MANUAL CHANGES

HP 4195A OPERATION MANUAL (04195-90000)

Dear users,

This MANUAL CHANGES makes your OPERATION MANUAL applicable to the upgraded HP 4195A.

Refer to the next page on how to change your OPERATION MANUAL (P/N 04195-90000).

The upgraded HP 4195A is equivalent to a unit with serial prefix 2904J- in the changed manual.

日本語版の「HP 4195A 取扱説明書」（部品番号：04195-97000）をお使いの場合、このﾏﾆｭｱﾙ･ﾁｪﾝｼﾞは不要です。

Part Number: 04195-90010 (included in P/N 04195-65010)

MANUAL CHANGES

HP 4195A

Network/Spectrum Analyzer

MANUAL IDENTIFICATION

Model Number: HP 4195A
Date Printed: February 1988
Part Number: 04195-90000

This supplement contains information for correcting manual errors and for adapting the manual to newer instruments that contain improvements or modifications not documented in the existing manual.

To use this supplement
1. Make all ERRATA corrections
2. Make all appropriate serial-number-related changes listed below

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
ALL	1
2904J and above	1, 2

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

▶ New Item

Supersedes the Manual Change printed on June 1988.

▶ **ERRATA 1**

Replace the following pages with the attached replacement pages in this supplement.

Page **iii/iv**, Page 4-25/4-26, Page 4-29/4-30, Page 5-43/5-44,

Page 5-51/5-52, Page 6-37/6-38, Page 6-49/6-50, Page 7-3 through 7-6

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

HEWLETT PACKARD

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▶ CHANGE 2

Replace the following pages with the attached replacement pages in this supplement. This covers the revision for changing ROM-based firmware from version 1.02 to 2.00, and the changes are indicated by a line marked on the right side of the text in this supplement.

Page **i/ii**, Page **vii/viii**, Page **xiii/xiv**

Page 3-1 through 3-12 (add page 3-13/3-14)

Page 4-7/4-8, Page 4-9/4-10, Page 4-23/4-24, Page 4-51 through 58

Page 5-1/2, Page 5-29/30, Page 5-33 through 5-36

Page 6-45/6-46

Page 7-7 through 7-28 (add page 7-29/7-30)

Page B-1 through B-20

Page D-7/D-8

Page E-3/E-4

Page F-1 through F-8

Page G-1 through G-8

HEWLETT PACKARD

OPERATION MANUAL

MODEL 4195A

NETWORK/SPECTRUM ANALYZER

(Including Option 001)

SERIAL NUMBERS

This manual applies directly to instruments whose serial number prefix is 2904J- and whose ROM-based firmware is revision 2.00.

With the changes described in Appendix A, this manual also applies to instruments whose ROM-based firmware is version 1.02 and below.

For additional important information about serial numbers, read SERIAL NUMBER in Section 7 of this Operation Manual.

Manual Part Number: 04195-90000
Microfiche Part Number: 04195-90050

Printed: February 1988
Updated: February 1989

Notice

Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product name/number was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648 is now model number Agilent 8648.

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Agilent Technologies

Printed in USA July 2004

MANUAL PRINTING HISTORY

October 1987	First Edition	This manual is the first edition Operation Manual for the HP 4195A Network/ Spectrum Analyzer. (Excluding Appendix G "Index".)
February 1988	Second Edition	Adds Appendix G "Index". Revision for changing ROM-based firmware from version 1.00 to 1.01.
	Revision 1	Minor corrections as of June 1988
	Revision 2	Revision for changing ROM-based firmware from version 1.02 to 2.00 as of February 1989.

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, or to the calibration facilities of other International Standards Organization members.

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Section 3 Basic Measurement Examples

Section 4 Measurement Capabilities

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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 **WARNING**s, **CAUTION**s, and **NOTE**s 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 or 75Ω

Recommended Accessories Used In The Following Example:

For 50Ω device measurement:

50Ω N(m)-N(m) Cable	11851B (4 cables included)
Power Splitter	11667A (two-way) or 11850C (three-way)

For 75Ω device measurement:

75Ω N(m)-N(m) Cable	11857B (2 cables included)
50Ω N(m)-N(m) Cable	11851B (4 cables included)
Power Splitter	11850D (three-way)
50Ω-75Ω Minimum Loss Pad	11852B (furnished with the 11850D)

Procedure:

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.

