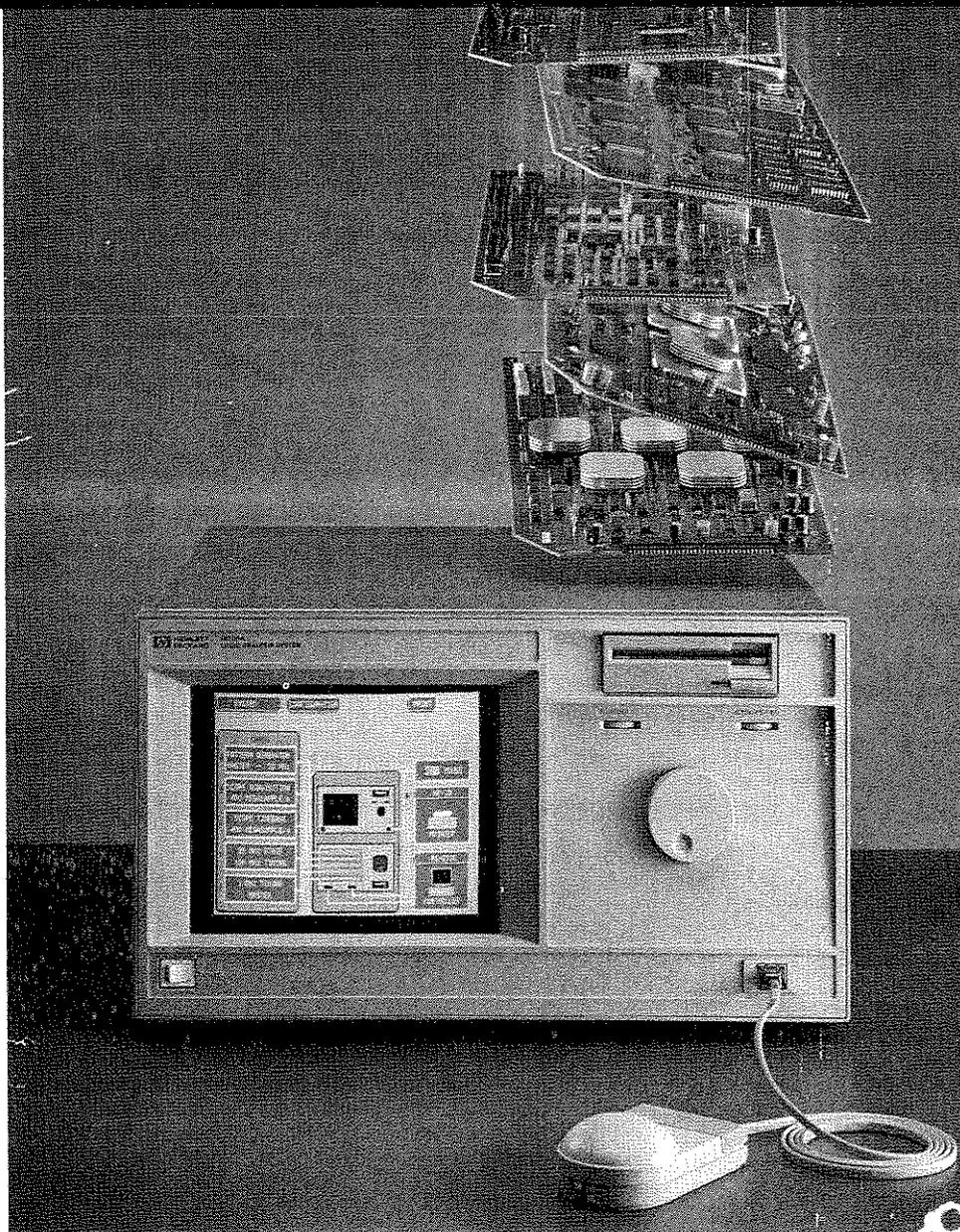


HP 16540A/HP 16541A

100 MHz State Analyzer Module

for the HP 16500A Logic Analysis System

Front-Panel Operation Reference



 **HEWLETT
PACKARD**

100

100

100

100

100

Your Comments Please

HP 16540A/HP 16541A

Your comments assist us in meeting your needs better. Please complete this questionnaire and return it to us. Feel free to add any additional comments that you might have. All comments and suggestions become the property of Hewlett-Packard. Omit any questions that you feel would be proprietary.

- | | Yes | No |
|--|--------------------------|--------------------------|
| 1. Did you receive your product when expected? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Were you satisfied with the operation of the instrument at turn-on? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Were the proper accessories supplied with your product?
If not, what was missing?
Probes <input type="checkbox"/> Manual(s) <input type="checkbox"/> Other _____ | | |
| 4. What measurements will this instrument be used to make? _____
_____ | | |
| 5. How will the instrument be controlled?
Front Panel <input type="checkbox"/> HP-IB <input type="checkbox"/> RS-232C <input type="checkbox"/> Controller Type _____ | | |
| 6. What do you like most about the instrument? _____
_____ | | |
| 7. What would you like to see changed or improved? _____ | | |
| 8. Which manuals have you used?
<input type="checkbox"/> Front-Panel Reference
<input type="checkbox"/> Programming Reference
<input type="checkbox"/> Service Manual | | |
| 9. Please rate the manuals on the following:
4 = Excellent 3 = Good 2 = Adequate 1 = Poor
<input type="checkbox"/> Breadth and depth of information
<input type="checkbox"/> Ability to easily find information
<input type="checkbox"/> Ability to understand and apply the information provided in the manual | | |
| Please explain: _____ | | |
| 10. What is your experience with logic analyzers?
<input type="checkbox"/> No previous experience
<input type="checkbox"/> Less than 1 year experience
<input type="checkbox"/> More than 1 year's experience on one model
<input type="checkbox"/> More than 1 year's experience on several models | | |

Name _____ Company _____
Address _____ Zip Code _____
Phone _____ Instrument Serial # _____

THANK YOU FOR YOUR HELP

NO POSTAGE NECESSARY IF MAILED IN U.S.A.

Your cooperation in completing and returning this form
will be greatly appreciated. Thank you.

FOLD HERE



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1303 COLORADO SPRINGS, COLORADO

POSTAGE WILL BE PAID BY ADDRESSEE

HEWLETT-PACKARD

COLORADO SPRINGS DIVISION

ATTN: PUBLICATIONS DEPT.

P.O. BOX 2197

COLORADO SPRINGS, COLORADO 80901-9959



Front-Panel Operation Reference

HP 16540A/HP 16541A
100 MHz State Analyzer Module
for the HP 16500A Logic Analysis System



©Copyright Hewlett-Packard Company 1991

Manual Set Part Number 16540-90902

Printed in the U.S.A. January 1991

Product Warranty

This Hewlett-Packard product has a warranty against defects in material and workmanship for a period of one year from date of shipment. During warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard. However, warranty service for products installed by Hewlett-Packard and certain other products designated by Hewlett-Packard will be performed at the Buyer's facility at no charge within the Hewlett-Packard service travel area. Outside Hewlett-Packard service travel areas, warranty service will be performed at the Buyer's facility only upon Hewlett-Packard's prior agreement and the Buyer shall pay Hewlett-Packard's round trip travel expenses.

For products returned to Hewlett-Packard for warranty service, the Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument software, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

**NO OTHER WARRANTY IS EXPRESSED OR IMPLIED.
HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE
IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS
FOR A PARTICULAR PURPOSE.**

Exclusive Remedies THE REMEDIES PROVIDED HEREIN ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Certification Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

Safety This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded.

Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition or a new update is published.

A software code may be printed before the date; this indicates the version level of the software product at the time of the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between product updates and manual updates.

Edition 1

January 1991

16540-90902

List of Effective Pages

The List of Effective Pages gives the date of the current edition and of any pages changed in updates to that edition. Within the manual, any page changed since the last edition is indicated by printing the date the changes were made on the bottom of the page. If an update is incorporated when a new edition of the manual is printed, the change dates are removed from the bottom of the pages and the new edition date is listed in Printing History and on the title page.

Pages	Effective Date
All	January 1991

Introduction

About this manual...

Welcome to HP logic analyzers! The HP 16500A Logic Analysis System has been designed to be easier to use than any Hewlett-Packard logic analyzer before. In addition, because of its configurable architecture, it can easily be tailored to your specific logic design and debug needs.

The user interface of the HP 16500A was designed for the most intuitive operation possible. Pop-up windows and color graphics help lead you through setups and measurements so you won't have to memorize a lot of steps. As you read this manual and the other manuals about the mainframe and the test/measurement modules, you will see just how easy the HP 16500A is to use.

The information in this logic analyzer reference manual is presented to you as follows:

Chapters 1 through 3 contain introductory information about the logic analyzer and the accessories supplied with the HP 16540A/16541A. They contain information that will familiarize you with the user interface and menus.

Chapters 4 through 11 describe the basic menus of the state analyzer.

Appendix A through D describe logic analyzer functions such as printing screens, and display of error messages. Also found in the appendix section is a summary of service information on installation, calibration, and product specifications.

If you're new to logic analyzers, or just need a refresher, we think you'll find *Feeling Comfortable with Logic Analyzers* valuable reading. It will eliminate most misconceptions or confusion you may have about logic analyzer applications, and it will show you how to get the most out of your new HP 16540A/16541A 100 MHz State Analyzer module.

Contents

Chapter 1:	General Information	
	Logic Analyzer Description	1-1
	User Interface	1-1
	Configuration Capabilities	1-2
	Key Features	1-3
	Accessories Supplied	1-4
	Accessories Available	1-5
	Preprocessor Modules	1-5

Chapter 2:	Probing	
	Introduction	2-1
	Probing Options	2-1
	The HP 10320C User-Definable Interface	2-1
	Microprocessor and Bus Specific Interfaces	2-2
	General-Purpose Probing	2-2
	The Termination Adapter	2-3
	The HP16540A/41A Probing System	2-4
	Probe Tip Assemblies	2-4
	Probe and Pod Grounding	2-5
	Probe Leads	2-5
	Grabbers	2-6
	Probe Cable	2-6
	Minimum Signal Amplitude	2-7
	Maximum Probe Input Voltage	2-7
	Pod Thresholds	2-7
	Connecting the Probe Cables to the Logic Analyzer	2-7
	Connecting the Pods to the Probe Cable	2-8
	Disconnecting Probe Leads from Probe Tip Assemblies	2-8
	Connecting Second Clock Lead	2-9
	Connecting the Grabbers to the Probes	2-10
	Connecting the Grabbers to the Test Points	2-10
	Labeling Probe Tip Assembly, Probe Leads, and Cables	2-11
	Labeling J and K Clocks	2-12

Chapter 3:**Using the Front-Panel Interface**

Introduction	3-1
Using the Mouse and Keyboard	3-1
Configuring the Logic Analyzer	3-2
How to Select Menus	3-2
Pop-up Menus	3-4
How to Close Pop-up Menus	3-4
Toggle Fields	3-4
How to Select Options	3-4
How to Enter Numeric Data	3-6
How to Enter Alpha Data	3-7
How to Roll Data	3-9
Assignment/Specification Menus	3-11
Assigning Pod Bits to Labels	3-11
Returning to the System Configuration Menu	3-13

Chapter 4:**The 100 MHz State Analyzer Module**

Introduction	4-1
Configuration Menu	4-1
Activity Indicators	4-1
Name	4-2
Type	4-2
Print	4-3
Run	4-4
Assigned Pods	4-4
Module Level Field	4-4
Menu Selection Field	4-5
State Analyzer Menu Maps	4-6
Configuration Menu Map	4-6
Format Menu Map	4-7
Trace Menu Map	4-8
Listing Menu Map	4-10
Compare Menu Map	4-11
State Waveform Menu Map	4-12
Chart Menu Map	4-14
Mixed Display Menu Map	4-16
Timing Waveform Menu Map	4-17

Chapter 5:**State Format Menu**

Introduction	5-1
Accessing the Format Menu	5-1
Format Menu	5-1
Format Menu Fields	5-3
Labels and Pods	5-3
Rolling Labels and Pods	5-3
Turn Label On	5-4
Modify Label	5-4
Turn Label Off	5-4
Polarity (Pol)	5-5
Bit Assignment	5-5
Pod Threshold	5-7
Clock	5-8
Pod Clock	5-11
Master	5-11
Slave	5-11
Setup/Hold	5-14
Symbol Table Menu	5-15
Symbol Table Menu Fields	5-16
Label	5-16
Base	5-16
Symbol Width	5-18
Symbol Name	5-19

Chapter 6:**State Trace Menu**

Introduction	6-1
Accessing the Trace Menu	6-2
Trace Menu Fields	6-2
Sequence Levels	6-5
Insert Level	6-6
Delete Level	6-6
Storage Qualifier	6-7
Branching Qualifier	6-7
Occurrence Counter	6-8
Reading the Sequence Level Display	6-9
Acquisition Fields	6-11
Branches	6-12

Off	6-12
Restart	6-12
Per Level	6-13
Count	6-16
Time	6-16
States	6-18
Qualifier and Pattern Fields	6-20
Label	6-20
Base	6-20
Qualifier Field	6-21
Patterns	6-21
Ranges	6-22
Pattern Fields	6-22
Using an Internal Clock	6-23
Setting the Clock Period	6-24
Setting the Sequence Levels	6-25

Chapter 7:

State Listing Menu

Introduction	7-1
Accessing the Listing Menu	7-2
Listing Menu Fields	7-2
X and O Markers	7-3
Markers set to Patterns	7-4
Find X - O pattern	7-5
Specify Stop Measurement	7-6
Using X-O	7-6
Using Compare	7-7
Markers Set to Statistics	7-8
Markers Set to Time	7-9
Markers Set to States	7-10

Chapter 8:

Waveform Menu

Introduction	8-1
Selecting State or Timing Display	8-1
Accessing the Waveform Menu	8-2
Selecting Waveforms for Display	8-2
Replacing Waveforms	8-6
Deleting Waveforms	8-6
Setting the Clock Period	8-6

Accumulate Mode	8-7
Selecting States per Division	8-7
Selecting Time per Division	8-7
Selecting Delay	8-8
X and O Markers	8-8
Markers Set to Patterns	8-9
Specify Patterns field	8-10
Stop Measurement function	8-11
Using X-O	8-11
Using Compare	8-12
Markers Set to Time	8-13
Markers Set to Statistics	8-15
Markers Set to States	8-16

Chapter 9:

State Compare Menu

Introduction	9-1
Accessing the Compare Menu	9-2
The Compare and Difference Listing Displays	9-2
The Compare Listing	9-2
The Difference Listing	9-3
Creating a Compare Image	9-3
Bit Editing of the Compare Image	9-4
Masking Channels in the Compare Image	9-5
Specifying a Compare Range	9-6
Repetitive Comparisons with a Stop Condition	9-7
Locating Mismatches in the Difference Listing	9-8
Saving Compare Images	9-8

Chapter 10:

State Chart Menu

Introduction	10-1
Accessing the Chart Menu	10-1
Selecting the Axes for the Chart	10-2
Scaling the Axes	10-2
The Label Value vs. States Chart	10-3
The Label Value vs. Label Value Chart	10-4
X & O Markers and Readouts for Chart	10-5
Marker Options	10-6

Chapter 11:	Mixed Display Menu	
	Introduction	11-1
	Accessing the Mixed Display Menu	11-2
	Intermodule Configuration	11-2
	Inserting Waveforms	11-2
	Time-Correlated Displays	11-3
	Markers	11-3
	Time Markers	11-3

Appendix A:	Using a Printer	
	Setting Printer Configuration	A-1
	Printing Options	A-1
	Printing Onscreen Data	A-2
	Printing Entire State Listing	A-2

Appendix B:	Installation and Calibration	
	Introduction	B-1
	Power Requirements	B-1
	Probe Cable Installation	B-1
	Module Installation	B-2
	Installation Considerations	B-2
	Installation Procedure	B-2
	Expansion Card Installation	B-7
	Calibration	B-8
	Description	B-8
	Equipment	B-8
	Procedure	B-9
	Master Clocking Calibration	B-9
	Expansion Clocking Calibration	B-11
	Calibration Factors	B-13

Appendix C:	Error Messages	
	Error Messages	C-1
	Warning Messages	C-4
	Advisory Messages	C-5

Appendix D:	Specifications and Characteristics	
	Introduction	D-1
	Specifications	D-1
	Maximum External Input Clock Rate	D-1
	Setup/Hold Time	D-1
	Characteristics	D-1
	Channel Count	D-1
	Maximum Sequencer Speed	D-1
	Internal Clock Rate Range	D-1
	Time and State Tagging	D-2
	Memory Depth per Channel	D-2
	Sequence Levels	D-2
	Trigger Width	D-2
	Input R	D-2
	Input C	D-2
	Lead Sets	D-2
	Supplemental Characteristics	D-2
	Probes	D-2
	Minimum Input Voltage Swing	D-2
	Input Threshold Accuracy	D-2
	Input Dynamic Range	D-2
	Minimum Input Overdrive	D-2
	Maximum Input Voltage	D-3
	Threshold Setting	D-3
	Threshold Range	D-3
	State Analysis	D-3
	External Clocking Mode	D-3
	Clocks	D-3
	Minimum Clock Pulse Width	D-3
	Clock Qualifiers	D-3
	Master-Slave Clocking (mixed clocking)	D-3
	Timing Analysis	D-4
	Internal Clocking Mode	D-4
	Sample Period	D-4
	Sec/div	D-4
	Triggering	D-4
	Pattern Recognizers	D-4
	Range Recognizer	D-4
	Triggering	D-4

Occurrence Counter	D-4
Storage Qualification	D-5
Qualifier	D-5
Branching	D-5
Tagging	D-5
State Tagging	D-5
Time Tagging	D-5
Measurement and Display Functions	D-6
Arming	D-6
Displayed Waveforms	D-6
Measurement Functions	D-6
Run/Stop Functions	D-6
Run	D-6
Stop	D-6
Trace Mode	D-6
Indicators	D-7
Activity Indicators	D-7
Markers	D-7
Trigger	D-7
Data Entry/Display	D-7
Labels	D-7
Display Modes	D-7
Timing Waveform	D-7
Bases	D-7
Symbols	D-8
Marker Functions	D-8
Time Interval	D-8
Delta States (state analyzer only)	D-8
Patterns	D-8
Statistics	D-8
Auxiliary Power	D-9
Power Through Cables	D-9
Current Draw Per Card	D-9
Operating Environments	D-9
Temperature	D-9
Humidity	D-9
Altitude	D-9
Vibration	D-9
Operating	D-9
Non-operating	D-9

General Information

Logic Analyzer Description

The HP 16540A/16541A 100 MHz State Analyzer module is part of a new generation of general-purpose logic analyzers.

The HP 16540A/16541A module is used with the HP 16500A mainframe, which is designed as a stand-alone instrument for use by digital and microprocessor hardware and software designers. The HP 16500A mainframe has HP-IB and RS-232C interfaces for hardcopy printouts and control by a host computer.

The logic analyzer module can be configured as a 100 MHz, 16-channel stand-alone master board, or as a multiple board module with up to 208 channels. With each expander board added to the master board, the state analysis width is increased by 48 channels.

User Interface

The HP 16500A has four easy-to-use user interface devices: the knob, the touchscreen, the optional mouse, and the optional keyboard.

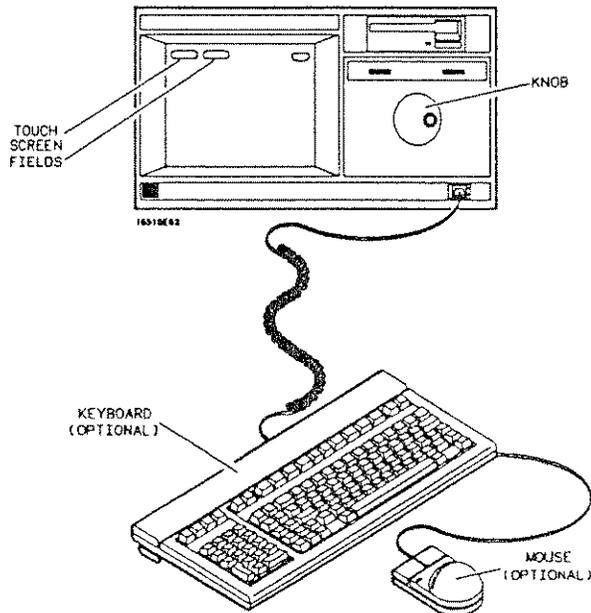


Figure 1-1. HP 16500A User Interface

The knob on the front panel is used to move the cursor on certain menus, to increment or decrement numeric fields, and to roll the display.

The touchscreen fields can be selected by touch or with the optional mouse. To activate a touchscreen field by touch, touch or press the field (the dark blue box) on the display with your finger until the field changes color. Then remove your finger from the screen to activate your selection.

To activate a field with the optional mouse, position the cursor (+) of the mouse over the desired field and press the button on the upper-left corner of the mouse.

The optional keyboard can control all instrument functions by using special function keys, the arrow keys, and the ENTER key. Alpha numeric entry is simply typed in.

All user interface devices are discussed in more detail in the HP 16500A Reference manual.

Configuration Capabilities

The HP 16540A/HP 16541A can be configured as a single or multiple board module. The number of data channels range from 16 channels (using just the HP 16540A) up to 208 channels (using a maximum of four HP 16541As). The table below shows all possible configurations for the 100 MHz state module.

Table 1-1. Analyzer Module Configurations

Configuration	Total Channels
Stand-alone Master	16
Master plus one Expander	64
Master plus two Expanders	112
Master plus three Expanders	160
Master plus four Expanders	208

Key Features

Two 3.5-inch disk drives are integral to the instrument for storing logic analyzer configurations and acquired data. The disk drive also provides a way of loading inverse assembly configuration files into the logic analyzer for configuring ease. Additional key features of the HP 16540A/HP 16541A are listed below:

- 100 MHz clock rate, 100 MHz triggering across all channels.
- Lightweight passive probes for easy hookup and compatibility with previous HP logic analyzers and preprocessors.
- HP-IB and RS-232C interface for programming and hard copy printouts.
- Variable setup/hold time, 4 ns window.
- External triggering.
- 4 kbytes deep memory on all channels.
- Marker measurements.
- Five sequence levels.
- Four pattern recognizers.
- One range recognizer.
- 100 MHz time and number-of-states tagging.
- Full programmability.
- Mixed State and Timing display.
- Compare, Chart, and Waveform displays.

Accessories Supplied

Table 1-2 lists the accessories supplied with your logic analyzer. If any of these accessories are missing, contact your nearest Hewlett-Packard sales office. If you need additional accessories, refer to the *Accessories for HP Logic Analyzers*.

Table 1-2. Accessories Supplied

Accessory	HP Part No.	Quantity
HP 16540A		
Probe assemblies	01650-61608	1
Probe cables	16540-61605	1
Grabbers (20 per pack)	5090-4356	1
Clock/Ground lead	16540-82101	2
Termination adapter	01650-63203	2
Cable and Pod labels - 1 clock	16500-94303	1
Cable and Pod labels - 2 clocks	16540-94304	1
Operating system disks	16500-68703	1
Front-Panel Reference manual	16540-90902	1
Programming Reference manual	16540-90903	1
Service manual	16540-90901	1
Probe cable ID clip	16500-41201	1
Intercard cable connect kit	16540-68701	1
Spare probe leads (5 per pack)	5959-9333	1
Probe ground leads (5 per pack)	5959-9334	1
HP 16541A		
Grabbers (20 per pack)	5090-4356	3
Probe cables	16540-61605	3
Probe cable ID clip	16500-41201	3
Probe assemblies	01650-61608	3
Cable and Pod labels	01650-94303	1
Probe ground leads (5 per pack)	5959-9334	3

Accessories Available

There are a number of accessories available that will make your measurement tasks easier and more accurate. You will find these listed in *Accessories for HP Logic Analyzers*.

Preprocessor Modules

The preprocessor module accessories enable you to quickly and easily connect the logic analyzer to your microprocessor under test.

Included with each preprocessor module is a 3.5-inch disk which contains a configuration file and an inverse assembler file. When you load the configuration file, it configures the logic analyzer for making state measurements on the microprocessor for which the preprocessor is designed. It also loads in the inverse assembler file.

The inverse assembler file is a software routine that will display captured information in a specific microprocessor's mnemonics. The DATA field in the State Listing is replaced with an inverse assembly field. The inverse assembler software is designed to provide a display that closely resembles the original assembly language listing of the microprocessor's software. It also identifies the microprocessor bus cycles captured, such as Memory Read, Interrupt Acknowledge, or I/O write.

Many of the preprocessor modules require the HP 10269C General Purpose Probe Interface. The HP 10269C accepts the specific preprocessor PC board and connects it to five connectors on the general purpose interface to which the logic analyzer probe cables connect.

A list of preprocessor modules are found in *Accessories for HP Logic Analyzers*. Descriptions of the preprocessor modules are found with the preprocessor module accessories.

Probing

Introduction

This chapter contains a description of the probing system of the HP 16540A/HP 16541A logic analyzer. It also contains the information you need for connecting the probe system components to each other, to the logic analyzer, and to the system under test.

Probing Options

You can connect the HP 16540A/HP 16541A logic analyzer to your system under test in one of the following ways:

- HP 10320C User-Definable Interface (optional).
- Microprocessor and bus specific interfaces (optional).
- The standard HP 16540A/16541A probes (general purpose probing.)
- Direct connection to a 20-pin, 3M-Series type header connector using the optional termination adapter (HP part number 01650-63203).

The HP 10320C User-Definable Interface

The optional HP 10320C User-Definable Interface module combined with the optional HP 10269C General Purpose Probe Interface allows you to connect the HP 16540A/HP 16541A logic analyzer to the microprocessor in your target system. The HP 10320C includes a breadboard (HP 64651B) which you custom wire for your system.

Another option for use with the HP 10320C is the HP 10321A Microprocessor Interface Kit. This kit includes sockets, bypass capacitors and a fuse for power distribution. Also included are wire-wrap headers to simplify wiring of your interface when you need active devices to support the connection requirements of your system.

You will find additional information about the HP 10320C and the HP 10321A in the *Accessories for HP Logic Analyzers* .

Microprocessor and Bus Specific Interfaces

There are a number of microprocessor and bus specific interfaces available as optional accessories which are listed in the *Accessories for HP Logic Analyzers*. Microprocessors are supported by Universal Interfaces or Preprocessor Interfaces, or in some cases both.

Universal Interfaces are aimed at initial hardware turn-on, and will provide the following:

- Fast, reliable, and convenient connections to the microprocessor system.

Preprocessor Interfaces are aimed at hardware turn-on and hardware/software integration, and will provide the following:

- All clocking and demultiplexing circuits needed to capture the system's operation.
- Additional status lines to further decode the operation of the CPU.
- Inverse assembly software to translate logic levels captured by the logic analyzer into microprocessor mnemonics.

Bus interfaces will support bus analysis for the following:

- Bus support for HP-IB, RS-232C, RS-449, SCSI, VME, and VXI.

General-Purpose Probing

General-purpose probing involves connecting the logic analyzer probes directly to your target system without using any interface. General purpose probing does not limit you to specific hook up schemes, for an example, as the probe interface does. General purpose probing uses grabbers that connect to both through hole and surface mount components

The Termination Adapter

The optional termination adapter (HP part number 01650-63203) allows you to connect the logic analyzer probe cables directly to test ports on your target system without the probes. However, since the probes contain the proper termination for the logic analyzer inputs, a termination must be provided when you are not using the probes.

The termination adapter shown below is designed to connect to a 20 (2x10) position, 4-wall, low profile header connector, 3M-Series 3592 or equivalent.

To connect the termination adapter, insert the probe cable into the 40 pin (2x20) end of the adapter, then connect the 20 pin (2x10) end of the adapter directly into your test port.

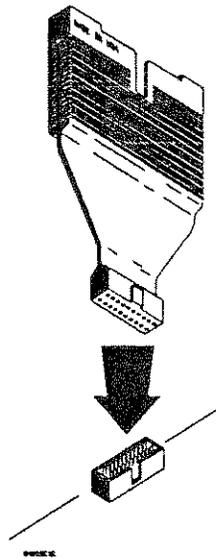


Figure 2-1. Termination Adapter

The HP16540A/41A Probing System

The standard HP 16540A/16541A probing system consists of a probe tip assembly, probe cable, and grabbers. Because of the passive design of the probes, there are no active circuits at the outer end of the cable. The rest of this chapter is dedicated to general-purpose probing.

The passive probing system is similar to the probing system used with high-frequency oscilloscopes. It consists of a series R-C network (90.9 k Ω in parallel with 8 pF) at the probe tip, and consists of a shielded resistive transmission line. The advantages of this system include the following:

- 250 Ω in series with 8 pF input capacitance at the probe tip for minimal loading.
- Signal ground at the probe tip for higher speed timing signals.
- Inexpensive removable probe tip assemblies.

Probe Tip Assemblies

Probe tip assemblies allow you to connect the logic analyzer directly to the target system. This general-purpose probing is useful for discrete digital circuits. Each probe tip assembly, as they will be referred to for consistency, contains 16 probe leads (data channels), one clock lead on the expander and two clock leads on the master, a pod ground lead, and a ground tap for each of the 16 probe leads. See the figure below.

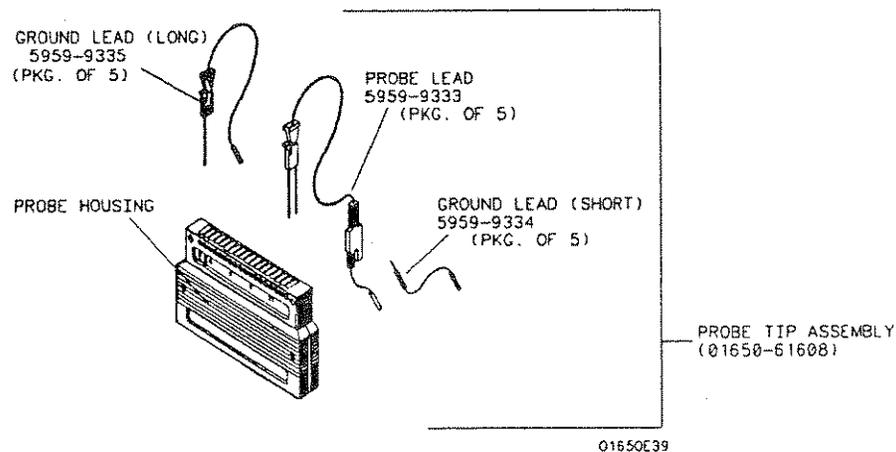


Figure 2-2. Probe Tip Assembly

Probe and Pod Grounding

Each pod is grounded by a long black pod ground lead. You can connect the ground lead directly to a ground pin on your target system or use a grabber. To connect the ground lead to grounded pins on your target system, you must use 0.63 mm (0.025 in) square pins, or use round pins with a diameter of 0.66 mm (0.026 in) to 0.84 mm (0.033 in). The pod ground lead should always be used.

Each probe can be individually grounded with a short black extension lead that connects to the probe tip socket. You can then use a grabber or the grounded pins on your target system in the same way you connect the data lines.

Note



When probing signals with rise and fall times of ≤ 1 ns, grounding each probe lead with the 2 inch ground lead, part number 5959-9334, is recommended. In addition, always use the probe ground on a clock probe.

Probe Leads

The probe leads, as they will be referred to for consistency, consists of a 12-inch twisted pair cable, a ground tap, and one grabber. The probe lead, which connects to the target system, has an integrated R-C network with an input impedance of 100 k Ω in parallel with approximately 8 pF, and all in series with 250 Ω . See figure 2-3.

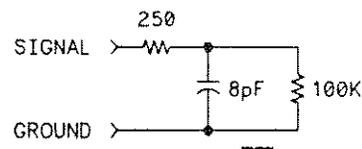


Figure 2-3. Probe Input Circuit

The probe lead has a two-pin connector on one end that snaps into the probe housing. See figure 2-4.

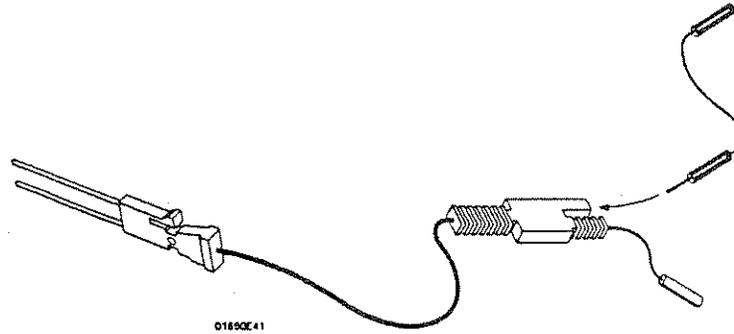


Figure 2-4. Probe Lead

Grabbers The grabbers have a small hook that fits around the IC pins and component leads. The grabbers have been designed to fit on adjacent IC pins on either through hole or surface mount components with lead spacing greater than or equal to 0.050 in.

Probe Cable The probe cable contains 18 signal lines, 17 chassis ground lines and two power lines for preprocessor use. The cables are woven together into a flat ribbon that is 4.5 feet long. The probe cable connects the logic analyzer to the pods, termination adapter, HP 10269C General Purpose Probe Interface, or preprocessor. Each cable is capable of carrying 0.33 amps for preprocessor power.

Caution 

DO NOT exceed this 0.33 amps per cable or the cable will be damaged.

Note 

Preprocessor power is protected by a current limiting circuit. If the current limiting circuit is activated, the fault condition must be removed. After the fault condition is removed, the circuit will reset in one minute.

**Minimum
Signal
Amplitude**

Any signal line you intend to probe with the logic analyzer probes, must supply a minimum voltage swing of 500 mV to the probe tip. If you measure signal lines with a voltage swing of less than 500 mV, you may not obtain a reliable measurement.

**Maximum
Probe Input
Voltage**

The maximum input voltage of each logic analyzer probe is ± 40 volts peak.

Pod Thresholds

Logic analyzer pods have two preset thresholds and a user-definable pod threshold. The two preset thresholds are ECL (- 1.3 V) and TTL (+ 1.5 V). The user-definable threshold can be set anywhere between - 3.5 volts and + 5 volts in 0.1 volt increments.

All pod thresholds on both the master board and the expander board are set independently of each other.

**Connecting the
Probe Cables
to the Logic
Analyzer**

All probe cables are installed at Hewlett-Packard. If you need to replace a probe cable, refer to the Service Manual that is supplied with the logic analyzer.

Connecting the Pods to the Probe Cable

To connect a probe tip assembly to a cable, align the key on the cable connector with the slot on the probe housing and press them together.

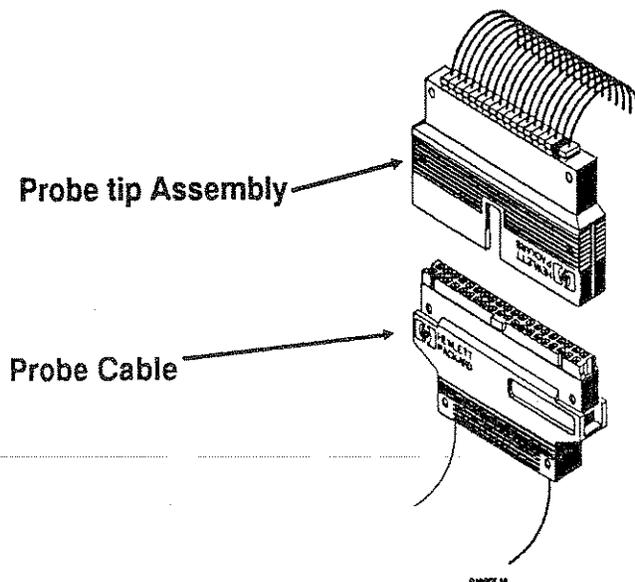


Figure 2-5. Connecting Probe Tip Assemblies

Disconnecting Probe Leads from Probe Tip Assemblies

When you receive the logic analyzer, the probe leads are already installed in the probe tip assemblies. To keep unused probe leads out of your way during a measurement, you can disconnect them from the pod if desired.

To disconnect a probe, insert the tip of a ball-point pen into the latch opening. Push on the latch while gently pulling the probe out of the pod connector as shown in figure 2-6.

To connect the probes into the pods, insert the double pin end of the probe into the probe housing. Both the double pin end of the probe and the probe housing are keyed so they will fit together only one way.

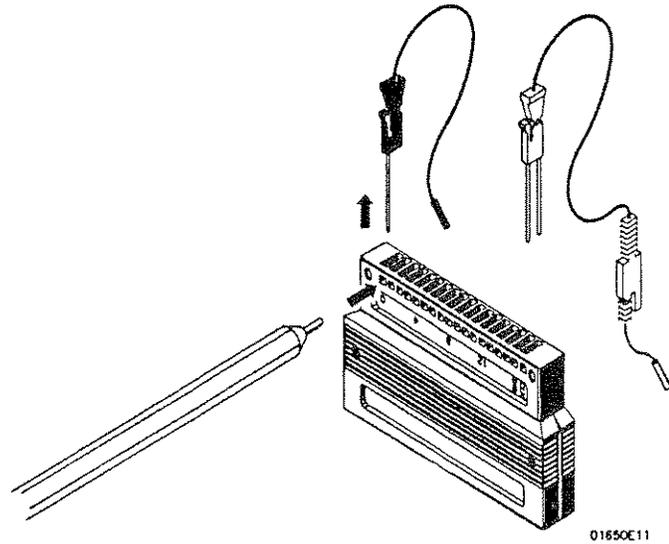


Figure 2-6. Removing Probe Leads From Probe Housing

Connecting Second Clock Lead

If you need a second clock lead on the master card, remove the pod ground lead from the pod and install the optional clock/ground lead (16540-82101) in its place. The figure below shows the optional clock/ground lead which becomes the K clock.

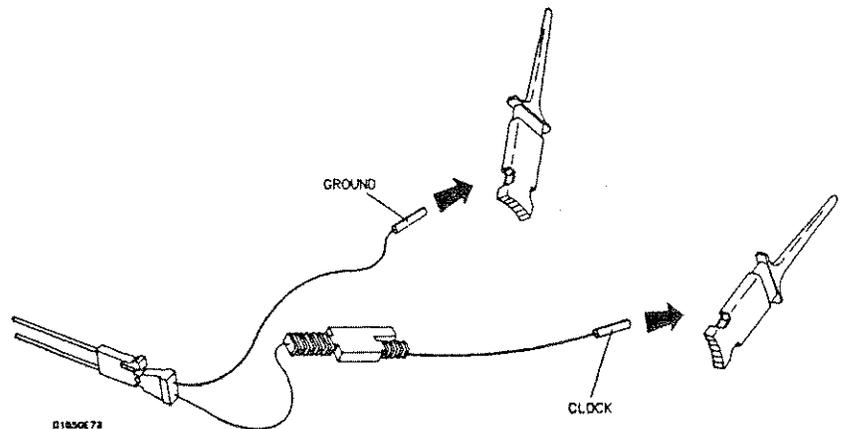


Figure 2-7. Clock/Ground Lead

Connecting the Grabbers to the Probes

Connect the grabbers to the probe leads by slipping the connector at the end of the probe onto the recessed pin located in the side of the grabber. If you need to use grabbers for either the pod or the probe grounds, connect the grabbers to the ground leads in the same manner.

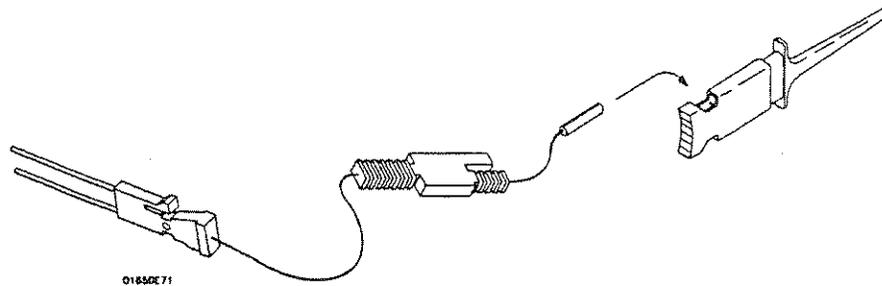


Figure 2-8. Connecting Grabbers to Probes

Connecting the Grabbers to the Test Points

The grabbers have a hook that fits around the IC pins and component leads. Connect the grabber to the test point by pushing the rear of the grabber to expose the hook. Hook the lead and release your thumb as shown below.

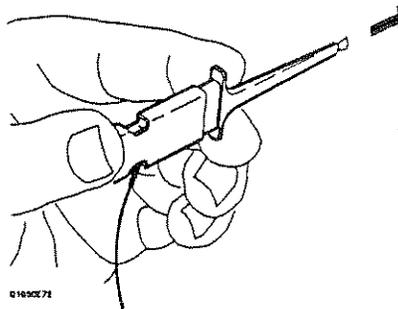


Figure 2-9. Connecting Grabbers to Test Points

Labeling Probe Tip Assembly, Probes Leads, and Cables

Included with your logic analyzer are self-adhesive labels. Each set has labels for each end of the cable, a label for the probe housing, a label for the clock probe and 16 labels for each of the data channels. The figure below shows the correct placement of the labels.

For one clock lead operation, use the label set, part number 16500-94303, for the master. Use the label set, part number 01650-94303, for the expander.

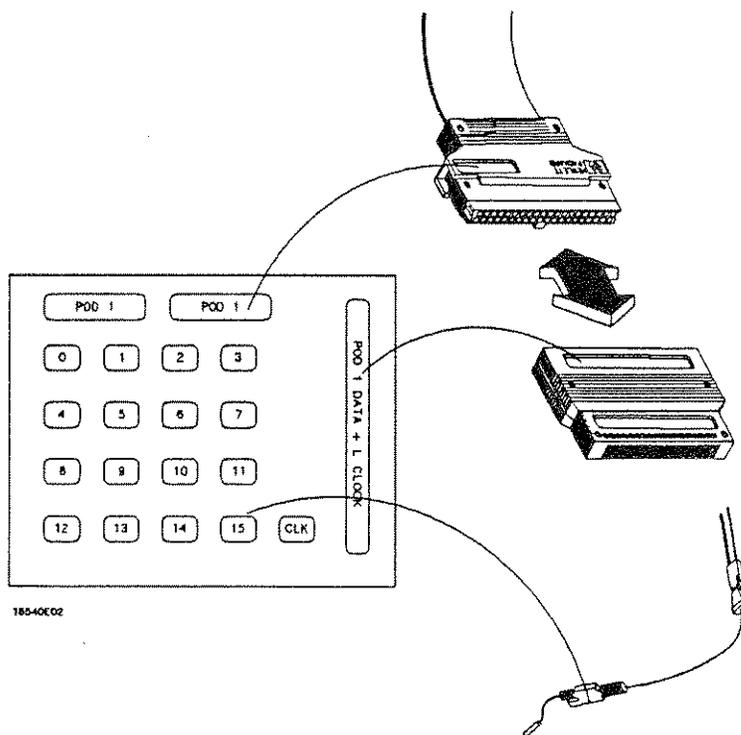


Figure 2-10. Label Locations

If you are using two clock leads, use the label set with the part number 16540-94304. The figure below shows the correct placement of the labels.

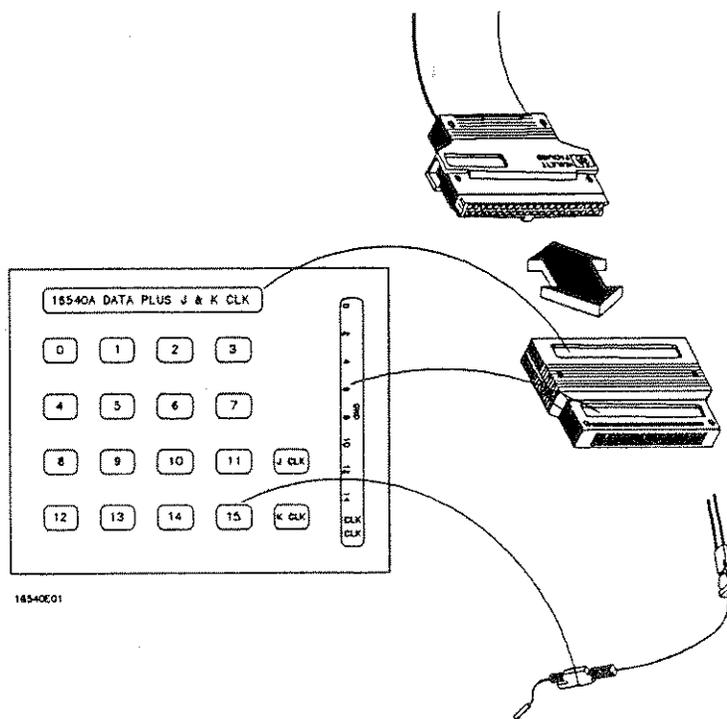


Figure 2-11. Label Locations With Two Clocks

Labeling J and K Clocks

If you are using the second clock lead (K clock), label both clock leads as shown below.

