example, if 20 ns does not capture data over a long enough time period, 30 ns can be selected. You are not forced to use 50 ns.

The external clock is derived from either the middle or lower data probes (see Section 2, *Installation*). Each clock line can be selected for a rising (↑) or falling (↓) edge.

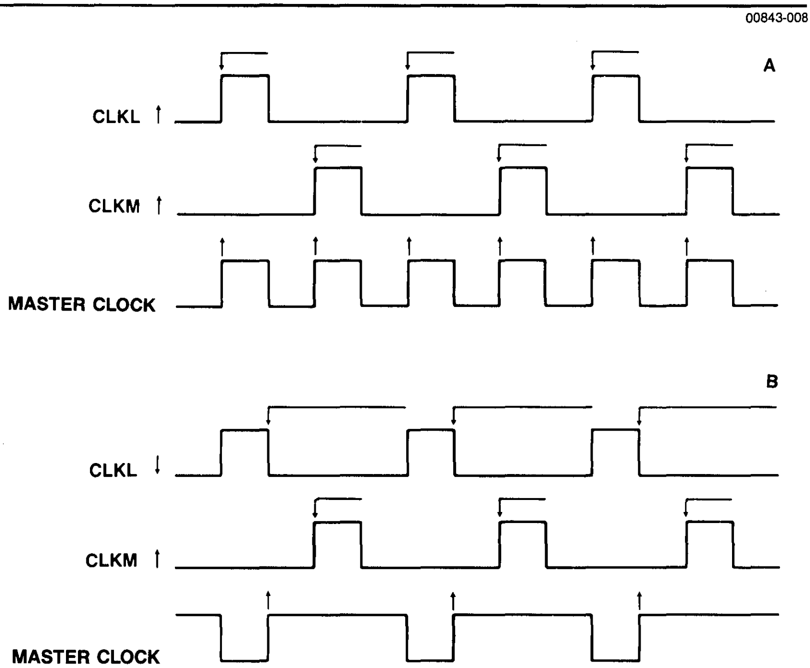
The two external clock lines can also be ORed together to create one master clock. As shown in Figure 4-1, when the two external clocks do not overlap in time, they produce a master clock consisting of the pulses contributed by each of the sample clock pulses. When the external clocks do overlap, the master clock, which is the OR of the sample clocks, merges the pulses to create a longer pulse.




**■ Figure 4-1. Using the lower and middle probe clocks in an ORed condition.**

You select the edge polarity of the external clocks in the Format Menu. The edge referred to in the menu is the active edge of the clock—the edge on which data is sampled.

Figure 4-2 shows how the edge polarity of the ORed clocks can affect the master clock. In Diagram A, CLKL and CLKM are both set to a rising-edge polarity. In Diagram B, CLKL's polarity is changed to a falling edge, thus its signal is inverted before being ORed with CLKM. The resulting master clocks are considerably different.




■ **Figure 4-2. The effects of clock polarity.**

# TRIGGERING MODES

The timing analyzer provides three triggering modes: Full-Memory Trigger, Immediate Trigger, or Multi-Triggers. These modes are available through the Format Menu.

### Full-Memory Trigger

Full-Memory Trigger is the normal trigger mode, particularly if the trigger condition occurs often. In this mode, the trigger is locked out until enough data has been acquired to fill all of the pre-trigger memory locations. Once the pre-trigger data is acquired, the timing analyzer starts looking for its trigger.

**NOTE**
This mode should not be used when the trigger is expected to occur early in the acquisition. The trigger might be missed while the analyzer is satisfying its pre-trigger requirement and the acquisition would never stop.

### Immediate Trigger

In this mode, the timing analyzer does not have a pre-trigger requirement. It starts looking for the trigger immediately and completes the acquisition the instant the trigger condition is satisfied. Any pre-trigger locations that are not filled with new data are displayed as lows (0s).

Use this mode when you're not concerned with acquiring pre-trigger data, or when you're in a situation where it may take a long time to fill memory (such as when you're using the transition timing mode with a slow timebase).

### Multi-Triggers

In this mode the timing analyzer's memory is divided into 15 separate, 32-sample segments. Sampling starts with the first segment and remains there until a trigger is received. The trigger sample is then positioned in the middle of the segment, with 15 pre-trigger samples and 16 post-trigger samples.

Once the first segment is filled, the analyzer enters the next segment, fills it, and so on, until all 15 segments are full.

The time span of the continuous data represented by a filled segment is called a region. If another trigger occurs before the 16 post-trigger samples are recorded in a given segment, that segment is combined with next segment, and both segments are counted as one region. If all the triggers occur closer together than the time necessary to acquire 16 post-trigger samples, all of the segments will be combined into one region.

The advantage of the Multi-Triggers mode is that it allows you to capture useful bursts of data around multiple occurrences of the same trigger condition, without requiring you to manually restart the timing analyzer. In addition, all of the data can be viewed and analyzed in one display. This is very handy for chasing intermittent events, where it is important to capture as many occurrences in a row as possible for study. The triggers may have occurred minutes, hours, or even days apart. For example, you could start the analyzer one evening and come back the next morning to examine 15 occurrences of an event that occurred only once every hour.

While the analyzer is running in Multi-Triggers, it advises you in real-time of its progress. It does this by displaying a row of 15 dashes in the upper-right corner of the screen. Each dash represents a memory segment. When a segment is filled, the dash is replaced by an asterisk (*).

## TRIGGER SPECIFICATION

The timing analyzer provides a wide variety of trigger modes. In each mode, the trigger pattern is compared to data values appearing on the lower ten channels (channels 0—9). The upper six channels (channels A—F) are not used.

The various trigger modes are discussed in the following paragraphs. These modes are available through the Format Menu.

### Occurrence of a Pattern

This is the simplest trigger. When the programmed pattern matches the current data sample, the timing analyzer triggers and completes its acquisition cycle.

The following paragraphs describe the different types of patterns that can be used:

1. The pattern can be any combination of levels (0s and 1s) and don't cares (Xs). To satisfy the trigger condition, the incoming data sample must match all the programmed 0 and 1 levels (the channels assigned to a don't care value are ignored).
2. The second kind of pattern is a single channel programmed to look for a rising, a falling, or either edge. The rest of the channels are programmed to don't cares (Xs).

   The analyzer detects edges by looking at two sequential samples on that channel. A rising edge is a change in levels from 0 to 1, while a falling edge is a change from 1 to 0. For either edge, any transition between successive samples is acceptable (0 to 1 or 1 to 0).
3. The third kind of pattern programming recognizes more than one edge. For example, the pattern could be set to a falling edge on channel 0, a rising edge on channel 1, and so on. Internally, the multiple edge recognizers are ORed together so that if any one of the programmed edge transitions occurs, the trigger condition will be satisfied.
4. Finally, levels and edges can be mixed. In this case, a trigger will occur only if all of the level conditions and at least one of the edge conditions are true.

   For example, assume that channel 0 is programmed to look for a rising edge, channel 1 a falling edge, and channel 2 a level 1. The rest of the channels are set to don't care. The analyzer will look for a rising edge on channel 0 or a falling edge on channel 1, but only when channel 2 is at level 1.

   To summarize: edges are ORed, levels are ANDed, and the results of the ORed edges and ANDed levels are ANDed.

### Occurrence of a Pattern Duration (Greater or Less Than) Time

This mode is similar to the Occurrence of a Pattern option, with the added qualification that the pattern must also meet the specified time requirement. The pattern can be defined as any combination of 0 and 1 levels or don't cares (Xs). Edge definition is not available.

The duration of the pattern can be specified as greater or less than a given time requirement. The duration range for "greater than" is 10 ns to 2000 ns; "less than" is 20 ns to 2000 ns. The duration value is a multiple of the internal timebase.

### Start, End of Pattern

These modes look for a change from *NOT* pattern to pattern (Start), or from pattern to *NOT* pattern (End). The pattern can be defined as any combination of 0 and 1 levels or don't cares (Xs). Edge definition has no meaning in this mode and is not available.

The Start and End modes are especially useful when you're using the Multi-Triggers mode. If the analyzer is running in Multi-Triggers and looking for the start or end of a pattern, it will only fill memory segments when a shift in the pattern occurs. It will not fill memory segments while the pattern is static.

### Setup Time, Hold Time Violations

The timing analyzer provides a trigger mode that allows you to verify hardware setup and hold times. You can verify if the signals in the system under test are stable long enough before (setup time) or after (hold time) some clock or control signal.

The option works in the following way. You program one channel to be the clock signal and specify a setup or hold time requirement. Then, one or more of the channels are tested against this clock channel. Any violations to the time requirement causes a trigger.

### Programming the Trigger Fields

Trigger programming is accomplished in the Format Menu. Command and message lines continually advise you about the selected option. The EXT line input (appearing at the back of the μAnalyst mainframe) and the Crosslink (CL) signal can be programmed as part of the trigger condition.

Triggering can also be programmed in the Trigger_find(vertical) Menu. In this menu, the single channel fields that make up the trigger pattern are stacked vertically next to the waveform display. Each channel field of the trigger word can be related visually to a waveform. In addition, a selected pattern at the current cursor position can be transferred directly into the trigger pattern by a single keystroke.

## RUN (GO) MODES

Several run modes are provided by the Interactive Timing Analyzer. These run modes are selected in the Timing Environment Submenu, and they are started by pressing G for Go from the command line.

The available run modes include:

- 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 data is approximate, and is specified in the Trigger Position field in the Format Menu.
- GO FOREVER—The analyzer takes successive acquisitions. This mode is often used while viewing the Waveform Display Menu. The analyzer updates the waveform display after each new acquisition, holding the display window constant relative to the trigger position.
- 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, such as fuzz factors and compare limits, are set up in the Timing 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.

# DISPLAY MODES & ANALYSIS

The timing analyzer provides two menus for viewing acquired data: the Waveform Display Menu and the List Display Menu. It also provides several tools for analyzing the acquisition. This subsection covers each area.

### Waveform Display

In this display, the acquired data is used to draw waveform diagrams on the screen. The screen can be thought of as a viewing window. The window can magnify any given portion of the acquisition data.

Two cursors are provided for manipulating the display and making time measurements. You can scroll the cursors across the waveforms, or you can use special function keys to scroll the waveform window while the cursors remain stationary.

Function keys are also provided for controlling the analyzer's threshold and timebase specifications. You do not have to leave the Waveform Display Menu to change these specifications. To enhance the display for a particular application, you can also label, delete, and insert traces.

Several indicators provide display status information. They tell you the current display window size and position, the current cursor and trigger locations, and the current memory being displayed (acquisition, reference, or both).

### List Display

The list display is essentially a state display. The timing data is displayed numerically in columns. The display format of these columns is programmed in the Format Menu.

In the list display, a time readout appears next to each line of data. In the absolute mode, the time readout is referenced to the trigger. That is, each sample in the list display is some amount of time away from the trigger point. (Pre-trigger data is displayed with a minus sign, post-trigger with a plus sign.)

In the relative mode, the number in the time readout indicates how long a given data word was present at the probe tip. If the analyzer gathered data while operating in the 16-channel standard mode, the numbers in the time readouts will all be the same, and equal to the timebase used. With 10-channel transition timing, the numbers will vary. (Relative and absolute modes are selected from the Timing Environment Submenu.)

**Reference Memory**

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 Timing Environment Submenu.

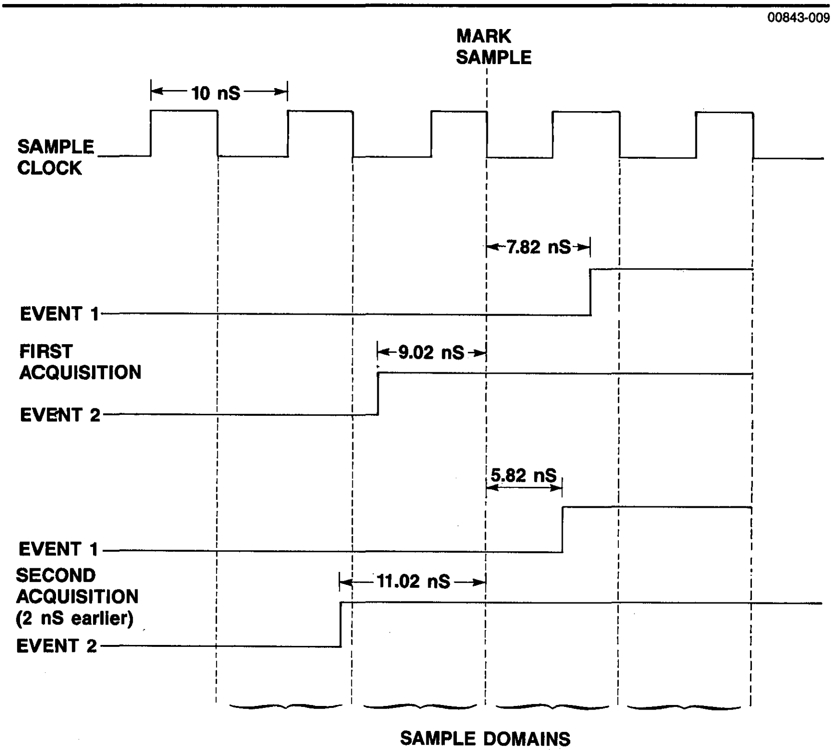
To make the data comparisons easy, the Waveform Display Menu stacks the channel traces from both memories in an alternating sequence. Each acquisition channel is stacked on top of its corresponding reference channel. In the List Display Menu, the memories are compared side by side, in two numerical columns.

**Comparisons and Fuzz**

Usually the timing analyzer is running asynchronously. Because the internal sample clock is independent of any system signal, it is not possible to determine precisely where within a given sample clock an event occurred. There is a certain *fuzziness* involved.

For example, imagine two different acquisitions, and assume that the sequence of events is the same in each. But because the sample clock is running asynchronously, there is no guarantee that the events in one acquisition will be in an identical time domain as those same events in the other acquisition.

Refer to Figure 4-3 and its MARK SAMPLE. On the first acquisition, EVENT 1 occurs 7.82 ns after the MARK. If EVENT 2 occurs 9.02 ns before the MARK, then that transition is caught by the previous sample.




■ **Figure 4-3: Timing Uncertainties.**

Assume that the first acquisition is now stored in reference memory, and that a second acquisition is made using the exact same trigger setup. As far as can be determined, the same activity is taking place in the system under test. But this time, purely by chance, the sample clock is 2 ns earlier, relative to the running circuit.

The trigger is detected in the same relative sample and everything happens as before—sampling, triggering, and acquisition—but it has been shifted 2 ns in time, relative to the first acquisition. Because the current sample is 2 ns earlier than the last sample, the two event times become −11.02 and 9.02, relative to the MARK. EVENT 2 has moved into an earlier sample domain. Had the trigger also fallen into another sample, there would have been an additional shift.

In most instances, this type of time skew presents no problem. But if one of the comparison modes (GO TIL ACQ=REF or GO TIL ACQ< >REF) is being used, there is difficulty. Even though the events happened just as before, the data in the analyzer will not be the same due to the time skew, and the compare conditions will not be met.

To allow for this type of time skew, a fuzz factor has been added to the comparison. That is, when making any comparisons, you can program the timing analyzer to look ahead or behind (plus or minus) a certain number of clock samples. In the example in Figure 4-3, a fuzz factor of ± 1 sample would be sufficient to catch the time skew.

A fuzz factor of ± 1 is the default setup for the analyzer. This takes care of sampling uncertainties as they apply to the analyzer running asynchronously.

A larger fuzz factor may be desired when you are acquiring data from a system that has tolerances larger than the timing analyzer's sample period. For example, suppose the system under test runs with a 500 ns clock (2 MHz), and due to numerous tolerances, events are allowed to occur within 5% (i.e., 25 ns) of the system clock edge. If the timing analyzer is sampling at 10 ns, you would need a fuzz factor of at least ± 3 to compensate for the variance.

The maximum fuzz factor allowed by the timing analyzer is ±9 samples. Be aware that too much fuzz may result in a very loose comparison. This may or may not be detrimental to analysis. In addition, larger fuzz factors require more comparison time. As the fuzz factor approaches ± 9 samples, consider using a slower sample rate.

### Comparisons and Offset

When comparing acquisition and reference memories, you can program an offset parameter of up to ± 5 memory locations. This feature allows for trigger-point uncertainties, and is especially useful when you are acquiring data with an external clock.

Unlike the fuzz factor, which adjusts the comparisons by a certain number of samples, the offset parameter adjusts the comparisons by a certain number of memory locations. It slides the acquisition data forward and backward through memory, relative to the locations of the reference data.

A comparison will always start with an offset of 0 locations. Then, if the compare condition fails, the comparison tries an offset of +1, then −1, +2, −2, and so on, up to the maximum offset you have programmed.

The offset parameter, like the fuzz factor, is programmed in the Timing Environment Submenu.

### Analysis Tools

In both the List and Waveform Display Menus, analysis tools are provided, such as the Find command. Once programmed in the Trigger_find(vertical) Menu, a find pattern and time qualification can be used to search through the acquired data.

Two cursors are provided: an active cursor and a reference cursor. The active cursor is always in the display, and can be moved by using the appropriate cursor keys. The reference cursor is fixed in place and cannot be moved with the cursor keys. You can, however, align the reference cursor with the active cursor (i.e., bring the reference cursor to the same location as the active cursor), or you can exchange the two cursors' positions.

Time readouts from the active cursor to the trigger point, and from the active cursor to the reference cursor, are always maintained. It is possible to measure various events and pulse widths using these cursors.

## STATE & TIMING TOGETHER MODES

If you have both the Interactive Timing Analyzer and the Model 2100 Interactive State Analyzer installed in your µAnalyst, you can use them together in time-aligned acquisition modes. The µAnalyst provides a full range of cross-arming and cross-triggering capabilities.

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

## MISCELLANEOUS

In addition to the items discussed in the previous portions of this section, the timing analyzer also provides the following utilities:

- Glitch Capture—The analyzer can sense and record glitches as narrow as 5 ns. This glitch detection is available through the Format Menu.
- Mass Storage—Through the I/O Menu, you can store the analyzer's menu setups on disk. Special menu setups that you use frequently can be programmed once, then stored on disk and recalled as needed. Once recalled and in memory, the menu programming can be modified and stored again.

  The contents of reference memory can also be stored, thus providing you with a source of data that can be recalled and used at a later date.
- Printer Output—Information can also be sent to an IBM-compatible printer to provide permanent hardcopy records. This print function is provided through the I/O Menu.

**Using this section.** This section details all facets of the menu structures used in the Interactive Timing 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 this entire section, then later use it as a reference guide.

## SECTION CONTENTS

# 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 Timing Analyzer, but menu also refers to a more visual, two-dimensional method of displaying selectable or programmable items. Several items within a given menu take on a two-dimensional quality—that is, 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 timing 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

Three lines at the bottom of the display are always reserved for status and error information. This way, the analyzer keeps you informed of what it is doing.

Starting at the very 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, such as pressing 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 long beep indicates a warning, a potential error condition, or an error condition. When you hear a click or beep, take a look at this line.

### Menu Flow and Hierarchy

Figure 5-1 shows the basic structure of the timing analyzer menu system.

Note that once in the Format Menu level 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 line, then by pressing the first letter of the menu name. For example, F for Format. You enter the environment submenu by pressing V for enVironment.

00843-0010

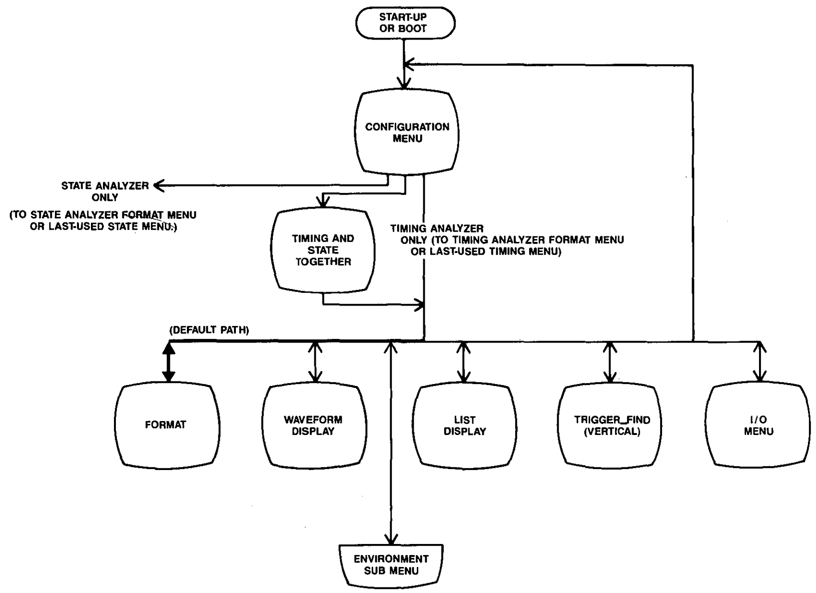



**Figure 5-1. Menu Flowchart.**

### Programming Fields within the 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 timing analyzer system. Keep these items in mind as you use the analyzer.

