



OPERATION MANUAL

MODEL 4195A

NETWORK/SPECTRUM

ANALYZER

(Including Option 001)

SERIAL NUMBERS

This manual applies directly to instruments whose serial number prefix is 2738J- and whose ROM-based firmware is version 1.01.

With the changes described in Appendix A, this manual also applies to HP 4195As whose ROM based firmware is 1.00.

For additional important information about serial numbers, read INSTRUMENTS COVERED BY MANUAL in Section 7 of this Operation Manual.

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MANUAL PRINTING HISTORY

October 1987	First Edition	This manual is the first edition Operation Manual for HP 4195A Network/Spectrum Analyzer. (Excluding Appendix G "Index".)
February 1988	Second Edition	Adds Appendix G "Index". Revision for changing ROM-based firm-ware from version 1.00 to 1.01.

HOW TO USE THIS MANUAL

This is the Operation Manual for HP Model 4195A Network/Spectrum Analyzer. This manual contains seven sections plus appendices, organized for the convenience of the first time user. After you receive your HP 4195A, begin with Section 1. If you are a first time user of an already installed 4195A, begin with Section 2. The performance test and adjustment procedures are described in the HP 4195A's maintenance manual.

Section 1, Getting Started

Section 1 includes unpacking, initial inspection, and preparation information necessary for you to know before you apply AC power. Read Section 1 before apply AC power to the 4195A.

Section 2, Product Overview

Section 2 includes information which will be necessary before operating your 4195A. Reading this section before operating the 4195A will help you to operate the 4195A more efficiently.

Section 3, Basic Measurement Examples

Section 3 includes basic measurement examples. Perform the procedures given in this section in order to familiarize yourself with the 4195A.

Section 4, Measurement Capabilities

Section 4 describes the 4195A's basic measurement capabilities.

Section 5, Extended Capabilities

Section 5 describes the 4195A's extended capabilities (flexible disc, Equivalent Circuit Analysis, USER Math, Program Point Measurement, Hardcopy, etc.).

Section 6, Programming

Section 6 includes information on automating measurement (User Defined Functions, User Programs and HP-IB programming).

Section 7, General Information

Section 7 includes the specifications, rack mount/handle kit installation, and other general information on the 4195A.

Appendices

Appendix A is the **Manual Backdating** and provides information to use this manual with a 4195A which was manufactured before the printing date of the manual. Appendices B through G are lists that will be often used. Appendix H and I are front and rear panel illustrations. The front panel illustration is a convenient foldout page for you to refer to while reading this manual.

CERTIFICATION

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

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ASSISTANCE

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

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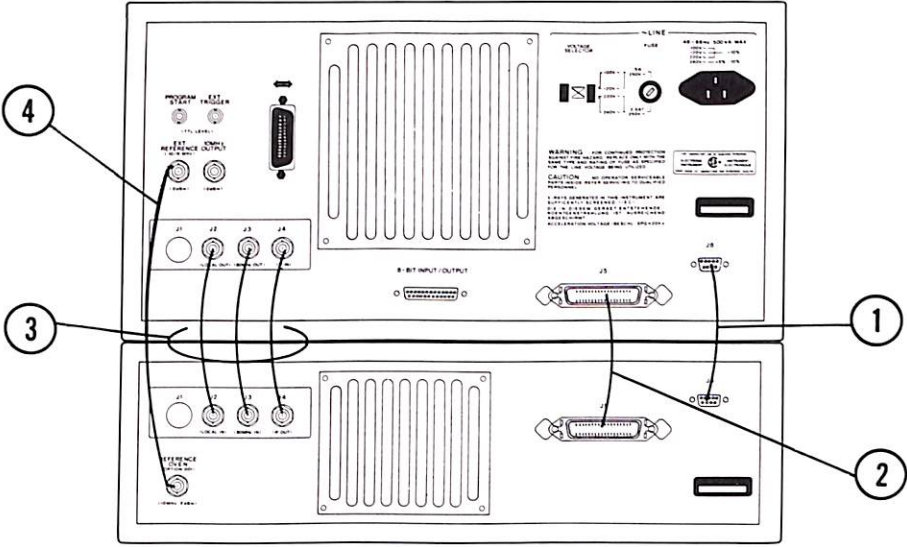


Figure 1-2. Cable Interconnections

1-3-2. POWER REQUIREMENTS

The 4195A requires an AC power source of 100, 120, 220 V $\pm 10\%$, or 240 V $+5\%$ -10% , 48 to 66 Hz single phase, power consumption is 500 VA maximum.

WARNING

THIS IS A SAFETY CLASS 1 PRODUCT (PROVIDED WITH A PROTECTIVE EARTH TERMINAL). A NONINTERRUPTABLE SAFETY EARTH GROUND MUST BE PROVIDED FROM THE MAIN POWER SOURCE TO THE INSTRUMENT'S POWER INPUT TERMINALS, POWER CORD, OR SUPPLIED POWER CORD SET. WHENEVER THE SAFETY EARTH GROUND HAS BEEN IMPAIRED, THE INSTRUMENT MUST BE MADE INOPERATIVE AND SECURED AGAINST ANY UNINTENDED OPERATION. IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER (NOT RECOMMENDED) FOR VOLTAGE REDUCTION, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE EARTH POLE OF THE POWER SOURCE.

1-3-3. LINE VOLTAGE AND FUSE SELECTION

CAUTION

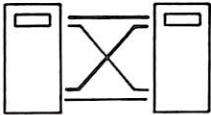
Before connecting the instrument to the power source, make sure that the correct fuse has been installed and the Line Voltage Selection Switch is correctly set.

Figure 1-3 illustrates the line voltage selection switch and fuse-holder on the instrument's rear-panel, instructions for line voltage and fuse selection, and the line voltage range for line voltage selection. Current ratings for the fuse are printed under the fuse-holder on the rear-panel and are listed, along with the fuse's HP part number, in Figure 1-3.

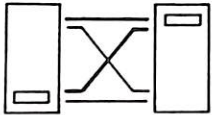
CAUTION

Use the proper fuse for the line voltage selected. Make sure that only fuses with the required current rating and of the specified type are used as replacements. DO NOT use a mended fuse or short-circuit the fuse-holder in order to by-pass the fuse.

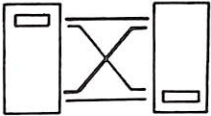
100 V Operation



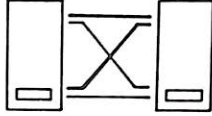
120 V Operation



220 V Operation



240 V Operation



Voltage Selector	Line Voltage
100 V	90 - 110 V, 48 - 66 Hz
120 V	108 - 132 V, 48 - 66 Hz
220 V	198 - 242 V, 48 - 66 Hz
240 V	216 - 252 V, 48 - 66 Hz

Line Voltage Selector:
Set the Line Voltage Selector switch.

Fuse Removal:
Turn the fuse holder counterclockwise until the fuse pops out.

Operating Voltage	Fuse Rating	Fuse Part No.
100 V 120 V	5 A, 250 V, Normal Blow	2110-0010
220 V 240 V	2.5 A, 250 V, Slow Blow	2110-0015

Figure 1-3. Line Voltage and Fuse Selection

1-3-4. POWER CABLE

To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The 4195A is equipped with a three-conductor power cable, which, when plugged into an appropriate AC power receptacle, grounds the instrument. The offset pin on the power cable is the ground wire.

To preserve the protection feature when operating the instrument from a two contact outlet, use a three-prong to two-prong adapter (PN 1251-8196) and connect the adapter's green pigtail to power-line ground.

SECTION 3

BASIC MEASUREMENT EXAMPLES

3-1. INTRODUCTION

This section gives examples of the HP 4195A's basic measurement operation. The examples in this section are designed so you can perform them to familiarize yourself with the 4195A. These examples are a guide to help you to learn the operation of the 4195A, they may not apply directly to your application. For more practical information on making accurate measurements, and for more examples, read Section 4.

The WARNINGS, CAUTIONS, and NOTES given throughout this document must be carefully followed to ensure the operator's safety and the serviceability of the 4195A.

WARNING

BEFORE TURNING THE 4195A ON, ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTOTRANSFORMERS, AND DEVICES CONNECTED TO THE 4195A MUST BE CONNECTED TO EARTH GROUND. ANY INTERRUPTION OF EARTH GROUND CONSTITUTES A SHOCK HAZARD WHICH MAY RESULT IN PERSONAL INJURY.

ONLY FUSES WITH THE REQUIRED CURRENT RATING AND OF THE SPECIFIED TYPE CAN BE USED. DO NOT USE A SUBSTITUTE FOR THE PROPER FUSE AND NEVER SHORT CIRCUIT THE FUSE-HOLDER. DOING SO CONSTITUTES A SHOCK HAZARD.

CAUTION

Before you turn your 4195A on, be sure to set the voltage selector to the line voltage to be used, or the instrument will be damaged.

3-2. NETWORK MEASUREMENT EXAMPLE

In this example you are going to observe the transmission frequency response of a Band-pass Filter. Prepare a bandpass filter with the following specifications, and then follow the given procedure.

Center Frequency	100 MHz or higher, and 400 MHz or lower
Input/Output Impedance	50Ω

1. Leave all front panel **OUTPUT/INPUT** connectors open.
2. Press the **CONFIG** key.

The **CONFIG** key is located in the **MEASURE** section of the control unit (upper unit of the 4195A) front panel.

You will see the softkey labels that includes '**NETWORK**', '**SPECTRUM**', etc. The 4195A measurement configuration can be selected on this page.

3. Press the '**NETWORK**' softkey.

The '**NETWORK**' softkey is located at the first key from the top at the right hand edge of the CRT. When the '**NETWORK**' softkey is pressed, the softkey label will change to **green**.

NETWORK will be displayed in the Function Area (the upper left corner of the CRT). This indicates that the 4195A is in network configuration.

4. Press the **PRESET** key.

The **PRESET** key is located at the lower center of the control unit front panel. The **PRESET** key will clear most of the previous control settings and return them to the default settings. The **PRESET** key will not clear control settings that are unique to unselected configurations.

5. Connect the bandpass filter as shown in Figure 3-1.

6. Press the **CENTER** key.

CENTER= 250000000.000 HZ will be displayed on the keyboard input line.

7. Enter the center frequency of your bandpass filter using the numeric and unit keys.

The center frequency can be changed using the up and down arrow keys instead of numeric and unit keys.

8. Press the **SPAN** key and change the frequency span as appropriate for measurement of your bandpass filter.

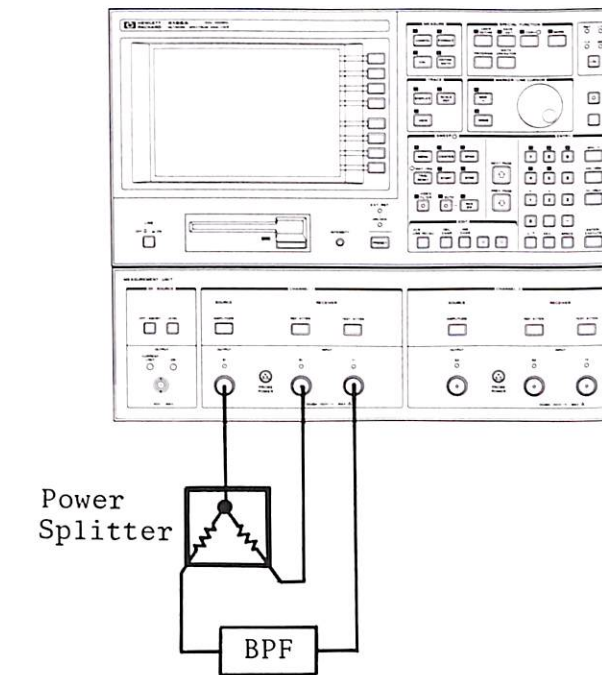


Figure 3-1. Network Measurement Example Setup

9. Press the **VIDEO FILTER** key.

The indicator located at the center of **VIDEO FILTER** turns **ON**. You will observe less fluctuation in the resulting measurement traces on the CRT, and the measurement time will increase.

10. Press the **RES BW** key.

RBW= (the currently set resolution bandwidth) will be displayed on the keyboard input line.

11. Press the down arrow key.

The **AUTO** indicator will be turned off. Every time you press the down arrow key, the time required for measurement will be increased, and you will observe less fluctuation on the traces.

12. Using the video filter and the resolution bandwidth filter settings, find the best measurement stability and the sweep time for your measurement.

13. Press the **MKR →** key and '**MKR→ MAX**' softkey.

The marker will move to the maximum value of the yellow trace. The frequency at which the insertion loss of the bandpass filter is minimum, the yellow trace maximum value (insertion loss) and the phase shift at the frequency are displayed above the graph area of the screen.

14. Press the **MODE** key and the 'oMKR & LCURS' softkey.

The softkey labels will change automatically when you press the softkey.

15. Press the 'Δmode on off' softkey so that **on** changes to **green**.

16. Press the 'more 1/2' and 'WIDTH on off' softkey to select **on**.

The difference between the marker and the line cursor in dBs and the frequency width between the two intersection points of the yellow trace and the line cursor will be displayed.

17. Rotate the **knob** in the both directions.

The line cursor will move up and down. You can read the difference between the o marker and the line cursor to determine the bandwidth of the filter.

18. Press the 'ΔVALUE entry' softkey.

DLCURS= will be displayed on the keyboard input line.

19. Press the minus (-), **3**, and **ENTER/EXECUTE** keys in sequence.

The line cursor will move to the point which is -3 dB from the insertion loss level, and the -3 dB band width will be displayed.

20. Press the 'Q VALUE' softkey.

The quality factor value of the filter at the -3 dB point will be displayed.

21. Press the **MODE** key and 'off' softkey.

The marker and the line cursor will disappear.

22. Press the **FORMAT** key and 'T/R-τ (dB)' softkey.

The blue trace shows the group delay, not the phase shift.

23. Press the **SCALE REF** key and 'SCALE forA forB' softkey to select **forB** (change to green).

24. Press the 'B AUTO SCALE' softkey.

The display scale for the group delay measurement result will be optimized.

NOTE

This example simply shows measurement operation, the calibration capability of the 4195A was not used. Refer to paragraph 4-8, MEASUREMENT CALIBRATION, for useful techniques when high accuracy measurements are required.

3-3. SPECTRUM MEASUREMENT EXAMPLE

In this example you are going to observe the harmonic distortion of a 10 MHz signal. The 10 MHz signal available from the control unit's rear panel is used for this example.

1. Leave all front panel **OUTPUT/INPUT** connectors open.

2. Press the **CONFIG** key.

The **CONFIG** key is located in the **MEASURE** section of the control unit (upper unit of the 4195A) front panel.

You will see the softkey labels that includes '**NETWORK**', '**SPECTRUM**', etc. The 4195A measurement configuration can be selected on this page.

3. Press the '**SPECTRUM**' softkey.

The '**SPECTRUM**' softkey is located at the second key from the top of the Soft-key Area (the right hand edge of the CRT). When the '**SPECTRUM**' softkey is pressed, the softkey label will change to **green**.

SPECTRUM will be displayed in the Function Area (the upper-left corner of the CRT) indicating that the 4195A is in spectrum configuration.

4. Press the **PRESET** key.

The **PRESET** key is located at the lower center of the control unit front panel. The **PRESET** key will clear most of the previous control settings and return them to the default settings. The **PRESET** key will not clear control settings that are unique to unselected configurations.

5. Press the **CHANNEL 1 RECEIVER REF ATTEN** key.

ATR1= 20 DB will be displayed on the keyboard input line, and the softkey labels are changed for IF Range selection. The '**IF RNG NORMAL**' softkey label will be change to **green**.

6. Press the **arrow up** key twice.

The R1 input attenuator will be set to 40 dB and the RANGE display for the R1 input (displayed on the right hand side of the system message line) will change to +20 dBm. This is for measuring a maximum amplitude signal of +20 dBm.

7. Connect the **10 MHz OUTPUT** connector on the control unit rear panel and the **R1** connector on the measurement unit front panel with a coaxial cable and an adapter.

You will see the 10 MHz fundamental signal and some spurious signals traces on the CRT. The 10 MHz OUTPUT signal is not a pure sine wave, because the purpose for which this signal is intended does not require high spectral purity.

8. Press the **SCALE REF** key and the '**A AUTO SCALE**' softkey.
9. Press the **START** key.

START= 0.001 HZ will be displayed on the keyboard input line. This reports that the currently set **START** frequency (the most left of the measurement trace) is 1 mHz.

10. Press the **5** and **MHz/V** keys.

When you press the **5** key, the previously displayed **0.001 HZ** will disappear. When you press **MHz/V** key, the start frequency is changed to 5 MHz and **START= 50000000.000 HZ** will be displayed. The currently set **START** and **STOP** frequencies are displayed below the displayed graph.

11. Press the **STOP**, **1**, **0**, **5**, and **MHz/V** keys in sequence.

12. Press the **MKR →** key and the '**MKR→ MAX**' softkey.

The marker will move to the 10 MHz point on the trace.