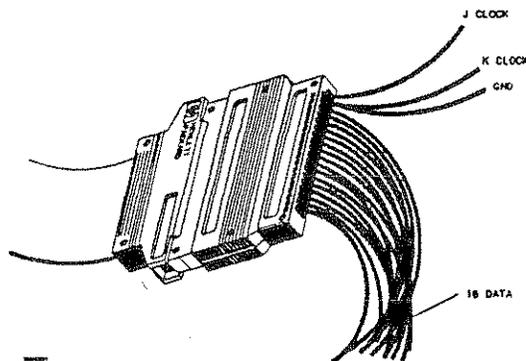


Figure 2-12. Labeling J and K Clocks

To select the logic analyzer's main menus, select the Configuration field as shown in figure 3-2.

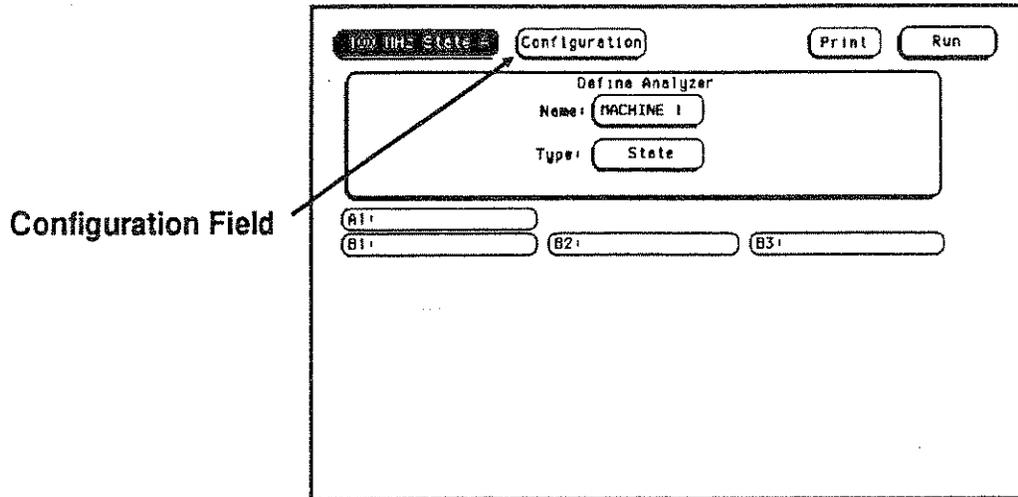


Figure 3-2. State Analyzer Configuration Menu

A pop-up appears that lists all the main analyzer menus. See the figure below. You will use this pop-up menu to select the main menus.

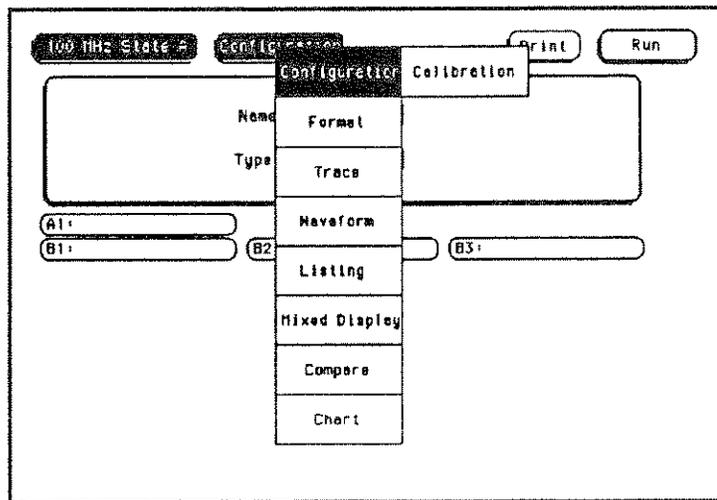


Figure 3-3. Analyzer Main Menu Pop-up

Once a main menu is selected, you can then access all other fields within that menu. The second field from the left, in the top row of fields, always displays the name of each menu displayed. To return to the menu selection pop-up, just select the menu name field. A more detailed definition of the Configuration menu appears in chapter 4.

Pop-up Menus

The pop-up menu enables you to move quickly through the menu tree to access the individual subsystems, menus, and fields you desire. To use the pop-ups when they appear, simply touch the field in the pop-up you want. The pop-up immediately closes and the selected menu appears.

How to Close Pop-up Menus

Some pop-up menus automatically close when you touch a desired field. After closing, the logic analyzer places your choice in the main menu field from which you opened the pop-up.

Other pop-up menus do not automatically close when you make your selection. An example is the alphanumeric keyboard. These menus have a **Done** option. To close the pop-up all you have to do is touch the **Done** field.

Toggle Fields

Some fields toggle between two options, like off and on. When you touch one of these fields, the displayed option toggles to the other choice.

How to Select Options

How to select options depends on what type of pop-up menu appears when you touch the field. When the pop-up appears, you will see a list of options. You select the option by touching the option field. In most cases, after the option has been selected, the pop-up menu will close. However, in some pop-ups, the option **Done** must be selected.

There are also pop-up menus where each option within the pop-up menu has more than one option available. In these cases, when you touch that field, another pop-up, with options, will be superimposed on the original pop-up.

An example of an option field is the clock field in the Format menu. When you select the clock field in this menu, a pop-up appears showing you both clocks (J, K). See the figure below.

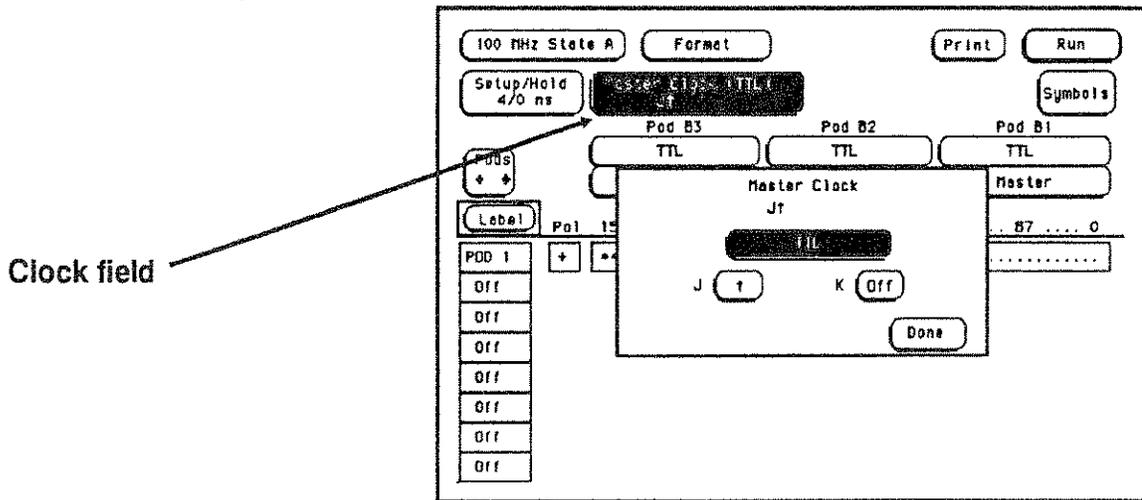


Figure 3-4. State Clock Pop-up Menu

When you select one of the two clocks, another pop-up appears showing you the available choices of clock specifications. See the figure below.

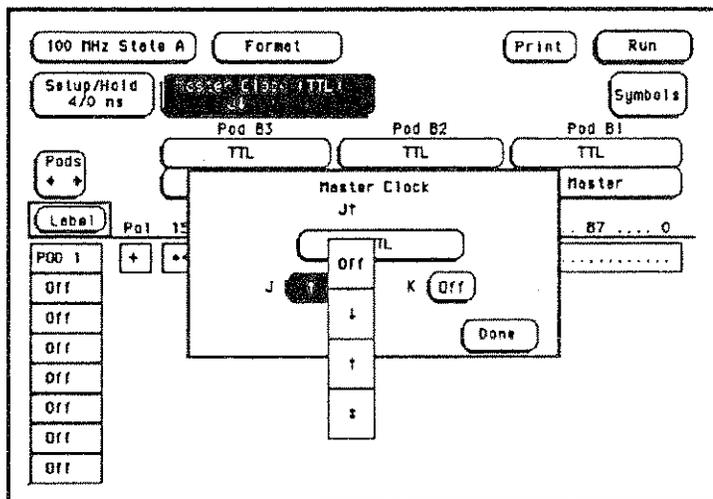


Figure 3-5. Clock Pop-up with J Clock Selected

When you touch one of these fields, the pop-up will close, however, the original clock pop-up still remains open. When you are finished specifying the choices for the clocks, you close the original pop-up menu by touching Done.

How to Enter Numeric Data

There are a number of pop-up menus in which you enter numeric data. The two major types of numeric data entry are listed below:

- Numeric entry with fixed units.
- Numeric entry with variable units.

There are several numeric entry menus where you only select a field, because the units are pre-determined for that selection. The TTL and ECL fields of the pod thresholds menu are an example of this type of predefined value.

There are other numeric entry selections, such as the User field of pod threshold pop-up, that require you to enter both the value and the unit.

To set pod thresholds to a specific voltage, you enter the Format menu and touch a pod field. From the pop-up that appears, select either TTL, ECL, or User. See the figure below.

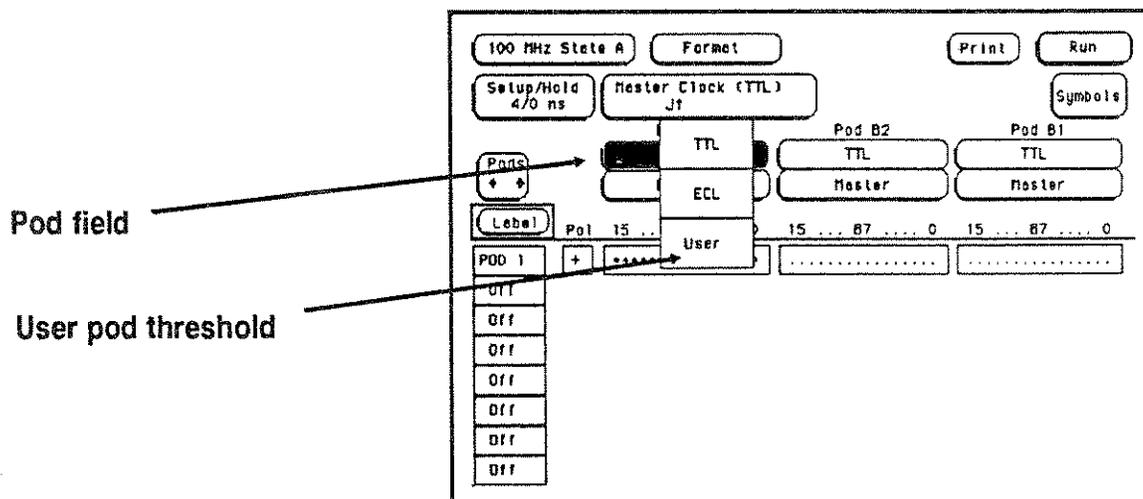


Figure 3-6. Pod Threshold

If you select the User option, a numeric keypad pop-up appears where you enter a value from -3.5 V to +5.0 V. After selecting the value, you select the units of mV or V. Touch Done when you have finished specifying the pod threshold.

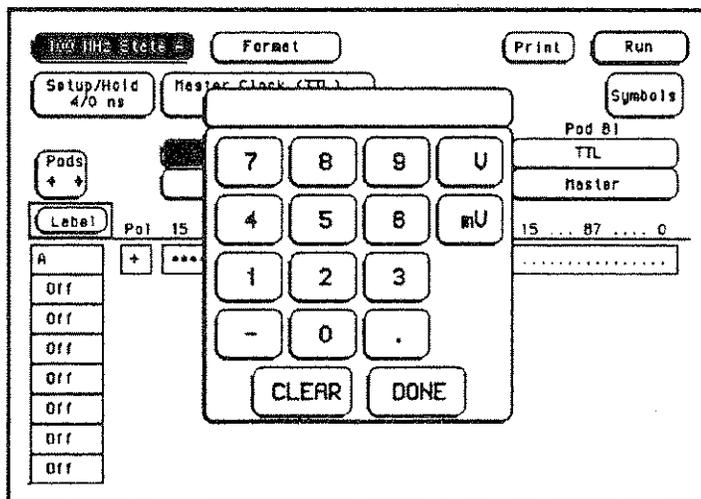


Figure 3-7. Numeric Entry Keypad

If you want a negative voltage for the threshold, press the – (minus sign) in the pop-up. Entering the – (minus sign) can be done either before or after the voltage level has been entered.

How to Enter Alpha Data

You can give specific names to several items. These names can represent your measurement specifically. For example, you might choose the name "Data" for a label in the Format menu.

Items that can have custom labels are listed below:

- Labels
- Symbols
- Filenames
- File descriptions

For an example, you can rename the analyzer in the Configuration menu with a name that is representative of your measurement. The default name for the analyzer is MACHINE 1. To rename the analyzer, touch the analyzer's name field, and when the alphanumeric pop-up menu appears, enter the name you desire. See the figure below.

The line above the alphanumeric keyboard contains the current name.

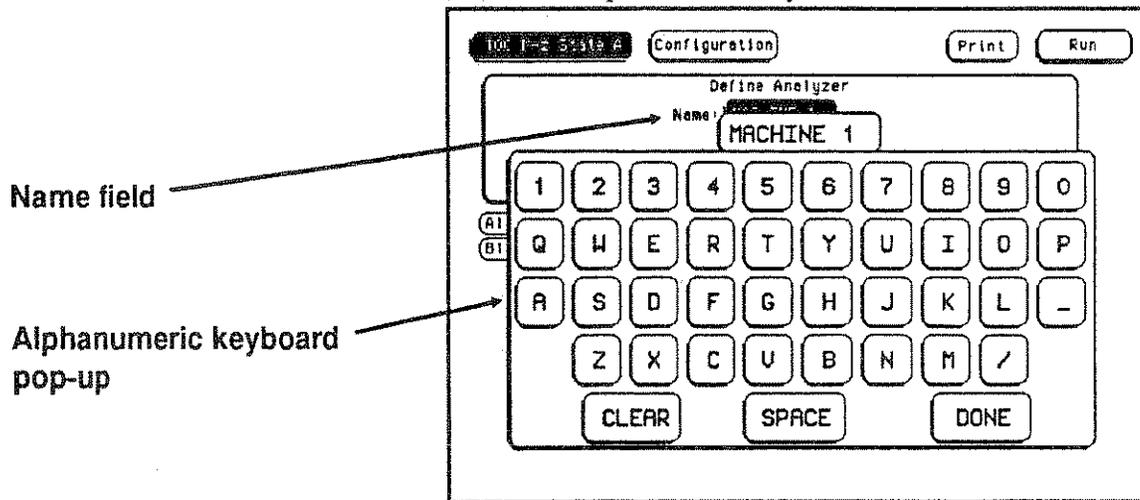


Figure 3-8. Alphanumeric Keypad

When you first enter the pop-up, the cursor in the name field is at the left. You can enter the name you wish by overwriting the existing name. If only a few changes need to be made, you can move the cursor using the knob to a character that needs changing and select a new character. You can also clear the entire field by touching Clear. When you have entered the desired name, touch Done and the pop-up will close.

How to Roll Data

The roll feature is available in all menus that contain off-screen data. This allows you to roll data for viewing. Data can be off-screen both above and below or left and right of what you see on screen.

One example of a menu having off-screen data above and below the screen is the State Listing. The state listing is normally a list of up to 4096 lines long, however, the display is only capable of showing you 16 lines at a time. To roll data in the state Listing (when the box in the left center of the listing area is light blue) simply turn the knob. If this box is not light blue, touch this box and then turn the knob. If you touch this box when it is light blue, a keypad will appear with which you can enter a state location. This allows you to effectively roll the displayed listing in large increments. See the figure below.

The screenshot shows a menu titled "100 MHz State A Listing" with "Print" and "Run" buttons. A "Markers Off" button is also present. Below is a table with columns for "Label", "PDD", and "Time". The "Label" column has a sub-column "Base" and the "PDD" column has a sub-column "Hex". The "Time" column has a sub-column "Relative". The row for state 0 is highlighted with a light blue background. An arrow points from the text "Touch this field when it is light blue, then use the keypad." to the highlighted row.

Label	PDD	Time
Base	Hex	Relative
-7	0B14	30 ns
-6	0B15	30 ns
-5	0B16	30 ns
-4	0B17	30 ns
-3	0B18	30 ns
-2	0B19	30 ns
-1	0B1A	30 ns
0	0B1B	30 ns
1	0B1C	30 ns
2	0B1D	30 ns
3	0B1E	30 ns
4	0B1F	30 ns
5	0B20	30 ns
6	0B21	30 ns
7	0B22	30 ns
8	0B23	30 ns

Figure 3-9. Listing Menu with Off-screen Data

Another example of off-screen data to the left and right is shown in the Trace menu in figure 3-10. In this example only six of the eight labels can be displayed at a time. Whenever there is data off screen to the left or right, an additional field exists in the menu as shown in figure 3-10. This is called a field because it is enclosed in a box and will turn light blue when touched.

If "Label >' is light blue, the field can be selected and data can be rolled.

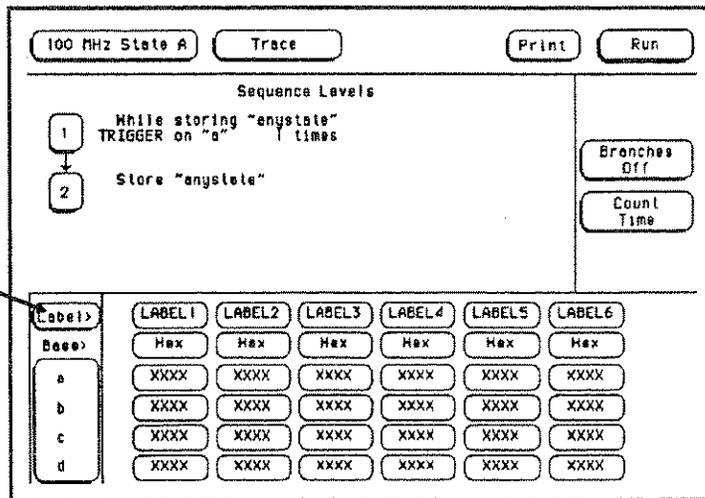


Figure 3-10. Off-screen Data Indicator

If data does not exist off screen, the term Label > will not be enclosed in a box. See the figure below.

If "Label >" is not light blue, there is no data to roll.

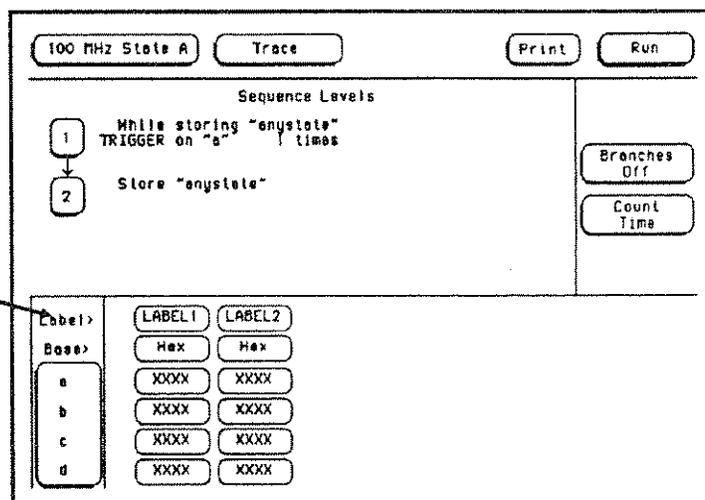


Figure 3-11. No Off-screen Data Left or Right

Assignment/ Specification Menus

There are a number of pop-up menus in which you can assign or specify what you want the logic analyzer to do. Menus of this type perform such actions as assign bits to pods or specify patterns.

Assigning Pod Bits to Labels

All bit assignment fields work identically. The convention for bit assignment is defined below:

- * (asterisk) indicates assigned bits.
- . (period) indicates un-assigned bits.

To assign bits to an analyzer, the pod must have a label assigned. As an example for you, the default Format menu automatically turns the first pod label on. See the figure below.

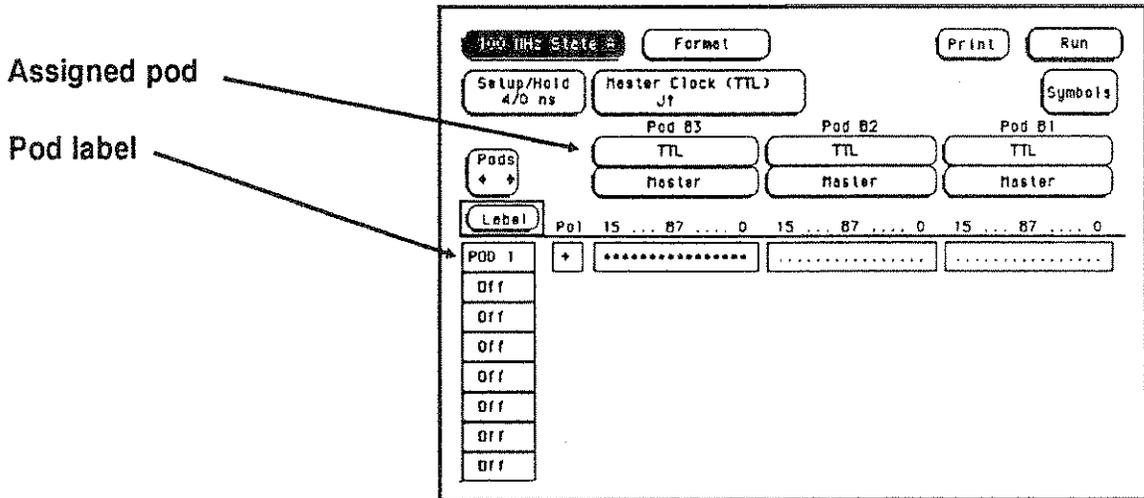


Figure 3-12. Bit Assignment Pop-up Menu

Returning to the System Configuration Menu

You can return to the analyzer's Configuration menu from any logic analyzer main menu. Select the menu name field as shown below, then select the Configuration field from the pop-up.

If you want to go to the mainframe System Configuration menu, select the 100 MHz State field, then select System.

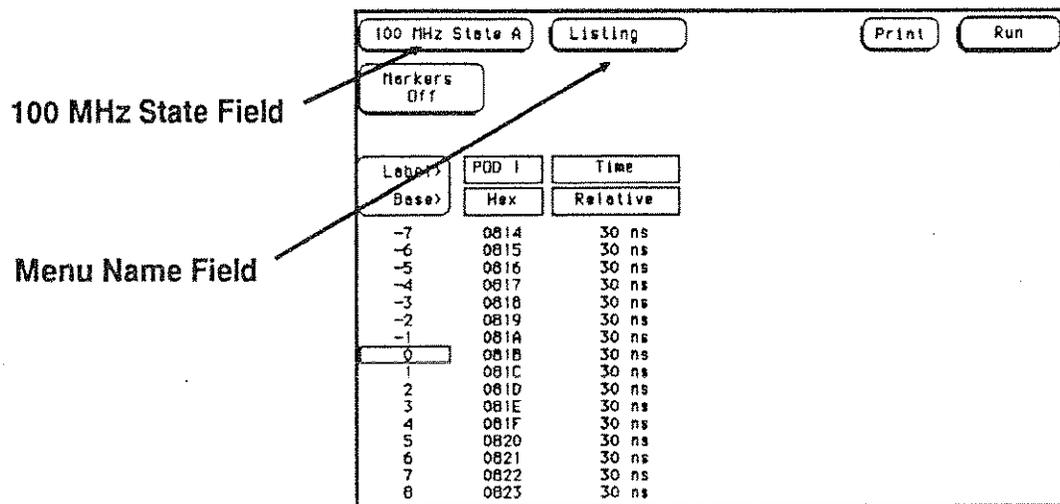


Figure 3-14. Menu Name Field

The 100 MHz State Analyzer Module

Introduction

In this chapter, you will find information on the menu fields of the analyzer's Configuration menu and a guide to information covering the other analyzer main menus. Also found in this chapter are the analyzer menu maps.

Information covering other analyzer main menus is listed below:

- Chapter 5 explains the Format menu.
- Chapter 6 explains the Trace menu.
- Chapter 7 explains the Listing menu.
- Chapter 8 explains the Waveform menu.
- Chapter 9 explains the Compare menu.
- Chapter 10 explains the Chart menu.
- Chapter 11 explains the Mixed Display menu.

Configuration Menu

When the 100 MHz State Analyzer is selected from the mainframe's System Configuration menu, the state analyzer's Configuration menu is displayed. In the state analyzer's Configuration menu, the type of clocking is set and a customized name for the analyzer can be assigned. A listing of available pods is shown to verify the cards in the analyzer module. The pods are shown on screen as they are viewed from the rear of the instrument.

Activity Indicators

A portion of the menu that is not a field is the Activity Indicators. The indicators appear in two places. One is in the pod list of the Configuration menu as shown in the figure on the next page. The other place is in the Format menu just above the pod bit numbers.

When the logic analyzer is properly connected to an active target system, you see either a high level dash, a low level dash, or a transitioning arrow in the Activity Indicator displays for each channel. These indicators are very useful in showing proper probe connection and that the logic levels are as expected.

The state analyzer's default Configuration menu is shown below. The following paragraphs define the fields in the Configuration menu.

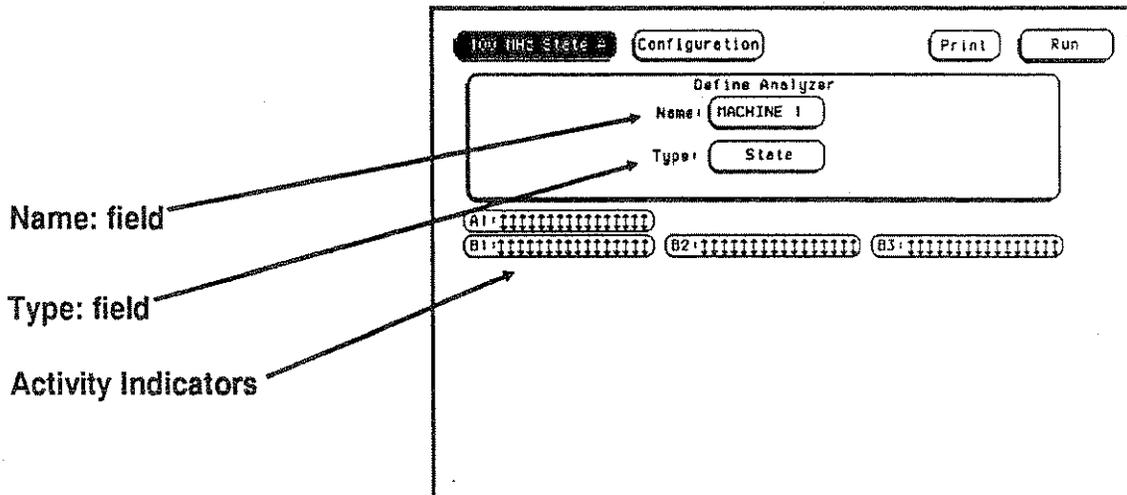


Figure 4-1. Analyzer's Default Configuration Menu

Name When the **Name:** field is selected, a pop-up keypad appears, which you use to create a customized name for the analyzer.

At the top of the keypad pop-up is a box where the current name appears, and where the new name will appear. In the name box is a cursor which indicates in what space your next selection will be placed.

You can name the analyzer in one of two ways. The first way is to position the cursor over the character to be replaced by using the KNOB, then simply touch the new character.

The second way is to touch **CLEAR**. This clears the entire name box and places the cursor at the beginning of the name box. You can then type in the name using the pop-up keypad.

When you have entered the correct name, touch **DONE**.

Type The **Type:** field defines the clocking mode the analyzer will have. When the **Type:** field is touched, a pop-up menu appears. You then select either the Timing or State field.

If the **Timing** field is selected, the analyzer uses its own internal clock to store data. If the **State** field is selected, the analyzer uses a clock from an external source. When the External clock (State) is selected, additional fields appear in the Format menu, which you use to select external clock types and clock qualifier criterion.

You will find more information on clock types and qualifiers in the Format menu chapter.

Print The Print field allows you to print what is displayed on the screen at the time you initiate the printout. When you touch the Print field, a pop-up appears showing you the print options **Cancel**, **Print Screen**, and in some menus, **Print All**.

When you select one of the print options, the information in the display is frozen, then the **Print** field changes to **Cancel** and turns red. While the printout is in process, the user interface is not usable, with the exception of the **Cancel** field. When the printout is complete, the advisory "Print Completed" is displayed and the user interface becomes usable again.

If you wish to stop a printout before it is completed, touch **Cancel**. This stops the print, and the message "Print Cancelled" appears in red.

Print Screen. In the Print Screen option, the printout will look just like the logic analyzer screen.

Print All. The Print All option prints not only what data is displayed on the screen, but data that is below the screen in the Listing menu.

If there is information below the displayed screen, as in the Listing menu, the information will be printed on multiple pages.

When you select the **Print All** option, the message "Printing All" appears at the top of the display. This message will not appear in your printout.



When you touch the **Print All** field, make sure the first line you wish to print is in the light blue box at the center of the listing area. Lines above this box will not print.

Run The **Run** field, which appears in all main menus, allows you to start a data acquisition. The pop-up that appears when you touch this field contains the trace mode options **Single**, **Repetitive**, and **Cancel**.

Single. Single data acquisition occurs one time when **Run** is touched.

Repetitive. Single data acquisitions are repeated until **Stop** is touched or any run/stop criterion is met.

Cancel. If you change your mind after you select **Run**, the **Cancel** field enables you to exit the **Run** selection pop-up without having to choose **Single** or **Repetitive**.

Assigned Pods The list of pods in the Configuration menu show the module configuration. Once an expander card is added to the module, the pods of that expander card are automatically assigned. If the master card is in slot A, and you have one expander connected, pods B1 through B3 are listed below pod A1. If you have the maximum number of expander cards connected around the master card, three pods for each letter A, B, D, and E will be listed.

Module Level Field The field in the upper-left corner of all analyzer menus identifies the module you are using. The module name field (100 MHz State) is used to return to the mainframe's System Configuration menu.

If you want to get back to the mainframe's System Configuration menu, touch the module name field in the upper-left corner, then from the pop-up that appears, touch the **System** field.

Menu Selection Pop-up

The state analyzer's **menu** field shown in the figure below, indicates you are in the analyzer's Configuration menu. When you touch this menu field, a pop-up appears that lists all the main analyzer menus. To access any other analyzer menu, just touch the desired menu name field in the pop-up. When the new menu appears, the menu field changes to the name of the menu you are in.

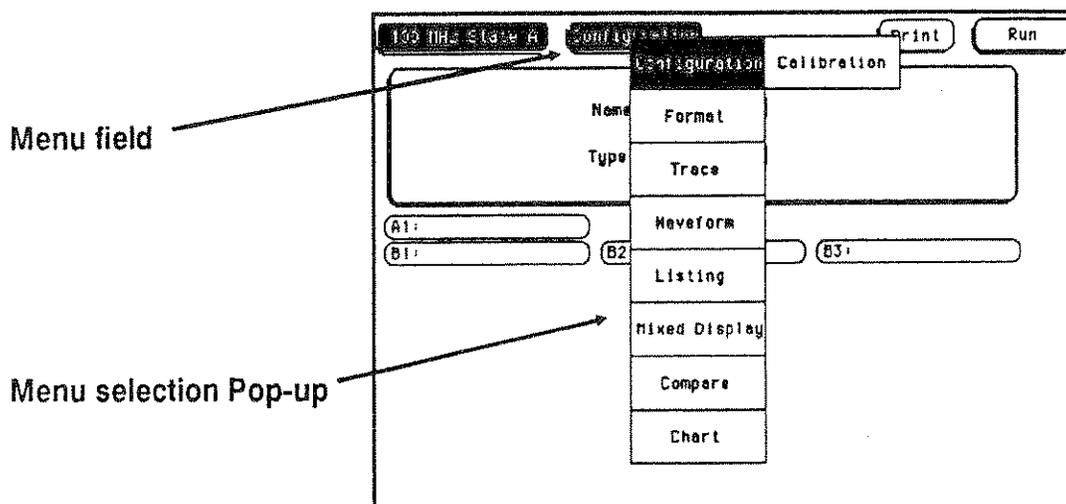


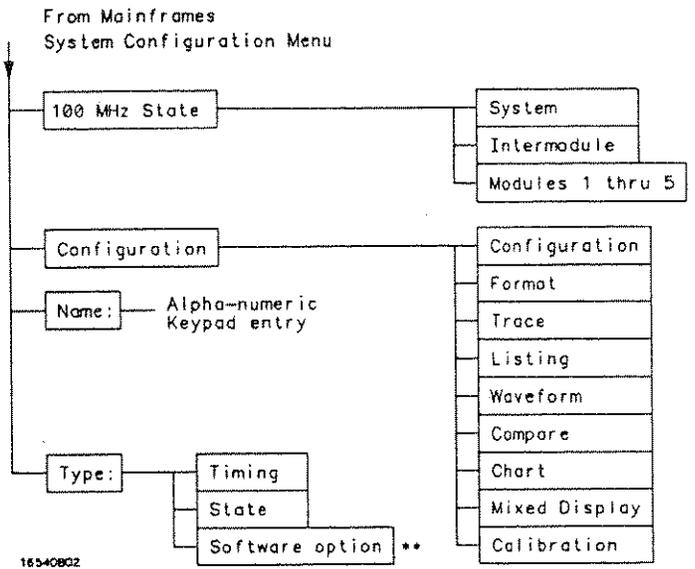
Figure 4-2. Menu Directory Pop-up

To return to the state analyzer's Configuration menu, as shown in figure 4-1, touch the menu field. Then, from the pop-up that appears, touch the **Configuration** field.

State Analyzer Menu Maps

The 100 MHz State Analyzer menu maps show you the fields and the available options of each field within the eight menus. The menu maps will help you get an overview of each menu, as well as provide you with a quick reference of what each menu contains.

Configuration Menu Map



* Modules 1 through 5 depend on what modules are installed in the HP 16500A.

** Optional

Figure 4-3. Configuration Menu Map

Format Menu Map

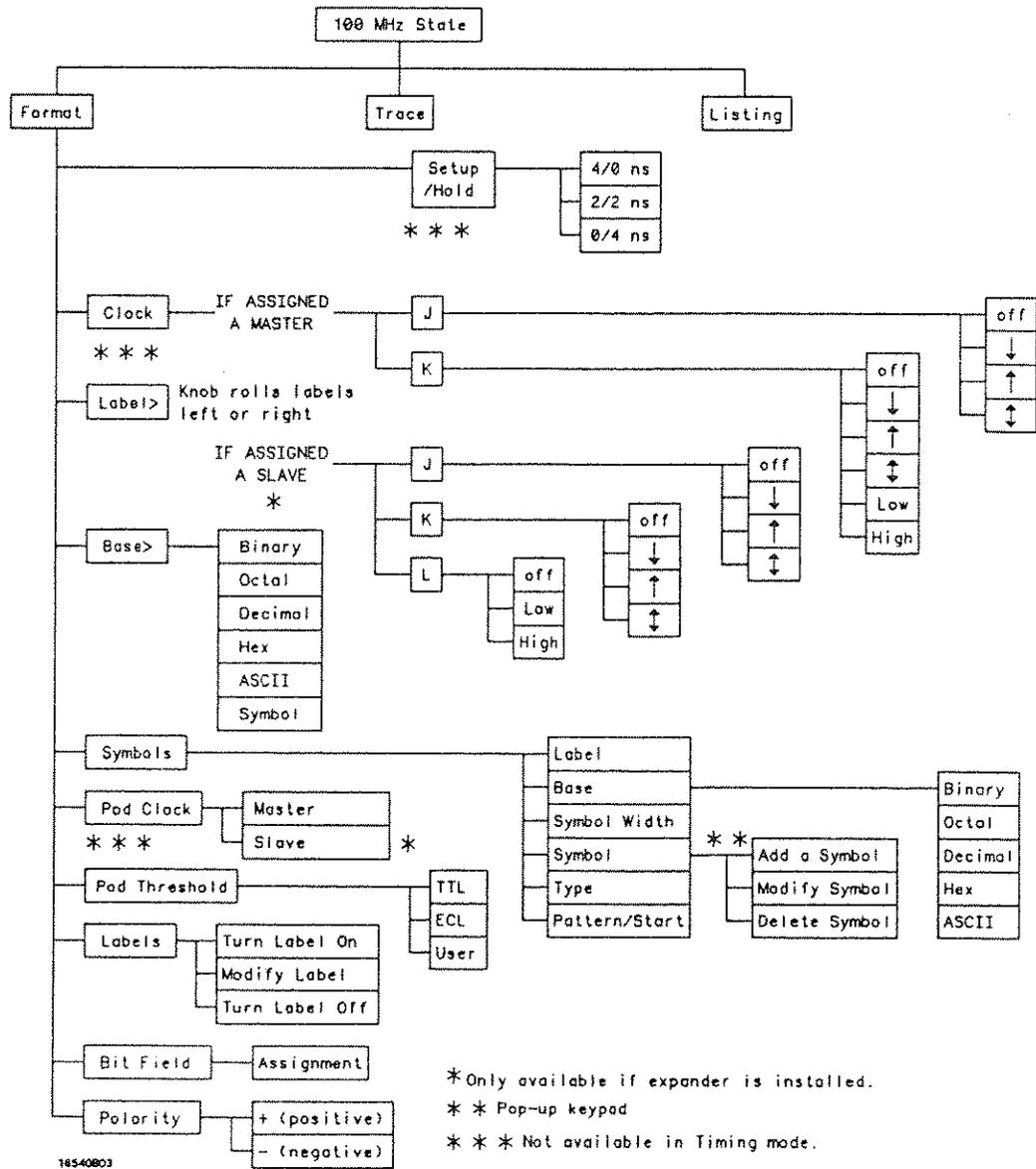


Figure 4-4. Format Menu Map

Trace Menu Map

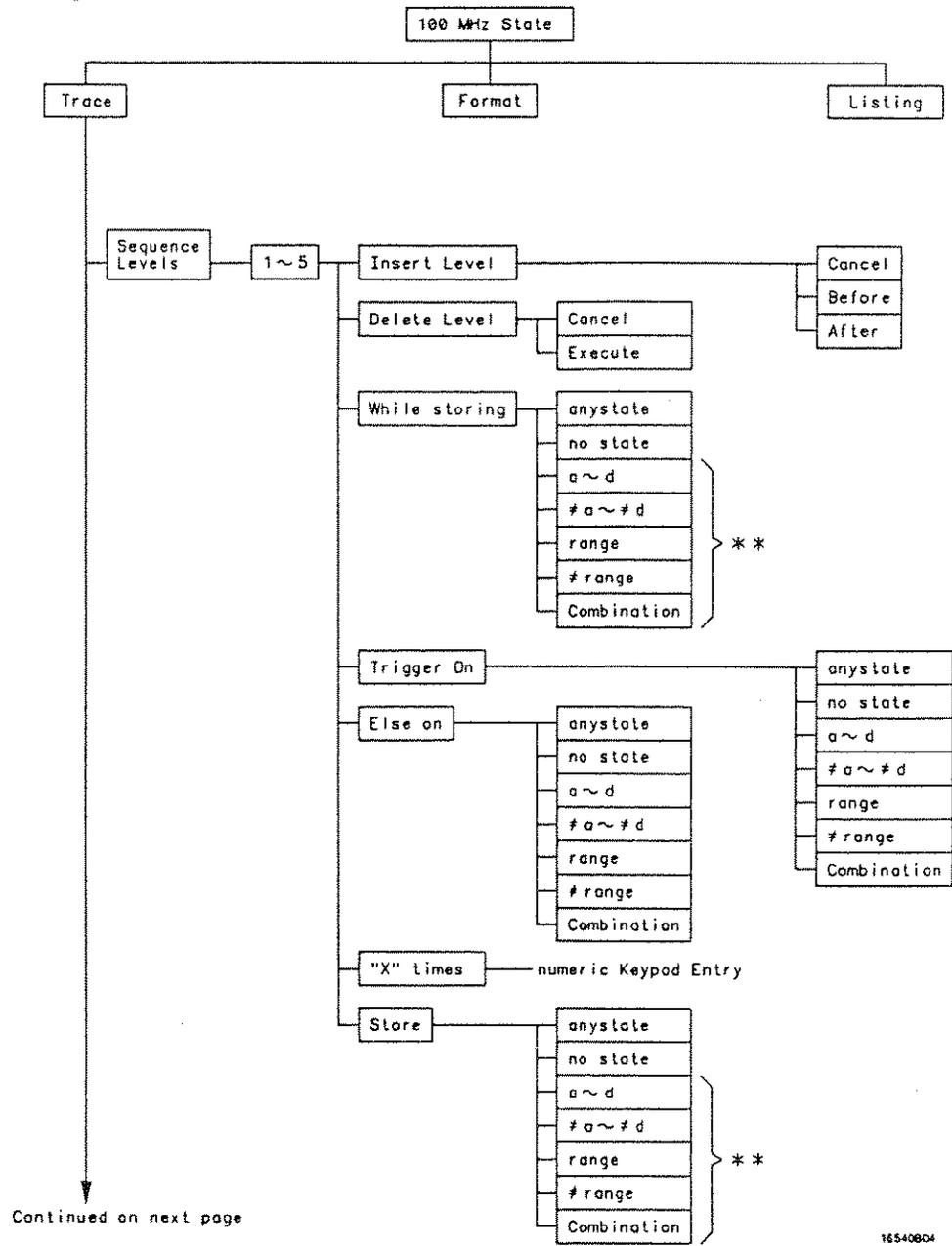
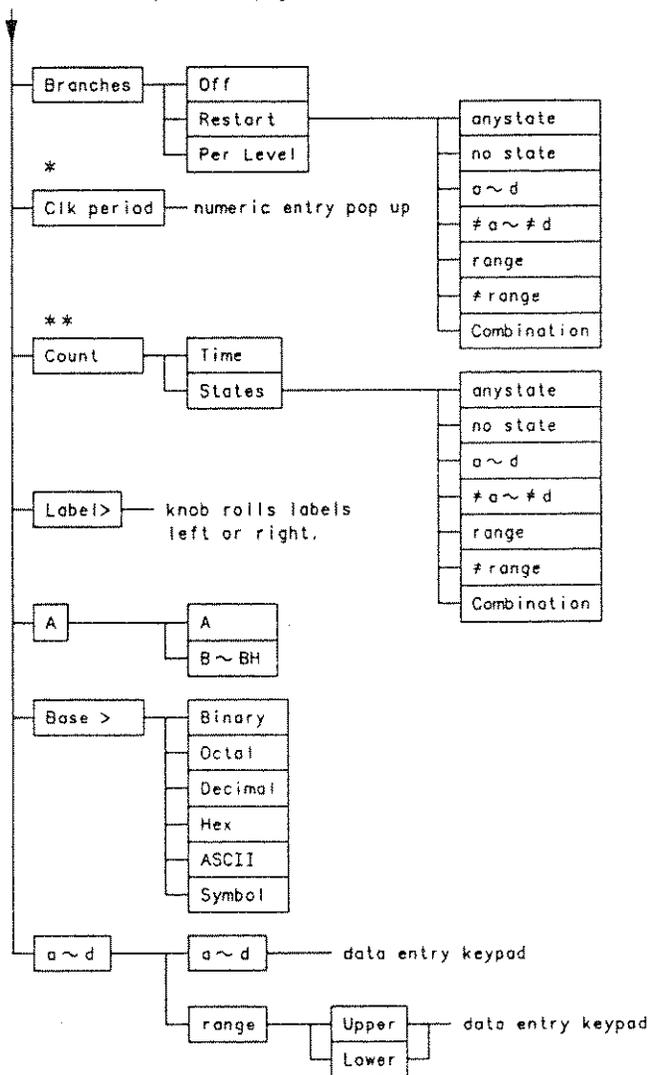


Figure 4-5. Trace Menu Map

Continued from previous page

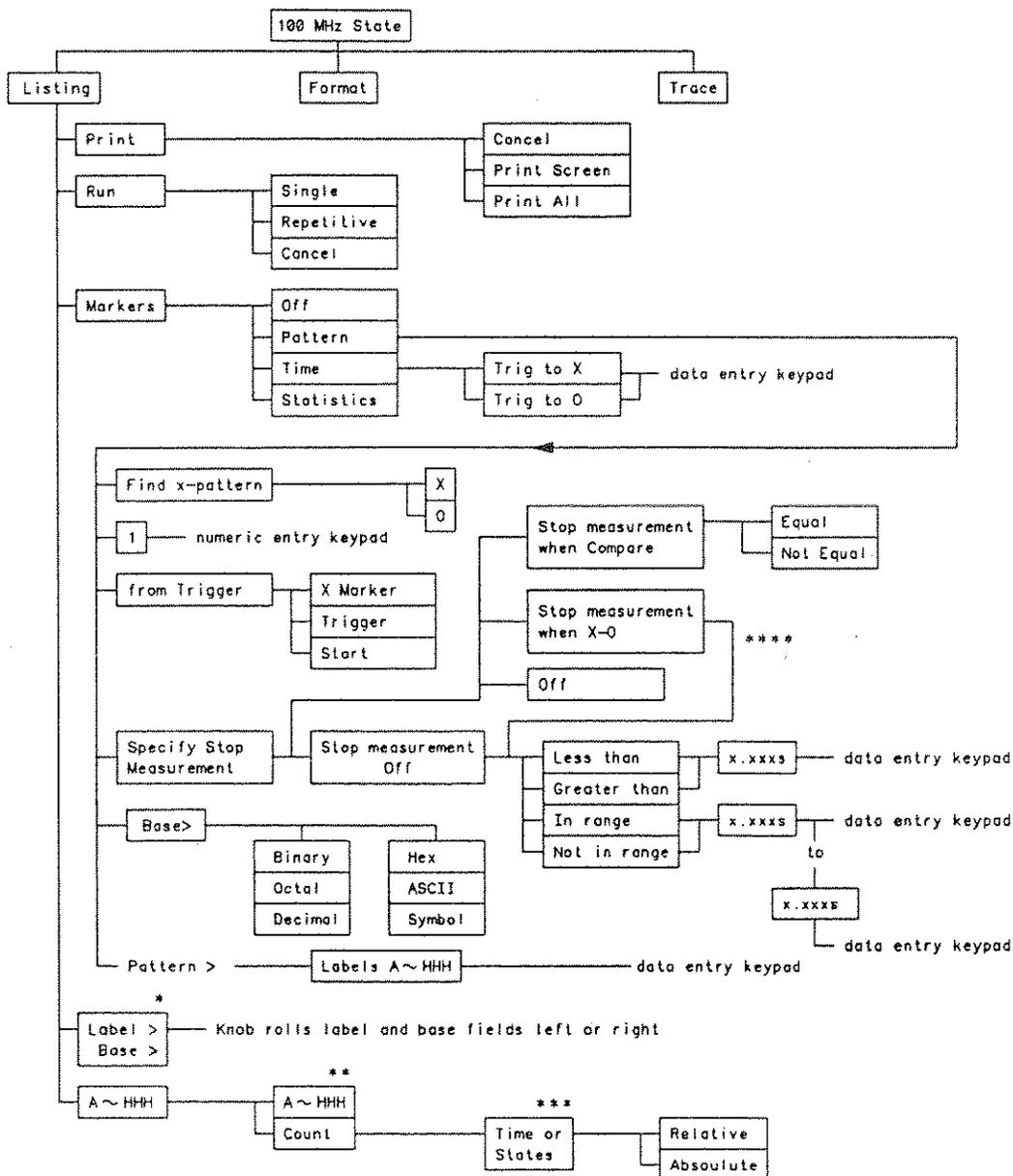


16540805

* Not available in the State mode.
 ** Not available in the Timing mode.