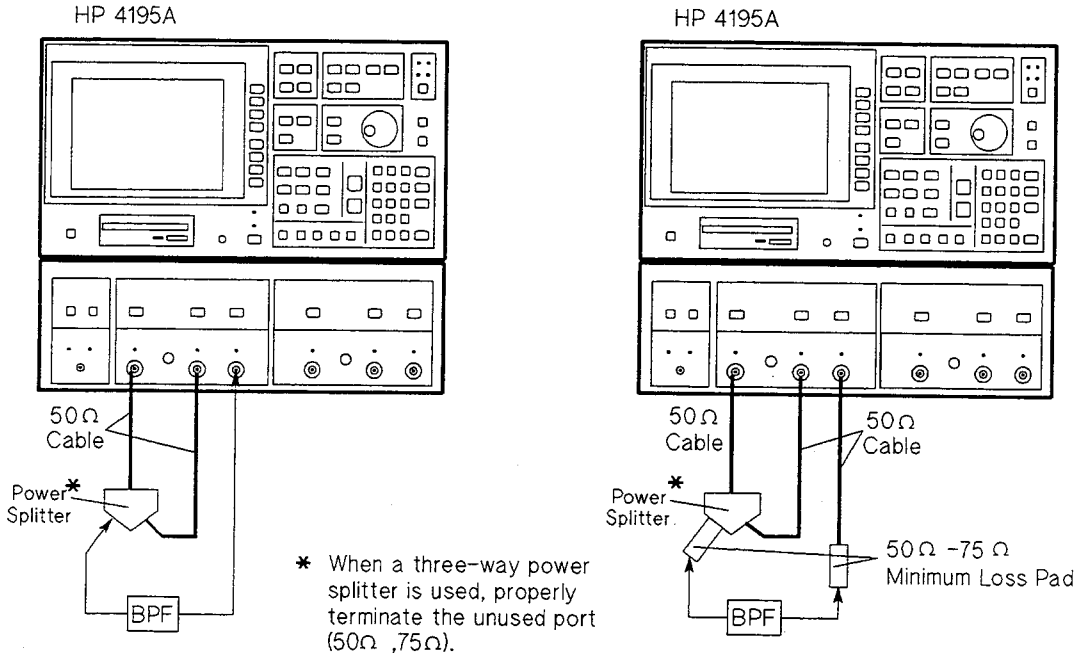


Figure 3-1. Network Measurement Example Setup

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

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

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

9. Press the **RES BW** key.

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

10. Press the **arrow down** key.

    Every time you press the **arrow down** key, the resolution bandwidth will be narrowed, the time required for measurement will be increased, and you will observe less fluctuation on the traces.

11. 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.

12. Using the resolution bandwidth filter and the video 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.

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 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 bandwidth 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.

Recommended Accessories Used In The Following Example:

50Ω BNC(m)-BNC(m) Cable, 122 cm	HP PN 8120-1840
N(m)-BNC(f) Adapter	HP PN 1250-1476

Procedure:

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= 10 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 three times.

   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 as shown in Figure 3-2.

   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.

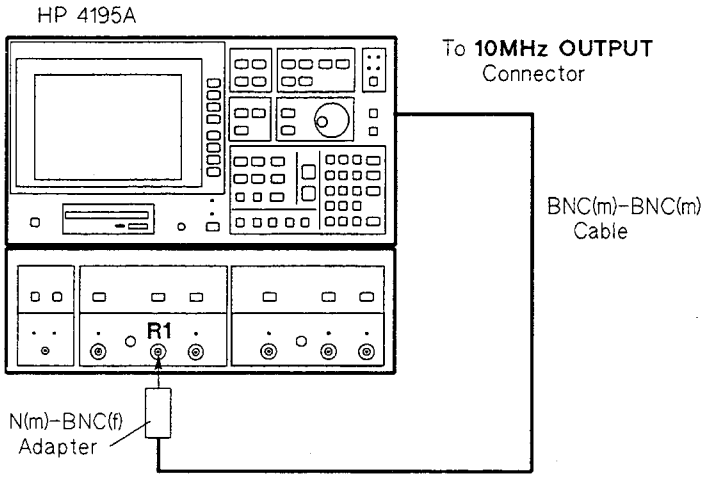


Figure 3-2. Spectrum Measurement Example Setup

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, each 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 chip type component under the following measurement conditions.

Test Frequency	100 kHz to 500 MHz (log sweep)
Output Level	0 dBm

Recommended Accessories Used In The Following Example:

Impedance Test Kit	41951A
Test Fixture	16092A

Procedure:

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

   Figure 3-3 shows the impedance test adapter connected to the 4195A.

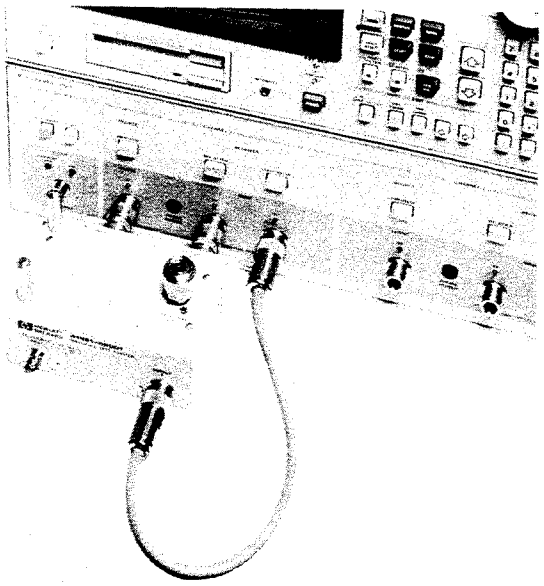


Figure 3-3. Impedance Test Adapter Connection

2. Press the **CONFIG** key and **'IMPEDNCE'** softkey, then press the **PRESET** key.

3. 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.