13. Press the '**NEXT PEAK**' softkey.

The marker will move to the next lower peak, every time you press '**NEXT PEAK**'.

14. Disconnect the input signal from the **R1** connector.

15. Press the '**more 1/2**', and '**NOISE on off**' softkeys to select **on**.

16. Rotate the **knob** to select a frequency at which to read the noise level.

The noise level (normalized per hertz) will be displayed above the graph area of the CRT.

3-4. IMPEDANCE MEASUREMENT EXAMPLE

This example shows how to measure the impedance characteristics of a component.

1. Connect the impedance test adapter from the HP 41951A to the front panel of the HP 4195A.

Figure 3-2 shows the impedance test adapter connected to the 4195A with a test fixture attached, but don't connect the test fixture yet.

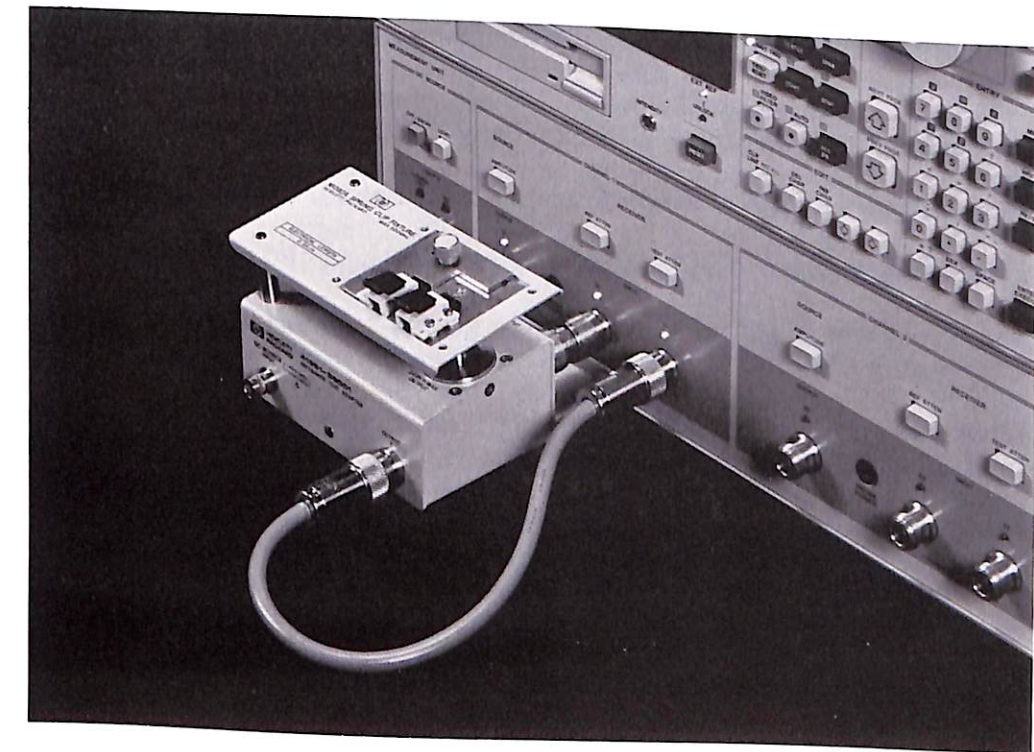


Figure 3-2. Impedance Test Adapter Connection

2. Press the **CONFIG** key and '**IMPEDNCE**' softkey.
3. Press the **PRESET** key.
4. Press the **CHANNEL 1 RECEIVER REF ATTN** key.

ATR1= 20 DB will be displayed on the keyboard input line.

5. Press the **down arrow** key twice.

The **R1** input attenuator will be set to 0 dB.

6. Press the **CHANNEL 1 RECEIVER TEST ATTN** key.

ATT1= 20 DB will be displayed on the keyboard input line.

7. Press the **down arrow** key twice.

The T1 input attenuator will be set to 0 dB.

8. Press the **CAL** key and the '**CAL menu**' softkey.

9. Press the '**ONE PORT FULL CAL**' softkey.

10. Connect the **OPEN** termination atop the APC-7 connector of the Impedance Test Adapter.

Rotate the coupling nut of the APC-7 connector CW (clockwise) so that the coupling sleeve protrudes fully. **Do not touch the terminal contact surface with your fingers (to maintain optimum contact cleanliness)**. Place the **OPEN** termination on the APC-7 connector. Hold the center brass part of the termination so it will not rotate, and rotate the termination cap nut CW (clockwise) until fully tightened, **DON'T OVER TIGHTEN**.

11. Press the '**OPEN**' softkey and the **ENTER/EXECUTE** key.

Measuring OPEN will be displayed, and **SHORT CAL required** will be displayed after a short time.

12. Disconnect the **OPEN** termination and connect the **SHORT** termination atop the APC-7 connector of the Impedance Test Adapter.

Place the **SHORT** termination on the APC-7 connector. **Carefully handle the termination so as not to damage or contaminate its precision contact surface**. Hold the center brass part of the termination so it will not rotate, and rotate the termination cap nut CW (clockwise) until fully tightened, **DON'T OVER TIGHTEN**.

13. Press the '**SHORT**' softkey and the **ENTER/EXECUTE** key.

Measuring SHORT will be displayed, and **LOAD CAL required** will be displayed after a short time.

14. Disconnect the **SHORT** termination and connect the **LOAD** termination (labeled as 50 Ω) atop the APC-7 connector of the Impedance Test Adapter.

Rotate the coupling nut of the 50 Ω termination so that the coupling sleeve of the termination is at its innermost free position. Place the 50 Ω termination on the APC-7 connector. Hold the termination body so it will not rotate, and rotate the outer nut of the termination CW (clockwise) until fully tightened, **DON'T OVER TIGHTEN**.

15. Press the '**LOAD**' softkey and the **ENTER/EXECUTE** key.

Measuring LOAD will be displayed, and **Load calibration completed** will be displayed after a short time.



16. Disconnect the 50 Ω termination and place a test fixture atop the Impedance Test Adapter as shown in Figure 3-2.

After use, leave the 50 Ω termination coupling sleeve screw protruding to prevent possible impairment to the termination surface.

17. Press the '**return**' softkey and the '**COMPEN menu**' softkey.

18. Press the '**0S&0 Ω OFFSET**' softkey.

Calculating CAL coefficient will be displayed on the system message line, and the softkey label will change to green after a short time.

19. Open the measurement terminal of the test fixture. Do not connect anything to the test fixture.

20. Press the '**0S**' softkey and the **ENTER/EXECUTE** key.

Measuring 0S will be displayed, and **0 Ω compen required** will be displayed after a short time.

21. Short the test fixtures measurement terminals.

22. Press the '**0 Ω** ' softkey and the **ENTER/EXECUTE** key.

Measuring 0 Ω will be displayed, and **0 Ω compensation complete** will be displayed after a short time.

23. Press the '**return**' softkey and the '**CORRECTN on off**' softkey.

Calculating CAL coefficient will be displayed, and the **on** in the '**CORRECTN on off**' softkey label will be changed to green after a short time.

24. Connect the component to be measured to the test fixture.

NOTE

Refer to paragraph 4-8, for details about Calibration.

3-5. S-PARAMETER MEASUREMENT EXAMPLE

In this example you will measure the S-parameters of a network.

1. Connect two Transmission/Reflection Test Sets (two HP 85044As) to the 4195A's front panel output/input connectors as shown in Figure 3-3.

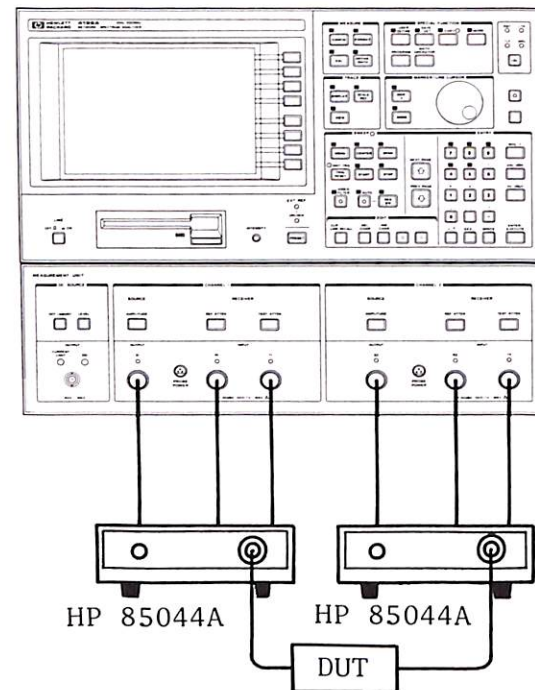


Figure 3-3. S-parameter Configuration Setup Example

2. Connect the network under test between the 50 Ω TEST PORTS of the HP 85044As.
3. Press the **CONFIG** key and '**S-PRMTR**' softkey, then press the '**S11**' softkey.
4. Press the **PRESET** key.

The yellow LED indicators at **S1**, **R1**, and **T1** connectors will turn **ON**.

5. Press the **DISPLAY** key and '**SMITH**' softkey.

The measurement **FORMAT** (parameter) is automatically changed to $\Gamma_x\text{-}\Gamma_y$. Now the 4195A displays S11 (forward reflection) on the Smith chart.

6. Press the **CONFIG** key and '**S21**' softkey, then press the **PRESET** key.

The yellow LED indicators at **S1**, **R1**, and **T2** connectors turn **ON**. Now the 4195A displays S21 (forward transmission) frequency response characteristics.

7. Press the **CONFIG** key and the '**S12**' softkey, then press the **PRESET** key.

The yellow LED indicators at **T1**, **S2**, and **R2** connectors will turn **ON**.

8. Press the **FORMAT** key and the '**T/R- τ (dB)**' softkey.

Now the 4195A displays S12 (reversed transmission) group-delay frequency response characteristics.

9. Press the **SCALE REF** key and the '**SCALE forA forB**' and '**B AUTO SCALE**' softkeys.

10. Press the **CONFIG** key and the '**S22**' softkey, then press the **PRESET** key.

The yellow LED indicators at **S2**, **R2**, and **T2** connectors will turn **ON**.

11. Press the **DISPLAY** key and '**POLAR**' softkey.

The measurement **FORMAT** (parameter) is automatically changed to $\Gamma_x\text{-}\Gamma_y$. Now the 4195A displays S22 (reversed reflection) on the polar chart.

12. Press the **SCALE REF** key and the '**A AUTO SCALE**' softkey.

13. Press the **CONFIG** key. Then press '**S11**', '**S21**', '**S12**', and '**S22**' softkeys in sequence.

As you can see, the 4195A remembers the measurement format (parameter) and the display format for each S-parameter configuration.

14. Select the measurement conditions (frequency range, resolution bandwidth, etc.) as you like.

You can measure all four S-parameters by only selecting the '**S11**', '**S21**', '**S12**', and '**S22**' softkeys.

NOTE

This example simply shows measurement operation, the calibration capability was not used. Refer to paragraph 4-8, MEASUREMENT CALIBRATION, for techniques you can use to make more accurate measurements.

4-4-4. NETWORK MEASUREMENT CALIBRATION

This paragraph describes the network measurement calibration procedures. For details about 4195A calibration, refer to paragraph 4-8. MEASUREMENT CALIBRATION.

1. Transmission Calibration Procedure

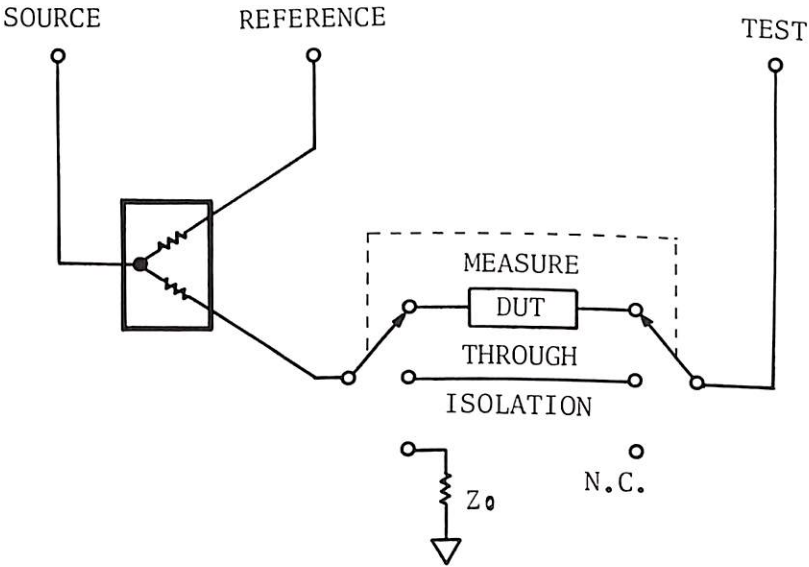


Figure 4-2. Transmission Calibration Diagram

1. Press the **CONFIG** key, the '**NETWORK**' softkey, and the **PRESET** key, in sequence.
2. Connect a power splitter, and a network as appropriate -- the MEASURE position shown in Figure 4-2.
3. Set the 4195A's stimulus and receiver settings as appropriate for the selected measurement.
4. Press the **CAL** key and the '**TRANS CAL** menu' softkey.
5. Press the '**NORM&ISN CAL**' softkey.

NOTE

If you don't need to perform the isolation calibration, press the '**NORMALIZE (THRU)**' softkey instead and skip to step 8.

6. Terminate the source signal with an impedance matched load, and disconnect the network under test from the setup, leave the test channel open -- the ISOLATION position shown in Figure 4-2.
7. Press the '**ISOLATN**' softkey and the **ENTER/EXECUTE** key, and wait until **THRU CAL required** is displayed.

8. Short circuit the test cables to make a through connection -- the THROUGH position shown in Figure 4-2.
9. Press the 'THRU' softkey and the ENTER/EXECUTE key, and wait until **Thru calibration completed** is displayed.
10. Connect the network under test as appropriate for the selected measurement -- the MEASURE position shown in Figure 4-2.
11. Press the 'return' and the 'CORRECTN on/off' softkeys. 'on' in the 'CORRECTN on/off' softkey will change to intensified green and **Cor** will be displayed in the function area of the screen. Succeeding measurements are corrected using this calibration measurement data.

2. Reflection Calibration Procedure

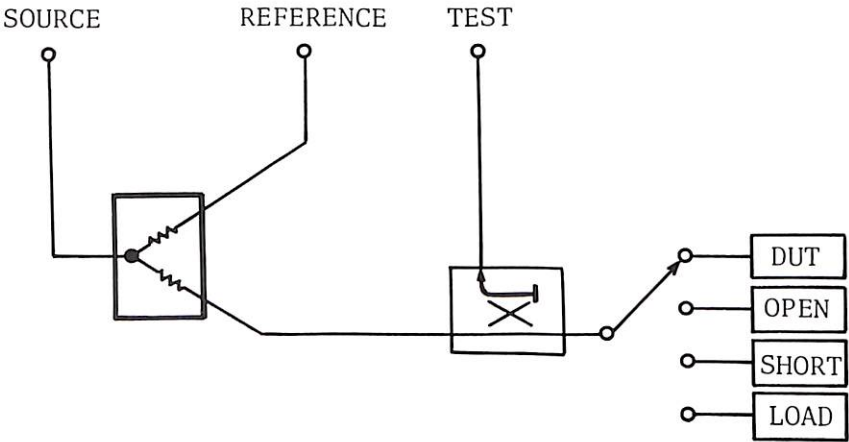


Figure 4-3. Reflection Calibration Diagram

1. Press the **CONFIG** key, the 'NETWORK' softkey, and the **PRESET** key in sequence.
2. Connect a directional bridge, a power splitter and the network under test as appropriate for the selected measurement -- the DUT position shown in Figure 4-3.
3. Set the 4195A's stimulus and receiver settings as appropriate for the measurement.
4. Press the **CAL** key and 'more 1/2' softkey.
5. Select the characteristic impedance of your measurement system -- 50Ω or 75Ω -- using the 'Z0 50Ω 75Ω' softkey. Each time the 'Z0 50Ω 75Ω' softkey is pressed, the selected impedance will be toggled to intensified green.
6. Press the 'CAL STD modify' softkey. Previously set (or default setting) calibration values for the reference calibration standards will be displayed.
7. Press the 'OPEN CAL STD' softkey. **OPNSTD** will be displayed on the keyboard input line.
8. Enter a good estimation of the OPEN standard's calibrated conductance in Siemens (S) and parallel capacitance in Farads (F) units separated by a comma (,). For example, you would press the following keys if the calibrated value is 0S + 310fF.

OPNSTD= [0] [,] [3] [1] [0] [EEX] [-] [1] [5] [ENTER/EXECUTE]

NOTE

If you need to perform only the calibration using OPEN, skip to step 13.