1. To actually change a programmable field, you must ordinarily be in the edit mode. A few fields in the Waveform Display Menu can also be programmed remotely by using function keys.

   You can only enter the edit mode when the Edit command appears in 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 is ready to be modified will blink. Fields in normal video are monitors or status indicators and cannot be modified.

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 the command or edit mode, your options are listed on the bottom line of the screen. When in doubt about what you can do next, consult this line. <SP> at the end of the line, means that the list of choices are 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 a desired field:

| | |
|---|---|
| Four Cursor (arrow) Keys | These keys move the screen cursor to the nearest programmable field in the direction selected.<br>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.<br>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 Menus command.)

The commands described below 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.

**E**dit — 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 your are in the edit mode, the edit prompt line appears. This prompt line tells you what edit options are available for a particular field.

Some edit options are specific to a particular menu or field within a menu. These edit options are covered in the appropriate portions of this section.

Press the escape key to exit the edit mode and return to the command mode.

**G**o — Press G to start the timing analyzer. The Go mode for the analyzer is determined in the Environment Submenu. Refer to the description of that submenu later in this section for a complete listing.

**M**enus — 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 Menus are not covered in this manual. These menus are only available if you have designed custom software for the Interactive Timing Analyzer.

**W**aveform — Press W to enter the timing analyzer's Waveform Display Menu.

**L**ist — Press L to enter the timing analyzer's List Display Menu.

en**V**ir — Press V to enter the Environment Submenu.

**U**ser_display Type U to enter a display you have programmed to work with the Interactive Timing Analyzer. (This type of custom programming is not covered in this manual.)

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

**NOTE**
The Help Information System is only available if you installed the μAnalyst'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.

Once you start the analyzer, two additional commands appear:

**H**alt Press H to Halt the current acquisition immediately. The system returns to the command line. Depending on when H was pressed, there may or may not be a trigger in acquisition memory.

**S**top Press S to Stop the analyzer once the current acquisition has been completed. This command is most useful when you're executing the Go Forever, Go Til ACQ = REF, or Go Til ACQ < > REF modes. The analyzer will look for a trigger and complete its current acquisition, but no new acquisitions will be started.

The following parts of this section are devoted to the individual timing analyzer menus. The documentation format employed has been designed to help you quickly find the information needed. Where possible, the text explains the interaction among fields and even among fields in other menus currently not displayed.

Each menu subsection begins with an overview of the menu. This is followed by a screen shot of a typical menu display. Each screen shot has several callout numbers, and these numbers refer to the specific blocks of text that cover the menu fields.

For first-time users, it is suggested that each menu subsection be read completely.

## OVERVIEW

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

The operating options available in the Configuration Menu are dependent on the type of hardware you have installed in the µAnalyst mainframe. This section describes the options available when you have both the Interactive Timing Analyzer and the Interactive State Analyzer installed.

## OPTION SELECTIONS

Figure 5-2 shows the Configuration Menu and its operating options. Use the numbered callouts in Figure 5-2 as a reference while reading the following paragraphs.

To select an option, move the blinking screen pointer to that option, then press the return key.

00843-01

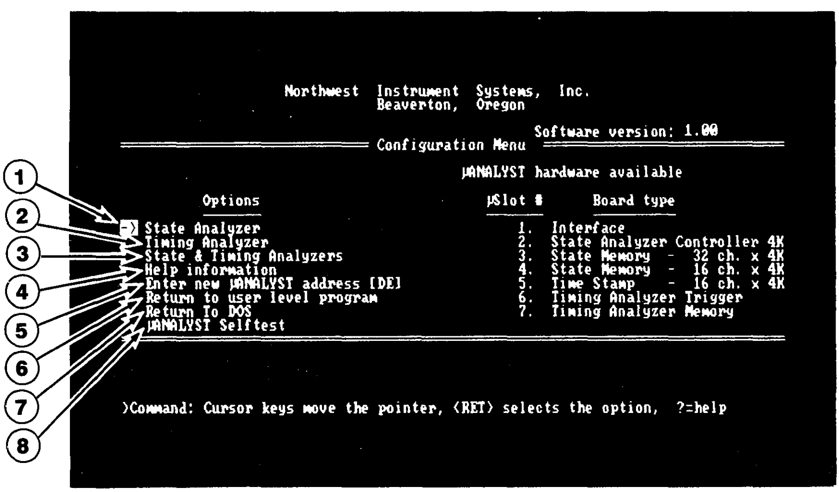



**Figure 5-2. The Configuration Menu and its options.**

### ① State Analyzer

This option is only available if you have the Interactive State Analyzer installed in the mainframe. By selecting this option, you can enter the state analyzer's menu system. For specific details about the menu system, refer to the *Interactive State Analyzer User's Manual.*

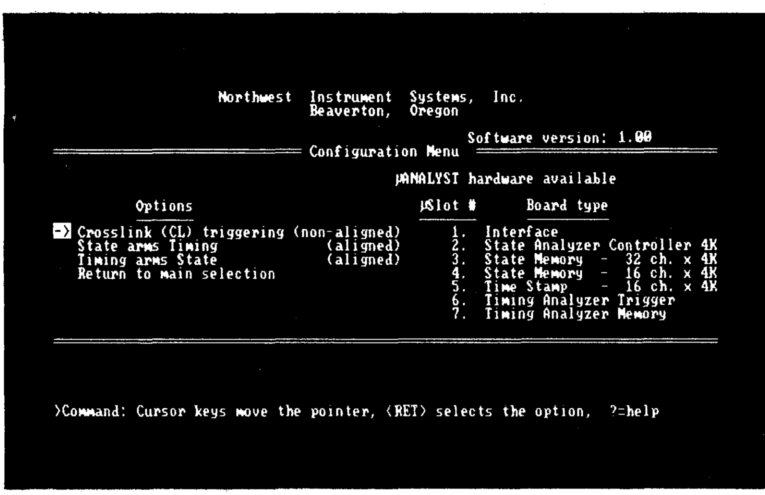
### ② Timing Analyzer

This option is only available if you have the Interactive Timing Analyzer installed in the mainframe. By selecting this option, you can enter the timing analyzer's menu system. Detailed information about the menu system is provided later this section.

### ③ State & Timing Analyzers

This option is only available if you have both the Interactive State Analyzer and the Interactive Timing Analyzer installed in the mainframe. By selecting this option, you can enter the various Crosslink Modes. Figure 5-3 illustrates these mode selections. Detailed information about these modes is provided in Section 6 of this manual.

00843-012




■ **Figure 5-3. Crosslink Modes.**

### (4) Help Information

This option accesses the $\mu$Analyst's Help Information System. When the option selected, the $\mu$Analyst displays general information about its menu conventions and 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.

### (5) Enter New $\mu$Analyst Address

This option allows you to enter a new memory range for the PC interface board (see Section 2, *Installing the PC Interface Board*).

**NOTE**
This option is only available on power up. It will not be available once any of the state or timing menus have been viewed or used.

The default setting for this option is DE (DE000—DEFFF 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 $\mu$Analyst SYSTEM DISK is not write-protected, the $\mu$Analyst stores the new address value. This way, whenever you restart the system, the new address is automatically entered.

### (6) Return to User Level Program

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

### (7) Return To DOS

This option exits the Configuration Menu and returns you to the DOS operating software. When the option is selected, the μAnalyst will prompt you with the message:

**"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 I/O Menu, or if you don't want to save your setups, enter Y for yes. The μAnalyst will exit into DOS.

If you want to save your menu setups, and have not yet done so, type N for no. Then, enter the I/O Menu and save your setups. When finished, return to the Configuration Menu and exit into DOS.

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

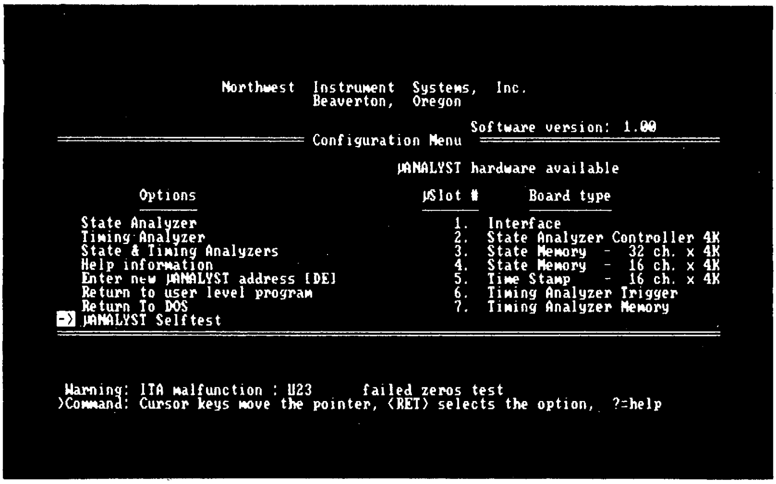
### (8) μAnalyst Selftest

This option is used to run the μAnalyst's internal diagnostics. These diagnostics perform a first-fault, static test of the μAnalyst boards. They take several minutes to execute.

While the diagnostics are being executed, the μAnalyst 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 μAnalyst will tell you that the board has passed the selftest. If a fault is found, the μAnalyst displays a coded message similar to that shown in Figure 5-4.

If a board is found to be faulty, contact Northwest Instrument Systems, Inc.

00843-0013




■ **Figure 5-4. An example of a selftest error.**

## OVERVIEW

The Format Menu is used to determine which data is stored in acquisition memory, and when.

Through this menu, you control all of the timing analyzer's initial acquisition parameters. You can specify acquisition and triggering modes, set up clocking and word recognition, and select probe input thresholds. You can also enable or disable the glitch latches, and format the acquired data for the list display.

In the rest of this subsection, we'll describe the Format Menu and its programmable fields. To enter this menu, simply press M for Menu, then F for Format from the command line.

## ACQUISITION MODE FIELDS

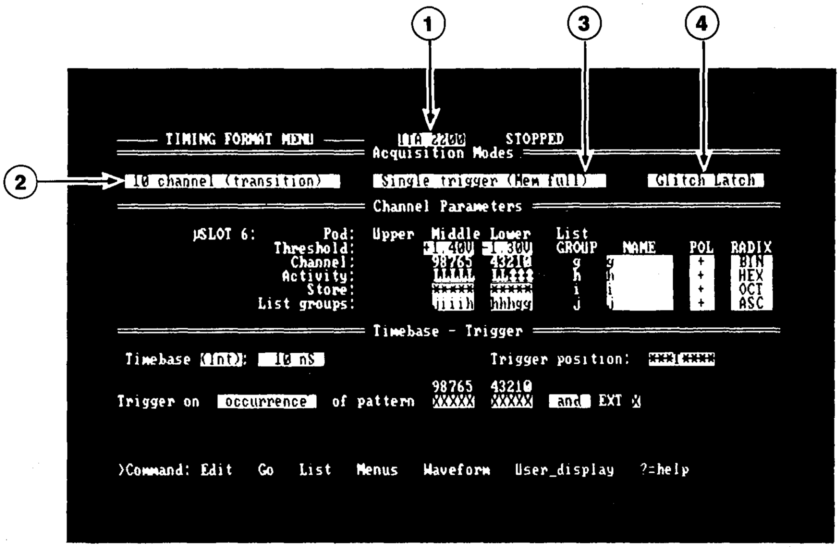
As shown in Figure 5-5, the fields within the Format Menu are grouped into three major categories: acquisition modes, channel parameters, and timebase—trigger.

In the following paragraphs, we will describe the fields used for controlling the analyzer's acquisition modes. For information about the channel parameter and timebase—trigger fields, refer to Figures 5-6 and 5-7, respectively.

Use the numbered callouts in Figure 5-5 as a reference 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 desired 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.

00843-014




■ **Figure 5-5. The Format Menu and its fields for controlling the analyzer's acquisition modes.**

### ① Name

This field lets you name your menu setups. The name you enter here will appear at the top of all other timing 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 ITA 2200. 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 8088_SYS or MEMCHECK.

### (2) Acquisition Modes

This field specifies how the analyzer will acquire data. Using the space bar, you can select:

- 16 Channel (Standard)
- 10 Channel (Transition)

**16 Channel (Standard).** In this mode, the analyzer acquires data on all 16 input channels. Data sampling and storage occurs on each tick of the selected clock.

**10 Channel (Transition).** In this mode, the analyzer acquires data on channels 0—9 only. Data sampling occurs on each tick of the selected clock, but data storage occurs only when the analyzer detects a transition on one or more of the channels.

An 8-bit counter is used to record the time intervals between stored samples. The time intervals are then displayed along with the captured data in the List Display.

With transition timing, you can selectively store channels. By using the programmable Store field (see Figure 5-6, callout number 8), you can choose to store on one or all ten available channels. This selective storing is not available in the standard mode.

For more information about the transition timing mode and its applications, refer to Section 4 *Modes of Operation*.

### (3) Trigger Modes

This field specifies the analyzer's trigger mode. Using the space bar, you can select:

- Single Trigger (Memory Full)
- Single Trigger (Immediate)
- Multi-Triggers

**Single Trigger (Memory Full).** This mode assures pre-trigger acquisition. In this mode, the trigger is locked out until enough data has been acquired to fill all of the pre-trigger memory locations. Once the pre-trigger data is acquired, the timing analyzer starts looking for its trigger.

**Single Trigger (Immediate).** This is the standard single-trigger mode. The analyzer will trigger the instant the trigger condition is satisfied, regardless of the amount of pre-trigger data collected.

**Multi-Triggers.** In this mode, the timing analyzer captures up to 15 occurrences of the same trigger event. Each occurrence of the trigger event is centered within a 32-sample memory segment. You see up to 15 events preceding the trigger occurrence, and up to 16 events following.

This mode is most helpful when you are tracking down a problem that occurs randomly or intermittently. The analyzer operates as 15 mini analyzers, allowing you to capture 15 successive occurrences of the intermittent problem. Once a memory segment is filled, the analyzer begins filling the next segment immediately. There is no down time, since the acquisition is continuous.

When setting up the trigger for Multi-Triggers, try to use an edge pattern or the start or end of pattern (see Figure 5-7, callout number 13). A level pattern, or a pattern of all don't cares, may fill up the analyzer's acquisition memory prematurely.

For example, suppose you set up a level pattern that matches a static state of the system under test. The analyzer will trigger on each acquisition of that static state. By using an edge pattern, you can ensure that the analyzer triggers only when a transition occurs. Each memory segment will contain a new occurrence of the trigger pattern.

### (4) Glitch Latch

This field lets you turn the analyzer's glitch latches on or off. Using the space bar, you can select:

- Glitch Latch — the glitch latches are turned on.
- Sample—the glitch latches are turned off.

Only channels 0—9 (from the lower and middle probes) are equipped with glitch latches. These 10 channels are simultaneoulsy in either sample or glitch detection mode. Channels A—F are always in sample mode.

When enabled, the latches detect first-order glitches as narrow as 5 ns and stretch them into the next sample. First-order glitches occur when one or more transitions are detected within a given clock cycle.

Glitch detection is mostly used during asynchronous acquisitions. If you select glitch latches with a synchronous clock, the μAnalyst will prompt you with the following message:

**"May get unexpected acq data with external clock and glitch mode"**

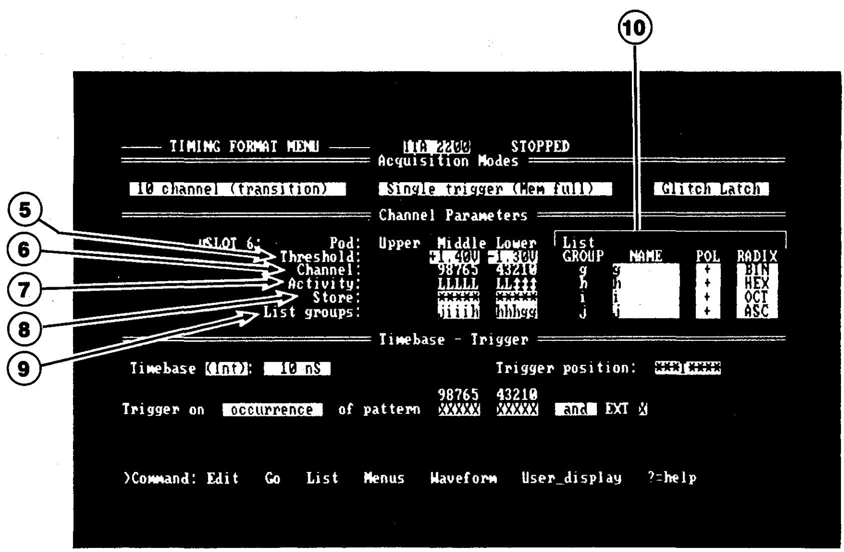
With synchronous acquisition, you are usually not concerned about activity that occurs outside of the clock edge.

## CHANNEL PARAMETER FIELDS

Figure 5-6 illustrates the fields used when establishing the timing analyzer's channel parameters. For information about the acquisition mode and timebase—trigger fields, refer to Figures 5-5 and 5-7, respectively.

Use the number callouts in Figure 5-6 as a reference while reading the following field descriptions.

00843-015




**■ Figure 5-6. The Format Menu and its fields for controlling channel parameters.**

## (5) Threshold

These fields allow you to specify the threshold levels used for determining the high (1) and low (0) states of incoming data.

In these fields, you may specify the threshold levels for both the middle and lower data probes. The upper data probe does not have a threshold field since it is jumpered internally to match either the middle or lower setting. (Refer to Section 2's *Setting the Upper Probe Threshold* subsection for more information).

To specify the threshold levels:

- Press E—this enters an ECL threshold of −1.30 V.
- Press T—this enters a TTL threshold of +1.40 V.
- Press I or D—this increments or decrements the current threshold setting in 50 mV steps between the range of -5.50 V and +5.50 V.

The middle and lower thresholds may be programmed independently to support acquisition from mixed circuitry. The threshold level you select applies to both the probe's data lines and its clock line.

When you are entering values into the threshold fields, the μAnalyst will prompt you with a message reading:

> **"Includes ClkM. Pod U threshold is board strapped to Pod M or Pod L," or**
>
> **"Includes ClkL. Pod U threshold is board strapped to Pod M or Pod L."**

The first part of each message means that the clock line threshold is the same level as the rest of the probe. Keep this in mind if you are analyzing mixed circuitry and attempt to use an external clock that is not the same hardware type, or if you are varying the threshold to a level outside of the external clock hardware specifications.

The second part of each message reminds you that the upper probe is slaved to the threshold programmed for either the middle or lower probe, depending on the position of the jumper on the timing memory board.

### (6) Channel Identifiers

The channel identifiers are not programmable; they are used as a screen reference only.

Note how the channel numbers from each of the three probes are grouped. The grouping matches the number of lines in each probe; and the numbers match those stamped on each square-pin connector in the flying lead set.

### (7) Activity

This is a non-programmable monitor field.

The characters in the Activity field provide a rough picture of the activity occurring at each probe channel tip. A ↕ character means that the signal on that channel is changing. An *L* (logic low) or an *H* (logic high) means that the state of that particular channel has not changed within the last few seconds.

### (8) Store

This field is only programmable if the analyzer is set to the 10-channel transition mode (see Figure 5-5, callout number 2).

The field allows you to decide which data channels will be stored. Enter an asterisk (*) into the channel fields you want to store, and leave a blank space in the channel fields you don't want to store.

In transition timing, the analyzer's decision to record a sample is an ORed function. That is, any transition on a stored (*) channel causes all of the channels to be stored for that event. You can conserve memory space by not storing extraneous channels that may have unwanted transitions.

Channels not stored will not be present in the Waveform, Trigger_find(vertical), and List Display Menus. They will, however, be available for trigger programming.

### (9) List Groups

As you will see later in this section, the List Display Menu shows timing data in a state fashion. That is, the waveform data is listed vertically in numerical form, similar to the state display in the state analyzer.