Figure 4-5. Trace Menu Map (cont.)

Listing Menu Map



* Only appears when off-screen labels exist.
 ** This field is used for repositioning labels in the display.
 *** Depends on what the Count field is set to in State Trace menu.
 **** Only available with External clock configuration with Time tags or internal clocking.

16510837

Figure 4-6. Listing Menu Map

Compare Menu Map

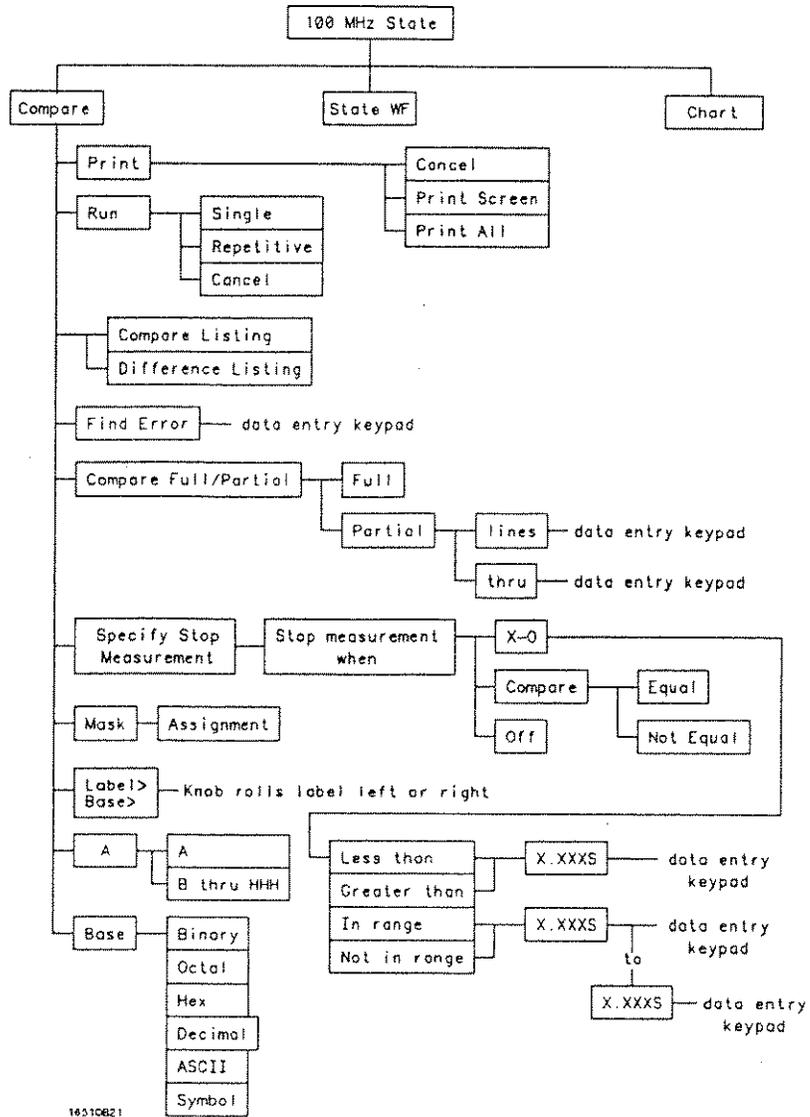


Figure 4-7. Compare Menu Map

State Waveform Menu Map

The following fields are available in the Waveform menu when the State field is selected as the analyzer type in the Configuration menu.

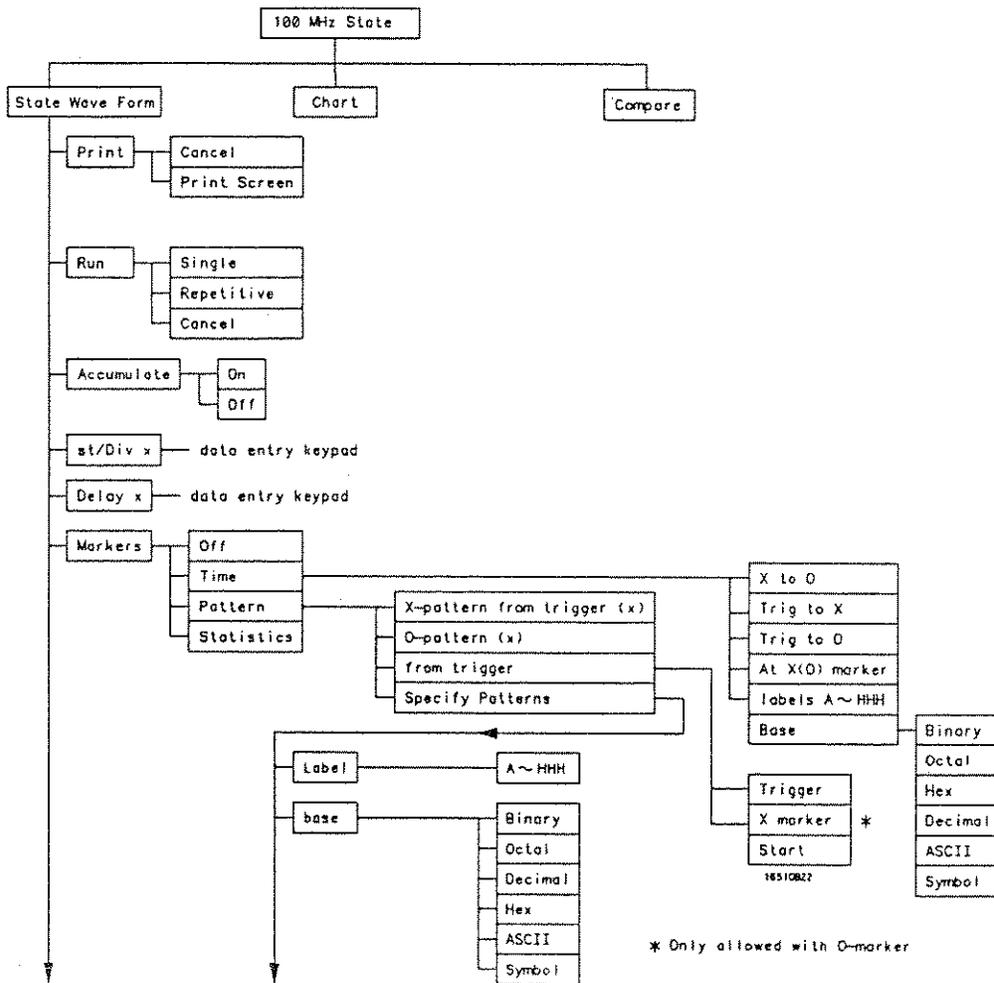
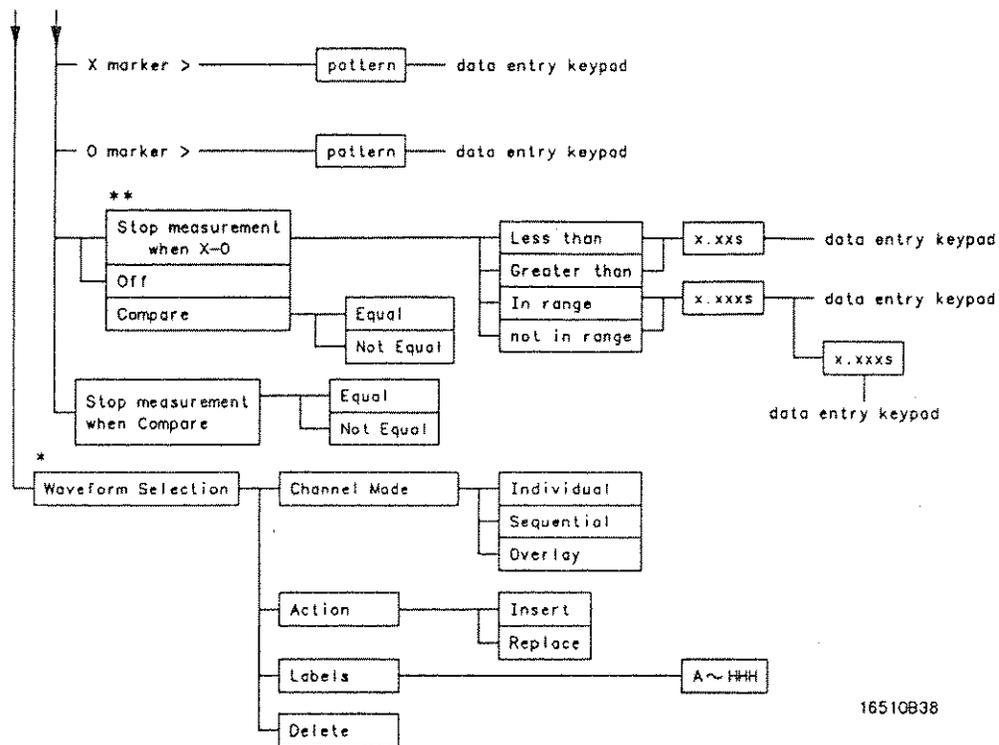


Figure 4-8. State Waveform Menu Map



16510B38

* Access by touching the box on the far left of the waveforms display where the labels are displayed
 ** Not available with External clock configuration with State tags.

Figure 4-8. State Waveform Menu Map (cont.)

Chart Menu Map

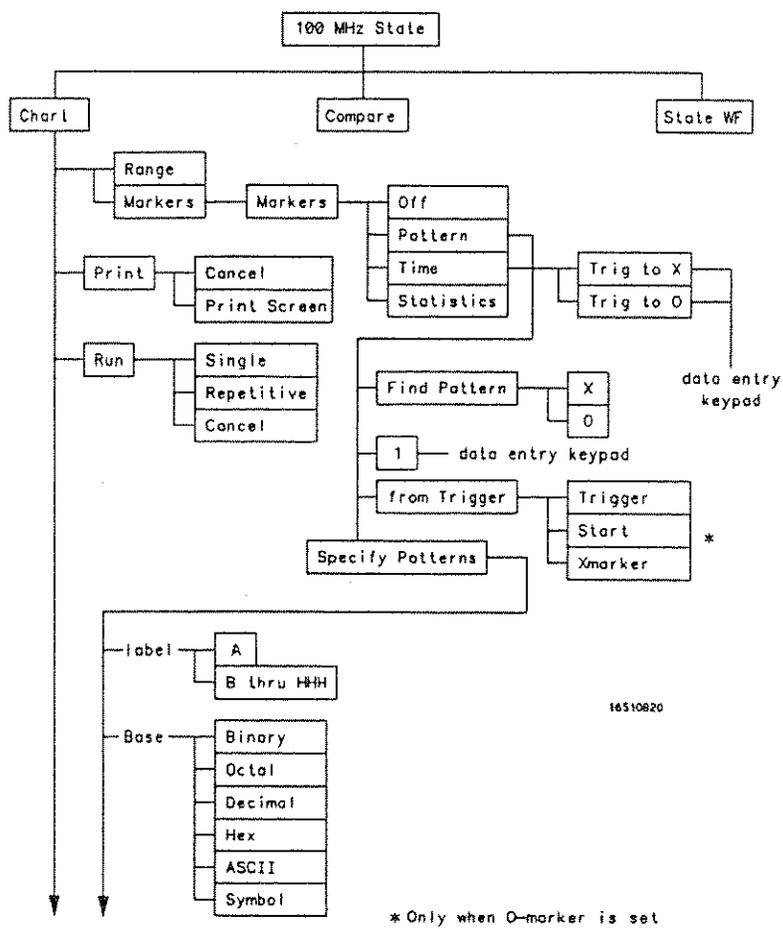
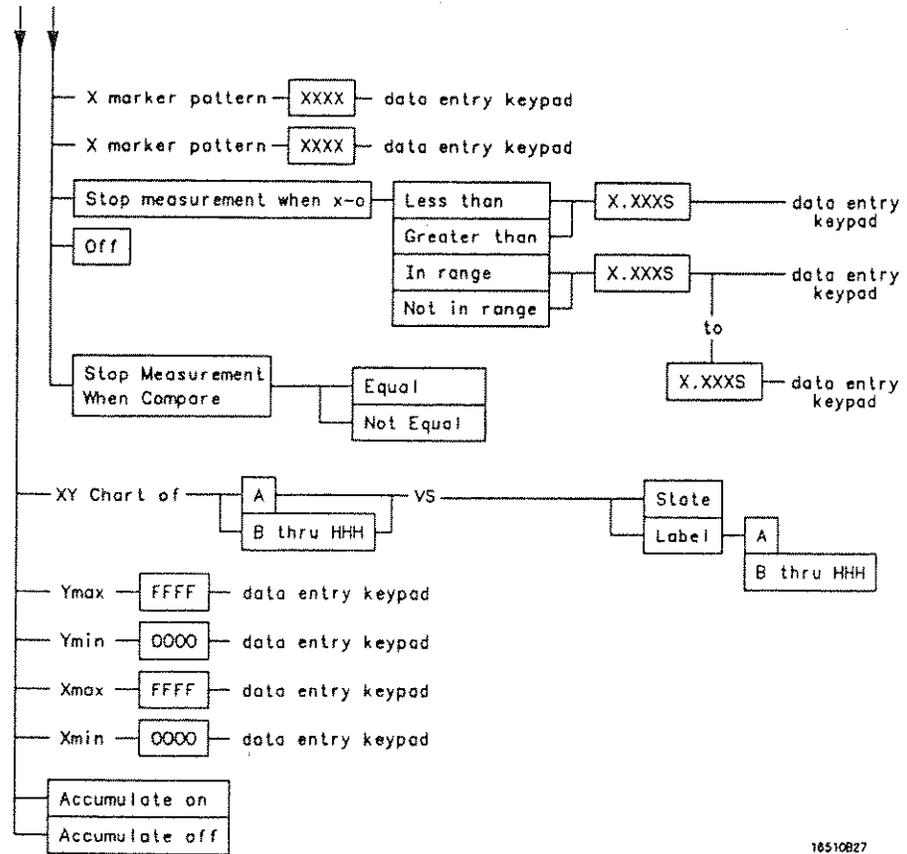


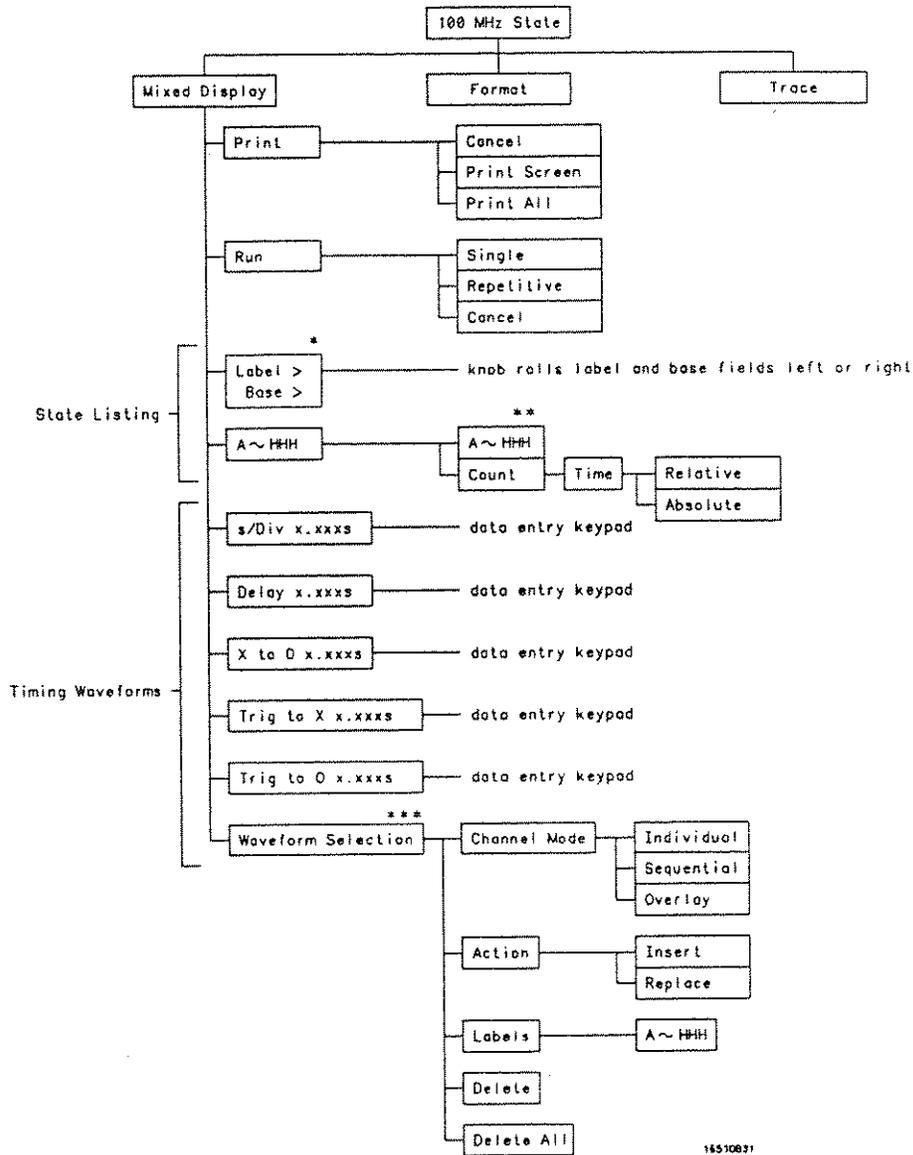
Figure 4-9. Chart Menu Map



16510827

Figure 4-9. Chart Menu Map (cont.)

Mixed Display Menu Map

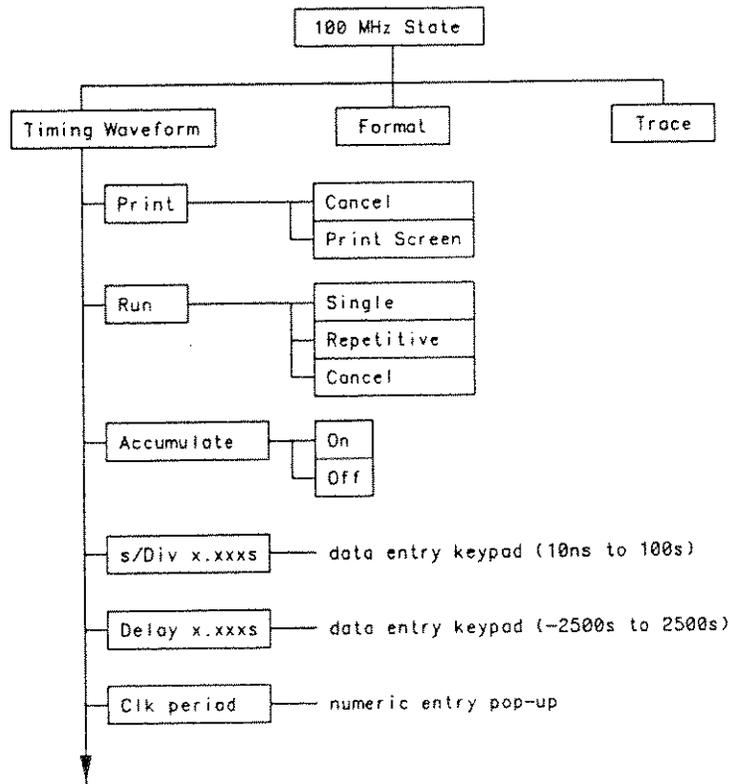


* Only appears when off-screen labels exist
 ** This field is used for repositioning labels in the display
 *** Access by touching the box on the far left of the waveforms display where the labels are displayed

Figure 4-10. Mixed Display Menu Map

Timing Waveform Menu Map

The following fields are available in the Waveform menu when the **Timing** field is selected as the analyzer type in the Configuration menu.

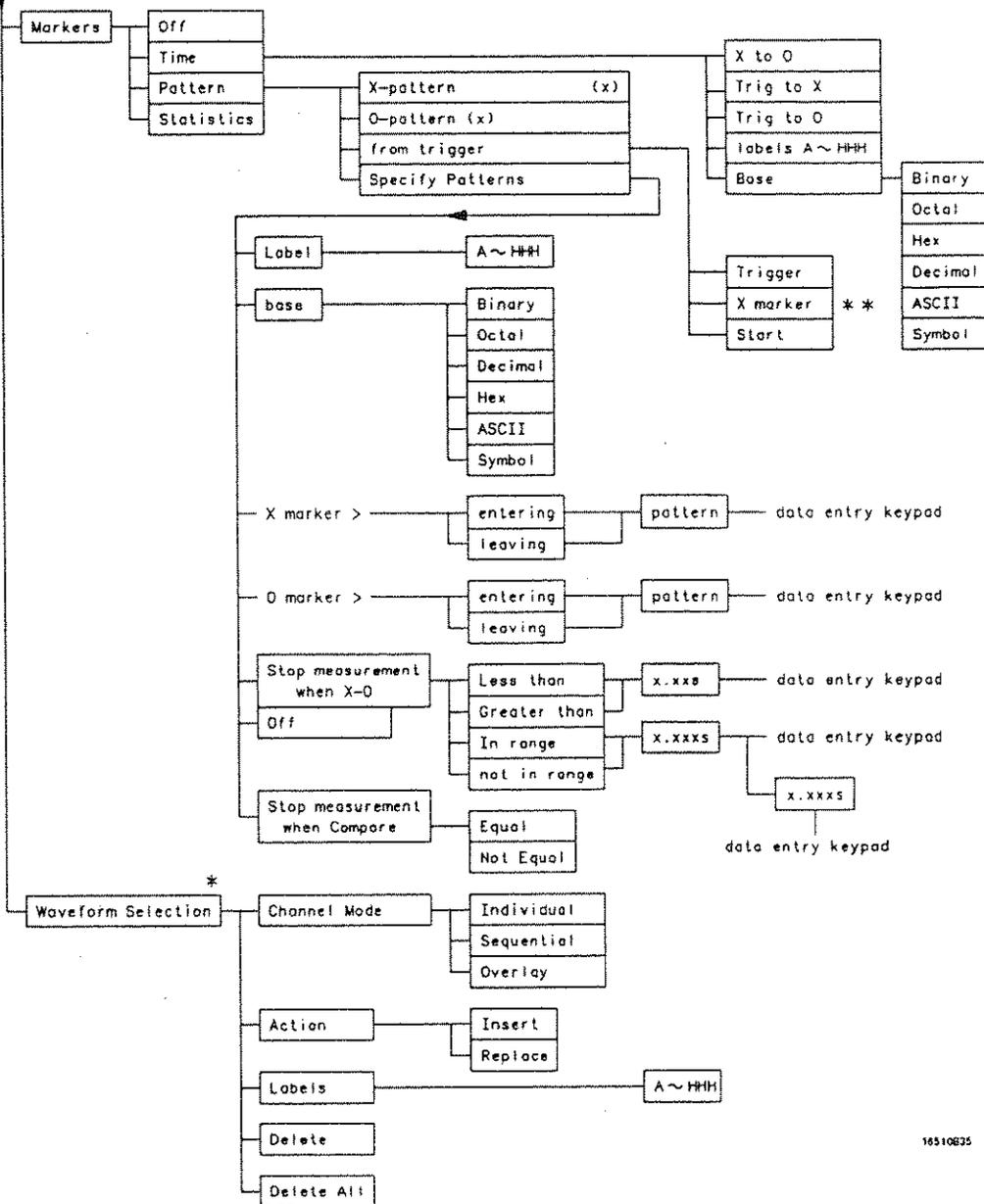


Continued on next page

16510834

Figure 4-11. Timing Waveform Menu Map

Continued from previous page



* Access by touching the box on the far left of the waveforms display where the labels are displayed
 ** Only available for O marker

Figure 4-11. Timing Waveform Menu Map (cont.)

State Format Menu

Introduction

This chapter describes in detail the Format menu and all pop-up menus that you use while in the Format menu. Many illustrations are provided to make the explanations clearer.

Accessing the Format Menu

The Format menu is accessed through the menu selection pop-up shown below. The menu selection pop-up appears when the menu name field, in any menu, is touched. The menu name field is always the second field from the left in the top row of fields.

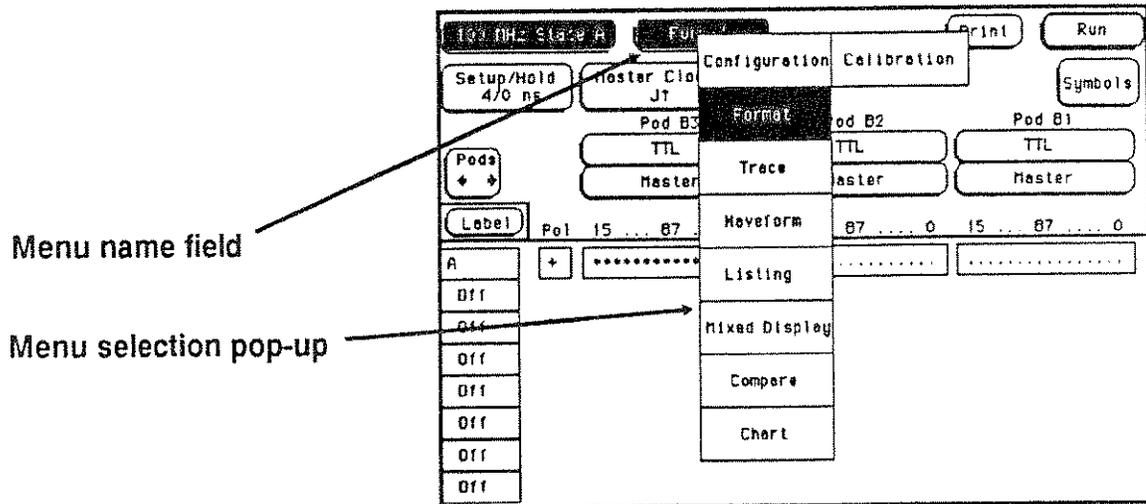


Figure 5-1. Menu Selection Pop-up

Format Menu

The Format menu is used for grouping and labeling the data channels from the system under test for your measurements. In addition, you can set individual pod and clock threshold levels, and specify symbols for user convenience. If the State mode is selected in the Configuration menu, you have master and slave clocks and qualifiers, and clock/qualifier thresholds.

If the **Type:** field in the Configuration menu is set to State, the default Format menu will appear as shown below.

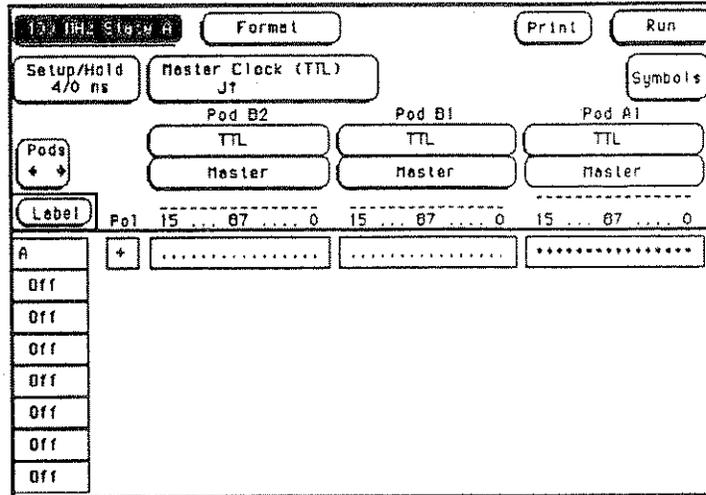


Figure 5-2. State Format Menu

If the **Type:** field in the Configuration menu is set to Timing, the fields controlling the clocks and qualifiers will not appear. The default Timing Format menu is shown below.

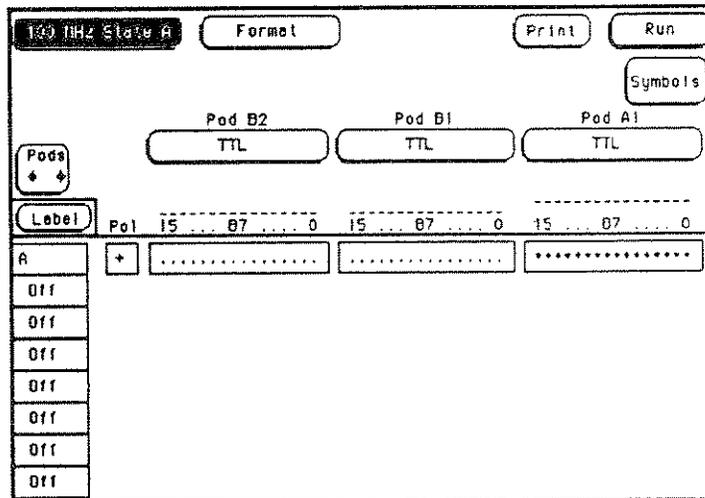


Figure 5-3. Timing Format Menu

Format Menu Fields

When setting up the Format menu for a measurement, you will encounter the ten different types of fields listed below:

- Label
- Polarity (Pol)
- Bit assignments
- Pod threshold
- Symbols
- Clock
- Clock threshold
- Clock qualifiers
- Pod Clock
- Setup/Hold

If the **Type:** field in the Configuration menu is set to Timing, the clock, clock threshold, pod clock, Setup/Hold, and clock qualifier fields will not be available.

In the following paragraphs, the Format menu fields are described. The clocking mode is set to State, so all menu fields can be illustrated.

Labels and Pods

The label column, as shown in figure 5-4, contains 60 label fields that you can define. The analyzer displays only 8 labels at any time. Depending on how many expander boards are in the analyzer module, you could have up to 13 pods to view. Similar to the labels, only three pods can be displayed at a time.

Rolling Labels and Pods.

To view offscreen labels, touch the **Label** roll field shown in figure 5-4, to ensure it is a light blue color, then rotate the KNOB. The labels scroll up and down.

To view offscreen pods, touch the **Pods** roll field shown in figure 5-4, to ensure it is a light blue color, then rotate the KNOB. Pods are positioned with the lowest numbered pod on the right.

For another example of how to roll data, refer to "How to Roll Data" in chapter 3.

To access one of the Label fields, simply touch the desired label. A pop-up menu appears as shown below.

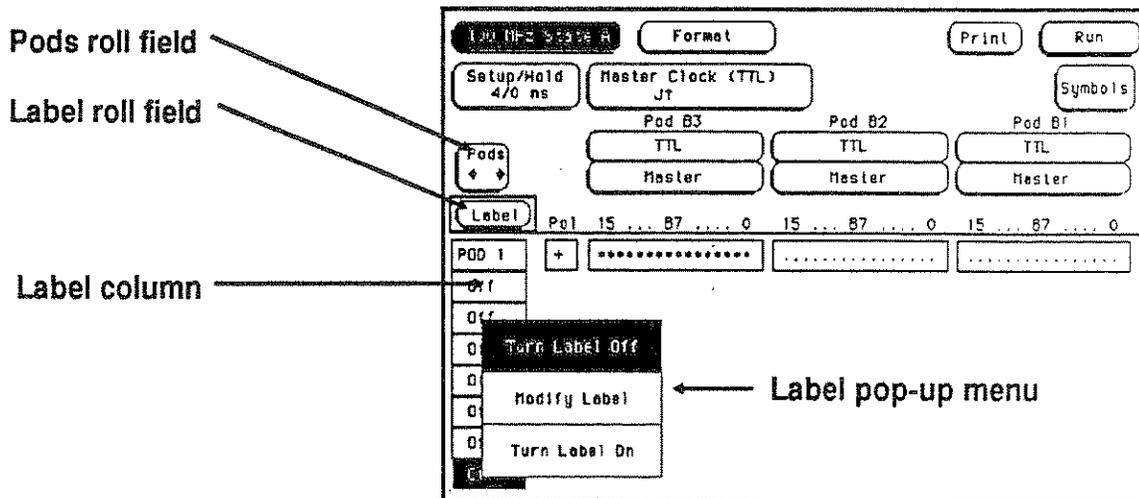


Figure 5-4. Label Pop-Up Menu

Turn Label On

Selecting this option turns the label on and gives it a default letter name. If you turned on all the labels they would be named A through HHH, from top to bottom. When a label is turned on, bit assignment fields and a polarity field appear to the right of the label and under the pods.

Modify Label

If you want to change the name of a label, or want to turn on a label and give it a specific name, you would select the Modify label option. When selected, an alphanumeric entry pop-up appears for you to enter a label name. A label name can be a maximum of six characters.

Turn Label Off

Selecting this option turns off the label. When a label is turned off, the bit assignments are saved by the logic analyzer. This gives you the option of turning the label back on and still having the bit assignments if you need them.

Polarity (Pol)

Each label has a polarity assigned to it. The default polarity for all labels is positive (+). You change the polarity of a label and invert the data by touching the polarity field, which toggles the polarity between positive (+) and negative (-). Changing the polarity field in the Format menu will not effect the Waveform, and Mixed Display menus. See the figure below.

Bit Assignment

The bit assignment fields as shown below, allows you to assign bits (channels) to labels. The convention for bit assignment is as follows:

- * (asterisk) indicates assigned bit.
- . (period) indicates unassigned bit.

To change a bit assignment configuration, touch the bit assignment field. A bit assignment pop-up appears. Using the KNOB, move the cursor to the bit you want to change, then select an asterisk or a period.

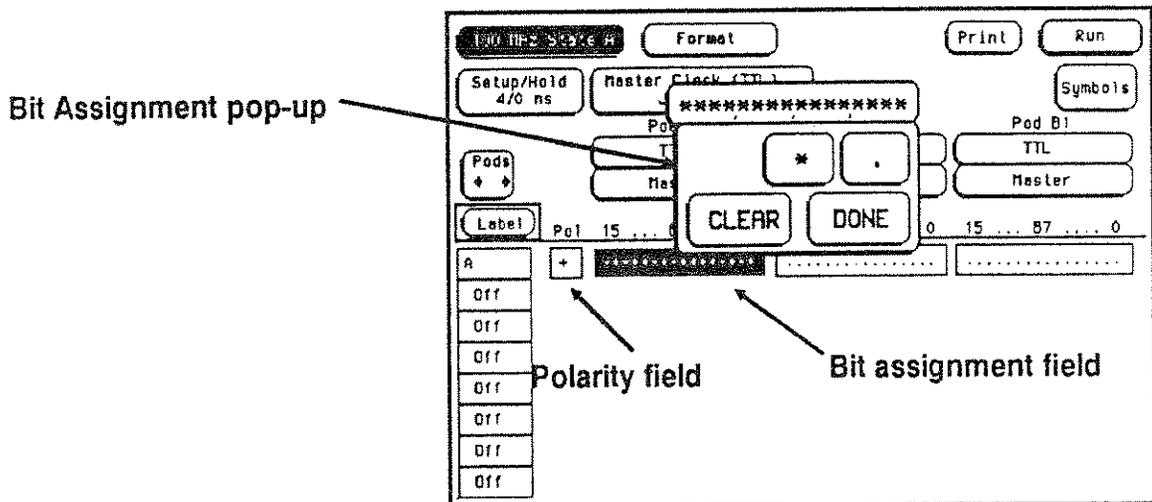


Figure 5-5. Polarity and Bit Assignment

When the bits (channels) are assigned as desired, touch the Done field. The pop-up closes and the screen displays the new bit assignment.

Above each column of bit assignment fields is a bit reference line that tells you the bit numbers from 0 to 15, with the left bit numbered 15 and the right bit numbered 0. This bit reference line helps you know exactly which bits you are assigning.

Labels may have from 1 to 32 channels assigned to them. If you try to assign more than 32 channels to a label, the logic analyzer will beep, indicating an error, and a message will appear at the top of the screen telling you that 32 channels per label is the maximum.

Channels assigned to a label are numbered from right to left by the logic analyzer. The least significant assigned bit on the far right is numbered 0, the next assigned bit is numbered 1, and so on. Since 32 channels can be assigned to one label at most, the highest number that can be given to a channel is 31.

Although labels can contain split fields, assigned channels are always numbered consecutively within a label. The numbering of channels is illustrated with the figure below.

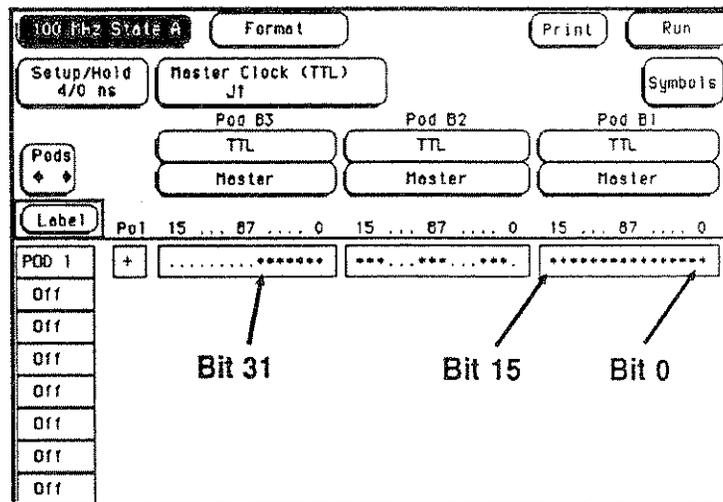


Figure 5-6. Numbering of Assigning Bits

For additional information and another example of bit assignment, refer to "Assignment/Specification Menus" in chapter 3.

Pod Threshold Each individual pod has a threshold level assigned to it. To set a pod's threshold, touch the desired pod threshold field, then, from the pop-up that appears, touch either TTL, ECL, or User. See the figure below.

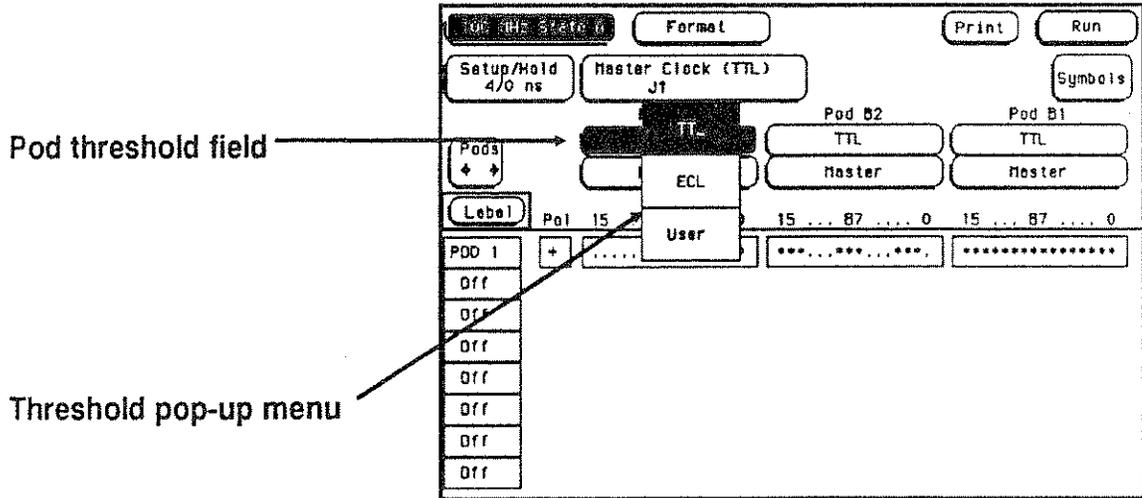


Figure 5-7. Pod Threshold Pop-Up Menu

If you choose TTL, the threshold is set to + 1.5 volts. If ECL is selected, the threshold is set at -1.3 volts. If User is selected, a keypad pop-up appears for you to enter a value between -3.5 V and + 5.0 V or change an existing user defined value. See the figure below.