9. Press the 'LOAD CAL STD' softkey. **LDSTD** will be displayed on the keyboard input line.
10. Enter a good estimation of the LOAD standard's calibrated series resistance in ohms (Ω) and the series inductance in Henries (H) separated by a comma (,). For example, you would press the following keys, if the calibrated value is 50Ω + 5 nH.

LDSTD= [5] [0] [,] [5] [Blue Shift] [N] [ENTER/EXECUTE]

NOTE

If you need to perform only the OPEN and LOAD calibration, skip to step 13.

11. Press the '**SHORT CAL STD**' softkey. **SHTSTD** will be displayed on the keyboard input line.
12. Enter a good estimation of the SHORT standard's calibrated series resistance in ohms (Ω) and the series inductance in Henries (H) separated by a comma (,). For example, you would press the following keys, if the calibrated value is $0\Omega + 5\text{ nH}$.

SHTSTD= [0] [,] [5] [Blue Shift] [N] [ENTER/EXECUTE]

13. Press the '**return**' and the '**REFLECTN CAL** menu' softkey.
14. Press the '**ONE PORT FULL CAL**' softkey.

NOTE

If you don't need to perform the SHORT calibration, press the '**ONE PORT PART CAL**' softkey instead and skip to step 17. If you don't need to perform the SHORT and LOAD calibration, press the '**NORMLIZE (OPEN)**' softkey instead and skip to step 19.

15. Disconnect the network under test, and connect the SHORT reference termination -- the SHORT position shown in Figure 4-3.
16. Press the '**SHORT**' softkey and the **ENTER/EXECUTE** key, and wait until **OPEN CAL required** is displayed.
17. Disconnect the SHORT reference termination, and connect the LOAD reference termination -- the LOAD position shown in Figure 4-3.
18. Press the '**LOAD**' softkey and the **ENTER/EXECUTE** key, and wait until **OPEN CAL required** is displayed.
19. Disconnect the LOAD reference termination, and connect the OPEN reference termination -- the OPEN position shown in Figure 4-3.
20. Press the '**OPEN**' softkey and the **ENTER/EXECUTE** key, and wait until **Open calibration completed** is displayed.
21. Connect the network under test -- the DUT position shown in Figure 4-3.
22. Press the '**return**' and the '**CORRECTN on/off**' softkeys. '**on**' in the '**CORRECTN on/off**' softkey will be change to intensified green and **Cor** will be displayed in the function area of the screen. Succeeding measurements are corrected using this calibration measurement data.

4-8-4. OS/0 Ω OFFSET COMPENSATION

OS and 0 Ω offset compensation are available only in the impedance configuration. OS and 0 Ω offset compensation can compensate for the stray admittance and residual impedance of a test fixture attached at the calibration plane. Figure 4-5 shows an example of a stray admittance and residual impedance circuit model. The HP 4195A has three type of OS/0 Ω offset compensation as follows.

OS offset compensation:	Compensates for the stray admittance.
0 Ω offset compensation:	Compensates for the residual impedance.
OS/0 Ω offset compensation:	Compensates for the stray admittance and residual impedance.

Compensation type is selected as follows.

1. Press the **CAL** key, and the '**COMPEN** menu' softkey.
2. Press the '**COMPEN NONE**' softkey (or send the **CMPT0** command) to select not to use the compensation function. Press the '**OS OFFSET**' softkey (or send the **CMPT1** command) to select the OS offset compensation. Press the '**0 Ω OFFSET**' softkey (or send the **CMPT2** command) to select the 0 Ω offset compensation. Press the '**OS&0 Ω OFFSET**' softkey (or send the **CMPT3** command) to select the OS&0 Ω offset compensation.

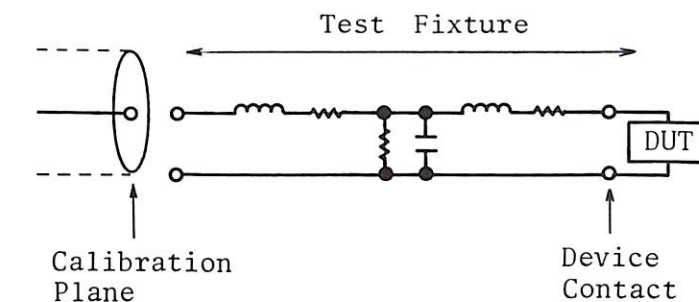


Figure 4-5. OS/0 Ω Offset Compensation

4-8-5. PORT EXTENSION

When a 50 Ω coaxial cable is used to extend calibration plane to the network (or device) under test, the port extension can offset the phase shifts due to the extension cables. Port extension compensates for phase shift by calculation using the extension length as the parameter, it doesn't compensate for the signal's attenuation due to the port extension. The port extension length data is not cleared or changed, even if the 4195A's configuration is changed. So it is necessary to clear and enter the length data when the measurement setup is changed.

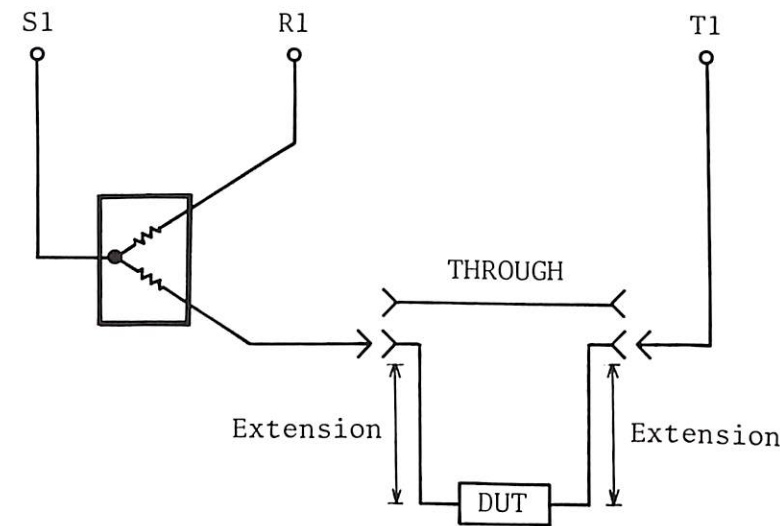


Figure 4-6. INPUT T1 Port Extension Example

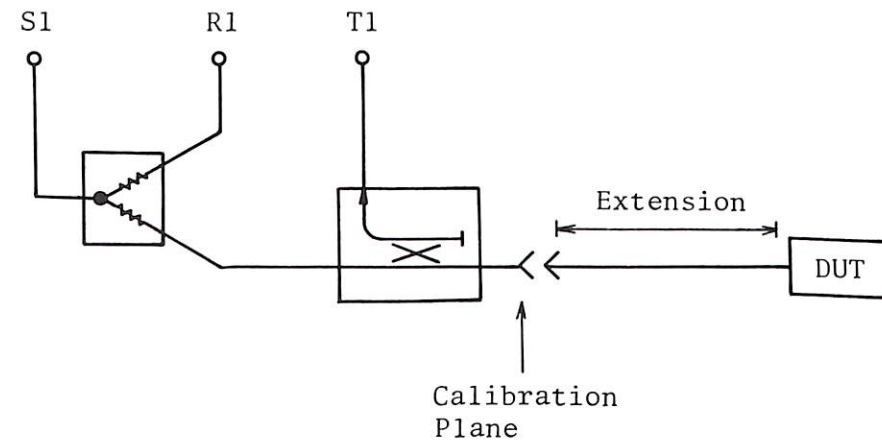


Figure 4-7. PORT 1 Extension Example

Port extension length data is entered by the following procedure.

1. Press the **CAL** key and the **'PORT EXTENSNS'** softkey.
2. Press the softkey corresponding to ports required extension.

For example, press the **'INPUT T1'** softkey for **T1** port extension as shown in Figure 4-6, press the **'PORT 1(R1)'** softkey for **CHANNEL 1** port extension as shown in Figure 4-7. The currently set extension length will be displayed on the keyboard input line.

3. Enter the extension length (in cm) and press the **ENTER/EXECUTE** key.
4. Repeat steps 2 and 3 for all port required extension.
5. Press the softkey corresponding to ports required no extension.



6. Enter **0** and press the **ENTER/EXECUTE** key for no extension ports.
7. Press the **'return'** softkey.
8. Press the **'PORT EXT on off'** softkey so that **on** is intensified **green**.

4-8-6. CALIBRATION HINTS

Here are some hints for obtaining accurate calibration.

1) Stimulus Settings/Receiver Settings and Calibration

For the most accurate calibration, perform the calibration with the same stimulus and receiver settings as will be used in the actual measurement.

Once the calibration/compensation are performed, calibration/compensation data will be stored into the dedicated registers for all points in the frequency sweep range, so that accurate measurements can be performed.

When calibration is performed using the full frequency span sweep setting (10 Hz to 500 MHz), all measurements can be corrected within a certain accuracy, even if the frequency range is changed or the sweep parameter is changed.

When Calibration has been Performed in the Frequency Sweep Mode:

All frequency sweep measurements are correctable. If a measurement frequency is within the calibrated frequency range, the calibration data is calculated using interpolation. If a measurement point is out of the calibrated frequency range, the calibration data of the closest frequency is used.

All DC source sweep and oscillator level sweep measurements are correctable. The constant frequency (Spot Frequency) calibration data is used. If the spot frequency is not one of the calibrated frequencies, the calibration data is calculated in the same manner as for frequency sweep measurements.

When Calibration has been Performed in the DC Source Voltage or Oscillator Level Sweep Mode:

Any measurement is correctable until the sweep parameter is changed to frequency. The calibration data taken at certain stimulus/receiver settings is used for the succeeding measurements, even if some the stimulus/receiver settings are changed.

If the sweep parameter is changed to frequency all the calibration data will be lost and correction is automatically turned off.

NOTE

Once the stimulus setting is changed from the settings used for calibration, **Cint** will be displayed in the function area of the screen when the calibration data is calculated using interpolation, **Cor?** will be displayed when a measurement point is out of the calibrated frequency range.

2) Calibration Data/Compensation Data Storage

The current calibration data is lost when a new calibration is performed, or when the 4195A is turned off. To save the calibration data, it must be saved on a flexible disc using the built-in flexible disc drive. Turn on the correction for selected calibration and save the instrument settings to the disc using the **save-state** function. If correction is not turned on, the calibration data will not be saved.

The impedance configuration's OS/O Ω offset compensation data is also saved only when the Impedance configuration's correction is turned on.

Port extension length data is saved in all cases, even if the port extension is turned off.

The four groups of calibration standards' values are stored on the disc in all cases and are also saved in the 4195A's battery back-up memory.

3) Calibration Data Independence between Configurations

The 4195A's calibration data is stored in its 32 calibration array registers. All of the calibration registers are used when the 4195A is in the S-Parameter configuration. The calibration registers for the S11 and S21 configurations are shared with the Network configuration's reflection and transmission calibration, respectively. The S22 configuration registers are shared with the Impedance configuration's calibration.

Network-transmission calibration data, network-reflection calibration data, and impedance calibration data are independent of each other. Once the S-Parameter calibration is performed, the Network and Impedance calibration data will be lost. The calibration data sets for the four S-Parameter configurations are independent of each other.

The port extension extension length data is the same for all configurations. If port extension is turned **ON** in one configuration, it will be turned **ON** for the other configurations also.

Impedance configuration's OS/O Ω offset compensation data is not destroyed when the other configurations are calibrated.



4-9-5. SWEEP TIME

The minimum sweep time is automatically calculated and set from other stimulus and receiver settings. When you want to increase the sweep time, perform the following steps.

1. Press the **MENU** key, the '**RESOLUTN menu**' softkey, and the '**SWEEP TIME**' softkey. **ST=** (currently set sweep time) **SEC** will be displayed on the keyboard input line.
2. Enter the required sweep time using the **ENTRY** keys or the **up/down** arrow keys.

NOTE

You cannot decrease the sweep time to be less than the AUTO setting.

4-9-6. NON-SWEEP PARAMETERS

In the frequency sweep mode, source amplitude and DC voltage are set to selected constant values. In a source amplitude sweep, the frequency and DC voltage are set to selected constant values. In a DC voltage sweep, the frequency and source amplitude are set to selected constant values.

To enter the constant frequency from the front panel, perform the following procedure.

1. Press the **SWEEP MENU** key, and the '**more 1/2**' and '**SPOT FREQ**' softkeys. Then **FREQ=** will be displayed on the keyboard input line.
2. Enter the selected constant frequency using the **ENTRY** area keys.

Use the following procedure to set the source amplitude from the front panel.

1. Press the **CHANNEL 1 SOURCE AMPLITUDE** key or the **CHANNEL 2 SOURCE AMPLITUDE** key. **OSC1=** or **OSC2=** will be displayed on the keyboard input line, respectively.
2. Enter the selected constant source amplitude using the **ENTRY** area keys or the **arrow up/down** keys.

NOTE

Select as high a source amplitude as possible to obtain the widest dynamic range, low noise, and the most stable measurements, but be sure the network under test and the 4195A's circuit is not overloaded. If the characteristics of the network under test is input power dependent, select the appropriate measurement amplitude.

Use the following procedure to set the DC voltage from the front panel.

1. Press the **DC SOURCE LEVEL** key, **BIAS=** will be displayed on the keyboard input line.
2. Enter the selected constant DC voltage using **ENTRY** area keys.

4-10. RECEIVER SETTINGS

4-10-1. INPUT RANGE

The 4195A input range (the maximum input power which does not cause the 4195A's internal circuit to saturate or distort the signal) for each of the R1, T1, R2, and T2 inputs is determined by the combination of the INPUT ATTENUATOR setting and the IF RANGE selection. Input attenuators are furnished at each of the four inputs. The IF range selection affects all four inputs. Tables 4-10 and 4-11 list input range values for the SPECTRUM configuration and the other configurations.

Table 4-10. Spectrum Configuration Input Ranges

Input Attenuation	IF Range Normal	IF Range Low Distortion	IF Range High Sensitivity
0 dB	-20 dBm	-30 dBm	-40 dBm
10 dB	-10 dBm	-20 dBm	-30 dBm
20 dB	0 dBm	-10 dBm	-20 dBm
30 dB	+10 dBm	0 dBm	-10 dBm
40 dB	+20 dBm	+10 dBm	0 dBm
50 dB	+20 dBm	+20 dBm	+10 dBm

Table 4-11. Input Ranges for other than Spectrum Configuration

Input Attenuation	IF Range Normal	IF Range High Sensitivity
0 dB	-10 dBm	-20 dBm
10 dB	0 dBm	-10 dBm
20 dB	+10 dBm	0 dBm
30 dB	+20 dBm	+10 dBm
40 dB	+20 dBm	+20 dBm
50 dB	+20 dBm	+20 dBm

CAUTION

The maximum allowable input signal power is +30 dBm and ± 7 V DC for each input. Do not input AC power or DC voltage exceeding these maximum levels.

4-14. INITIAL SETTINGS

The 4195A is initialized when the instrument is turned on, the CLEAR statement (device clear) is entered via HP-IB, or the PRESET key on the front panel is pressed ("RST" command is entered). The initialization method differences are shown in Table 4-15.

NOTE

Pressing the PRESET key is same as entering the "RST" command.

Table 4-15. Initialization Differences

Parameter	Turn on	CLEAR	PRESET
Measurement Configuration (N/S/I/S11/S12/S21/S22) ¹	YES ²	YES ²	NO ³
General Parameter	YES	YES	NO
Parameter couple to Measurement Configuration Network measurement Spectrum measurement Impedance measurement S11 measurement S12 measurement S21 measurement S22 measurement	YES YES YES YES YES YES YES	YES YES YES YES YES YES YES	YES ³
HP-IB Definition (addressable/talk-only)	YES ⁴	NO ⁵	NO
Single Variable Register	YES	NO ⁶	NO ⁶
Array Variable Register	YES	NO	NO
YES: initialized NO: not initialized			

NOTE: ¹ N, S, and I indicates Network, Spectrum, Impedance measurement configuration, respectively.

² The measurement configuration is set to Network.

³ The PRESET key ("RST" command) can initialize only the setting at the current measurement configuration, and not initialize the Measurement Configuration.

⁴ The HP-IB definition is set to ADDRESSABLE mode.

⁵ Before sending the CLEAR statement to the 4195A from the controller, the 4195A's HP-IB definition must be set to the "ADDRESSABLE" mode.

⁶ A part of the single variable register is initialized. Refer to paragraph 4-14-2.

4-14-1. INITIAL FUNCTION SETTINGS

1. General Parameter

Table 4-16 shows the initial setting of the general parameters, independent of the measurement configurations (Network, Spectrum, Impedance, S11, S12, S21, or S22). These parameters are initialized by all initialization methods.

