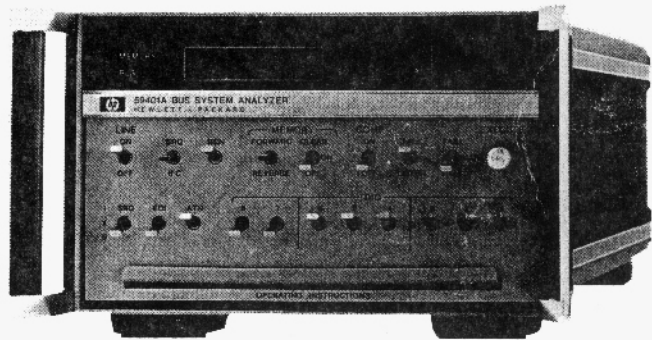


BUS SYSTEM ANALYZER MODEL 59401A



HEWLETT  PACKARD



OPERATING MANUAL

MODEL 59401A

BUS SYSTEM ANALYZER

Serials Prefixed: 1914A- and greater

-hp- Part No. 59401-90001

Microfiche Part No. 59401-90051

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P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

HEWLETT  PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains installation and operating instructions, and general performance information for the Model 59401A Bus System Analyzer.

1-3. This section of the manual contains a general description and performance specifications of the Model 59401A. Also included in this section are lists of accessories supplied with the 59401A, other accessories available, and instrument and manual identification information.

1-4. DESCRIPTION.

1-5. The Model 59401A Bus System Analyzer is designed to assist the Hewlett-Packard Interface Bus (HP-IB) user in designing hardware as well as diagnosing software and hardware problems. The 59401A acts as a "listener", "talker", "controller", or "systems controller" for complete testing of HP-IB systems.

1-6. SPECIFICATIONS.

1-7. Table 1-1 is a complete listing of the -hp- Model 59401A critical specifications that are controlled by tolerances. Table 1-2 contains general information that describes the operating characteristics of the Model 59401A.

1-8. Any change in the specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards will be listed on the manual change sheet included with this manual. The manual and manual change sheet supersede all previous information concerning specifications of the 59401A.

Table 1-1. Specifications.

Listen Accept Time: < 750 ns Ready Time: < 750 ns
Talk 1) Data changed > 500 ns before DAV pulled low 2) ATN driven low > 1 μs before DAV pulled low 3) DAV driven high < 700 ns after NDAC is false 4) DAV driven low < 700 ns after NRFD is false, if conditions 1 and 2 are met
Power: 100/120/220/240 V + 5%, - 10%, 48 Hz to 66 Hz line operation ≤ 42 VA
Operating Temperature: 0° - 50° C Storage Temperature: - 40° C - + 75° C Humidity Range: < 95% R.H. 0° C - 40° C

Table 1-2. General Information.

External Clock Input: 1 standard power TTL gate input, 10 MHz repetition rate. Compare Output: 1 standard power TTL gate output (LOW TRUE). HP-IB: 1 Bus load (capable of driving 14 other bus devices). Height: 14.55 cm (5.73 inches) including feet 13.28 cm (5.227 inches) without feet Width: 24.51 cm (9.650 inches) with handles 20.51 cm (8.075 inches) without handles Depth: 49.53 cm (19.500 inches) overall length 42.60 cm (16.775 inches) for rack mounting purposes Weight: 5.64 kg (12 lb., 7 oz.)

1-9. ACCESSORIES SUPPLIED.

1-10. The following accessories are supplied with the Model 59401A:

- One six-foot bus cable, -hp- Accessory No. 10631B
- One power cable, -hp- Part No. 8120-1538
- One extender board, -hp- Part No. 5061-0734

1-11. ACCESSORIES AVAILABLE.

1-12. The following accessories are available for the Model 59401A:

- Three foot bus cable, -hp- Accessory No. 10631A
- Twelve foot bus cable, -hp- Accessory No. 10631C
- Six foot BNC interconnecting cable, -hp- Accessory No. 10519A
- Rack Mount Frame, -hp- Part No. 5020-8862
- Filler Panel, -hp- Part No. 5061-0006

1-13. Instrument and Manual Identification.

1-14. Instrument identification by serial number is located on the rear panel of the instrument. Hewlett-Packard uses a two section serial number consisting of a four-digit prefix and a five-digit suffix, separated by a letter designating the country in which the instrument was manufactured (A = USA; G = West Germany; J = Japan; U = United Kingdom).

1-15. This manual applies to instruments with the serial numbers shown on the title page. If changes have been made in the instrument since this manual was printed, a "Manual Changes" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Backdating information in the back of this manual adapts it to instruments with serial numbers lower than that shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.

SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing and interfacing the Model 59401A Bus System Analyzer. Included are initial inspection procedures, power and grounding requirements, environmental information, installation instructions, interface connection procedures, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument has been damaged, file a claim with the carrier as soon as possible. Check for supplied accessories (Paragraph 1-9) and test the electrical performance of the instrument using the performance test procedures outlined in Section IV. If there is damage or deficiency, refer to the warranty in the front of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 59401A can be operated from any power source supplying 100 V, 120 V, 200 V or 240 V (- 10%, + 5%), 48 Hz to 66 Hz. Power dissipation is 42 VA maximum. A circuit board located beneath the power fuse in the power input module is used to select the appropriate voltage operation. The instrument leaves the manufacturer with this circuit board in the 120 V position. To operate the Model 59401A from another voltage, use the following procedure and Figure 2-1.

- a. Remove the power cord from the Model 59401A.
- b. Slide the plastic power module cover to the left to gain access to the fuse compartment.
- c. Remove the line fuse by pulling outward on the fuse puller (see Figure 2-1).
- d. Remove the printed circuit board located beneath the fuse holder.

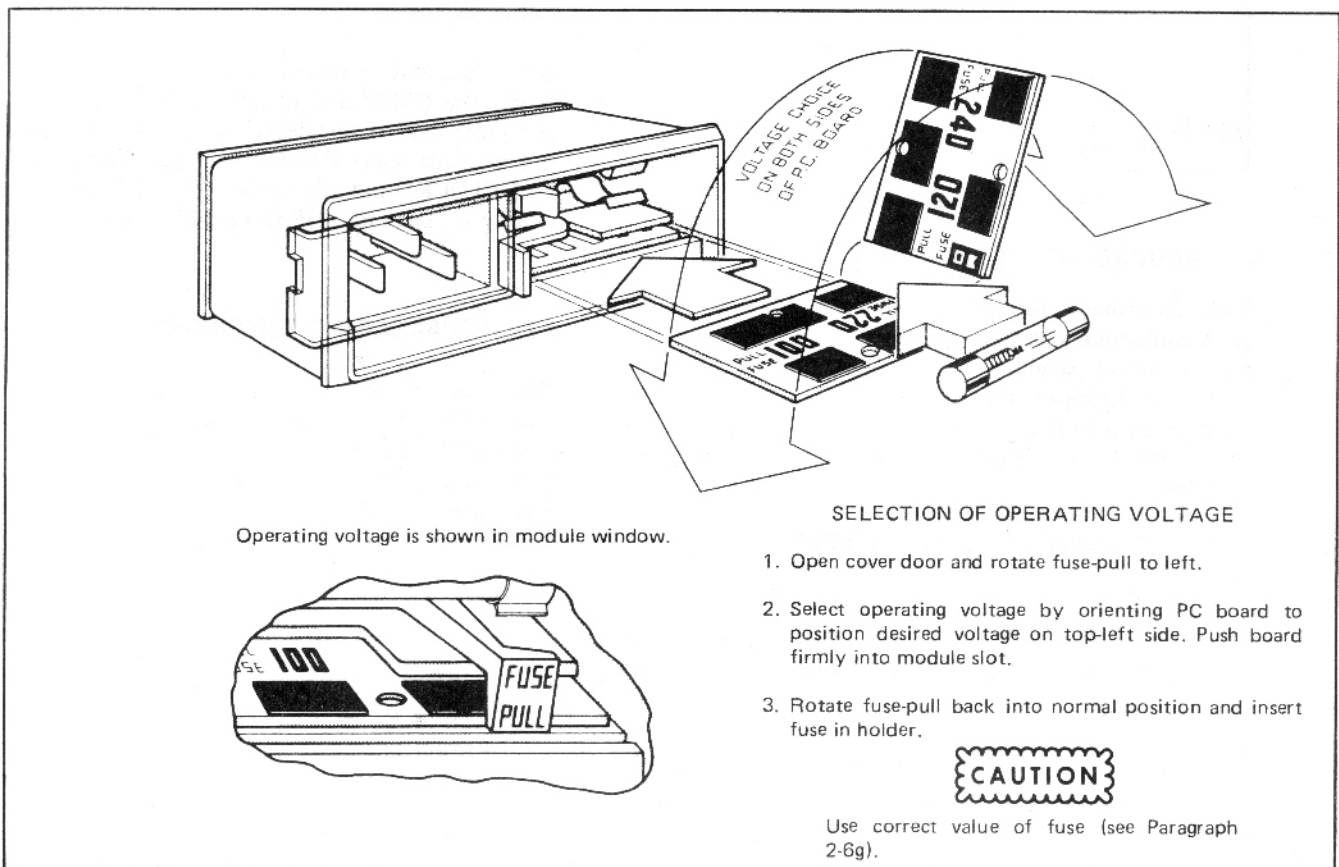


Figure 2-1. Power Module.