4. Press the **1**, **0**, **0**, and **kHz/dBm** keys.

   When you press the **1** key, the previously displayed **0.001 HZ** will disappear. When you finaly press the **kHz/dBm** key, the start frequency is changed to 100 kHz and **START= 100000.000 HZ** will be displayed. The currently set **START** and **STOP** frequencies are displayed below the displayed graph.

5. Press the **MENU** key and the **'TYPE lin log'** softkey.

   When you press the **'TYPE lin log'** softkey, the **'log'** of the **'TYPE lin log'**softkey label will change to intensified **green**, and log sweep is set.

NOTE

Steps 10 and 11 set the 4195A's output level to 12 dBm so that the output level at the 41951A impedance test adapter's measurement terminal will be 0 dBm (insertion loss of the 41951A is approximately 12 dB). Steps 6 to 9 set the input attenuators to 20 dB so that the input ports will not be overloaded by the 12 dBm input level.

6. Press the **CHANNEL 1 RECEIVER REF ATTEN** key on the lower unit's front panel.

   ATR1= 10 DB will be displayed on the keyboard input line.

7. Press the **arrow up** key once.

   The R1 input attenuator will be set to 20 dB.

8. Press the **CHANNEL 1 RECEIVER TEST ATTEN** key on the lower unit's front panel.

   ATT1= 10 DB will be displayed on the keyboard input line.

9. Press the **arrow up** key once.

   The T1 input attenuator will be set to 20 dB.

10. Press the **CHANNEL 1 SOURCE AMPLITUDE** key on the lower unit's front panel.

    OSC1= 0.0 DBM will be displayed on the keyboard input line.

11. Press the **1, 2** and **kHz/dBm** keys.

    The output level value displayed on the keyboard input line will be changed to **OSC1= 12.0 DBM.**

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

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

14. Connect the **OPEN** termination furnished with the 41951A (labeled as OS) 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.**

15. 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.

16. Disconnect the **OPEN** termination and connect the **SHORT** termination furnished with the 41951A (labeled as 0Ω) 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.**

17. 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.

18. Disconnect the **SHORT** termination and connect the **LOAD** termination furnished with the 41951A (labeled as 50Ω) atop the APC-7 connector of the Impedance Test Adapter.

    Rotate the coupling nut of the 50Ω termination so that the coupling sleeve of the termination is at its innermost free position. Place the 50Ω 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.**

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

    Measuring LOAD will be displayed, and **Calculating CAL coefficient** will then be displayed after a short time.

NOTE

To confirm that calibration is being perfomed properly, press the **'CORRCTN on off'** softkey to set calibration function to on, and the **TRIG/RESET** key to measure the 50Ω termination. If measurement result is approximately 50Ω, calibration is being perfomed properly, and you can proceed to step 20 after the **CAL** key is pressed.

20. Disconnect the 50Ω termination and place the test fixture atop the Impedance Test Adapter as shown in Figure 3-4.

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

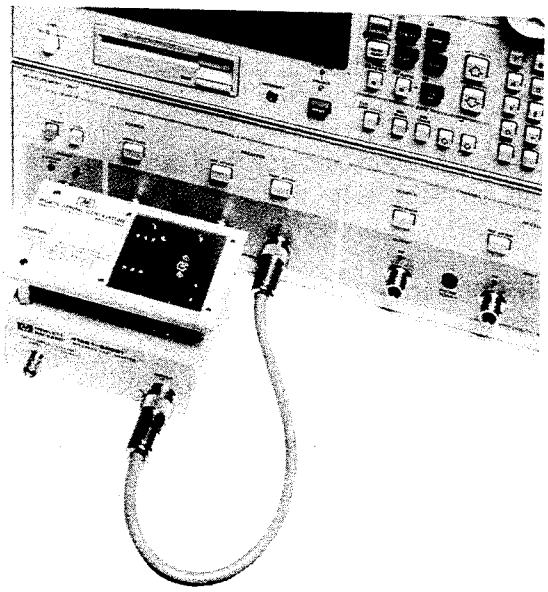


Figure 3-4. Test Fixture Connection

21. Press the **'COMPEN menu'** softkey and **'0S&0, OFFSET'** softkey.

22. Open the measurement terminal of the test fixture.

    Set the attachment as shown in Figure 3-5 open position so that the center conductor does not short to the outer conductor.