Table 4-16. Initial Setting for General Parameter

Parameter	Initial Setting
Sweep Mode continuous/single/manual	continuous
Sweep Type lin/log	Single ¹ lin
Sweep Direction up/down	up
Sweep Parameter	Frequency
Partial Sweep on/off	off
Programmed Points Table Measurement on/off	off
Table Number No.1/2/3/4	No.1
Trigger Mode internal/external	internal
AUTO (Coupled to Span) on/off	on
Video Filter on/off	off
Graticule on/off	on
Phase Scale normal/expand	normal
Superimpose C and D on/off	off
Storage mode on/off	off
Marker/Line Cursor Mode	o Marker Mode
Available data A/B (effective data for marker action)	A
User Math A and B on/off	off
Sweep End Function A, B and C on/off	off
Partial Analysis on/off	off
Port Extension Correction on/off	off
Characteristics Impedance 50/75Ω	50Ω
Copy Mode	Dump Mode
Equivalent Circuit A/B/C/D/E	A
Status Byte Mask	Disable All Bits
Data Output Format	ASCII Format

NOTE: ¹ When the instrument is initialized by the "RST" command in a User Program (ASP), the sweep mode is set to SINGLE.

2. Parameters Coupled to the Measurement Configurations

This paragraph describes the initial setting of the parameters which are measurement configuration dependent. When the instrument is turned on, or the CLEAR statement (device clear) is entered, the settings for all measurement configurations are initialized. But when the **PRESET** key is pressed (the "RST" command is entered), the setting for the current measurement configuration is initialized (ex. when the **PRESET** key is pressed during a S11 measurement, the setting for the Network, Impedance, Spectrum, S12, S21, and S22 measurement are not initialized).

(1) NETWORK measurement

Parameter	Initial Setting
Measurement Format	T/R[dB]-θ
Input Port	T1/R1
Correction mode on/off	off
Calibration mode	none
IF Range	normal
Display Format	X-A&B
Trace A on/off	on
Trace B on/off	on
Scale Type lin/log	lin
Reference Value for data A	0 dB
Division Value for data A	10 dB
Bottom Value for data A	-100 dB
Reference Value for data B	180 deg
Division Value for data B	36 deg
Bottom Value for data B	-180 deg

(2) SPECTRUM measurement

Parameter	Initial Setting
Measurement Format	dBm
Input Port	R1
Source off/CH1/CH2	off
IF Range	normal
Display Format	X-A&B
Trace A on/off	on
Trace B on/off	off
Scale Type lin/log	lin
Reference Value for data A	0 dBm
Division Value for data A	10 dBm
Bottom Value for data A	-100 dBm
Reference Value for data B	0 dBm
Division Value for data B	10 dBm
Bottom Value for data B	-100 dBm

(3) IMPEDANCE measurement

Parameter	Initial Setting
Measurement Format	$ Z - \theta$
Input Port	T1/R1
Compensation Mode on/off	off
Correction Mode on/off	off
Calibration Mode	none
IF Range	normal
Display Format	X-A&B
Trace A on/off	on
Trace B on/off	on
Scale Type lin/log	lin
Reference Value for data A	1 M Ω
Division Value for data A	100 k Ω
Bottom Value for data A	0 Ω
Reference Value for data B	180 deg
Division Value for data B	36 deg
Bottom Value for data B	-180 deg

(4) S-Parameter measurement (S11, S12, S21, and S22)

Parameter	Initial Setting
Measurement Format	RL- θ (S11 or S22)
Input Port	T/R(dB)- θ (S12 or S21)
	T1/R1 (S11)
	T1/R2 (S12)
	T2/R1 (S21)
	T2/R2 (S22)
Correction Mode on/off	off
Calibration Mode	none
IF Range	normal
Display Format	X-A&B
Trace A on/off	on
Trace B on/off	on
Scale Type lin/log	lin
Reference Value for data A	0 dB
Division Value for data A	10 dB
Bottom Value for data A	-100 dB
Reference Value for data B	180 deg
Division Value for data B	36 deg
Bottom Value for data B	-180 deg

4-14-2. DEFAULT VALUE OF SINGLE VARIABLE REGISTERS

When the instrument is turned on, all single variable registers are cleared (set to zero). Only the registers which are set to a specific default value are introduced here.

During initialization using the **CLEAR** statement or the "RST" command, no single variable registers are cleared (data is not changed), but the following registers are set to a default value.

1. Single Variable Registers Coupled to the Sweep Mode

The START, STOP, STEP, CENTER, SPAN, and NOP register which are coupled to the sweep mode (sweep parameter), have the following default values.

Resister	Sweep Mode				
	Frequency [Hz]	DC bias [V]	OSC [V]	OSC [dBm]	OSC [dB μ V]
START	0.001 Hz	0.000 V	0.010 V	-26.000 dBm	81.000 dB μ V
STOP	500000000.000 Hz	0.000 V	0.110 V	0.000 dBm	107.000 dB μ V
STEP	1250000.000 Hz	0.100 V	0.001 V	0.200 dBm	0.200 dB μ V
CENTER	250000000.000 Hz	0.000 V	0.060 V	-13.000 dBm	94.000 dB μ V
SPAN	499999999.999 Hz	0.000 V	0.100 V	26.000 dBm	26.000 dB μ V
NOP	401	101	101	131	131
RBW	300 kHz	100 kHz	100 kHz	100 kHz	100 kHz

2. Single Variable Registers for General Use

Register	Default Value	Register	Default Value
FREQ	10000000.000 Hz	ATR1	20 dB
OSC1	0.0 dBm	ATR2	20 dB
OSC2	0.0 dBm	ATT1	20 dB
BIAS	0.00 V	ATT2	20 dB
DFREQ	0.50 %		
PER1	0.000 cm	MKR	(CENTER)
PER2	0.000 cm	SMKR	(CENTER)
PET1	0.000 cm	DMKR	0
PET2	0.000 cm	LCURS	(REF+BTM)/2
PEP1	0.000 cm	DLCURS	0
PEP2	0.000 cm		
MANUAL	(CENTER)	EQVR	0
		EQVL	0
		EQVCA	0
		EQVCB	0
PTSWP	1		

4-14-3. DEFAULT VALUE OF ARRAY VARIABLE REGISTERS

When the 4195A is turned on, all array registers are cleared (set to zero), and only the **X** register is set to a default data.

During initialization by the **CLEAR** statement or the **PRESET** key, the array registers are not cleared, only the **X** register is initialized.

The default data of the **X** register depends on the value of the "START", "STOP", and "STEP" registers.

4-15. BATTERY BACK-UP MEMORY

The 4195A is equipped with a rechargeable battery which is used to provide standby power for the storage registers when the instrument is turned off. This paragraph describes the data stored in battery back-up memory, and the specifications of the battery backup function.

4-15-1. DATA STORED IN THE BATTERY BACK-UP MEMORY

The following parameters are always stored in the battery back-up memory.

- 1. User Math, User Defined Function, and Sweep End Function
- 2. HP-IB Address and Plot Scale
- 3. Standard Value for Calibration

When the 4195A is shipped, the parameters are set as follows.

1. User Math, User Defined Function, and Sweep End Function

The User Math, User Defined Function, and Sweep End Function are not defined, and are not labeled (no equation, no label, no parameter).

2. HP-IB Address and Plotter Scale

HP-IB Address: ADRS= 17

Plot Scale: PSCALE= 2000, 800, 9200, 7208

3. Standard Value for Calibration

Register	Network, S-Parameter		Impedance	
	Z=50 Ω	Z=75 Ω	Z=50Ω	Z=75Ω
OPNSTD	0.00Ω, 108fF	0.00Ω, 63.5fF	0.00Ω, 82fF	0.00Ω, 0.00pF
SHTSTD	0.00Ω, 0.00nH	0.00Ω, 0.00nH	0.00Ω, 0.00nH	0.00Ω, 0.00nH
LDSTD	50.00Ω, 0.00nH	75.00Ω, 0.00nH	50.00Ω, 0.00nH	75.00Ω, 0.00nH

'Z' indicates the characteristics impedance.

4-15-2. BATTERY BACKUP SPECIFICATIONS

The specifications of the rechargeable battery backup function are given below. The battery is automatically recharged while the instrument is on.

Operating Time: Approximately 2000 hours (after a full charge)

Recharge Time: Approximately 48 hours
 (Time required to fully recharge the battery)

Lifetime: Approximately 5 years (at 25°C)

4-16. SYNCHRONIZING WITH OTHER INSTRUMENTS

The HP 4195A provides the reference signal input/output connectors which are used to synchronize with the external instruments.

4-16-1. EXTERNAL REFERENCE SIGNAL INPUT

The 4195A's internal reference signal can be synchronized to an external reference signal input through the rear panel **EXT REFERENCE** connector when the front panel **EXT REF** indicator is **on**. If the 4195A's internal reference signal cannot synchronize with the input reference signal, the **UNLOCK** indicator on the 4195A's front panel is turned **on**. The signal entered to the **EXT REFERENCE** connector must meet the following specifications.

Frequency:	10/N MHz, ± 30 ppm at $23 \pm 5^{\circ}\text{C}$ (N is integer from 1 to 10)
Level:	Typical 0 dBm ± 5 dBm
Input Impedance:	Approximately 50Ω

NOTE

In HP 4195As equipped with Option 001 (High Stability Frequency Reference) the **EXT REFERENCE** connector is connected to the **REFERENCE OVEN** connector which supplies the internal high stability reference signal.

4-16-2. REFERENCE SIGNAL OUTPUT

The **10 MHz OUTPUT** connector supplies a 10 MHz signal with which to phase-lock external instruments.

Frequency:	10 MHz, ± 20 ppm at $23 \pm 5^{\circ}\text{C}$
Output Level:	Typical 0 dBm
Output Impedance:	Approximately 50Ω

SECTION 5

EXTENDED CAPABILITIES

5-1. INTRODUCTION

This section contains information about the functions, capabilities, and operating procedures for the HP 4195A's powerful extended capabilities and functions.

NOTE

This section includes some of the 4195A's control commands. All control commands corresponding the softkey labels are shown in Appendix D. All of the 4195A commands can be seen in Appendixes E and F.

5-2. INTERNAL REGISTERS

The 4195A has internal registers, most of which are assigned to specific operations. The registers are categorized into three types -- array, multiple, and single type registers.

5-2-1. ARRAY REGISTERS

The array registers can have as many as 401 elements each. The elements in an array register are addressed by element number -- 1 through 401. Data at a specific array register element can be read from or written to by specifying element number (indexing into the array) as follows:

A(5) [ENTER/EXECUTE]	Displays the data at the fifth element of the Array Register A on the system message line.
B(5) = 3 [ENTER/EXECUTE]	Enters the value (3) into the fifth element of Array Register B.

There are three kinds of Array Registers -- Display/Measurement Registers, General Purpose Registers, and Calibration Registers. All array registers are listed in Appendix F.

1) Display/Measurement Registers

The **A** and **B** registers are measurement data registers and are displayed on the CRT in bright yellow and intensified greenish-blue (cyan) traces, respectively. When the 4195A is performing a measurement (and the User Math function is turned off) data in registers A and B are updated automatically.

The **C** and **D** registers are superimpose data registers whose data can be displayed on the CRT in low intensity yellow and cyan traces, respectively.

The **MA** and **MB** registers are read only measurement data registers. These registers are used with the User Math function.

The sweep point measurement data is stored in the read only **X** register. The data in this register is automatically computed using the START, STOP, etc., parameters.

2) General Purpose Registers

The **E, F, G, H, I, J, RA, RB, RC, RD, RE, RF, RG, RH, RI, and RJ** registers are general purpose registers. They are used for temporary storage of measurement data, calculation results, etc..

3) Calibration Data Registers

The calibration data registers have four letter names. The first letter of a register name -- **M** and **T** -- means **M**easured and **T**heoretical value (computed), respectively. The **M**easured registers are used to store the calibration measurement result data. The **T**heoretical registers are used to store a standards' computed OPEN, SHORT or LOAD calibration value.

The second letter of a register name -- **F** and **R** -- means **F**orward and **R**eversed, respectively. **F**orward registers are used to store the forward S-Parameter (**S11** and **S21**) calibration data. The **R**eversed registers are used to store the reversed S-Parameter (**S12** and **S22**) calibration data.

The third letter of a register name -- **O, S, L, T, or I** -- means **O**pen, **S**hort, **L**oad, **T**hrough, or **I**solation, respectively. The **O**pen registers are used to store the OPEN calibration data. The **S**hort registers are used to store the SHORT calibration data. The **L**oad registers are used to store the LOAD calibration data. The **T**hrough registers are used to store the THROUGH calibration data. The **I**solation registers are used to store the ISOLATION calibration data.

The last letter of a register name -- **R** and **I** -- mean **R**eal or **I**maginary, respectively. The **R**eal and **I**maginary registers are used to store the **R**eal and **I**maginary components of the calibration data.

5-13. HARD COPY

The 4195A provides the hard copy capability for making a hard copy of the information displayed on the screen by using a plotter or printer via an HP-IB, without a controller.

5-13-1. COPYING CAPABILITIES

The 4195A has three copy modes: **PLOT, PRINT, DUMP**. In the **PLOT** mode, a plotter must be connected to the 4195A, and in the **PRINT** and **DUMP** modes, a printer must be connected. Table 5-5 shows the copy capabilities of these three modes.

- (1) **PLOT** mode Plot the information displayed on the 4195A's screen.
- (2) **PRINT** mode Print the data (in the register A, B, and X) as the numerical tabular form data. In the PROGRAMMED POINTS Table, ASP LIST and DISK CATALOG pages, the all programmed points data, the all program lines, and a list of all stored programs are printed, respectively.
- (3) **DUMP** mode Dump the screen to a raster graphics printer.

Table 5-5. Capabilities of Three Copy Modes

CRT page	PLOT mode	PRINT mode	DUMP mode
RECTANGULAR X-A&B	YES	YES	YES
RECTANGULAR A-B	YES	YES	YES
TABLE	NO	YES	YES
SMITH	YES	YES	YES
POLAR	YES	YES	YES
PROGRAMMED POINTS TABLE	NO	YES	YES
EQUIVALENT CIRCUIT PAGE	NO	NO	YES
ASP LIST	NO	YES	YES
DISC CATALOG	NO	YES	YES

YES: Available

NO: Not available. An error message "Plot allowed X-A&B/A-B/SMITH/POLAR" or "Can't print data on this display" will be displayed on the System Message Line.

5-13-2. HOW TO MAKE A HARD COPY

The following three methods can be used to make a copy of the measurement data.

- 1. Manually using the 4195A's front panel keys.
- 2. Using a User Program.
- 3. Using an HP-IB controller.

In method No. 1, the plotter or printer must be interconnected to the 4195A via HP-IB. The 4195A must be set to the Talk-only mode, and the plotter or printer must be set to the Listen-only mode. The procedure for making a copy of the 4195A's display is described in paragraph 5-13-5.

In method No. 2, the connected listen-only device and a User Program are required to make a copy of the display. You can use the 'TALK only' softkey or the "HADM2" command to set the 4195A to the Talk-Only. Refer to paragraph 6-4, User Program, for User Program details.

NOTE

The commands used to copy, are listed in the APPENDIX D, Softkey Tree.

In method No. 3, the HP-IB controller, plotter or printer, and a program to control the peripherals are required to copy the display. Then the 4195A must be set to the Addressable mode, using the 'ADDRESSABLE' softkey (the plotter or printer must be addressable). Refer to the paragraph 6-5-8, Example 3, Hard Copy.

NOTE

By using the following query commands, it is possible to print the characters on the Comment Area or the System Message Line, and the data in the register. The details of the query commands, are described in paragraph 6-5-4.

- DISP? (output the characters on the System Message Line)
- CMT? (output the characters on the Comment Area)
- (register)? (output the data in register: MKR?, R0? and etc.)

5-13-3. RECOMMENDED PLOTTERS AND PRINTER

Table 5-6 lists the recommended Plotters and Printer.

Table 5-6. Recommended Plotters and Printers

Plotter	HP 7440A with HP 17440A (PLOT mode only) 8 colors HP 7475A (PLOT mode only) 6 colors HP 7550A (PLOT mode only) 8 colors
Printer	HP 2225A (PRINT and DUMP mode only)

NOTE

To draw the smith chart, or polar chart, the following equation must be satisfied.

$$P2x-P1x : P2y-P1y = 9 : 8.01 \text{ (at 'P1,P2 normal') }$$

5-13-5. COPY PROCEDURE

- 1. Connect the plotter or printer using an HP-IB cable, and set the plotter or printer to Listen-only.
- 2. Display the information to be copied on the screen.
- 3. Press the **COPY** key on the 4195A's front panel, the **COPY** menu will then be displayed in the Softkey Area of the screen.
- 4. Press the 'HP-IB define' softkey, the HP-IB define menu will be displayed in the Softkey Area.
- 5. Press the 'TALK only' softkey, to configure the 4195A for **TALK ONLY** mode. Then the softkey label will change to green.
- 6. Press 'return' softkey or the **COPY** key, to return to the **COPY** menu.
- 7. Press the 'PLOT mode', 'PRINT mode', or 'DUMP mode' softkey, to select the copy mode.
- 8. Press the 'COPY start' softkey, then a printer or plotter will start copy. To abort a copy, press the 'COPY abort' softkey.

