Chapter 1
General Information

INTRODUCTION

The 1631A/D is a general purpose Logic Analyzer capable of performing State, Timing and Analog waveform measurements. Each of these analyzer functions may be used alone or simultaneously and interactively. The high performance, ease of use, and interactive nature of the 1631 measurement set lends itself readily to the design, debug and characterization of digital systems. The 1631 provides the digital hardware designer, the microprocessor software designer and the system integrator with a diversity of windows into the system under test which allows observations never before attainable in a single stand alone instrument.

MANUAL ORGANIZATION

This manual describes how to install, operate and program the HP Models 1631A and 1631D Logic Analyzers. For the first time user, Chapter 1 and the introductions to each of the chapters on Analog, Timing, State, and Interactive measurements will provide the overview of the machine organization and the process of making measurements necessary to get started. The experienced user will find the detailed menu information in the chapters as well as the menu map in chapter 3 to be a good reference source when making complex measurement setups.

MANUAL CONTENTS

Chapter 1 contains a description of the 1631 measurement capability as well as physical and electrical information about the logic analyzer. At the end of this chapter tables list the specifications and operating characteristics of the analyzer.

Chapter 2 describes how to install the logic analyzer. Directions are provided for intiating the self test and for connecting the analyzer to the target system.

Chapter 3 is a front panel keyboard description and a menu map. The menu map is a hierarchical description of the logic analyzer menus.

Chapter 4 describes the analog measurement capability of the machine followed by a detailed description of analog user interface menus.

Chapter 5 contains a description of the analyzer's timing measurement set followed by a detailed description of the timing menus.

Chapter 6 is devoted to state measurements.

Chapter 7 describes software performance analysis. These measurements are an extension of state measurements and allow software to be viewed on a higher level than the state to state transaction detail provided by the state analyzer.

Chapter 8 addresses configuring the analyzer for interactive analog/timing/state measurements.

Chapter 9 describes the use of peripherals with the logic analyzer. The peripherals menu is described and use of the analyzer with a disc memory and printer is explained.

Chapter 10 contains the instructions for remotely programming the analyzer via HP-IB or HP-IL.

Appendix A delineates and interprets all the possible status, error, and prompt messages which may appear on the logic analyzer display during operation.

Appendix B contains information to aid in HP-IB interfacing.

ANALYZER DESCRIPTION

The 1631 is a general purpose instrument for use in the design, debug, and functional test of digital hardware and microprocessor hardware and software. It features measurement capability in all three domains of interest to the digital system designer: Analog, Timing, and State. Functionality in each of these domains is available to the user separately or in interactive combination.

The 1631 is a stand alone, benchtop instrument with integral keyboard and display, but it may be remotely programmed by an external controller over its built in HP-IB. HP-IB also provides linkage to peripherals such as a number of discs and printers. A micro floppy disc can be connected to the 1631 for the store and recall of measurement configurations and acquired data. A printer will provide hardcopy of waveforms, listings, and instrument configurations at the touch of a key.

The two channel Analog Analyzer has all the utility of a general purpose digitizing oscilloscope. It provides the hardware designer with the power to reliably trigger and display single shot of low repetition rate events with ease. Because of its digital storage architecture, simultaneous acquisition on both channels with inherent time correlation and negative time capture are possible. When triggered interactively from the Timing or State Analyzers, the Analog Analyzer can capture highly qualified parametric data which could never before be observed with a conventional oscilloscope.

The Timing Analyzer couples high speed asynchronous sampling on up to 16 channels (1631D) with the convenience of a logic waveform display. It allows the designer to view and measure timing relationships across all channels and to observe and trigger on glitches, patterns, and edges. Built-in Post Processing of acquired timing data extends the power of the Timing Analyzer. Automatic post acquisition marking of the x and o cursor system on user specified events provided instant time interval measurements. For repetitive events, post processing provides statistical characterization of user specified events and increased time interval measurment accuracy.