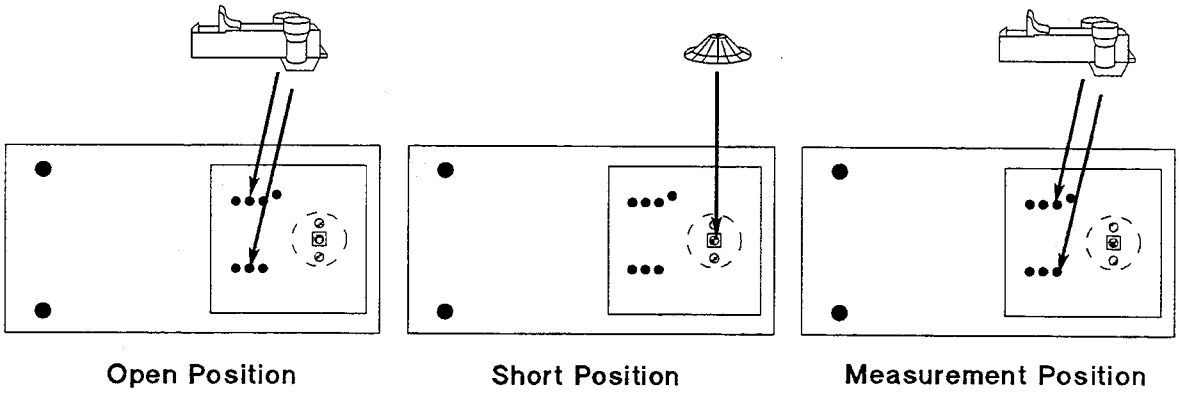


Figure 3-5. Attachment Connection

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

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

24. Short the measurement terminal of the test fixture.

    Remove the attachment from the 16092A, and set the short ring (furnished with the 16092A) to the 16092A's center conductor as shown in Figure 3-5 short position.

25. Press the **'0,'** softkey and the **ENTER/EXECUTE** key.

    Measuring 0, will be displayed, and **Compen completed (TURN ON "CORR" KEY)** will be displayed after a short time.

26. Press the **'CORRECTN on off'** softkey.

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

NOTE

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

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

    Set the attachment on the 16092A as shown in Figure 3-5 measurement position, and connect the component to the attachment.

28. Press the **TRIG/RESET** key to measure the device under test.

3-5. S-PARAMETER MEASUREMENT EXAMPLE

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

Recommended Accessories Used In The Following Example:

For 50Ω device measurement:

Transmission/Reflection Test Set	41952A, 2 set

For 75Ω device measurement:

Transmission/Reflection Test Set	41952B, 2 set

Procedure:

1. Connect two Transmission/Reflection Test Sets (two HP 41952A/Bs) to the 4195A's front panel output/input connectors as shown in Figure 3-6.

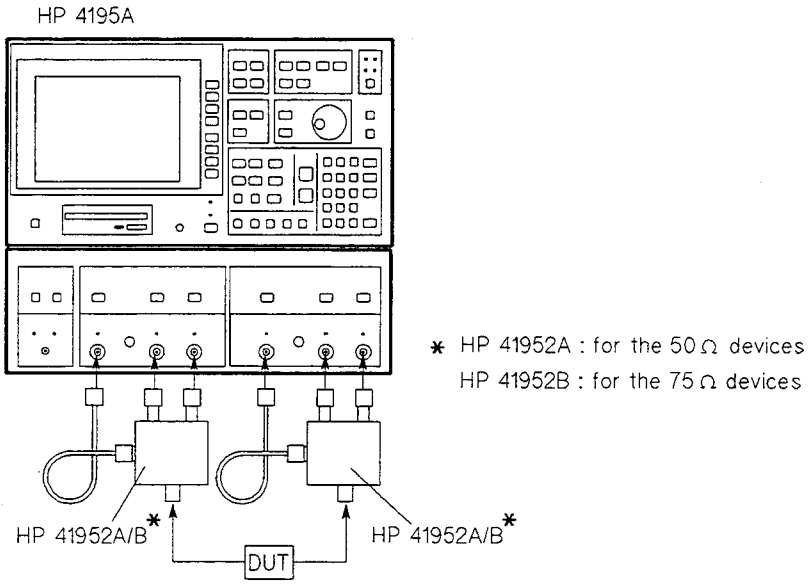


Figure 3-6. S-Parameter Configuration Setup Example

2. Connect the network under test between the TEST PORTs of the two HP 41952A/Bs.
3. Press the **CONFIG** key and **'S-PRMTR'** softkey, then press the **'S11'** softkey.
4. Press the **PRESET** key.

   The yellow LED indicators at connectors **S1**, **R1**, and **T1** will turn **ON.**
5. Press the **DISPLAY** key and **'SMITH'** softkey.

   The measurement **FORMAT** (parameter) is automatically changed to Γx-Γy. 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 connectors **S1**, **R1**, and **T2** will turn **ON**. Now the 4195A displays S21 (forward transmission) frequency response characteristics.

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

   Now the 4195A displays S21 (forward transmission) group-delay frequency response characteristics.

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

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

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

   The yellow LED indicators at the **T1**, **S2**, and **R2** connectors will turn **ON**. Now the 4195A displays S12 (reversed transmission) frequency response characteristics.

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

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

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

    The measurement **FORMAT** (parameter) is automatically changed to Γx-Γy. Now the 4195A displays S22 (reversed reflection) on the polar chart.

12. Press the **SCALE REF** key and the **'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.).

    You can measure all four S-parameters by just 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.