With the List Group field, you can organize the timing data into meaningful groups for the List Display. Four groups (labeled G, H, I, and J) are available for use, and each group can contain from one to 16 channels.

The channels can be assigned in any order and combination within the groups; they do not have to be contiguous. 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.

The individual digits within a group will always be displayed from left to right, most significant bit (msb) to least significant bit (lsb).

### (10) Group Name, Radix, and Polarity

These fields are used to assign names, radices, and logic polarities to the list display's channel groups. They do not affect the waveform display.

In the Name field, enter any desired group name, up to 8 characters. Type or space directly over any unwanted information.

In the Radix field, use the space bar to scroll through the radix options of BIN (binary), OCT (octal), HEX (hexadecimal), or ASC (ASCII). When you are using the ASCII radix, Appendix A at the back of this manual may be useful.

In the Polarity field, use the space bar to select positive (+) or negative (−) polarity for a specific channel group. If positive polarity is selected, the List Display Menu interprets the data above the probe threshold as high (1) and the data below the probe threshold as low (0). If negative polarity is selected, the List Display Menu interprets the data above the probe threshold as low (0) and the data below the probe threshold as high (1).

# TIMEBASE—TRIGGER FIELDS

Figure 5-7 illustrates the fields used when establishing the timing analyzer's timebase—trigger. For information about the acquisition mode and channel parameter fields, refer back to Figures 5-5 and 5-6, respectively.

Use the number callouts in Figure 5-7 as a reference while reading the following field descriptions.

00843-016

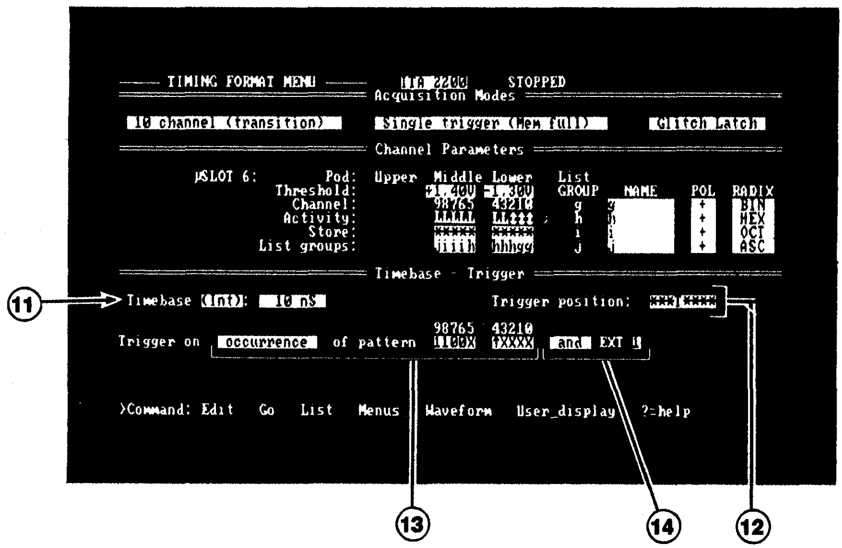



**Figure 5-7. The Format Menu and its fields for controlling the timebase—trigger.**

### (11) Timebase

This field allows you to specify the timing analyzer's clock source and rate. You can use an internal clock for asynchronous sampling at intervals ranging from 10 ns to 10 ms, or you can use an external clock for synchronous sampling up to 100 MHz. The selections are made by using the space bar.

The timebase selections include:

- Int (10 ns—10 ms)—this sets the timebase to the analyzer's internal (asynchronous) clock. The clock offers a sampling range of 10 ns to 10 ms, with each decade divisible by 10. You can increment and decrement the clock's sampling interval by using the I and D keys, respectively.
- Ext ClkL ↑ (↓)—this sets the timebase to the lower probe's external clock line. You can set the clock polarity to rising (↑) or falling (↓) edge by using the space bar in the appropriate field.
- Ext ClkM ↑ (↓)—this sets the timebase to the middle probe's external clock line. You can set the clock polarity to rising (↑) or falling (↓) edge by using the space bar in the appropriate field.
- Ext ClkL or ClkM—this establishes a master clock based on the ORed condition of the two external clock lines. You can set the polarity for either external clock to rising or falling edge.

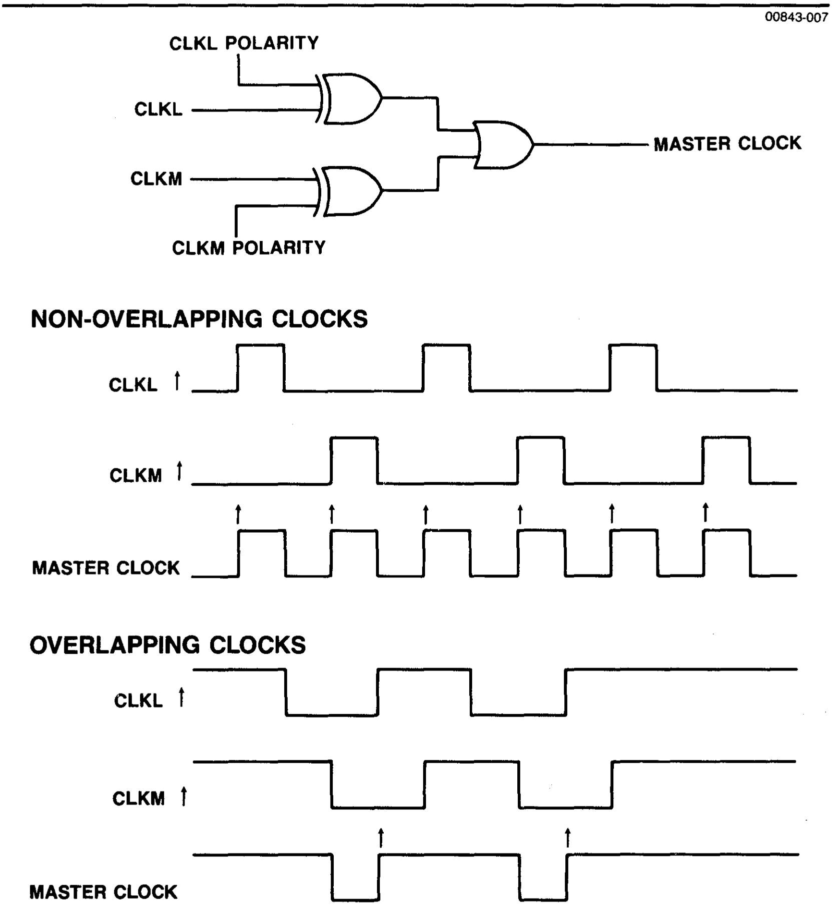
**Using the Internal Clock**. The analyzer's timebase determines the resolution of the sample. The faster the clock, the better the resolution.

Traditionally, a higher sampling rate has also meant proportional reductions in the length of the sample, due to the high rate of memory use. But recall the nature of the transition timing mode. In this mode, the effective memory is extended. Therefore, we suggest you always start with the fastest sampling rate possible (10 ns), and only decrease the sampling rate if needed.

**Using External Clocks**. When using an external clock, be sure to choose the correct edge polarity for your application. Also, remember that the logic level expected at the lower or middle probe clock input (ClkL or ClkM) is the same as the level set in the probe's Threshold field (see Figure 5-6, callout number 5).

If you are ORing the clock lines from the middle and lower probes, try to avoid overlapping clock pulses. If the two clocks overlap, the master clock combines the pulses to create a longer pulse.

An example of overlapping and non-overlapping clocks is provided in Figure 5-8. Data sampling occurs on the rising edge of the master clock.




■ **Figure 5-8. The effects of overlapping external clocks.**

### ⑫ Trigger Position

This field is used to position the trigger event within acquisition memory.

Each asterisk in the field represents approximately 12% of the memory. Using the space bar, you can position the trigger by moving the T indicator to the desired 12% block. The left side of the field corresponds to the beginning of memory, while the right side corresponds to the end of memory.

The amount of pre- and post-trigger data, relative to the trigger position, is approximate. In the transition timing mode, the size of a sample can vary greatly from one acquisition to the next. Therefore, it is convenient to think of the trigger position as proportional, rather than absolute.

**NOTE**
The Trigger Position field is not available when the analyzer is set to the Multi-Triggers mode (see Figure 5-5, callout number 3). In the Multi-Triggers mode, the trigger positions are fixed internally.

### ⑬ Trigger Recognition Modes

This field is used for setting up the analyzer's trigger. The modes available in this field include:

- Occurrence of Pattern
- Occurrence of Pattern of Duration Greater Than [time]
- Occurrence of Pattern of Duration Less Than [time]
- Start of Pattern
- End of Pattern
- Setup Time
- Hold Time

The following paragraphs describe each mode in detail. Note that the Occurrence of Pattern of Duration Modes, and the Setup and Hold Time Modes, are only available when the analyzer is set to an internal timebase of 10 ns to 1 $\mu$s.

#### Occurrence of Pattern

This is the most direct trigger mode. Simply stated, if a data sample matches the programmed pattern, a trigger is generated.

In this mode, the pattern can be comprised of data levels and/or edges. To enter data levels, press 0 for low or 1 for high. To enter edges, press R for rising (↑), F for falling (↓), or E for either edge.

During recognition, the edges are ORed together and ANDed with the levels. For example, suppose you are looking for a problem that seems to occur only when a certain 8-bit data word is present. You are suspicious of erroneous signals on one or more control lines. The analyzer would be connected to the appropriate data and control lines, and started. Because the edges are ORed with each other and then ANDed with the levels, the trigger will only occur when all the levels are present, and when any of the selected edges are present. You can then narrow down which edges are causing the problem.

The pattern can also contain don't cares (Xs). A pattern composed of all don't cares will generate a trigger on any sample.

**Occurrence of Pattern of Duration Greater Than [time]**
**Occurrence of Pattern of Duration Less Than [time]**

These two modes are only available when the analyzer is set to an internal timebase of 10 ns to 1 μs.

With these modes, you are able to add a time requirement to the trigger. The Greater Than mode specifies that a trigger occurs only if the duration of the incoming event exceeds the time requirement. The Less Than mode specifies that a trigger occurs only if the duration of the incoming event falls within the time requirement.

The trigger pattern for these modes can be comprised of levels (0s and 1s), and don't cares (Xs).

When either mode is used, a time subfield appears. Move to this subfield and enter the value desired. Note that the time entered should be a multiple of the timebase selected. If not, the system will automatically round up the duration value to the nearest timebase multiple when the field is exited. The available time range will change according to the timebase. Refer to the rounding and ranging specifications that follow.

Duration Limits:

- In the Greater Than mode, the minimum duration equals the timebase, and the maximum duration is a multiple of the timebase ≤ 2000 ns.
- In the Less Than mode, the minimum duration equals the timebase times 2, and the maximum duration is a multiple of the timebase ≤ 2000 ns.

Relationship of the timebase to the duration time value:

- If the internal timebase is incremented past 1 μs, the trigger mode automatically changes to the next mode (Start of Pattern). If the timebase is decremented below 2 μs, the trigger mode returns to the earlier mode.
- As the internal timebase is incremented or decremented, the duration value is automatically modified to be a multiple of the timebase. The system tries to match the entered duration value as closely as possible.
- If you switch the internal timebase to the external timebase, the trigger mode automatically changes to the next mode (Start of Pattern). If you switch back to the internal timebase, the earlier trigger mode reappears.

**Start of Pattern**

At first glance, this mode may appear to be the same as the Occurrence of Pattern mode noted earlier. However, there is a distinct difference. While the Occurrence of Pattern mode triggers on a satisfied state condition, the Start of Pattern mode triggers on a state change from logical NOT pattern to pattern.

Triggering on a state change is especially useful when you are operating the analyzer in the Multi-Triggers mode. For example, assume that the trigger pattern occurs at the probe tips and is present for 100 ns. With the Occurrence of Pattern mode, the analyzer generates a trigger at each 10 ns sample clock. With the Start of Pattern mode, however, the analyzer triggers at the transition into the pattern, and then does not trigger again until the pattern goes away and comes back. Triggers are not being wasted on a static state.

Note that only levels (0s and 1s) and don't cares (Xs) may be used to define the pattern in the Start of Pattern mode. A trigger pattern of all don't cares (Xs) would be interpreted as an "always trigger" condition.

### End of Pattern

The End of Pattern mode is similar to Start of Pattern, except that it generates a trigger when the state changes from pattern to NOT pattern.

Again consider how this mode can be applied to Multi-Triggers acquisition. Suppose you want the analyzer to trigger when a pattern goes away. You do not want additional triggers generated while the system under test is static on some NOT-pattern state. Therefore, End of Pattern is used.

Note that only levels (0s and 1s) and don't cares (Xs) may be used in the trigger pattern. A trigger pattern set to all don't cares (Xs) is interpreted as a "never trigger" condition.

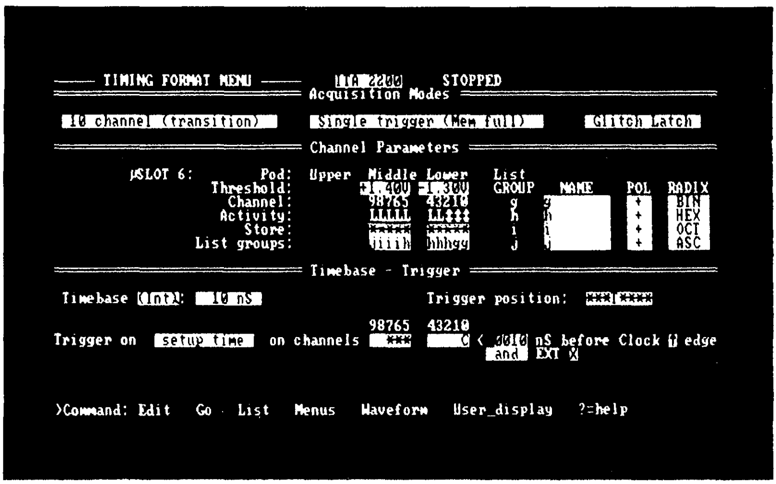
### Setup Time/Hold Time

These two modes are only available if the analyzer is set to an internal timebase of 10 ns to 1 $\mu$s.

With these modes, the analyzer is able to look for setup and hold time violations. Selected lines in the system under test can be checked to see if sufficient time is allowed for the hardware to settle prior to performing some action (setup time); or if sufficient time is allowed to perform that action (hold time).

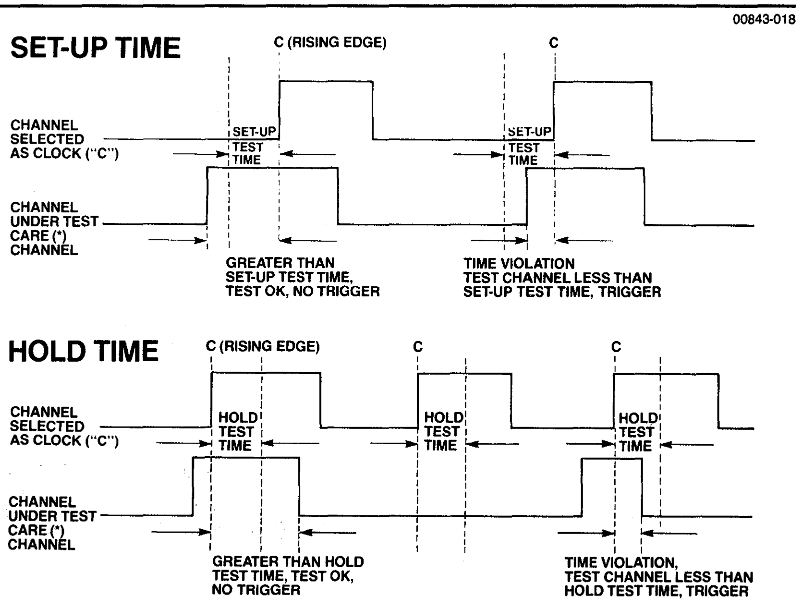
Figure 5-9 illustrates how the menu looks when the Setup or Hold Time mode is selected. Asterisks and one C (clock indicator) appear in the pattern field. The asterisked channels are checked against the setup or hold times, and the C channel is used as the clock reference. The time field specifies the amount of setup or hold time that is to be met before the clock. Once G (Go) is pressed from the command line, a trigger will be generated if there is a time violation.

00843-017




■ **Figure 5-9: Setup and Hold Time fields in the Format Menu.**

Figure 5-10 illustrates the how the Setup and Hold Time modes work. Each channel marked by an asterisk (*) is compared against the setup or hold time requirement. If a transition is detected on any of the channels during this time requirement, a trigger is generated. If all the channels remain stable, the setup or hold time specification is met, and no trigger is generated.




■ **Figure 5-10. Time Violations.**

You can assign any channel as the clock channel. To do this, simply position the screen cursor in the desired channel field and press C.

The rest of the channels may be set to care or don't care. A care channel is indicated by an asterisk (*), and a don't care channel is indicated by a blank space.

In the time field, enter any time value within the range specified in the edit prompt line. The available range will vary depending on the timebase selected. However, the time entered should be a multiple of the timebase. If not, the time figure entered will be automatically rounded up to the next timebase multiple. The channel assigned as the clock may be programmed to be either a rising or falling edge.

These modes can be useful even though you may not be looking for hardware setup and hold time violations. The modes could be used to check whether or not various pulses are occurring too soon or too late in relation to each other.

For example, suppose you have two control signals connected to data channels 1 and 2. You want to verify that the signal in channel 1 is occurring 1 μs prior to the signal in channel 2. To do this, you would select the Hold Time mode with a time requirement of 1 μs. Channel 1 would serve as the clock (C) and channel 2 as the compare (*). If the edge on channel 2 occurs less than 1 μs after the edge on channel 1, a trigger will be generated, and you will know that a violation has occurred. If the signals are occurring properly, no trigger will be generated.

### (14) EXT Input

These fields allow you to include the EXT input as part of the trigger. This EXT input is derived via the BNC connector located on the back of the μAnalyst mainframe.

In the first EXT field, select how the external signal is to be combined with the main trigger word, AND or OR. In the second EXT field, select the pattern: 1, 0, or X (don't care).

**NOTE**
Do not set EXT to don't care when OR is selected. This would cause the timing analyzer to always trigger, regardless of the main trigger pattern.

# CROSSLINK (CL) TRIGGERING

If you are operating the timing analyzer in conjunction with another μAnalyst instrument, such as the Interactive State Analyzer, new fields may appear in the Format Menu. These new fields assert and/or sense the μAnalyst's Crosslink (CL) signal.

The following paragraphs briefly describe the new fields and show how they are programmed. For information on how to apply these fields, refer to Section 6 of this manual.

**Timing Arms State (Aligned)**

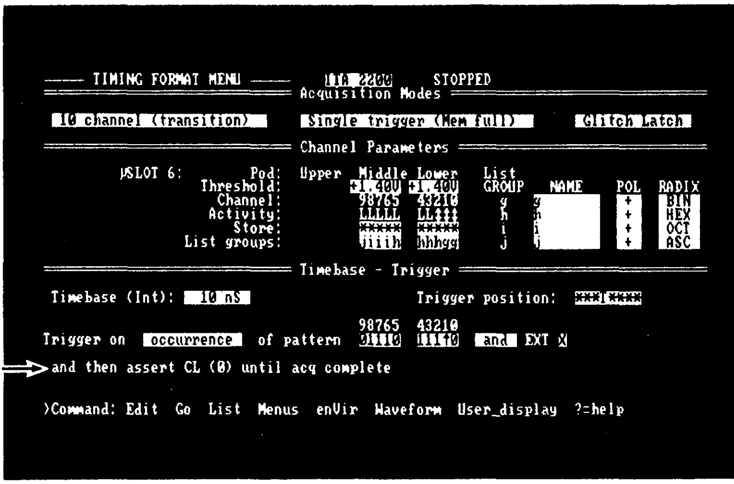
If you are operating the two analyzers in the Timing Arms State mode, the timing analyzer asserts the CL signal. As shown in Figure 5-11, a message appears below the word recognizer field. This messages reads:

**"and then assert CL (0) until acq complete"**

As soon as the timing analyzer triggers, it will assert CL=0 and hold it until the acquisition is complete. The CL signal will then arm the state analyzer to start looking for its trigger. The CL signal will also appear at the CL BNC on the back panel of the mainframe.

When operating in the Timing Arms State mode, you cannot use the Multi-Triggers mode. In addition, the timebase is limited to 10 or 20 ns.