NOTE

When the 'COPY start' softkey is pressed, the sweep mode changes to the SINGLE mode, and the sweep stops.

NOTE

When using the HP-IB controller, set the 4195A's HP-IB definition to **ADDRESSABLE**. The details of the HP-IB definition are described in paragraph 6-5-2. The example using the Hard Copy capability is shown in paragraph 6-5-8, Example 3.

5-13-6. PLOT PEN SELECTION

Table 5-7 indicates the the relation of the pen number and the information on the 4195A's screen.

Table 5-7. Plot Pen Selection (1 of 2)

(1) Rectangular X-A&B

Pen Number	Description
1	Data A; A REF (label, data, unit); DIV or BTM of the data A (label, data); Data C (Superimpose; dotted line)
2	Data B; B REF (label, data, unit); DIV or BTM of the data B (label, data); Data D (Superimpose; dotted line)
3	Graticule; Sweep Range; RBW; ST (Sweep Time); RANGE (R, T); Function
4	Information in the marker area; o marker; * marker; line cursor; Analysis Range
5	Information in the comment area, and the keyboard input line
6	System Message

(2) Rectangular A-B

Pen Number	Description
1	REF, DIV, BTM for data A (label, data, unit)
2	REF, DIV, BTM for data B (label, data, unit)
3	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function; <Horizontal>; <Vertical>
4	Information in the marker area; o marker; * marker
5	Information in the comment area, and the keyboard input line; Data A-B; Data C-D (Superimpose, dotted line)
6	System Message

Table 5-7. Plot Pen Selection (2 of 2)

(3) Smith Chart

Pen Number	Description
1	R (label, unit); X (label, unit)
2	Ls (label, unit); Cs (label, unit)
3	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function
4	Information in the marker area; o marker; * marker; R, X, Ls, Cs (data)
5	Information in the comment area, and the keyboard input line; Data A-B; Data C-D (Superimpose, dotted line)
6	System Message

(4) Polar Chart

Pen Number	Description
1	RTN LOSS (label, unit), VSWR (label)
2	REF, DIV (label, data)
3	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function
4	Information in the marker area; o marker; * marker; RTN LOSS (data); VSWR (data)
5	Information in the comment area, and the keyboard input line; Data A-B; Data C-D (Superimpose, dotted line)
6	System Message

5-14. EQUIVALENT CIRCUIT FUNCTION

The Equivalent Circuit function is used to calculate the equivalent circuit parameters of the measured impedance, and to simulate the frequency characteristics of the impedance. This capability is available at the Impedance measurement $|Z|-\theta$, $|Y|-\theta$. Frequency characteristic simulation also can be used for Impedance (R-X, G-B) S11, and S22 measurements.

5-14-1. HOW TO ENTER THE EQUIVALENT CIRCUIT ANALYSIS MODE

To enter the equivalent circuit analysis mode, press the **MORE** key, and **'EQV CKT'** softkey, in the Impedance, S11, or S22 measurement configuration. In the Network, Spectrum, S12, or S21 measurement configuration, the Equivalent Circuit Function is unavailable.

5-14-2. HOW TO SELECT THE EQUIVALENT CIRCUIT MODEL

To use the Equivalent Circuit Function, the Equivalent Circuit Model must be selected first. Five Equivalent Circuit Models can be selected, as shown in Table 5-8.

To select the Equivalent Circuit Model, the **'CKT A'**, **'CKT B'**, **'CKT C'**, **'CKT D'** and **'CKT E'** softkeys are used.

NOTE

The Equivalent Circuit Function can be used by the User Program, or via HP-IB.
The commands to use this function are listed in APPENDIX D, Softkey Tree.

5-16. DISPLAY CHARACTERS/REGISTER DATA ON THE CRT

It is possible to display the characters or the data in the register on the screen, by using the "CMT" command (**'COMMENT'** softkey) or the "DISP" command. These commands can be used by the USER DEFINED FUNCTION, USER PROGRAM, and via HP-IB. And it is possible to enter these commands from the keyboard input line.

5-16-1. CMT command

The CMT command is used to display the characters (max. 26 characters) to the Comment Area. This command corresponds to the **'COMMENT'** softkey which is included to the softkey menu in the **DISPLAY** key. This command is used in the following syntax.

CMT "ABCDEFGHIJKLMNOPQRSTUVWXYZ"

When this command is entered, the following comment is displayed on the comment area.

ABCDEFGHIJKLMNOPQRSTUVWXYZ

5-16-2. DISP command

The DISP command is used to display the characters or the data in the register **Rn** (n= 0 to 99) or both to the System Message Line. The number of the characters that can be displayed in the System Message Line is 44. This command corresponds to the **'DISP'** softkey which is included to the softkey menu in the **EDIT** mode. But this softkey is usable only in the User Program (ASP) editor mode. This command is used to the following syntax.

DISP "XXXXX"

When this command is entered, the following comment is displayed on the system message line.

XXXXX

DISP Rn (n= 0 to 99)

When this command is entered, the value in the register Rn is displayed on the system message line, as follows.

0.000000000000E+00

DISP "XXXX=", Rn (n= 1 to 99)

When this command is entered, the comment and value of the register Rn is displayed, as follows.

XXXX= 0.000000000000E+00

5-17. USING ACTIVE PROBES

The 4195A provides two **PROBE POWER** jacks. The **PROBE POWER** jack locates on the front panel of the 4195A's MEASUREMENT UNIT, and supplies power to the active probes for the incircuit measurement of AC circuits. The voltage outputs are shown in Figure 5-9. The maximum current for the '+15V' pin is 300 mA, and the maximum current for the '-12V' pin is 160 mA. This values are total current of the two **PROBE POWER** jacks.

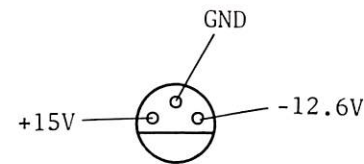


Figure 5-9. PROBE POWER Jack

5-18-14. PURGING A FILE

In order to purge an unnecessary data file from the disc, perform the following procedure.

1. Press the **SAVE/GET** key, '**CAT**' and '**PURGE**' softkeys. **PURGE**(first file name)" will be displayed on the keyboard input line.
2. Using the **up/down** arrow keys scroll through the catalog entries until the desired file name is displayed on the keyboard input line.
3. Press the **ENTER/EXECUTE** key.

5-18-15. RECOVERING A FILE

To recover a data file which has been purged form a disc, perform the following procedure.

1. Press the **SAVE/GET** key, '**more 1/2**', '**RECOV. files**' and '**RECOVER**' softkeys. **RECOVER**(first recoverable file name)" will be displayed on the keyboard input line.
2. Use the **up/down** arrow keys to scroll through the catalog entries until the desired file name is displayed on the keyboard input line.
3. Press the **ENTER/EXECUTE** key.

5-18-16. DISC CAPACITY

Data is stored in 256-byte sectors on the 4195A's flexible disc, and a formatted flexible disc can hold a maximum of 2440 sectors. The remaining number of usable sectors (2440 minus the number of sectors already used) is displayed in the file catalog display. The 4195A can manage up to 192 files per disc. Table 5-9 lists the data length (in sectors) for all data types.

NOTE

In the file catalog display, "AVAILABLE SECTOR" is the total number of unused sectors. A data file cannot be saved for the the following reasons.

1. 192 files already exist on the disc, even though there may be enough available space (unused sectors).
2. The remaining unused sectors on the disc are fragmented and there are not enough contiguous sectors to store the file even though the catalog display says there are enough sectors to store the file.

Table 5-9. Stored Data Length

Storing Data	Data Size
Program Point Table	16 sectors
User Program (ASP) ¹	1 sector
Register Data (A, B, and R0 through R99)	30 sectors
Instrument Settings (without CAL data)	21 sectors
Instrument Settings (Network Reflection CAL on)	109 sectors
Instrument Settings (Network Reflect/Trans CAL on)	134 sectors
Instrument Settings (S11 and S22 CAL on)	197 sectors
Instrument Settings (S21 and S12 CAL on)	97 sectors
Instrument Settings (All S-parameter CAL on)	272 sectors
Instrument Settings (Impedance CAL on)	109 sectors
Instrument Settings (Impedance Compensation on)	59 sectors
Instrument Settings (Impedance CAL/Compen. on)	134 sectors
Instrument Settings (All Netwk/Impdnce CAL/Compen on)	247 sectors
Instrument Settings (All S-prmtr CAL/Impdnce Cmpn on)	310 sectors

¹: When a 5-line program with 40 characters per line is saved.

5-18-17. WRITE PROTECT TAB

Double-sided, 3 1/2-inch discs are equipped with a write protect tab (see Figure 5-13). Write protecting prevents the data on a disc from being overwritten or erased accidentally. Make backup copies and write protect discs that contain valuable data.

To write protect a disc, use the tip of a ball point pen to slide the write protect tab over until the write protect window is open and the tab locks into place. Slide the tab over to cover the write protect window, make sure the tab locks into place. If the write protect tab is missing from a disc, the disc is write protected. To override the write protected disc due to a missing write protect tab, place tape over the tab window.

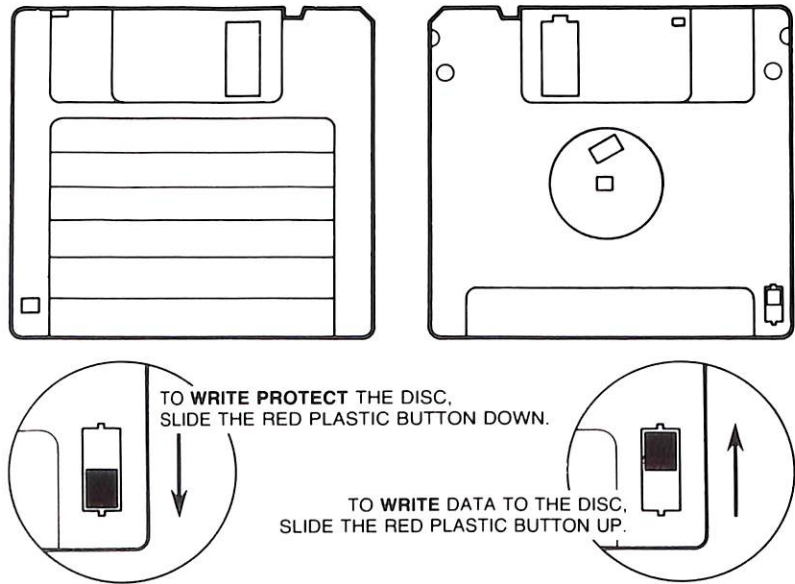


Figure 5-13. Write Protect Tab

LOCAL (GTL):

LOCAL returns control of a listening device to front panel control.

LOCAL 717

LOCAL LOCKOUT (LLO):

LOCAL LOCKOUT disables the **LOCAL** key of all devices on the bus. After this command is sent you will be unable to operate the 4195A from the front panel. Execute the **LOCAL** command to undo **LOCAL LOCKOUT**.

LOCAL LOCKOUT 7

REMOTE:

REMOTE sets the 4195A to the remote mode. When this command is sent, the front panel with the exception of the **LCL** key will be disabled. If **LOCAL LOCKOUT** is asserted then the front panel **LCL** key will also be disabled.

REMOTE 7: sets all devices on port 7 to remote

REMOTE 717: sets the instrument with address 17 to remote.

SPELL:

SPELL is the SERIAL POLLING command used to place the status byte of the addressed instrument on the bus. The eight bits of the status byte can be masked off and read to determine the 4195A's operating state. See paragraph 6-5-7 for more information on the status byte.

SPELL(717): the instrument with address 17 is serial polled.

SERVICE REQUEST:

The 4195A sends an **SRQ** (Service Request) control signal when it requires the controller to perform a task. **SRQ** can be thought of as an interrupt which informs the controller that information is ready to be transmitted, or that an error condition exists in the instrument. When the 4195A sends an **SRQ**, it also sets Bit 6 of the status byte. Bit 6 is the **RQS** (Request Service) bit, sometimes referred to as the "status bit" in connection with polling. When the 4195A is serially polled, it clears the **RQS** bit and the **SRQ** line, one of the five management control lines of the system interface. Any bit in the status byte can initiate an **SRQ**. The status byte may be masked by the user to determine which bits caused the 4195A to set the **SRQ** line. See paragraph 6-5-7, for more status byte information.

TRIGGER (GET):

This command may be sent to a selected listener on the HP-IB bus. The 4195A must be in the addressable mode, and the trigger mode must be set to the external trigger mode, before the trigger message is sent.

TRIGGER 7 : Trigger all devices on port 7

TRIGGER 717 : Trigger the instrument with address 17

NOTE

See the BASIC Interface Techniques manual supplied with the computer, for a full description of the HP-IB bus commands.

2. 4195A QUERY Commands

When a QUERY command is entered, data is output to the 4195A's output buffer. These commands can be entered using a User Defined Function, Sweep End Function, User Program, via HP-IB, and from the Keyboard Input Line.

STB?

Reads the status byte. When **STB?** is entered, the status byte will be read as a decimal number. If this command is entered via HP-IB when the status byte is '01011011', you will read '91'. Refer to paragraph 6-5-6, for the details of the status byte.

REV?

Reads the 4195A's firmware revision number. When **REV?** is entered, the revision date code will be output via HP-IB in the following format.

yyzz

When **REV?** is entered from the Keyboard Input Line, the revision number is displayed on the System Message Line, in the following format.

Rev x.xx

where

x.xx: version number

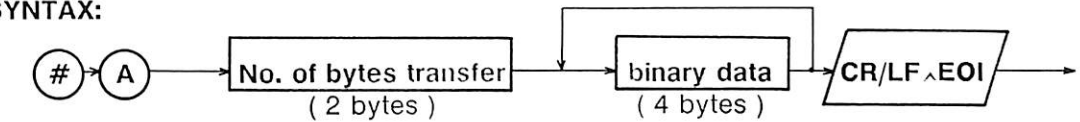
yy: released date (year)

zz: released date (week)

3. IEEE 32-BIT Binary Type: FMT3

This data type is the 32-bit floating point binary specified in the IEEE Standard 728-1982. This data type has the fastest data transfer rate. The syntax diagram and the data format for FMT3, are shown below. The 4195A does not output un-normalized data and '-0'.

SYNTAX:



DATA FORMAT:

SEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFF

where	S: Sign bit of the fractional part	1 bit
	E: Exponent part	8 bits
	F: Fractional part	23 bits
	e: All bits of Exponent part	
	f: All bits of Fractional part	

Real number (RN) can be defined as follows.

- 1) when $0 < e < 11111111$ (255)

$$RN = (-1)^S \times 2^{(e-1 \cdot 2^7)} \times \{ 1 + f/(2^{23}) \}$$

- 2) when $S = 0$, $e = 0$ and $f = 0$

RN = 0 (zero)

Example:

- a) If the sign bit (S) is 0, the exponent part (e) is 01111111 (127), and the fractional part (f) is 010000000000000000000000 (2^{-1}), the real number (RN) is +1.25.
- b) If S=1, e= 10000000 (128), and f= 100000000000000000000000 (2^{-2}), then RN= -3.

6-5-6. DATA TRANSFER RATE

As previously stated, each data format has a different data transfer rate. Table 6-7 lists the typical data transfer rates when an array variable register consisting of 401 register elements is used.