NOTES

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

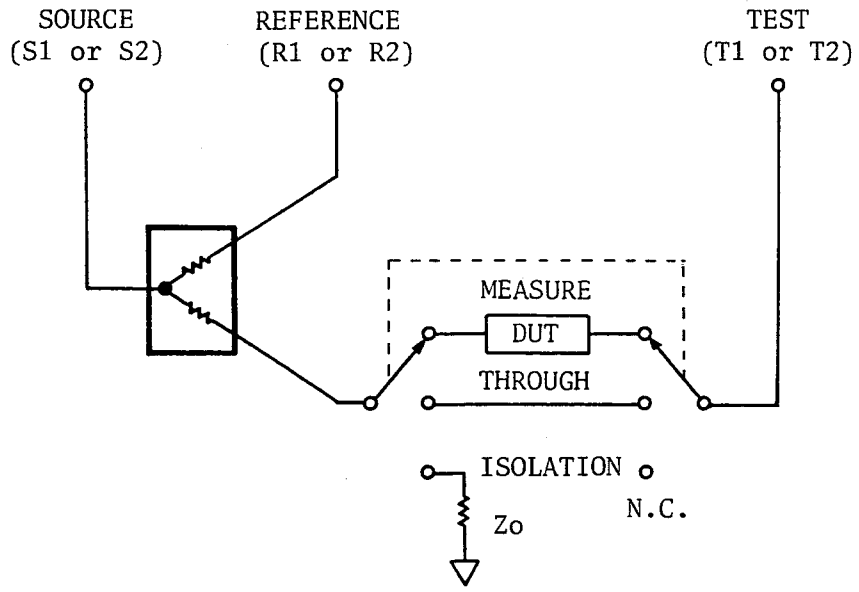


Figure 4-2. Transmission Calibration Diagram

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 **Cal completed (TURN ON "CORR" KEY)** 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 **'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

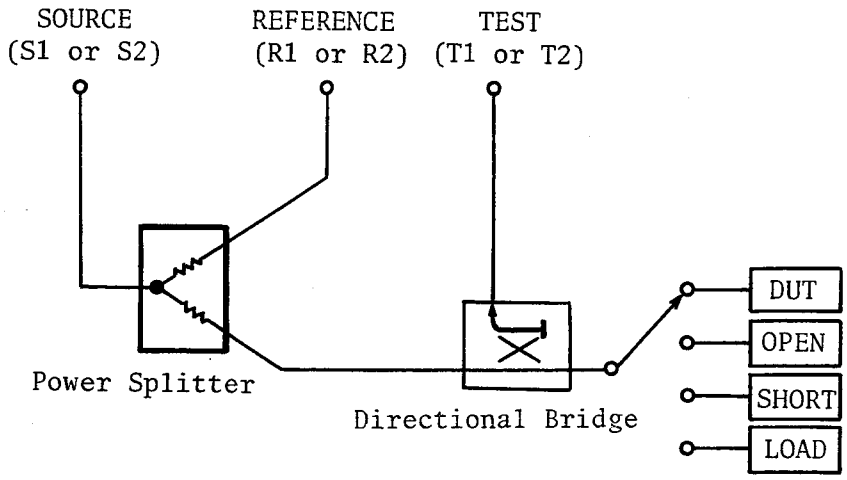


Figure 4-3. Reflection Calibration Diagram

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 0Ω + 5 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 **Cal completed (TURN ON "CORR" KEY)** is displayed.

21. Connect the network under test -- the DUT position shown in Figure 4-3.

22. Press 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. 0S/0Ω OFFSET COMPENSATION

0S and 0Ω offset compensation are available only in the impedance configuration. 0S and 0Ω 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 0S/0Ω offset compensation as folloes.

0S offset compensation:	Compensates for the stray admittance.
0Ω offset compensation:	Compensates for the residual impedance.
0S/0Ω 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 **'0S OFFSET'** softkey (or send the **CMPT1** command) to select the 0S offset compensation. Press the **'0, OFFSET'** softkey (or send the **CMPT2** command) to select the 0Ω offset compensation. Press the **'0S&0, OFFSET'** softkey (or send the **CMPT3** command) to select the 0S&0Ω offset compensation.

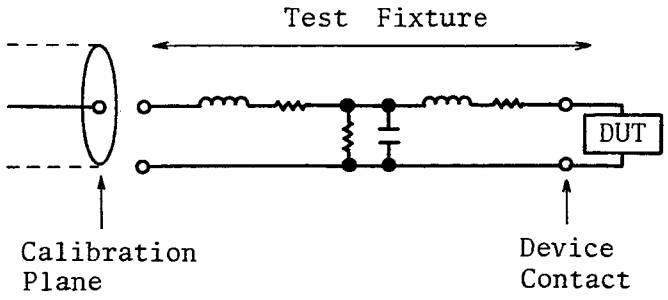


Figure 4-5. 0S/0Ω Offset Compensation

4-8-5. PORT EXTENSION

When the 50Ω coaxial cables are 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 signal 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.