e. Position the circuit board such that the desired operating voltage is on the left side of the upper surface.

f. Replace the circuit board. The selected voltage should be visible after the board is replaced.

g. Install the appropriate line fuse. (For 110/120 volt operation, use a 1A normal blow fuse, -hp- Part No. 2110-0001; for 220/240 volt operation, use a 500 mA normal blow fuse, -hp- Part No. 2110-0012.)

2-7. POWER CORDS.

2-8. Figure 2-2 illustrates the various power cords that are available for the Model 59401A. The part number is shown above each plug drawing. If the appropriate power cord is not included with the instrument, notify the nearest -hp- Sales and Service Office and a replacement power cord will be provided.

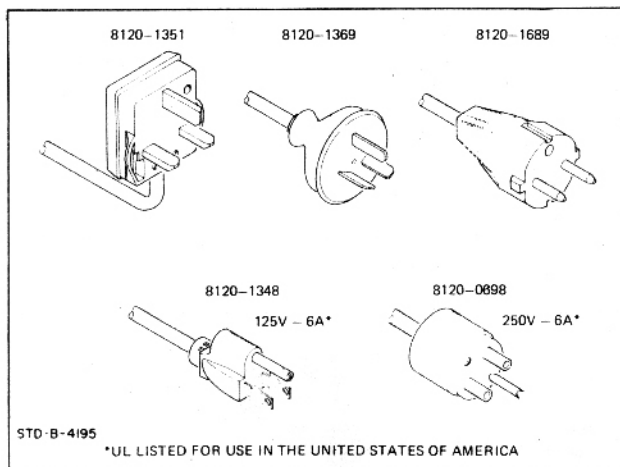


Figure 2-2. Power Cords.

2-9. GROUNDING REQUIREMENTS.

2-10. To protect operating personnel, the National Electrical Manufacturers Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 59401A is equipped with a three-wire power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable is the ground connection.

2-11. ENVIRONMENTAL REQUIREMENTS.

2-12. Cooling.

2-13. The Model 59401A is cooled by convection. The instrument should not be mounted in any manner which can obstruct the flow of air around it.

2-14. Operating and Storage Temperature.

2-15. The Model 59401A should not be operated where the ambient temperature range exceeds 0°C (32°F) to 50°C (131°F) or stored where the ambient temperature range exceeds -40°C (-40°F) to 75°C (167°F).

2-16. INSTALLATION.

2-17. Bench Use.

2-18. The Model 59401A is shipped with plastic feet and tilt stands in place, ready for use as a bench instrument. The front of the instrument may be elevated for convenience of operating and viewing by lowering the tilt stands.

2-19. Rack Mounting.

2-20. The Model 59401A may be rack mounted by using an adapter frame, -hp- Part No. 5020-8862. This adapter frame fits all standard 19 inch racks and accepts a combination of submodular units for rack mounting only. If only the 59401A is to be rack mounted, the half modular filler panel, -hp- Part No. 5061-0006, is also required.

2-21. INTERFACE CONNECTIONS.

2-22. The Model 59401A is connected to the Hewlett-Packard Interface Bus (HP-IB) with the bus cable provided (-hp- Accessory No. 10631B). This cable is a 24 conductor shielded cable terminated at each end with identical dual blue ribbon connectors. These connectors permit one cable to be plugged into another, eliminating the need for special "Y" or split cables.

2-23. All bus lines may be monitored at test points on the rear panel.

2-24. Two BNC connectors are also provided on the rear panel. The COMPARE OUTPUT, provides a TTL compatible pulse when coincidence occurs between the bus data and the code selected by the front panel DIO switches. The EXT CLOCK input allows the 59401A to be driven at any rate up to maximum HP-IB speed by means of an external signal source.

2-25. REPACKAGING FOR SHIPMENT.

2-26. The following paragraphs contain a general guide for repackaging the instrument for shipment. Refer to Paragraph 2-27 if the original container is to be used; 2-28 if it is not. If you have any questions, contact your nearest -hp- Sales and Service Office (see Appendix A for office locations).

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number.

2-27. Place the instrument in the original container with appropriate packing material and seal well with strong tape or metal bands. If the original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

2-28. If the original container is not to be used, proceed as follows:

a. Wrap the instrument in heavy paper or plastic before placing it in an inner container.

b. Place packing material around all sides of the instrument and protect the panel face with cardboard strips.

c. Place the instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark the shipping container "DELICATE INSTRUMENT", "FRAGILE", etc.

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains information and instructions necessary for operation of the -hp- Model 59401A Bus System Analyzer. Included is a functional description of all controls, indicators, and connectors and basic operating procedures and considerations.

3-3. INSTRUMENT CAPABILITIES.

3-4. The Model 59401A is designed to aid HP-IB users in hardware design and in diagnosing hardware and software problems encountered in HP-IB compatible systems. Basically, the 59401A has two modes of operation, as described in the following paragraphs.

3-5. Listen Mode.

3-6. When used as a "listen" device the Model 59401A monitors Bus traffic and can accept and store up to 32 characters from the Bus for later examination, or can be used to compare Bus information to a code selected by the front panel DIO switches. When coincidence occurs between the code selected and the Bus signal, a pulse output is provided at the rear panel COMPARE OUTPUT jack. The 59401A can also be set to stop all Bus traffic when coincidence occurs.

3-7. Talk Mode.

3-8. When used in the "talk" mode the 59401A is used to drive the Bus. The Bus can be driven one character at a time by setting the DIO switches to the appropriate code and outputting this information to the Bus. It is also possible to store a program of up to 32 characters in the 59401A memory and output this information to the Bus at a rate determined by the front panel FAST/SLOW/HALT switch. This switch selects speeds of one character at a time, two characters per second, or full HP-IB system speed.

NOTE

For a description of the Hewlett-Packard Interface Bus, refer to the Condensed Description of the Hewlett-Packard Interface Bus which can be purchased through your local Sales and Service Office.

3-9. CONTROLS AND INDICATORS.

3-10. Figure 3-1 illustrates groups of controls and indicators. These groups are classified according to function. Location and a brief description of individual controls are given in Figure 3-2.

3-11. GENERAL OPERATING INSTRUCTIONS.

3-12. Turn On.

3-13. Before connecting ac power to the Model 59401A, make certain the proper operating voltage has been selected to correspond to the voltage of the available power line as outlined in Paragraph 2-6.

3-14. Bus Connection.

3-15. The Model 59401A is connected to the Bus by means of the HP-IB cable provided. Connection can be made at any point on the Bus by plugging this cable into any mating connector on the system cables.

3-16. OPERATING PROCEDURES.

3-17. The following paragraphs describe the basic operating modes of the Model 59401A. These modes are presented in order of operating complexity. To avoid confusion, it is suggested that the operator follow the sequence of operating procedures to familiarize himself with the capabilities of the Model 59401A.

NOTE

For simplicity of explanation, the following operating procedures are written using the Model 59401A to test a system consisting of one or more instruments controlled by an -hp- Model 9820A, 9821A or 9830A Calculator.

However, these operating procedures also apply to the testing of individual HP-IB compatible devices and systems controlled by devices other than the calculators mentioned, such as, computers, card readers, or another Model 59401A.

3-18. LISTEN MODES.