Table 6-7. Data Transfer Rate

1. Data transfer rate using the ENTER command with an HP 9000 series 300 computer.

Code	Transfer Time		
	Model 310	Model 320	Model 350
FMT1	700 msec	540 msec	480 msec
FMT2	120 msec	80 msec	80 msec
FMT3	50 msec	40 msec	30 msec

2. Data transfer rate using the TRANSFER command with an HP 9000 series 300 computer.

Code	Transfer Time		
	Model 310	Model 320	Model 350
FMT2	70 msec	70 msec	70 msec
FMT3	30 msec	30 msec	30 msec

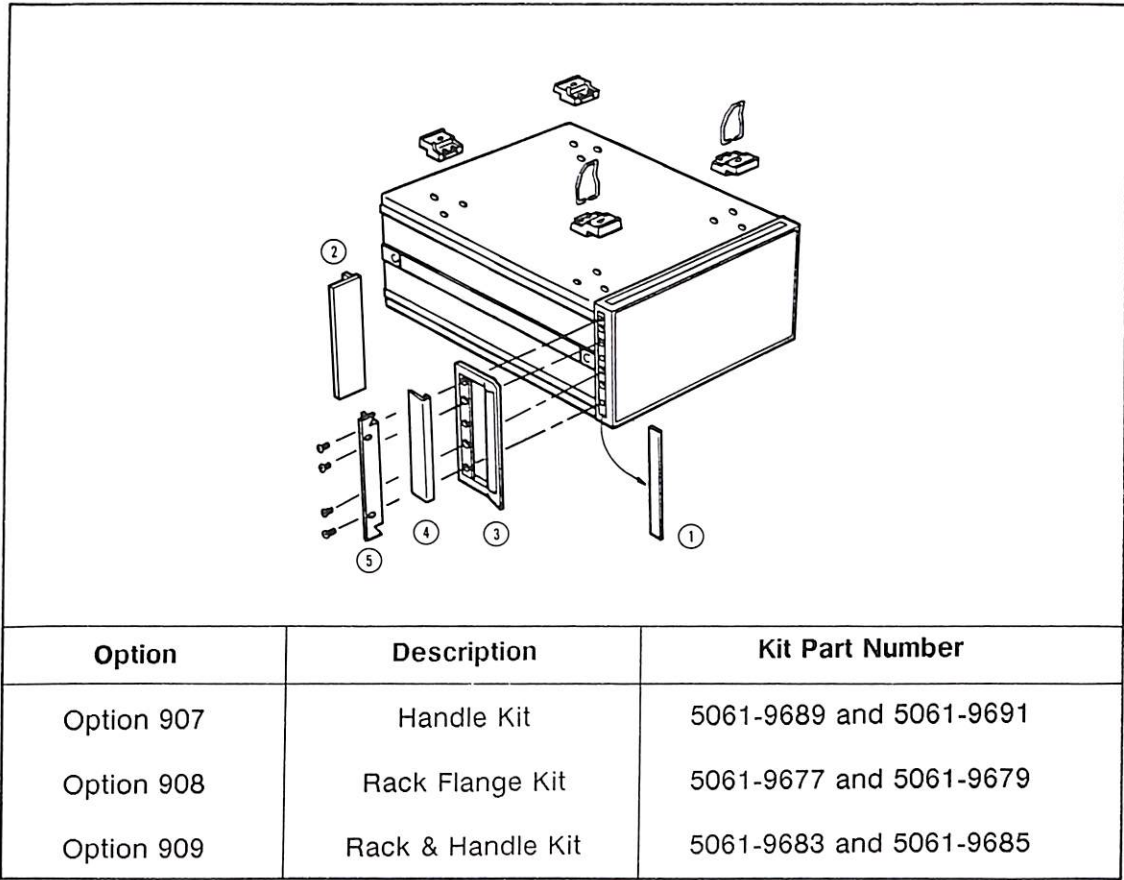


Figure 7-2. Rack Mount Kits

7-6-1. FRONT HANDLE KIT

This kit is installed to facilitate instrument handling on the bench, due to the 4195A's weight (41 Kg).

PROCEDURE:

1. Remove the adhesive-backed trim strip (1) from both sides of the front panel frame for the both units (Control Unit, and Measurement Unit).
2. Attach the handles (3) to both sides of the front panel frame with the screws provided, and attach the trim (4).

7-6-2. RACK FLANGE KIT AND RACK & HANDLE KIT

The Rack Flange Kit is required to rack-mount the 4195A in a cabinet. The Rack & Handle Kit are used to rack-mount the 4195A in a cabinet, with a handle.

PROCEDURE:

1. Remove the Rear Panel Lock Foot Kit, or the four feet of the Control Unit, and the four feet of the Measurement Unit (refer to paragraph 1-3).
2. Remove the adhesive-backed trim strip (1) from both sides of the front panel frame.
3. a) For Rack Flange Kit
Attach the rack mount flange (2) to both sides of the front panel frame with the screws provided.

b) For Rack & Handle Kit
Attach front handle (3) and rack mount flange (5) to both sides of the front panel frame with screws provided.
4. Install an instrument support rail on each side of the instrument rack. The instrument support rails, used to support the weight of the instrument, are included with HP rack-mount cabinets.

WARNING

THE WEIGHT OF THE 4195A MUST BE SUPPORTED BY INSTRUMENT SUPPORT RAILS INSIDE THE INSTRUMENT RACK. DO NOT, UNDER ANY CIRCUMSTANCES, ATTEMPT TO RACK-MOUNT THE HP 4195A USING ONLY THE FRONT FLANGES.

THE 4195A'S CONTROL UNIT IS HEAVY (APPROXIMATELY 25 kg.). USE EXTREME CARE WHEN LIFTING IT.

5. Two people should lift the 4195A to its position in the rack on top of the instrument support rails.
6. Use the appropriate fasteners to fasten the 4195A's Rack-Mount Flanges to front of the rack-mount cabinets.

7-7. BOTTOM FEET/TILT STAND

How To Remove The Bottom Foot

The 4195A has feet attached to the bottom cover of each unit when it is shipped from the factory. The bottom feet must be removed, when connecting the control unit and the measurement unit of the 4195A, or rack-mounting the 4195A.

1. Lift the tab of the bottom foot.
2. Slide the bottom foot in the direction of the tab.

How To Use The Tilt Stand

The front of the 4195A can be lifted by using the tilt stand.

1. Lift the front of the 4195A.
2. Pull the tilt stands down into the down locked position.

WARNING

THE 4195A IS HEAVY (APPROXIMATELY 41 kg.). USE EXTREME CARE WHEN LIFTING IT.

7-8. STORAGE/REPACKING

This paragraph describes the environment for storing or shipping the 4195A, and how to repackage the 4195A for shipment when necessary.

7-8-1. ENVIRONMENT

The 4195A should be stored in a clean, dry environment. The following environmental limitations apply for both storage and shipment.

Temperature:	-40 °C to 70 °C
Humidity:	≤95% RH (@ 40 °C)

To prevent condensation from taking place inside of the 4195A, protect the instrument against temperature extremes.

7-8-2. ORIGINAL PACKAGING

CAUTION

Before packing the 4195A for shipment, the Rear Panel Lock Foot Kit, which secures the control unit to the measurement unit, must be removed. The units must be packaged separately to prevent damage during transit.

Containers and materials identical to those used in factory packaging are available from Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the service required, the return address, the model number, and the full serial number. Mark the container **FRAGILE** to ensure careful handling. In any correspondence, refer to the instrument by model number and its full serial number.

7-8-3. OTHER PACKAGING

The following general instructions should be used when repacking with commercially available materials:

- 1. Wrap the 4195A in heavy paper or plastic. If shipping to a Hewlett-Packard sales office or service center, attach a tag indicating the service required, return address, model number, and the full serial number.
- 2. Use a strong shipping container. A double-walled carton made of at least 350 pound test material is required.
- 3. Use enough shock absorbing material (a 3 to 4 inch layer) around all sides of the 4195A to provide a firm cushion, and to prevent movement of the 4195A inside of the container. Protect the front-panel using cardboard.
- 4. Seal the shipping container securely.
- 5. Mark the shipping container **FRAGILE** to help ensure careful handling.
- 6. In any correspondence, refer to 4195A by model number and full serial number.

NOTE

When returning the 4195A to the HP service office, return both units: Control unit (upper unit), and Measurement unit (lower unit).

Table 7-1. Specifications (1 of 14)

--- GENERAL ---	
OPERATING ENVIRONMENT:	Temperature: 0°C to 55°C Humidity: ≤95% RH (at 40°C)
STORAGE TEMPERATURE:	-40°C to 70°C
SAFETY:	Based on IEC-348, ANSI-C-39.5
EMI:	Based on FTZ-526/527
POWER REQUIREMENTS:	100, 120, 220 V ±10%, 240 V -10% +5%, 48 Hz to 66 Hz, 500 VA (max)
DIMENSIONS:	Approximately 425(W) × 375(H) × 620(D) (mm)
WEIGHT:	Approximately 41 kg
EXTERNAL TRIGGER:	Rear Panel BNC(f), TTL level
USER PROGRAM TRIGGER:	Rear Panel BNC(f), TTL level
EXTERNAL STANDARD FREQUENCY INPUT (EXT REFERENCE connector):	
Frequency:	10/N MHz, ≤30ppm (N is integer from 1 to 10)
Level:	-5 to +5 dBm (Typical)
Input Impedance:	Approximately 50Ω
Connector:	BNC(f)
STANDARD FREQUENCY OUTPUT:	
10 MHz OUTPUT connector:	
Frequency:	10 MHz, ±20 ppm at 23 ±5°C
Level:	Typical 0 dBm
Connector:	BNC(f)
REFERENCE OVEN connector: (Option 001 only)	
Frequency:	10 MHz, ±1 ppm at 23 ±5°C
Level:	Typical 2 dBm
Connector:	BNC(f)
8 BIT INPUT/OUTPUT:	D-SUB connector (25pin), TTL level

Table 7-1. Specifications (2 of 14)

--- BASIC SPECIFICATIONS ---	
NETWORK MEASUREMENT	
SOURCE:	
Frequency:	
• Range:	10 Hz to 500 MHz
• Resolution:	1 mHz
• Accuracy:	±20 ppm (23 ±5°C) ±1 ppm (23 ±5°C; with Option 001)
• Stability:	±5 × 10 ⁻⁶ /day (23 ±5°C; Typical) ±1 × 10 ⁻⁸ /day (23 ±5°C; with Option 001)
Output:	
• Range:	-50 to +15 dBm at 50Ω
• Resolution:	0.1 dB
• Unit:	dBm, dBμV, Vrms
• Level Accuracy:	
Accuracy:	±0.5 dB at +10 dBm, 50 MHz (23 ±5°C)
Linearity:	±0.5 dB at -35 to +10 dBm
Flatness:	±1.5 dB
• Impedance:	Nominal 50Ω
	Return Loss (Typical):
	≥ 15 dB (at ≤ +5 dBm)
	≥ 10 dB (at > +5 dBm)
• Connector:	Type-N(f) connector
• Spectral Purity:	
Harmonics:	< -30 dBc at 10 dBm
Non-Harmonic Spurious:	< -50 dBc at 10 dBm
Phase Noise:	< -90 dBc/Hz at 20 kHz offset
Sweep:	
• Sweep Parameter:	Frequency, Power, and DC Bias Voltage
• Power Sweep Range:	Max. 26dB at -50 to +15 dBm
• Power Sweep Linearity:	±0.2 dB/10 dB
• Sweep Type:	Liner, Log, CW, Programmed Points, and Partial
Programmed Points Sweep:	Sweeps the points set to the programmed points table. The sweep points, and resolution band width can be set.
Partial Sweep:	Sweeps one part of the sweep range.
• Sweep Mode:	Continuous, Single, Manual
• Trigger Mode:	Internal, External, Manual
• Number of Measurement Points:	2 to 401 points
• Sweep Time:	Approximately 3.5 msec/point to 1500 sec/point
DC Bias Level:	
• Range:	-40 to +40 V (Max. 20 mA)
• Resolution:	10 mV
• Accuracy:	±(0.12% + 5 mV) at 23 ±5°C

Table 7-1. Specifications (3 of 14)

RECEIVER:

Input:

- Frequency Range: 10 Hz to 500 MHz
- Inputs: 4 Inputs (R1, T1, R2, T2)
- Connector: Type-N(f) connector
- Resolution Band Width: 3 Hz to 300 kHz, 1, 3, 10 steps
- Impedance: Nominal 50Ω
Return Loss ≥ 15 dB
- Attenuator: 0 to 50 dB, 10 dB step (for all Inputs)
- IF Range: Normal mode or High Sensitivity mode is selectable.
High Sensitivity mode is effective at the low level signal measurement.
- Input Range: Input range is changed by the Attenuator and IF range, as follows. The value of Input Range is displayed on the System Message Line.

Attenuator	IF Range	
	Normal mode	High Sensitivity mode
0 dB	-10 dBm	-20 dBm
10 dB	0 dBm	-10 dBm
20 dB	10 dBm	0 dBm
30 dB	20 dBm	10 dBm
40 dB	20 dBm	20 dBm
50 dB	20 dBm	20 dBm

- Maximum Input Level: +20 dBm at 50Ω
- Damage Level: +30 dBm or ± 7 VDC (Typical)
- Input Cross Talk: < -100 dB at ≤ 400 MHz
< - 90 dB at > 400 MHz

Table 7-1. Specifications (4 of 14)

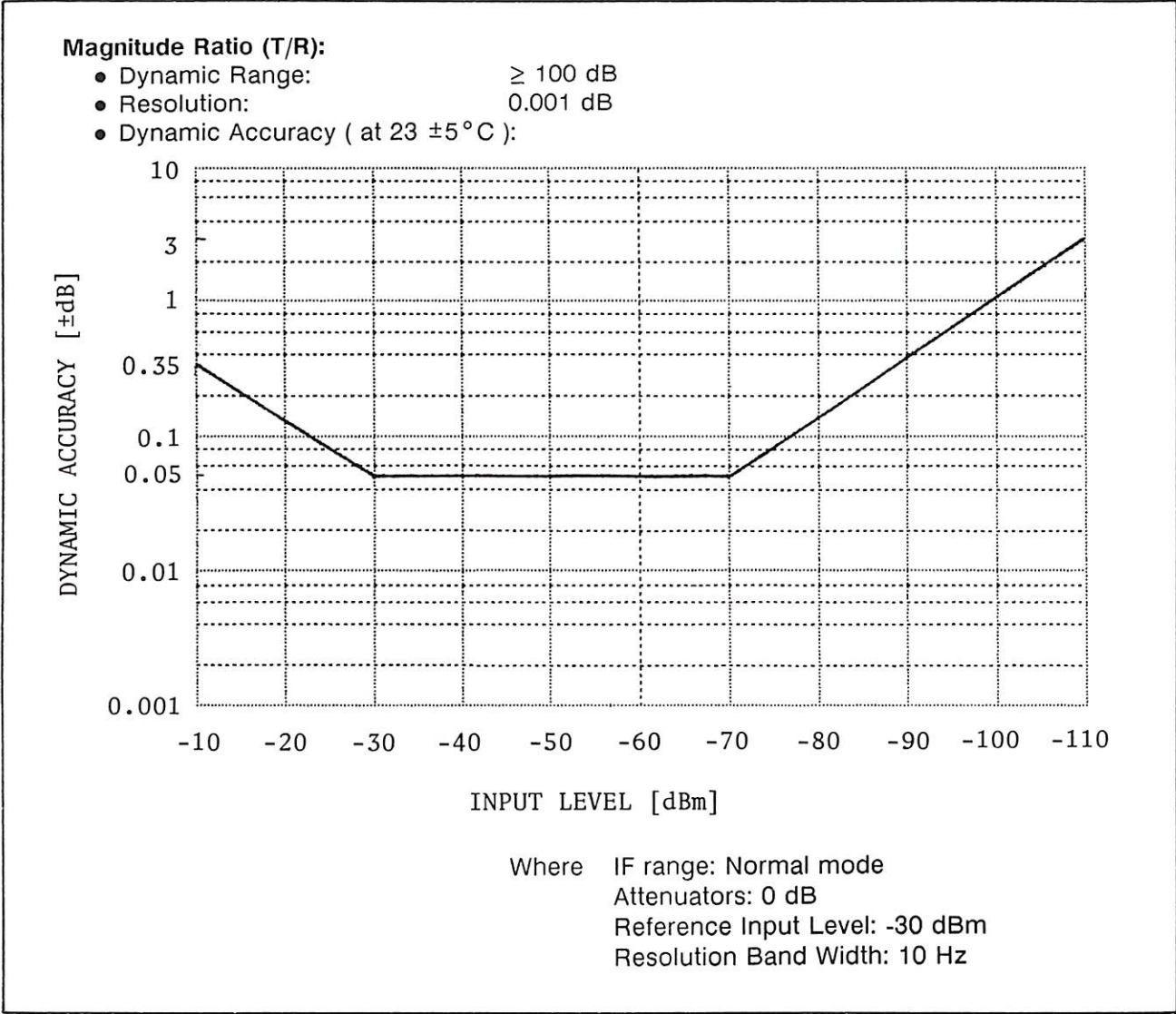


Table 7-1. Specifications (5 of 14)