00843-019




ASSERTS CL

■ **Figure 5-11. CL assertion in the Timing Arms State mode.**

### Crosslink Triggering (Non-Aligned)

If you are operating the two analyzers in the Crosslink Triggering mode, the timing analyzer can assert and/or sense the CL signal. This allows for interactive triggering with the state analyzer.

As shown in Figure 5-12, two new fields appear in the Format Menu. The first field senses the CL signal as it is asserted by the state analyzer, and the second field asserts the CL signal.

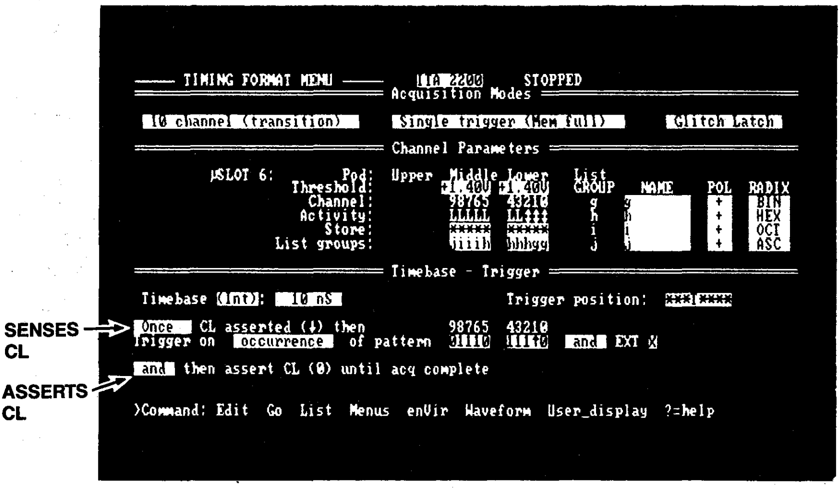
The Senses CL field determines how the CL line will affect the timing analyzer's triggering. Using the space bar, you can select:

- ONCE CL—this specifies that the timing analyzer can look for its trigger once the CL (0) signal has been asserted by the state analyzer.
- WHILE CL—this specifies that the timing analyzer can look for its trigger while the CL (0) signal is being asserted by the state analyzer. If the CL signal goes high (1) again, the timing analyzer's trigger is disarmed. In this way, you can create a trigger window.

If you leave the Senses CL field blank, the timing analyzer ignores the CL signal.

The Asserts CL field allows the timing analyzer to assert the CL (0) signal once it has triggered.

00843-020




■ **Figure 5-12. CL assertion in the Crosslink Triggering mode.**

## OVERVIEW

The Waveform Display Menu lets you view acquired data in a timing diagram format. Each data channel appears as a logic waveform, drawn across a timing grid.

You can use the menu to view acquisition and reference memory, either separately or in comparison. When viewed in comparison, the data channels from the two memories are displayed sequentially, with each acquisition channel stacked above its corresponding reference channel.

Special commands are provided for manipulating the display. You can use the menu's magnification control to view the entire memory content, or to center in on any specific area of interest. You can also use the menu's two cursors to scroll through the waveforms and make timing measurements.

The rest of this subsection describes the Waveform Display Menu and its programmable fields. It also shows how to use the menu's special function keys and commands.

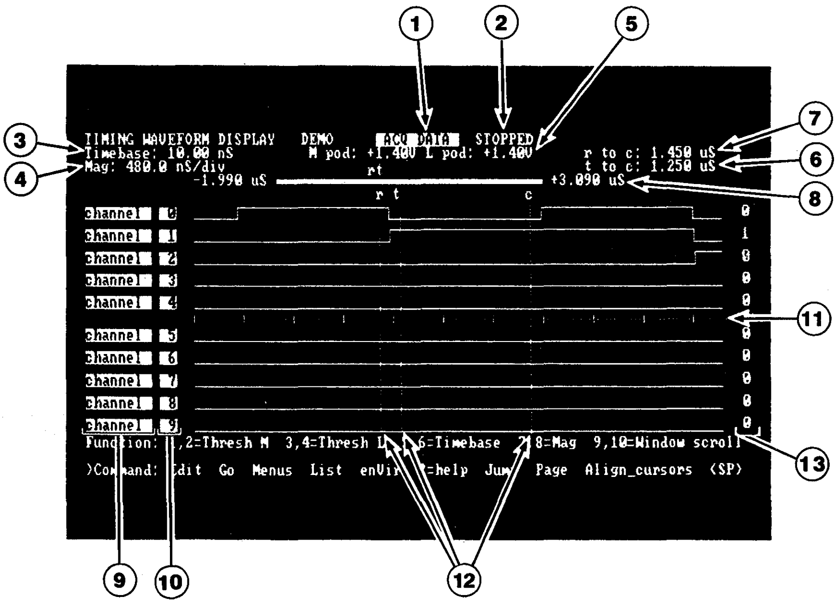
## MENU FIELDS

Figure 5-13 illustrates a typical Waveform Display. You enter this display by pressing W for Waveform from the command line.

Use the numbered callouts from Figure 5-13 as a reference while reading the following field descriptions. To make any changes to a 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 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.

00843-021




■ **Figure 5-13. The Waveform Display Menu and its fields.**

### ① Memory Selection

This field allows you specify the origin of the data in the display. Using the space bar, you can select:

- ACQ—this displays the current acquisition memory.
- REF—this displays the current reference memory.
- ACQ, REF—this displays a comparison of the current acquisition and reference memories.

A fourth display choice, labeled SPLIT-ACQ, is available if you are operating the timing analyzer in an aligned mode with the Interactive State Analyzer (see Section 6 of this manual). The SPLIT-ACQ display lets you view timing and state data in a time-correlated format.

Refer to *Display Examples* at the end of this subsection for an example of each of the above displays.

### ② Acquisition Status

The status field tells you the current activity of the analyzer. A blank field means that no acquisition has occurred since start-up or boot. The word RUNNING means that the analyzer is in the middle of an acquisition. (In some cases, the acquisition happens so quickly that the word RUNNING is not seen.) The word STOPPED means that the acquisition is over, and the analyzer is waiting for your next command.

If the analyzer is acquiring data in the Multi-Triggers mode, the status field shows the progress of the acquisition. It does this by displaying a line of 15 dashes (———————————————) next to the word RUNNING. Each dash represents a memory segment. When a segment is filled with data, an asterisk (*) replaces the dash.

No matter which menu is currently displayed on the screen, the status field will be present whenever the G (Go) command is available and pressed.

### ③ Timebase

This reference field tells you the timebase used to acquire the data.

Since this is only a reference field, the timebase cannot be edited in this menu. But you can use function keys F5 or F6 to change the timebase value (refer to *Function Keys* later in this section), or you can return to the Format Menu to reprogram the timebase value.

If the timebase is changed from the timebase used for the acquisition currently displayed, the word "new" appears just to the right of the Timebase field. This reminds you that the data you see currently was not collected using the timebase indicated. Once another acquisition is made, the word "new" goes away.

### ④ Magnification

This field shows the time represented between each tick mark on the center graticule. If an internal timebase was used for the acquisition, the time is based on the sample rate. If an external timebase was used, the time is based on clock divisions.

The less time indicated in this field, the more the same segment of data in the waveform display has been magnified to fill the window. Magnification occurs around the active (c) cursor, and can be changed using function keys F7 and F8 (refer to *Function Keys* later in this subsection).

### ⑤ Thresholds

These fields show the probe threshold values programmed in the Format menu. *M* is the middle probe (channels 5-9), and *L* is the lower probe (channels 0-4). Recall that the upper probe (channels A-F) threshold value is assigned via a hardware jumper to match the programmed threshold value of either the middle or lower probe. Refer to Section 2 of this manual for information on changing the jumper.

The threshold values are not edited from this menu, but you can use Function keys F1, F2, F3, or F4 to change the threshold values (refer to *Function Keys* later in the subsection). The threshold values displayed indicate the threshold values to be used on the next acquisition.

### ⑥ c to *t* (or *t* to c)

This field displays the amount of time from the active (*c*) cursor to the trigger (*t*). If the internal timebase was used to acquire the data, the time readout is based on the internal sample rate. If an external timebase was used, the time readout is based on clock cycles.

The *c* cursor can be moved to any point on the waveforms, and the readout will be updated. Since the readout is a measurement, the value shown is absolute. There is no negative time if the *c* cursor is moved to the left of the trigger point. Instead, the order of *c* and *t* are reversed in the field.

You can use this field to determine when a certain pattern or event occurred in relation to the trigger. Using the cursor keys, you can move the *c* cursor to the desired location in relation to the trigger, then read the value in the *c* to *t* field. (The resolution of the measurement is limited to the sample rate of the timebase.)

### ⑦ c to *r* (or *r* to c)

This field displays the amount of time between the active (*c*) and reference (*r*) cursors. If an internal timebase was used for the acquisition, the time readout is based on the internal sample rate. If an external timebase was used, the time readout is based on clock cycles.

Use this field to make timing measurements. For example, if you have a write strobe that appears to be too narrow, use the cursor keys to position the *c* cursor at the leading edge of the pulse. Press A to execute the Align_cursors command. This places the *r* cursor on top of the *c* cursor. Now, move the *c* cursor to the trailing edge of the pulse. The time value in the *c* to *r* field will show you the duration of the pulse.

The resolution of the *c* to *r* field is limited to the sample rate of the timebase. If *r* is positioned to the left of *c*, the order of *c* and *r* are reversed in the field.

### ⑧ Data-Time Indicator

This line shows the total size of the acquired sample. The number on the left side of the line shows the amount of pre-trigger data in the acquisition. (A negative number indicates the amount of time before the trigger.) The number on the right shows the amount of post-trigger data. In Multi-Triggers, the numbers refer to the size of the region currently displayed in the window.

The wide horizontal band on the line indicates the amount of data displayed on the screen, and the size of the window. The relative position of the band on the line indicates where the data in the window is located.

**NOTE**
If you are in transition timing mode, the indicator numbers may show a change in the size of the acquisition from one acquisition to the next, even though you've made no changes to the acquisition setup. This occurs because of the dynamic nature of transition timing. Refer to Section 4 *Modes of Operation* for a more detailed discussion of transition timing.

### ⑨ Trace Names

In these fields, you can assign a name to each channel trace, such as MWRITE, SYNC, HALT, IC5-PIN3, and so on. The name can be up to eight characters.

You can also use these fields to insert or delete a trace. To insert a trace, press the insert key. A new, blank field will appear at the cursor location, and all of the following traces will move down one line on the screen. To delete a trace, press the delete key.

### ⑩ Trace Numbers

The number in this field refers to the probe channel used in making the trace. Several display alterations may be made by changing the contents of these fields. You can rearrange the order of the traces, insert and delete traces, and duplicate traces. You can set up the display window to make it easy to see the particular channels or group of channels that are of the most interest.

In default, the menu shows the first 10 channels (0-9). To display the upper six channels (A-F) of the 16-channel mode, you must use the insert procedure detailed below. If you should change from the 16-channel mode to the 10-channel mode, any of the upper six channels that are displayed will go to a blank, don't care status. If you then return to the 16-channel mode, the original channels will return to the display.

**NOTE**

The edit utilities listed below have no effect on the actual acquisition or reference data. These utilities merely change the way in which the data is displayed on the screen.

To edit the trace numbers:

0-F — Enter a channel number. The corresponding channel waveform will appear in the trace position. You can rearrange the display any way you wish, or even duplicate traces by using the same channel number more than once. (Note that only channels 0-9 are available in the transition timing mode.)

For an alternate method of selecting a trace, use the Control-S key.

X — Press this key to blank the trace. The trace is no longer seen, but the space in the display is reserved. Contrast this with the delete key's function.

Delete — Press this key to delete the trace. The trace name, trace, and channel number will all be erased from the screen. The window is reformatted to fill in the gap left by the deleted trace.

Insert — Press this key to insert a trace. A new trace will appear at the cursor position, and all of the following traces will move down one line on the screen. You may then enter the new channel number.

Control–S — Press this key to scroll through the acceptable channel numbers. Note that in the 10-channel mode, the choices are 0-9 and X. In the 16- channel mode, the choices are 0-F and X.

As the trace numbers are scrolled, the corresponding waveforms are also scrolled through the current horizontal trace field. If you are moving or duplicating traces, you can see and verify the selected trace.

### (11) Graticule

The horizontal graticule in the center of the window, along with its tick marks, is fixed. To determine the significance of each tick mark, read the number shown in the Magnification field (see callout number 4).

### (12) Cursors

There are three cursors: the active (*c*) cursor, the reference (*r*), and trigger (*t*). Each cursor is a thin vertical line crossing through the waveform display.

You can scroll the *c* cursor through the display by using the left or right cursor keys. These keys will move the cursor to the next edge. To speed up the scrolling, you can also use the Control key in conjunction with the cursor keys. This moves the cursor by 10 edges.

When moved, the *c* cursor will always land on an edge. The *c* cursor cannot move off-screen during the scrolling. Instead, the window will scroll. If the window is scrolled past the current position of the *c* cursor, the *c* cursor will move with the window.

The *r* cursor, once positioned, remains stationary. The window can be scrolled so that the *r* cursor is no longer seen. The *r* cursor can be repositioned by using the Align_cursors or Switch_cursors commands. The Align_cursors command moves the *r* cursor to the current position of the *c* cursor. The Switch_cursors command exchanges the positions of the *r* and *c* cursors.

The *t* cursor cannot be moved. It remains stationary at the trigger point.

Because the *t* and *r* cursors do not move and at times may not be visible in the display window, the *t* and *r* cursors also appear at their relative locations on the Data-Time Indicator (see callout number 8).

### (13) Bit Pattern

This column is a non-programmable monitor field. It indicates the level values at the current position of the *c* cursor. If the cursor is located on an edge, the level value in the column reflects the level immediately to the right of the edge.

As the window or *c* cursor is scrolled, the data in this column will be updated.

## FUNCTION KEYS

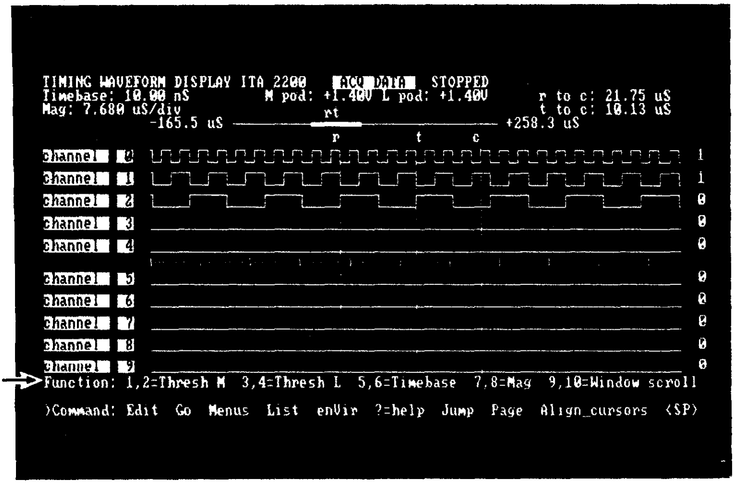
The block of ten function keys (F1 through F10) located on the left-hand side of your IBM or IBM-compatible computer are used to control parts of the waveform display and to simplify certain programming tasks.

As shown in Figure 5-14, each pair of side-by-side function keys can modify one parameter. The odd numbered keys decrement the parameter, while the even numbered keys increment it. With the F7,F8=Mag and F9,F10=Window keys, you can also use the control or shift key to speed up the magnification and window scrolling functions.

Some of the function keys duplicate the functions of the fields in the Format Menu. For example, rather than going back to the Format Menu and entering the edit mode to change a threshold or timebase value, you can use the function keys to make the same changes from Waveform Display Menu. This means that once the analyzer has been set up for the current task, you will rarely have to leave the Waveform Display Menu.

Another benefit of the function keys is that they can be used while the analyzer is operating in the Go Forever acquisition mode (see *Environment Submenu* later in this section). The analyzer does not have to be stopped before you can vary threshold or timebase parameters. This allows for dynamic testing of system specifications.

00843-022




FUNCTION KEYS

■ **Figure 5-14. Function keys in the Waveform Display Menu.**

The following list details the Waveform Display's function keys.

F1,F2=M Pod Th These keys change the middle probe threshold (channels 5-9). Each press of key F1 will decrease the threshold value by 50 mV, and each press of F2 will increase the threshold by 50 mV. The voltage range is ± 5.50 V.

F3,F4=L Pod Th These keys are similar to F1,F2=M Pod Th, except that they change the lower threshold (channels 0-4) Each press of key F3 will decrease the threshold value by 50 mV, and each press of key F4 will increase the threshold by 50 mV. The voltage range is ± 5.50 V.

F5,F6=Timebase These keys change the analyzer's timebase settings. Each press of key F5 will decrement the timebase to the next accepted value (10 steps per decade). When the lowest possible value has been reached (10 ns), key F5 becomes inactive. Each press of key F6 will increment the timebase. The upper limit is 10 ms.

Note that if the timebase has been changed since the last acquisition, the word "new" appears next to the field.

F7,F8=Mag These keys change the magnification of the display window. To increase the magnification, press or hold key F8. Each press of F8 increases the magnification by a factor of 2. The screen graphics limit of the magnification is 16 pixels per clock cycle.

To decrease the magnification, press or hold key F7. Each press of F7 will reduce the magnification by a factor of 2. At minimum magnification, all of the data in the acquisition will be seen in the display window.

Pressing the control or shift key with F7 or F8 will make magnification changes much faster.

You can judge the relative amount of magnification by observing the Data-Time Indicator (see callout number 8). The length of the wide horizontal band compared to the narrow band indicates the relative amount of data displayed on the screen.

F9,F10=Window These keys scroll the display window left or right through the data. The greater the magnification factor, the longer it will take to move from one end of the acquisition to the other. Pressing key F9 moves the window to the left; key F10 moves it to the right.

Pressing the control or shift key with F9 or F10 will make the scrolling faster.

The window's location and size are indicated by the position and length of Data-Time Indicator (see callout number 8).

## SPECIAL COMMANDS

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

All of the commands do not all fit on one line. To view all of the commands, press the space bar <SP>.

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.

**J**ump — This command lets you jump to specific locations within memory. These locations include:

**B**egin—jump to the beginning of memory.
**E**nd—jump to the end of memory.
**T**rigger—jump to the trigger's position in memory.

If the data was acquired in the Multi-Triggers mode, two additional locations are provided:

**N**ext_region—jump to next region in memory.
**P**revious_region—jump to the previous region in memory.

**P**age — This command lets you move to the next adjacent block of data in the waveform window. The pointer at the front of the command line determines the direction of the paging.

**A**lign_cursors — This command aligns the reference (*r*) cursor with the active (*c*) cursor position.

| | |
|---|---|
| <Home> | This key moves the display window to the beginning of memory. |
| <End> | This key moves the display window to the end of memory. |
| <PgUp> | This key moves the display window one page backward in memory (toward pre-trigger data). |
| <PgDn> | This key moves the display window one page forward in memory (toward post-trigger data). |
| **S**witch_cursors | This command switches the current positions of the active (*c*) and reference (*r*) cursors. |
| cursors_**O**ff | This command removes the vertical cursors from the screen. You can return the cursors to the screen by pressing any key. |
| **F**ind | 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.<br>The data pattern being searched is defined in the Trigger-find(vertical) Menu. |
| **N**ext_diff | This command is especially useful when you are viewing a comparison of acquisition and reference memory. It 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. |
| **R**ef<—acq | This command transfers acquisition memory to reference memory. The previous contents of reference memory are lost. The μAnalyst will ask you to verify the operation by pressing Y for yes. |

## DISPLAY EXAMPLES

The following paragraphs illustrate some variations to the standard waveform display. Unless otherwise noted, all the fields and commands in these displays operate as specified earlier in this subsection.

### Multi-Triggers Display

Figure 5-15 illustrates a typical display of Multi-Trigger data.

In this display, the window is limited to one region at a time. The region that is currently being displayed is indicated in the upper-right corner of the screen.