The State Analyzer is a synchronous acquisition system up to 43 channels wide (1631D) which derives its clock from the system under test. The analyzer captures the logic state of all its input channels on the user specified edge of this clock. The State Analyzer is frequently used to monitor microprocessor program flow by probing the processor's address, data, and status busses but it also has utility in debugging synchronous communication busses or algorithmic state machine. The State Analyzer features powerful sequencing and data storage qualification through its Trace Specification which allows the hardware or software designer to window in on events of interest. The Format Specification maps user specified labels to input channels to make the analyzer's displays reflect activity in the context of the user's system. A number of useful output display formats are available including state listings, disassembled code listings, or histograms of activity.

Analyzer Memory

The trace memory of each section of the analyzer (analog, timing, or analog) is 1024 states deep. The analog memory stores 1024 six-bit samples per channel during a trace measurement. The state memory stores each qualified state captured by the input probes. The compare memory of the state mode is sixteen states deep. It stores up to sixteen lines for comparison with the corresponding lines in the trace memory. The timing memory stores 1024 sample measurements for the timing listing so periods of time between occurrences of interest may be analyzed.

Analog Performance Features

- 200 MHz sample rate
- 50MHz analog bandwidth
- 2 channel simultaneous acquisition
- 1024 deep acquisition memory per channel

- analog triggering - slope/level on internal or external
- analog waveform displayed in full pixel graphics
- x and o cursor system for waveform time and voltage measurements
- post acquisition processing for auto answers and statistical characterization
- cumulative display mode for infinite persistence applications

Timing Performance Features

- 100 MHz sample rate on up to 16 channels
- 1024 deep acquisition memory per channel
- pattern, edge, and glitch triggering
- waveform or list displays of acquired data
- x and o cursor system for waveform time interval measurements
- post acquisition processing for auto answers and statistical characterization

State Performance Features

- external clock rates to 25 MHz
- two phase demultiplexing
- up to 43 channels (1631D)
- 1024 deep acquisition memory per channel
- pattern, sequence, and occurrence count triggering
- storage qualification
- state and time interval histogramming

USING THE 1631A/D LOGIC ANALYZER

The 1631A/D is a menu driven instrument with six basic menus divided equally between input specification menus and output display menus. The six keys along the top of the analyzer's keyboard select the currently displayed menu. The user interacts with the machine by selecting the menu of interest and moving the on-screen flashing cursor into inverse video selet fields in the displayed menu. NEXT[ ] and PREV[ ] keys may then be used to roll through the options available in that select field. User specified input such as labels or numeric entry is accomplished via the keyboard. The function of each of the six major menus are outlined as follows.

The System Specification

The System Specification menu is used to configure the function modes of the anaylyzer: as an analog, timing, state or mixed machine. This menu is also used to identify how the analyzer will operate, as part of a system or, when capabiltities offered by accessories are available.

The Format Specification

The Format Specification menus are used to set up the way the analyzer will organize and arrange the acquired data. Individual bits, or groups of bits may be labeled to identify address ranges or specific values found in the labeled bits. The analyzer displays are composed from the labels.

The Trace Specification

Parameters and conditions for making measurements are determined by the Trace Specification menus. Trace measurements are made when the conditions of the trace specification have been met. Post processing and statistical measurements for analog and timing are specified in this menu. The software performance overview measurements are set up in the state trace specification menu.

Waveform Displays

The analyzer displays up to 16 state or timing waveforms, both analog channels, or a combination of timing and analog channels. Each state and timing trace is shown as a continuous line of high and low states. The waveform shows how the states changed with time at each monitored point. When glitch mode has been selected, points on the timing trace where glitches were detected are marked. Glitch detection is accomplished by internally combining two timing channels attached to a single probe, using one channel for data values and the other channel for glitch detection. The trace specification can be displayed with the analog waveforms for stand alone scope operation.

List Displays (State and Timing Analyzers)

The analyzer composes lists of information captured from the labeled sets of bits. The lists show series of software executions or a sequence of electrical activites at nodes in a target system. Values in these lists can be expressed with user names or in binary, octal, decimal, or hexidecimal number bases. Values may also be expressed as ASCII codes for labels having from 6 to 16 bits.

Chart Displays (State and Timing Analyzers)

The analyzer formats two types of chart displays: XY charts and histograms. XY charts show a plot of the flow of values on a labeled set of bits. The horizontal and vertical scales of the chart may be controlled to examine the details around areas of interest on the XY chart.