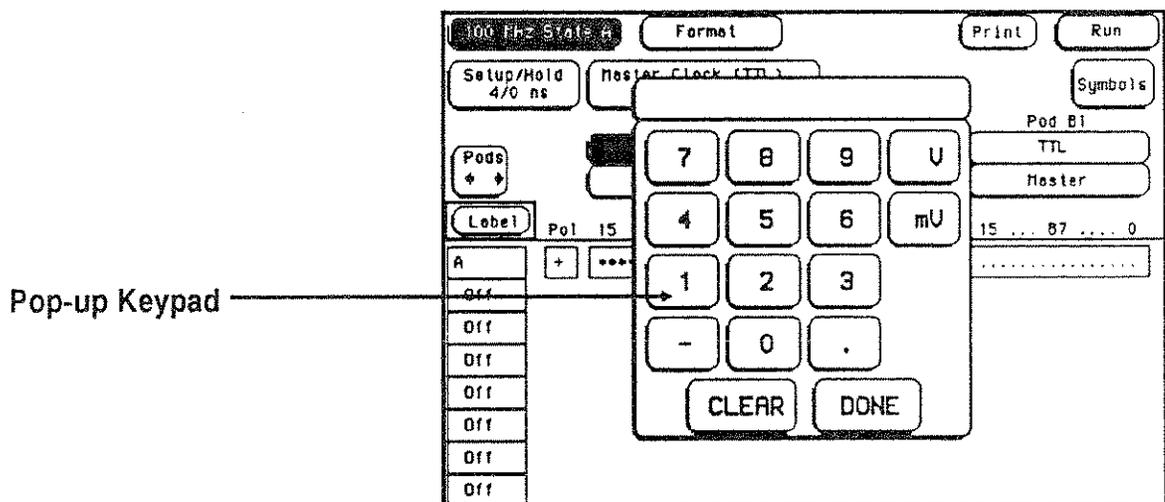


Figure 5-8. User Defined Keypad Pop-up

When you select a Clock field, a pop-up menu will appear as shown below. You use this pop-up menu to specify the clocking arrangement.

You can use one of the clocks alone, or you can combine them to build a more complex clocking arrangement. If you select the field to the right of the clock letters (J or K) in the clock pop-up menu, another pop-up menu appears with the edge and level choices.

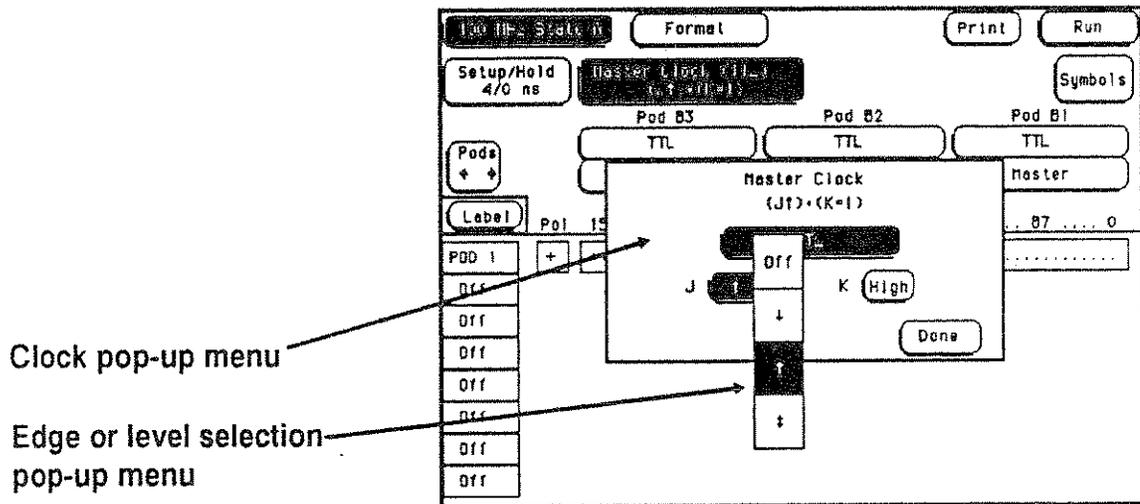


Figure 5-10. Clock Field Pop-Up Menu

You can specify the negative edge of the clock, the positive edge, either edge, or Off. If the clock is used as a qualifier, you can specify a high level or a low level.

The clocks are combined by ORing and ANDing them. Clock edges are ORed to clock edges, clock levels are ANDed to clock edges.

For example, with the Master clock arrangement in figure 5-10, the analyzer will clock the data on all pods when there is a rising edge on the J clock, and a high level on the K clock.

You must always specify at least one clock edge in the State mode. If you try to use only clock levels, the logic analyzer displays a message telling you that at least one edge is required.

Each Master and Slave clock arrangement can have its own clock threshold level. When the clock threshold field, as shown below, is touched, a threshold selection pop-up menu appears. The TTL, ECL, and User settings for the analyzer clocks operate identical to the pod thresholds. For more information, refer to "Pod Threshold", found earlier in this chapter.

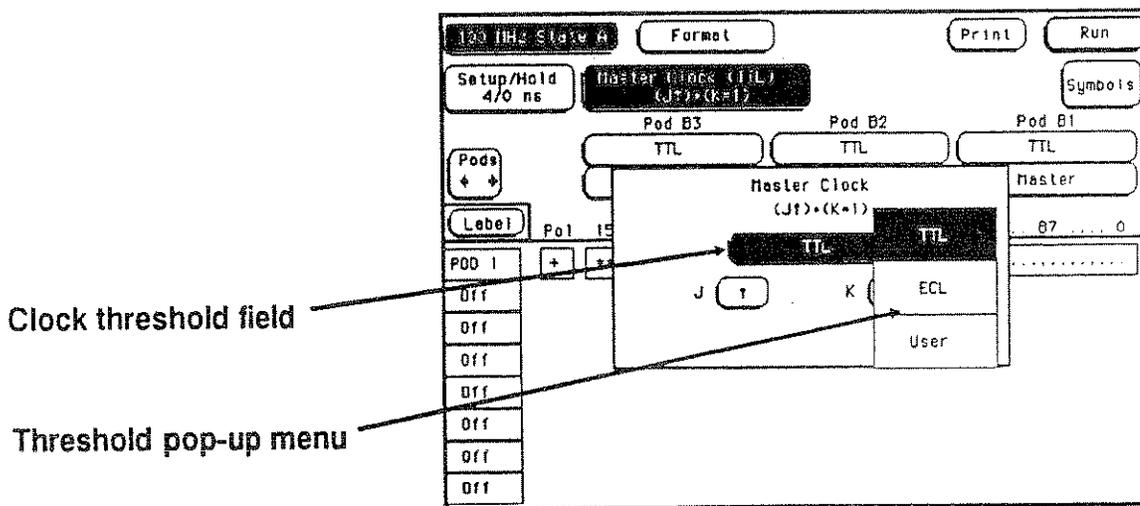


Figure 5-11. Clock Threshold Setting

Pod Clock Your logic analyzer has the capability of clocking state data in two different ways. The pod clock fields shown in figure 5-12 are where you specify the clocking choice.

Normally all pods of the analyzer are clocked in phase by the master clock arrangement. However, with additional pod clock fields for each expander pod, you can clock the three pods on each expander with their own separate slave clock arrangement.

Because all pod clocks on an expander card are clocked from the same source, when any one of the three pod clock fields is changed, the other two will also change.

As with the clock field discussed in the previous section, the pod clock fields are present only in the state mode.

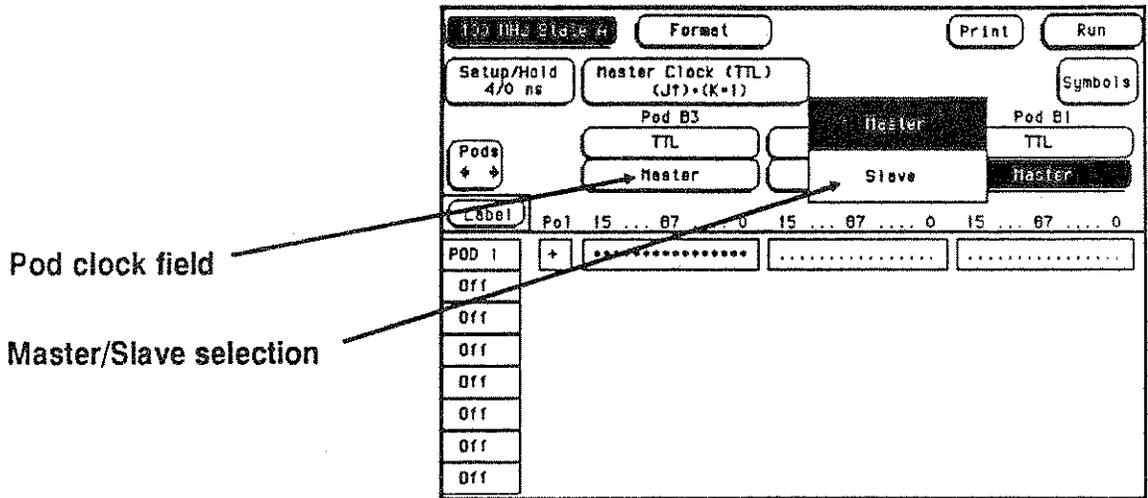


Figure 5-12. Master/Slave Clock Selection Pop-up

Master

This option specifies that a pod will be clocked by the master clock arrangement. If a master clocking arrangement is selected for an expander pod, all pods on that expander will be clocked with the master clock. If you have only a master card in the analyzer configuration, you will have only the master clocking arrangement available.

The master clock arrangement is the default selection for all pods in an analyzer configuration after power-up.

Slave

For each expander card added to the analyzer configuration, you will gain an additional slave clocking arrangement. These additional slave clocking arrangements are individually specified in the Slave Clock fields of each expander. See figure 5-13 on the next page.

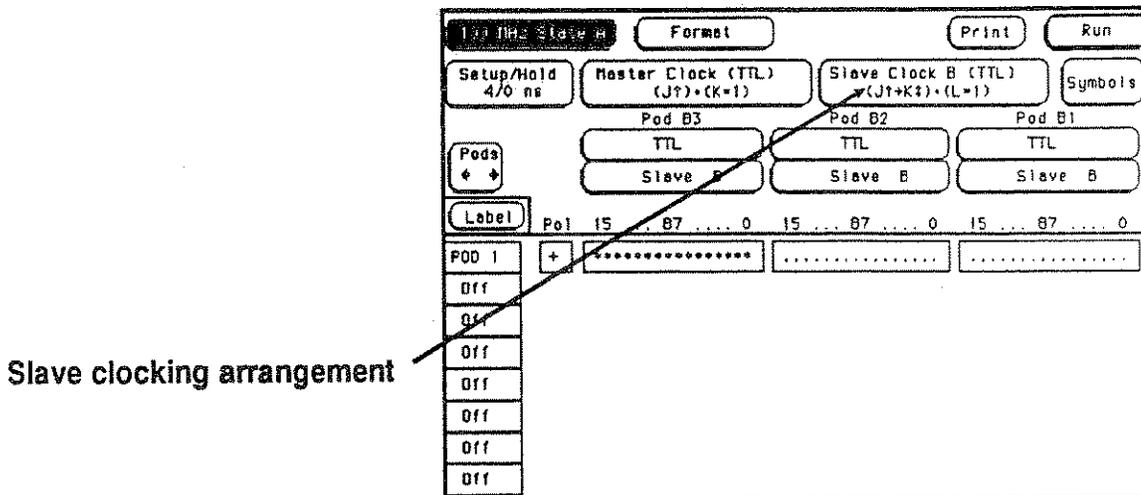


Figure 5-13. Slave Clocking Arrangement

Slave clocking is used for multi-phase clocking applications. All slave clocks must precede the master clock. The pods which are connected to a slave clock, sample data based on their slave clocking arrangement. The pods which are connected to the master clock, will sample data when the master clocking arrangement occurs. At this time, data on all pods is aligned and strobed into the analyzer.

When you touch the Slave Clock field, the Clock Selection pop-up appears as shown below.

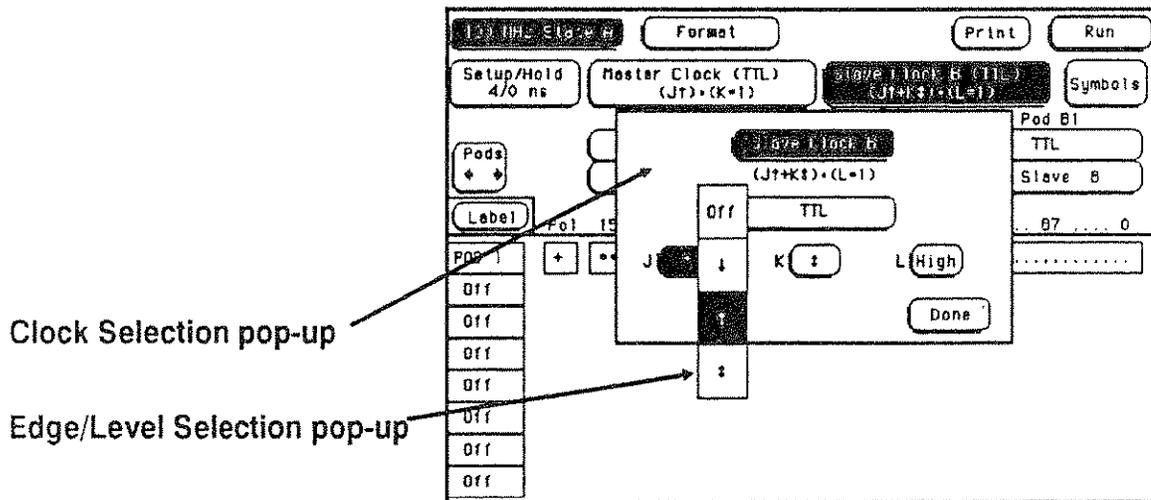


Figure 5-14. Slave Clock Selection Pop-up

You set the Slave clocking arrangement the same way the Master clocking arrangement was set in figure 5-10. Notice, in the Slave clock selection pop-up, you have an additional L qualifier clock available. All expander cards have three external clock connections, one from each pod. An Expander card can only use its own three clocks, or the Master clock to clock its data.

For example, with the Slave Clock B arrangement in figure 5-14, the analyzer clocks the data on expander pods B1 through B3 only when there is a rising edge on the J clock, or either edge on the K clock, and a High level (qualifier) on the L clock.

You must always specify at least one clock edge if you select slave clocking. If you try to use only clock levels, the logic analyzer will display a message telling you that at least one edge is required.

Accessing the different clocking arrangements with multiple expansion boards is done through the Slave Clock pop-up. Select the Slave Clock Listing field as shown in figure 5-15. Another pop-up appears that lists the Slave clocks from all expansion cards in the module.

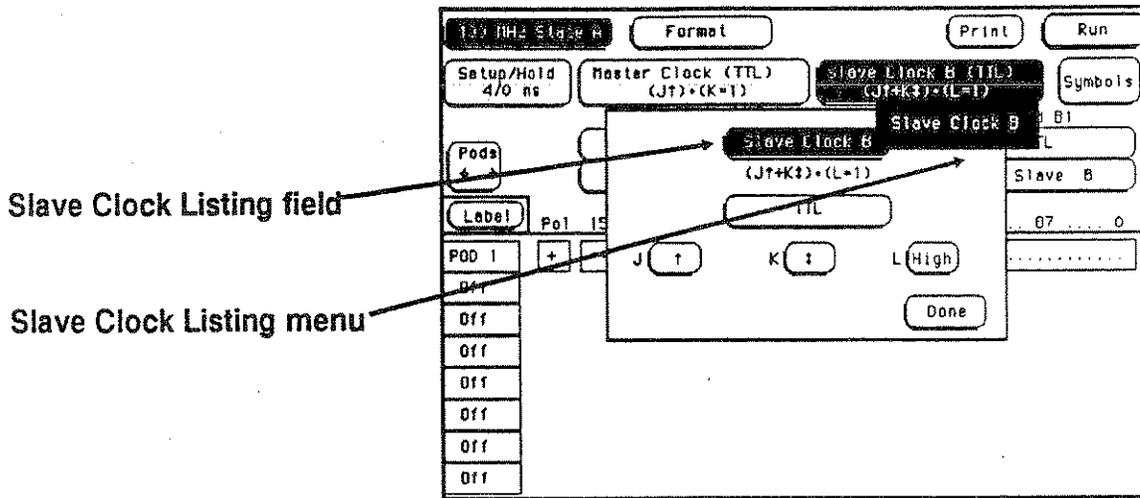


Figure 5-15. Slave Clock Selection List Field

Setup/Hold If you need to vary the setup and hold time of the clock signal to capture valid data, select the Setup/Hold field shown below.

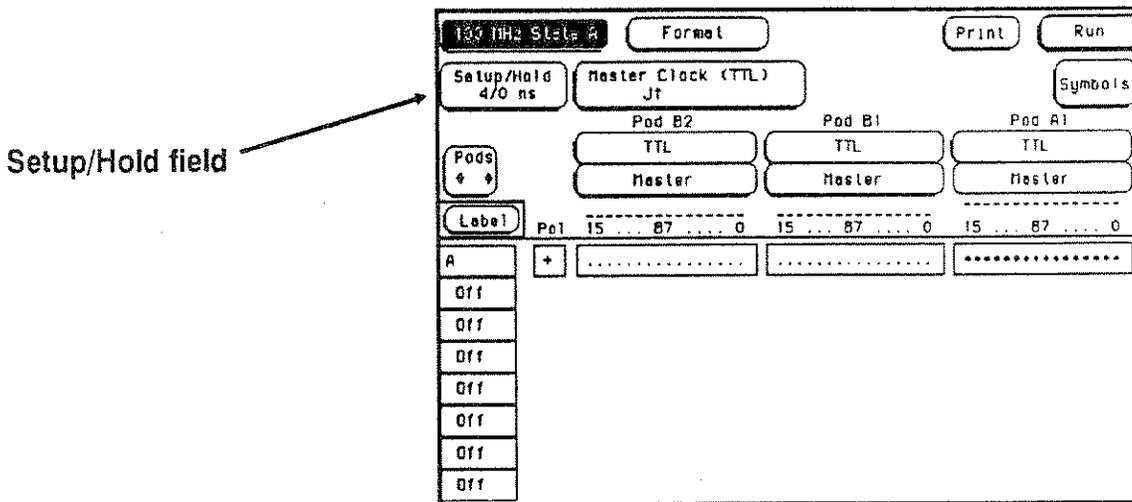


Figure 5-16. Setup and Hold Pop-up

When the Setup/Hold field is selected, another pop-up appears, as shown in figure 5-17, that gives you three different combinations. If the instrument has not been calibrated, the pop-up will not appear, and the Setup/Hold will default to a setting that typically captures data with 4 ns of setup time and 0 ns of hold time.

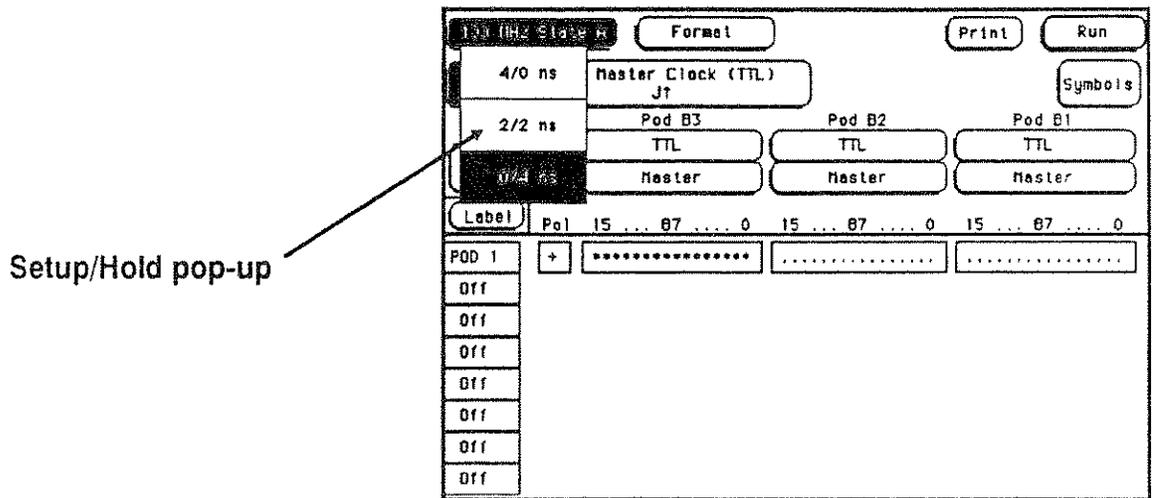


Figure 5-17. Setup/Hold Selection Pop-up

Symbol Table Menu

The state analyzer supplies symbol tables in which you can define a mnemonic for a specific bit pattern of a label. To access the Symbol Table, touch the **Symbols** field shown below.

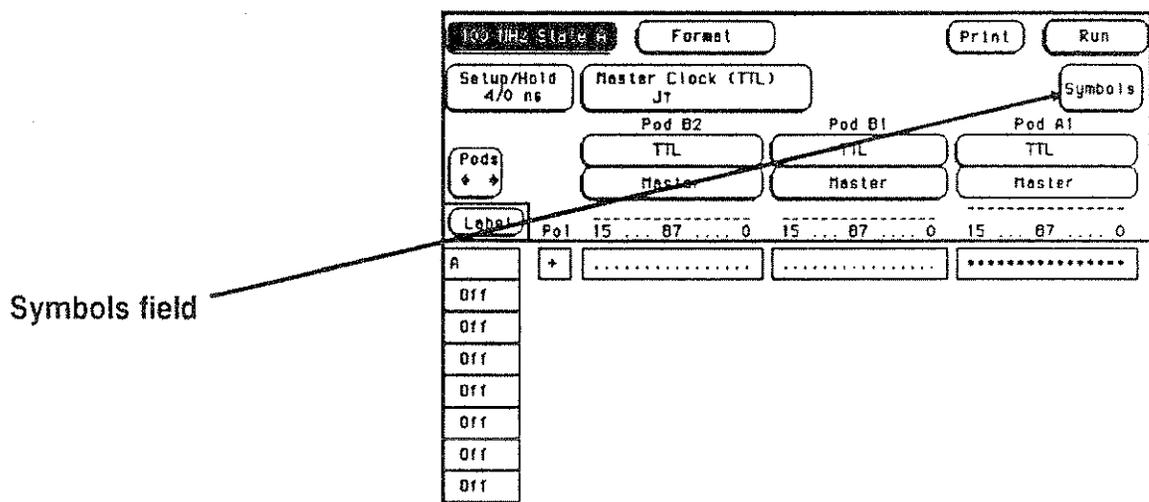


Figure 5-18. Symbol Table Menu

It is possible for you to specify up to 500 symbols. When measurements are made, the symbol is displayed where the bit pattern occurs if the Symbol base is selected. The figure below shows the default Symbol Table menu.

Symbol Table Menu Fields

The four fields available in the Symbol Table menu are listed below:

- Label.
- Base.
- Symbol width.
- Symbol name.

Label The Label field identifies the label for which you are specifying symbols. If you select this field, you will get a pop-up that lists all the labels turned on for that analyzer.

Each label has a separate symbol table so you can give the same name to symbols defined under different labels. In the Label pop-up select the label for which you wish to specify symbols.

Base The Base field tells you the numeric base in which the pattern will be specified.

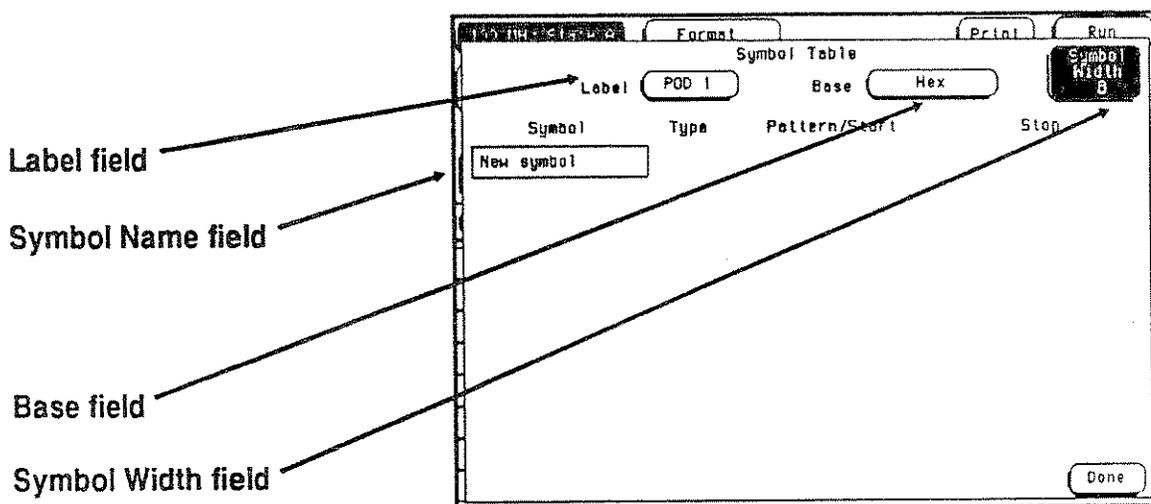


Figure 5-19. Default Symbol Table Menu

If more than 20 channels are assigned to a label, the Binary option is not offered in the pop-up. As a result, when a symbol is specified as a range, there is only enough room for 20 bits to be displayed on the screen. Decide which base you want to work in and choose that option from the numeric Base pop-up menu.

If you choose the ASCII option, you can see what ASCII characters the patterns and ranges defined by your symbols represent. ASCII characters represented by the decimal numbers 0 to 127 (hex 00 to 7F) are offered on your logic analyzer. Specifying patterns and ranges for symbols is discussed in the next section.

Note 

You cannot specify a pattern or range when the base is ASCII. First define the pattern or range in one of the other bases, then switch to ASCII to see the ASCII characters.

Symbol Width The **Symbol Width** field lets you specify how many characters of the symbol name will be displayed when the symbol is referenced in the Trace and Listing menus. When the Symbol Width field is selected, the following pop-up keypad appears. Use this pop-up keypad to set the number of characters in the symbol.

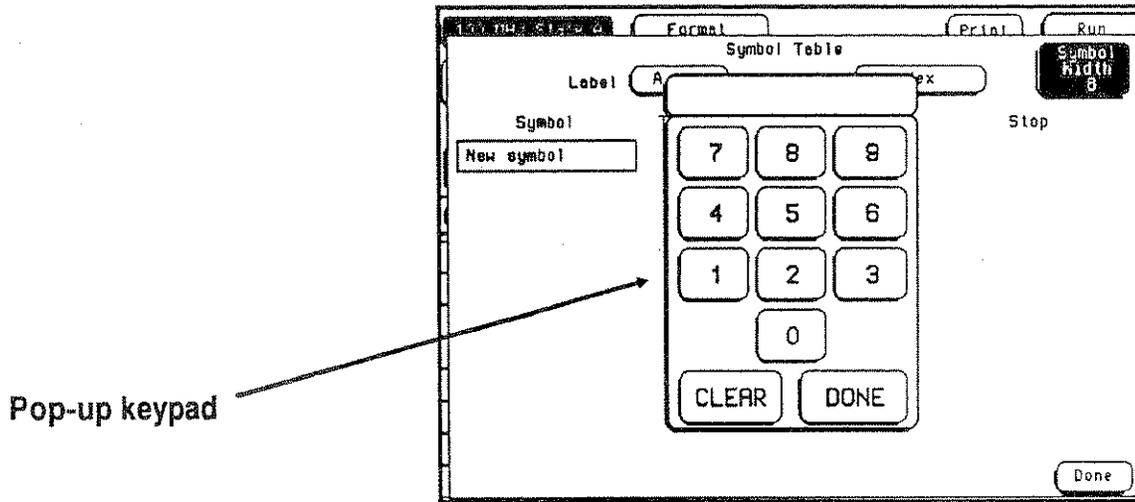


Figure 5-20. Symbol Width Pop-Up Menu

You can have the logic analyzer display from 1 to 16 of the characters in the symbol name. For more information see chapter 6, "State Trace Menu," and chapter 7, "State Listing Menu".

Symbol Name When you first access the Symbol Table, there are no symbols specified. The symbol name field reads "New Symbol." If you touch this field, a pop-up keypad appears. Use this pop-up keypad to enter the name of your symbol. A maximum of 16 characters can be used in a symbol name.

When you touch the Done field in the pop-up keypad, the name that appears in the Symbol name field is assigned, and two more fields appear in the display.

The first of these fields defines the symbol type as either a pattern or a range. If you touch this field, it will toggle between Pattern and Range.

When the symbol is defined as a pattern, one field appears to the right of the Type field as shown below. Use this field to specify what the pattern is. Selecting this Pattern/Start field makes a pop-up keypad appear. Use the keypad to enter the desired pattern. Be sure to enter the pattern in the numeric base that you specified in the Base field.

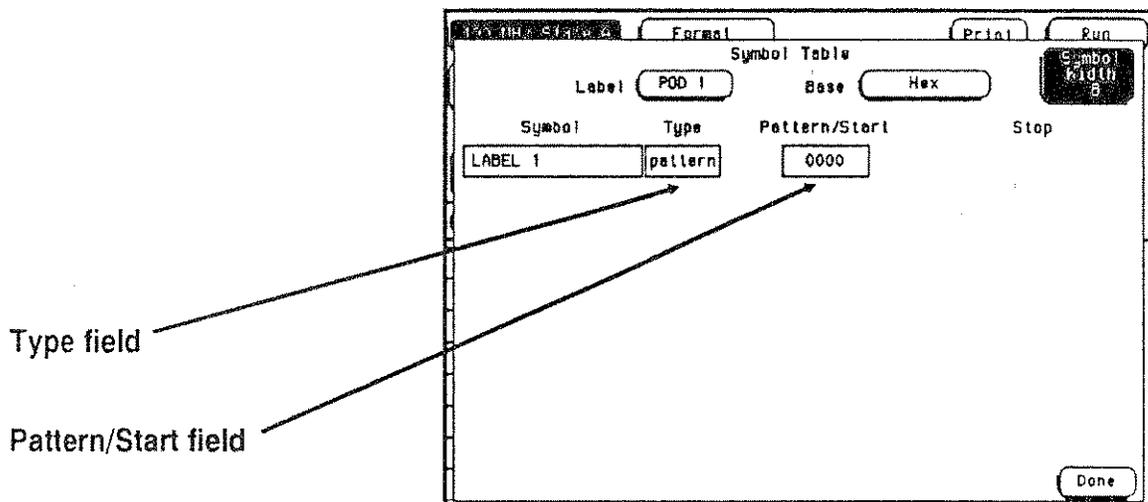


Figure 5-21. Symbol Defined as a Pattern

If the symbol is defined as a range, two fields appear as shown below. Use these fields to specify the upper and lower boundaries of the range.

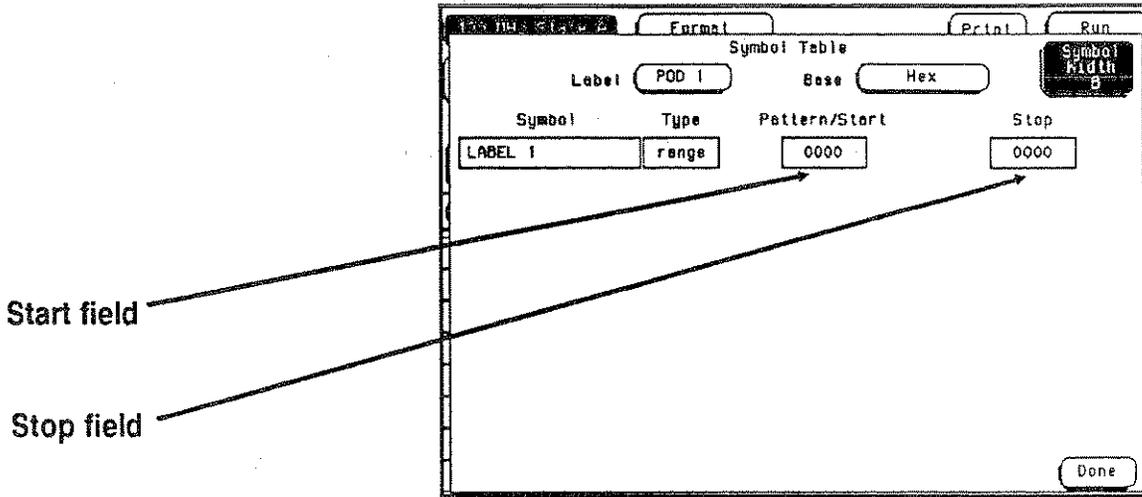


Figure 5-22. Symbols Defined as a Range

Selecting either of these fields gives you a pop-up keypad with which you can specify the boundary of the range. You can also specify ranges that overlap or are nested within each other.

To add more symbols to your symbol table, select the last symbol defined. A pop-up menu appears as shown below.

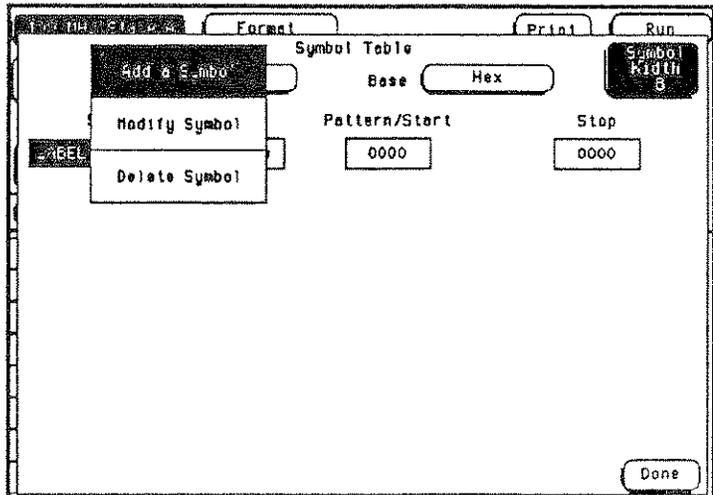


Figure 5-23. Add/Modify/Delete Symbols Pop-up

The first option in the pop-up is **Add a Symbol**. It allows you to specify another symbol. When you select this field, a pop-up keypad appears. Use the keypad to enter the name of your new symbol. When you select **Done**, your new symbol will appear in the Symbol Table.

The second option in the pop-up is **Modify Symbol**. If you select this option, you will see a pop-up keypad with which you can change the name of the symbol.

The third option in the pop-up is **Delete Symbol**. If you select this option, the highlighted symbol will be deleted from the Symbol Table.

When you have specified all your symbols, you can leave the Symbol Table menu by simply touching the **Done** field.

State Trace Menu

Introduction

This chapter describes the Trace menu and the pop-up menus that you use while in the Trace menu. The Trace menu is used to specify what the analyzer triggers on and when it triggers.

Depending on the analyzer Type: selection (State or Timing) in the Configuration menu, some fields in the Trace menu will change. The following menu descriptions document the analyzer using an external clock (State). Menu field descriptions that change when the analyzer is configured using an internal clock (Timing) are located at the end of this chapter.

With the analyzer configured to use an external clock (State), the default Trace menu will look like the figure below.

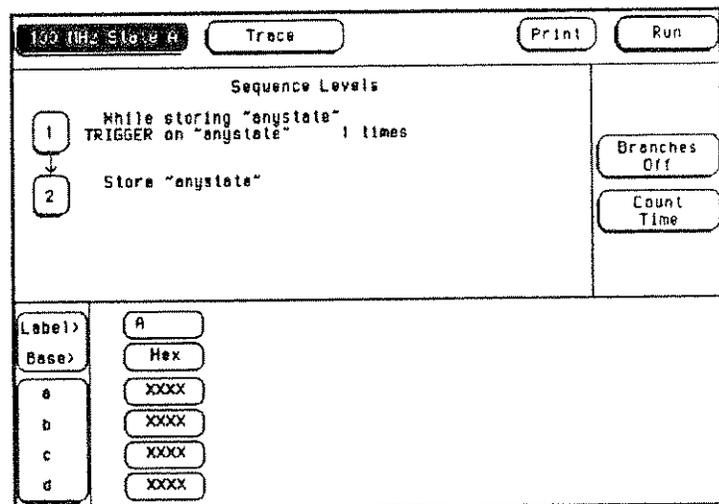


Figure 6-1. Default Trace Menu with External Clock

The Trace menu is divided into three sections. One section is the Sequence Levels, located in the large light blue center box. The second section is the acquisition fields, which are to the right of the Sequence Levels box, and the third section is the qualifier and pattern fields, which are located at the bottom of the menu.

Accessing the Trace Menu

The Trace menu is accessed through the menu selection pop-up shown below. The menu selection pop-up appears when the main menu name field, in any menu, is touched. The menu name field is always the second field from the left in the top row of fields. See the figure below.

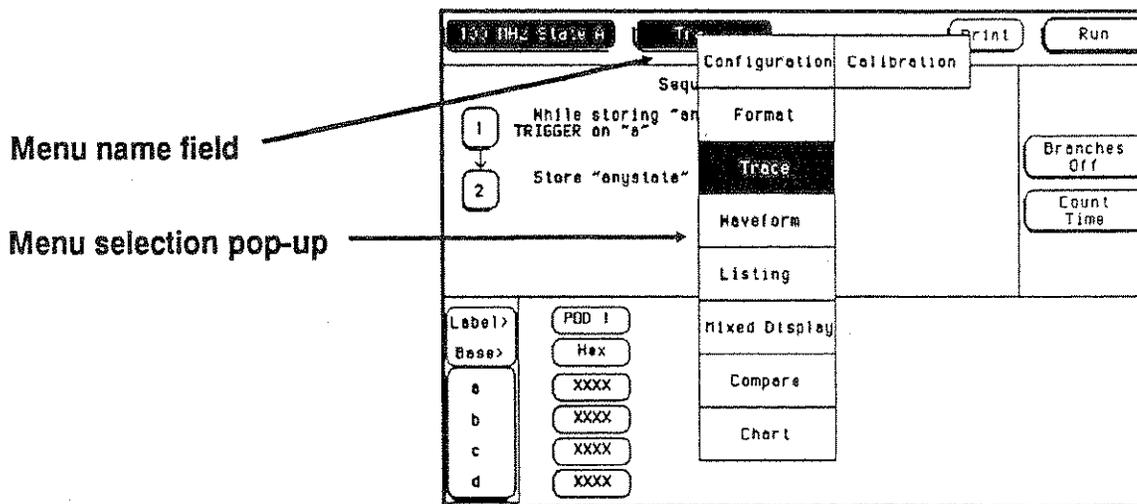


Figure 6-2. Menu Selection Pop-up

Trace Menu Fields

Before describing the fields in the Trace menu, we need to define a few terms. The following terms will be used in the discussions of the fields, so understanding their meanings is essential.

Pattern Recognizer: recognizes a pattern of bits (0, 1, or X) in each label. There are four recognizers available. The pattern recognizers are given the names a through d.

Range Recognizer: recognizes data which is numerically between or on two specified patterns. One range term is available and can be assigned to 32 channels on pods 2 and 3 of any HP 16541A expander.

Qualifier: user-specified term that can be anystate, no state, a single pattern recognizer, a range recognizer, or a logical combination of pattern and range recognizers.

To specify a qualifier for counting States, use the pop-up shown below. This same pop-up will appear whenever qualifier selections are required.

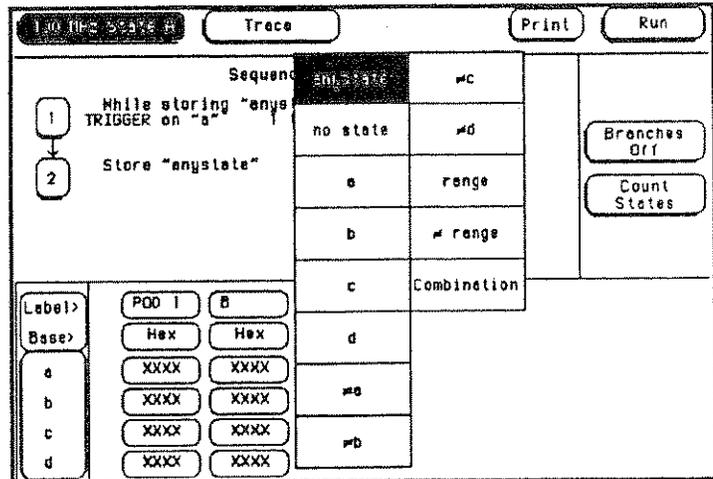


Figure 6-3. Qualifier Pop-up Menu

If the **Combination** option is selected from the pop-up in figure 6-3, another pop-up appears as shown in the figure below.

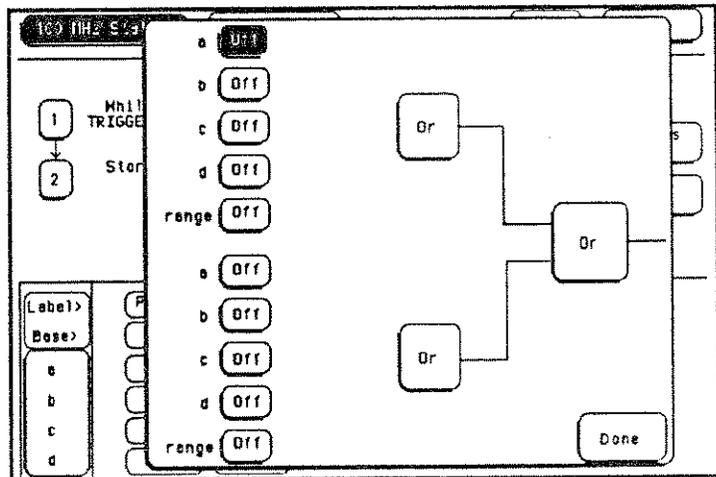


Figure 6-4. Qualifier Specification Pop-up

With the Qualifier Specification pop-up shown in figure 6-4, you specify combinations of patterns or ranges as the qualifier. Only one operator is allowed between the patterns in each group (a - d).

To specify a pattern, touch the Pattern Recognizer field. The field toggles from Off to On and a connection is drawn from the Pattern Recognizer field to the gate. In the figure below, patterns b, c, and range are ORed together.

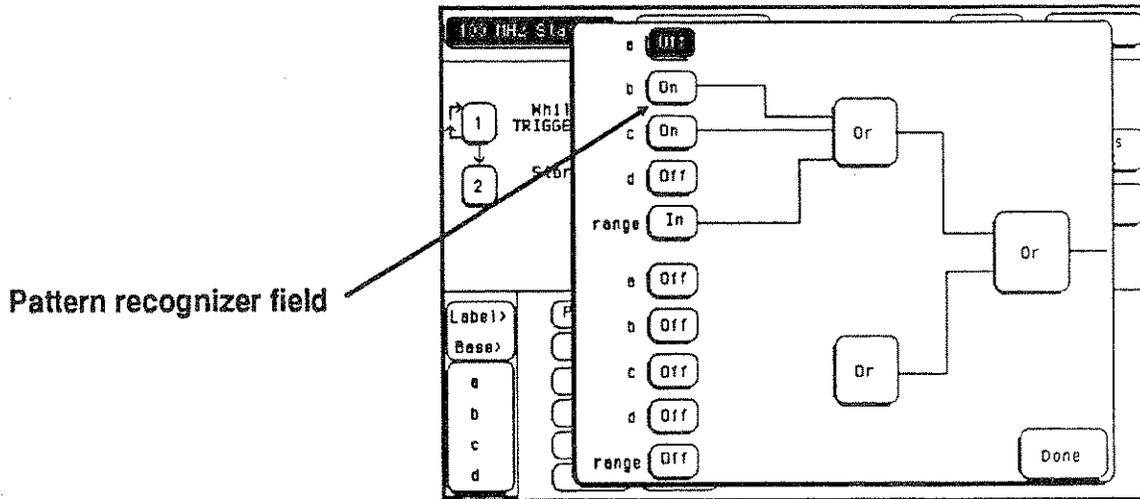


Figure 6-5. Assigned Pattern

If you select the Range field, you will see the following pop-up menu.