3-19. The "listen" modes of the Model 59401A are used to monitor signals on the Bus. The three "listen" modes available are LISTEN/HALT, which monitors Bus signals one byte at a time, LISTEN/SLOW, which monitors the Bus signals at a two bytes per second rate, and LISTEN/FAST, which allows the Bus to be monitored at full system speed.

3-20. LISTEN/HALT Mode.

3-21. The LISTEN/HALT mode of the 59401A monitors Bus signals one character at a time. To use this mode, set the front panel switches as follows:

LINEON
 RENOFF
 MEMORY, CLEAR/ON/OFFOFF
 COMPOFF
 TALK/LISTENLISTEN
 FAST/SLOW/HALTHALT

3-22. Clear the Bus by pressing the calculator STOP key. Start the system program by pressing the calculator RUN PROGRAM or RUN, EXECUTE key(s).

3-23. The first program step should be displayed on the 59401A digital readout (both the ASCII character and the octal equivalent). If not, momentarily press the 59401A EXECUTE button.

3-24. The following 59401A indicator lights should be lit:

BUS (Indicating the 59401A is monitoring the Bus.)
 ATN (IF the program step is a command, such as a listen or talk address or unaddress code.)
 DAV (Indicates the information on the Bus is valid.)
 NRFD (Indicates the data has been accepted by one or more instruments on the Bus and that they are not ready for further data at this time.)
 NDAC (Indicates that not all units have accepted the data. In this case, the 59401A is usually the last instrument to accept data.)
 REN (Permits instruments on the Bus to go to remote control.)

NOTE

For a description of the HP-IB "handshake" signal sequence, refer to the Condensed Description of the Hewlett-Packard Interface Bus which can be purchased through your local Sales and Service Office.

3-25. The "system" program is stepped by momentarily pressing the 59401A EXECUTE button.

NOTE

Data observed on the 59401A digital readout is valid only when the DAV indicator is lit. It is possible for invalid data to be displayed when the EXECUTE button is held in.

3-26. The sequence of Bus control (handshake) signals is as follows:

- a. The "talker" puts data on the data lines and drives the DAV line low to indicate the data is valid.
- b. The fastest "listener" accepts the data and sets NRFD low.
- c. All other instruments on the Bus accept the data at their individual rates.

d. The 59401A accepts the data and allows NDAC to go high when the EXECUTE button is pressed.

e. The "talker" senses NDAC high, sets DAV high, and puts new data on the Bus.

f. Instruments on the Bus become "ready for data" (set NDAC low and NRFD high).

g. The 59401A sets its NDAC output low and allows NRFD to go high when the EXECUTE button is released.

h. The "talker" senses NRFD high and sets DAV low, starting the cycle over.

3-27. LISTEN/SLOW Mode.

3-28. Operation of the 59401A in the LISTEN/SLOW mode is similar to that of the LISTEN/HALT mode, except data on the Bus is automatically read at a two character per second rate.

3-29. To use the LISTEN/SLOW mode to monitor the Bus, set the front panel switches as follows:

LINEON
 RENOFF
 MEMORY, CLEAR/ON/OFFOFF
 COMPOFF
 TALK/LISTENLISTEN
 FAST/SLOW/HALTSLOW

3-30. Clear the Bus by pressing the calculator STOP key and start the system program by pressing the calculator RUN PROGRAM or RUN, EXECUTE key(s).

3-31. The Bus data will automatically be displayed on the 59401A digital readout at two characters per second.

3-32. LISTEN/FAST Mode.

3-33. The LISTEN/FAST mode allows monitoring of the Bus at full system speed or at any rate up to full system speed by using an external signal to drive the rear panel EXTERNAL CLOCK INPUT. To display the Bus data it is necessary to store the Bus information in the 59401A memory and then recall it one character at a time. The following paragraphs describe use of the memory and compare features of the Model 59401A.

3-34. Memory.

3-35. The memory feature of the Model 59401A can be used to store up to 32 bytes of data for later reference or can be used to store a program from the Bus to be later output by the 59401A. The 59401A has a memory capacity of 32 characters (bytes).

3-36. To use the memory feature, first clear the memory by switching the OFF/ON/CLEAR switch to CLEAR and releasing. The memory OFF/ON/CLEAR switch should now be in the ON position. Bus data is now loaded into

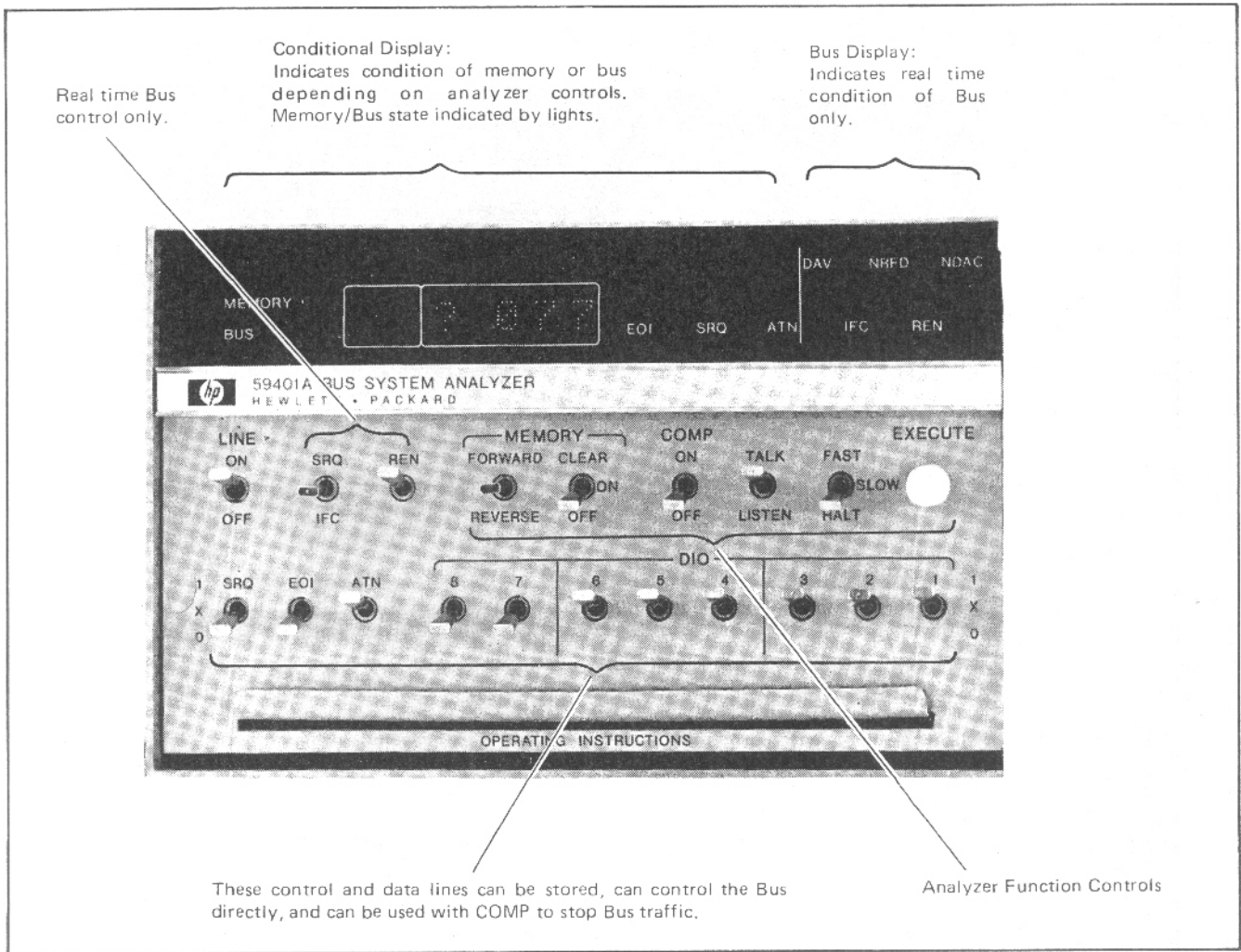


Figure 3-1. Control and Indication Groups.

memory as the 59401A accepts data. Current data is loaded into memory location 31, the previous contents of location 31 are shifted to location 30, the contents of 30 to 29 and so on, leaving the last program byte stored in location 31. If the program is greater than 32 steps, only the last 32 characters will be stored. All previous data will be lost.

3-37. Compare.