Histogram charts are bar graphs used to measure the performance of software modules in a target system. The analyzer can show two types of histograms: state label histograms and time interval histograms. A state label histogram shows the relative number of executions within each range of states that have been defined in the state label overview specification. Up to eight ranges of states can be defined for a label histogram. Time interval histograms show eight time ranges which are user defined in the time interval overview specification. Time interval measurements are made each time the software executes from one selected point to another in the target system. The time interval histogram shows how often execution of the selected software module was completed within each time of the ranges defined in the overview specification.

PHYSICAL CONFIGURATIONS

The following are lists of physical configurations of the 1631A/D, the standard accessories shipped with each instrument and the optional accessories available.

Analyzer Configurations

HP Model 1631A Logic Analyzer. Offers 35 channels for state measurements, of which 8 channels may be used for timing measurements, and 2 analog channels with an external trigger channel.

HP Model 1631D Logic Analyzer. Offers 43 channels for state measurements, of which 16 channels may be used for timing measurements, and 2 analog channels with an external trigger channel.

Standard Accessories

HP Model 10271A General Purpose State Probe with 10 channel clip assembly. Provides nine channels for collecting state activity and one channel for an input clock. Used to supply state activity only. Three state probes are supplied with the 1631A and the 1631D.

HP Model 10272A General Purpose State/Timing Probe with 8 channel clip assembly. Provides eight channels for collecting state or timing activity. No input clock channel. One state/timing probe is supplied with the 1631A and two are supplied with the 1631D.

HP Model 10017A Probe. 10:1 1 Megohm/8.0 pF probe for 1 Megohm/9-14 pF Input. Each probe is supplied with one retractable hook tip, on IC probe tip adapter, one alligator clip, one 20 cm (8 inches) gound lead, one grounding spring, and one Operating Note. Two probes are supplied with each 1631A and 1631D.

HP Model 1250-1454. BNC to Probe Adapter. For logic analyzer rear panel BNC calibration signal for analog probe compensation.

One 2.3 meter (7.5 feet) power cord.

One Operating and Programming Manual.

Optional Accessories

HP Model 9121D/S or 9122D/S Flexible Disc Drive. Accessory to store instrument setups and captured data in disc memory.

HP Model 10269A/B Probe Interface. Accessory used to make connections to interface the analyzer to a specific microprocessor.

SAFETY CONSIDERATIONS

WARNING

To prevent personal injury, observe all safety precautions and warnings stated on the instrument and in the manual.

This product is a Safety Class I instrument (provided with a protective earth terminal). The instrument and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page supplied at the beginning of this manual for a summary of general safety information. Safety precautions for installation, operation, are placed in appropriate locations throughout the Operating and Programming Manual. These precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in the manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard assumes no liability for failure to comply with these requirements.

SPECIFICATIONS, OPERATING AND GENERAL CHARACTERISTICS

Features and specifications are listed in tables 1-1. The specifications in table 1-1 are the performance standards or limits by which the instrument is tested and guaranteed by Hewlett-Packard. The operating characteristics are listed in table 1-2 and general characteristics are listed in table 1-3. The characteristics are not specifications but typical characteristics included as additional information for the user.

Table 1-1. 1631A/D Features and Specifications

MEASUREMENT CONFIGURATION/CHANNELS

HP 1631A State	HP 1631A Timing	HP 1631A Analog	HP 1631D State	HP 1631D Timing	HP 1631D Analog
35	—	—	43	—	—
27	8	—	35	8	—
—	8	—	27	16	—
—	—	2	—	16	—
—	8	2	—	—	2
27	8	2	—	16	2
35	—	2	27	16	2
			35	8	2
			43	—	2

NOTE: Number of timing channels halved in glitch mode.

MEASUREMENT FUNCTIONS

Analog Specifications

Channels 1 and 2 (Vertical)

Probe Factors: 1:1, 10:1, or 50:1 probe attenuation factors may be entered to scale the HP 1631A/D to input voltages at the probe tip. All vertical specifications relate to a 1:1 probe factor.