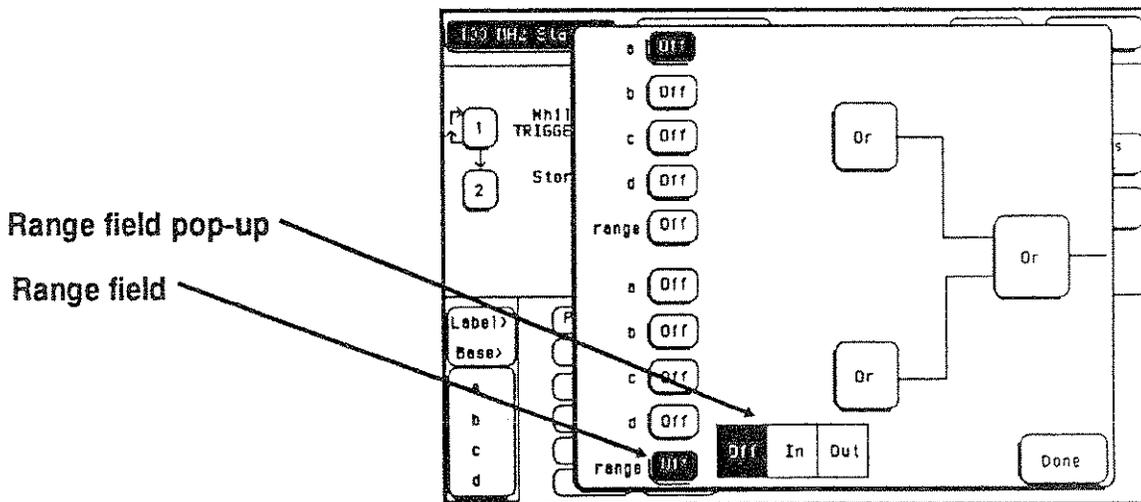


Figure 6-6. Range Specification Pop-Up Menu

Off disconnects the range from the Qualifier Specification. In indicates that the contents of the range are to be in the qualifier specification, and Out indicates that the complement of the range is to be in the qualifier specification.

When you have specified your combination qualifier, select Done. The Qualifier Specification pop-up closes and the Boolean expression for your qualifier appears in the Sequence Level for which you specified it. Figure 6-7 illustrates a typical Boolean expression.

While storing c + d + range

Figure 6-7. Boolean Expression for Qualifier

Sequence Levels

There are five sequence levels available. You can add and delete levels so that you can have from two to five levels at a time. Only three levels appear in the Sequence Levels display at one time. To display other levels so that they can be accessed, touch the Sequence Levels field, to ensure it is light blue, and rotate the KNOB.

If you select the level 1 field, the pop-up menu for sequence level 1 will appear as shown below.

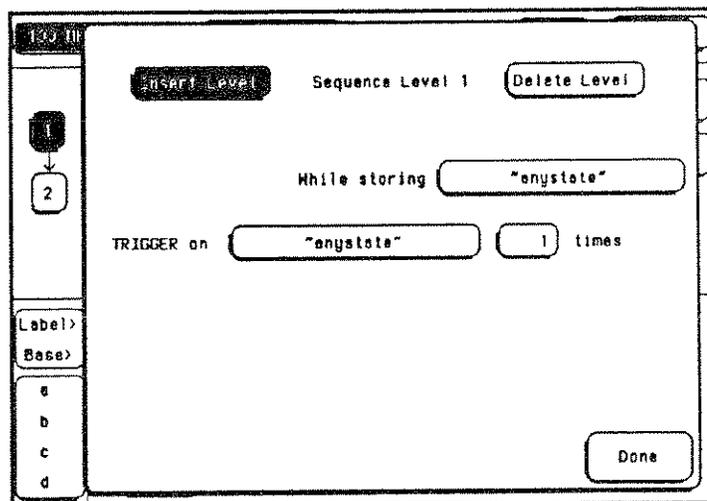


Figure 6-8. Sequence Level Pop-Up Menu

Not all sequence level pop-up menus will look like figure 6-8. This happens to be the trigger sequence level in which you specify the state on which the analyzer is to trigger. The "TRIGGER on" term will only occur in the second to the last level. The fields in the menu of figure 6-8 are described on the following pages.

Insert Level To insert a level, touch the field labeled **Insert Level**. The following pop-up menu will appear.

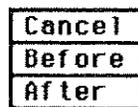


Figure 6-9. Insert Level Pop-Up Menu

Cancel returns you to the sequence level pop-up without inserting a level. **Before** inserts a level before the present level. **After** inserts a level after the present level. If there are five levels assigned, the **Insert Level** field will not appear in the sequence level pop-ups.

Delete Level If you want to delete the present level, select the field labeled **Delete Level**. You will see a pop-up menu with the choices **Cancel** and **Execute**. **Cancel** returns you to the sequence level pop-up without deleting the level. **Execute** deletes the present level and returns you to the State Trace menu.

Note 

If there are only two levels, neither field can be deleted even though the **Delete Level** field still appears in the menu. There will always be a trigger term level and a store term level in **Sequence Levels**. Therefore, if you try to delete either of these, all terms you have specified in these levels will be set to default terms, and, the trigger and store term levels will remain.

Storage Qualifier

Each sequence level has a storage qualifier. The Storage Qualifier field, as shown below, specifies the states that are to be stored and displayed in the Listing display. Selecting this field gives you the qualifier pop-up menu shown back in figure 6-3. Remember, it is in the pop-up in figure 6-3 with which you specify the qualifier.

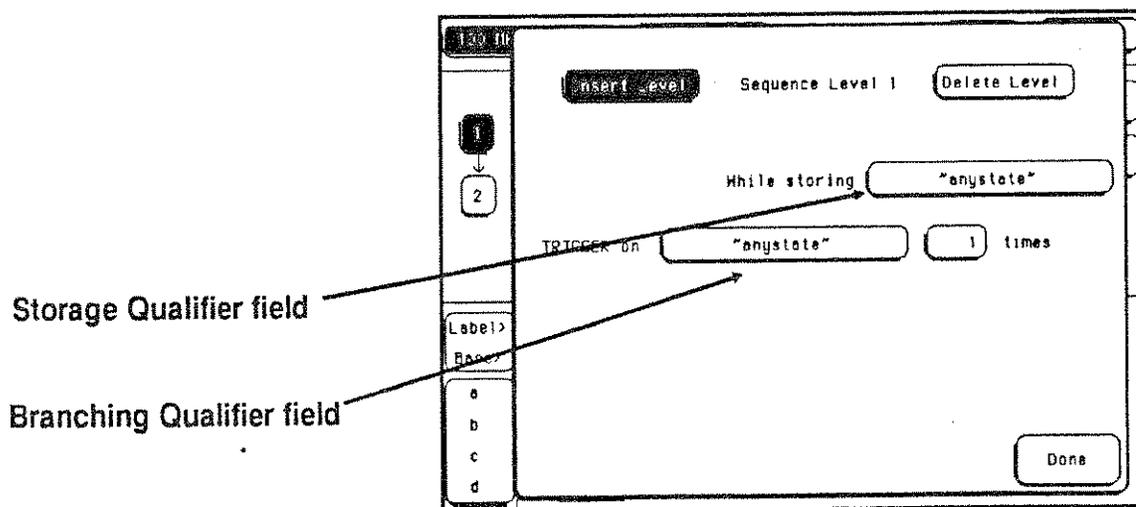


Figure 6-10. Storage and Range Qualifier Fields

Branching Qualifier

Every sequence level except the last has a primary Branching Qualifier field as shown in figure 6-10. With the branching qualifier, you tell the analyzer when to trigger. In other sequence levels, the qualifier may specify a state that the analyzer is to look for before continuing to the next level.

In the example in figure 6-10, the branching qualifier tells the analyzer when to trigger. In other sequence levels, the qualifier may specify a state that the analyzer is to look for before continuing to the next level.

Some sequence levels also have a secondary branching qualifier. The secondary branch will, if satisfied, route the sequencer to a level that you define. This is covered in more detail in "Branches" later in this chapter.

Occurrence Counter

The primary branching qualifier has an occurrence counter. With the occurrence counter field shown below, you specify the number of times the branching qualifier is to occur before moving to the next level.

To change the value of the occurrence counter, touch the occurrence counter field and enter the appropriate number in the pop-up that appears. See the figure below.

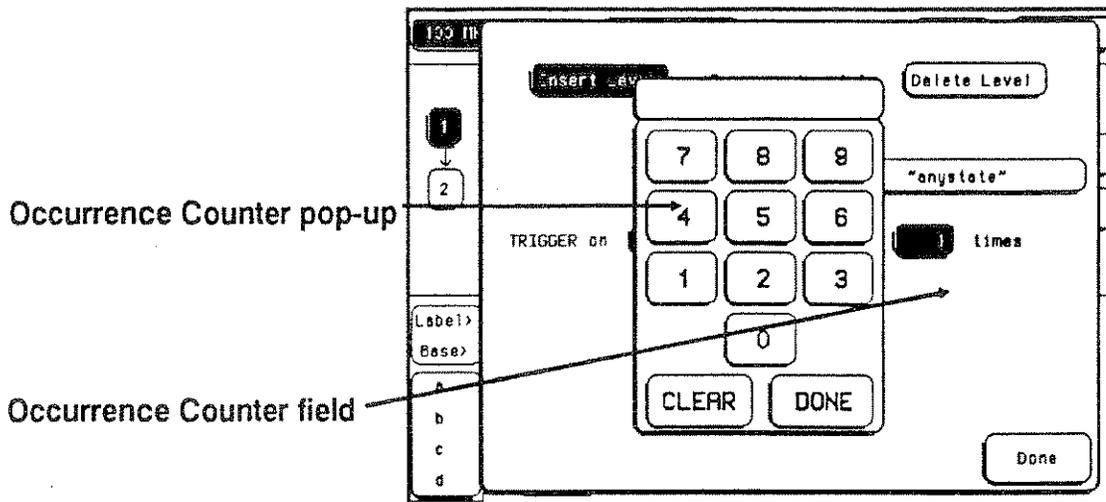


Figure 6-11. Occurrence Counter Pop-Up

You can change the value by touching the appropriate numeric keys, then touching the DONE field. The qualifier can be specified to occur from one to 65,535 times.

Reading the Sequence Level Display

Reading the Sequence Levels display is fairly straightforward. For example, suppose your display looks like that shown below.

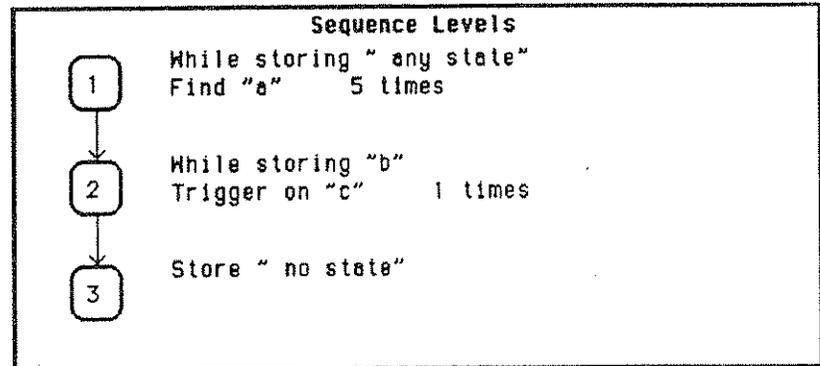


Figure 6-12. Sequence Level Display Example

In level 1, anystate is stored while the logic analyzer searches for five occurrences of the pattern given by pattern recognizer *a*. When the five occurrences are found, the sequencer moves on to level 2. In level 2, the state given by pattern recognizer *b* is stored until one occurrence of the pattern given by pattern recognizer *c* is found and the logic analyzer triggers. In level 3, no state is stored; so, the last state stored is the trigger state.

An example of a listing for the previous Trace configuration is shown below. The state patterns specified are as follows:

a = B03C
b = 0000
c = 8930

```
MACHINE 2 - STATE LISTING
Label > A
Base > Hex
-0028 4E75
-0027 61E6
-0026 0000
-0025 88C8
-0024 B03C
-0023 00FF
-0022 6730
-0021 48E7
-0020 4E75
-0019 3000
-0018 0000
-0017 8930
-0016 B03C
-0015 00FF
-0014 67FB
-0013 B03C
-0012 61FA
-0011 B03C
-0010 0000
-0009 8930
-0008 4EFA
-0007 FF9A
-0006 61E6
-0005 B03C
-0004 0000
-0003 0000
-0002 0000
-0001 0000
+0000 8930
```

Figure 6-13. State Listing Example

Notice that Anystate was stored while the analyzer looked for five occurrences of the state B03C. After the fifth occurrence was found, only state 0000 was stored until state 8930 was found, and the analyzer triggered. After the trigger, no states were stored.

Acquisition Fields

The acquisition fields are comprised of the Branches and Count fields as shown below.

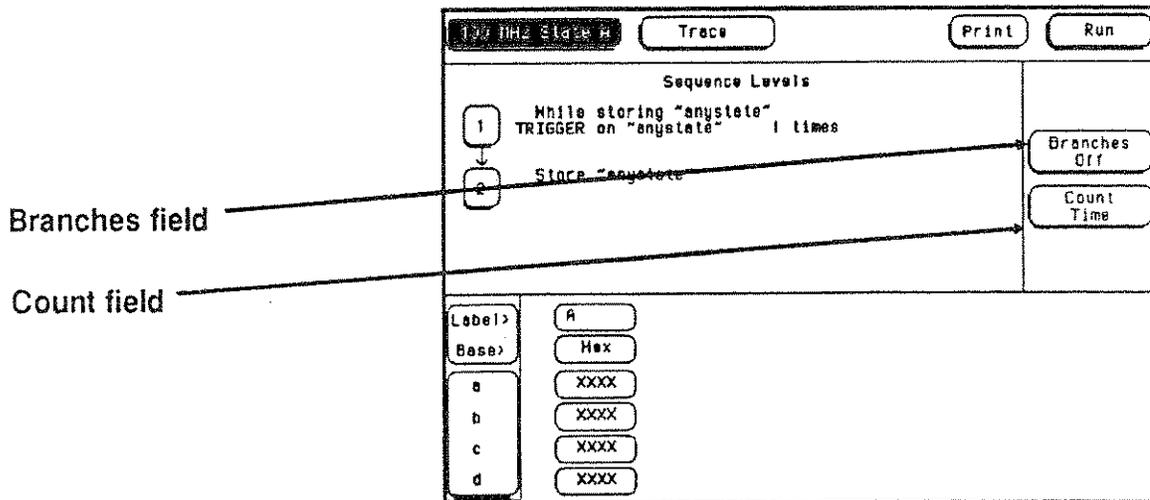


Figure 6-14. Trace Acquisition Fields

Branches The Branches field allows you to configure the sequencer of the state analyzer to branch from one sequence level to another with secondary branching qualifiers, or to restart when a certain condition is met. Selecting this field gives you the following pop-up menu.

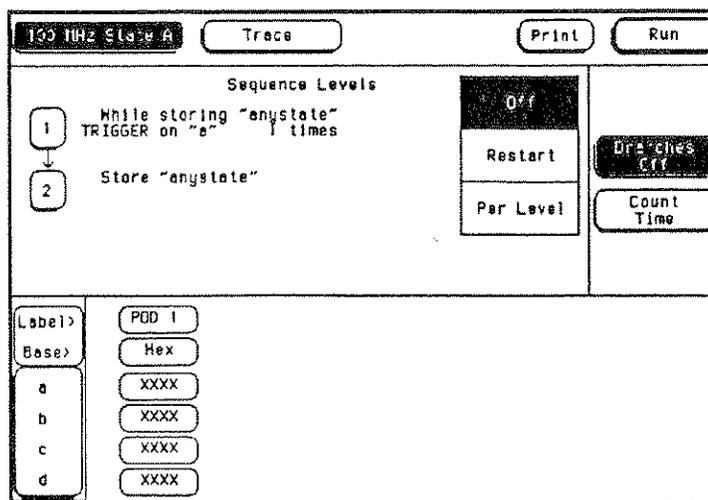


Figure 6-15. Branches Pop-Up Menu

Off

If you select Off, all secondary branching qualifiers are deleted from the sequence levels. Only the primary branches remain.

Restart

The Restart option allows you to start over from sequence level 1 when a specified condition is met. This can be handy if you have code that branches off in several paths and you want the analyzer to follow one certain path. If the analyzer goes off on an undesired path, you would want the analyzer to stop and go back to the beginning and take the correct path.

If you select the Restart option, you will see the Qualifier pop-up menu like that shown back in figure 6-3. With the Qualifier pop-up you select the qualifier for the pattern on which you want your analyzer to start over.

When the state analyzer is reading data, it proceeds through the sequence. If a term doesn't match the branching qualifier, it is then checked against Restart. If the term matches, the state analyzer moves back to sequence level 1.

Per Level

Selecting the Per level option allows you to define a secondary branching qualifier for each sequence level. A statement is added in each level so that you can configure the analyzer to move to a different level when a specified condition is met. An example of a sequence level with a secondary branching qualifier is shown in the figure below.

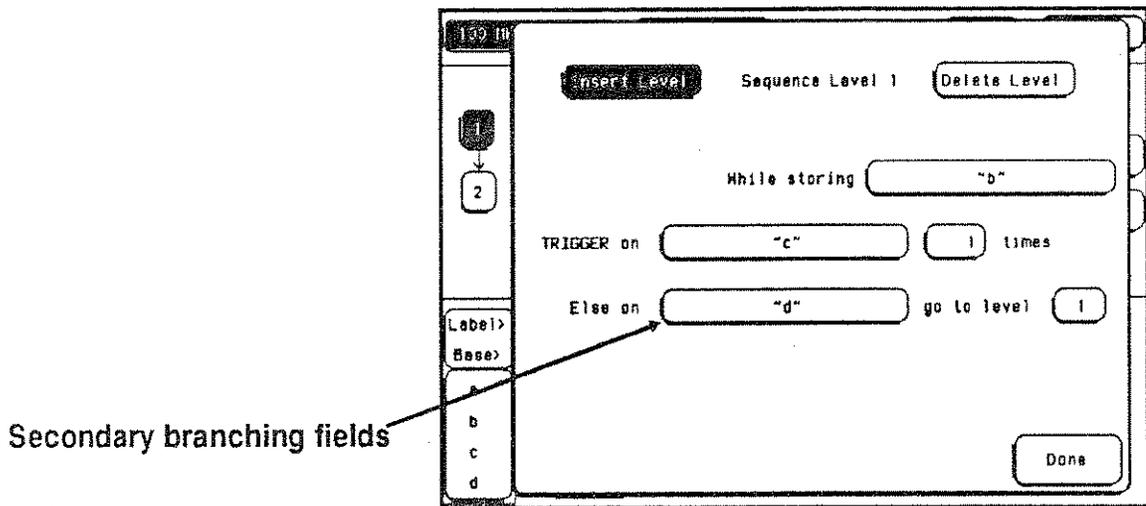


Figure 6-16. Secondary Branching Qualifier

With this configuration, the state analyzer will store b until it finds c. If it finds d before it finds c, it will branch to sequence level 1.

The trigger sequence level is used as a boundary for secondary branch qualifiers between sequence levels. The trigger sequence level is always the second to the last sequence level. That is, if you assign all five sequence levels, the trigger sequence level will be level 4. If you assign three sequence levels, the trigger sequence level will be level two.

The trigger sequence level and the sequence levels that occur before it cannot branch to levels that occur after the trigger sequence level. Therefore, if there are five sequence levels with level four being the trigger sequence level, then levels 1 through 3 can branch to levels 1 through 3 only.

You can tell if secondary branch qualifiers have been specified by looking at the Sequence Levels display. Figure 6-17 shows how the display looks with the configuration that was given in figure 6-16. An arrow is drawn out of level 1, indicating that branching originates from that level, and an arrow is drawn back to level 1 to indicate that a branch is going to that level.

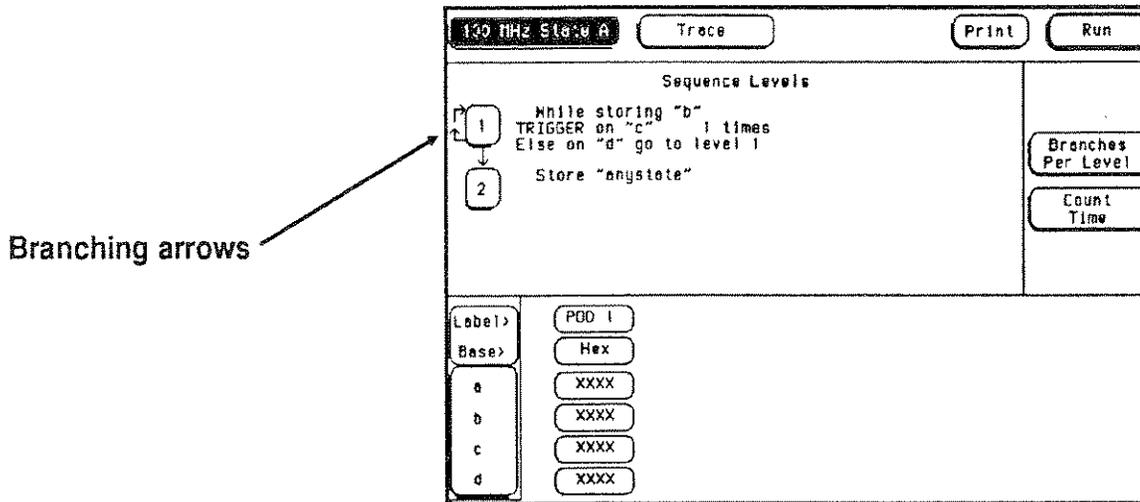


Figure 6-17. Branching

Each sequence level can branch to only one level through a secondary branching qualifier. However, the number of times to which a level can be branched is limited only by the number of levels present. A level can have two arrows pointing away from it, and two arrows pointing to it if more than one other level is branching to it. An example of this is shown in the figure below. The arrow with two tails indicates that a level above and a level below branch to this level.

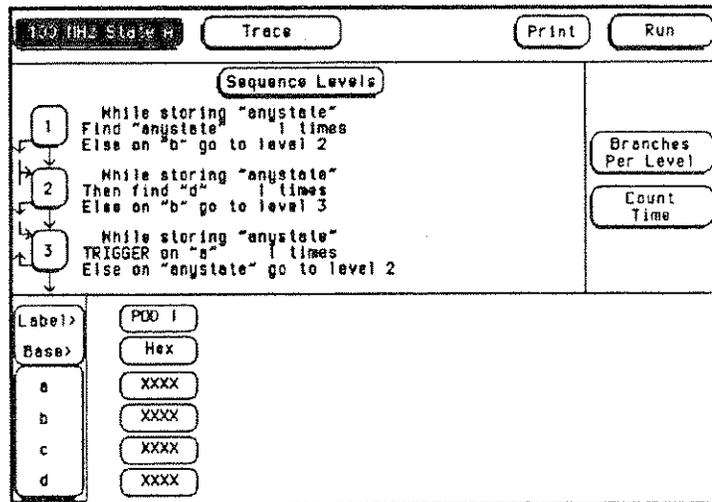


Figure 6-18. Branching Between Sequence Levels

Count The Count field allows you to place tags on states so you can count them. This feature is only available in the State mode.

Selecting the Count field gives you the following pop-up menu.

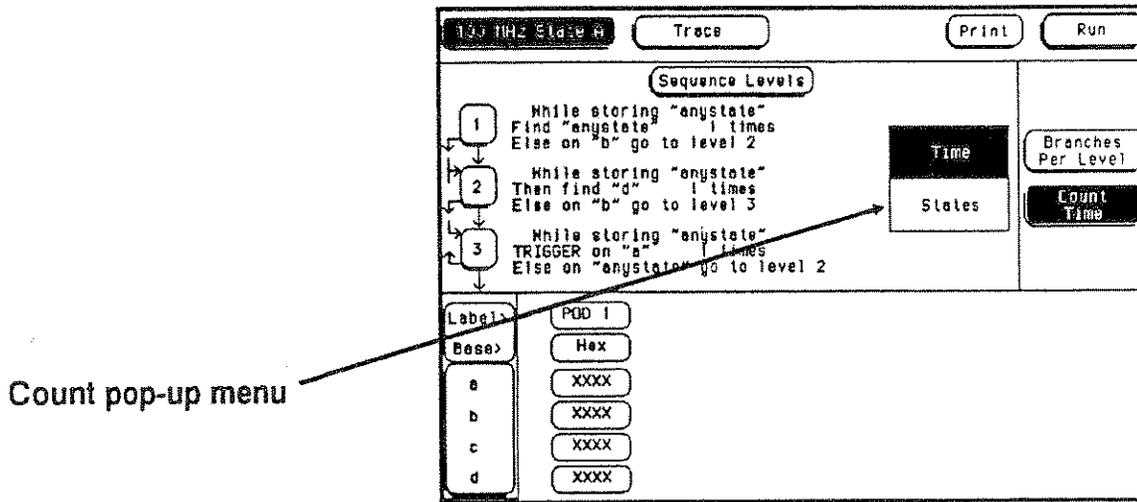


Figure 6-19. Count Pop-up Menu

Time

If you select Time counting, the time between stored states is measured and displayed (after the next run) in the Listing menu under the label Time. The time displayed can be either relative to the previous state or relative to the trigger.

An example of a listing with time tagging relative to the previous state is shown in figure 6-20.

Label>	PDD I	Time
Base>	Hex	Relative
-7	0814	30 ns
-6	0815	30 ns
-5	0816	30 ns
-4	0817	30 ns
-3	0818	30 ns
-2	0819	30 ns
-1	081A	30 ns
0	081B	30 ns
1	081C	30 ns
2	081D	30 ns
3	081E	30 ns
4	081F	30 ns
5	0820	30 ns
6	0821	30 ns
7	0822	30 ns
8	0823	30 ns

Figure 6-20. Relative Time Tagging

An example of a listing with time tagging relative to the trigger is shown below.

Label>	PDD I	Time
Base>	Hex	Absolute
-7	0814	-210 ns
-6	0815	-180 ns
-5	0816	-150 ns
-4	0817	-120 ns
-3	0818	-90 ns
-2	0819	-60 ns
-1	081A	-30 ns
0	081B	0 ns
1	081C	30 ns
2	081D	60 ns
3	081E	90 ns
4	081F	120 ns
5	0820	150 ns
6	0821	180 ns
7	0822	210 ns
8	0823	240 ns

Figure 6-21. Absolute Time Tagging

States

State tagging counts the number of qualified states between each stored state. If you select this option, you will see a qualifier pop-up menu like that shown in figure 6-3. You select the qualifier for the state that you want to count.

In the Listing menu, the state count is displayed (after the next run) under the label States. The count can be relative to the previous stored state or to the trigger. The maximum count is 4.4×10^{12} .

An example of a listing with state tagging relative to the previous state is shown below.

The screenshot shows a menu interface for a 100 MHz State A. At the top, there are buttons for 'Listing', 'Print', and 'Run'. Below these, a 'Markers Off' button is visible. The main display area contains a table with three columns: 'Label', 'Hex', and 'States'. The 'Label' column ranges from -7 to 8. The 'Hex' column shows values from 07F9 to 0808. The 'States' column shows a count of 3 for each label. The 'States' column is highlighted, indicating it is the selected view.

Label	Hex	States
-7	07F9	3
-6	07FA	3
-5	07FB	3
-4	07FC	3
-3	07FD	3
-2	07FE	3
-1	07FF	3
0	0800	3
1	0801	3
2	0802	3
3	0803	3
4	0804	3
5	0805	3
6	0806	3
7	0807	3
8	0808	3

Figure 6-22. Relative State Tagging

An example of a listing with state tagging relative to the trigger is shown below.

Label	Hex	Absolute
-7	07F9	-21
-6	07FA	-18
-5	07FB	-15
-4	07FC	-12
-3	07FD	-9
-2	07FE	-6
-1	07FF	-3
0	0800	0
1	0801	3
2	0802	6
3	0803	9
4	0804	12
5	0805	15
6	0806	18
7	0807	21
8	0808	24

Figure 6-23. Absolute State Tagging

Qualifier and Pattern Fields

The qualifier and pattern fields appear at the bottom of the Trace menu. They allow you to specify patterns for the qualifiers that are used in the sequence levels.

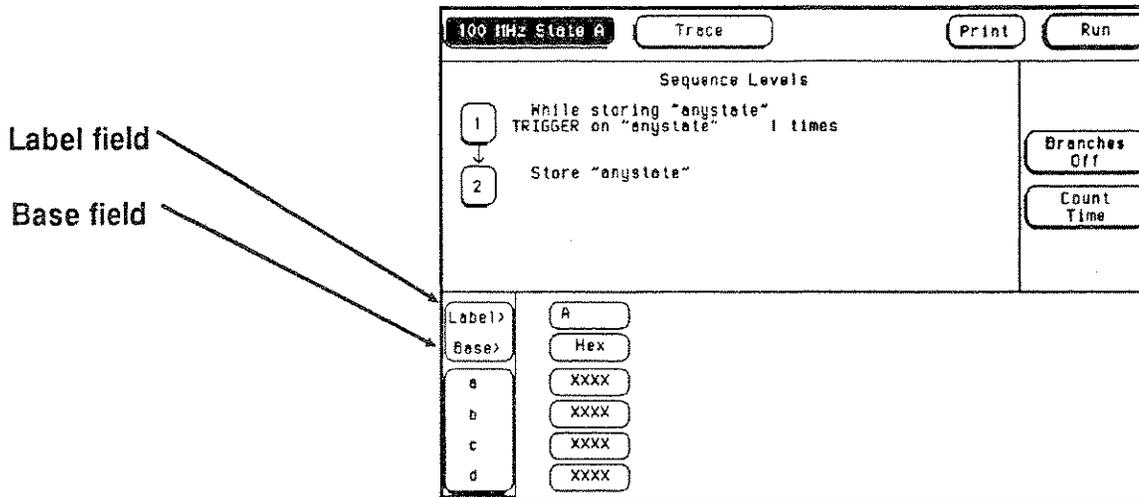


Figure 6-24. Label and Base Fields

Label The Label fields display the labels that you specified in the state Format menu. The labels appear in the order that you specified them; however, you can change the order. Select one of the label fields and you will see a pop-up menu with all the labels. Decide which label should appear in the label field, then select that label. The label that was there previously, switches positions with the label you selected from the pop-up.

Base The base fields allow you to specify the numeric base in which you want to define a pattern for a label. The base fields also let you use a symbol that was specified in the State Symbol Table in the Format menu, for the pattern. Each label has its own base defined separately from the other labels.

One of the options in the Base pop-up is ASCII. It allows you to see the ASCII characters that are represented by the pattern you specify in the pattern fields.

Note 

You cannot define ASCII characters directly. You must first define the pattern in one of the other numeric bases; then, you can switch the base to ASCII to see the ASCII characters.

The Symbol option in the Base pop-up allows you to use a symbol that has been specified in the Symbol Tables as a pattern. In the pattern fields you specify the symbols you want to use.

Qualifier Field If you select the qualifier field, you will see the following pop-up menu.

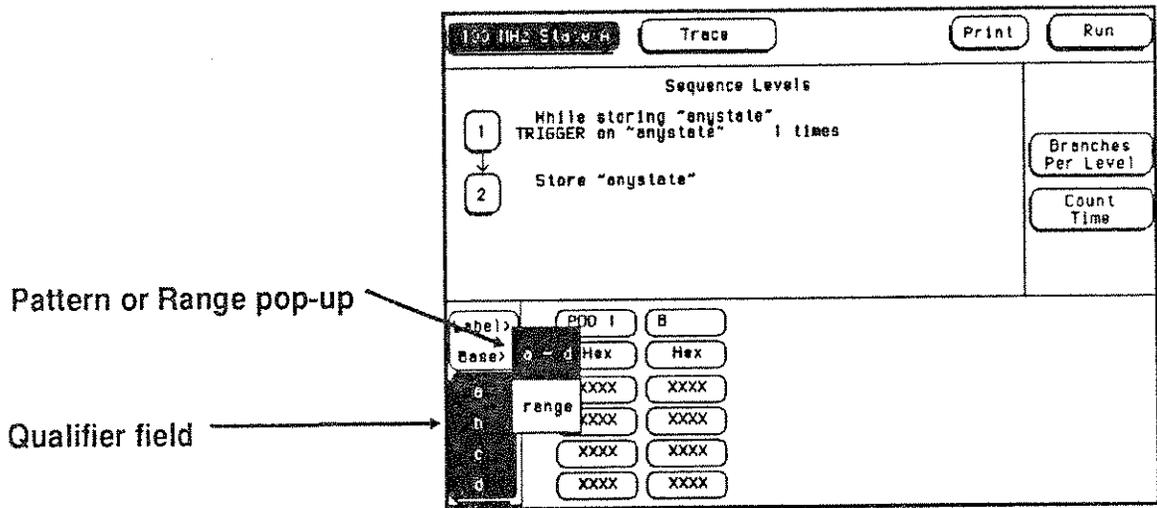


Figure 6-25. Qualifier Field Pop-Up Menu

Patterns

Four pattern recognizers are available. They are labeled a through d. You can also select the **Range** field which is assigned to the lowest 32 bits (channels) of one of the expander boards.

Ranges

If you select the range option, the qualifier and pattern fields look similar to that shown below.

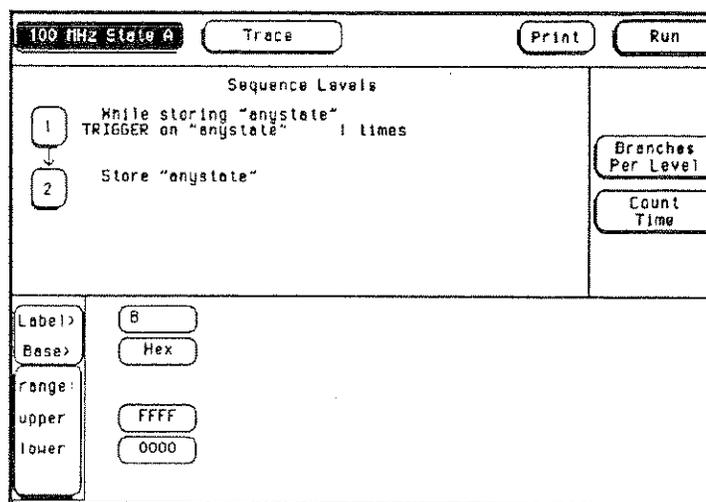


Figure 6-26. Range Qualifier and Pattern Fields

One range can be defined, and it can be defined over only one label, and over a maximum of 32 channels. The channels must be adjacent to each other, and must be in pods 1 and 2 of the expander board. The logic analyzer selects the label over which the range will be defined by looking at the labels in order, then choosing the first one that has channels assigned under only two pods.

You can switch to a different range label by touching the **Label >** field and selecting a different label.

Pattern Fields

The pattern fields allow you to specify the states that you want the state analyzer to search for and store. Each label has its own pattern field that you use to specify a pattern for that label (if you are defining a pattern for a pattern recognizer).

During a run, the state analyzer looks for a specified pattern in the data. When it finds the pattern, it either stores the states, or it triggers, depending on the step that the sequencer is on.

Using an Internal Clock

When you select Timing as the analyzer Type: in the Configuration menu, you are using the internal clock of the analyzer. This is similar to the operation of a timing analyzer. The changes to the Trace menu that occur when using the internal clock (Timing) are listed below:

- A new clock period field appears with a selectable range of 10 ns to 4 s.
- The option of storing data is only available in the first and last sequence levels, and only "anystate" and "no state" is allowed.
- The Count field (tagging) is not available.

With the analyzer configured to use an internal clock (Timing), the default Trace menu will look like the figure below.

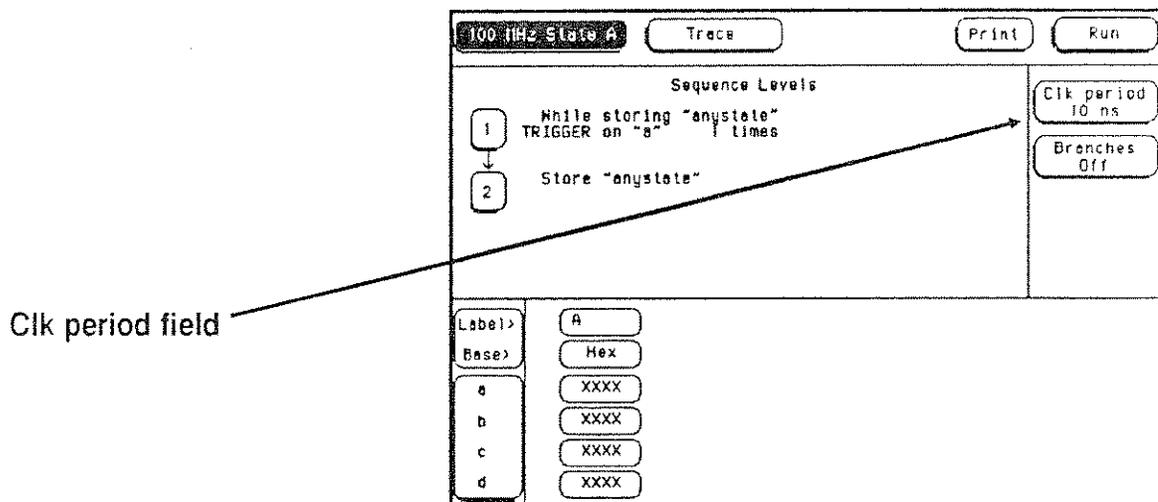


Figure 6-27. Trace Menu Using Internal Clock

Setting the Clock Period

The Clk period field is used to set the rate at which input data is clocked into analyzer memory.

When you select the Clk period field, the following pop-up appears.

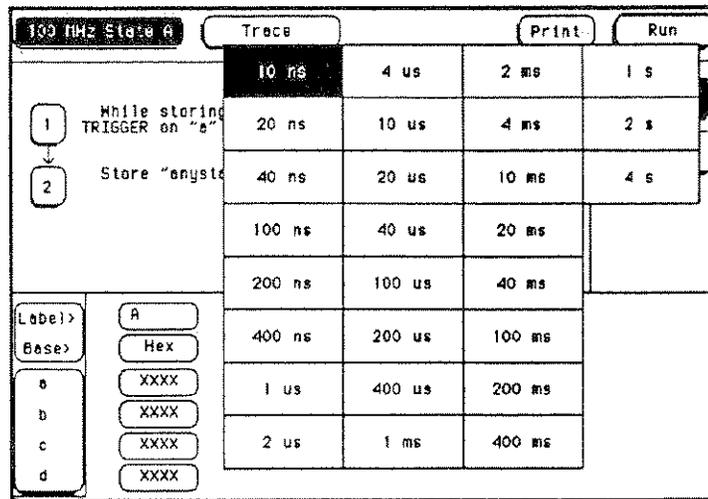


Figure 6-28. Clock Period Pop-up

Select the clock period you desire from the pop-up. When your selection is made, the pop-up closes and the selection is displayed inside the Clk period field.

Setting the Sequence Levels

When making timing measurements, the Sequence Levels operation is changed so the option to store is only available in the first and last sequence levels.

If you set multiple levels, you will be instructing the analyzer to find patterns or states a selected number of times in each sequence level. The last sequence level will instruct the analyzer to store input data.

When you touch the level indicator the following pop-up appears.

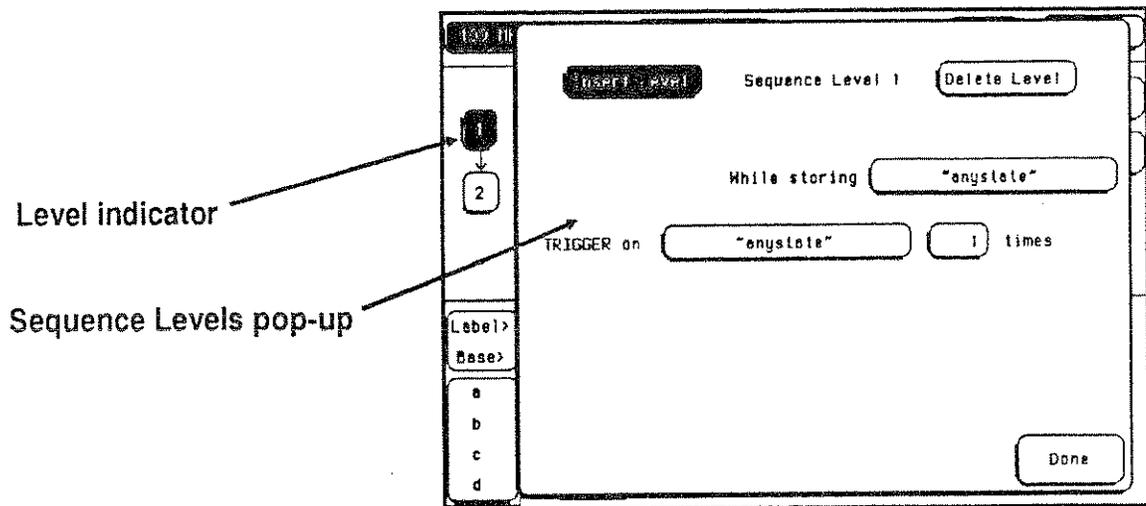


Figure 6-29. Sequence Level Pop-up

The procedure for setting up the Sequence Levels pop-up is the same as when using an external clock except the option to store is only available in the first and last levels. In addition, the only store choices available are "no state" and "anystate".

State Listing Menu

Introduction

This chapter describes the Listing menu and how to interpret it. It also tells you how to use the fields to manipulate the displayed data so you can find your measurement answers.

The Listing display is divided into two different areas. The menu area is located in the top one-fourth of the screen. The listing area is the bottom three-fourths of the screen.

The listing area displays the data that the state analyzer acquires. The data is displayed in a listing format as shown below.

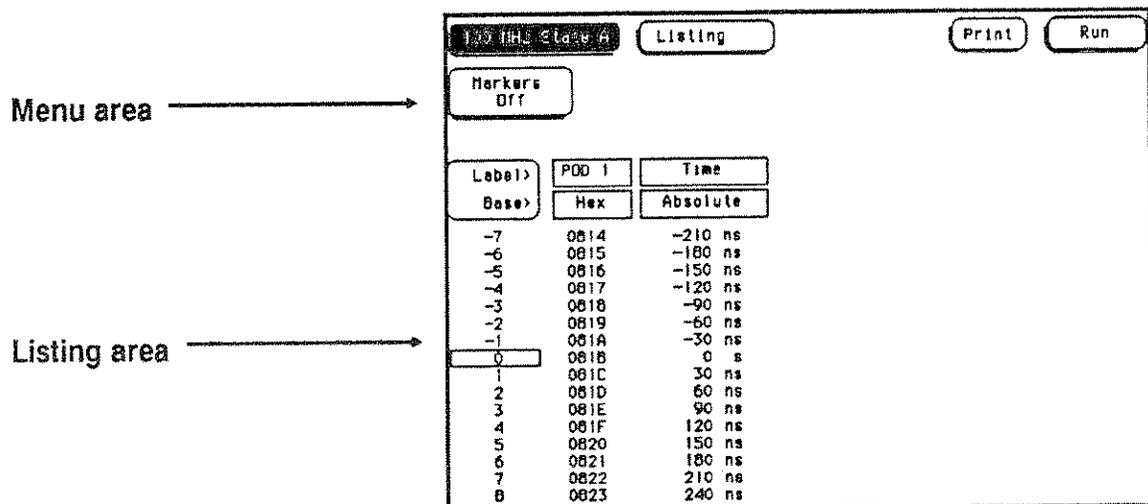


Figure 7-1. Listing Menu

This listing area shows you 16 of the possible 4096 lines of data at one time. You can roll the listing to display the lines of data or labels that are offscreen. See "How to Roll Data" in chapter 3.

Accessing the Listing Menu

The Listing menu is accessed by touching the Listing field in the menu Selection pop-up. This pop-up appears when the menu name field, in any menu, is touched.

Listing Menu Fields

The menu area of the Listing display contains fields that allow you to change the display parameters, place markers, and display listing measurement parameters.

As shown in the figure below, the column of numbers at the far left represents the location of the acquired data in the state analyzer's memory. The trigger state is always 0. At the vertical center of the memory location column, you will see a light blue box containing a number (default is 0). When this light blue box is selected, a pop-up keypad appears which can be used to quickly select another location in the listing.