3-38. In the LISTEN modes the compare feature (COMP) outputs a pulse at the rear panel COMPARE OUTPUT jack and can be used to halt all Bus traffic when the Bus signal matches the code set on the 59401A lower switch register. A TTL compatible pulse is output in all modes whether the COMP switch is OFF or ON. Bus traffic is halted only when the COMP switch is ON.

3-39. When used with the memory feature, any 32 character segment of a program can be stored by setting the 59401A lower switch register to the code of the last character to be observed and setting the COMP switch to ON. The 59401A will store the program until the program information matches the code selected on the lower switch register and then halt the Bus.

3-40. When a lower register switch is set to the "X" (don't care) position it automatically matches the corresponding data bit on the Bus.

NOTE

The MEMORY and COMPARE features apply to all "listen" modes but are most commonly used with the LISTEN/FAST mode.

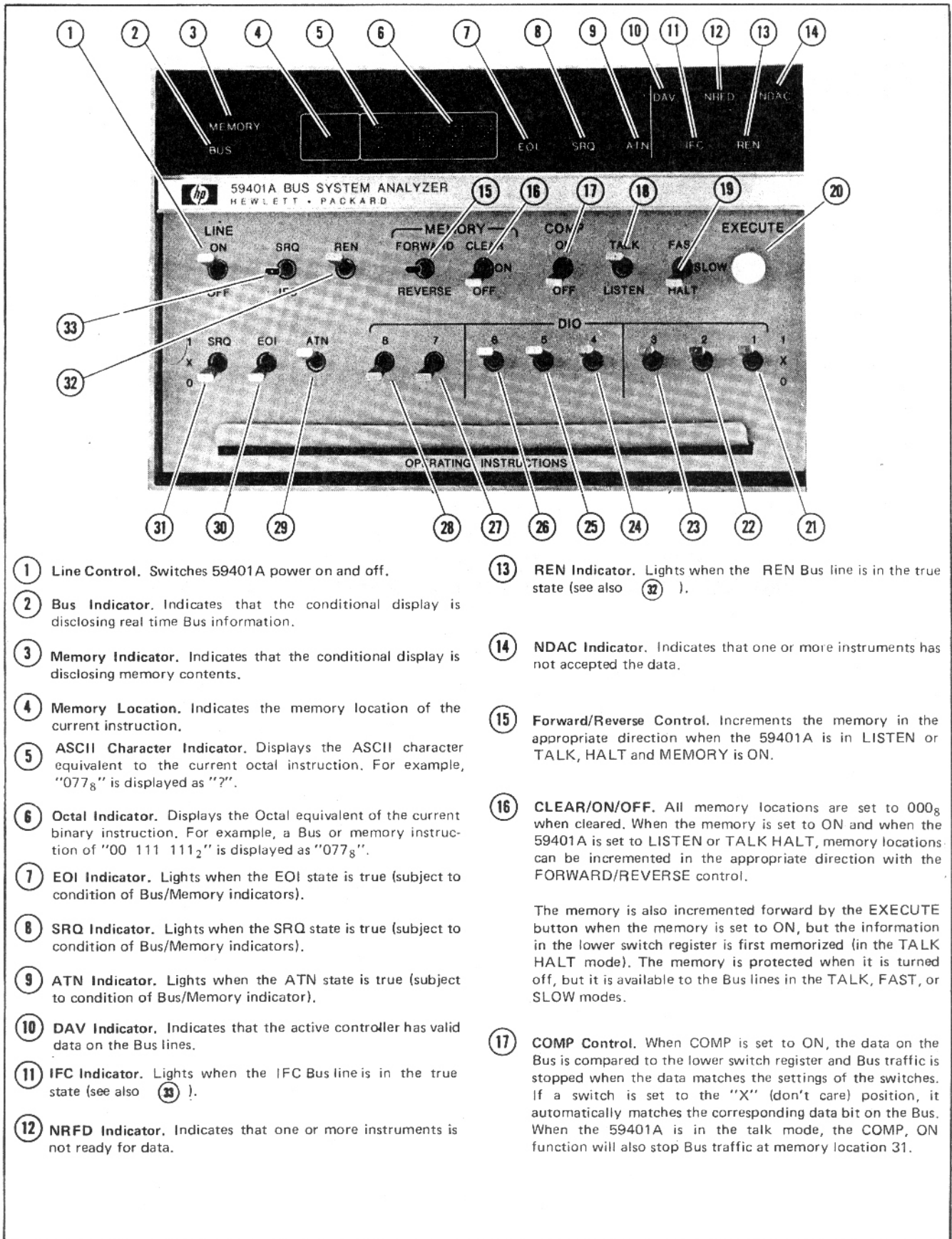
3-41. To use the LISTEN/FAST mode, set the 59401A front panel switches as follows:

- LINEON
- RENOFF
- MEMORY, CLEAR/ON/OFF CLEAR-ON
- COMPON
- TALK/LISTEN LISTEN
- FAST/SLOW/HALT FAST

Set the lower switch register (SRQ, EOI, ATN, and DIO 1 through 8) to the code of the last character to be observed.

3-42. Clear the Bus by pressing the calculator STOP key and start the system program by pressing the calculator RUN PROGRAM or RUN, EXECUTE key(s).

3-43. The 59401A will automatically halt the Bus when the Bus signal matches the code selected on the lower switch register.



- ① Line Control. Switches 59401A power on and off.
- ② Bus Indicator. Indicates that the conditional display is disclosing real time Bus information.
- ③ Memory Indicator. Indicates that the conditional display is disclosing memory contents.
- ④ Memory Location. Indicates the memory location of the current instruction.
- ⑤ ASCII Character Indicator. Displays the ASCII character equivalent to the current octal instruction. For example, "077₈" is displayed as "?".
- ⑥ Octal Indicator. Displays the Octal equivalent of the current binary instruction. For example, a Bus or memory instruction of "00 111 111₂" is displayed as "077₈".
- ⑦ EOI Indicator. Lights when the EOI state is true (subject to condition of Bus/Memory indicators).
- ⑧ SRQ Indicator. Lights when the SRQ state is true (subject to condition of Bus/Memory indicators).
- ⑨ ATN Indicator. Lights when the ATN state is true (subject to condition of Bus/Memory indicator).
- ⑩ DAV Indicator. Indicates that the active controller has valid data on the Bus lines.
- ⑪ IFC Indicator. Lights when the IFC Bus line is in the true state (see also ③).
- ⑫ NRFD Indicator. Indicates that one or more instruments is not ready for data.
- ⑬ REN Indicator. Lights when the REN Bus line is in the true state (see also ③).
- ⑭ NDAC Indicator. Indicates that one or more instruments has not accepted the data.
- ⑮ Forward/Reverse Control. Increments the memory in the appropriate direction when the 59401A is in LISTEN or TALK, HALT and MEMORY is ON.
- ⑯ CLEAR/ON/OFF. All memory locations are set to 000₈ when cleared. When the memory is set to ON and when the 59401A is set to LISTEN or TALK HALT, memory locations can be incremented in the appropriate direction with the FORWARD/REVERSE control.

The memory is also incremented forward by the EXECUTE button when the memory is set to ON, but the information in the lower switch register is first memorized (in the TALK HALT mode). The memory is protected when it is turned off, but it is available to the Bus lines in the TALK, FAST, or SLOW modes.
- ⑰ COMP Control. When COMP is set to ON, the data on the Bus is compared to the lower switch register and Bus traffic is stopped when the data matches the settings of the switches. If a switch is set to the "X" (don't care) position, it automatically matches the corresponding data bit on the Bus. When the 59401A is in the talk mode, the COMP, ON function will also stop Bus traffic at memory location 31.

Figure 3-2. Controls and Indicators.

rate and the TALK/FAST mode outputs the stored program at full system speed.

3-48. TALK/HALT Mode (Memory OFF).

3-49. To use the TALK/HALT mode to output data to the Bus, set the front panel switches as follows:

```

LINE .....ON
REN .....ON
MEMORY, CLEAR/ON/OFF .....OFF
COMP .....OFF
TALK/LISTEN .....TALK
FAST/SLOW/HALT .....HALT
    
```

Insure that the 59401A has control of the Bus by momentarily switching the SRQ/IFC switch to IFC.



When using the 59401A to test an HP-IB compatible system, it is possible for the 59401A and another instrument on the Bus to be "talking" at the same time. This condition can result in damage to the tri-state output drivers of the 59401A. To insure that no other instrument is talking when the 59401A is to be used to drive the Bus, it is necessary to momentarily switch the SRQ/IFC switch to IFC. When the 59401A is not being used to drive the Bus it should be placed in one of the "listen" modes or in the TALK/HALT/MEMORY ON mode.