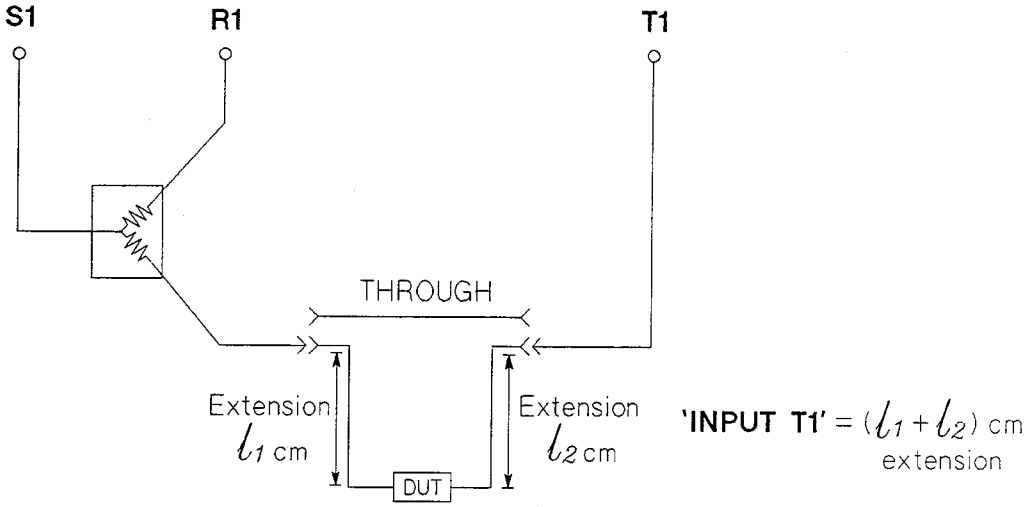


Figure 4-6. INPUT T1 Port Extension Example

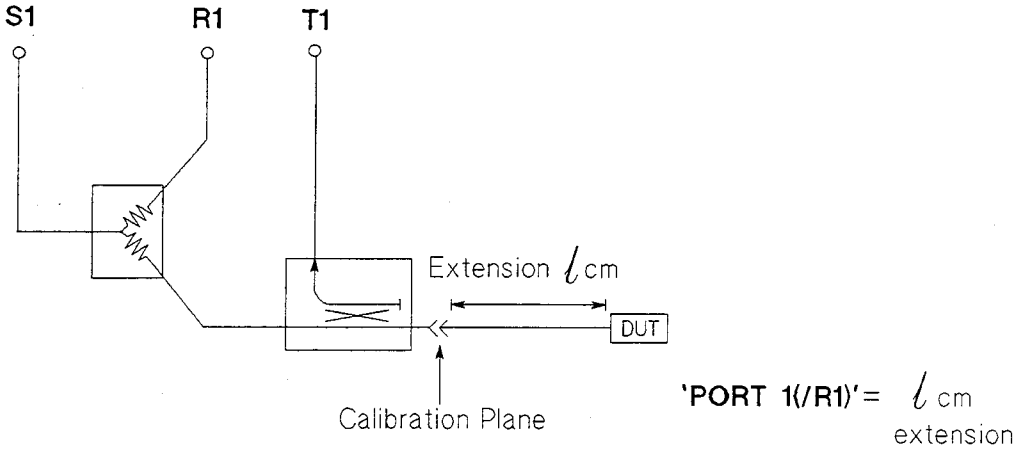


Figure 4-7. PORT 1 Extension Example

Port extension length data is entered by the following procedure.

1. Press the **CAL** key and the **'PORT EXTENSN'** 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, -999.99 cm to +999.99 cm) and press the **ENTER/EXECUTE** key.

4. Repeat steps 2 and 3 for all ports which require 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 resisters for all points in the frequency sweep range, so the 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 is 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 is 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 0S/0Ω 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.

NOTE

All of the calibration standards' values are stored on the disc in all cases and are also saved in the 4195A's battery backed-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 Network and Impedance configuration are shared with the S-Parameter configuration calibration registers as follows.

Network-transmission calibration registers	:	shared with S11 calibration
Network-reflection calibration registers	:	shared with S21 calibration
Impedance calibration resisters	:	shared with S22 calibration

(S12 calibration resisters are used independently.)

If you switch the configuration between the Network-transmission, Network-reflection and Impedance, the resisters are used and the proper calibration is performed. Once the configuration is changed to S-Parameter and all of the S-Parameter calibration is performed, the Network and Impedance calibration data will be lost, because the shared registers are overwritten.

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 0S/0Ω 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.

There are three modes for the IF range as follows.

Normal mode : is normally used.
Low Distortion mode : reduces distortion within the 4195A and is used for low distortion measurements.
High Sensitivity mode : reduces the internal noise of the 4195A and is suitable for measurement of low level signals.

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	YES	YES	YES [3]
Spectrum measurement	YES	YES	
Impedance measurement	YES	YES	
S11 measurement	YES	YES	
S12 measurement	YES	YES	
S21 measurement	YES	YES	
S22 measurement	YES	YES	
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 Single [1]
Sweep Type lin/log	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
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
AUTO (Coupled to Span) on/off	off
Resolution Bandwidth (RBW)	10 kHz
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
AUTO (Coupled to Span) on/off	on
Resolution Bandwidth (RBW)	300 kHz
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	-10 dBm
Division Value for data A	10 dB
Bottom Value for data A	-110 dBm
Reference Value for data B	-10 dBm
Division Value for data B	10 dB
Bottom Value for data B	-110 dBm

(3) IMPEDANCE measurement

Parameter	Initial Setting
Measurement Format	|Z|-θ
Input Port	T1/R1
AUTO (Coupled to Span) on/off	off
Resolution Bandwidth (RBW)	3 kHz
Compensation Mode on/off	off
Correction Mode on/off	off
Calibration Mode	none
IF Range	High Sensitibity
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 MΩ
Division Value for data A	100 kΩ
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) T/R(dB)-θ (S12 or S21)
Input Port	T1/R1 (S11) T1/R2 (S12) T2/R1 (S21) T2/R2 (S22)
AUTO (Coupled to Span) on/off	off
Resolution Bandwidth (RBW)	10 kHz
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.