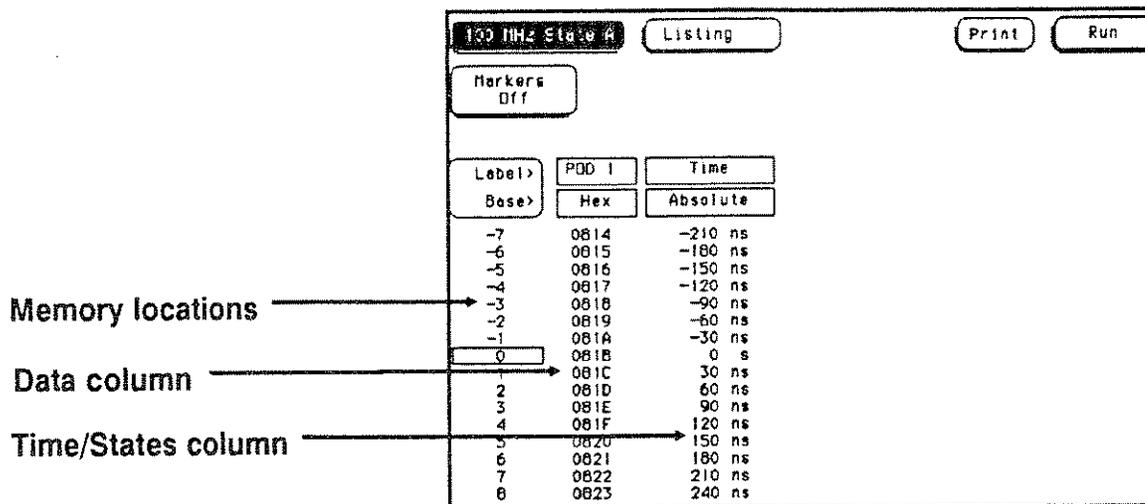


Figure 7-2. Menu Listing Area

The data columns are grouped by label and displayed in the number base you have selected (Pod 1 and Hex are default). Data will be displayed with either Time or States tags, depending on the option selected in the Count field of the Trace menu. See figure 7-2.

The Time/States column (Time and Absolute are default) displays either the Relative time or number of qualified states from one state to the next, or the Absolute time or number of qualified states of each state to the trigger. See figure 7-2.

X and O Markers

For the most part, the fields and functions of the X and O markers will be the same in both the State and Timing modes. When the Markers field is selected from the Listing menu, a pop-up menu appears that lists the marker options available.

If the Count field in the state Trace menu is set to Time, the marker options available are as follows:

- Off
- Pattern
- Time
- Statistics

If the Count field in the state Trace menu is set to States, the marker options available are as follows:

- Off
- Pattern
- States

When the Markers field is set to Off, markers are not displayed, but the analyzer still performs statistics using previously placed markers. In addition, if a Stop measurement is specified, and the Stop measurement criteria are met, the measurement will stop even though the markers are off. See "Specify Stop Measurement", found later in this chapter.

Markers Set to Patterns

When markers are set to **Pattern**, you can specify patterns on which the logic analyzer will place the X and O markers. You can also specify the number of occurrences of each marker pattern the logic analyzer looks for. This use of the markers allows you to find a specific pattern for each label in the acquired data.

Patterns for each marker can be specified for both markers in each label. The logic analyzer searches for the logical "and" of patterns in all labels.

To set a pattern for the current marker, select the pattern field and designate the desired pattern using the pop-up keypad. See the figure below.

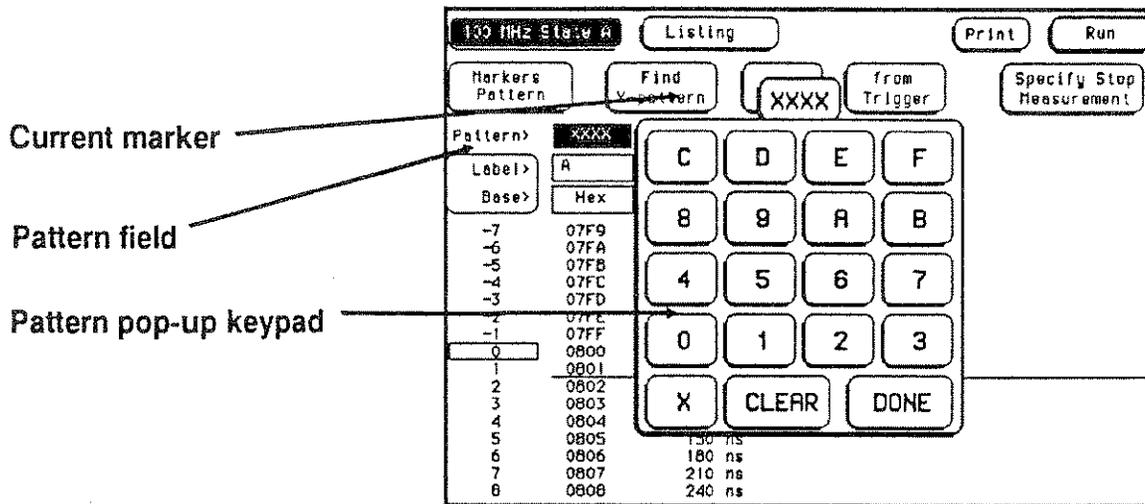


Figure 7-3. Markers Set to Patterns

Find X - O pattern

The Find X - O pattern field is used to perform two functions. The first is to select either the X or O marker prior to setting the marker criteria. The second function is to indicate which marker is displayed at center screen. When this field is selected, it toggles between Find X-pattern and Find O-pattern. The marker color will also change to aid in recognizing the current active marker.

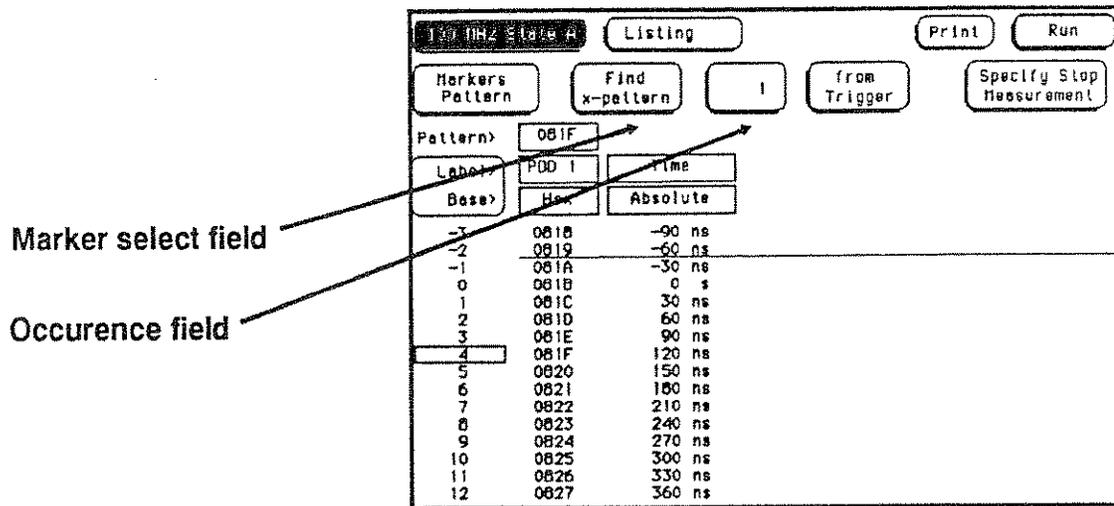


Figure 7-4. X and O Marker Select Field

The occurrence field, just to the right of the Find X-O pattern field, is used to set the number of pattern occurrences from the trigger, start, or X marker the analyzer looks for. See figure 7-6.

The from Trigger/from Start/from X marker field is used to set the reference point from which the occurrence number is set. The Trigger reference point is the point you have specified as the trigger, the Start is the beginning of the trace, and the X marker is the X marker. Default is from Trigger.

Specify Stop Measurement

Another feature of pattern markers is Specify Stop Measurement. Depending on the analyzer **Type**: selection in the Configuration menu, you can specify two ways to stop a measurement. The first way is using the time relationship of the X and O markers. The second way is to Compare the listing to the Compare image in the Compare menu.

When the **Specify Stop Measurement** field is selected, a pop-up appears, as shown below, that is used to set the Stop measurement criteria.

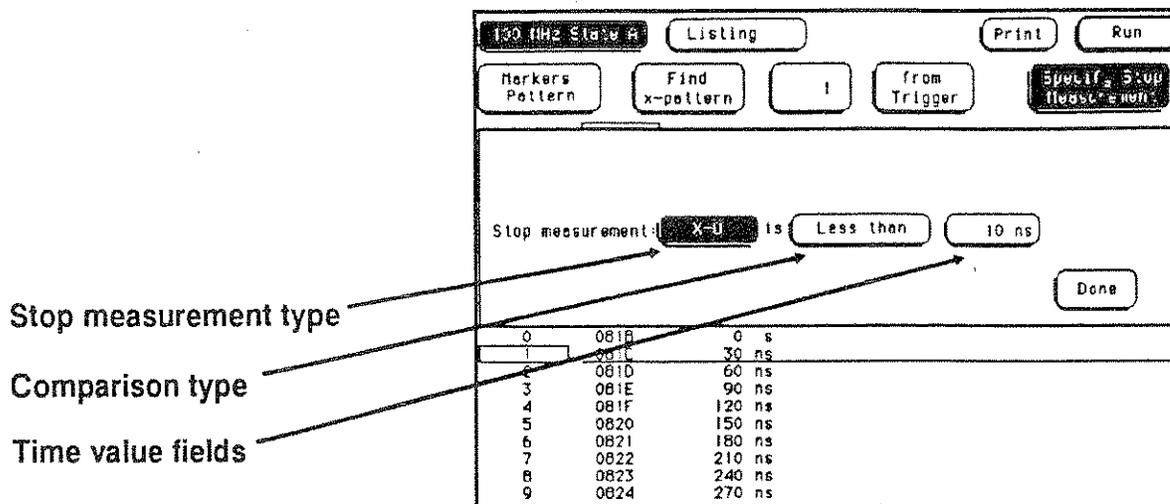


Figure 7-5. Stop Measurement Pop-Up Menu

Using X-O

You can stop a measurement when the time relationship of the X and O markers meet the following criterion:

- X-O is Less than a time value
- X-O is Greater than a time value
- X-O is In range between a time value to another time value
- X-O is Not in range between a time value to another time value

The appropriate pop-up menus appear when you select the comparison type field and the time value fields.

To get a positive time value, the relative time value of the X marker must be less than the value of the O marker; so, in that sense, the X marker must precede the O marker.

Note 

The upper and lower range boundaries must not be the same value. For example, if you want to stop a measurement when the X and O markers are in range of 200 ns, you should set the range values to 190 ns and 210 ns. This eliminates erroneous measurement termination.

Using Compare

You can stop a measurement using the same X-O method just described, or you can use an additional method of Comparing for equality to a Compare image in the Compare menu.

You can stop a measurement when data meets one of the following criterion:

- Compare is Equal to the Compare image.
- Compare is Not Equal to the Compare image.

The appropriate pop-up menus appear when you select the comparison type field and the equality field. See the figure below. For complete information on the Compare function, refer to chapter 9, "Compare Menu" later in this manual.

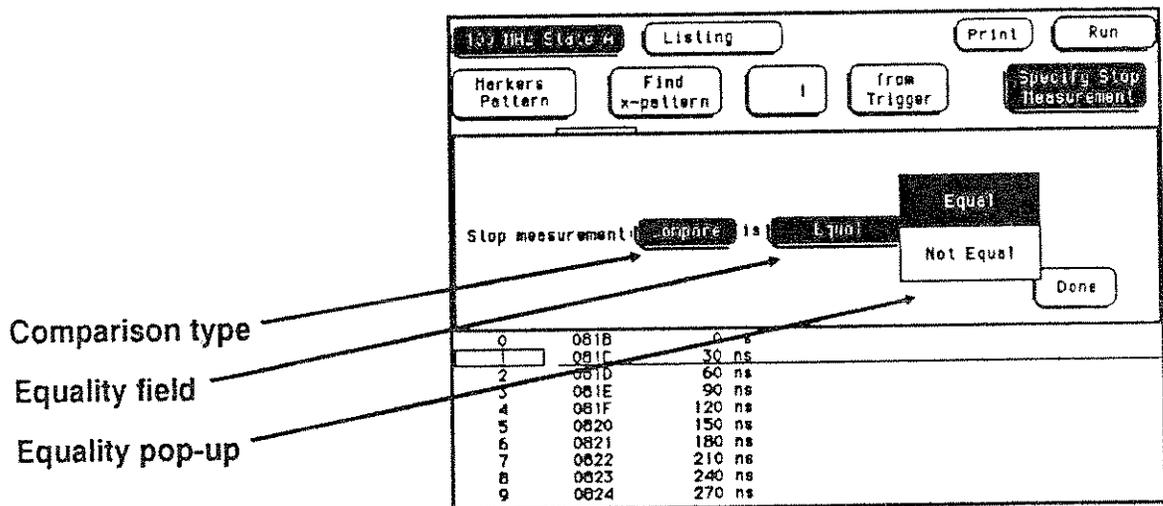


Figure 7-6. Compare Equality Fields

Markers Set to Statistics

After the X and O markers have been set using Pattern markers, statistical information can be displayed when markers are set to Statistics. The logic analyzer displays the following statistical information:

- Number of valid runs (runs where markers were able to be placed on specified patterns).
- Minimum time between the X and O markers.
- Maximum time between the X and O markers.
- Average time between the X and O markers.

Label>	PDD 1	Time
Base>	Hex	Absolute
-7	0814	-210 ns
-6	0815	-180 ns
-5	0816	-150 ns
-4	0817	-120 ns
-3	0818	-90 ns
-2	0819	-60 ns
-1	081A	-30 ns
0	081B	0 s
1	081C	30 ns
2	081D	60 ns
3	081E	90 ns
4	081F	120 ns
5	0820	150 ns
6	0821	180 ns
7	0822	210 ns
8	0823	240 ns

Figure 7-7. Markers Set to Statistics

How the statistics will be updated depends on the run mode (repetitive or single).

In repetitive mode, statistics will be updated each time a valid run occurs until you touch STOP. When you touch RUN after touching STOP, the previous statistics will be cleared and will restart from zero.

In single mode, each time you touch RUN an additional valid run will be added to the data and the statistics will be updated. This process will continue unless you change the placement of the X and O markers between runs.

Markers Set to Time

When markers are set to **Time**, you can place markers on states of interest within the listing. The logic analyzer will show the following information:

- Trig(ger) to X.
- Trig(ger) to O.
- X to O.

To position the markers, touch the **Trig to X** or **Trig to O** field shown below. Either rotate the KNOB or touch the same field again, then enter a numeric value from the pop-up keypad.

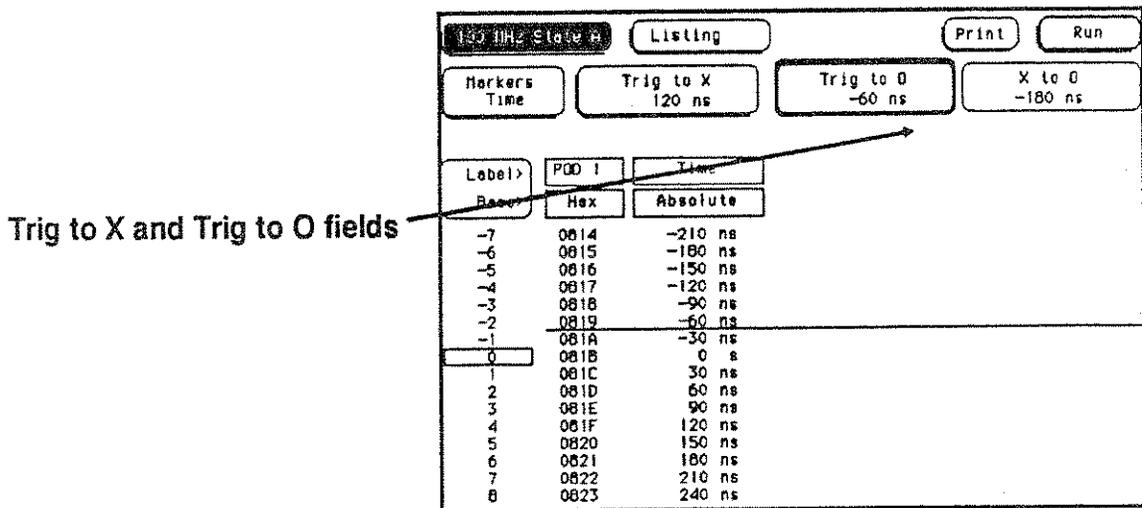


Figure 7-8. Markers Set to Time

The **X to O** field will change according to the position of the X and O markers. It displays the total time between the states marked by the X and O markers.

Markers Set to States

If the Count field in the state Trace menu is set to States, the marker options available are as follows:

- Off
- Pattern
- States

When Markers are set to States, you can specify how many states from trigger to place the X and O markers. The X to O readout at the far right of the display shows the number of states between the X and O markers.

The screenshot shows the front panel of an HP 16540A/16541A instrument. At the top, it displays '100 kHz State A', 'Listing', 'Print', and 'Run'. Below this are four buttons: 'Markers States', 'Trig to X 15', 'Trig to O -9', and 'X to O -24'. A table below shows state listings with columns for 'Label', 'Base', 'POD I', 'Hex', and 'Time'. The 'Time' column is further divided into 'Hex' and 'Absolute'.

Label	Base	POD I		Time
		Hex	Absolute	
-6		0815		-18
-5		0816		-15
-4		0817		-12
-3		0818		-9
-2		0819		-6
-1		081A		-3
0		081B		0
1		081C		3
2		081D		6
3		081E		9
4		081F		12
5		0820		15
6		0821		18
7		0822		21
8		0823		24
9		0824		27

Figure 7-9. Markers Set to States

To set the Trig to X or Trig to O marker, select the Trig to X field or the Trig to O field and use the knob or select the field twice and use the pop-up keypad.

Waveform Menu

Introduction

The Waveform menu allows you to view state and timing data in the form of waveforms identified by label name and bit number. Up to 96 waveforms can be displayed simultaneously.

The data is displayed in a format similar to an oscilloscope with the horizontal axis representing either states or time and the vertical axis representing amplitude.

Selecting State or Timing Display

The type of display that is shown in the Waveform menu depends on which clocking type you choose in the Configuration menu. To display a state waveform, set the **Type:** field in the Configuration menu to State. To display a timing waveform, you must set the **Type:** field in the Configuration menu to Timing. See the figure below.

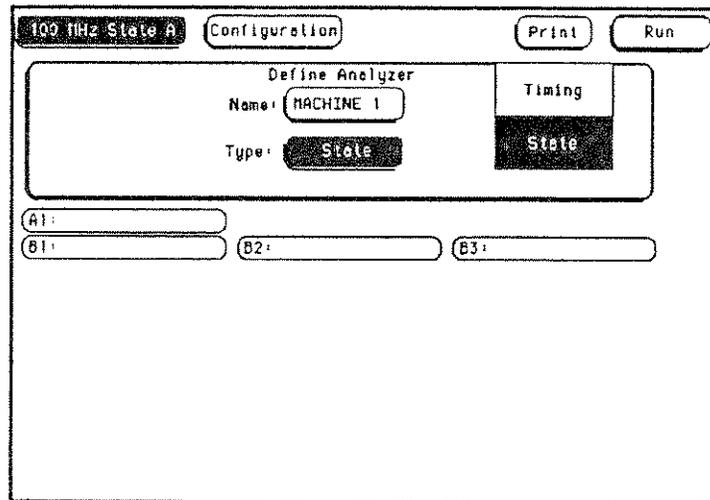


Figure 8-1. Analyzer Type Selection

Accessing the Waveform Menu

The Waveform menu is accessed through the menu selection pop-up shown below. The menu selection pop-up appears when the menu name field, in any menu, is touched. The menu name field is always the second field from the left in the top row of fields. See the figure below.

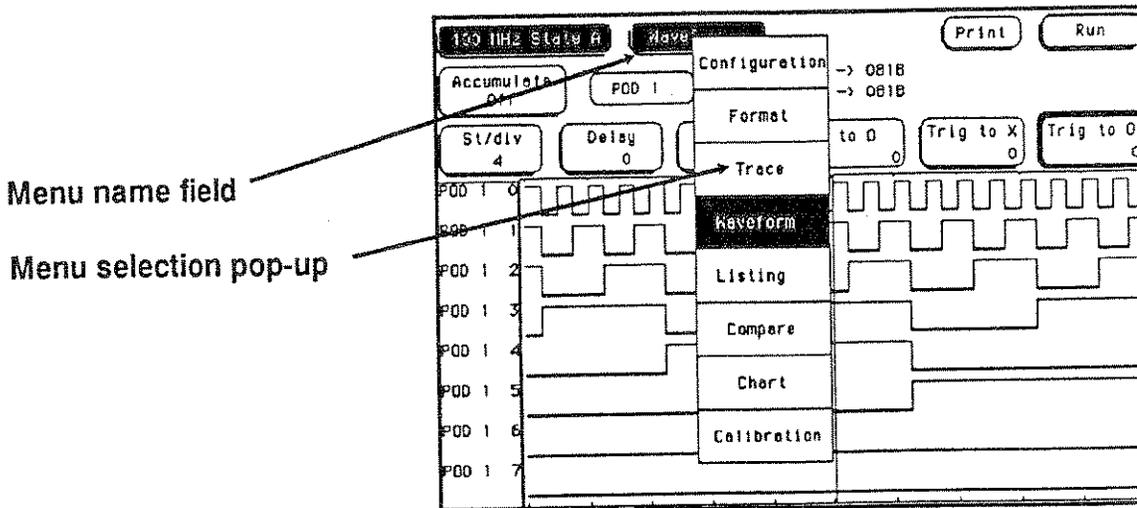


Figure 8-2. Menu Selection Pop-up

Selecting Waveforms for Display

The function of selecting waveforms for display, then modifying or deleting those waveforms, is identical for both state and timing waveforms.

Only waveforms with their bits assigned in the Format menu can be displayed. Each waveform is a member of a set of waveforms grouped under a label. The label name you assign in the Format menu is the label name that appears in the Labels list of the Waveform Selection pop-up menu.

To display waveforms, touch the blue bar (field) on the left side of the waveform portion of the display as shown below.

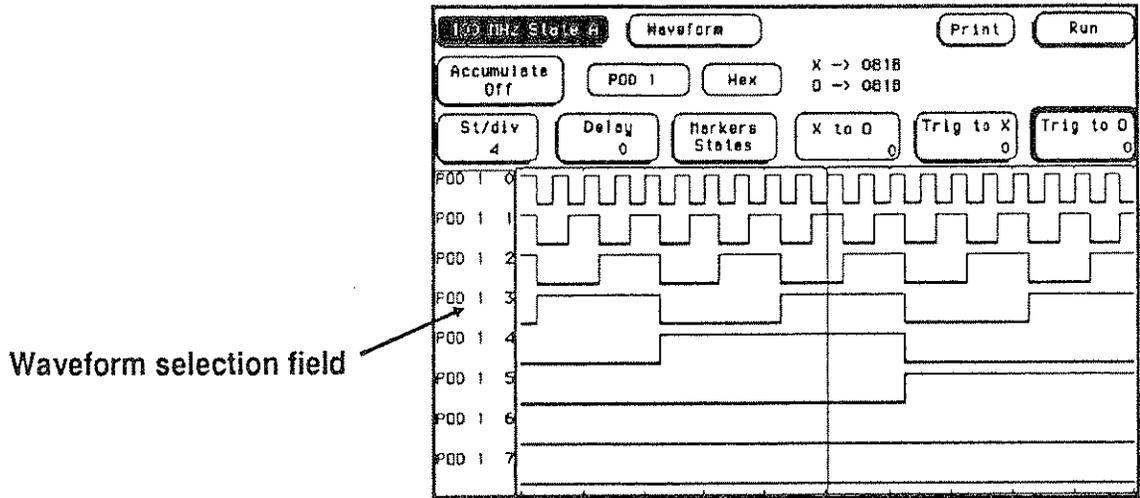


Figure 8-3. Waveform Selection Field

The field will either turn light blue, which is the label roll function, or the field will turn dark blue with a Waveform Selection pop-up menu next to it. If the field turns light blue, you must select the field a second time for the Waveform Selection pop-up to appear.

When the Waveform Selection pop-up menu appears, you will select which waveforms are displayed, replaced, or modified. You can display up to 24 waveforms onscreen at one time.

Single waveforms or all waveforms under a label can be displayed or turned off. The specific waveform bit or multiple waveform bits displayed depends on what **Channel Mode** is currently displayed. If **Sequential** is currently displayed, all label bits will be inserted automatically as shown below.

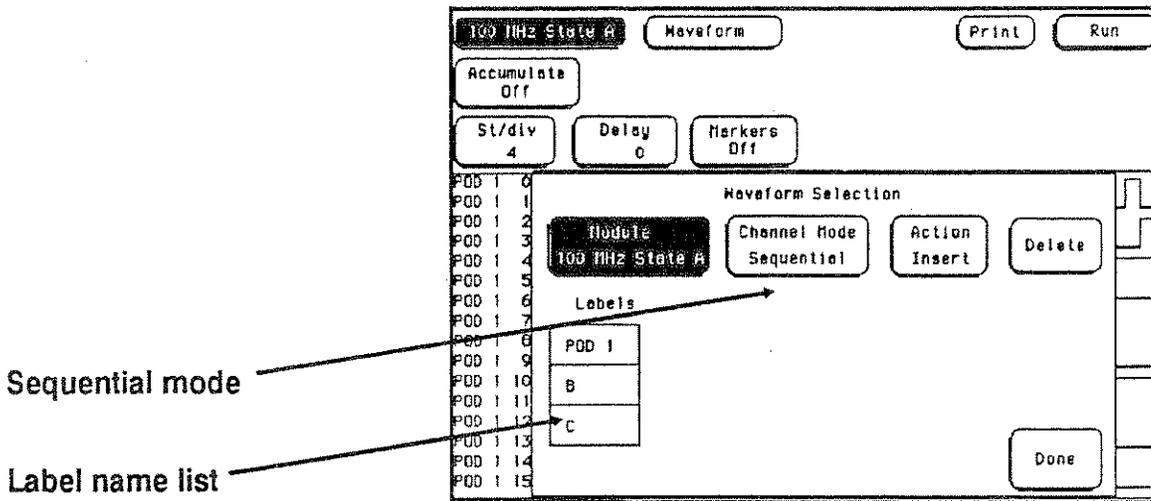


Figure 8-4. Sequential Channel Mode

If **Individual** is currently displayed, another pop-up menu appears as shown below in which you select the specific bit you want displayed.

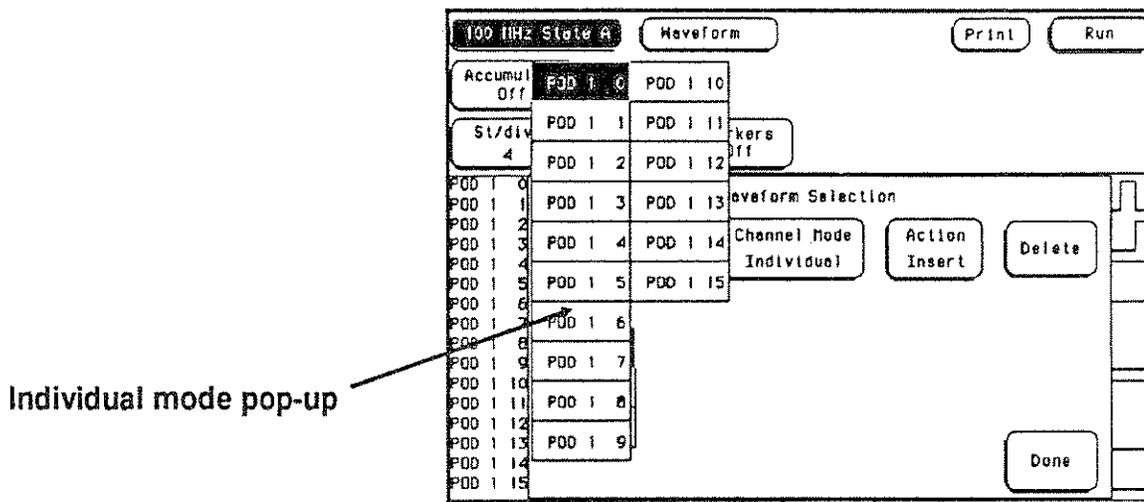


Figure 8-5. Individual Channel Mode

If **Overlay** is currently displayed, all bits of the label are inserted in a single waveform to form a composite waveform label as shown below.

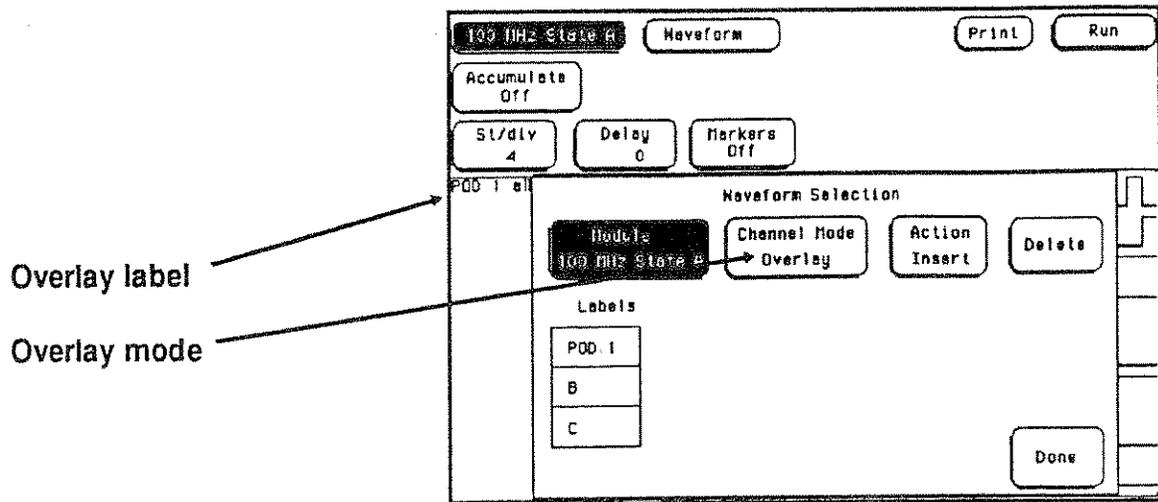


Figure 8-6. Overlay Channel Mode

In the above figure, label Pod 1 has all of its bits specified to be overlaid in the waveform display. The onscreen indication for the Overlay mode is All following the label name.

Replacing Waveforms

You can replace a currently displayed waveform (label) with another one of the predefined waveforms (labels). To replace one waveform with another, position the cursor on the waveform you wish to replace using the knob. Touch the **Action Insert** field to toggle it to **Action Replace**. Then select the label that will replace the old label. See the figure below.

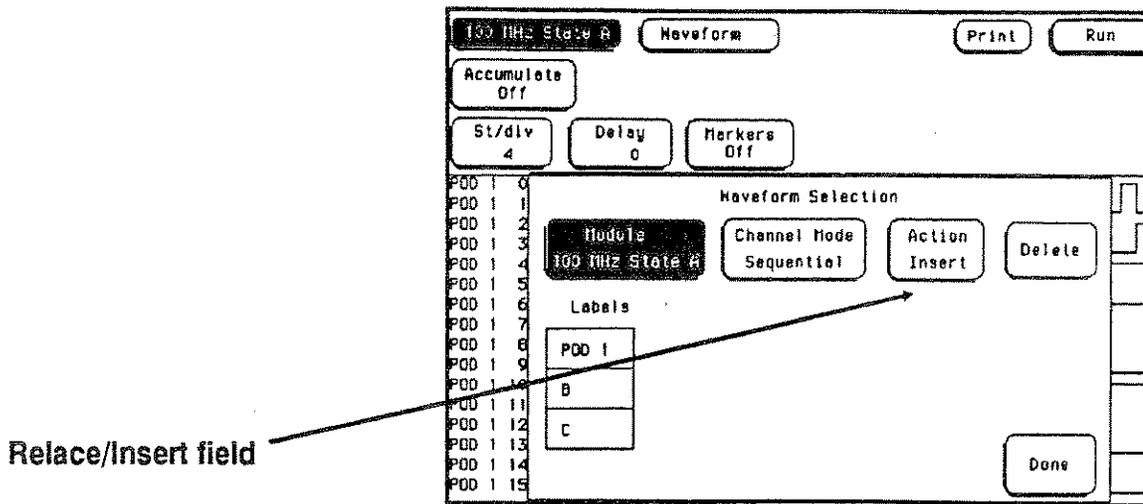


Figure 8-7. Action Insert/Replace

Deleting Waveforms

You can delete any of the currently displayed waveforms by placing the cursor on the waveform you wish to delete using the knob and selecting **Delete** in the pop up. In addition you can delete all the waveforms at once with the **Delete All** field.

Setting the Clock Period

When the analyzer is configured to use Timing clocks, a clock period field appears next to the menu name field. Refer to the section "*Setting the Clock Period*" in the Trace Menu chapter for information on the operation of this field.

Accumulate Mode

Accumulate mode is selected by touching the **Accumulate** field. The **Accumulate** field will toggle ON/OFF. When **Accumulate** is on, the analyzer displays the data from a current acquisition on top of the previously acquired data.

When the old data is cleared depends on whether the analyzer is run in **Single** or **Repetitive** mode. In **Single** mode new data will be displayed on top of the old each time the **RUN** field is selected. In **Repetitive** mode, data is cleared from the screen only when you start a run after stopping acquisition by touching the **STOP** field.

The **Accumulate** mode field operation is identical in both state and timing waveform menus.

Selecting States per Division

When the analyzer is configured to use external clocks, the X-axis of the waveform display is measured in states per division (st/Div). You can specify between 1 and 500 states per division by touching the **st/Div** field and rotating the **KNOB**, or by touching the **st/Div** field twice and then use the pop-up keypad.

Selecting Time per Division

When the analyzer is configured to use internal clocks, the X-axis of the waveform display is measured in time per division (s/Div). The **s/Div** field allows you to change the width of the time window of the Waveform display.

The range of the **s/Div** field is 10 ns/Div to 1.0 ks/Div. You set the **s/Div** field by either touching the **s/Div** field and rotating the **KNOB**, or by touching the **s/Div** field twice and then use the pop-up keypad.

When using the knob to set the **s/Div**, the value will change in a 1-2-5 sequence.

Selecting Delay

Depending on the analyzer configuration, a positive or negative delay measured in either states or time can be set. The Delay field allows you to place the time/states window of the acquired data at center screen.

The logic analyzer is capable of maximum delays of -2500 seconds to $+2500$ seconds, when configured with the internal clock, or -4150 states to $+4150$ states when configured with external clocks.

If you want to trace after the trigger point, enter a positive delay. If you want to trace before the trigger point (similar to negative time), enter a negative delay.

X and O Markers

For the most part, the fields and functions of the X and O markers will be the same in both the Timing and State analyzer types. Select the Markers field in the Waveform menu. A pop-up menu appears that lists the marker options shown below.

If the Count field in the state Trace menu is set to **Time**, the marker options available are as follows:

- Off
- Pattern
- Time
- Statistics

If the Count field in the state Trace menu is set to **States**, the marker options available are as follows:

- Off
- Pattern
- States

When the Markers field is Off, markers are not displayed but are still present in the data if they were previously set. In addition, if a Stop measurement is specified, and the Stop measurement criteria are met, the measurement will stop even though the markers are off. See "Specify Stop Measurement", found later in this chapter.

When using an internal clock configuration with markers Off, a sample period is displayed. The sample period displayed is the sample period of the last acquisition. If you change the Time/Div setting, you must press RUN to initiate another acquisition before the sample period is updated.

Markers Set to Patterns

When Markers are set to Patterns, you specify data patterns that you want the analyzer to place the X and O markers on. You also specify which occurrence of each pattern the analyzer places the marker on.

Pattern markers allows you to find the time period or states between specific patterns, the trace start, or trigger.

The X-pattern ___ from ___ fields allow you to specify how many pattern occurrences from a reference point you want the analyzer to place the X marker. The reference points are the Trigger and the Start of the trace.

The O-pattern ___ from ___ fields functions the same as the X-pattern field above with one exception. The O-pattern can also be referenced to the X marker.

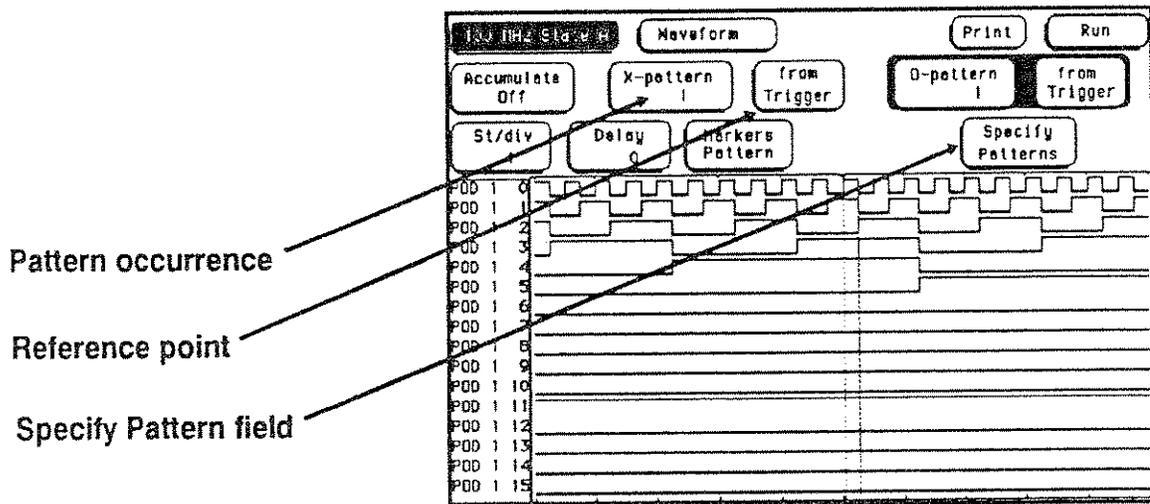


Figure 8-8. Pattern Occurrence and Reference

Specify Patterns field

A unique Pattern can be specified for each X and O marker in all designated labels. The logic analyzer searches for the logical "and" of patterns for all labels.

When the Specify Patterns field is touched, the following pop-up appears.

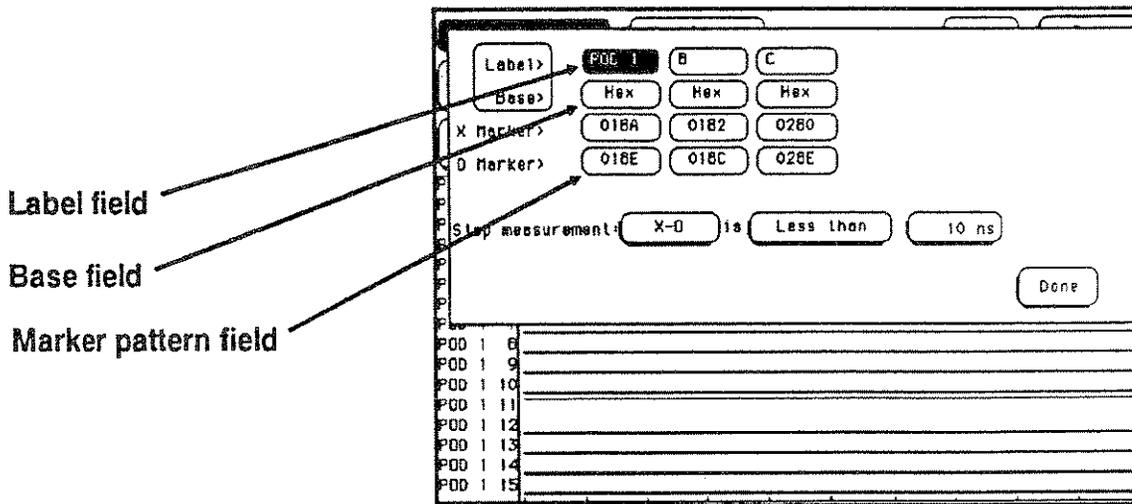


Figure 8-9. Specify Pattern Pop-up

To assign patterns to X and O markers, touch the Label field as shown above. Select a label from the label list pop-up that appears. This is the label the pattern is assigned to.

Touch the Base field and select the numeric base you want the pattern to use.

Select the X or O marker pattern field, and using the pop-up keypad, assign a data pattern.

If the analyzer is configured with an internal clock, you have the choice of specify whether the marker is placed at the beginning of the pattern occurrence (entering) or at the end of its occurrence (leaving).

Stop Measurement function

The Stop measurement function allows the analyzer to stop a repetitive run when specified criteria is met. When the **Specify Stop Measurement** field is selected, a pop-up appears as shown below. Use this pop-up to select either the X-O or Compare listing information to stop a measurement.

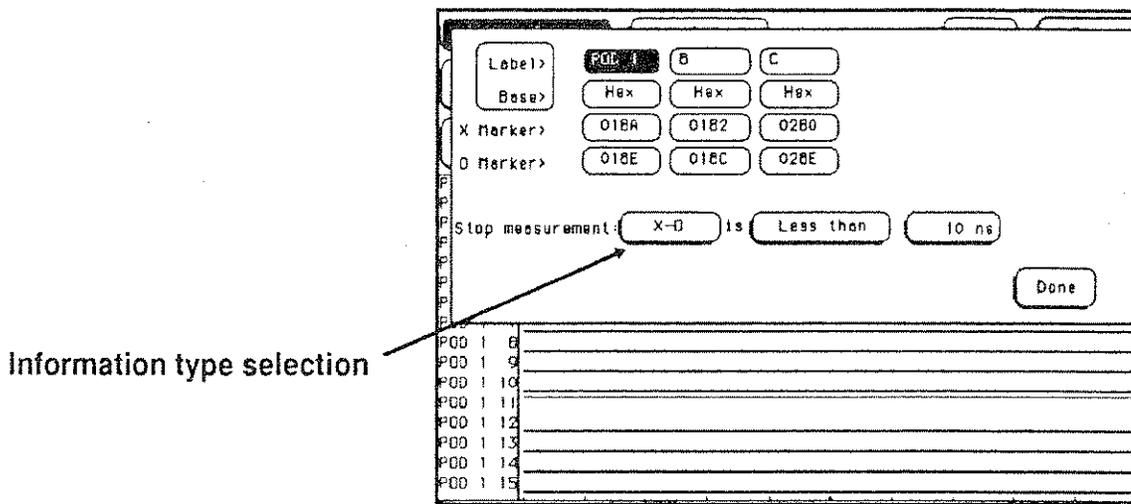


Figure 8-10. Stop Measurement Specifiers

Using X-O

You can stop a measurement when the time difference between the X and O markers meet one of the following criterion:

- X-O is Less than a time value.
- X-O is Greater than a time value.
- X-O is In range between a time value to another time value.
- X-O is Not in range between a time value to another time value.

The appropriate pop-up menus appear when you select the comparison type field and the time value fields.

The relative time value of the X marker must be less than the value of the O marker; so, in that sense, the X marker must precede the O marker.

Note



The upper and lower range boundaries must not be the same value. For example, if you want to stop a measurement when the X and O markers are in range of 200 ns, you should set the range values to 190 ns and 210 ns. This eliminates erroneous measurement termination.

Using Compare

You can stop a measurement when the data in the Listing menu meet one of the following criterion:

- Compare is Equal to the Compare listing criteria in the Compare menu.
- Compare is Not Equal to the Compare listing criteria in the Compare menu.

The equality type pop-up appears when you select the comparison type field as shown below. For complete information on the Compare function, refer to chapter 9, "Compare Menu".