Set the code of the character to be output to the Bus on the lower switch register (SRQ, EOI, ATN, and DIO 1 through 8).

3-50. The 59401A digital readout will display the ASCII character and the octal equivalent corresponding to the position of the DIO switches. The state of the SRQ, EOI, and ATN switches will be shown by the appropriate indicators.

NOTE

If the display information does not agree with the setting of the front panel switches, it is likely that another instrument on the Bus is driving some of the Bus lines. This condition can be overcome by momentarily switching the 59401A SRQ/IFC switch to IFC. (See the CAUTION in Paragraph 3-49.)

3-51. The information set on the lower switch register is output to the Bus by momentarily pressing the 59401A EXECUTE button.

3-52. The "handshake" signal sequence for this mode is as follows:

- a. Initially, DAV and NRFD are high and NDAC is low.
- b. The 59401A outputs the data set on the lower switch register and sets DAV low when the EXECUTE button is pressed in.

c. The first instrument to accept the data sets NRFD low and NDAC high.

d. All other instruments accept the data, set NRFD low and NDAC high at their particular rate.

e. The last instrument to accept the data sets NDAC high.

f. The 59401A senses NRFD low and NDAC high and sets DAV high when the EXECUTE button is released.

g. When DAV goes high, instruments on the bus set NRFD high and NDAC low at their individual rates, turning the Bus to the initial state.

NOTE

For a description of HP-IB signals, refer to the Condensed Description of the Hewlett-Packard Interface Bus which can be purchased through your local Sales and Service Office.

3-53. TALK/HALT Mode (Memory ON).

3-54. This mode is used to program the 59401A memory. To load information into memory, set the front panel switches as follows:

```

LINE .....ON
MEMORY, CLEAR/ON/OFF .....CLEAR-ON
TALK/LISTEN .....TALK
FAST/SLOW/HALT .....HALT
    
```

Set the memory to location "00" by momentarily switching the FORWARD/REVERSE switch to FORWARD.

3-55. Set the lower switch register to the code of the character to be stored (A list of the available ASCII characters and the octal codes is printed on the front panel "pull out" card.)

3-56. Store the information by pressing the EXECUTE button. When the EXECUTE button is pressed, the digital display shows the memory location and the information being stored in that location. When the EXECUTE button is released the memory is automatically stepped to the next location.

3-57. Repeat the steps in Paragraphs 3-55 and 3-56 until the desired program has been loaded.

3-58. Switch the MEMORY, CLEAR/ON/OFF switch to OFF to protect the memory contents.

3-59. TALK/SLOW Mode.

3-60. The TALK/SLOW mode automatically outputs data from the 59401A memory at two bytes per second. To use this mode, load the desired program in the 59401A memory as outlined in Paragraphs 3-53 through 3-58 and set the front panel switches as follows:

LINEON
 RENON
 MEMORY, CLEAR/ON/OFFOFF
 COMP*
 TALK/LISTENTALK
 FAST/SLOW/HAULTSLOW

*The COMP switch affects the 59401A operation as follows:

- a. COMP OFF. The 59401A will continuously output the data stored in memory.
- b. COMP ON (all lower register switches set to "0"). The 59401A will output the program data and halt transmission at memory location 31 if the program contains no information matching the lower switch register (octal code 000).
- c. COMP ON (lower switch register set to the code of one of the program characters). The 59401A will output the program data until the program information matches the code set on the lower switch register and then halt transmission.
- d. COMP ON (all lower register switches set to the "X" position). The 59401A will halt after outputting each program step. This permits transmitting one character at a time from the memory.

NOTE

In all cases the program starts at memory location "00".

To make the 59401A continue outputting the program after it has halted, momentarily press the EXECUTE button.

3-61. The 59401A digital display will show the memory location and the program information stored in that location as it is output to the Bus.

NOTE

If the display indicates the information being output to the Bus disagrees with the information stored in memory, it is possible that

another instrument on the Bus is driving some of the Bus lines. This condition can be overcome by momentarily switching the SRQ/IFC switch to IFC. (See the CAUTION in Paragraph 3-49.)

3-62. TALK/FAST Mode.

3-63. Operation of the TALK/FAST mode is the same as the TALK/SLOW mode except the program information is output at full system speed or variable speed if an external source is used to drive the rear panel EXTERNAL CLOCK INPUT. To use this mode follow the procedure outlined in Paragraphs 3-59 through 3-61 with the exception of the FAST/SLOW/HAULT switch. This switch should be set to FAST.

3-64. OPERATOR'S MAINTENANCE.

3-65. Fuses.

3-66. The 59401A line fuse is located in the power input module on the rear panel. In addition to replacement, it is necessary to change this fuse when the 59401A is set to operate from a different line voltage (see Paragraph 2-5). To change the fuse, use the following procedure and Figure 2-1.

- a. Remove the power cord from the Model 59401A.
- b. Slide the plastic power module cover to the left to gain access to the fuse compartment.
- c. Remove the line fuse by pulling outward and to the left on the fuse puller.
- d. Rotate the fuse puller back to its normal position and insert the proper fuse in the holder. (For 110/120 volt operation, use a 1 A normal blow fuse, -hp- Part No. 2110-0001; for 220/240 volt operation, use a 500 mA normal blow fuse, -hp- Part No. 2110-0012.)
- e. Slide the plastic cover to the right and replace the power cord.

SECTION IV PERFORMANCE TESTS

4-1. INTRODUCTION.

4-2. This section contains performance tests to verify that the Model 59401A is operating within its specifications. The 59401A contains no user maintainable assemblies. For service, contact the nearest -hp- Sales and Service Office. See Appendix A for office locations.

4-3. RECOMMENDED TEST EQUIPMENT.

4-4. Equipment required for the performance tests is listed in Table 4-1, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

Table 4-1. Recommended Test Equipment.

Instrument Type	Required Characteristics	Model
DC Voltmeter	10 volts full scale, ± 2%	-hp- 427A
Function Generator	100 kHz square wave, 0 to + 5 V, complimentary outputs	-hp- 3310A
Oscilloscope	Dual trace, 50 MHz bandwidth	-hp- 180C
DC Power Supply	+ 5 V dc, 1 amp	-hp- 6213A
Test Load	100 ohm load for each "bus" line	See Figure 4-1

4-5. PERFORMANCE TEST CARD.

4-6. A Performance Test Card is provided at the end of this section for the purpose of recording the results of the Performance Tests. This form lists all of the Performance Tests and their acceptable limits. The form may be removed from the manual and retained as a permanent record of the incoming inspection or routine maintenance performed on the instrument. The Test Card may be reproduced without written permission from Hewlett-Packard.

4-7. PERFORMANCE TESTS.

4-8. The following tests verify that your instrument is operating within the specifications outlined in Table 1-1 of this manual. None of these tests require access to the interior of the instrument. If it has been determined, after completing the Performance Tests, that the instrument does not meet one or more of its specifications contact your nearest -hp- Sales and Service Office. See Appendix A for office locations.

NOTE

Do not connect the Model 59401A to the Bus for any of the following Performance Tests.

4-9. Display Indicator Test.

DESCRIPTION:

This procedure tests the operation of the Model 59401A front panel display indicators and individual LED's in the numeric display.

RECOMMENDED TEST EQUIPMENT:

This test does not require the use of any test equipment.

a. Set the lower row of switches to the "0" position. Set the upper switches as follows:

```

LINE .....ON
SRQ/IFC .....*
REN .....OFF
MEMORY, FORWARD/REVERSE .....*
MEMORY, CLEAR/ON/OFF .....OFF
COMP .....OFF
TALK/LISTEN .....TALK
FAST/SLOW/HALT .....HALT
    
```

*Does not apply to test

b. Set the DIO switches as indicated in each step of Table 4-2. Observe that all LED's necessary to make up the character or numeral listed in the "Display" column of Table 4-2 light properly.

c. Switch the MEMORY, CLEAR/ON/OFF switch to ON. The BUS indicator should go off and the MEMORY indicator should come on. The numeric display should show memory location "31".

d. Momentarily switch the MEMORY, CLEAR/ON/OFF switch to CLEAR. The numeric display should show an octal code of "000". There should be no ASCII character displayed. All indicators except the MEMORY indicator should be off.