00843-023

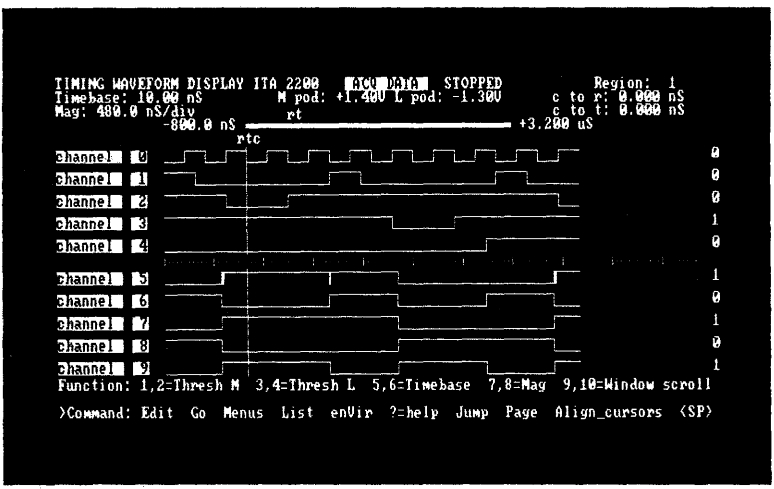
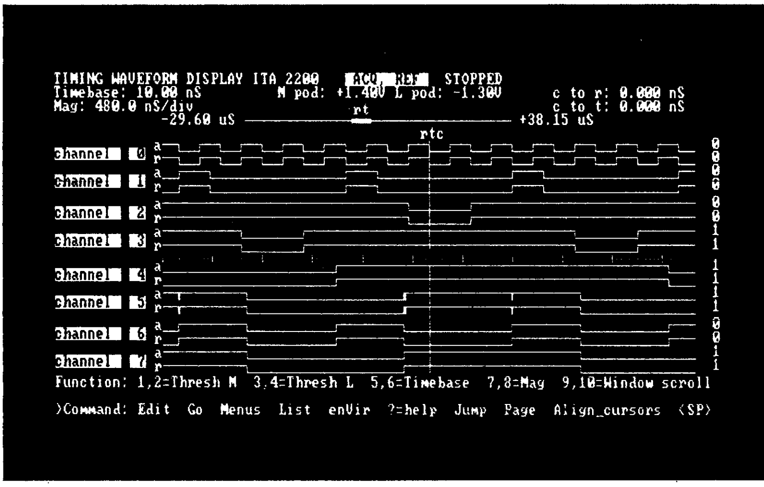



**Figure 5-15. Multi-Triggers display.**

## ACQ, REF Display

Figure 5-16 illustrates how the Waveform Display Menu appears during an acquisition and reference memory comparison. Each acquisition channel (*a*) is stacked above its corresponding reference channel (*r*).

00843-024



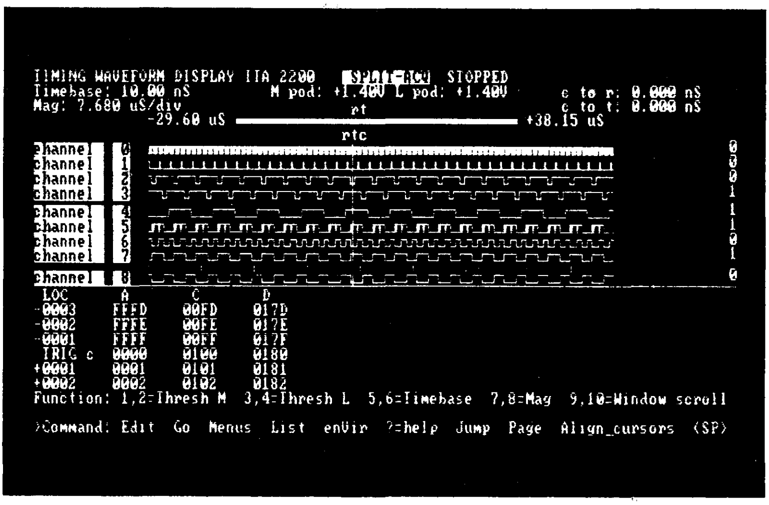

■ **Figure 5-16. ACQ, REF display.**

### SPLIT-ACQ Display

Figure 5-17 shows how the Waveform Display Menu appears when the SPLIT-ACQ format is selected. The timing data appears on the top portion of the screen, while the state data appears on the bottom. The two sets of data are time-correlated, and their data cursors are linked.

Note that this display is only available if you have acquired data in one of the timing and state aligned modes (see Section 6 of this manual for more details).

00842-052




■ **Figure 5-17. SPLIT-ACQ display.**

## OVERVIEW

The Trigger_find(vertical) Menu is a variation of the Waveform Display. It provides two main functions. It allows you to define a trigger setup based on waveform patterns, and it allows you to program a find word for searching through memory.

The trigger fields in this menu are similar to those found in the Format Menu. The only difference is that the trigger pattern has been stacked vertically next to the waveform display. If you enter a trigger pattern in this menu, it is automatically entered in the Format Menu, and vice versa.

The find word is also stacked vertically next to the waveform display. You can define any waveform pattern as the find word, then use it for searching through memory in either the waveform or the list display. This searching process is started by executing the Find command.

The rest of this subsection describes the Trigger_find(vertical) Menu and shows how to use its programmable trigger and find fields. For information regarding the waveform portion of the menu, you will need to refer to the description of the *Waveform Display Menu* contained earlier in this section.

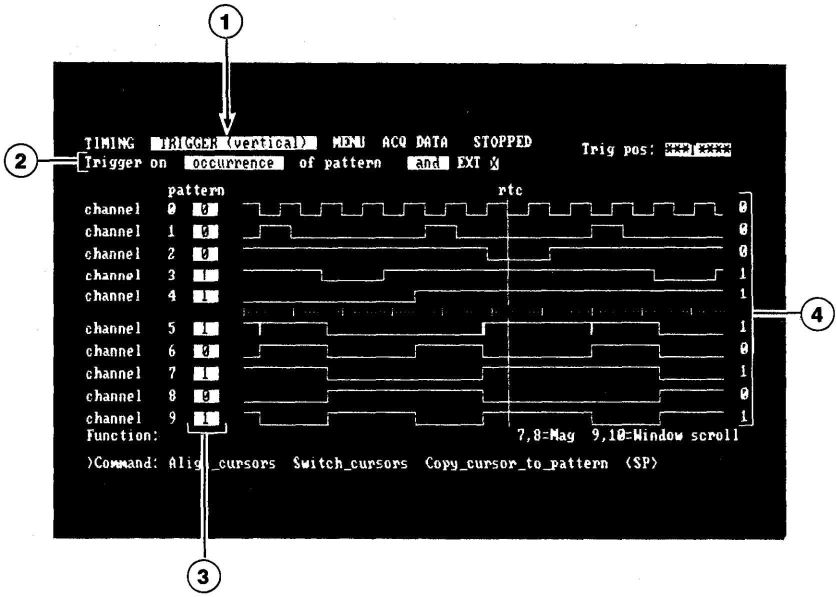
## TRIGGER FIELDS

Figure 5-18 illustrates the Trigger_find(vertical) Menu and its trigger fields. You enter the menu by pressing M for Menu, then T for Trigger_find(vertical) from the command line.

Use the numbered callouts in Figure 5-18 as a reference while reading the following paragraphs. 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 specific field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.

00843-026




■ **Figure 5-18. The Trigger_find(vertical) Menu and its fields for defining a trigger pattern.**

### ① Trigger/Find Selection

This field allows you to specify which submenu is displayed. Using the space bar, you can select:

- TRIGGER (VERTICAL)—this submenu is used for defining a trigger setup.
- FIND (VERTICAL)—this submenu is used for defining a find pattern.

The TRIGGER and FIND (VERTICAL) submenus are shown in Figures 5-18 and 5-19, respectively.

### ② Trigger Fields

The trigger fields at the top of the menu are identical to the fields in the Format Menu. Using these fields, you can select the trigger's position in memory and program the trigger recognition mode.

The trigger recognition modes include:

- Occurrence of Pattern
- Occurrence of Pattern of Duration Greater Than [Time]
- Occurrence of Pattern of Duration Less Than [Time]
- Start of Pattern
- End of Pattern
- Setup Time
- Hold Time

For information about the above modes, refer to the *Format Menu* earlier in this section.

### ③ Trigger Pattern

The data pattern used for the trigger is entered in the vertical fields next to the waveform display. Only those channels which appear in the waveform display are available for programming. If any duplicate channels are shown, only the first copy of the channel will have a programmable trigger digit associated with it.

**NOTE**
The channels that are not shown in the waveform display are not affected by the entry you make here. If you need to change the pattern in the channels that are not shown, you must use the Format Menu.

You can enter a pattern in one of two ways:

- Data Entry—use the appropriate alphanumeric keys to type in the pattern for each channel. To do this, you must be in the edit mode.
- Copy_cursor_to_pattern—press C to execute this command while in the command mode. The command copies the data values at the active (c) cursor location into the fields. You can scroll the *c* cursor to any location in the waveforms by using the left and right cursor keys.

The data pattern you enter only applies to the selected trigger mode. If you change modes, you must enter a new pattern.

Once you've entered a pattern for the channels, the patterns are automatically entered for the same channels in the Format Menu.

### (4) Waveform Display

You can magnify or scroll through the waveform portion of the menu using the methods described under *Waveform Display Menu* earlier in this section. You cannot, however, change the order of the displayed traces. To change the displayed traces, you must be in the Waveform Display Menu.

## FIND FIELDS

Figure 5-19 illustrates the Trigger_find(vertical) Menu and its find fields. To access these fields, enter the field at the top of the menu and press the space bar.

Use the numbered callouts in Figure 5-19 while reading the following field descriptions.

00843-027

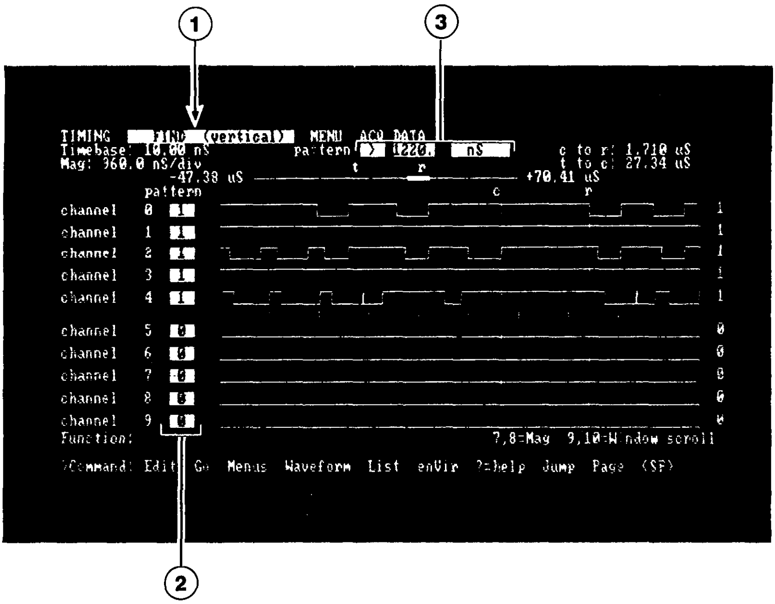



**Figure 5-19. The Trigger_find(vertical) Menu and its fields for defining a Find Pattern.**

## (1) Trigger/Find Selection

This field allows you to specify which submenu is displayed. Using the space bar, you can select:

- TRIGGER (VERTICAL)—this submenu is used for defining a trigger setup.
- FIND (VERTICAL)—this submenu is used for defining a find pattern.

The TRIGGER and FIND (VERTICAL) submenus are shown in Figures 5-18 and 5-19, respectively.

## (2) Pattern

These fields are used for entering the find pattern. Two methods are provided:

- Data Entry—use the appropriate alphanumeric keys to type in the pattern for each channel. To do this, you must be in the edit mode.
- Copy_cursor_to_pattern—press C to execute this command while in the command mode. The command copies the data values at the active (c) cursor location into the fields. You can scroll the c cursor to any location in the waveforms by using the left and right cursor keys.

The type of pattern you can enter depends on whether or not you have used the Pattern Duration field (see callout number 3). If you are not using a pattern duration, the find pattern can consist of levels (0s and 1s), edges (rising, falling, or either edge), and don't cares (Xs). If you are using a pattern duration, the find pattern can only consist of levels (0s and 1s) and don't cares (Xs).

You must enter the pattern values for the duration and non-duration modes separately.

### ③ Pattern Duration

This field allows you to add a time qualifier to the find pattern. Using the space bar, you can select:

- < (less than)—the memory data must have a duration less than the time specified; otherwise, it will not match the find pattern.
- > (greater than)—the memory data must have a duration greater than the time specified; otherwise, it will not match the find pattern.
- Blank field—no time specification is programmed.

If you select either < or >, you must enter the time requirement in the appropriate field. You can specify from 0 to 999 ns, $\mu$s, or ms, for use with an internal timebase; or specify from 0 to 999 clks or kclks, for use with an external timebase. The only restriction is that the value must be $\geq$ to the timebase used during the acquisition.

## OVERVIEW

The List Display Menu offers an alternative to the waveform display. It allows you to view the waveform data in a columnar state format. The data is organized by groups, and is shown in the radices and polarities you defined in the Format Menu.

A special feature of the List Display Menu is its data-time readout. A time column appears next to the data columns and shows you the relative or absolute time of each data sample. Relative time is the duration of the individual sample, while absolute time is the distance between the sample and the trigger point.

Other features of the menu include an active and reference cursor. You can use these cursors to measure the time between any two points in memory. In addition, these cursors are linked to the cursors in the waveform display, so you can switch back and forth between the two displays and see the same area of interest.

The following parts of this subsection illustrate the List Display Menu and describe its programmable fields.

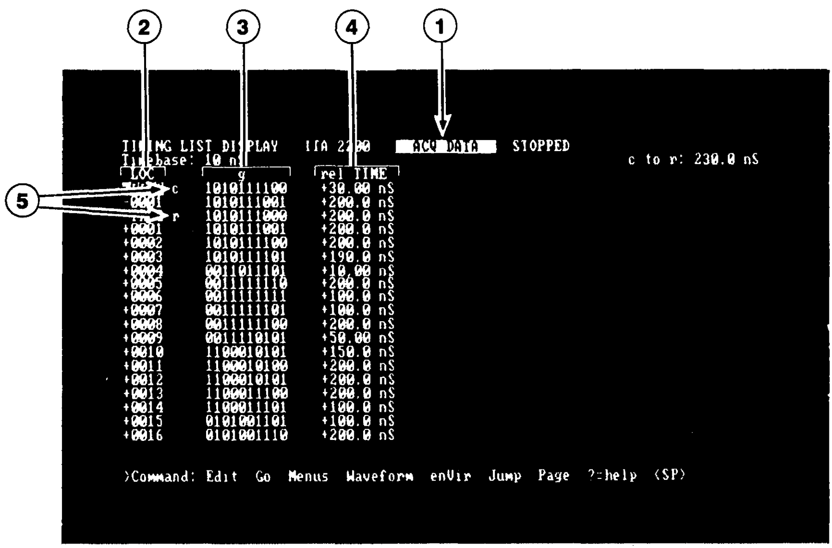
## MENU FIELDS

Figure 5-20 illustrates a typical list display of data. You enter this display by pressing L for List from the command line.

Use the numbered callouts in Figure 5-20 as a reference while reading the following field descriptions. To make changes to a 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 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.

00843-028




■ **Figure 5-20. The List Display Menu and its fields.**

### ① 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.

When <—ACQ REF—> is selected in the field, the menu shows the two memories side by side. Acquisition memory is shown on the left side of the display, and reference memory is shown on the right.

### ② 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. Samples acquired before the trigger (pre-trigger data) have negative number values, and samples acquired after the trigger (post-trigger data) have positive number values.

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

- −512 to +512—the display updates to the location number specified, or to the location nearest that number. For example, if you specify −512 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 Commands*.

### ③ Data Groups

The acquired data is shown in a columnar format. The group names above the columns, as well as the display radices and polarities, are set up in the Format Menu.

### ④ Time

This field is a column header. It will only appear if the List Time Readout field in the Environment Submenu has been set to relative or absolute.

The data in the column is time data relative to the sample. If relative time has been selected in the Environment Submenu, the time value reflects the duration of the current sample. If absolute time has been selected, the time value indicates the distance from the beginning of the trigger sample to the current sample.

Figure 5-21 illustrates the difference between relative and absolute time.

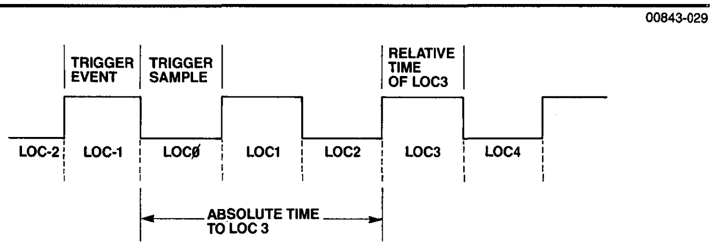



**Figure 5-21. Absolute and relative time.**

### ⑤ Cursors

There are two cursors: the active (*c*) cursor and the reference (*r*) cursor.

The *c* cursor can be scrolled through the display by using the up or down cursor keys. The *r* cursor, once positioned, remains stationary. The display window can be scrolled so that the *r* cursor is no longer seen. You can reposition the *r* cursor by using the Align_cursors or Switch_cursors commands. The Align_cursors command moves the *r* cursor to the current position of the *c* cursor. The Switch_cursors command exchanges the positions of the *r* and *c* cursors.

The distances between the *c* and *r* cursors, and between the *c* cursor and the trigger, are always displayed in the upper-right corner of the screen.

## SPECIAL COMMANDS

The List Display Menu provides several specialized commands that allow you to manipulate the display of data.

All of these commands do not all fit on one line. To view all of the commands, press the space bar <SP>.

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.

**J**ump

This command lets you jump to specific locations within memory. These locations include:

**B**egin—jump to the beginning of memory.
**E**nd—jump to the end of memory.
**T**rigger—jump to the trigger's position in memory.

If the data was acquired in the Multi-Triggers mode, two additional locations are provided:

**N**ext_region—jump to next region in memory.
**P**revious_region—jump to the previous region in memory.

**P**age

This command lets you to scroll through the data one page at a time. The pointer at the front of the command line determines the direction of the paging.

| | |
|---|---|
| **A**lign_cursors | This command aligns the reference (*r*) cursor with the active (*c*) cursor position. |
| <Home> | This key moves the display window to the beginning of memory. |
| <End> | This key moves the display window to the end of memory. |
| <PgUp> | This key moves the display window one page backward in memory (toward pre-trigger data). |
| <PgDn> | This key moves the display window one page forward in memory (toward post-trigger data). |
| **S**witch_cursors | This command switches the current positions of the active (*c*) and reference (*r*) cursors. |
| **F**ind | 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.<br><br>The data pattern being searched is defined in the Trigger_find(vertical) Menu. |
| **N**ext_diff | This command is especially useful when you are viewing a comparison of acquisition and reference memory. It 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. |
| **R**ef<—acq | This command transfers acquisition memory to reference memory. The previous contents of reference memory are lost. The μAnalyst will ask you to verify the operation by pressing Y for yes. |

## OVERVIEW

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

- Setting acquisition (Go) modes.
- Setting the List Display mode to standard or compressed, with absolute or relative time readouts.
- Setting up comparisons between acquisition and reference memory, with options for range, offset, and fuzz.

The rest of this subsection shows you how to set up and use the above parameters, and explains the effects of these parameters on the waveform and list displays.

## SUBMENU FIELDS

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

Figure 5-22 illustrates how the submenu appears when it is called from the List 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 5-22 as a reference while reading the following field descriptions.

00843-030

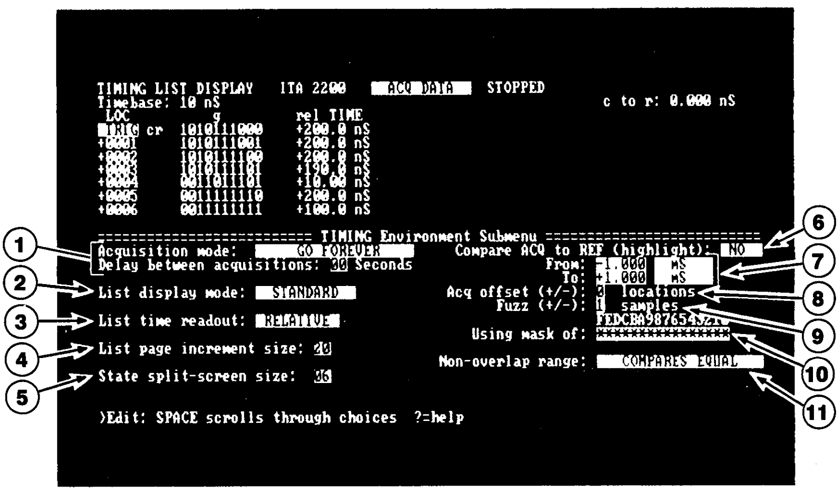



**Figure 5-22. The Environment Submenu and its fields.**

### ① Acquisition Mode

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

- GO ONCE—the analyzer acquires data until the trigger condition has been met.
- GO FOREVER—the analyzer makes repetitive acquisitions, until stopped by the H (Halt) or S (Stop) key.
- 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 not equal.

