SECTION 1
GENERAL INFORMATION

1-1. INTRODUCTION

This service manual contains information on installing, testing, adjusting, and servicing the Hewlett-Packard Models 1650A and 1651A Logic Analyzers. This section of the manual includes instrument identification, description, options, accessories, specifications and other basic information.

A microfiche part number is listed under the manual part number on the title page of this manual. This number may be used to order 4 X 6-inch microfiche transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also contains the latest Manual Changes supplement as well as pertinent Service Notes.

1-2. INSTRUMENTS COVERED BY MANUAL

On the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is composed of two parts; the first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments and changes only when a change has been made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

An instrument manufactured after the printing of this manual may have a serial number prefix different than those listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this instrument is accompanied by a yellow Manual Changes supplement. This supplement contains the necessary "change information" that explains how to adapt the manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as accurate as possible, periodically request the latest Manual Change supplement for the instrument manual. The supplement for this manual is identified with the manual part number and print date, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial prefix number not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-3. INSTRUMENT DESCRIPTION

The HP 1650A is an 80-channel STATE/TIMING (25 MHz/100 MHz) logic analyzer, selectable in 16 channel groupings. The 1651A is a 32-channel STATE/TIMING logic analyzer, also selectable in 16 channel groupings. The user interface consists of a panel keyboard with an RPG knob and a nine-inch white phosphor, high resolution CRT for information display. A 3 1/2 inch Sony disc drive, for setup storage and retrieval, is integral to the analyzer. An RS-232-C port and external scope trigger are available on the rear panel. The RS-232-C port is used for printer hardcopy output or for analyzer control via a controller.

1-4. ACCESSORIES SUPPLIED

The following accessories are supplied with the HP 1650A/51A Logic Analyzers:

Probe Cables. Probe cables with a 40-pin connector on each end are supplied with each instrument. The probe cable is woven with 17 signal lines, 34 return lines, 34 chassis ground lines, and two power lines.

The power lines supply + 5 V for preprocessor power. Each cable supplies 600 milliamperes and the maximum power available from the HP 1650A/51A is 2 amperes. Five probe cables are supplied with the HP 1650A and two are supplied with the HP 1651A. *HP Part Number 01650-61608.*

Probe Tip Assemblies. Provides 16 data channels, 1 clock channel and 1 ground lead per pod assembly. Probe tip assemblies are supplied for direct probing and are removable for use with HP Model 10269C Probe Interface. The probe input specifications are listed in Table 1-1. Five Probe Tip Assemblies are supplied with the HP 1650A Logic Analyzer and two are supplied with the HP 1651A. *HP Part Number 01650-61607.*

Grabbers. Grabbers for the probe tip assemblies are supplied in packages of 20. 100 grabbers are supplied with the HP 1650A and 40 grabbers are supplied with the HP 1651A. *HP Part Number 5959-0288 (package of 20).*

One 2.3 metre (7.5 feet) **power cord.** See section 2 for available power cords.

One **Operating and Programming Manual Set.**

Two **Operating System Discs.**

One **Service Manual.**

One **RS-232-C Loopback Connector.**

1-5. ACCESSORIES AVAILABLE

The following accessories are available for use with the HP 1650A/51A:

HP Model 10269C Probe Interface. Used to interface the logic analyzer directly to a specific microprocessor.

Soft Carrying Case. *HP Part Number 1540-1066.*

HP Model 1008A Option 006 Testmobile.

HP Model 92192A 3.5" Microfloppy Discs *(box of ten).*

Rackmount Kit. *HP Part Number 5061-6175.*

1-6. SPECIFICATIONS

Table 1-1 is the list of specifications for the HP 1650A/51A Logic Analyzer. These specifications are the performance standards or limits against which the logic analyzer is tested.

1-7. OPERATING CHARACTERISTICS

Table 1-2 is a list of the operating characteristics of the HP 1650A/51A Logic Analyzer. The operating characteristics are a summary of performance capabilities of the HP 1650A/51A.

1-8. GENERAL CHARACTERISTICS

Table 1-3 is general characteristics of the HP 1650A/51A Logic Analyzer. The general characteristics are useful environmental operating conditions, shipping weights, and instrument dimensions.

1-9. RECOMMENDED TEST EQUIPMENT

Table 1-4 is a list of the test equipment required to test performance, make adjustments, and troubleshoot the HP 1650A/51A Logic Analyzer. The table indicates the critical specification of the test equipment and for which procedure the equipment is necessary. Equipment other than the recommended model may be used if it satisfies the critical specification listed in table 1-4.

Table 1-1. HP Model 1650A/51A Specifications

PROBES

Minimum Swing: 600 mV peak-to-peak.

Threshold Accuracy:

Voltage Range	Accuracy
-2.0V to +2.0V	±150 mV
-9.9V to -2.1V	±300 mV
+2.1V to +9.9V	±300 mV

Dynamic Range: ± 10 volts about the threshold.