Table 4-2. Numeric Display Test.

Step	DIO Switch Settings 87 654 321	Display	
		ASCII Character	Octal Code
1	00 000 000		000
2	10 100 100	\$	244
3	11 110 110		366
4	11 111 111		377
5	01 001 001	I	111
6	01 001 000	H	110
7	00 100 011	#	043

e. Momentarily switch the MEMORY, FORWARD/REVERSE switch to FORWARD. The numeric display should show memory location "00". Momentarily switch the FORWARD/REVERSE switch to REVERSE. The numeric display should again show memory location "31". Hold the switch in the FORWARD position. The memory location numbers should automatically increase from 00 through 31 at a 2 character per second rate. Hold the switch in the REVERSE position. The memory location numbers should automatically decrease at a 2 character per second rate. Switch the CLEAR/ON/OFF switch to OFF.

f. Switch the SRQ, EOI, and ATN switches to the "1" position. The corresponding display indicators should light. Return the SRQ, EOI, and ATN switches to the "0" position.

g. Switch the SRQ/IFC switch to SRQ. The SRQ indicator should light. Switch to IFC and observe that the IFC indicator lights.

h. Switch the REN switch to REN and observe that the REN indicator lights. Return the REN switch to OFF.

i. Press the EXECUTE button and observe that the DAV indicator lights.

j. Switch the TALK/LISTEN switch to LISTEN. The NDAC indicator should light.

k. Use a clip lead to connect the rear panel DAV and NDAC test points. Press and hold the EXECUTE button. Observe that the NRFD indicator lights. Remove the clip lead.

4-10. Switch Register Test.

DESCRIPTION:

This procedure tests the operation of the front panel control switches and the corresponding rear panel outputs.

RECOMMENDED TEST EQUIPMENT:

- DC Voltmeter, -hp- 427A
- DC Power Supply, -hp- 6213A
- Test Load, See Figure 4-1

a. Set the lower row of switches to the "0" position. Set the upper switches as follows:

```

LINE .....ON
SRQ/IFC .....*
REN .....OFF
MEMORY, FORWARD/REVERSE .....*
MEMORY, CLEAR/ON/OFF .....OFF
COMP .....OFF
TALK/LISTEN .....TALK
FAST/SLOW/HALT .....HALT
    
```

*Does not apply to test

b. Connect the ground lead of the voltmeter to the ground lug on the rear panel of the 59401A. Measure the voltage of each test point on the printed circuit board which extends through the rear panel. These readings must be between + 2.4 and + 5.0 V dc.

c. Set all lower switches to the "X" position and again measure the rear panel test points. The voltage readings should be the same as those measured in Step b.

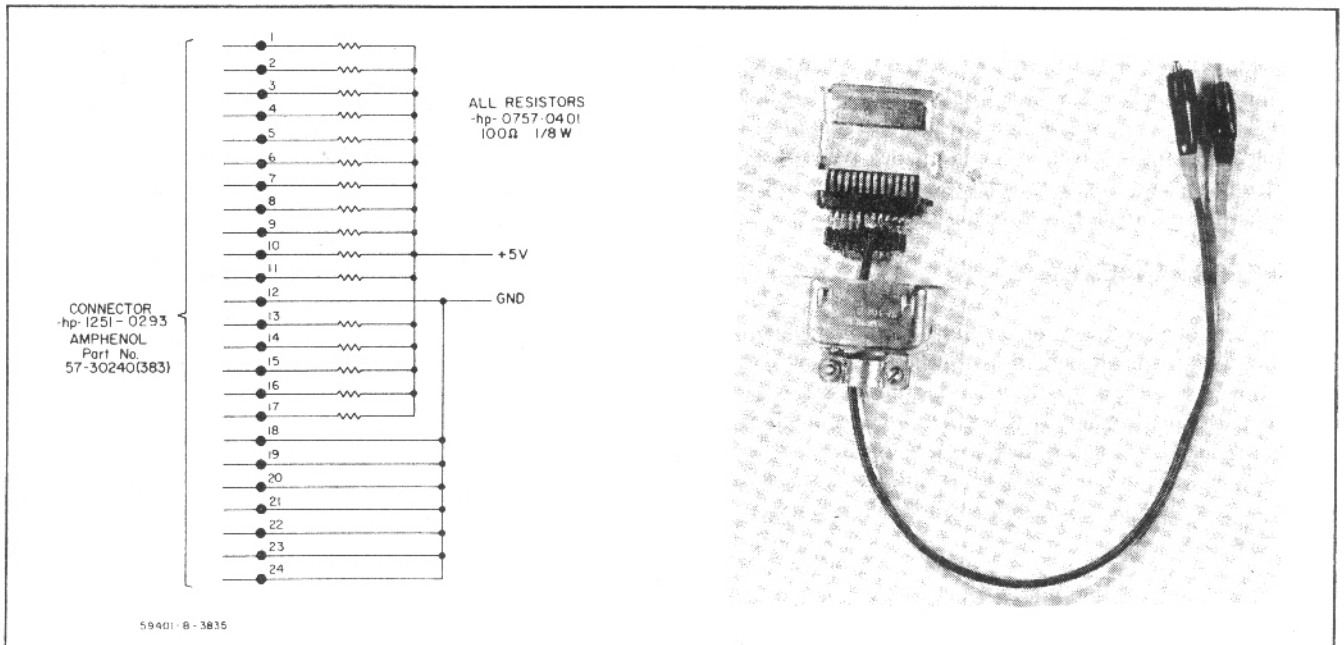


Figure 4-1. Test Load Construction.

- d. Adjust the Power Supply for an output of + 5 V dc.
- e. Connect the Test Load, described in Figure 4-1, to the rear panel "HP-IB" connector. Connect the Test Load ground lead to the negative output of the Power Supply and the + 5 lead to the positive output.
- f. Set all lower switches to the "1" position.
- g. Connect the Voltmeter common lead to the ground lead of the Test Load (negative output of the power supply). Measure the rear panel test points DIO 1 through 8 and SRQ, EOI, and ATN. The voltage readings must be less than +0.4 V dc. Return all lower switches to the "0" position.
- h. Hold the SRQ/IFC switch in the IFC position and measure the IFC test point. The voltage reading must be less than +0.4 V dc.
- i. Switch the REN switch to REN and measure the REN test point. The voltage reading must be less than +0.4 V dc.
- j. Press the EXECUTE button and measure the DAV test point. The voltage reading must be less than +0.4 V dc.
- k. Switch the TALK/LISTEN switch to LISTEN and measure the NDAC test point. The voltage reading should be less than +0.4 V dc.
- l. Use a clip lead to connect the rear panel DAV and NDAC test points. Press and hold the EXECUTE button. Measure the NRFD test point. The voltage reading should be less than +0.4 V dc. Remove the clip lead and Voltmeter test leads.
- m. Switch the TALK/LISTEN switch to TALK, the DIO 1 switch to "1", the COMP switch to ON, and the FAST/SLOW/HALT switch to SLOW. The numeric display should begin at memory location "00", count to memory location "31" and then halt. Press the EXECUTE button. The 59401A should repeat this sequence.
- n. Remove the Test Load from the 59401A.

4-11. Talk Mode Tests.

DESCRIPTION:

This procedure tests the response time of the 59401A "Handshake" signals when the 59401A is used in the "talk" mode.

NOTE

For a description of the "HP-IB Handshake" signals, refer to the Condensed Description of the Hewlett-Packard Interface Bus which can be purchased through your local Sales and Service Office.

RECOMMENDED TEST EQUIPMENT:

Function Generator, -hp- Model 3310A
Oscilloscope, -hp- Model 180C

- a. Set the lower row of switches to the "0" position. Set the upper switches as follows:

```

LINE .....ON
SRQ/IFC .....*
REN .....OFF
MEMORY, FORWARD/REVERSE .....*
MEMORY, CLEAR/ON/OFF .....OFF
COMP .....OFF
TALK/LISTEN .....TALK
FAST/SLOW/HALT .....FAST
    
```

*Does not apply to test

- b. Set the controls of the Function Generator to obtain a 100 kHz square wave. Adjust the OUTPUT LEVEL control for minimum output.
- c. Set the Oscilloscope controls for a vertical sensitivity of 2 volts per centimeter, a horizontal sweep speed of 100 nanoseconds per centimeter, and a positive going internal trigger from the channel "B" amplifier.