If GO FOREVER or GO TIL ACQ = REF is selected, a new subfield appears immediately below the Acquisition Mode field. This subfield is labeled Delay Between Acquisitions. Use the subfield to specify the amount of delay time you want between the successive acquisitions. You can enter from 0 to 99 seconds.

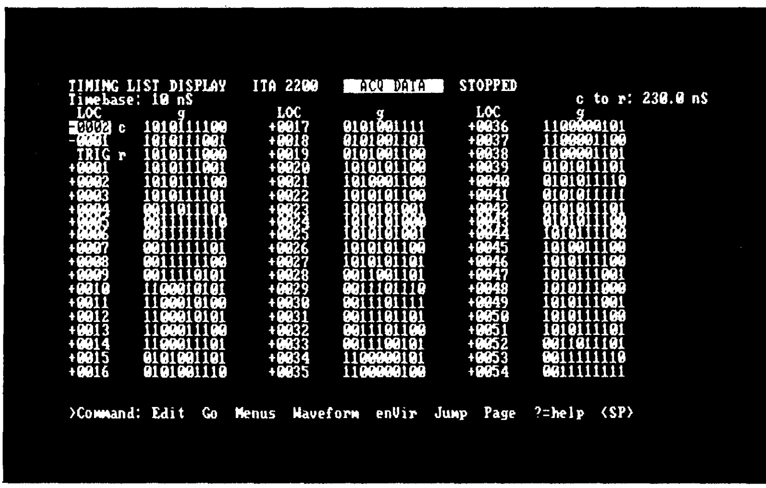
### ② List Display Mode

This field is used to compress the list 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. Figure 5-23 illustrates an example of the compressed display format.

00843-031




■ **Figure 5-23. Example of the compressed display format.**

### (3) List Time Readout

This field determines the basis for the time readouts in the list display. Using the space bar, you can select:

- RELATIVE—the time readouts reflect the duration of the individual samples.
- ABSOLUTE—the time readouts reflect the distance from the start of the trigger sample to the current sample.
- OFF—the time readouts are not shown.

For more information about the time readouts, refer to the *List Display Menu* earlier in this section.

### (4) List Page Increments

This field determines the page size of the list display's Page command. You can enter D (default) to select the number of lines currently displayed on the screen; or, if you wish to page through the data quickly, you may select a larger number. The page size can be from 0 to 99 lines.

### (5) State Split-Screen Size

This field is only available if the timing and state analyzers are operating in an aligned mode (see Section 6 of this manual).

The field determines what proportion of the screen is to be reserved for the state analyzer. There are 20 lines per screen. You can reserve from 0 to 10 lines for the state analyzer. The rest of the screen lines are used by the timing analyzer.

There is no hard and fast formula for determining which analyzer's display should take up what portion of the screen. Typically, you can divide the screen equally between the two. Enter 10 (one half of 20) for ten lines.

If one analyzer's data takes on more importance than the other, adjust the proportion of data display accordingly.

### (6) Compare ACQ to REF

This field enables the highlighting of differences between the acquisition and reference data in the list display. Difference highlighting applies only to the list display, and will occur only if the acquisitions were acquired using the same timebase.

Using the space bar, you can select:

- YES—this turns on the comparison highlighting.
- NO — this turns off the comparison highlighting.

If the acquisition and reference data was acquired in the 16-channel mode, the comparison highlighting will be shown in the List Display Menu's <—ACQ REF—> format. You can easily spot the differences between the two memories as they are shown side by side.

If the data was acquired in the 10-channel transition mode, the comparison highlighting will not be available in the <—ACQ REF—> format. The time variations between the samples prohibits a linear, side-by-side comparison. The highlighting will be shown in the individual ACQ DATA and REF DATA displays.

### (7) From/To

This field is used to enter the boundaries of the comparison window. The boundaries are defined in terms of time.

In the From field, enter the comparison starting point relative to the trigger. In the To field, enter the end point. Negative time means that the point is before the trigger, and positive means that the point is after the trigger. The starting point must be located before the end point.

The boundaries for the comparison window are only used for the GO TIL ACQ = REF and GO TIL ACQ < > REF modes, and for the comparison highlighting in the list display. They have no effect on the amount of data transferred from the acquisition memory to the reference memory. When the Ref<—acq transfer command is used, all of the acquisition data is transferred.

### (8) Acquisition Offset

When comparing acquisition and reference memories, you can program an offset parameter of up to ± 5 memory locations. This feature allows for trigger-point uncertainties, and is especially useful when you are acquiring data with an external clock.

The offset parameter adjusts the comparisons by a certain number of memory locations. It slides the acquisition data forward and backward through memory, relative to the locations of the reference data.

A comparison will always start with an offset of 0 locations. Then, if the compare condition fails, the comparison tries an offset of +1, then −1, +2, −2, and so on, up to the maximum offset you have programmed.

### (9) Fuzz

Any timing analyzer is subject to some uncertainty about exactly where a pulse in the system under test took place. The faster the timebase, the more accurate the sample becomes, but still the resolution is limited to the timebase.

In most instances, this type of time skew presents no problem. But if one of the comparison modes (GO TIL ACQ=REF or GO TIL ACQ< >REF) is being used, there is difficulty. Even though the system under test is operating the same during both acquisitions, the data in the two memories may not be the same due to the time skew, and the compare conditions will not be met.

To allow for this type of time skew, a fuzz factor has been added to the comparison. When making any comparisons, you can program the timing analyzer to look ahead or behind (plus or minus) a certain number of clock samples.

A fuzz factor of ± 1 is the default setup for the analyzer. This takes care of sampling uncertainties as they apply to the analyzer running asynchronously.

A larger fuzz factor may be desired when you are acquiring data from a system that has tolerances larger than the timing analyzer's sample period. The maximum fuzz factor allowed by the timing analyzer is ± 9 samples.

Be aware that too much fuzz may result in a very loose comparison. This may or may not be detrimental to analysis. In addition, larger fuzz factors require more comparison time. As the fuzz factor approaches ± 9 samples, consider using a slower sample rate.

### (10) Using Mask Of

These fields enable you to program a mask for the comparison operation.

In default, all channels are set to a compare status as indicated by asterisks. To mask out a channel, simply use the space bar to enter a blank space in place of the channel's asterisk.

Masked channels are ignored during the various compare operations. These operations include highlighting, GO TIL ACQ = REF and GO TIL ACQ < > REF modes, and Next_diff commands.

### (11) Non-Overlap Range

The non-overlap range parameter is used to define whether non-overlapping data should compare as equal or not equal. Non-overlapping data occurs when the acquisition data spans a range of time that is not the same as that of the reference data. For example, if the acquisition data ranges from −2.5 ms to +5.6 ms, and the reference data ranges from −2.5 ms to +7.2 ms, then the non-overlapping range is from +5.6 ms to +7.2 ms.

Use the space bar to select COMPARES EQUAL if you do not want the non-overlapping data to be highlighted when the comparison is active. Select COMPARES NOT EQUAL if you do want the non-overlapping data to be highlighted.

## 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 to the timing analyzer at any time. Setup files contain information from the Format Menu and Environment Submenu, and from parts of the Trigger_find(vertical), Waveform Display, and List Display Menus. Data files contain the data contents from acquisition or reference memory.

Using the menu's printer function, you can also make hard copies of the data in the Waveform and List Display Menus. You can send these menus to a printer or save them on disk for later loading to a printer.

The rest of this subsection shows how to use the I/O Menu and its disk-storage and printer capabilities.

## DISK FIELDS

Figure 5-24 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 2, later in this subsection).

Use the numbered callouts in Figure 5-24 as a reference while reading the following field descriptions. To change a menu field, you must first 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.

00843-032

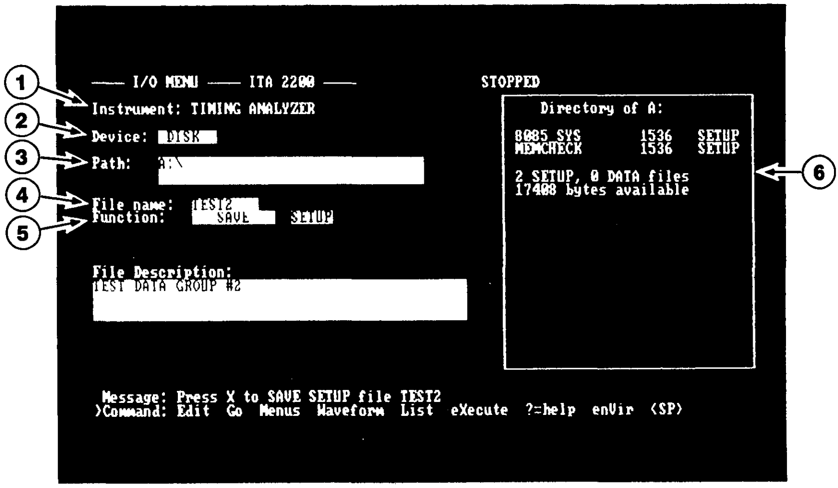



**Figure 5-24. The I/O Menu with DISK as the selected device.**

## (1) Instrument

This field is only programmable when you are operating the timing and state analyzer in the Crosslink Triggering, Non-Aligned Mode (see Section 6 of this manual). You can select which analyzer's setup information or data is to be saved to or loaded from disk.

In all other modes, this field is a monitor field only. It indicates which analyzer's setup information and data is being manipulated. Note that in any of the timing and state analyzer aligned modes, the setup information or data from both analyzers is saved or loaded simultaneously. Also note that in any of the aligned modes, only reference memory data may be saved from either analyzer.

## (2) Device

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

**NOTE**
For information on how use to the PRINTER device, see Figure 5-25 later in this subsection.

### 3 Path

This field lets you specify the drive-directories path leading 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 63 characters.

**NOTE**
Only one path name can be specified at any one time. The timing 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, do not use the <d>: designation. Instead, just enter the directories. The timing 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 timing analyzer files located at that directory level (see callout number 6). The window will not show any DOS system files or user programs.

### 4 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.

### (5) 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 to the timing 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 Commands* 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 into the File Name field as described under callout number 4. 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 $\mu$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 either acquisition or reference memory. You can use the subfield which appears to the right of DATA to specify the memory source.

**NOTE**
The byte structures used for the timing analyzer's DATA files is provided in Appendix B at the back of this manual.

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

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

**LOAD Function.** This function is the reverse of SAVE. It lets you load a file to timing 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 μAnalyst 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 μAnalyst will ask you to confirm the action by pressing Y for yes.

### (6) Directory Window

The directory window lists the timing 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 files contained on the directory and indicate how many bytes are still available for use.

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

## PRINTER FIELDS

Figure 5-25 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 5-25 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.

00843-033

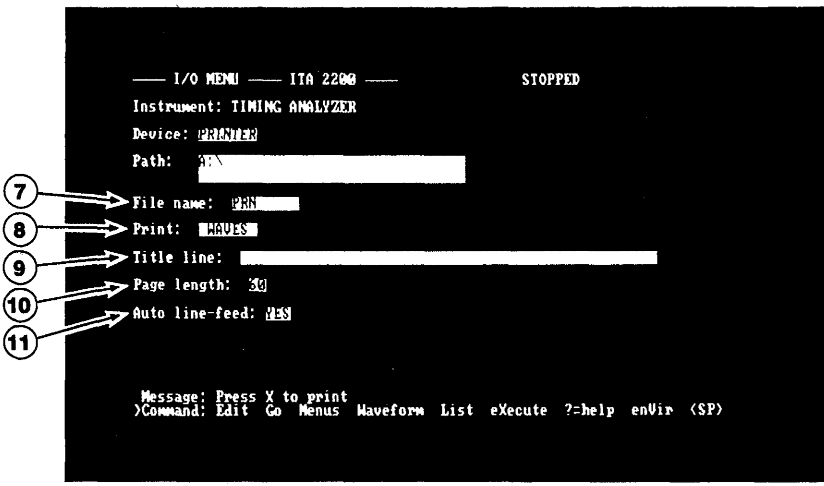



**Figure 5-25. The I/O Menu with PRINTER as the selected device.**

### ⑦ File Name

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

To send a file to a printer device, 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 printers that can be used with the $\mu$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. This new file will then be printed to the drive-directory location specified in the Path field.

When you save a printer file on disk, the new file is only suitable for later loading to a compatible printer device. The ASCII character format used in the file is not suitable for loading to the timing analyzer. To create a file that can be loaded to the timing analyzer, you must use the DISK device as shown in Figure 5-24.

### (8) Print

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

- WAVES—prints the contents of the Waveform Display Menu.
- DATA—prints the contents of the List Display Menu.

The data being printed will come from either the acquisition or reference memory, depending on which memory was last viewed in the Waveform and List Display Menus.

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 locations in memory. Instead of entering numerical ranges, you may also enter B for Beginning, E for End, and T for trigger.

### (9) 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.

### (10) 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.

### (11) Auto Line-Feed

For printers that need it, 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 COMMANDS

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**X**ecute 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 2200 Interactive Timing Analyzer in time-aligned acquisition with the Model 2100 Interactive State 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 timing analyzer menus, and refer to the *Interactive State Analyzer User's Manual* for information on state analyzer menus.

## SECTION CONTENTS

## OVERVIEW

You can use the Interactive Timing Analyzer in conjunction with the Interactive State Analyzer if you have both products installed in the $\mu$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 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 $\mu$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.

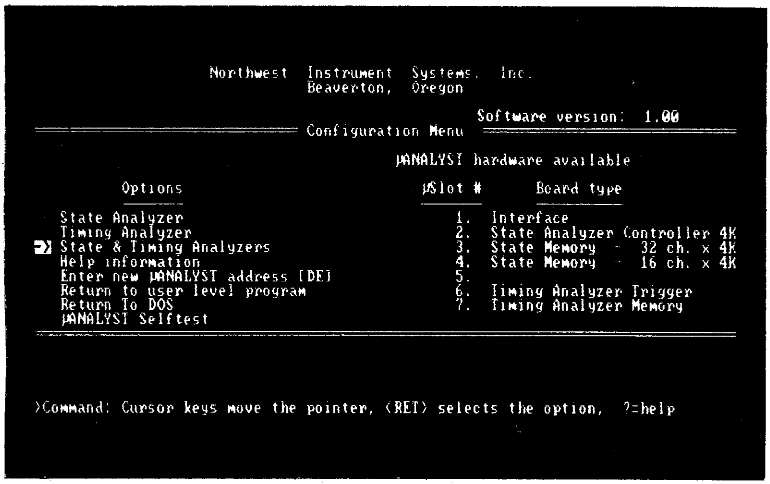
The Crosslink (CL) is an internal bus line that is used to communicate the arm/not-armed condition. The CL can be used in either direction—state arms timing or timing arms state. (The signal on the CL line also appears as an output at the CL BNC connector located on the mainframe's back panel).

## 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 μAnalyst 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.

00843-044




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

00842-049

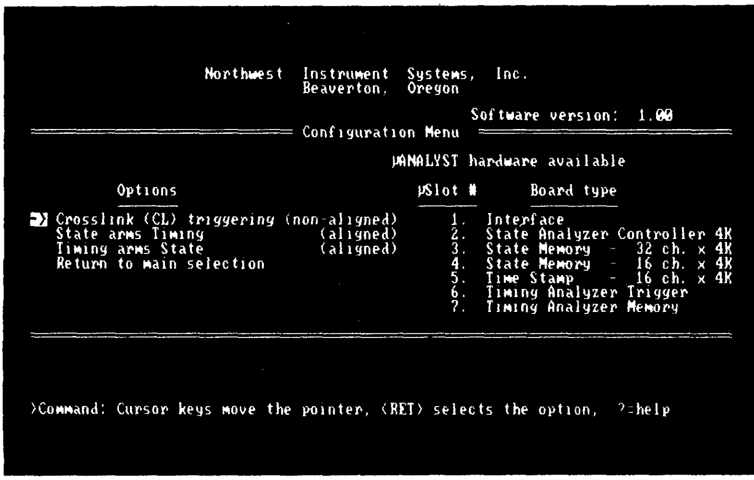



**Figure 6-2. Aligned/non-aligned acquisition modes.**

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 to set to all don't cares (Xs), it will trigger immediately.

There are several programming requirements in the State Arms Timing mode that must be followed. These requirements are listed in the paragraphs below.

**State Analyzer Programming Requirements, Aligned Mode, State Arms Timing** (for information about the specific menus mentioned, refer to the *Interactive State Analyzer User's 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 Section 5 of this 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 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, labeled NoArm. This state is internally programmed to look for CL going low. The state analyzer will enter this state when acquisition is started, and will remain there until CL is asserted.

**NOTE**
The NoArm state will not be seen in the state analyzer's Trigger-Store Menu.

Once 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 several programming requirements in Timing Arms State mode that must be followed. These requirements are listed in the paragraphs below.

**State Analyzer Programming Requirements, Aligned Mode, Timing Arms State** (for information about the specific menus mentioned, refer to the *Interactive State Analyzer User's 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 Section 5 of this manual):

1. The Multi-Triggers Mode is not available in 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 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.

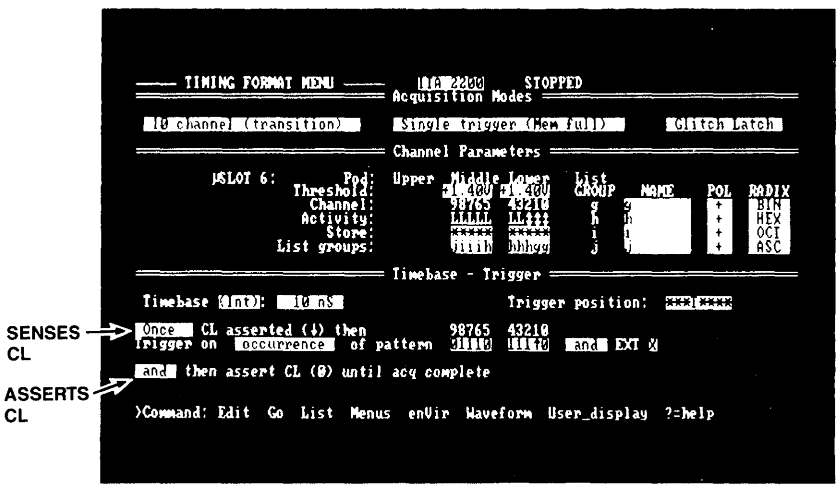
In the non-aligned mode, the state and timing analyzers can both sense and/or assert the Crosslink (CL) line. In the state analyzer, the CL is sensed within each defined symbol in the Symbol Menu, and the CL is asserted within each defined state in the Trigger-Store Menu.

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 the 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.

00843-020




**■ Figure 6-3. The Timing Analyzer's Format Menu when the non-aligned 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 μAnalyst will make all the necessary programming corrections. If you press N for No, you will need to make another choice.

Once you have made a mode choice, press the return key again. The μAnalyst 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.

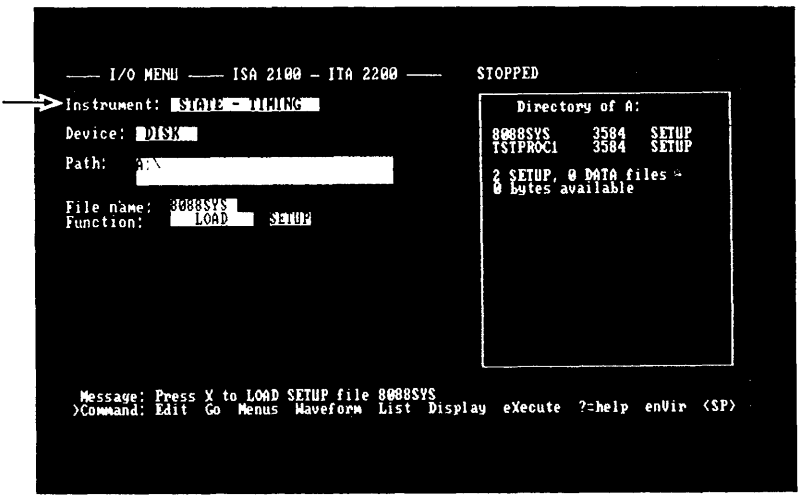
If at some point you need to identify which set of menus you are using, simply press M for Menus. You'll see which menus are currently active. Once familiar with both analyzers, you will notice that the state and timing menus are quite different and easy to distinguish.