Range: 40 mV to 2.5 V full-scale, automatically calibrated internally with two-digit resolution with each change in format specification.

Bandwidth (-3 dB)
dc coupled: dc to 50 MHz

Dc gain accuracy: ±2.5% of full-scale
Channel isolation: 55 dB from dc to 50 MHz

Analog-to-Digital Conversion (ADC) resolution:
±1 LSB, which is ±1.6% of full-scale

Dc offset range/resolution:

Offset Range	Offset Resolution
±1.5 V	approximately 1 mV

Transition time: ≤5.25 ns, 20% to 80% of full-scale.

Input coupling: dc

Input RC: 1 MΩ ±2%, shunted by approximately 14 pF

Maximum safe input voltage: ±40 V (dc + peak ac)

Trigger (Analog)

Sources: channel 1, channel 2, or external trigger input.

Edge: rising or falling edge may be selected for any source.

Sensitivity: (square wave up to 10 MHz)
.2 of full-scale for channels 1 and 2
50 mV p-to-p for external
Up to 50 MHz
.3 of full-scale for channels 1 and 2
100 mV p-to-p for external

Table 1-1. 1631A/D Features and Specifications (Cont'd)

Level range/resolution:
internal: within the display window/approximately 1% of full scale
external: ±2 V in 1 mV steps

External trigger input:
Maximum safe input voltage: ±40 V (dc + peak ac)
input coupling: dc
input RC: 1 MΩ ±2%, shunted by approximately 14 pF

Time Base (Horizontal)

Sample period: 5 ns to 500 ms in a 1-2-5 sequence.

Range: 125 ns to 500 s full-scale (10 divisions).

Time base accuracy
sample period: ±.01%
time-interval measurement accuracy: (equal rise and fall times)
single-shot: ±1.5 ns for 5 ns sample period
±1 sample period for sample periods of 10 ns or greater
continuous: ±.15 times sample period, based on 100 averages

Tracepoint and Delay

tracepoint: equals trigger plus delay; trace point can be delayed from 0 to 262, 143 sample periods after the trigger.
tracepoint placement accuracy: within ±1 sample period ±.1 times full-scale voltage divided by the slew rate of the input signal.
tracepoint position: can be set approximately 50 sample periods from the start, end, or near the center of the data record. A 1024-sample record can be positioned with about 950 samples before the tracepoint, or with the entire data record beginning up to 262, 074 samples after the trigger.

Notes: specifications apply after a 30 minute warm up period.
Single-shot reconstruction uncertainty = ±1 ns (applies for time ranges of 50 ns thru 2 us)

State/Timing Input Specifications

Probes

RC: 100 kΩ ±2% shunted by approximately 5 pF at probe body.
Minimum, Swing: 600 mV p-to-p
Minimum Input Overdrive (Above Pod Threshold): 250 mV or 30% of input amplitude, whichever is greater.
Maximum Voltage: ±40 V, peak.
Threshold Voltage: −9.9 V to +9.9 V in 0.1 V increments.
accuracy: 2.5% ±120 mV.
Dynamic Range: ±10 V about threshold.

State Mode

Clock Repetition Rate
single phase: 25 MHz with single clock and single edge specified; 20 MHz with any ORed combination of clocks and edges.
multiplexed: master-slave clock timing; master clock must follow slave clock by at least 10 ns and precede next slave clock by 50 ns or more.
Clock Pulse Width: ≥ 20 ns at threshold.
Setup Time: ≥ 20 ns, the time data must be present prior to clock transition.
Hold Time: 0 ns, the time data must be present after clock transition.

Time Mode

Glitch: with glitch detection on, number of timing channels is halved.
Minimum detectable glitch: 5 ns width at threshold.

Table 1-2. 1631A/D Operating Characteristics

ANALOG

Digitizer: Two channels are digitized simultaneously.
Digitizing Technique Real-time digitizing: all data points are digitized, at equal selectable increments in time, on each acquisition.
Digitizing Rate: selectable, 2 samples/second to 200 megasamples/second
Voltage Resolution: 6 bits; 1 part in 64.
Acquisition Memory: 1024 samples, 6 bits each per channel, 2 channels; up to 1000 samples are used for display; magnifier allows full screen display from 1000 samples to 25 samples; the entire 1024 sample record can be accessed via HP-IB and HP-IL.