4-12. Talker Response to NDAC.

- a. Connect the Function Generator SYNC OUTPUT to the 59401A rear panel NDAC test point and the HIGH output to the NRFD test point. Adjust the OUTPUT LEVEL and DC OFFSET controls to obtain an amplitude of 0 to + 5 V at the HIGH OUTPUT connector.
- b. Connect channel "A" of the Oscilloscope to the 59401A DAV test point, and the channel "B" input to the NDAC test point.
- c. The Oscilloscope display should be similar to that shown in Figure 4-2. The time between the positive going edge of the NDAC signal and the positive going edge of the DAV signal must be less than 700 nanoseconds.

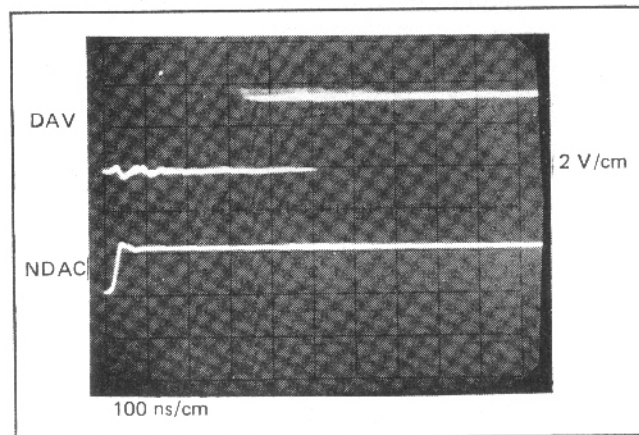


Figure 4-2. Talker Response to NDAC.

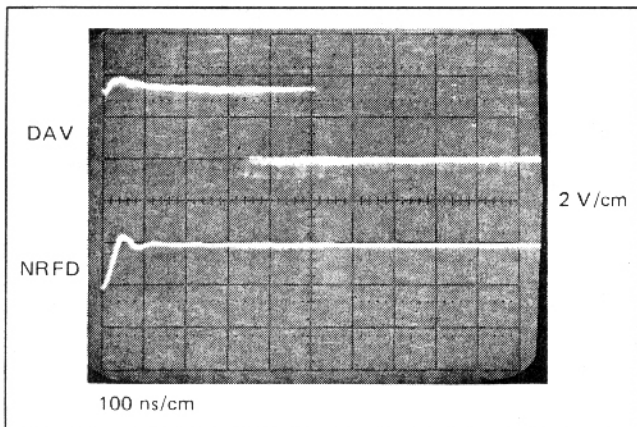


Figure 4-3. Talker Response to NRFD.

4-13. Talker Response to NRFD.

a. Remove the Oscilloscope channel "B" input from the 59401A NDAC test point and connect it to the NRFD test point.

b. The Oscilloscope display should be similar to that shown in Figure 4-3. The time between the positive going edge of the NRFD signal and the negative going edge of the DAV signal must be less than 700 nanoseconds. Remove the Function Generator leads from the 59401A.

4-14. DAV Delay to ATN.

a. Switch the FAST/SLOW/HALT switch to HALT.

b. Switch the MEMORY, CLEAR/ON/OFF switch to CLEAR and release. The memory should now be ON as indicated by the MEMORY indicator.

c. Switch the DIO 1 switch to the "1" position and momentarily press the EXECUTE button. This loads the octal code "001" in memory location 31.

d. Switch the DIO 1 switch to "0", the ATN switch to "1" and momentarily press the EXECUTE button to load ATN in memory location 00.

e. Switch the DIO 1 switch to the "1" position and momentarily press the EXECUTE button to load octal code "001" and ATN in location 01.

f. Switch the MEMORY, CLEAR/ON/OFF switch to OFF and the ATN switch to "0".

g. Connect the Oscilloscope external trigger input to the 59401A COMPARE OUTPUT connector and set the scope to trigger on a positive going external signal.

h. Remove the Oscilloscope channel "B" input from the NRFD test point and connect it to the ATN test point.

i. Switch the FAST/SLOW/HALT switch to FAST.

j. With the Oscilloscope sweep speed set to 200 nano-seconds per centimeter, the display should be similar to that shown in Figure 4-4. The time between the negative going edge of the ATN signal and the negative going edge of the DAV signal should be greater than 1 microsecond.

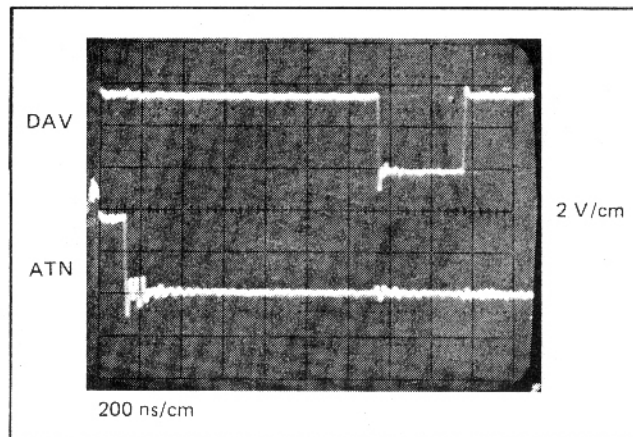


Figure 4-4. DAV Delay to ATN.

4-15. DAV Delay to Data.

a. Remove the Oscilloscope channel "B" input from the ATN test point and connect it to the DIO 1 test point.

b. Set the Oscilloscope to trigger on a negative going external signal.

c. Switch the ATN switch to the "1" position.

d. The Oscilloscope display should be similar to that shown in Figure 4-5. The time between the positive going edge of the DIO 1 signal and the negative going edge of the DAV signal must be greater than 500 nanoseconds.

e. Remove all test equipment connections.

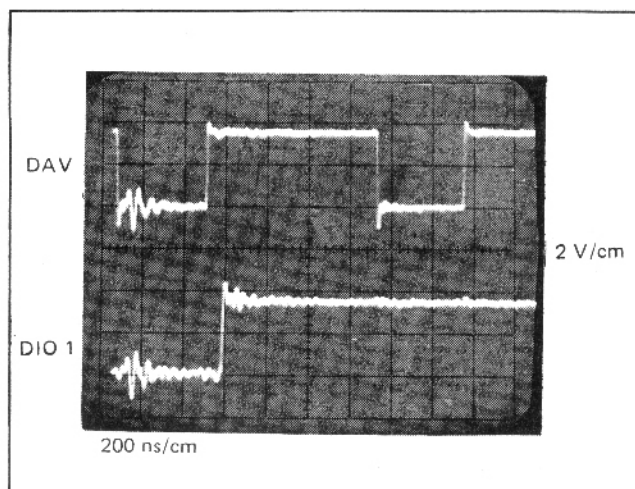


Figure 4-5. DAV Delay to Data.

4-16. Listen Mode Tests.

DESCRIPTION:

This procedure tests the response time of the 59401A to "Handshake" signals when it is used in the "listen" mode.

RECOMMENDED TEST EQUIPMENT:

- Function Generator, -hp- Model 3310A
- Oscilloscope, -hp- Model 180A
- DC Power Supply, -hp- Model 6213A
- Test Load, See Figure 4-1

a. Set the lower row of switches to the "0" position. Set the upper switches as follows:

```

LINE .....ON
SRQ/IFC .....*
REN .....OFF
MEMORY, FORWARD/REVERSE .....*
MEMORY, CLEAR/ON/OFF .....OFF
COMP .....OFF
TALK/LISTEN .....LISTEN
FAST/SLOW/HALT .....FAST
    
```

*Does not apply to test

b. Set the controls of the Function Generator to obtain a 100 kHz square wave. Adjust the OUTPUT LEVEL control for minimum output.

c. Set the Oscilloscope controls for a vertical sensitivity of 2 volts per centimeter, a horizontal sweep speed of 100 nanoseconds per centimeter, and a negative going internal trigger from the channel "B" amplifier.

d. Adjust the Power Supply for an output of + 5 V dc.

e. Connect the Test Load described in Figure 4-1, to the rear panel "HP-IB" connector. Connect the Test Load ground lead to the negative output of the Power Supply and the + 5 lead to the positive output.