## 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.

00843-045




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

## SPLIT-SCREEN DISPLAY

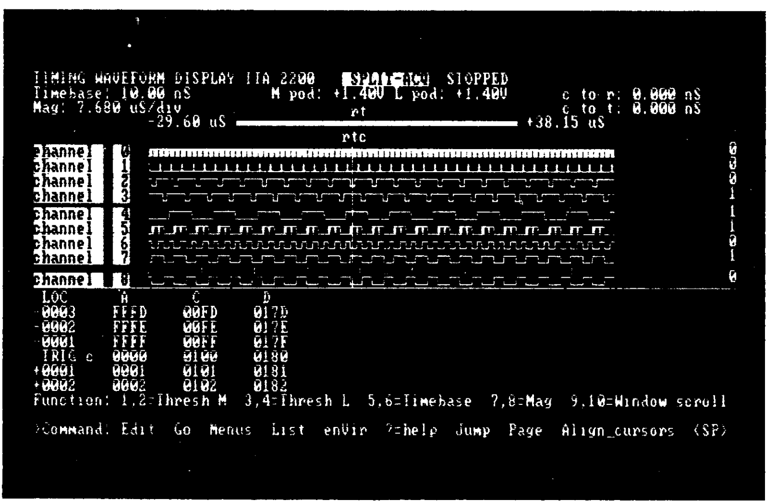
A split-screen display mode is available if either of the aligned modes has been selected. As shown in Figure 6-5, this mode allows the simultaneous display of both timing and state data.

**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.

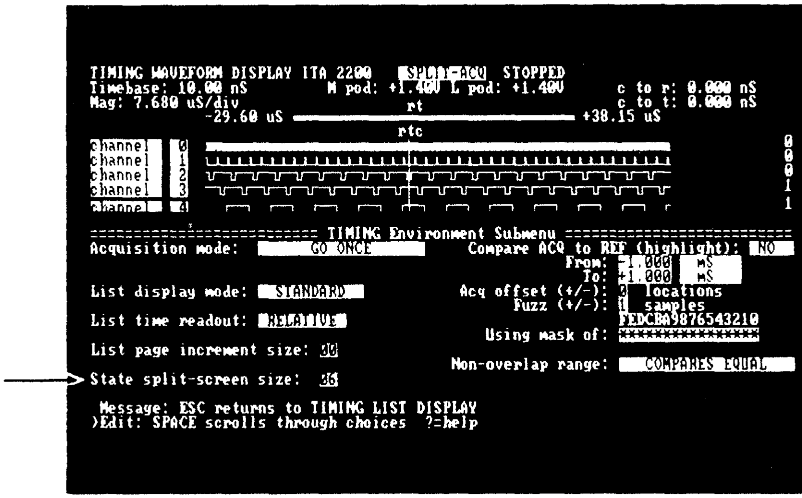
The split-screen shows up to 20 data lines, divided into two windows. You can specify the relative size of the windows in the timing analyzer's Environment Submenu. As shown in Figure 6-6, the submenu provides a field labeled State Split-Screen Size. This field determines how many lines of the display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

00842-052




■ **Figure 6-5. Split-screen display.**

00842-053




**■ 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.

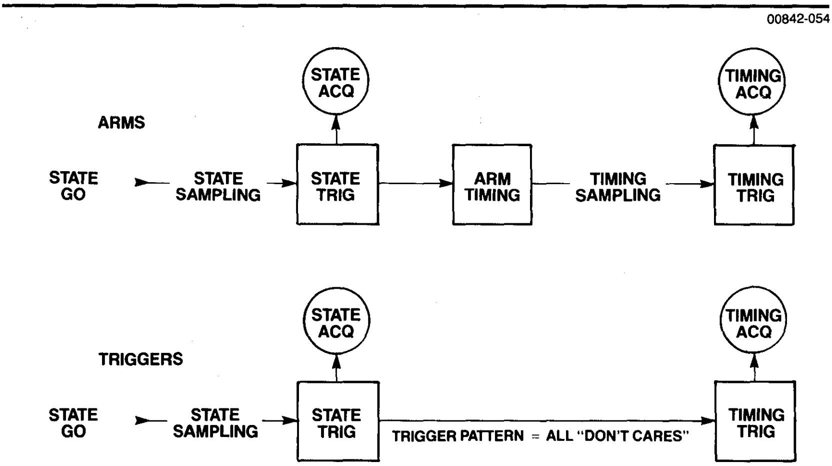



**Figure 6-7. State Arms/Triggers Timing.**

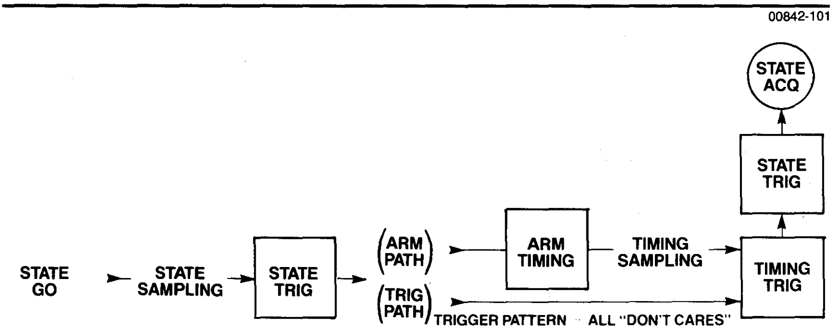



**Figure 6-8. State Arms/Triggers Timing, Timing Triggers State.**

**Using this section.** This section gives you an opportunity to operate the Interactive Timing Analyzer before getting into actual applications. The demonstration examples are built around the demo circuit board, which you received as part of your timing analyzer package.

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

## SECTION CONTENTS

This demonstration section is divided into three parts:

- Getting Started—which explains the demo board circuitry and shows you how to connect it to the timing analyzer.
- Basic Demonstration—which introduces you to the timing analyzer and its basic operations, such as triggering and display manipulation.
- Advanced Demonstration—which shows you how to exercise the analyzer's more sophisticated features, including Multi-Triggers and memory comparisons.

The demonstrations in this section are progressive. Start at the beginning of this section and work through the demonstrations consecutively.

## GETTING STARTED

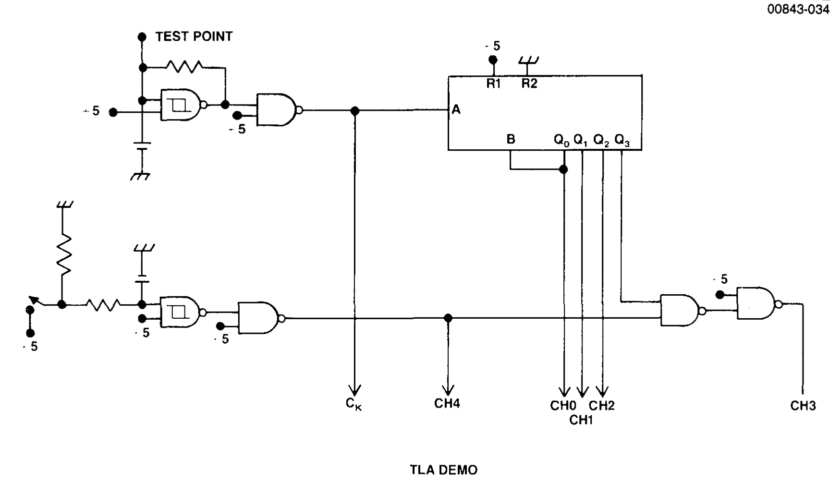
Figure 7-1 provides a schematic of the demo board. The main circuit on the demo board is a free-running, 4-bit ripple counter. By "ripple," we mean that there is a slight delay when a less significant bit toggles the next significant bit. This toggling does not occur precisely on edges.

Five data output lines and one clock line appear at the TLA PROBE connector on the demo board. The first lines (analyzer channels 0 - 3) are tied to the corresponding bits of the counter. The most significant bit (MSB) of the counter (analyzer channel 3) is enabled by the push-button on the board. When the button is pressed and held, the MSB of the counter appears in data channel 3. When the button is in the up position, the MSB signal does not appear.

The fifth data line (analyzer channel 4) is the debounced output of the push-button. At rest, the data line is at a logic low. When the button is pushed, the data line goes high. The output of this data line will stay high as long as the button is held down.

The demo board's clock activates the counter. This clock also drives the CLK input of the timing analyzer and the S1 CLK input of the state analyzer clock probe.

The clock that drives the counter appears at the EXT clock line of the data probe. It also feeds the STATE CK connector. Later, when exploring the analyzer on your own, you may want to try using the EXT clock from the demo board.



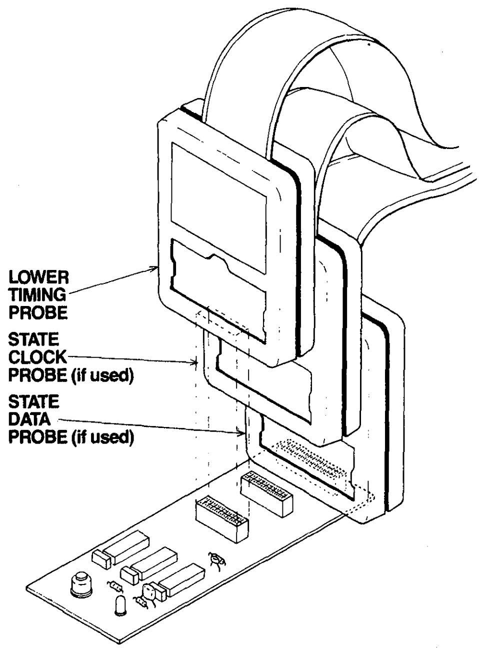

**■ Figure 7-1. Schematic of the demo board.**

## Connecting the Demo Board

If you haven't already done so, install the $\mu$Analyst and its PC interface, the timing analyzer boards, and the probes as detailed in Section 2 of this manual.

Now, attach the probes to the demo board as shown in Figure 7-2. Attach the timing analyzer's lower probe to the board's TLA PROBE connector. If you have a state analyzer installed, attach the first 16-channel state probe to the board's SLA DATA PROBE connector, and attach the state clock probe to the board's SLA CK PROBE connector.

00843-035




■ **Figure 7-2. Connecting the probes.**

### Starting the System

Once you have connected the probes, start the system by performing the following steps:

1. Install a DOS diskette (version 2.00 or higher) into drive A of your personal computer.
2. Power up both the μAnalyst mainframe and the personal computer.
3. Remove the DOS diskette from drive A and replace it with the μAnalyst's HELP DISK.
4. Insert the μAnalyst'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 demonstrations.

**NOTE**
If you're using a fixed-disk computer, load the μAnalyst software as specified in Section 3, *Getting Started*.

### Acquiring Data

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 7-3, although you may not have a state analyzer installed. The state analyzer is not required for the demonstrations in this section.

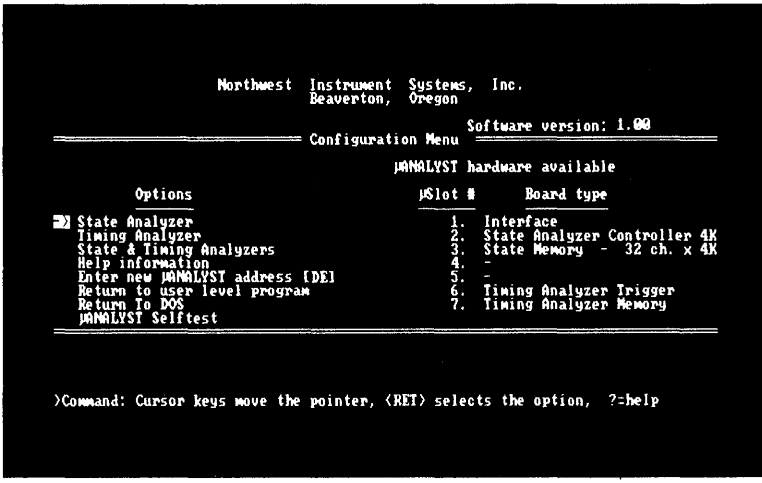
Now, move the screen pointer to the menu's Timing Analyzer option selection and press the return key. The timing analyzer will enter its Format Menu.

Do not make any changes in the Format Menu at this time. The default values in the menu will cause the analyzer to trigger on any incoming data word, once the full-memory requirement has been met. You can collect some demonstration data without doing any menu programming.

Now, enter the Waveform Display Menu by pressing W. The analyzer will show you an empty waveform display.

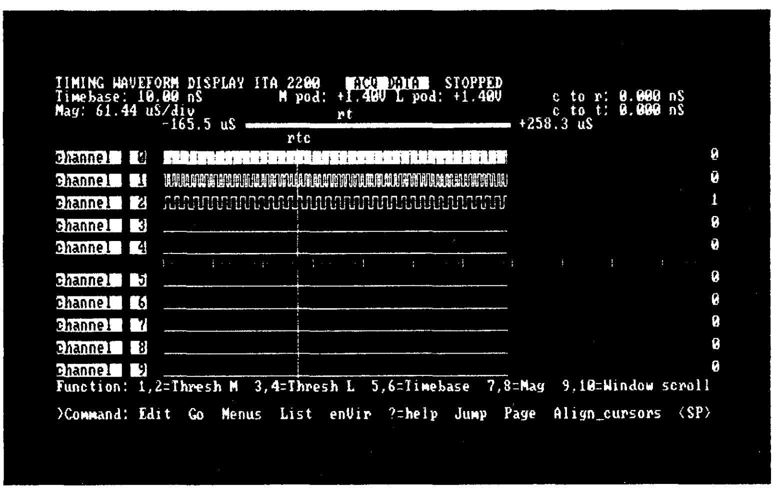
Press the G for Go. The analyzer will acquire data from the demo and update the waveform display as shown in Figure 7-4.

00843-036




■ **Figure 7-3. The Configuration Menu.**

00843-037




■ **Figure 7-4. Waveform display of demo data.**

While you are viewing the Waveform Display Menu, take a few moments to use the following keys and observe their results:

- F7 and F8 function keys, for magnifying the display window.
- Control-F7 and -F8 function keys, for fast-change magnification.
- Left/Right Cursor keys, for moving the *c* (active) cursor to the next edge.
- Control-Left/Right Cursor keys, for moving the *c* cursor by 10 edges.
- F9 and F10 function keys, for scrolling the display window.

Continue using the above keys until you feel familiar with the operation of the waveform display. With the paired function keys, notice that the odd numbered key decreases the parameter, while the even numbered key increases it. For example, F9 moves the display window to the left, while F10 moves it to the right.

Now, try the following commands:

- Press A to execute the Align_cursors command. The *r* (reference) cursor will move to the current position of the *c* (active) cursor.
- Press the right cursor key to move the *c* cursor a few edges away from the *r* cursor. Then, press S to execute the Switch_cursors command. The *c* and *r* cursors will exchange positions.

While moving the cursors, notice the time readouts in the upper-right corner of the screen. These readouts indicate the times between the cursors.

By using the readouts, you can make several time measurements, including:

- Measuring Pulse Widths—Select any pulse on any of the displayed channel traces. If the trace you want to look at is a solid or near solid block of reverse video, increase the magnification (press the F8 function key) until an actual pulse can be seen.

  Now, use the cursor keys to move the *c* cursor to the leading edge of the pulse. Press A to align the cursors. Then, use the cursor keys again to move the *c* cursor to the trailing edge of the pulse.

Read the number in the *r* to *c* field in the upper-right corner of the screen. This number tells you the width of the pulse.

The display convention used in the time measurement is always left-to-right. For example, press S to switch the cursor locations. Notice how the time readout changes so that the measurement is read from *c* to *r*.

- Measuring Event Durations—Using the above techniques, you can now measure the duration of an event. For example, you can measure how long it took the counter to ripple from bit 0 to bit 1.

  First, scroll through the waveforms until you locate a point where the falling edges of the first two traces are nearly coincident. (You will need to be at maximum magnification. Press the control-F8 key until the message "Magnification already at maximum" appears in the message line.)

  Now, move the *c* cursor to the falling edge on the first trace. Press A to align the cursors. Then, move the *c* cursor to the falling edge on the second trace. The time value in the *r* to *c* readout is the duration of the ripple.

  If you want to know the ripple duration for bits 0, 1, and 2, scroll through the waveforms until you locate a point where the falling edges of the first three traces are nearly coincident. Position the *c* cursor on the falling edge of the first trace. Press A to align the cursors. Then, position the *c* cursor on the falling edge of the third trace. Read the time value.

- Measuring Events Relative to the Trigger Point—As you may have noticed, the time from the *c* cursor to the trigger is always displayed. If the *c* cursor is positioned before the trigger point, the time value is not negative. Instead, the order of the labels in the *t* to *c* field is reversed. The same is true for the *r* cursor in relation to the trigger.

Now, use the F1—F4 function keys, and verify that the applicable threshold field value is changing. Also, try changing the timebase value by using the F5 and F6 function keys. (A detailed description of these function keys is provided in Section 5's *Waveform Display Menu* subsection.)

As you changed the display's magnification and window position, you may have noticed the Data-Time indicator which appears directly above the waveform traces. This indicator is a visual reference that shows the length of time represented by the acquisition in memory. It also shows the current display window and its location relative to the total acquisition.

Make a note of the numbers on both ends of the Data-Time indicator. These numbers will be used in a later demonstration.

Now that you have used several of the main controls, let's begin programming.

## BASIC DEMONSTRATION

In this subsection, you will be changing certain items in the Format Menu and monitoring their effects on the acquisitions. If you need additional information about any of the items used, refer to Section 5 of this manual and its *Format Menu* subsection.

**16/10 Channel Acquisition Mode Programming**

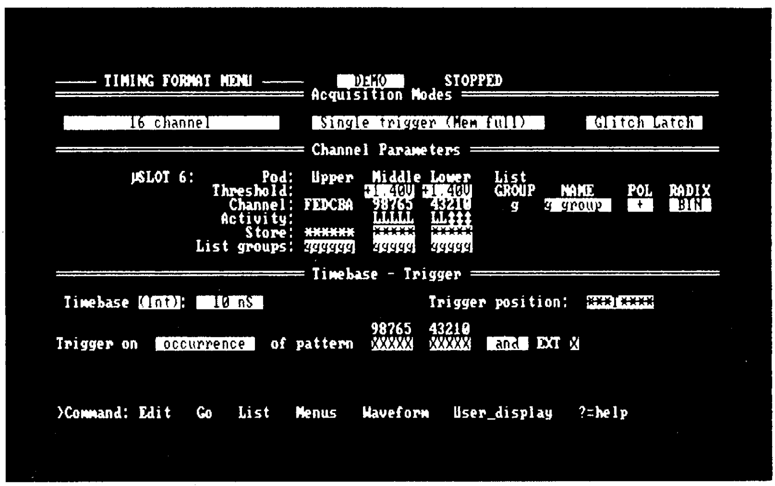
1. Enter the Format Menu by pressing M for Menu, then F for Format from the command line.
2. Once the menu appears on the screen, press E to enter the edit mode. If you have not previously entered the edit mode in this menu, the screen cursor should appear in the Name field (ITA 2200) at the top of the display. If the screen cursor appears in another field, use the cursor keys to move the screen cursor to the Name field.

   Now, enter the word DEMO into the field.
3. Once the name entry is complete, press return. The screen cursor will move to the Acquisition Mode field. Press the space bar to select the 16 channel mode.
4. Check the threshold fields in the middle of the menu to verify that they are set to a TTL +1.40 V threshold. Also, make sure that the Timebase field is set to 10 nS.
5. Press the escape key to exit the edit mode. The Format Menu should now look like Figure 7-5.

6. Press W to enter the Waveform Display Menu. Then, press G (for Go) to make a new acquisition. When the acquisition is completed, the word STOPPED will appear at the top of the screen.
7. Adjust the magnification of the display by using the F7 and F8 function keys. Then, refer to the numbers on both sides of the Data-Time Indicator. Compare these numbers with the set you noted earlier. Notice how this recent 16-channel acquisition represents a much smaller segment of time than the earlier acquisition. The earlier acquisition was made in the 10-channel transition timing mode.

   Again, make a note of the new Data-Time numbers for use in a later demonstration.