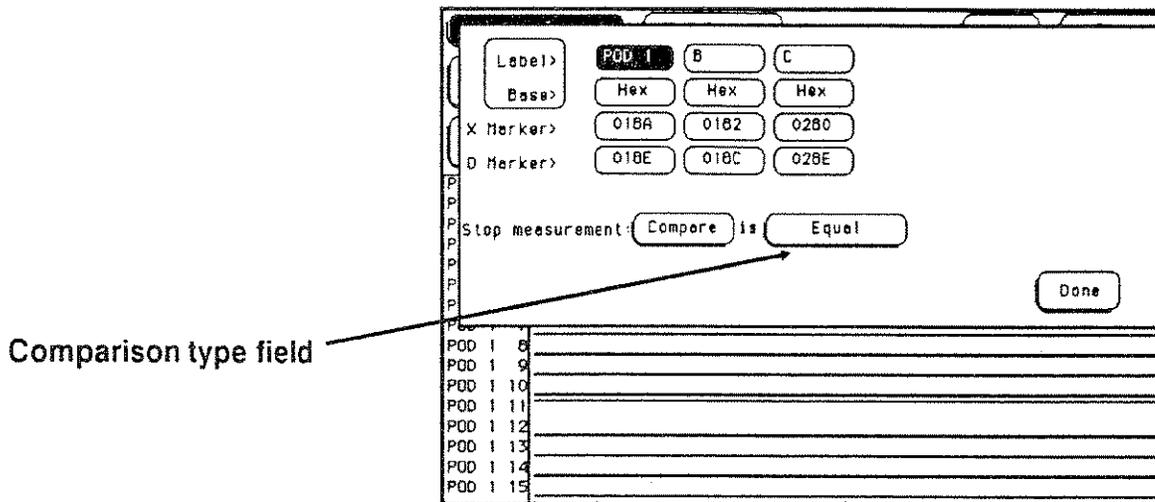


Figure 8-11. Stop Measurement Specifiers

If the Count field in the state Trace menu is set to States, the only method available to stop a repetitive run is to compare data to the listing in the Compare menu.

Markers Set to Time

When markers are set to **Time**, you can place the markers on the waveforms at events of interest and the logic analyzer will display the following information:

- X to O.
- Trig(ger) to X.
- Trig(ger) to O.

To position the markers, touch the **Trig to X** or **Trig to O** field shown below. Either rotate the **KNOB** or touch the same field again, then enter the numeric value from the pop-up keypad.

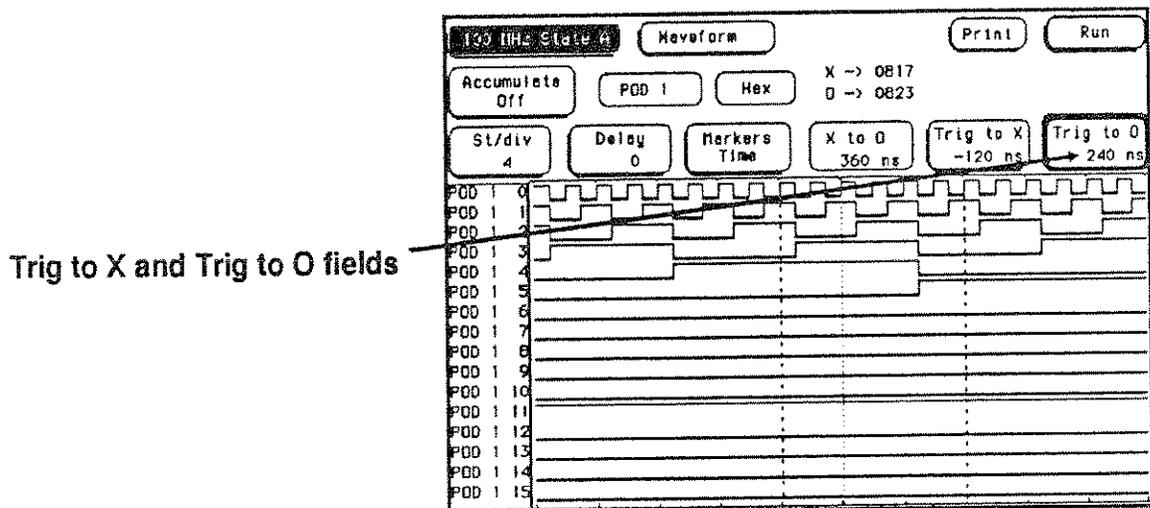


Figure 8-12. Time Markers

In a State analyzer configuration, the X to O field is a "read only" field that displays the difference between the X and O markers. As the X and O markers are changed, the display changes accordingly.

In a Timing analyzer configuration, the X to O field can be selected and set. If this field is changed, both X and O markers will move simultaneously with the relative difference remaining unchanged.

In the middle row of fields, notice the label and base fields (default is A and Hex). See the figure below.

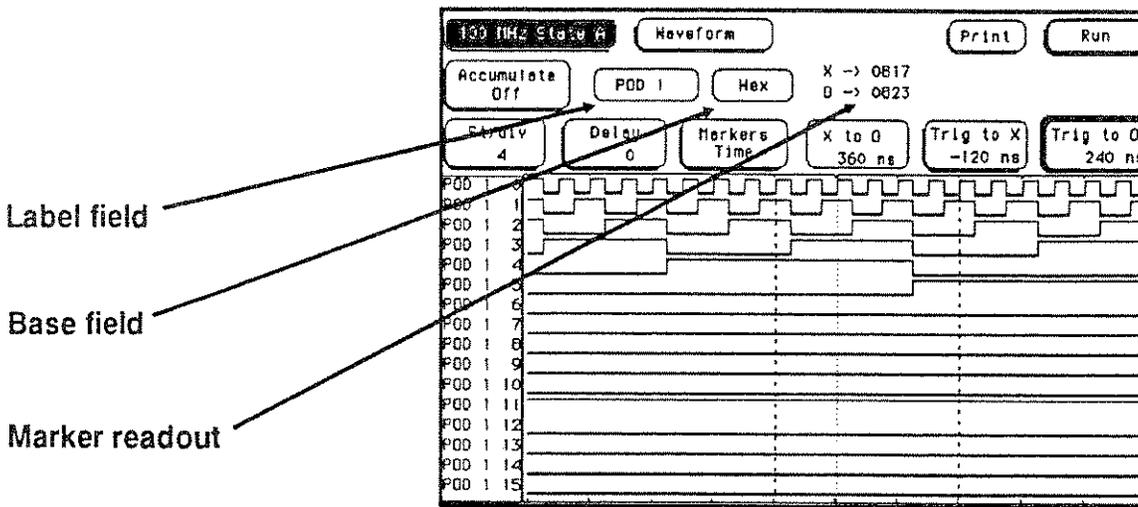


Figure 8-13. Pattern Readout Fields by Label

When you select the label field, a list of all assigned labels will appear. When a label is selected from this list, the data patterns where the X and O markers are currently placed will appear next to the appropriate marker readout.

When you select the base field next to the label field, the base selection pop-up will appear. If you change the base, the base type in all menus will change.

Markers Set to Statistics

After X and O markers are set with Pattern markers, statistical information is available when markers are set to Statistics. The logic analyzer displays the following information:

- Number of valid runs (runs where markers were able to be placed on specified patterns).
- Minimum time between the X and O markers.
- Maximum time between the X and O markers.
- Average time between the X and O markers.

Statistics are based on the time between the markers which are placed on the waveform. If one of the marker positions is not specified, that marker will be placed on the trigger point by default. In this case the statistical measurement will be the time from the trigger point to the other specified marker. The default Statistics menu is shown below.

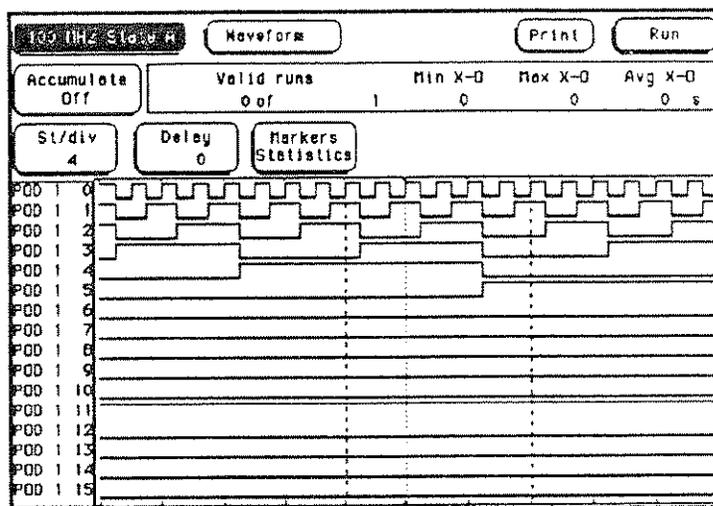


Figure 8-14. Statistics Markers

How the display is updated depends on the Run mode. In repetitive, statistics will be updated each time a valid run occurs until you press STOP. When you press RUN after STOP, the statistics will be cleared and will restart from zero.

In single, each time you press RUN an additional valid run will be added to the data and the statistics will be updated. This process continues unless you change the placement of the X and O markers between runs.

Markers Set to States

If the Count field in the state Trace menu is set to States, the marker options available are as follows:

- Off
- Pattern
- States

The use of Pattern markers is the same as what is described on the previous pages.

When Markers are set to States, you can specify how many states from trigger to place the X and O markers. The X to O field displays the number of states between the X and O markers.

To set the Trig to X or Trig to O marker, select the Trig to X field or the Trig to O field and use the knob or select the field twice and use the pop-up keypad. See the figure below.

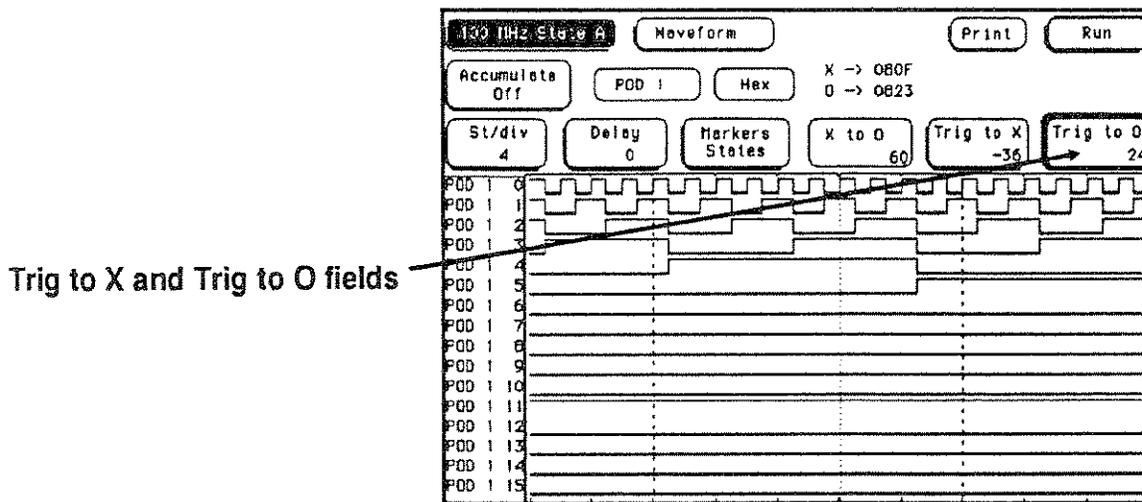


Figure 8-15. State Markers to Trigger fields

State Compare Menu

Introduction

Compare is a software postprocessing feature that provides the ability to do a bit-by-bit comparison between the acquired state data listing and a compare data image. You can view the acquired data and the compare image separately. In addition, there is a separate difference listing that highlights the bits in the acquired data that do not match the corresponding bits in the compare image.

You can use the editing capabilities to modify the compare image. Masking capabilities are provided for you to specify the bits that you do not want to compare. "Don't compare" bits can be specified individually for a given label and state row, or specified by channel across all state rows. A range of states can be selected for a comparison. When a range is selected, only the bits in states on or between the specified boundaries are compared.

The comparison between the acquired state listing data and the compare image data is done relative to the trigger points. This means that the two data records are aligned at the trigger points and then compared bit by bit. Any bits in the acquired data that do not match the bits in the compare image are treated as unequal. The don't compare bits in the compare image are ignored for the comparison.

When a logic analyzer configuration is saved to or loaded from a disk, any valid compare data including the data image, is also saved or loaded.

Accessing the Compare Menu

The Compare menu is accessed through the menu selection pop-up shown below. The menu selection pop-up appears when the menu Name field, in any menu, is touched. The menu Name field is always the second field from the left in the top row of fields.

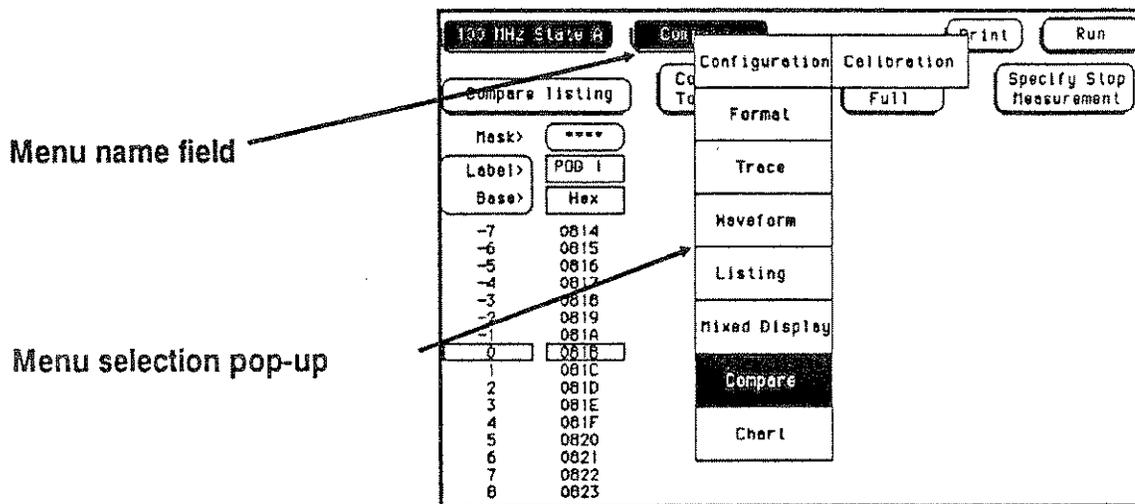


Figure 9-1. Menu Selection Pop-up

The Compare and Difference Listing Displays

Two menus (or displays) in addition to the normal state listing, are available for making comparison measurements. The two menus are the Compare listing and the Difference listing.

The Compare Listing

The Compare listing contains the image (or template) that acquired data is compared to during a comparison measurement. The boundaries of the image (or size of the template) is controlled by using the channel masking and compare range functions described below. Any bits inside the image displayed as "X" have been set to don't compare bits.

The Difference Listing

Any differences between the acquired data and the compare image will be highlighted as rows of inverse video in the Difference listing.

In addition, when the base is hexadecimal, octal, or binary, the bit (or digit containing the bit) that differs from the compare image is highlighted with inverse video. If the base is inverse assembled or symbols, the whole field will be highlighted if there is a difference.

To display the Compare listing or the Difference listing, touch the field labeled either **Compare listing** and **Difference listing**. When selected, this field toggles between Compare listing and Difference listing.

The controls that roll the listing in all three menus (state listing, the Compare listing and the Difference listing) are synchronized unless the number of pre-trigger states differ between the Compare listing and the acquired data. This means that when you change the current row position in the Difference listing, the analyzer automatically updates the current row in the acquired state listing, Compare listing and vice-versa.

If the three listings are synchronized and you re-acquire data, the Compare listing may have a different number of pretrigger states depending on the state trace trigger criteria. The Compare listing can be resynchronized to the state and Difference listings by entering the desired state (acquisition memory) location from the pop-up keypad.

This allows you to view corresponding areas of the two lists, to cross-check the alignment, and analyze the bits that do not match.

Creating a Compare Image

An initial compare image can be generated by copying acquired data into the compare image buffer. When you touch the **Copy Trace to Compare** field in the Compare listing menu, a pop-up appears with the options **Cancel** and **Execute**. If the **Execute** is selected, the contents of the acquisition data structure is copied to the compare image buffer. The previous compare image is lost if it has not been saved to a disk. If you select **Cancel** the current compare image remains unchanged.

Bit Editing of the Compare Image

Bit editing allows you to modify the values of individual bits in the compare image or specify them as don't compare bits. The bit editing fields are located in the center of the Compare listing display as shown below. A bit editing field exists for every label in the display unless the label's base is ASCII or inverse assembled symbols. You can access any data in the Compare listing by rolling the desired row vertically until it is located in the bit editing field for that label (column).

When you select one of the bit editing fields a pop-up appears in which you enter your desired pattern or don't compare for each bit.

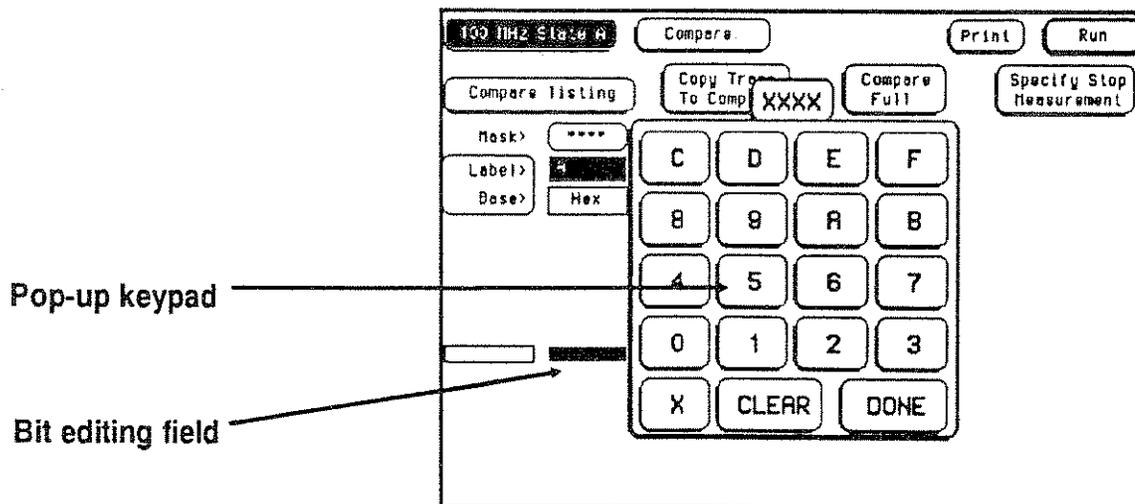


Figure 9-2. Bit Editing Fields

Masking Channels in the Compare Image

The channel masking function allows you to specify a bit, or bits in each label, that you do not want compared. This causes the corresponding bits in all states to be ignored in the comparison. The compare data image itself remains unchanged on the display. The Mask fields are directly above the label and base fields at the top of both the Compare and Difference listings. See the figure below.

When you select one of these fields, an assignment pop-up appears in which you specify channels to be compared and which channels are to be masked. A "." (period) indicates a don't compare mask for that channel and an "*" (asterisk) indicates which channel is to be compared.

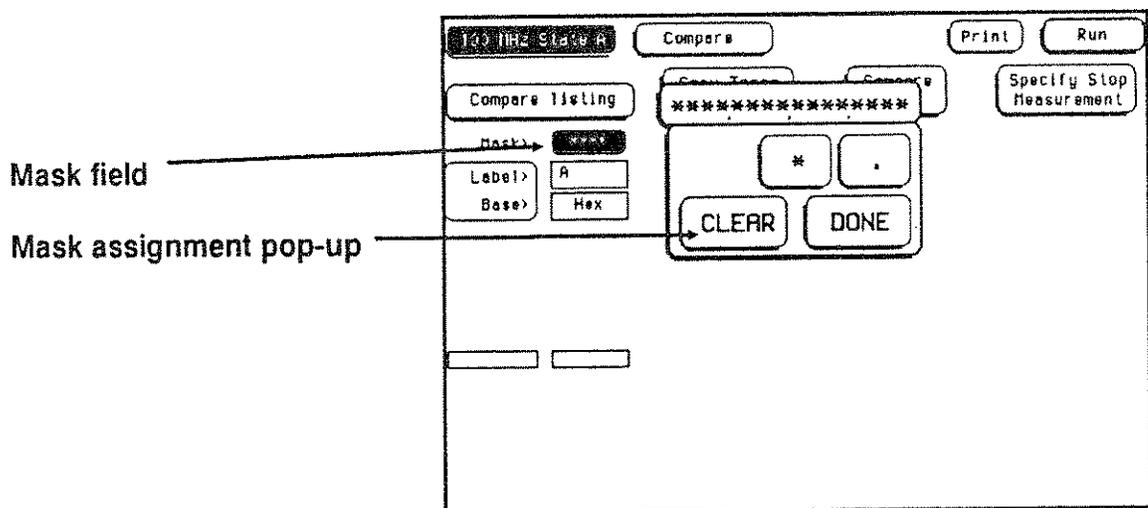


Figure 9-3. Bit Masking Fields

Specifying a Compare Range

The Compare Range function allows you to define a subset of the total number of states in the compare image to be used in the comparison. The range is specified by setting start and stop boundaries. Only bits in states (lines) on or between the boundaries are compared against the acquired data.

The Compare mode is accessed by touching the Compare Full field in either the Compare or Difference listing menus. When selected, a pop-up appears in which you select either the Full or Partial option. When you select the Partial option, fields for setting the start state and stop state values appear. See the figure below.

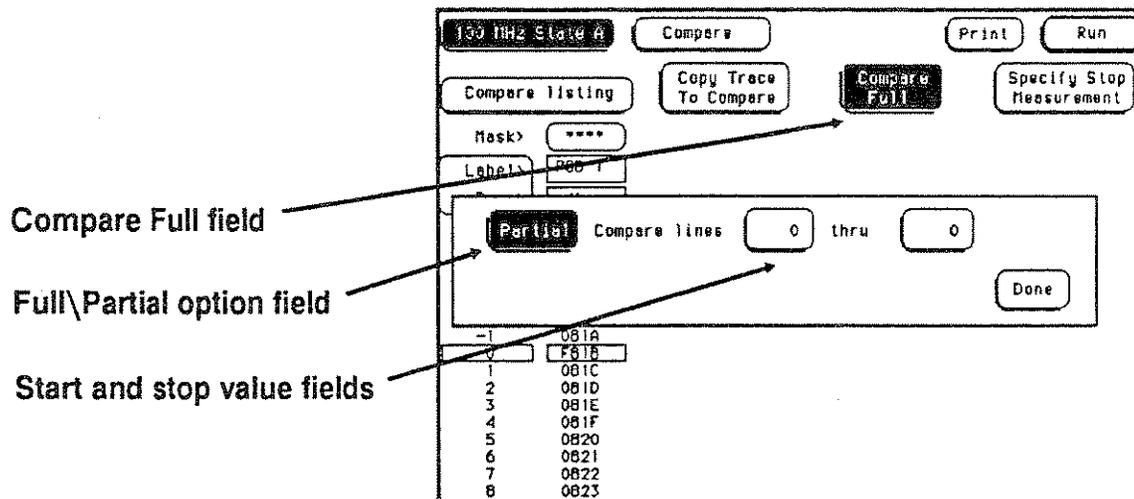


Figure 9-4. Compare Full/Compare Partial Field

Repetitive Comparisons with a Stop Condition

When you do a comparison in the repetitive trace mode, a stop condition may be specified. The stop condition is either **Stop Measurement when Compare is Equal** or **Not Equal**. In the case of **Equal**, bits in the compare image must match the corresponding bits in the acquired data image for the stop condition to be true. In the case of **Not Equal**, a mismatch on a single bit will cause the stop condition to be true.

You access the stop measurement function by selecting the **Specify Stop Measurement** field in either the **Compare** or **Difference Listing** menus. When you select this field, the **Stop Measurement Parameters** pop-up appears as shown below. The first field in this pop-up, just to the right of "Stop measurement" contains either **Off**, **X-O**, or **Compare**.

If you select the **Compare** option, you are given the option to select either the **Equal** or **Not Equal** option in the next field to the right.

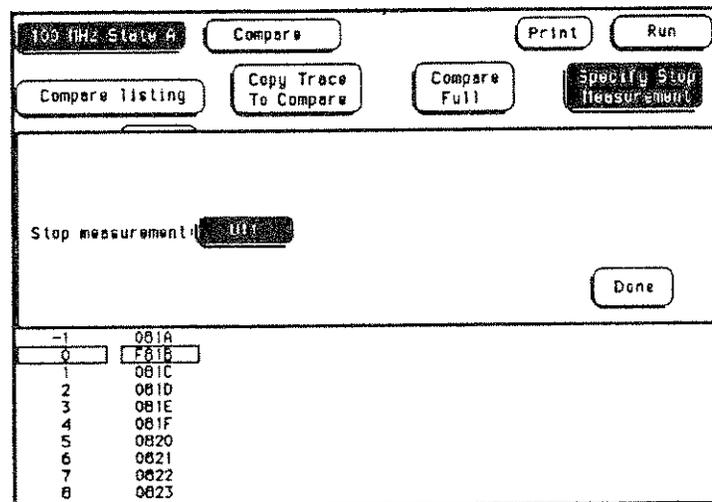


Figure 9-5. Specify Stop Measurement Field

Locating Mismatches in the Difference Listing

The **Find Error** feature allows you to easily locate any patterns that did not match in the last comparison. Occurrences of differences are found in numerical ascending order from the start of the listing. The first occurrence of an error has the numerical value of one.

This feature is controlled by the **Find Error** field in the Difference Listing menu. When you select this field, a pop-up keypad appears in which you enter a number indicating which difference you want to find. The listing is then scanned sequentially until the specified occurrence is found and rolled into view.

Saving Compare Images

When you save a logic analyzer configuration to a disk, the compare images for both state analyzers are saved with it. The compare data is compacted to conserve disk space. Likewise, when you load a configuration from disk, valid compare data will also be loaded.

State Chart Menu

Introduction

The Chart menu allows you to build X-Y plots of label activity using state data. The Y-axis always represents data values for a specified label. You can select whether the X-axis represents rows in the state List or the data values for another label. You can scale both the axes to selectively view data of interest. An accumulate mode is available that allows the chart display to build up over several runs. When State is selected for the X-axis, X and O markers are available that allow the current sample (state or time) relative to trace point and the corresponding Y-axis data value to be displayed. Marker placement is synchronized with the normal state Listing.

Accessing the Chart Menu

The Chart menu is accessed through the main menu selection pop-up shown below. The menu selection pop-up appears when the menu Name field, in any menu, is touched. The menu Name field is always the second field from the left in the top row of fields.

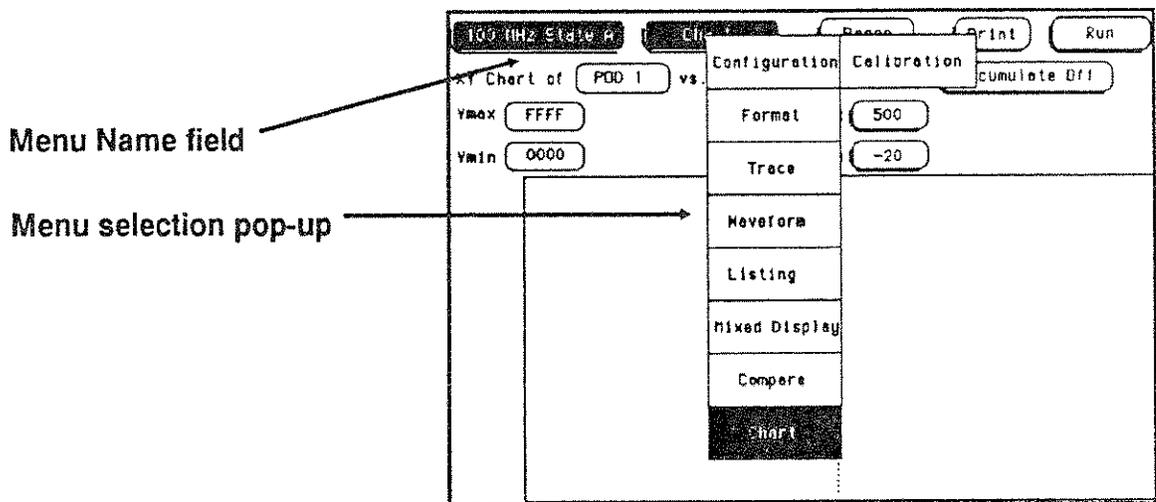


Figure 10-1. Menu Selection Pop-up

Selecting the Axes for the Chart

When using the Chart display, you first select the data you want plotted on each axis. To assign the vertical axis label, touch the Y-axis Label field in the menu. This is the field just to the right of "XY Chart of " label. When selected, a pop up appears in which you select one of the labels that were defined in the state Format menu. The X-axis assignment field is just to the right of "vs", and it toggles between State and Label. When label is selected, a third field appears to the right of Label . When this field is selected, a pop-up appears that lists the state labels to select from.

Scaling the Axes

Either axis of the X - Y chart can be scaled by using the associated vertical or horizontal min (minimum) or max (maximum) value fields. When selected, a pop up keypad appears in which you specify the actual minimum and maximum values that will be displayed.

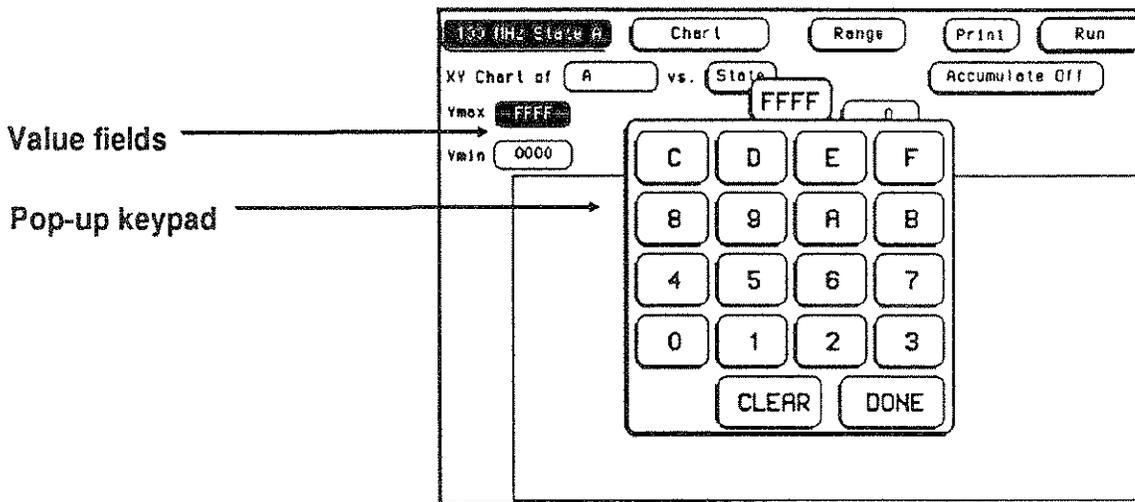


Figure 10-2. Axis Scaling Pop-up Menu

When State is selected for the X-axis, state acquisition memory locations are plotted on the X-axis. The minimum and maximum values can range from -4096 to +4096 depending on the trace point location. The minimum and maximum values for labels can range from 00000000H to FFFFFFFFH (0 to 2^{32-1}) regardless of axis, since labels are restricted to 32 bits.

The Label Value vs. States Chart

The Label value versus State chart is a plot of label activity versus the memory location in which the label data is stored. The label value is plotted against successive analyzer memory locations. For example, in the following figure, label activity of POD 1 is plotted on the Y axis and the memory locations (State) are plotted on the X axis.

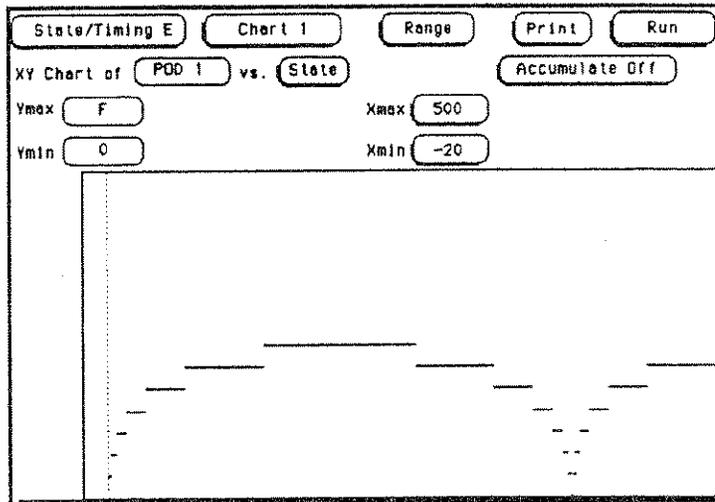


Figure 10-3. Label vs. State Chart

The Label Value vs. Label Value Chart

When labels are assigned to both axis, the chart shows how one label varies in relation to the other for a particular state trace record. Label values are always plotted in ascending order from the bottom to the top of the chart and in ascending order from left to right across the chart. Plotting a label against itself will result in a diagonal line from the lower left to upper right corner. X & O markers are disabled when operating in this mode.

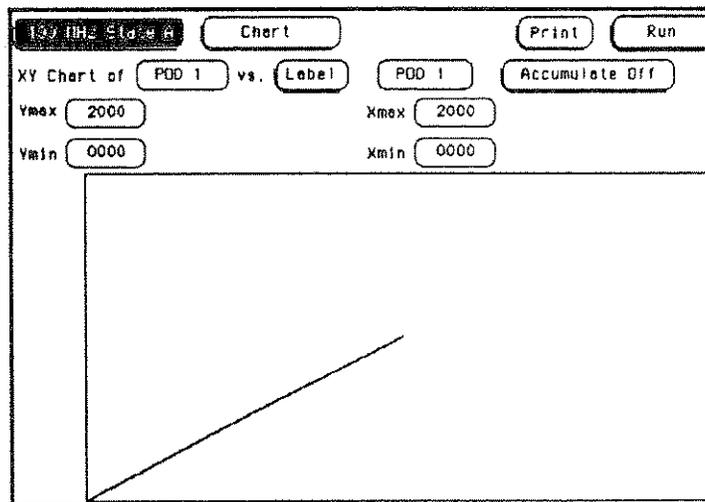


Figure 10-4. Label vs. Label Chart

X & O Markers and Readouts for Chart

When State is specified for the X-axis, X & O markers are available which can be moved horizontally. The markers are synchronized with the X and O markers in the normal state listing.

To select the marker mode for Chart (if it is not presently displayed), touch the Range field. This field will toggle to Markers, and a Markers field will appear as shown below.

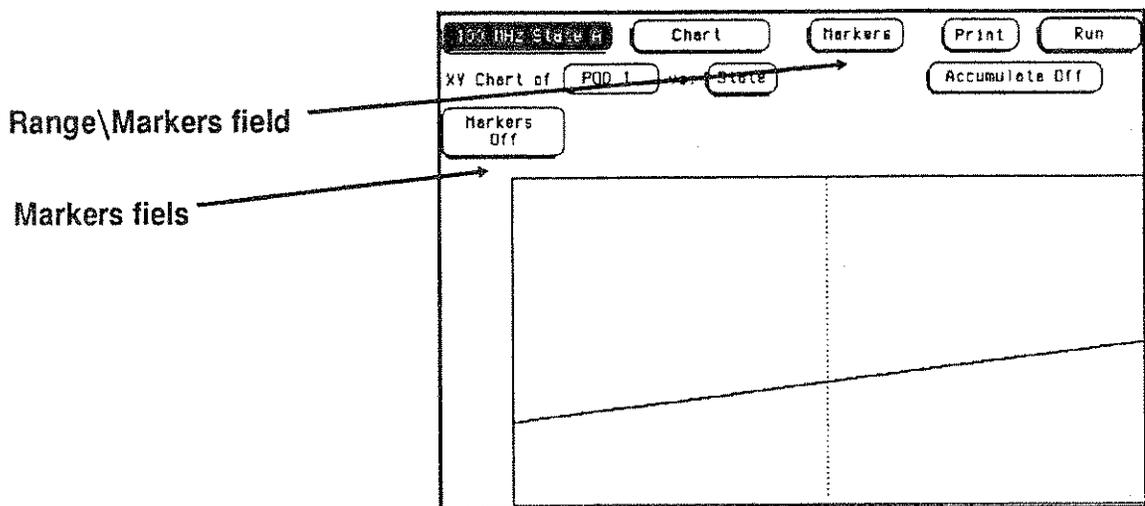


Figure 10-5. Marker Fields

When the Markers field is selected, a marker type pop-up menu appears. Use this pop-up menu to select a marker type to use.

When a marker is positioned in the state Chart menu, it is also positioned in the state Listing menu and vice-versa. The Chart marker operation is identical to the markers in the state Listing menu.

Marker Options The marker options in the State Chart menu depend on what Count is set to in the Trace menu.

When Count is set to **Time**, the Chart markers can be set to:

- Off.
- Pattern.
- Time.
- Statistics.

When Count is set to **States**, the Chart markers can be set to:

- Off.
- Pattern.
- States.

Refer to the chapter, "State Listing Menu", for the definition and operation of the different types of markers.

Mixed Display Menu

Introduction

This chapter explains the Mixed Display menu which consists of the HP 16540A/16541A Listing display located at the top of the menu and a blank Waveform display located at the bottom of the menu. You will use the blank Waveform display to bring in and display waveforms from other modules within the HP 16500A mainframe.

The Mixed Display menu is only available when the analyzer is configured to use an External clock (Type: State) and the Count field in the Trace menu is set to Time. In addition, before waveforms from other modules can be displayed, the modules for which you want the waveforms to come from and the HP 16540A/16541A module must be configured as a Group run in the Intermodule menu.

For the most part, the operation of the menu fields in the Listing and Waveform portions of the Mixed Display menu are identical to their operation in their respective menus.

Only the unique functions and features of the Mixed Display menu are described in this chapter. For complete information of the menu fields refer to the Listing and Waveform menu chapters found earlier in this manual.

Accessing the Mixed Display Menu

The Mixed Display menu is accessed through the menu selection pop-up shown below. The menu selection pop-up appears when the menu name field, in any main menu, is touched. The menu name field is always the second field from the left in the top row of fields.

Menu name field

Main menu selection pop-up

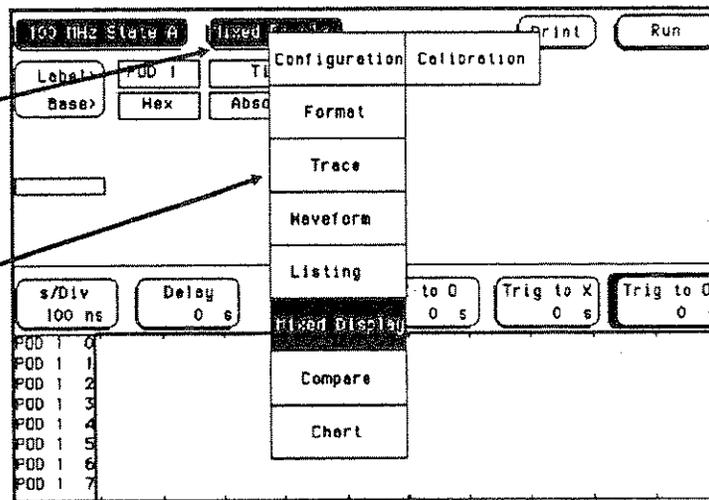


Figure 11-1. Mixed Display Menu Selection

Intermodule Configuration

Before waveforms from one module can be displayed in the Mixed Display menus of other modules, all modules involved in the measurement must be configured in the Group Run of the Intermodule menu. For complete information on Intermodule operation, refer to the "Intermodule Measurements" chapter in the *HP 16500A Logic Analysis Reference Manual*.

Inserting Waveforms

To insert waveforms from other modules, use the same procedure for selecting waveforms that is documented in the chapter "Waveform Menu" found earlier in this manual. The only difference is that an additional field will appear above the Label list. To see an example of this new field, refer to the "Intermodule Measurements" chapter in the *HP 16500A Logic Analysis Reference Manual*.

Time-Correlated Displays

Once the Time markers are set in the Waveform display area of the Mixed Display menu, time-correlated X and O markers will be displayed in both the Listing and the Waveform display areas.

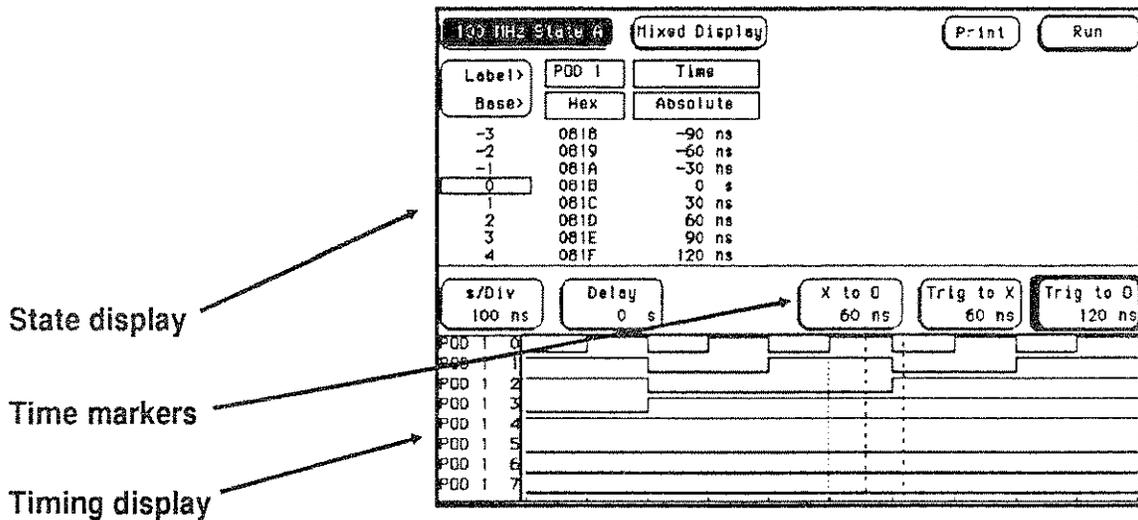


Figure 11-2. Waveforms/Listing Display

The analyzer uses a counter to track time between the triggering of one display and the triggering of the other display. It uses this count to reconstruct time-correlated data.

Markers

The markers in the Mixed Display menu are not the same as in the individual Listing and Waveform menus. You must place new markers on your points of interest in the Mixed Display. Even though you have placed markers in the individual Listing and Waveform displays, the markers will not transfer to the Mixed Display menu.

Time Markers

Only Time markers are available in the Mixed Display menu. You set the Time markers in the Waveform display. Refer to the chapter "Waveform Menu" found earlier in this manual for complete information on Time marker operation.

Using a Printer

Setting Printer Configuration

All printer parameters are set in the System Configuration menu. If you have just connected your printer and are unsure of how to set the configuration, refer to the *HP 16500A Reference Manual* chapter entitled "Connecting a Printer." The HP 16500A supports HP-IB and selected RS-232C printers.

All the pictures in this manual were taken from an HP 16500A with one HP 16540A State Analyzer card. If the screens on your instrument differ from the pictures in this manual, it simply means that you have a different card configuration. All other functions will work the same, except where noted.

Printing Options

All logic analyzer menus include a Print field in the upper right of the screen. If you are in the Trace menu and touch the Print field, a pop-up like the one shown below appears.

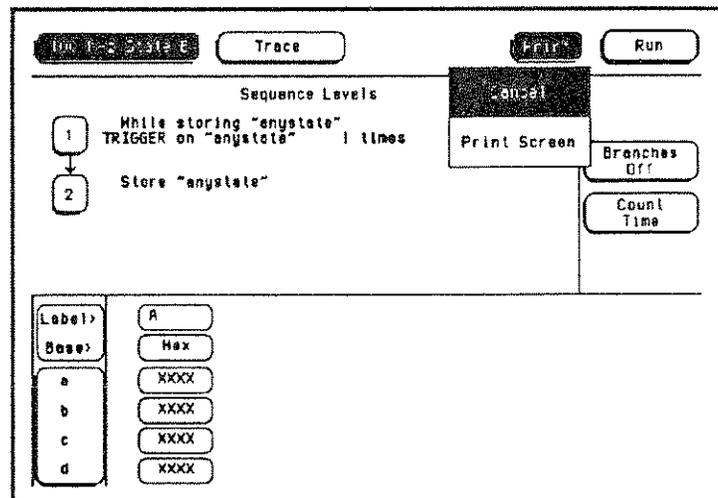


Figure A-1. Print Option Menu

There are two fields in the pop-up, Cancel and Print Screen.