STATE MODE

Clock Repetition Rate:

Single phase is 25 MHz maximum. With time or state counting, minimum time between states is 60 ns. Both mixed and demultiplexed clocking use master-slave clock timing; master clock must follow slave clock by at least 10 ns and precede the next slave clock by >50 ns.

Clock Pulse Width: ≧10 ns at threshold.

Setup Time: Data must be present prior to clock transition, ≧ 10 ns.

Hold Time: Data must be present after rising clock transition; 0 ns.

Data must be present after falling clock transition, 0 ns (HP 1651A); data must be present after falling L clock transition, 0 ns (HP 1650A); data must be present after falling J, K, M, and N clock transition, 1 ns (HP 1650A).

TIMING MODE

Minimum Detectable Glitch: 5 ns wide at the threshold.

Table 1-2. HP 1650A/51A Operating Characteristics

PROBES

Input RC: 100 KΩ ±2% shunted by approximately 8 pF at the probe tip.

TTL Threshold Preset: +1.6 volts.

ECL Threshold Preset: -1.3 volts.

Threshold Range: -9.9 to +9.9 volts in 0.1V increments.

Threshold Setting

> Threshold levels may be defined for pods 1 and 2 individually (HP 1651A). Threshold levels may be defined for pods 1, 2, and 3 on an individual basis and one threshold may be defined for pods 4 and 5 (HP 1650A).

Minimum Input Overdrive: 250 mV or 30% of the input amplitude, whichever is greater.

Maximum Voltage: ± 40 volts peak.

Maximum Power Available Through Cables:

> 2/3 amp @ 5V per cable; 2 amp @ 5V per HP 1650A/51A.

MEASURMENT CONFIGURATIONS

Analyzer Configurations:

Analyzer 1	Analyzer 2
Timing	Off
Off	Timing
State	Off
Off	State
Timing	State
State	Timing
State	State
Off	Off

Channel Assignment:

> Each group of 16 channels (a pod) can be assigned to Analyzer 1, Analyzer 2, or remain unassigned. The HP 1650A contains 5 pods; the HP 1651A contains 2 pods.

Table 1-2. HP 1650A/51A Operating Characteristics (cont'd)

STATE ANALYSIS

MEMORY

Data Acquisition:

1024 samples/channel.

TRACE SPECIFICATION

Clocks:

Five clocks (HP 1650A) or two clocks (HP 1651A) are available and can be used by either one or two state analyzers at any time. Clock edges can be ORed together and operate in single phase, two phase demultiplexing, or two phase mixed mode. Clock edge is selectable as positive, negative, or both edges for each clock.

Clock Qualifier:

The high or low level of four ORed clocks (HP 1650A) or one clock (HP1651A) can be ANDed with the clock specification. Setup time: 20 ns; hold time: 5 ns.

Pattern Recognizers:

Each recognizer is the AND combination of bit (0, 1, or X) patterns in each label. Eight pattern recognizers are available when one state analyzer is on. Four are available to each analyzer when two state analyzers are on.

Range Recognizers:

Recognizes data which is numerically between or on two specified patterns (ANDed combination of 0s and/or 1s). One range term is available and is assigned to the first state analyzer turned on. The maximum size is 32 bits and on a maximum of 2 pods.

Qualifier:

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

Sequence Levels:

There are eight levels available to determine the sequence of events required for trigger. The trigger term can occur anywhere in the first seven sequence levels.

Branching:

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

Table 1-2. HP 1650A/51A Operating Characteristics (cont'd)

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 storage qualifier that specifies the states that are to be stored.

Enable/Disable:

Defines a window of post-trigger storage. States stored in this window can be qualified.

Prestore:

Stores two qualified states that precede states that are stored.

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 4.4 X (10 to the 12th power).

Time Tagging:

Measures the time between stored states, relative to either the previous state or the trigger. Maximum time between states is 48 hours.

With tagging on, the acquisition memory is halved; minimum time between states is 60 ns.

SYMBOLS

Pattern Symbols:

User can define a mnemonic for the specific bit pattern of a label. When data display is SYMBOL, mnemonic is displayed where the bit pattern occurs. Bit pattern can include 0s, 1s, and don't cares.

Range Symbols:

User can define a mnemonic covering a range of values. Bit pattern for lower and upper limits must be defined as a pattern of 0s and 1s. When data display is SYMBOL, values within the specified range are displayed as mnemonic + offset from base of range.

Number of Pattern and Range Symbols: 100 per analyzer.

Symbols can be down-loaded over RS-232-C.

Table 1-2. HP 1650A/51A Operating Characteristics (cont'd)

TIMING ANALYSIS

TRANSITIONAL TIMING MODE

Sample is stored in acquisition memory only when the data changes. A time tag stored with each sample allows reconstruction of waveform display. Time covered by a full memory acquisition varies with the number of pattern changes in the data.

Sample Period:

10 ns.

Maximum Time Covered By Data: 5000 seconds.

Minimum Time Covered by Data: 10.24 μs.

GLITCH CAPTURE MODE

Data sample and glitch information stored every sample period.

Sample Period:

20 ns to 50 ms in a 1-2-5 sequence dependent on sec/div and delay settings.