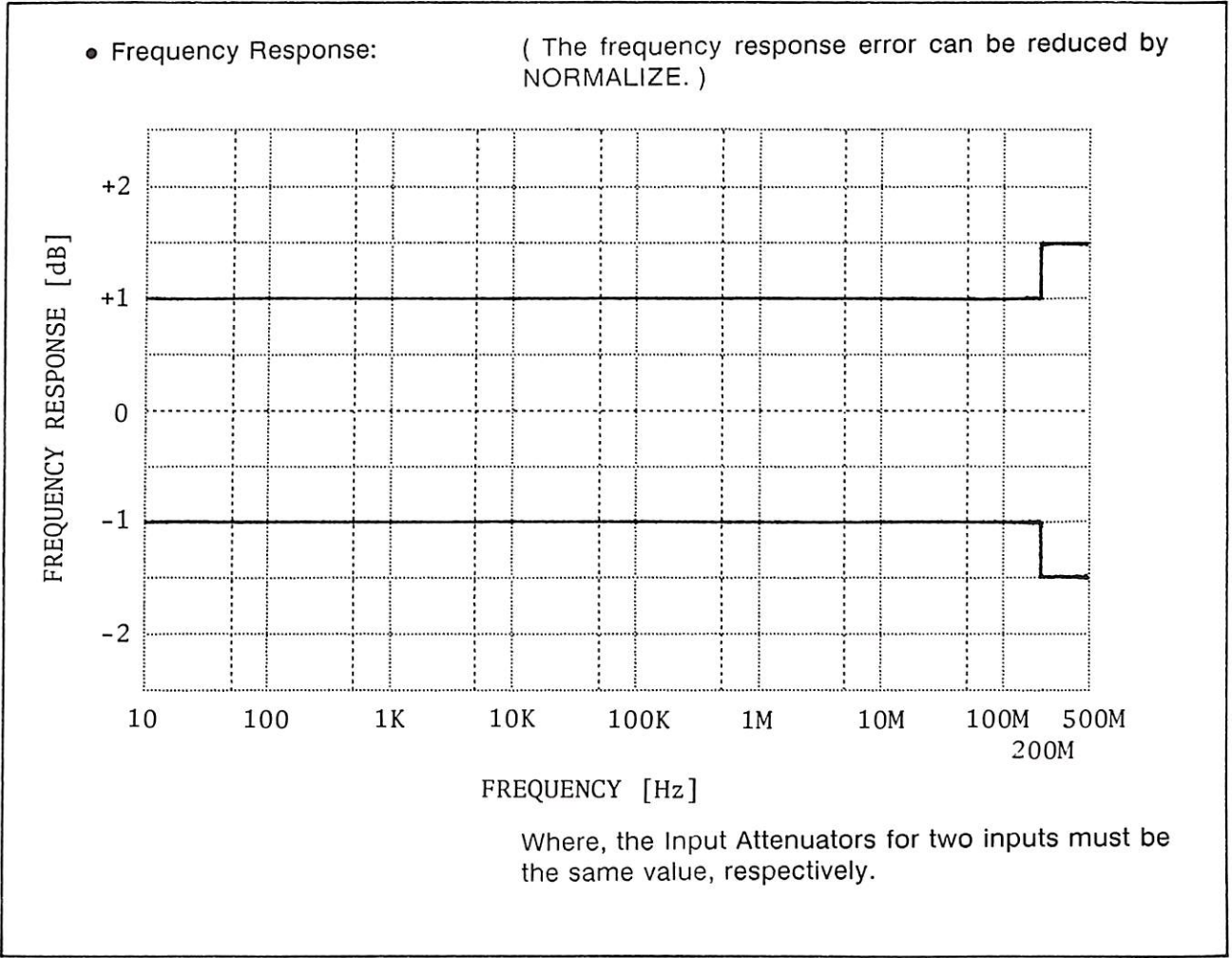
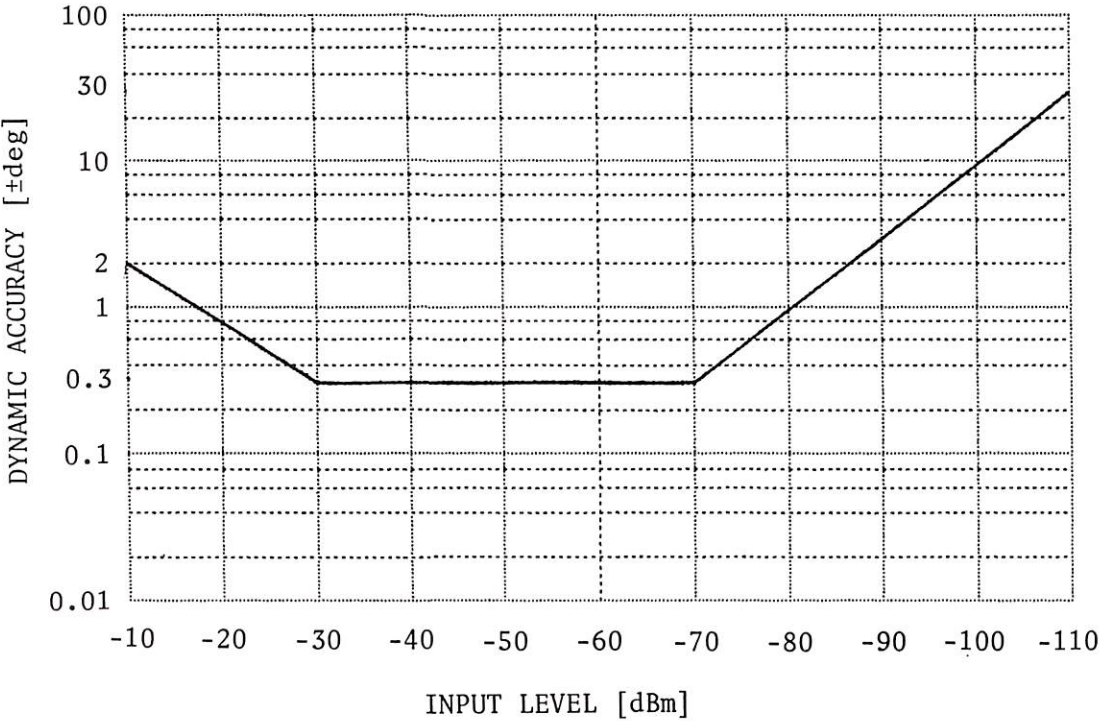


Table 7-1. Specifications (6 of 14)

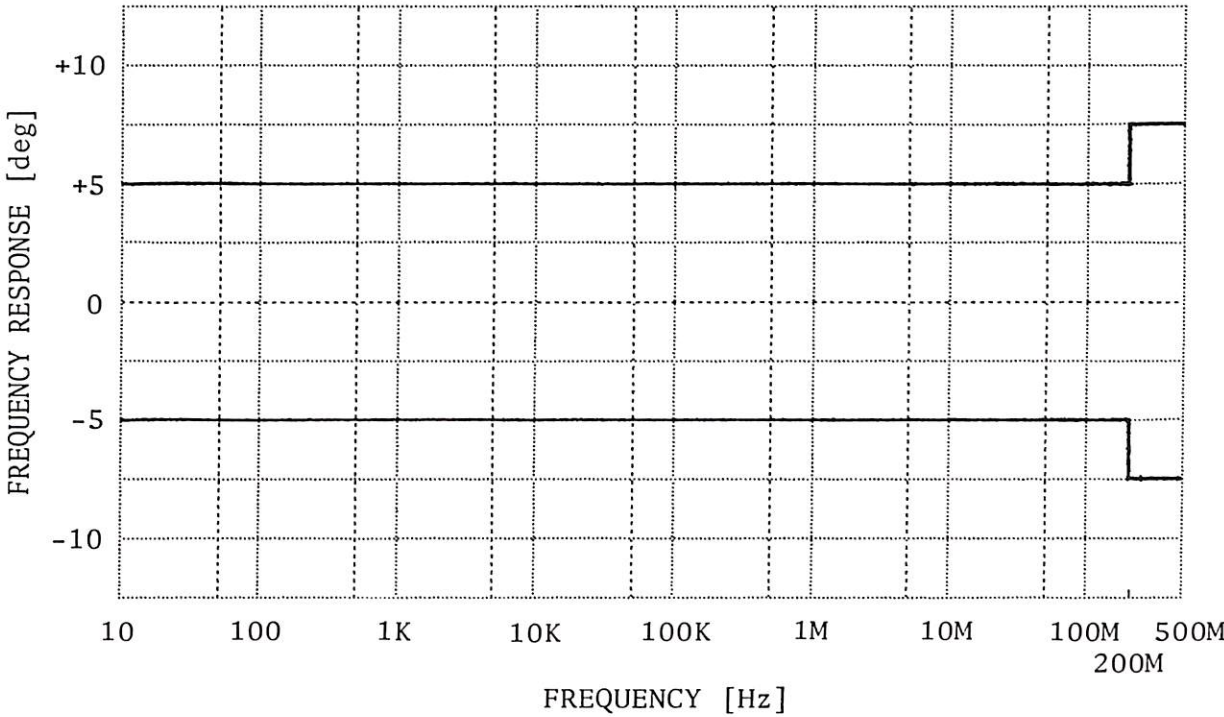
- Phase:
- Range: ± 180 deg
 - Resolution: 0.01 deg
 - Dynamic Accuracy (at $23 \pm 5^{\circ}\text{C}$):



Where IF range: Normal mode
Attenuators: 0 dB
Reference Input Level: -30 dBm
Resolution Band Width: 10 Hz

Table 7-1. Specifications (7 of 14)

- Frequency Response: (The frequency response error can be reduced by the Normalize.)



Where, the Input Attenuators for two inputs must be the same value, respectively.

Table 7-1. Specifications (8 of 14)

Group Delay:	
• Range:	100 fsec to 500 sec
• Resolution:	(2.78×10^{-5})/(Aperture Frequency by Hz) sec
• Aperture Frequency:	0.5% to 100% of SPAN at 401 point sweep
• Accuracy (at $23 \pm 5^{\circ}\text{C}$):	$P/(360(\text{deg}) \times F)$ sec Where P: Dynamic Phase Accuracy (deg) F: Aperture Frequency (Hz)
Calibration:	
• NORMALIZE:	Compensates for the frequency response error at the transmission or reflection measurement.
• 1 Port Partial Calibration:	Compensates for the frequency response error and the directivity error.
• 1 Port Full Calibration:	Compensates for the frequency response error, the directivity error, and the source match error.
• Port Extension:	Compensates for phase shift existing in the extension from the calibration plane. A new reference plane can be defined from 0 to 999.999 cm with 0.001 cm resolution.

Table 7-1. Specifications (9 of 14)

SPECTRUM MEASUREMENT

Frequency:

- Measurement Range: 10 Hz to 500 MHz
- Accuracy (CENTER, SPAN, START, STOP):
±20 ppm (23 ±5°C)
±1 ppm (23 ±5°C, Option 001)
- Resolution:
Resolution Bandwidth(3dB) : 3 Hz to 300 kHz, 1, 3, 10 steps
Selectivity (60 dB/3 dB):

Band Width Accuracy: <4.5 at RBW ≤ 30 Hz
<12 at 100 Hz ≤ RBW ≤ 10 KHz
<8.5 at RBW ≥ 30 KHz
±10%
- Standard Frequency Stability: ±5 × 10⁻⁶/day (23 ±5°C, Typical)
±1 × 10⁻⁸/day (23 ±5°C, with Option 001)
- Noise Sideband: <-90 dBc/Hz at 20 kHz offset

Input Characteristics:

- Inputs: 4 Inputs (R1, T1, R2, T2)
- Impedance: Nominal 50Ω
Return Loss ≥15 dB
- Attenuator: 0 to 50dB, 10 dB step (for all Inputs)
- IF Range: Normal mode, Low Distortion mode, or High Sensitivity mode is selectable.
- Input Range: Input Range is changed by the Input Attenuator, and IF Range, as follows. The value of Input Range is displayed on the System Message Line.

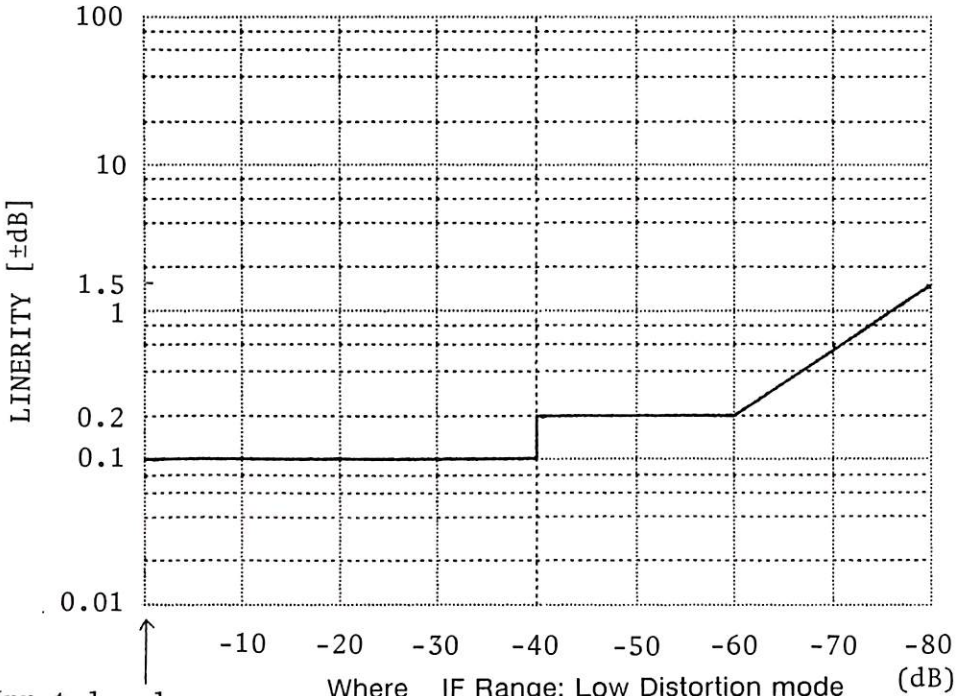
Attenuator	IF Range		
	Normal	Low Distortion	High Sensitivity
0 dB	-20 dBm	-30 dBm	-40 dBm
10 dB	-10 dBm	-20 dBm	-30 dBm
20 dB	0 dBm	-10 dBm	-20 dBm
30 dB	10 dBm	0 dBm	-10 dBm
40 dB	20 dBm	10 dBm	0 dBm
50 dB	20 dBm	20 dBm	10 dBm

- Maximum Input Level: +20 dBm
- Damage Level: +30 dBm or ±7 VDC (Typical)

Table 7-1. Specifications (10 of 14)

Amplitude:

- Measurement Range: -135 dBm to +20 dBm
- Unit: dBm, dBμV, Vrms, dBm/Hz, and μVrms/√Hz
- Accuracy: ±1.0 dB at 50 MHz, 23 ±5°C (at the upper limit level of Input Range)
- Linearity (at 23±5°C):



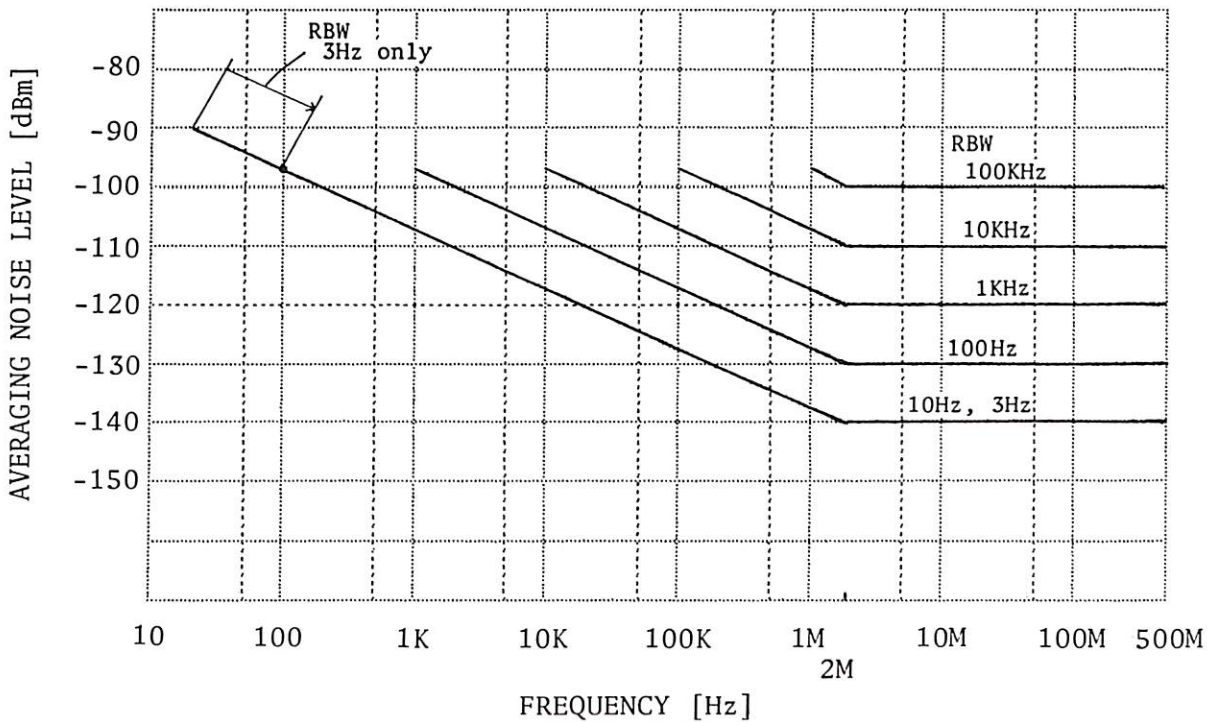
- Frequency Response: ±1.5dB when Attenuator= 10 dB

Dynamic Range: (at 23 ±5°C)

- Spurious Response: ≤-70 dBc at $|\Delta f| > 100$ kHz offset
≤-60 dBc at $10 \text{ kHz} < |\Delta f| \leq 100 \text{ kHz}$
≤-50 dBc at $|\Delta f| \leq 10 \text{ kHz}$
 $|\Delta f|$ is frequency deviation of carrier
- 2nd Harmonics Distortion: ≤-70 dBc referenced to the sinusoidal signals (≥2 MHz) which is equal to every Input Ranges (IF Range: Low Distortion mode)
- 3rd Order Intermodulation Distortion: ≤-80 dBc referenced to two sinusoidal signals (≥2 MHz; 500 kHz separation) which are lower 6dB than every Input Ranges (IF Range: Low Distortion mode)
- Residual Response: -110 dBm at ≥100 kHz, Attenuator= 0 dB (IF Range: High Sensitivity mode)

Table 7-1. Specifications (11 of 14)

Averaging Noise Level (Typical):



Sweep:

- Sweep Type: Liner, Log, CW, Programmed Points, and Partial
- Sweep Mode: Continuous, Single, and Manual
- Trigger Mode: Internal, External, and Manual
- Sweep Time: Approximately 500 msec/span to 1800 sec/span

Table 7-1. Specifications (12 of 14)

IMPEDANCE MEASUREMENT	
The following specifications are applied only when the 4195A is used with the 41951A Impedance Test Kit.	
Measurement Parameter:	$ Z $, $ Y $, θ , R, X, G, B, L, C, D, Q (=1/D)
Frequency Range:	100 kHz to 500 MHz
Test Signal Level:	-62 dBm to +3 dBm at 50 Ω load
DC Bias Level:	± 40 V (Max. 20 mA)
Measurement Range:	30 m Ω to 30 k Ω (Typical, after a 1 Port Calibration)
Measurement Basic Accuracy:	$\pm 1.5\%$ at 23 $\pm 5^{\circ}$ C (Typical, after a 1 Port Calibration)
Error Correction Capability:	• 1 Port Full Calibration • Open/Short Offset Compensation • Port Extension
Equivalent Circuit Analysis Capability:	• Approximation: Approximate equivalent circuit constants using impedance measurement data. • Simulation: Simulate the frequency characteristics of impedance by specifying the equivalent circuit constants.