Display

Waveform

Straight line: waveforms are displayed by connecting adjacent sample points with a vertical and a horizontal line.

Filtered: a post acquisition interpolation filter provides up to 19 additional points between each sample point; waveforms are displayed by connecting adjacent interpolated points with two lines, as above.

Data Display Formats: one or two analog waveforms can be displayed simultaneously in the analog waveform display or with a combination of timing waveforms in the timing waveform display.

Number of Analog Waveforms	Number of Timing Waveforms Without Glitch	Number of Timing Waveforms With Glitch
2	8	4
1	12	6

Single: the display retains the previous acquisition until RUN is pressed.
Continuous: the display is updated with each new waveform acquisition.
Cumulative: all successive waveform acquisitions are displayed together until STOP is pressed.
Real-time: allows selected trace point conditions to be changed in continuous trace/display mode.

Graticules: full grid

Indicators

Memory: the amount of acquisition memory displayed is indicated below the graticule as a solid bar with the remaining memory shown in dots at double the graticule dot density.

Cursors: x and o cursors are shown as solid vertical lines in the display. The x cursor is indicated as a tic mark on the top of the memory bar; the o cursor is indicated as a tic mark on the bottom of the memory bar.

Tracepoint: Shown as a vertical dashed line in the display.

Run/Real-Time/Stop/Resume

RUN: allows an acquisition when tracepoint conditions are met. Clears all previous traces and statistics.
STOP: immediately halts acquisition; acquisition can be resumed. If in continuous trace mode/single display mode, acquisition is halted after trace is complete.
RESUME: Allows acquisition to continue after STOP for the purpose of continuing to obtain statistics under tracepoint and/or x-o cursor conditions. The waveform display is not cleared if in the cumulative display mode.
STOP/STOP: aborts acquisition; acquisition cannot be resumed.

Measurement Aids

Cursors: two cursors (x and o) are provided for making voltage and time measurements on displayed waveforms. Both absolute and differential values are provided for voltage measurements. Dual cursor time measurements can be made between two points on the same waveform or between two points on different waveforms.

Table 1-2. Operating Characteristics (Cont'd)

Cursor Statistics: x to o cursor statistics are provided for continuous voltage and time measurements: maximum, minimum, mean, and standard deviation. Single cursor voltage statistics can be obtained on either waveform. Dual cursor statistics can be obtained between two points on the same waveform or between two points on different waveforms (time only).

Cursor Placement: Both x and o cursors can be uniquely specified with respect to the tracepoint or acquisition start, by selection of channel 1 or 2, rising or falling edge, voltage level, hold or delay time.

STOP Continuous RUN: pressing RUN processes waveform acquisitions until the cursor-based RUN-STOP condition is met; RUN-STOP conditions include greater-than/less-than time intervals, or a specific number of acquisitions. The time from the end of an acquisition until the instrument is ready to accept a new acquisition is approximately 40 ms (with statistical measurements OFF).

Setup Aids

Presets: scales the vertical range to predetermined values for displaying ECL (0.0 V to −2.0 V) or TTL (−0.5 V to +5.5 V) waveforms.

Activity: aids the scaling of vertical range and offset using a display of signal activity placed with respect to the voltage limits specified. Activity shown while not running.

TIMING

Timing Mode/clock

Ranges: 10 ns to 500 ms in a 1-2-5 sequence.

Timebase Accuracy

sample period: ±0.01%

time interval accuracy

single-shot: = ±1 sample period

continuous: = ±.15 sample period, based on 100 averages.

Timing Mode/data Indexing

Asynchronous pattern: 20 ns to 1 ms in a 1-2-5 sequence with an accuracy of ±20% or 15 ns, whichever is greater. Glitch or edge on selected channels ANDed with asynchronous pattern.

Maximum time delay: Approximately 2^{18} times the sample period to a maximum of 9999 seconds.

Timing Mode/expansion

Times 1 to times 40 in a 1-2-4 sequence. Display is a compressed representation of the 1k memory in times 1 magnification. In times 2 magnification and above, each display sample represents a single sample in memory.