4-17. Listen Accept Time Test.

a. Connect the Function Generator HIGH output to the DAV test point and adjust the OUTPUT LEVEL and DC OFFSET controls for an amplitude of 0 to + 5 V at the HIGH output connector.

b. Connect the Oscilloscope channel "A" input to the NDAC test point and the channel "B" input to the DAV test point.

c. The Oscilloscope display should be similar to that shown in Figure 4-6. The time between the negative going edge of the DAV signal and the positive going edge of the NDAC signal must be less than 750 nanoseconds.

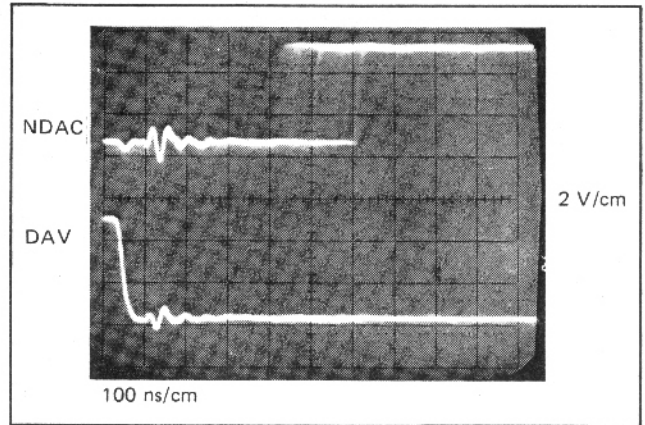


Figure 4-6. Listen Accept Time Test.

4-18. Listen Ready Time Test.

a. Remove the Oscilloscope channel "A" input from the NDAC test point and connect it to the NRFD test point.

b. Set the Oscilloscope to trigger on a positive going internal trigger.

c. The Oscilloscope display should be similar to that shown in Figure 4-7. The time between the positive going edge of the DAV signal and the positive going edge of the NRFD signal must be less than 750 nanoseconds.

d. Remove all test equipment connections.

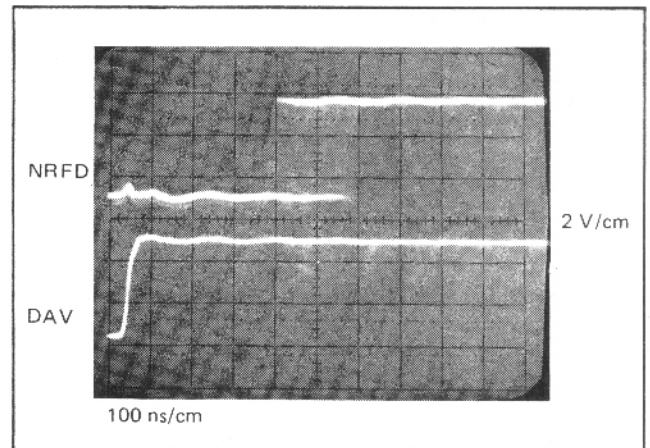


Figure 4-7. Listen Ready Time Test.

PERFORMANCE TEST CARD

Hewlett-Packard Model 59401A
 Bus System Analyzer
 Serial No. _____

Tests Performed by _____
 Date _____

DISPLAY INDICATOR TEST

Step

b.	ASCII Character	Pass		Fail		Octal Code	Pass		Fail		Proper LED's Light	
		_____	_____	_____	_____		_____	_____	_____	_____	_____	_____
	None	_____	_____	_____	_____	000	_____	_____	_____	_____	_____	_____
	\$	_____	_____	_____	_____	244	_____	_____	_____	_____	_____	_____
	None	_____	_____	_____	_____	366	_____	_____	_____	_____	_____	_____
	None	_____	_____	_____	_____	377	_____	_____	_____	_____	_____	_____
	I	_____	_____	_____	_____	111	_____	_____	_____	_____	_____	_____
	H	_____	_____	_____	_____	110	_____	_____	_____	_____	_____	_____
	#	_____	_____	_____	_____	043	_____	_____	_____	_____	_____	_____

- c. The BUS indicator must go off. Pass _____ Fail _____
 The MEMORY indicator must go on. Pass _____ Fail _____
 The numeric display must show memory location 31. Pass _____ Fail _____
- d. The numeric display must show an octal code of 000. Pass _____ Fail _____
 There must be no ASCII character displayed. Pass _____ Fail _____
 All indicators, except the MEMORY indicator, must be off. Pass _____ Fail _____
- e. The memory advances to location 00. Pass _____ Fail _____
 The memory returns to location 31. Pass _____ Fail _____
 The memory automatically counts forward. Pass _____ Fail _____
 The memory automatically counts backward. Pass _____ Fail _____
- f. The SRQ, EOI, and ATN indicators must light when the corresponding switches are in the "1" position. SRQ, Pass _____ Fail _____
 EOI, Pass _____ Fail _____
 ATN, Pass _____ Fail _____
- g. The SRQ and IFC indicators must light when the SRQ/IFC switch is in the appropriate position. SRQ, Pass _____ Fail _____
 IFC, Pass _____ Fail _____
- h. The REN indicator must light when the REN switch is set to REN. Pass _____ Fail _____
- i. The DAV indicator must light when the EXECUTE button is pressed. Pass _____ Fail _____

PERFORMANCE TEST CARD (Cont'd)

j. The NDAC indicator must light when the TALK/LISTEN switch is in the LISTEN position. Pass _____ Fail _____

k. The NRFD indicator must light when the DAV test point is connected to the NDAC test point and the EXECUTE button is pressed.
Pass _____ Fail _____

SWITCH REGISTER TEST

Step

b. All rear panel test points must measure between + 2.4 and + 5.0 V dc.

Test Point	Pass	Fail	Test Point	Pass	Fail
DIO1	_____	_____	ATN	_____	_____
DIO2	_____	_____	EOI	_____	_____
DIO3	_____	_____	SRQ	_____	_____
DIO4	_____	_____	REN	_____	_____
DIO5	_____	_____	IFC	_____	_____
DIO6	_____	_____	NDAC	_____	_____
DIO7	_____	_____	NRFD	_____	_____
DIO8	_____	_____	DAV	_____	_____

c. All readings must remain within the limits in Step b.

g. The following test points must measure less than + 0.4 V dc when the corresponding switches are set to "1".

Test Point	Pass	Fail	Test Point	Pass	Fail
DIO1	_____	_____	DIO7	_____	_____
DIO2	_____	_____	DIO8	_____	_____
DIO3	_____	_____	ATN	_____	_____
DIO4	_____	_____	EOI	_____	_____
DIO5	_____	_____	SRQ	_____	_____
DIO6	_____	_____			

h. The IFC test point reading must be less than + 0.4 V dc when the SRQ/IFC switch is held in the IFC position. Pass _____ Fail _____

i. The REN test point must measure less than + 0.4 V dc when the REN switch is set to REN. Pass _____ Fail _____

j. The DAV test point must measure less than + 0.4 V dc when the EXECUTE button is pressed. Pass _____ Fail _____

k. The NDAC test point must measure less than + 0.4 V dc when the TALK/LISTEN switch is set to LISTEN. Pass _____ Fail _____

l. The NRFD test point must measure less than + 0.4 V dc with the DAV test point connected to the NDAC test point and the EXECUTE button pressed. Pass _____ Fail _____

PERFORMANCE TEST CARD (Cont'd)

m. The memory location must automatically advance to location 31 and halt. Pass _____ Fail _____

This step must repeat when the EXECUTE button is pressed. Pass _____ Fail _____

TALKER RESPONSE TO NDAC

The time between the positive going portion of the NDAC signal and the positive going portion of the DAV signal must be less than 700 nanoseconds. Pass _____ Fail _____

TALKER RESPONSE TO NRFD

The time between the positive going portion of the NRFD signal and the negative going portion of the DAV signal must be less than 700 nanoseconds. Pass _____ Fail _____

DAV DELAY TO ATN

The time between the negative going portion of the ATN signal and negative going portion of the DAV signal must be greater than 1 microsecond. Pass _____ Fail _____

DAV DELAY TO DATA

The time between the positive going portion of the DI01 signal and the negative going portion of the DAV signal must be greater than 500 nanoseconds. Pass _____ Fail _____

LISTEN ACCEPT TIME TEST

The time between the negative going portion of the DAV signal and the positive going portion of the NDAC signal must be less than 750 nanoseconds. Pass _____ Fail _____

LISTEN READY TIME TEST

The time between the positive going portion of the DAV signal and the positive going portion of the NRFD signal must be less than 750 nanoseconds. Pass _____ Fail _____