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

2. Single Variable Registers for General Use

Register	Default Value
FREQ	10000000.000 Hz
OSC1	0.0 dBm
OSC2	0.0 dBm
BIAS	0.00 V
DFREQ	0.50 %
PER1	0.000 cm
PER2	0.000 cm
PET1	0.000 cm
PET2	0.000 cm
PEP1	0.000 cm
PEP2	0.000 cm
MANUAL	(CENTER)
PTSWP	1

Register	Default Value
ATR1	10 dB
ATR2	10 dB
ATT1	10 dB
ATT2	10 dB
MKR	(CENTER)
SMKR	(CENTER)
DMKR	0
LCURS	(REF+BTM)/2
DLCURS	0
EQVR	0
EQVL	0
EQVCA	0
EQVCB	0

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=50Ω	Z=75Ω	Z=50Ω	Z=75Ω
OPNSTD	0.00S, 108fF	0.00S, 63.5fF	0.00S, 82fF	0.00S, 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 3 weeks (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, ± 10 ppm at 23 ±5°C (N is integer from 1 to 10)
Level:	Typical 0 dBm ± 5dBm
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 ±5°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**, and **RF** 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 Open, Short, Load, Through, or Isolation, 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 four copy modes: **PLOT**, **PRINT**, **DUMP** and **color DUMP**. In the PLOT mode, a plotter must be connected to the 4195A, in the PRINT and DUMP modes, a printer must be connected, and in the color DUMP mode, a color printer must be connected. Table 5-5 shows the copy capabilities of these four 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 DISC 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.

(4) **color DUMP** mode — Dump the screen to a color graphics printer (fixed color).

Table 5-5. Capabilities of Three Copy Modes

CRT page	PLOT	PRINT	DUMP	color DUMP
Rectangular X-A&B	YES	YES	YES	YES
Rectangular A-B	YES	YES	YES	YES
Table	NO	YES	YES	YES
Smith	YES	YES	YES	YES
Polar	YES	YES	YES	YES
Programmed Points Table	NO	YES	YES	YES
Equivalent Circuit Page	NO	NO	YES	YES
ASP List	NO	YES	YES	YES
Disc Catalog	NO	YES	YES	YES
CAL Standard Definition Page	NO	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. Using front panel keys Manually
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 peripheals 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)
Color Printer	HP 3630A (PRINT, DUMP,color 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 (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'**, **'DUMP mode'** or **'color 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 in the **PLOT** mode, color selected in the **color DUMP** mode, and the information on the 4195A's screen.

Table 5-7. Plot Pen Selection (1 of 4)

(1) Rectangular X-A&B (**PLOT** and **color DUMP** mode)

Pen No. (PLOT)	Color (color DUMP)	Description
1	Dark Red	Data A; A REF (label, data, unit); DIV or BTM of the data A (label, data)
1	Orange	Data C (Superimpose)
2	Blue	Data B; B REF (label, data, unit); DIV or BTM of the data B (label, data)
2	Light Blue	Data D (Superimpose)
3	Gray	Graticule; Sweep Range; RBW; ST (Sweep Time); RANGE (R, T); Function
4	Black	Information in the marker area; o marker; * marker; line cursor; Analysis Range
5	Green	Information in the comment area, and the keyboard input line
6	Red	System Message

(2) Rectangular A-B (**PLOT** and **color DUMP** mode)

Pen No. (PLOT)	Color (color DUMP)	Description
1	Dark Red	REF, DIV, BTM for data A (label, data, unit)
2	Blue	REF, DIV, BTM for data B (label, data, unit)
3	Gray	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function; <Horizontal>; <Vertical>
4	Black	Information in the marker area; o marker; * marker
5	Green	Information in the comment area, and the keyboard input line; Data A-B
5	Yellow Green	Data C-D (Superimpose)
6	Red	System Message

Table 5-7. Plot Pen Selection (2 of 4)

(3) Smith Chart (**PLOT** and **color DUMP** mode)

Pen No. (PLOT)	Color (color DUMP)	Description
1	Dark Red	**R** (label, unit); **X** (label, unit)
2	Blue	**Ls** (label, unit); **Cs** (label, unit)
3	Gray	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function
4	Black	Information in the marker area; **o** marker; ***** marker; **R, X, Ls, Cs** (data)
5	Green	Information in the comment area, and the keyboard input line; Data A-B
5	Yellow Green	Data C-D (Superimpose, dotted line)
6	Red	System Message

(4) Polar Chart (**PLOT** and **color DUMP** mode)