Timing Mode/overview

Graph: A graph of any user-defined label can be shown. The user can specify the upper and lower bounds of the graph, and all 1024 states of the memory can be simultaneously displayed.

Measurement Aids

Cursors: two cursors (x and o) are provided for making time measurements on waveform patterns.

Cursor Statistics: x-to-o cursor statistics are provided for time measurements: maximum, minimum, mean, and standard deviation.

Cursor Placement/data Marks: both x and o cursors and up to four data marks (a,b,c, and d) can be uniquely specified with respect to the trace point or acquisition start by selecting up to eight timing patterns (Pn) in conjunction with choices of entering/leaving the pattern (including any glitch) along with greater-than/less-than time intervals.

STOP Continuous RUN: Pressing RUN processes timing data acquisitions until the cursor-based RUN-STOP condition is met. RUN-STOP conditions include greater-than/less-than time intervals or a specific data mark quantity, a specific number of acquisitions, or a sequence of up to four data mark terms. The time from the end of the acquisition until the instrument is ready to accept a new acquisition is approximately 100 ms (with statistical measurements and data marking off).

Table 1-2. Operating Characteristics (Cont'd)

STATE

Memory

Data acquisition: 1024 words

Compare: 16 words

Search: Memory may be searched for any pattern defined within a label set. All pattern matches in memory may be marked or separately displayed.

State Mode/clocks: three ORed clocks operate in one-phase or two-phase demultiplexing mode. Clock edge is selectable as positive, negative, or both edges for each clock. Different edge selections may be made on the same clock if it is used in both phases of the multiplexed mode.

State Mode/data Indexing

Resources: four terms including the Boolean NOT of each term, any pattern or NO pattern; a term is the AND combination of bit patterns in each label. Terms may be used as often as desired.

Trigger: up to four resource terms may be used in sequence to establish the trace parameter. The last term in the sequence may use up to four resource terms in an ORed format.

Restart: one to four resource terms may be used in an ORed condition for a sequence restart condition.

Store qualifiers: one to four resource terms may be used in an ORed format. Store qualification may be separately defined for each term in the trigger sequence.

Occurrence: the number of occurrences of the last event in the sequence may be specified up to n=59999.

Edit compare: trace until compare "equal to" or "not equal to" is provided. The compare file is the width of the analyzer, with a depth of up to 16 words. Each word in the compare buffer can have "don't cares" and can be compared anywhere in the 1024-word memory.

State Mode/overview

XY chart: a chart of any user-defined label can be shown. The user can specify the upper and lower bounds of the chart, and all 1024 states of the memory can be simultaneously displayed.

Time-interval measurement: A timer can be started on completion of a sequence of up to three resource terms with restart and occurrence capabilities such as state data indexing. The timer can be stopped on an ORed combination of one to four resource terms. A histogram of the start/stop measurement is displayed. The user can specify up to eight time ranges. Minimum time, maximum time, average time, last time, total time, and total samples are also displayed.

Resolution: displayed statistics—250 ns or 1% of reading, whichever is greater, (four digit display). histogram ranges: 1 ms.

State label measurement: a histogram of any user-defined label can be shown. The user can specify up to eight labels and ranges.

Maximum count: $2^{63}-1$.

INTERACTIVE MEASUREMENTS

Acquisition: analog, timing and state data acquisition occur simultaneously.

Arming: either of the three analyzers can be master while the remaining two are slave.

Master state: the waveform analyzer and the timing analyzer can be simultaneously armed by the full data indexing capability of the state analyzer.

Master timing: the waveform analyzer and the state analyzer can be simultaneously armed by the full data indexing capability of the timing analyzer.

Master analog: the timing analyzer and the state analyzer can be simultaneously armed by the full analog indexing capability of the waveform analyzer.

Arming time: the time required to arm and be armed in a master/slave configuration is:

state index to arm reference high: approximately 75 ns.

timing index to arm reference: approximately 12 times (sample period) + 10 ns

analog index to arm reference high: approximately eight times (sample period) + 10 ns

arm reference high to analog armed: approximately −5 ns

arm reference high to timing armed: approximately −20 ns

arm reference high to state armed: approximately −30 ns

Table 1-2. Operating Characteristics (Cont'd)

Tracepoint Alignment: analog, timing, and state acquisition data can be correlated in time.