00843-038




■ **Figure 7-5. Programming the 16/10 Channel Acqusition Modes.**

### Simple Triggering

1. Return to the Format Menu by pressing M for Menu, then F for Format. Again, press E to enter the edit mode.
2. Move the screen cursor to the Acquisition Mode field, then press the space bar to select the 10 channel (transition) mode.
3. Use the cursor keys to move down to the trigger fields.

   In the first field, press the space bar to select Occurrence of Pattern (with no durations).

   Now, press the cursor keys or the return key to move to the pattern field for channel 4. All of the pattern fields are currently filled with Xs. Press R to select a rising edge for channel 4.
4. Press the escape key to exit the edit mode. The Format Menu should look like Figure 7-6.
5. Press W to enter the Waveform Display Menu. Then, press G to start the acquisition.

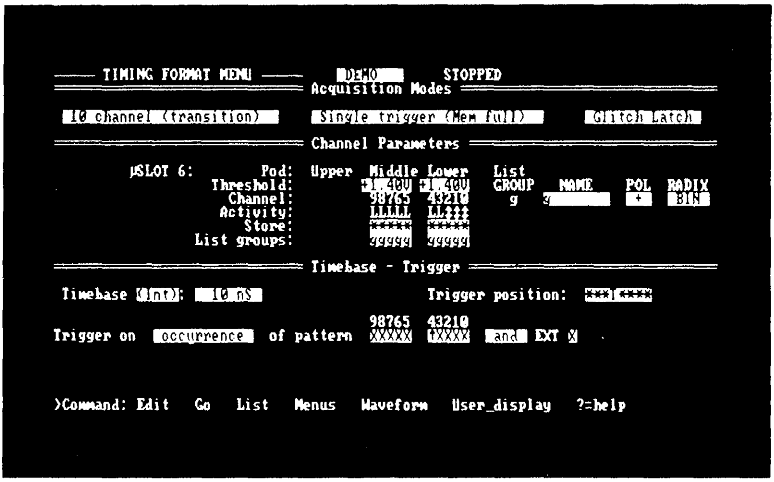
   The status message at the top of the screen should tell you that the analyzer is RUNNING. The analyzer is sampling data, and per your trigger programming, is waiting for a rising edge on channel 4.

   Recall from our earlier discussion of the demo board, that the debounced output from the board's push-button is connected to channel 4. Wait for a few seconds, then press the button. This satisfies the trigger condition, so that the analyzer is able to complete its acquisition.

   Once acquisition is completed, the status message at the top of the screen will tell you that the analyzer is STOPPED.

On your own, try changing the rising edge trigger specification to a falling edge. Then, press the demo button and hold it down for a few seconds before releasing it. Notice that the trigger now occurs on the release of the button.

00843-039



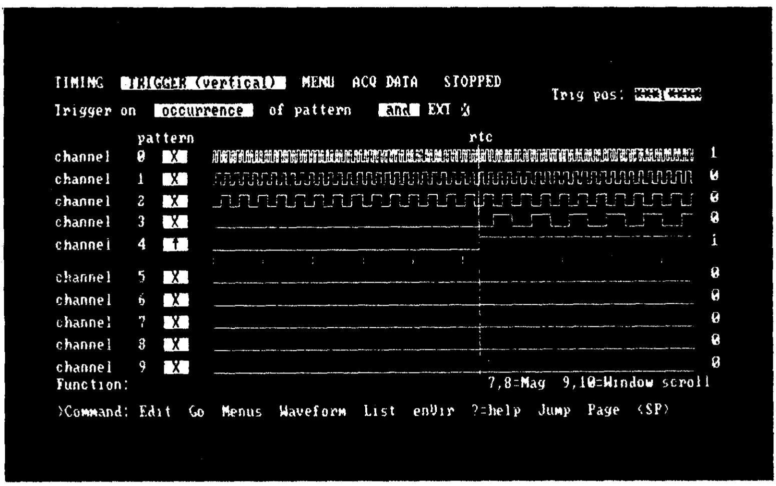

■ **Figure 7-6. Simple triggering.**

### Using Trigger_find(vertical)

The Trigger_find(vertical) Menu can also be used to program the analyzer's trigger conditions.

1. Enter the Trigger_find(vertical) Menu by pressing M, then T. Your screen should look similar to Figure 7-7.
2. Use the cursor keys to move the *c* cursor to any desired spot on the waveforms.
3. Press C to copy the data values at the *c* cursor position into the trigger pattern fields.
4. Press G to start acquisition. When the newly entered pattern is recognized, the analyzer will trigger and complete its acquisition.

00843-040




■ **Figure 7-7. Trigger_find(vertical) Menu.**

### Using the Format Menu's Store Fields

1. Enter the Format Menu and set it to the edit mode. Verify that the menu's acquisition mode is 10 channel (transition).
2. Now, move the screen cursor to the Store field's channel 0 position. All of the Store fields are currently set to store (*). Set channel 0 to don't store by entering a blank space with the space bar.
3. Move the screen cursor to the word recognizer's pattern fields and enter Xs (don't cares) into all of the channels.
4. Press escape to exit the edit mode. The Format Menu should now look like Figure 7-8.
5. Press G to make another acquisition.

   Refer to the Data-Time numbers made in your first acquisition (see *16/10 Channel Acquisition Mode Programming* earlier in this section). Compare the numbers from your first acquisition to the current Data-Time numbers. A longer range of time is indicated in the current acquisition because the most active channel of the counter has been eliminated.

On your own, experiment with the Store fields, and see how the length of time represented by the acquisition can change.

00843-041

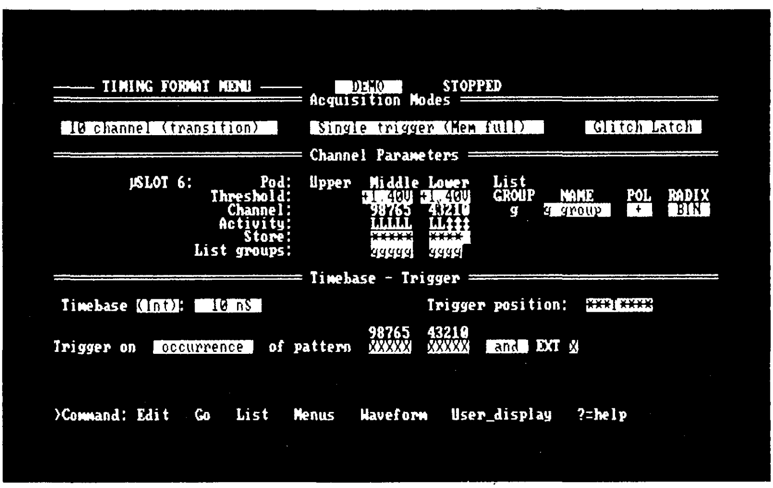



**Figure 7-8. Using the Store fields.**

### Basic Features of the Waveform Menu

The following paragraphs show you how to name and manipulate the traces on the waveform display.

1. Enter the Waveform Display Menu by pressing W. Then, enter the edit mode by pressing E.
2. Use the cursor keys to move the screen cursor to the Name field of the top waveform trace. Name this top trace CTR BIT0. Name the next three traces CTR BIT1, CTR BIT2, and CTR BIT3, respectively. Finally, name the fifth trace BUTTON.
3. Now, delete the bottom traces from the screen. Do this by entering their Name fields, then pressing the delete key.
4. Move to one of the Channel Number fields and try the following:
   - Insert a blank trace by pressing the insert key.
   - Enter a new trace by typing in the trace's channel number.
   - Scroll through the current traces at one trace location by using the control-S key.

Note the minimum and maximum number of traces available, and how the screen reformats itself for the best display.

### Using the GO FOREVER Mode

1. Enter the Format Menu and set it to the edit mode. Then, move the screen cusror to the Store field for channel 0 and enter an asterisk (*). Also, check the trigger pattern to make sure it is set to Xs (don't cares).

   Then, return to the Waveform Display Menu.
2. Press V to enter the Environment Submenu. Notice that the submenu is automatically in edit mode.
3. If the screen cursor is not already positioned in the Acquisition Mode field, move it there now. Then, press the space bar until the GO FOREVER mode appears in the field.

   A new field, labeled Delay Between Acquisitions, appears below the Acquisition Mode field. Make sure that this field is set to a value of 00.

   The Environment Submenu should now look like Figure 7-9.
4. Press the escape key to exit the Environment Submenu and return to the Waveform Display Menu.

5. Press and hold function key F6 until 5.00 mS appears in the timebase readout in the upper-left corner of the screen. (A slow timebase is required for this part of the demonstration.) If you overshoot 5.00 mS, use function key F5 to decrement the timebase.
6. Press G to start the acquisition. Notice that a new acquisition is occurring about once a second.

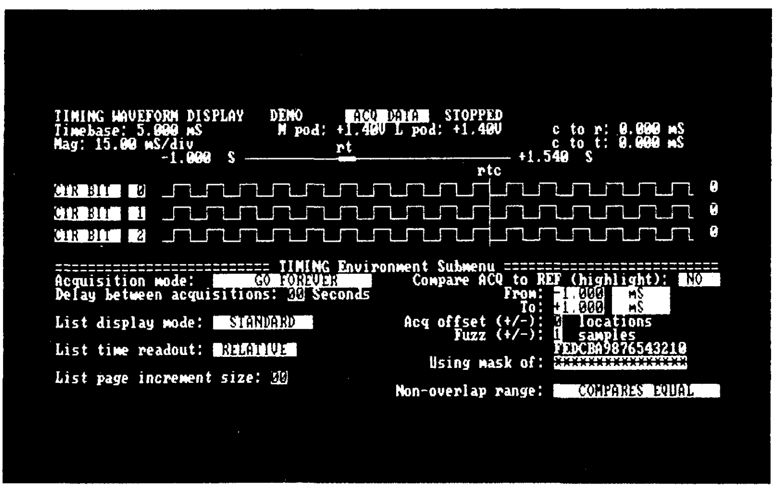
   Press and hold the button on the demo board. Notice that channel 3 is now toggling, and that channel 4 is now high.

   Begin pressing and releasing the button about two times a second. Observe how channel 4 is reflecting your finger motion. Also note how the button presses are enabling/disabling the count bit on channel 3.

If you wish, you can measure your finger motions. Push S to stop the analyzer. (Be sure to continue toggling the demo button until the word STOPPED appears at the top of the screen.)

Now, using the techniques discussed in the first portion of this section, measure the duration of your button presses on channel 4.

00843-042




■ **Figure 7-9. Using the GO FOREVER mode.**

## ADVANCED DEMONSTRATION

The rest of this section demonstrates the more advanced features of the timing analyzer.

Because the first part of this section illustrated most of the mechanical aspects of menu programming, you will no longer be given explicit key-press instructions. Rather, it is assumed that you know how to get to the Format Menu, and how to program the trigger. Any new keying sequences will be spelled out.

**Comparing Acquisitions**

1. Go to the Format Menu. Set the trigger to recognize the Occurrence of Pattern XXXXX 1X000. (Make sure that you do not use one of the Duration modes).
2. Enter the Environment Submenu and set the Acquisition Mode field to GO ONCE.
3. Exit the submenu and enter the Waveform Display Menu. Press G to start acquisition. Then press and hold the button on the demo board until the word STOPPED appears at the top of the display screen. You now have an acquisition with the trigger point set to the start of the demo's count cycle.
4. Press R to copy the acquisition data into reference memory.
5. Enter the Environment Submenu and change the Acquisition Mode field to GO TIL ACQ=REF.
6. Exit the submenu, then enter the Waveform Display Menu. Press G to start the acquisitions. The analyzer will begin sampling the first three bits of the counter, but until the button on the demo board is pressed and held, the acquisitions will not match.
7. Press and hold the demo button. If the acquisitions match, the analyzer will complete the current acquisition, then stop. If the acquisitions do not match, the analyzer will continue.

   If the acquisitions do not match and the analyzer continues, press H to Halt the acquisition. Then refer to the next step of this demonstration.

8. Recall the discussion in Section 4's *Comparisons and Fuzz* subsection. A time skew may be causing the mismatch.

   Enter the Environment Submenu and change the Fuzz field to ± 3. Then, return to the Waveform Display Menu and restart acquisition.

   Press and hold the button on the demo board. The memories should now match, and the analyzer should stop acquisition.

### Multi-Triggers

1. Enter the Format Menu and select the Multi-Triggers mode. Also, set the word recognizer's pattern to XXXXX ↑XXXX. The ↑ character is entered by pressing R for rising edge.
2. Return to the Waveform Display Menu, then enter the Environment Submenu. Set the submenu's Acquisition Mode field to GO ONCE. Exit the submenu.
3. Press G to start the acquisition. Notice the status monitor that appears at the top of the screen. Each of the 15 dashes represents one of the Multi-Trigger memory segments.

   Press and release the button on the demo board once every four or five seconds, and observe the status monitor. When a memory segment is filled, an asterisk appears, replacing the dash.

   Continue pressing the button until the Multi-Triggers acquisition has stopped.
4. Return to the Format Menu. Change the trigger pattern to XXXXX ↕XXXX. The ↕ character is entered by pressing E for either edge.
5. Return to the Waveform Menu and start another acquisition. Press the button the demo board and hold it down for a few seconds before releasing it. Wait for a moment, then repeat the push-hold pattern. Notice that now the analyzer is triggering on both the push and release of the button.

For more background on the Multi-Triggers Mode, refer to Section 4 of this manual.

## 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 | ˇ | 124 | \| |
| 29 | GS | 61 | = | 93 | ] | 125 | } |
| 30 | RS | 62 | > | 94 | ^ | 126 | ~ |
| 31 | US | 63 | ? | 95 | — | 127 | DEL |

This appendix explains the data structures and formats used in the I/O Menu's ITA DATA files. These files are created whenever you save the contents of the timing analyzer's acquisition or reference memory on disk.

### Constants

```
{used to address timebase array}
   opt_norm  = 0; {normal option acq mode}
   opt_align = 1; {alignment mode}
{acquisition mode values}
   linear_16 = 0; {16 channel normal}
   trans_10  = 1; {10 channel transition}
   aux_10    = 2; {10 channel auxiliary, future expansion}
{acquisition length constants}
   total_acq   = 511;
   t_acq_div_2 = 255;
{timebase exponent settings}
   nsx10   = 0;
   nsx100  = 1;
   µsx1    = 2;
   µsx10   = 3;
   µsx100  = 4;
   msx1    = 5;
   msx10   = 6;
{constant values for external clock polarity}
   posit = 0;
   neg   = 1;
{possible external clock modes}
   int         = 0; {internal timebase}
   clk_l       = 1;
   clk_m       = 2;
   clk_l_or_m  = 3;
```

## Acquisition Data Structures

```
Opt_Acq_Type  = opt_norm..opt_align; {type of optional
                acq mode}
Acq_Type      = linear_16..aux_10; {type of acquisition possible}
All_Chnls     = WORD; {LS bit = channel 0; MS bit =
                channel 15}
T_B_Type      = RECORD {timebase}
                  digit       [00]: 1..9;
                  exp         [02]: nsx10..msx10;
                  clk_l_pol   [04]: posit..neg;
                  clk_m_pol   [06]: posit..neg;
                  t_b_mode    [08[: int..clk_l_or_m;
                  multiplier  [10]: INTEGER; {calculated
                                    equivalent of exp & mantissa}
                END;
Region_Range  = 0..1023;
Acq_Region    = RECORD
                  acq_start: Region_Range; {acq data array
                             offset for beginning}
                  acq_end  : Region_Range; {and
                             end of region}
                  trig     : Region_Range; {if trig > end then
                             trig not in data}
                END;
Tla_Data      = RECORD
                  chanls     [0000]: ARRAY[0..total_acq] OF
                                     INTEGER;
                  time       [1024]: ARRAY[0..t_acq_div_2] OF
                                     INTEGER; {transition time
                                     data}
                  tag_bits   [1536]: ARRAY[0..t_acq_div_2] OF
                                     INTEGER; {512 bytes}
{the following two variable types determine the unique aspect of
the acquired data}
                  acq_mode [2048]: Acq-Type; {whether 10 or
                                     16 channel mode}
                  opt_acq_mode [2050]: 0..1; {whether normal
                                     or align}
                  region     [2052]: ARRAY[0..14] OF
                                     Acq_Region;
                  region_cnt [2142]: -1..14; {total number of
                                     regions—0 for normal acq
                                     modes, up to 14 for multi-
                                     triggers mode, -1 —> no
                                     data valid}
```

## Acquisition Data Structures (cont.)

{valid_chnls is the mask for accessing acq/ref data. For transition mode, it must include store_chnls. All 1's when in the linear_16 mode.}

```
        valid_chnls [2144]: All_Chnls; {LS bit
                              represents channel 0,
                              MS bit represents
                              channel 15}
        timebase    [2146]: T_B_Type;{timebase
                              of acquisition}
        align_loc   [2158]: -1..512;
      END;
```

## Data File Formats

Bytes 0 to 511, and bytes 2562, 2564, 2656, and 2658, 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 in Table B-1.

**■ Table B-1: Byte Definitions**

| Public Name | Byte Offset | Contents |
|---|---|---|
| <none> | 0..511 | Reserved for filer header block. |
| region_acq | 512 | The number of the region {0...14} last displayed. |
| chanls | 513..1536 | Words of acquisition data, chanls[0] is the first sample of data, chanls[1] is the second, and chanls[511] is the last. |
| time | 1537..2048 | Transition time data—indexed the same as 'chanls'. Each element of 'time' corresponds to the number of clocks that the data lasted +1. For example, if time[5] = 0, then sample number 6 {chanls[5]} lasted for 1 clock. If time[5] = 255, then sample number 6 lasted for 256 clocks. |

Continued

**■ Table B-1 (cont): Byte Definitions**

| Public Name | Byte Offset | Contents |
|---|---|---|
| tag_bits | 2049..2560 | The tag_bits contain the value of the Crosslink {CL}, and are used by the compare routines. |
| acq_mode | 2561 | Whether in 10 or 16 channel mode:<br>0 —> 16 channel, non-transition<br>1 —> 10 channel, transition<br>2 —> reserved |
| <none> | 2562 | Reserved. |
| opt_acq_mode | 2563 | Whether in normal or align:<br>0 —> normal<br>1 —> ITA & ISA aligned |
| <none> | 2564 | Reserved. |
| region | 2565..2654 | Indicates where in the data record the different regions are located. In 'normal' mode, there is only one region. In 'multi-triggers' mode, there can be more than 1. region[0] describes the first region, region[1] the second, and so on. 'region_cnt' should be used to determine the number of valid regions. 'acq_start' is an index into 'chanls' and 'time', indicating the beginning of the region. 'acq_end' is a similar index, pointing to the end of the the region. 'trig' is the index value of the trigger word {if trig > acq_end, then no trigger words}. |
| region_cnt | 2655 | Total number of regions: 0 for normal acq_modes, up to 14 for multi-triggers mode, −1 —> no valid data. |
| <none> | 2656 | Reserved. |
| valid_chnls | 2657 | Mask for accessing acq/ref data. For transition mode, it includes store_chnls. All 1's when in linear_16 mode. LS bit represents channel 0, MS bit represents channel 15. |
| <none> | 2658 | Reserved. |

Continued

**■ Table B-1 (cont.): Byte Definitions**

| Public Name | Byte Offset | Contents |
|---|---|---|
| timebase | 2659..2670 | time_base record. 'digit' is the digit of the timebase {1..9}. 'exp' is the exponent.<br>0 —> 10 nanoseconds<br>1 —> 100 nanoseconds<br>2 —> 1 microsecond<br>3 —> 10 microseconds<br>4 —> 100 microseconds<br>5 —> 1 millisecond<br>5 —> 10 milliseconds<br>'clk_l_pod' is the polarity of the L clock.<br>0 —> positive<br>1 —> negative<br>'clk_m_pod' is the polarity of the M clock; 't_b_mode' is the clock mode.<br>0 —> internal<br>1 —> external, L pod<br>2 —> external, M pod<br>3 —> external, L or M pod<br>'multiplier' is reserved. |
| align_loc | 2671..2672 | For acquisition done in the 'align mode', this variable contains the index into 'chanls' and 'time' of the time sample that is aligned with the ISA. |

# INDEX

**C (continued)**

**C (continued)**

**C (continued)**



**D**

**L (continued)**



**M**

**M (continued)**



**N**



**O**



**P**

**P (continued)**



**Q**



**R**

## R (continued)



## S

**S (continued)**



**T**

**T (continued)**



**U**

**U (continued)**



**V**



**W**



**X**