Memory Depth:

512 samples/channel.

Time Covered by Data: Sample period X 512

WAVEFORM DISPLAY

Sec/div:

10 ns to 100 s; 0.01% resolution.

Delay:

-2500 s to 2500 s; presence of data dependent on the number of transitions in data between trigger and trigger plus delay (transitional timing).

Accumulate:

Waveform display is not erased between successive acquisitions.

Overlay Mode:

Multiple channels can be displayed on one waveform display line. Primary use is to view summary of bus activity.

Maximum Number Of Displayed Waveforms: 24

Table 1-2. HP 1650A/51A Operating Characteristics (cont'd)

TIME INTERVAL ACCURACY

Channel to Channel Skew: 4 ns typical.

Time Interval Accuracy:

± (sample period + channel-to-channel skew + 0.01% of time interval reading).

TRIGGER SPECIFICATION

Asynchronous Pattern:

Trigger on an asynchronous pattern less than or greater than specified duration. Pattern is the logical AND of specified low, high, or don't care for each assigned channel. If pattern is valid but duration is invalid, there is a 20 ns reset time before looking for patterns again.

Greater Than Duration:

Minimum duration is 30 ns to 10 ms with 10 ns or 0.01% resolution, whichever is greater. Accuracy is +0 ns to -20 ns. Trigger occurs at pattern + duration.

Less Than Duration:

Maximum duration is 40 ns to 10 ms with 10 ns or 0.01% resolution, whichever is greater. Pattern must be valid for at least 20 ns. Accuracy is +20 ns to -0 ns. Trigger occurs at the end of the pattern.

Glitch/Edge Triggering:

Trigger on glitch or edge following valid duration of asynchronous pattern while the pattern is still present. Edge can be specified as rising, falling or either. Less than duration forces glitch and edge triggering off.

Table 1-2. HP 1650A/51A Operating Characteristics (cont'd)

MEASUREMENT AND DISPLAY FUNCTIONS

AUTOSCALE (TIMING ANALYZER ONLY)

Autoscale searches for and displays channels with activity on the pods assigned to the timing analyzer.

ACQUISITION SPECIFICATIONS

Arming:

Each analyzer can be armed by the run key, the other analyzer, or the external trigger in port.

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. There is only one trace mode when two analyzers are on.

LABELS

Channels may be grouped together and given a six character name. Up to 20 labels in each analyzer may be assigned with up to 32 channels per label. Primary use is for naming groups of channels such as address, data, and control busses.

INDICATORS

Activity Indicators:

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

Markers:

Two markers (X and 0) are shown as dashed lines on the display.

Trigger:

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

MARKER FUNCTIONS

Time Interval:

The X and 0 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).

Table 1-2. HP1650A/51A Operating Characteristics (cont'd)

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 nth occurrence of a specified pattern before or after trigger, or after the beginning of data. The O marker can also find the nth occurrence of a pattern before or after the X marker.

Statistics:

X to 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.

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.

DATA DISPLAY/ENTRY

Display Modes:

State listing; timing waveforms; interleaved, time-correlated listing of two state analyzers (time tagging on); time-correlated state listing and timing waveform display (state listing in upper half, timing waveform in lower half, and time tagging on).

Timing Waveform:

Pattern readout of timing waveforms at X or O marker.

Bases:

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

Table 1-3. HP 1650A/51A General Characteristics

OPERATING ENVIRONMENT

Temperature

Instruments, 0° to 55 ° C (+32° to 131°F); probes and cables, 0° to 65°C (+32° to 149°F). Recommended temperature range for disc media, 10° to 50°C (+50° to 149°F).

Humidity

Instruments up to 95% relative humidity at +40°C; (104°F). Recommended humidity range for disc media, 8% to 80% relative humidity at +40°C (+104°F).

Altitude

To 4600 m (15,000 ft).

Vibration
  Operation

Random vibration 5-500 Hz, 10 minutes per axis, ≈2.41 g (rms).

  Non-operating

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

Weight

10.0 kg (22 lbs) net; 18.2 kg (40 lbs) shipping.

Power

115V/230V, 48-66 Hz, 200 W max

Dimensions

Notes:

1. Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP field engineer.

2. Dimensions are in millimetres and (inches).

Table 1-4. Recommended Test Equipment

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL	USE*
OSCILLOSCOPE	dual channel dc to 300 MHz	HP 54201A	P, T
PULSE GENERATOR	5 ns pulse width 20 ns period 1.3 ns risetime double pulse	HP 8161A/020	P
POWER SUPPLY	+ or - 10.2 V output current: 0 - 0.4 amperes	HP 6216B	P
POWER SPLITTER	50 ohms	HP 11549A	P
ADAPTER	Type N male to BNC female (qty 2)	HP Part Number 1250-0780	P
ADAPTER	Type N male to BNC male	HP Part Number 1250-0082	P
DMM	5.5 digit resolution	HP 3478A	A, T
RESISTOR	2 Ohms, 25 Watts	HP Part Number 0811-1390	T
* P=Performance Tests A=Adjustments T=Troubleshooting			