Table 7-1. Specifications (13 of 14)

--- AVAILABLE FUNCTIONS ---	
DISPLAY AND ANALYSIS:	
Display:	7.5 inch color CRT
Display Format:	Rectangular (X-A&B, A-B), Smith chart, Polar chart, and Table
Trace:	Maximum 4 traces
Scale Type:	Liner, Log
Auto Scaling Function:	Optimize scaling of the displayed data
Phase Display Extend Function:	Displays continuously the phase over ± 180 deg.
Video Filter:	Average the measurement data of four measurements.
Comment Entry:	Display up to a 26 character comment on the CRT.
Marker:	NEXT PEAK, Marker Target, Delta Marker, NOISE Marker, MKR $\rightarrow$ MAX(MIN, REF, CENTER, START, STOP)
Math Operator/Math Function:	+, -, *, /, SQR, EXP, LOG, LN, SIN, COS, TAN, ATAN, ABS, DIF, MAX(,), MIN(,), COMPLEX< , > and etc.
USER FUNCTION:	
User Math Function:	Change the format of the measured data, using the math operators/math functions at the real time.
User Defined Function:	Define the control of measurement and analysis to a softkey.
User Program:	Control the 4195A's operation using the internal program language. The program can be entered using the front panel keys or down loaded from a host computer using HP-IB.

Table 7-1. Specifications (14 of 14)

HARD COPY:									
Copy to HP plotters or printers set to the LISTEN ONLY mode without an external computer.									
DUMP Graphics mode:	Copy the CRT display on a graphics printer.								
PLOT mode:	Copy the CRT display on a plotter for a color hardcopy.								
PRINT mode:	Output measurement data in tabular form on a printer.								
STORAGE									
Save/get the measurement condition, measured data, User Program (ASP), programmed points table to the 3.5 inch flexible disc by the internal disc drive.									
Capacity:	630 k byte, Double Sided								
Format:	LIF								
REMOTE PROGRAMMING									
Based on IEEE STD 488-1978, IEEE STD 728-1982.									
Interface Function:	SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1								
Data Output Format:	ASCII, Binary IEEE 32 or 64 bit								
Data Transfer Rate (Typical):	Using the ENTER command with an HP 9000 series 310 computer.								
<table><tr><th>Data Format</th><th>Transfer Rate</th></tr><tr><td>ASCII</td><td>Approximately 700 msec</td></tr><tr><td>Binary 32-bit</td><td>Approximately 30 msec</td></tr><tr><td>Binary 64-bit</td><td>Approximately 70 msec</td></tr></table>		Data Format	Transfer Rate	ASCII	Approximately 700 msec	Binary 32-bit	Approximately 30 msec	Binary 64-bit	Approximately 70 msec
Data Format	Transfer Rate								
ASCII	Approximately 700 msec								
Binary 32-bit	Approximately 30 msec								
Binary 64-bit	Approximately 70 msec								

Table 7-2. Options

Option Number	Description
001	High Stability Frequency Reference Test Frequency Accuracy: ± 1 ppm ($23 \pm 5^{\circ}\text{C}$) Stability: $\pm 1 \times 10^{-8}$ /day ($23 \pm 5^{\circ}\text{C}$)
907 * ¹	Front Handle Kit
908 * ¹	Rack Flange Kit
909 * ¹	Rack & Handle Kit
910	Extra Operation Manual (English)
91P	Extra Operation Manual (Japanese)

*¹: Installation procedures for these options are detailed in paragraph 7-6.

Table 7-3. Furnished Accessories

Description	Qty.	HP Part Number or Model Number
Disc Kit 3.5inch Disc (2ea.) Disc Case (1ea.)	1 ea.	04195-61001
Cable Assy (Power)	1 ea.	04194-61603
Cable Assy (Control)	1 ea.	04194-61602
BNC-BNC Cable	3 ea.	8120-1838
BNC-BNC Cable (Option 001 only)	1 ea.	04194-61601
Rear Panel Lock Foot Kit Full Modules	1 ea.	5061-9699
Power Cable	1 ea.	8120-1378

Table 7-4. Available Accessories (1 of 6)

Model	Description
11850C/D	Three-Way Power Splitters The 11850C/D are used with the 4195A for the transmission measurement from 10 Hz to 500 MHz. Insertion Loss (Nominal): 11850C: 9.5 dB + 1 dB/GHz 11850D: 7.8 dB Equivalent Source Match: 30 dB at 1.3 GHz Input Port Match: 20 dB at ≤ 1.3 GHz Maximum Operating Level: +20 dBm RF Connectors: RF Input: 50Ω type N(f) Test Port: 11850C: 50Ω type N(f) 11850D: 75Ω type N(f)
11667A	Power Splitter (Type N) The 11667A is used to measure the transmission characteristics at 10 Hz to 500 MHz. Insertion Loss (Nominal): 6 dB Equivalent Source Match: 26 dB Input Port Match: 23 dB Maximum Operating Level: +27 dBm Connectors: 50Ω type N(f)
11852B	50-75Ω Minimum Loss Pad Insertion Loss (Nominal): 5.7 dB Return Loss: 26 dB (50Ω), 30 dB (75Ω) Maximum Input Level: +24 dBm Connectors: 50Ω type N(f) - 75Ω type N(m)

Table 7-4. Available Accessories (2 of 6)

Model	Description
85044A/B	Transmission/Reflection Test Set The 85044A/B are used with the 4195A to measure the transmission/reflection characteristics at 300 kHz to 500 MHz. Directivity: 35 dB at ≤ 1.3 GHz Insertion Loss: (Nominal, Input to Test Port) 85044A: 12.5 dB + 0.5 dB/GHz 85044B: 22 dB + 1 dB/GHz Equivalent Source Match (Test Port): 85044A: 15 dB at ≤ 2 MHz, 20 dB at ≤ 1.3 GHz 85044B: 15 dB at ≤ 2 MHz, 17 dB at ≤ 1.3 GHz Maximum Operating Level: +20 dBm DC Bias Range: ± 30 VDC, ± 200 mA, Max. ± 500 mA Connector (Test Port): 85044A: 7 mm 85044B: 75Ω type N(f) Accessories: 85044A: 7 mm-50Ω type N(f) Adapter (1ea.) 85044B: 11852B Minimum Loss Pad (1ea.)
35676A/B	50/75Ω Reflection/transmission Test Kit The 35676A/B are used with the 4195A for the transmission/reflection measurement from 10 Hz to 200 MHz. Test Port Impedance: 35676A: 50Ω $\pm 2\%$ 35676B: 75Ω $\pm 2\%$ Insertion Loss (Input to Test port): 10 dB ± 1 dB Equivalent Directivity: > 40 dB Equivalent Source Match: 35676A: > 30 dB 35676B: > 25 dB

Table 7-4. Available Accessories (3 of 6)

Model	Description
11851B	RF Cable Kit 610 mm 50Ω cable (3ea.), 810 mm cable (1ea.)
11857B	75Ω Type N Test Port Extension Cables 610 mm cable (2ea.)
11853A	50Ω Type N Accessory Kit
11854A	50Ω BNC Accessory Kit
11855A	75Ω Type N Accessory Kit
11856A	75Ω BNC Accessory Kit
85031B	7mm Calibration Kit
85032B	50Ω Type N Calibration Kit
85033C	3.5 mm Calibration Kit
85036B	75Ω Type N Calibration Kit
85033A	SMA Calibration Kit

Table 7-4. Available Accessories (4 of 6)

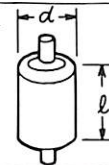
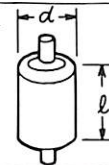
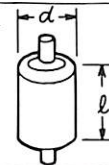
Model	Description																		
41951A 	Impedance Test Kit The 41951A is used with the 4195A for the impedance measurement from 100 kHz to 500 MHz. Contains the following accessories in a carrying case. <table><tr><td>Impedance Test Adapter</td><td>1</td></tr><tr><td>50 Ω Termination</td><td>1</td></tr><tr><td>Open Termination</td><td>1</td></tr><tr><td>Short Termination</td><td>1</td></tr><tr><td>N(m)-N(m) Adapter</td><td>2</td></tr><tr><td>N-type Cable</td><td>1</td></tr><tr><td>BNC Cable</td><td>1</td></tr><tr><td>Operation Note</td><td>1</td></tr><tr><td>Carrying Case</td><td>1</td></tr></table>	Impedance Test Adapter	1	50 Ω Termination	1	Open Termination	1	Short Termination	1	N(m)-N(m) Adapter	2	N-type Cable	1	BNC Cable	1	Operation Note	1	Carrying Case	1
Impedance Test Adapter	1																		
50 Ω Termination	1																		
Open Termination	1																		
Short Termination	1																		
N(m)-N(m) Adapter	2																		
N-type Cable	1																		
BNC Cable	1																		
Operation Note	1																		
Carrying Case	1																		
16091A 	Coaxial Fixtures Two coaxial termination type Test Fixtures for holding cylindrical shaped material samples. The two fixtures can be used for samples of the following dimensions next: <table><tr><th>Sample</th><th>Fixture</th><th colspan="2">Max. dimensions</th></tr><tr><td rowspan="2"></td><td rowspan="2">04191-85302</td><td>d</td><td>7 mm</td></tr><tr><td>ℓ</td><td>20 mm</td></tr><tr><td rowspan="2"></td><td rowspan="2">16091-60012</td><td>d</td><td>10 mm</td></tr><tr><td>ℓ</td><td>20 mm</td></tr></table> Usable frequency range: DC to 1000 MHz. Electrical length: 1.87 cm (typical). Maximum applied dc bias voltage: ± 40 V. NOTE: The HP 16091A fixture of 7 mm inner diameter (P/N 04191-85302) is the OS standard termination furnished with the HP 41951A. Thus, this fixture is not supplied with the 16091A fixture set since the OS termination can be used.	Sample	Fixture	Max. dimensions			04191-85302	d	7 mm	ℓ	20 mm		16091-60012	d	10 mm	ℓ	20 mm		
Sample	Fixture	Max. dimensions																	
	04191-85302	d	7 mm																
		ℓ	20 mm																
	16091-60012	d	10 mm																
		ℓ	20 mm																

Table 7-4. Available Accessories (5 of 6)

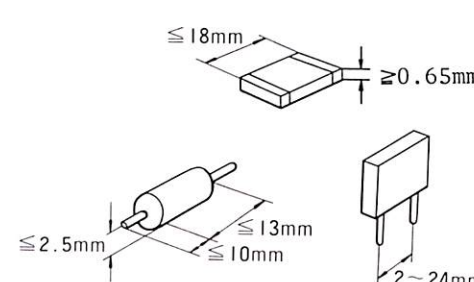
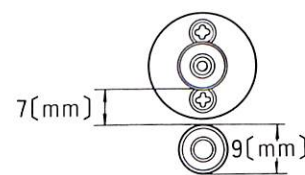
Model	Description
16092A	Spring Clip Fixture Test Fixture (direct attachment type) for measurement of both axial and radial lead components and leadless chip elements. Spring clip contacts are capable of holding samples of the dimensions given below:  A combined slide gauge provides direct read-out of the physical length of the test sample. Usable frequency range: DC to 500 MHz Electrical length: 0.34 cm typical Maximum applied DC bias voltage: ±40 V.
16093A	Test Fixture Test Fixture (direct attachment type) for measurement of both axial and radial lead miniature components. Two binding post terminals at an interval of 7 mm on the terminal deck ensure optimum contact of terminals and sample leads.  Usable frequency range: DC to 250 MHz Electrical length: 0.34 cm typical Maximum applied dc bias voltage: ±40 V.

Table 7-4. Available Accessories (6 of 6)

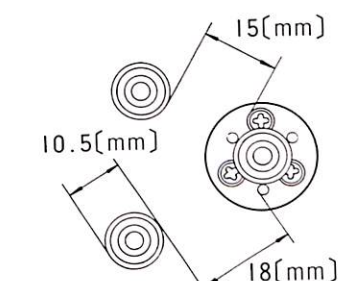
Model	Description
16093B	Binding Post Fixture Test Fixture (direct attachment type) for general measurement of both axial and radial lead components. Three binding post terminals are located on the terminal deck as shown below:  Usable frequency range: dc to 125 MHz Electrical length: 0.34 cm typical Maximum applied dc bias voltage: ±40 V.
16094A	Probe Fixture Test Fixture for measurement of circuit impedances and components mounted on circuit assemblies. The probe adapter unit can be attached at the tip of an extension line connected to the test port. The probe connector fits APC-7 connector of a coaxial test cable or a flexible air line. Probe needle interval is variable from 1 mm to 15 mm. Electrical length compensation in the instrument must be adjusted for probe cable length.  Usable frequency range: DC to 125 MHz. Electrical length: 2.32 cm (typical). Maximum applied dc bias voltage: ±40 V.

Table 7-5. Accessories Selection Guide for Network Measurement

	50Ω			75Ω		
	T	T/R	S	T	T/R	S
Power Splitter	11850C 11667A			11850D		
Test Set		85044A 35676A	85044A* ¹ 35676A* ¹		85044B 35676B	85044B* ¹ 35676B* ¹
Cable		11851B	11851B* ²	11851B	11851B	11851B* ² 11857B
Accessory Kit N-type BNC-type	11853A 11854A	11853A 11854A	11853A 11854A	11855A 11856A	11855A 11856A	11855A 11856A
Calibration Kit 7 mm N-type 3.5 mm		85031B 85032B 85033C	85031B 85032B 85033C		85036B	85036B

T: Transmission measurement
T/R: Transmission/Reflection measurement
S: S-Parameter measurement

*¹: For S-Parameter measurement, two set (same model) are required.

*²: For S-Parameter measurement, two 11851B are required.

APPENDIX B

ERROR MESSAGES AND INSTRUCTIONS

Appendix B lists the 4195A's error messages and instructions, with brief descriptions, in alphabetical order.

The 4195A displays error messages and instructions on the System Message Line to inform the user of error conditions, and to guide the user in the operation of the 4195A.

The error messages are displayed in **red**, and are listed in this appendix in **Bold** face type. The action that caused error will be ignored and the error will not affect the 4195A. Operation instructions are displayed in yellow, and are listed herein as normal (unbolded) type face.

NOTE

The black triangle (►) and black bullet (●) indicate that Bit 5 (Error) and Bit 3 (End Status) of the HP-IB status byte are set, respectively, when the message is displayed. If the bit is enabled for SRQ (service request), Bit 6 (RQS) of the HP-IB status byte is also set. Refer to paragraph 6-5-7.

The 4195A error messages and instructions related only to its service functions or hardware failure are not listed here. If any message other than those listed herein are displayed on the screen in red characters, the 4195A may need to be repaired. Contact your nearest Hewlett-Packard office.

- A -

Message	Description
► Allowed only in IMPEDANCE	'CALC EQV para' softkey was pressed when the 4195A was not in the impedance mode. Equivalent circuit approximate value calculation may be performed only while in the Impedance configuration.
► Allowed only in IMPEDANCE/S11/S22	'EQV CKT' or 'SIMULATE f-char' softkey was pressed when the configuration was not impedance, S11, or S22. Equivalent circuit frequency response simulation may be performed only while in the Impedance, S11, or S22 configuration.