Mixed display: timing channels can be displayed on the same screen with analog channels; the tracepoint and time/div are common to timing and analog in this display mode, and set by the timing analyzer.

Tracepoint alignment: analog waveform data alignment to timing analyzer data is less than 1 analog sample period + timing sample period + 15 ns

Operating modes: to correlate data between analyzers, the slave analyzer must be set up to trigger on a DON'T CARE (timing) or TRIGGER IMMEDIATE (analog) condition. Any other slave trigger condition results in uncorrelated data.

Timing analyzer master: analog slave - trigger immediate.

Analog master: timing analyzer slave - trigger pattern, all DON'T CARES.

State analyzer master: timing analyzer slave - trigger pattern, all DON'T CARES; analog slave - trigger immediate.

Insert-to-correlate: provides cursor correlation, between timing and analog data. Cursors in one waveform display can be directly placed at the same time location as those cursors in the other waveform display by pressing insert-to-correlate. The cursor in the MAGNIFY ABOUT [ ] selection is cursor-correlated. Going to a post-processing menu causes the cursors to return to their specified location.

Table 1-3. General Characteristics

Labels

Input channel labels: up to eight state, 16 timing, user-defined, five-character labels may be assigned bit patterns in any configuration up to 43 bits per label. Bits may be used in more than one label and need not be contiguous. Primary use is for identifying bits assigned to bus structures such as address, data, and status.

User field: all labels with four bits or less allow mnemonics to be assigned to specific patterns. Primary use is to identify such functions as read, write, opcode, etc.

Relocatable field: any single label may be defined to have relocatable properties to facilitate viewing software modules in the format they were written. Up to sixteen module starting-locations may be specified, allowing trigger parameters to be based on module names, plus an offset value. An on board calculator that operates in hex, octal, binary, or decimal facilitates generating the offset table.

Time-of-day-clock: a 24-hour clock prints out the time of data collection on all stored records.

Activity Markers: provided in the format display for identification of active inputs.

HP-IB Outputs: an HP-IB connector, along with an eight-position HP-IB switch, is located on the rear panel. Five positions on the switch are used to determine the address, two positions are used to determine "talk-only," for hardcopy, or system controller modes. The HP-IB can be used in the following environments.

1. Logic analyzer being controlled from a controller, such as an HP 9826A.
2. Hardcopy on graphics printer, such as the HP 2225A.
3. Storage of setups and data. Using the HP 9121S/D or 9122S/D disc drive, up to 64 files can be stored on one disc. Also, when coupled with an appropriate microprocessor, the HP 1631A/D can assume a microprocessor-specific personality to present data in a mnemonic format.

Outputs/rear-panel BNCs: one output BNC is located on the rear panel with TTL output. High is ≥2V into 50Ω; low is 0.4 V into 50 Ω. The BNC can be programmed from the keyboard to provide the following signals.

1. Pulse on state tracepoint
2. High until state tracepoint
3. Low until state tracepoint
4. High on last sequence
5. Constant high
6. Constant low
7. High on timing pattern
8. Probe compensation source
9. Positive edge on analog trigger.

A second BNC is located on the rear panel to provide +5 V for the HP 10269B probe (proprocessor) interface.

Operating Environment

Temperature: 0° to 55° C (32 to 131° F)

Humidity: up to 95% relative humidity at 40° C.

Altitude: to 4 600 m (15 000) ft).

Vibration: vibrated in three planes for 15 minutes each with 0.3 mm excursions, 5 to 55 Hz.

Dimensions: refer to outline drawing:

Weight: HP 1631A: 13.2 kg (29 lb) net; 17.7 kg (39 lb) shipping.
HP 163D: 13.8 kg (30 lb) net; 18.4 kg (40 lb) shipping.

Power: 115/230 Vac, −22% to +10%; 300 W max; 48-66 Hz.

Programmability; all instrument configurations and acquisition data may be remotely programmed via HP-IB (IEEE-448) or HP-IL.