If you are in the Listing, Mixed Display, or Compare menus, a slightly different pop-up will appear, like the figure shown below.

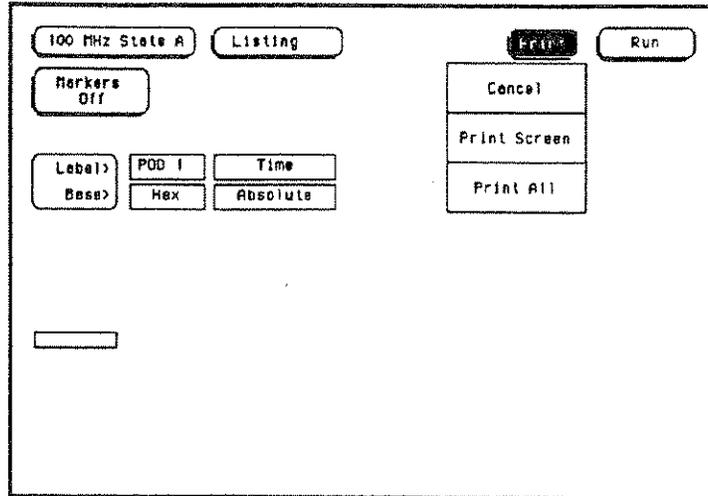


Figure A-2. Print Option in Listing Menu

The pop-up contains three fields, Cancel, Print Screen, and Print All.

Printing Onscreen Data

If you want a hardcopy record of the screen, touch the **Print** field and then the **Print Screen** field from the pop-up. This will send a copy of the screen to the printer in graphics mode.

If you want to print part of a menu in graphics mode that is off screen, you must roll the screen vertically or horizontally to place the part on screen. When the desired part is onscreen, touch the **Print Screen** field.

Printing Entire State Listing

If you need a hardcopy record of an entire state listing, touch the **Print** field and then the **Print All** field from the pop-up. The **Print All** field causes all the list and label data to be sent to the printer, but not in graphics mode like the **Print Screen** field. The data is sent in text mode to speed printing of long data lists.

Installation and Calibration

Introduction

This appendix explains how to install and calibrate the HP 16540A/16541A 100 MHz State Analyzer module. For complete service information including initial inspection, operating environment, and storage, refer to the Service Manual.

Power Requirements

All power supplies required for operating the HP 16540A/16541A 100 MHz State Analyzer are supplied to the module through the backplane connector of the mainframe.



Do not install, remove, or replace the module in the instrument unless the instrument power is turned off.

Probe Cable Installation

The HP 16540A/16541A 100 MHz State Analyzer comes with probe cables installed by the Hewlett Packard. If a cable is to be switched or replaced, refer to section 6-9, "Probe Cable Replacement" in the Service Manual.

Module Installation

The HP 16540A master takes up one slot in the card cage. As many as four HP 16541A expansion cards may be connected to the master. For every expansion card you install, you need one additional slot.

Caution

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when you are performing any kind of service to this module.

Installation Considerations

- Cards or filler panels below the slots intended for module installation do not have to be moved.
- The probe cables of the module do not have to be removed.
- If previously installed modules prevent proper installation, reposition them in the card cage.
- A one-card module, the HP 16540A master card with no expansion card, can be installed in any available card slot.
- A two-card module, the HP 16540A master card with one HP 16541A expansion card, must be installed in adjacent slots.
- A module with three or more cards, the HP 16540A master card with two or more HP 16541A expansion cards, must be installed with each expansion card in the closest adjacent slot to the master card.

Installation Procedure

1. Turn off the instrument power switch, then unplug the power cord. Disconnect any input or output connections.

- Use figure B-1 to plan the module configuration and select the correct cable.

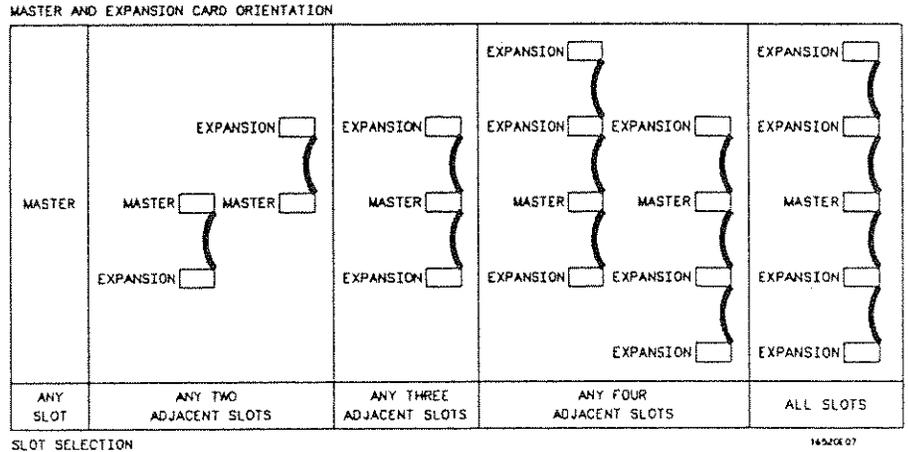


Figure B-1. Installation Guide



All multi-card modules will be cabled together. Care should be taken to pull these cards out together.

- Starting from the top, loosen the thumb screws on the filler panels and cards that need to be moved. Starting from the top, pull the cards and filler panels halfway out. See figure B-2.

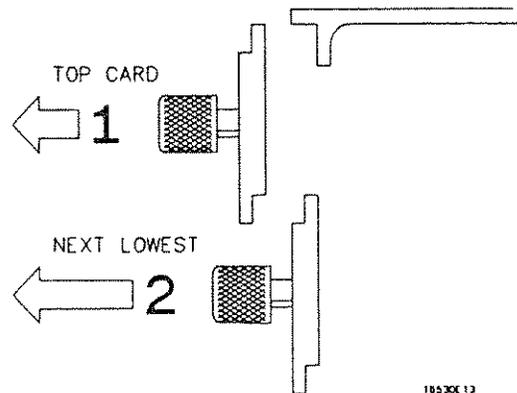


Figure B-2. Endplate Overlap

4. Remove the filler panels and cards that are in the slots intended for the module installation. Push all other cards into the card cage, but not completely in. This is to get them out of the way for installing the 100 MHz state analyzer module.
5. Connect the intercard cable to the first card of the module to be installed. See figure B-3. Lay the cable flat and pointing out to the rear of the card. If the module consists of only the master card, an intercard cable is not used.

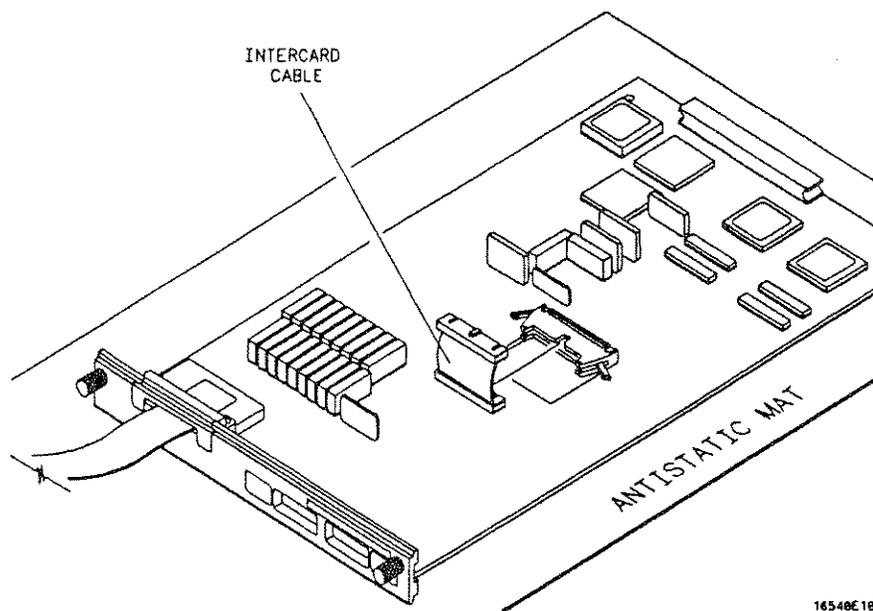


Figure B-3. Intercard Cable

6. With the probe cables facing away from the mainframe, slide the first card of the module approximately halfway into the lowest slot used by the module.

7. Slide the next card of the module halfway into the next highest slot, then feed the intercard cable up through the hole in the card. Connect the intercard cable from the first module card to the next highest module card.
8. If there are more cards to install, repeat step 7 until all cards of the module are in place.
9. Slide the complete module into the mainframe, but not completely in. See figure B-4.

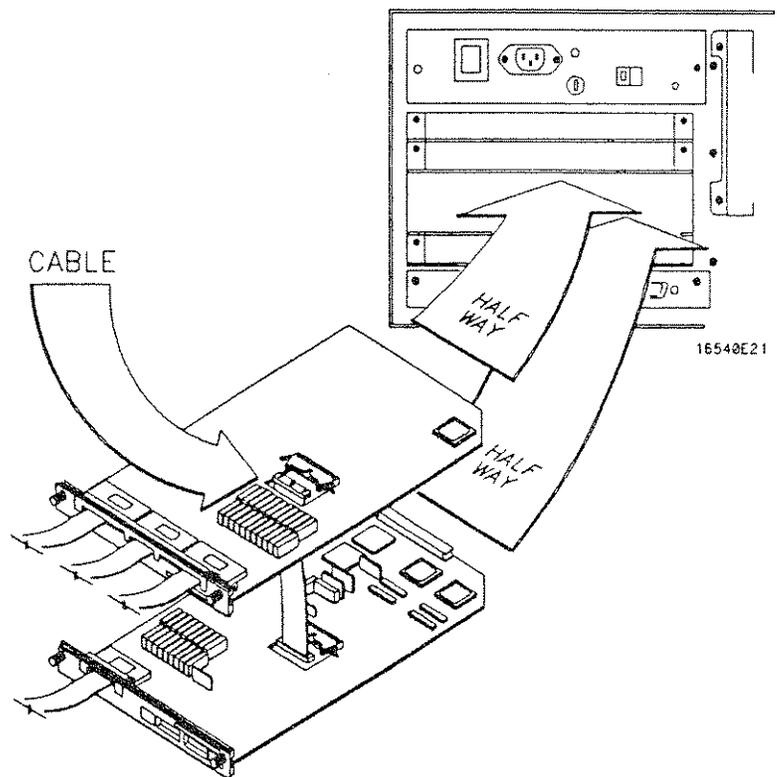


Figure B-4. Installing Cards Into The Mainframe

10. Position all cards and filler panels so that the endplates overlap, as shown in figure B-5.

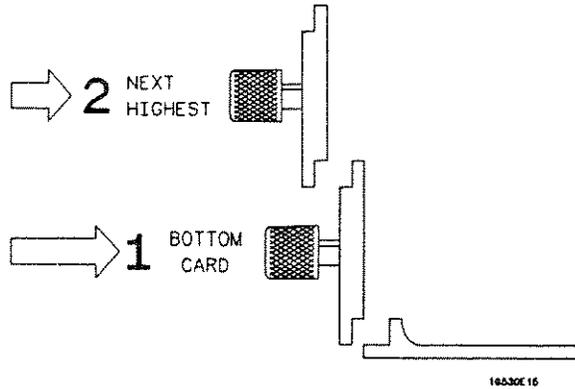


Figure B-5. Endplate Overlap

11. Firmly seat the bottom card into the backplane connector. Keep applying pressure to the center of the card endplate while tightening the thumb screws finger-tight. Repeat this step for all cards and filler panels starting at the bottom and moving to the top.

Note 

Filler panels must be installed in all unused card slots for correct air circulation. Any filler panels that are not used should be kept for future use.

Expansion Card Installation

Caution



To add HP 16541A expansion cards to a previously installed 100 MHz State Analyzer Module, follow the same considerations and procedures used to install the module in the previous section "Module Installation."

The effects of ELECTROSTATIC DISCHARGE can damage electronic components. Use grounded wriststraps and mats when you are performing any kind of service to this module.

Procedure

1. Remove the previously installed HP 16540A/16541A 100 MHz State Analyzer Module.
2. Reconfigure the module to include the new expansion card and a new intercard cable.
3. Install the reconfigured module.

Refer to section 2-7, "Module Installation" in the Service Manual, for installation considerations, configuration examples, and the complete installation procedure.

Calibration

The HP 16540A/16541A calibration optimizes the relationship between the master clock and incoming data for the three setup and hold configurations, accommodating any channel-to-channel skew generated by the probe cables and by the logic analyzer. The calibration is performed on the pod of the HP 16540A master card first, then on the pods of each attached HP 16541A expansion card. If the module includes expansion cards, expansion clocking calibration can be performed after master clocking calibration is complete.

Description

This procedure gives instructions to calibrate the HP 16540A/16541A 100 MHz State Analyzer module and to store the calibration factors to a disk. Using termination adapters to connect pod cables to test stimulus ports, follow the prompts on the screen to connect and disconnect the pod cables.

Note



The calibration performed in this procedure operates the same as the calibration performed during the self-tests. To verify the operation of the module and to perform a calibration at the same time, you can perform the self-tests. Refer to section 6-5 in the service manual, "Self-Tests." Performing the self-tests requires using the Performance Verification disk.

Equipment

Termination Adapter (2) HP 01650-63203

Procedure

1. In the System Configuration menu, touch **System**, **100 MHz State**, then **Configuration**.
2. In the pop-up menu shown in figure B-6, touch **Calibration**.

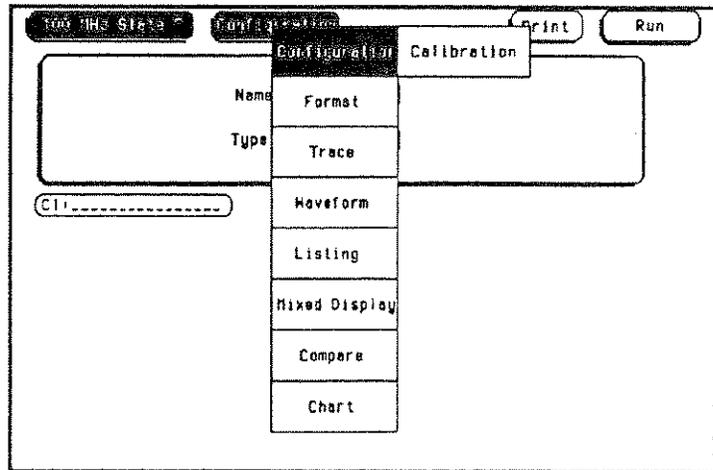


Figure B-6. Select Calibration

Master Clocking Calibration

3. Remove the connector plug located in the stimulus ports on the master card. Touch **Perform Master Clocking System Calibration** in the 100 MHz State Calibration menu, see figure B-7.

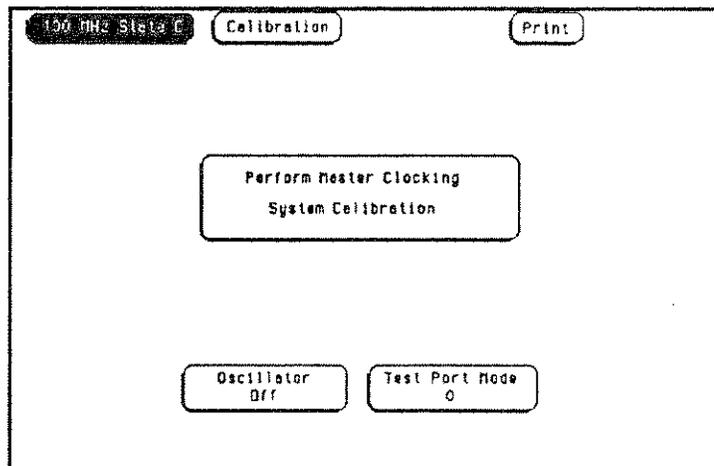


Figure B-7. Master Clocking Calibration

4. Figure B-8 shows step 1 in the calibration. Follow the instructions on the screen to connect the pod from the master card through a termination adapter to test stimulus port 1. The test stimulus ports are labeled on the rear panel of the HP 16540A master card. Touch Proceed. An asterisk will flash in the upper, right corner of the screen while calibration is in progress.

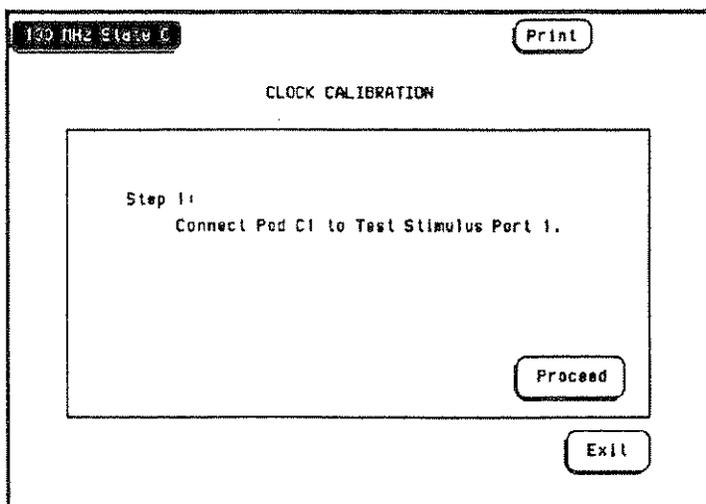


Figure B-8. Master Clocking Calibration Step 1

If the module consists of only the master card, the calibration procedure is complete when the master card pod is calibrated. Go to step 9 to store the calibration values.

If the module consists of the master card and expansion cards, continue with the next step.

5. Figure B-9 shows step 2 in the calibration. Move the master card pod to test stimulus port 2, connect pod 1 of the first expansion card to be calibrated to test stimulus port 1, the touch **Proceed**.

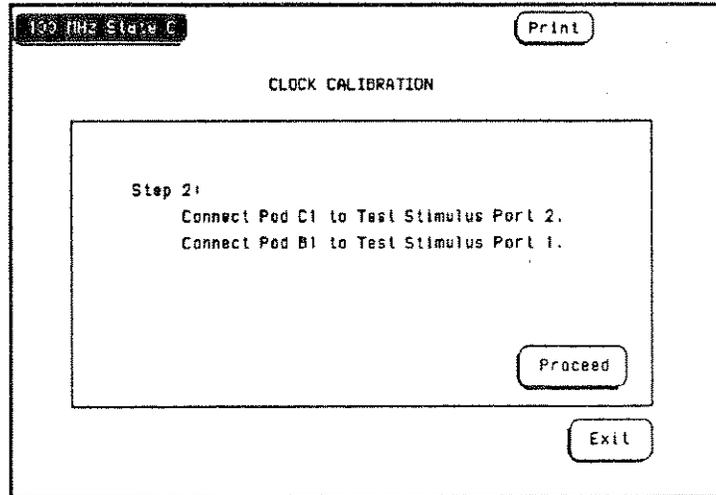


Figure B-9. Master Clocking Calibration Step 2

6. Continue following instructions on the screen to connect the various pods to the test stimulus ports, until all of the expansion card pods are calibrated with the master clock.

Expansion Clocking Calibration

7. The expander clocking system can be calibrated or skipped, as shown in figure B-10.

Note 

For applications using only master clocking, master clocking calibration is sufficient and expansion clocking calibration need not be performed. To use expansion clocking in applications, perform the expansion clocking calibration.

To perform the expansion clocking calibration, touch **Perform Expander Clocking System Calibration**.

To skip the expansion clocking calibration, touch **Skip Expander Clocking System Calibration**.

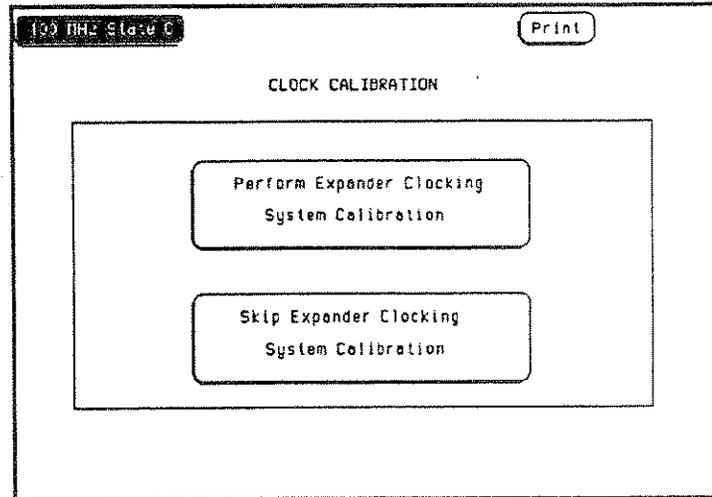


Figure B-10. Expander Clocking Calibration

8. Follow the step-by-step instructions on the screen to connect the pods of the expansion cards to the test stimulus ports. Step 1 is shown in figure B-11.

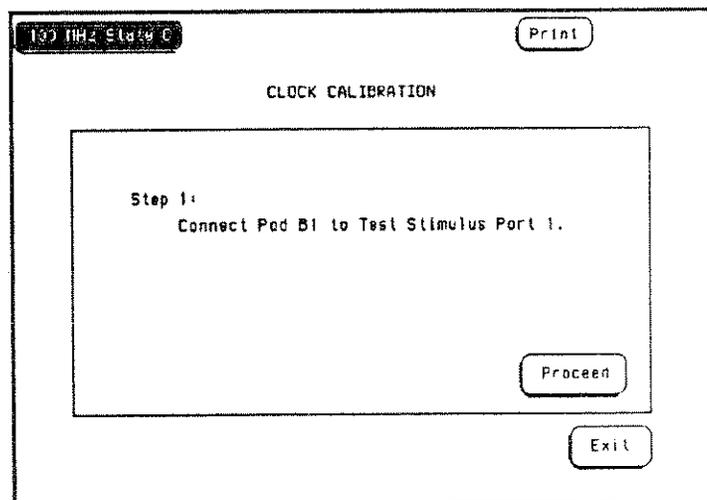


Figure B-11. Expander Clocking Calibration Step 1

Calibration Factors

9. When the calibration is complete, the choice is given to save the calibration factors or to not save the calibration factors, as shown in figure B-12.

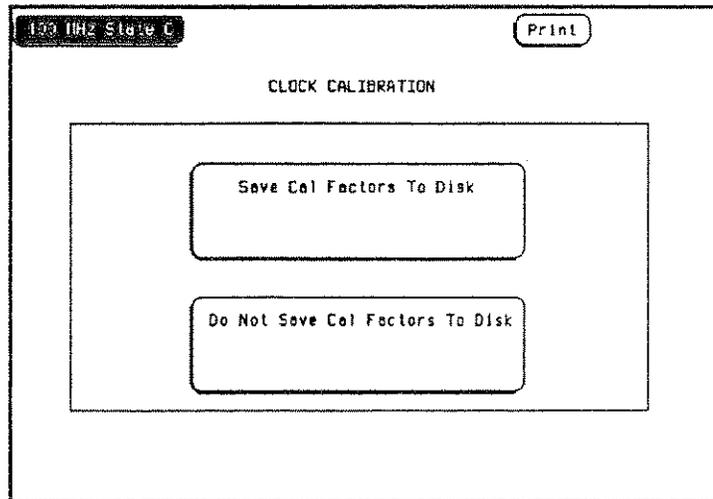


Figure B-12. Save The Calibration Factors

To not save the calibration factors, touch **Do Not Save Cal Factors**.

To save the calibration factors, touch **Save Cal Factors To The Disk**. A keypad pop-up appears on the screen, as shown in figure B-13 on the next page. Before storing the calibration factors to a disk, you can use the keypad pop-up to enter a description of the file to contain the calibration factors or use the default description provided. Important information to include in the description may be the calibration date and time and the HP 16540A serial suffix. Touch **Done** and the calibration factors are stored to the disk.

Note 

The calibration software accesses the rear disk drive first, then the front disk drive. If a disk is in the rear disk drive, the file with calibration factors will be saved to the disk in the rear disk drive.

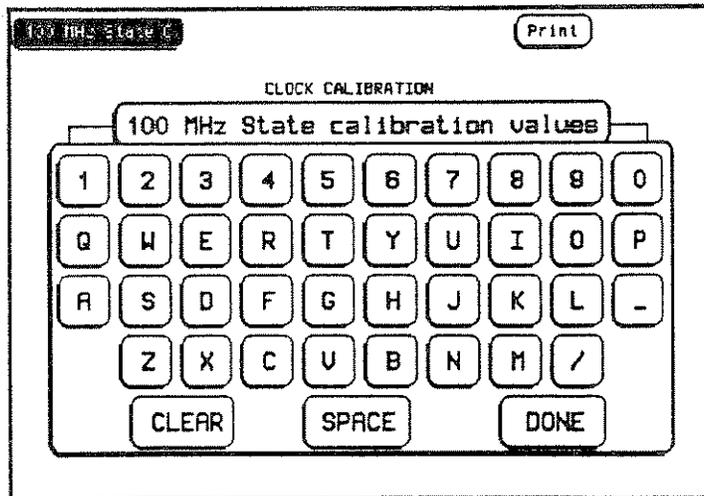


Figure B-13. Keypad For Calibration File

10. To exit the calibration menu, touch Calibration, then touch Configuration in the pop-up menu. See figure B-14.

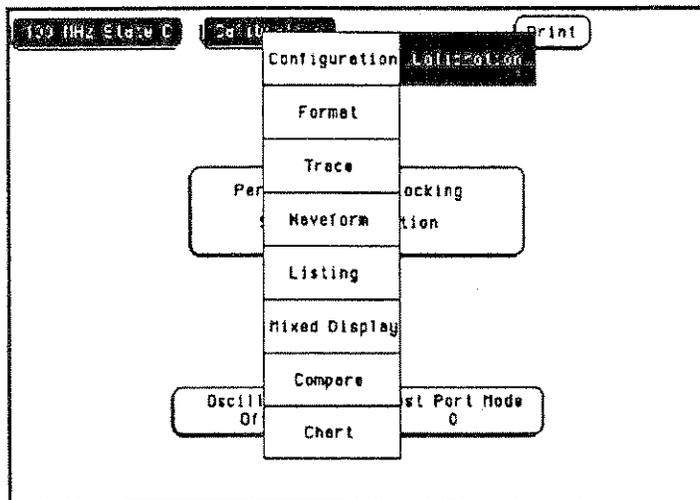


Figure B-14. Exit Calibration

11. Remove the connector plug located in the stimulus ports on the master card.

Error Messages

Introduction

This appendix lists the error messages, warning messages and advisory messages that may be encountered during operation of the analyzer. Error messages have a red background, warning messages have a yellow background, and advisory messages have a green background.

The message is highlighted in bold and a short explanation follows.

Error Messages

Must have at least 1 edge specified. Clock equations must have at least one edge.

Inverse assembler not loaded - bad object code. Corrupt inverse assemble file.

Insufficient memory to load IAL - load aborted. There is not a block of free memory large enough to load inverse assembler.

Time correlation of data is not possible. Count must be set to Time in the Trace menu.

Maximum of 32 channels per label. The user tried to assign more than 32 channels to a label.

ASCII entry not available. ASCII base is not available so another base must be used.

Calibration window too narrow. If the user is doing a master or slave clock cal, and the cal algorithm detects that the window has collapsed to far, this message appears. Cal factors are defaulted.

Unable to open cal factor file. When the user attempts to store cal factors, the save routine returned an error saying the file could not be opened.

No disk. There are no disks in either drive.

Cal factor file not found. Indicator to the user that no cal factor file was found on either front or rear disk drives.

Cal factor file doesn't match hardware. The hardware configuration corresponding to the cal file on the disk does not match the current configuration in the frame.

Cal factor file length mismatch. The expected length of the cal factor file being loaded does not match.

At least one cal dependent test failed. This message appears when the user backs out of the cal dependent tests to the top level if a lower level test failed.

At least one cal independent test failed. This message appears when the user backs out of the cal independent tests to the top level if a lower level test failed.

Threshold Test Failed. This messages will appear if the threshold test failed.

Threshold Test. This messages will appear when the threshold test is being run.

Timetag Test Failed. This messages will appear if the timetag test failed.

Timetag Test. This messages will appear when the timetag test is being run.

Replace These Cards - XXXXX. This message will appears if a PV test fails and serves as instruction to the user to replace the indicated cards.

Memory system failed -- Replace card X. This message will appear in the configuration menu of analyzer if FISO redundancy was unable to correct defects in the memory system of the card identified.

Replace card X. This message will appears if a PV test fails and serves as instruction to the user to replace the indicated card.

Data/Clock Test Failed. This messages will appear if the Data/Clock test failed.

Data/Clock Test. This messages will appear when the Data/Clock test is being run.

Data Memory Test Failed. This messages will appear if the memory system test failed.

Data Memory Test. This messages will appear when the memory system test is being run.

Pattern/Range Detect Test Failed. This messages will appear if the pattern/range test failed.

Pattern/Range Detect Test. This messages will appear when the pattern/range test is being run.

Patt/Rng Memory Test Failed. This messages will appear if the pattern memory test failed.

Patt/Rng Memory Test. This messages will appear when the pattern memory test is being run.

test specific message. This message will appears if a PV test fails and serves as failure information about the indicated card.

Sequencer Test Failed. This messages will appear if the sequencer test failed.

Sequencer Test. This messages will appear when the sequencer test is being run.

Timebase Test Failed. This messages will appear if the timebase test failed.

Timebase Test. This messages will appear when the timebase test is being run.

Warning Messages

Waiting for Poststore. Trigger has been found and module is trying to fill poststore.

Search failed - X pattern not found. Could not place pattern marker.

Search failed - O pattern not found. Could not place pattern marker.

Warning: Run HALTED due to variable change. User has changed an analyzer setting during a repetitive run.

Data was acquired without time tags. Data was acquired without time tags so can't display the time tags values.

Compare not available - Insufficient Memory. Not enough memory available for a Compare image.

Default cal factors loaded. When the system is booted, if a cal factor file is not found that matches current hardware, default values are used.

Waiting for Trigger. At the trigger level and waiting for the trigger to occur.

Invalid card configuration. This would be reported on power-up if the ordering of master and expander omega cards is not in accordance with the rules (ie. master in middle of slaves, contiguous).

Error not found. Compare error number not found.

s/Div set to limit. At the limit of seconds per division.

Delay set to limit. At the limit of the Delay setting.

Machine name: "al name" inverse assembler not found. Indicates missing inverse assembler file.

Slow Clock. Indicates Slow or missing clock.

Advisory Messages

Storing cal factor file completed. Indicator to the user that the saving of cal file is complete.

Loading cal factor file from disk. Indicator to the user that the cal file is being loaded.

Enter cal factor file descriptor. Once Cal is complete and the user requests to save them to disk, this message accompanies a QWERTY keypad to allow the user to uniquely name the cal file.

Storing cal factor file on disk. Indicator to the user that the cal file is being saved.

The current setup will be lost if Calibration is performed. This message will appear when the user enters the calibration at the top level. The current configuration will be lost when the calibration is performed. The configuration should be saved to protect it.

Specifications and Characteristics

Introduction

This appendix lists the specifications, operating characteristics, and supplemental characteristics of the HP 16540A/16541A 100 MHz State Analyzer Module.

Specifications

Maximum External Input Clock Rate: 100 MHz.

Setup/Hold Time: * Adjustable

<u>Setup</u>	<u>Hold</u>
4 ns	0 ns
2 ns	2 ns
0 ns	4 ns

* Specified for an input signal $V_H = -0.9$ V, $V_L = -1.7$ V, slew rate = 1 V/ns, and threshold = -1.3 V.

Characteristics

Channel Count:

HP 16540A: 16 channels. **

HP 16541A: 48 channels (208 channels).

** HP 16540A master supports a maximum of four HP16541A expander boards.

Maximum Sequencer Speed: 100 MHz.

Internal Clock Rate Range: 10 ns to 4 s.

Time and State Tagging:

10 ns time tagging.
Up to 100 MHz state tagging.

Memory Depth per Channel: 4096.

Sequence Levels: 4 + trigger level.

Trigger Width:

Pattern recognition to full width of analyzer at 100 MHz.

Input R: $100\text{ k}\Omega \pm 2\%$.

Input C: $\approx 8\text{ pf}$.

Lead Sets Included:

Yes, (mini-grabbers support included through-hole and surface mount).

Supplemental Characteristics

Probes Minimum Input Voltage Swing: 500 mV peak-to-peak.

Input Threshold Accuracy: $\pm 100\text{ mV} \pm 2\%$ of threshold setting.

Input Dynamic Range: $\pm 10\text{ volts}$ about the threshold.

Minimum Input Overdrive:

250 mV or 30% of the input amplitude, whichever is greater.

Maximum Input Voltage: ± 40 volts peak.

Threshold Setting:

Threshold levels may be defined for each pod on an individual basis and one threshold may be defined for the clocks and qualifiers on each board.

Threshold Range: -3.5 to +5.0 volts in 0.1 volt increments.

State Analysis

External Clocking Mode

Clocks:

Two master clocks are available on the HP 16540A. They can be used to clock in data on the HP 16540A and the HP 16541A. Two expander clocks are available on each HP 16541A when in multiphased mixed mode. Clock edges can be ORed together and operate in single-phase or multiphase mixed mode. Clock edge is selectable as positive, negative, or both edges for each clock.

Minimum Clock Pulse Width: 3 ns.

Clock Qualifiers:

The HP 16540A has one global clock qualifier. The HP 16541A has one local clock qualifier that can qualify data on its channels only when in multiphase mixed mode. The high or low level of the clock qualifiers can be ANDed with the clock specification. Setup time 5 ns; hold time: 1 ns.

Master-Slave Clocking (mixed clocking):

MASTER clock must follow SLAVE clock by at least 10 ns, and precede the next SLAVE clock by at least 10 ns.

Timing Analysis Internal Clocking Mode

Sample Period: 10 ns to 4 s in a 1-2-4 sequence, user selectable.

Sec/div: 10 ns to 1000 s in a 1-2-5 sequence.

Triggering

Pattern Recognizers:

Each recognizer is the AND combination of bit patterns (0,1, or dont care) in each label. Four pattern recognizers are available.

Range Recognizer:

Recognizes data which is numerically between or on two specified patterns (ANDed combination of zeros and/or ones) at 100 MHz. The maximum size is 32 bits, assigned to the least significant bits (pods 1 and 2) of an HP 16541A.

Triggering:

There are one to four trigger sequence levels. Each level before trigger has an occurrence counter, store qualifier, and a branch to any level. The trigger is followed by an additional storage qualification level.

Occurrence Counter:

Sequence qualifier may be specified to occur up to 65535 times before advancing to the next level.

Storage Qualification:

Each sequence level has a qualifier that specifies the states that are to be stored. There is no storage qualification in internal clocking mode, except for the first and last sequence levels.

Qualifier:

A user-specified term definable as anystate, nostate, a single pattern recognizer, range recognizer, or a logical combination of pattern and range recognizers.

Branching:

Each sequence level has a branching qualifier. When satisfied, the analyzer will restart the sequence or branch to another sequence level.

Tagging

State Tagging:

Counts the number of qualified states between each stored state. Measurement can be shown relative to the previous state or relative to trigger. Maximum count is 32 bits.

Time Tagging:

Measures the time between stored states, displayed relative to either the previous state or to the trigger with 10 ns resolution. Maximum time between states is 43 seconds.

Measurement and Display Functions

Arming:

Each module can be armed by the RUN key, external PORT IN, or by another module via the Intermodule Bus (IMB).

Displayed Waveforms:

24 lines maximum, with scrolling across 96 waveforms.

Measurement Functions

Run/Stop Functions

Run: Starts acquisition of data in specified trace mode.

Stop:

In single trace mode or the first run of a repetitive acquisition, STOP halts acquisition and displays the current acquisition data. For subsequent runs in repetitive mode, STOP halts acquisition of data and does not change current display.

Trace Mode:

Single mode acquires data once per trace specification. Repetitive mode repeats single mode acquisitions until stop is pressed or until time interval between two specified patterns is less than or greater than a specified value, or within or not within a specified range.

Indicators **Activity Indicators:**

Provided in the Configuration and Format menus for identifying high, low, or changing states on the inputs.

Markers:

Two markers (green X and yellow O) are shown as dashed lines on the display.

Trigger:

Displayed as a red vertical dashed line in the timing waveform display and as line 0 in the state listing display.

Data Entry/Display **Labels:**

Channels may be grouped together and given a 6-character name. Up to 60 labels in each analyzer may be assigned with up to 32 channels per label.

Display Modes:

State listing, State Waveforms, Chart, Compare Listing, Compare Difference Listing, Timing Waveforms, and Timing Listings. State Listing, Timing Waveforms and Oscilloscope Waveforms can be time-correlated on the same displays.

Timing Waveform:

Pattern readout of timing waveforms at X and O marker.

Bases:

Binary, Octal, Decimal, Hexadecimal, ASCII (display only), and User-defined symbols.

Symbols:

500 maximum. Symbols can be downloaded over RS-232 or HP-IB.

Marker Functions **Time Interval:**

The X and O markers measure the time interval between one point on a timing waveform and trigger, two points on the same timing waveform, two points on different waveforms, or two states (time tagging on).

Delta States: (state analyzer only)

The X and O markers measure the number of tagged states between one state and trigger or between two states.

Patterns:

The X and O markers can be used to locate the *n*th occurrence of a specified pattern from trigger, or from the beginning of data. The O marker can also find the *n*th occurrence of a pattern from the X marker.

Statistics:

X and O marker statistics are calculated for repetitive acquisitions. Patterns must be specified for both markers, and statistics are kept only when both patterns can be found in an acquisition. Statistics are minimum X to O time, maximum X to O time, average X to O time, and ratio of valid runs to total runs.

Auxiliary Power

Power Through Cables: 1/3 amp at 5 V maximum per cable.

Current Draw Per Card:

1/3 amp at 5 V maximum per HP 16540A

1 amp at 5 V maximum per HP 16541A

Operating Environments

Temperature:

Instrument, 0 °C to 55 °C (+32 °F to 131 °F). Probe lead sets and cables, 0 °C to 65 °C (+32 °F to 149 °F).

Humidity:

Instrument, up to 95% relative humidity at +40 °C (+122 °F).

Altitude: To 4600 m (15,000 ft).

Vibration:

Operating: Random vibration 5 to 500 Hz, 10 minutes per axis, ≈ 0.3 g (rms).

Nonoperating: Random vibration 5 to 500 Hz, 10 minutes per axis, ≈ 2.41 g (rms), and swept sine resonant search, 5 to 500 Hz, 0.75 g (0-peak), 5 minute resonant dwell at 4 resonances per axis.

Index

A		C	
accessories available	1-5	Calibration	B-8
accessories supplied	1-4	Calibration factors	B-13
accumulate	8-7	channel mode,	
acquisition,		Individual	8-4
fields (state trace)	6-11	overlay	8-5
Activity Indicators	4-1	sequential	8-4
Advisory messages	C-1	Characteristics	D-1
Alpha data		Clear	3-8, 4-2
how to enter	3-7	clock,	3-5
analyzer,		external type	4-3
configuration capabilities	1-2	internal type	4-3
Assigning bits to pods	3-11	clock field,	
Axes (State Chart)		State Format menu	5-8
Scaling the	10-2	Connecting clock leads	2-9
Selecting the	10-2	Clocking mode,	
		External	5-2
B		Internal	5-2
base,		Type mode	5-2
State Trace	6-20	Compare Image,	9-3
bit assignment	3-11, 5-5	Bit Editing of the	9-4
branches,	6-12	Creating a	9-3
per level	6-13	Masking Channels in the	9-5
restart	6-12	Compare Images	
branching,		Saving	9-8
multiple levels	6-15	Compare Listing Display	9-2
secondary	6-13	Compare Range,	9-6
branching qualifier	6-7	specifying a	9-6
		Configuration menu	3-13, 4-1
		Configuration, intermodule	11-2
		Configuring a printer	A-1

Configuring the analyzer	1-2, 3-2
Connecting,	
Grabbers to probes	2-10
Grabbers to test points	2-10
Labels to pods, probes, cables	2-11
Pods to probe cables	2-8
probe cables to analyzer	2-7
count,	6-16
States	6-18
Time	6-16
cursor	1-2, 3-1, 3-8

D

Data	
how to roll	3-9
Data entry	
alpha	3-7
numeric	3-6
Delay	8-8
Deleting Waveforms	8-6
Difference Listing	
Locating Mismatches in	9-8
Difference Listing Display	9-3
disk drive	1-3, 3-1

E

ECL	5-7
Entering data,	
numeric	3-6
Error messages	C-1

F

Features of analyzer	1-3
Find X-O markers from trigger	7-7
Front-Panel interface,	
how to use	3-1
mouse	3-1
keyboard	3-1
selecting menus	3-2
selecting options	3-4
using pop-up menus	3-4
entering numbers	3-6
entering letters	3-7
rolling data	3-9
assigning bits to pods	3-11

G

General Purpose Probe Interface	2-2
Grabbers	2-6

I

Input Voltage for Probes	2-7
Inserting waveforms	8-6, 11-2
Installation,	
additional expander cards	B-7
card	B-2
power requirements	B-1
probe cable	B-1
interface,	
front-panel	3-1

N	
name,	
analyzer	3-8
label	5-4
Name: field	4-2
Numeric entry,	
how to enter	3-6

O	
O to Trig(ger)	8-9
occurrence counter	6-8

P	
pattern,	
recognizers	6-2
Pattern Fields (state)	6-22
patterns,	6-21
fields	6-20
Pod Clock,	5-11
master	5-11
slave	5-11
Pod Grounding	2-5
Pod rolling	5-3
Pod Thresholds	2-7
Pods,	
clock	5-11
threshold	5-7
Polarity (Pol)	5-5
pop-up menus,	3-4
how to close	3-4
options	3-4
Preprocessors	1-5,
print,	

all	4-3, A-2
cancel	4-3
options	A-1
screen	4-3, A-2
Probing	2-1
Probe Cables	2-6
Probe Connecting,	
Clock leads	2-9
Disconnecting Probes from Pods	2-8
Grabbers to Probes	2-10
Grabbers to Test Points	2-10
Labels to Pods, Probes, and Cables	2-11
Pods to Probe Cables	2-8
Probe Cables to Analyzer	2-7
Probe Grounding	2-6
Probe Pod Assemblies	2-4
Probes	2-5
Probing Options,	
General Purpose Probing	2-2
Microprocessor and Bus	2-2
HP 10320C User-Definable	
Interface	2-1
Termination Adapter	2-3
Probing System for Analyzer,	
description	2-4
Grabbers	2-6
Maximum Probe Input Voltage	2-7
Probe and pod Grounding	2-5
Probe Cable	2-6
Probe Grounding	2-6
Probe Tip Assemblies	2-4
Probes Leads	2-5
Minimum System Amplitude	2-7
Maximum probe input voltage	2-7

Q	
Qualifier Field (state)	6-21
qualifier,	6-2
branching	6-7

fields	6-20	fields	5-3
storage	6-7	Listing menu,	3-9, 7-1
		Accessing the	7-2
		fields	7-2
		state tagging	6-18
		Trace menu,	6-1
		Accessing the	6-2
		fields	6-2
		states per division	8-7
		statistics updating	7-5
		Stop Measurement	7-8
		storage qualifier	6-7
		symbols,	
		base	5-16
		delete	5-21
		label	5-16
		modify	5-21
		name	5-19
		width	5-18
		symbols,	
		insert	5-21
		System Configuration Menu,	
		returning to	3-13
		T	
		tagging,	6-16
		state	6-18
		time	6-17
		Termination Adapter	2-2
		threshold,	
		pod	5-7
		Time-correlated displays	11-3
		time tagging	6-17
		Time/Div (time per division)	8-7
		touchscreen	1-2
		Trace menu	6-1
		TTL	5-7
		Type: field,	4-2, 5-2, 8-1
		State or Timing clocks	8-1

U

User Interface	1-1
User-Definable Interface	2-1

W

Warning messages	C-1
Waveform Menu,	8-1
accessing	8-2
selecting state or timing	8-1
waveform selection	8-2
Waveforms,	
insert/replace/delete	8-6, 11-2

X

X and O markers,	
Chart menu	10-5
Listing menu	7-3
Waveform menu	8-8
X to Trig(ger)	8-9

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100



Printed in U.S.A.