Pen No. (PLOT)	Color (color DUMP)	Description
1	Dark Red	RTN LOSS (label, unit), VSWR (label)
2	Blue	REF, DIV (label, data)
3	Gray	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function
4	Black	Information in the marker area; **o** marker; ***** marker; RTN LOSS (data); VSWR (data)
5	Green	Information in the comment area, and the keyboard input line; Data A-B
5	Yellow Green	Data C-D (Superimpose, dotted line)
6	Red	System Message

Table 5-7. Plot Pen Selection (3 of 4)

(5) Table (**color DUMP** mode)

Color (color DUMP)	**Description**
Dark Red	Data A (label, unit)
Blue	Data B (label, unit)
Gray	Graticule; Sweep Range; RBW; ST; RNG (R, T); Function; MEASURE N= (label)
Black	N (data); **o** marker; ***** marker
Green	Information in the comment area, and the keyboard input line
Yellow Green	N; Sweep parameter; Data A (data); Data B (data)
Red	System Message

(6) Programmed Points Table (**color DUMP** mode)

Color (color DUMP)	**Description**
Dark Red	CPL (label)
Blue	Sweep Parameter
Gray	Graticule; Function
Black	Title; Table number; N (label); Sweep parameter (label); N (label); Sweep points (label); RBW (label)
Green	Information in the comment area, and the keyboard input line
Yellow Green	N (data); Sweep points (data); RBW (data)
Red	System Message

(7) Equivalent Circuit Page (**color DUMP** mode)

Color (color DUMP)	**Description**
Gray	Graticule; Figure of equivalent circuits; Function
Black	Title; Equivalent parameter values
Green	Information in the comment area, and the keyboard input line; Selected mode; Figure of selected equivalent circuit
Red	System Message

Table 5-7. Plot Pen Selection (4 of 4)

(8) ASP List (Program Editor Page;**color DUMP** mode)

Color (color DUMP)	**Description**
Blue	File name (label)
Gray	Function
Black	Title
Green	Information in the comment area, and the keyboard input line
Yellow Green	File name; ASP list
Red	System Message

(9) Disc Catalog (**color DUMP** mode)

Color (color DUMP)	**Description**
Blue	Volume label (label); Available sector (label)
Gray	Function; File name (label); Type (label); Sector/File (label)
Black	Title
Green	Information in the comment area, and the keyboard input line; Selected file name; Type of selected file; Sector/File of selected file
Yellow Green	File name; Type; Sector/File
Red	System Message

(10) Calibration Stadard Definition Page (**color DUMP** mode)

Color (color DUMP)	**Description**
Blue	Title; Calibration standard values
Gray	Function; RBW; ST (Sweep Time); RANGE (R, T)
Green	Information in the comment area, and the keyboard input line
Red	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 $|Z|$-θ, $|Y|$-θ. 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.

0.00000000000E+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= 0.00000000000E+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.

When the HP 41800A Active Probe is used with the 4195A, connect the power plug of the probe directly into the **PROBE POWER** jack.

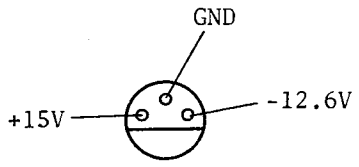


Figure 5-9. **PROBE POWER** Jack

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 (S11 or S22 CAL on)	109 sectors
Instrument Settings (S21 and S12 CAL on)	97 sectors
Instrument Settings (S21 or S12 CAL on)	59 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.

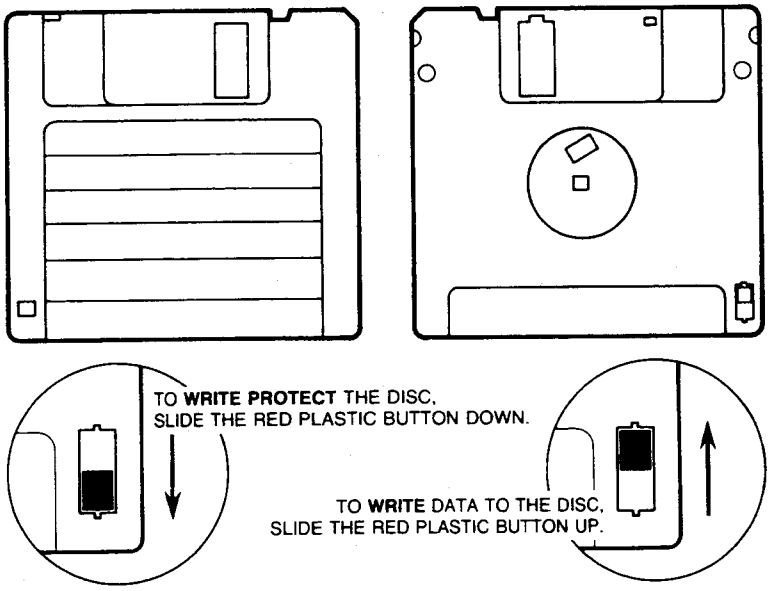


Figure 5-13. Write Protect Tab

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.

SPOLL:

SPOLL 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.

SPOLL(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 yy zz

where
x.xx: version number
yy: released date (year)
zz: released date (week)

6-5-5. DATA OUTPUT FORMATS

This paragraph describes the three 4195A data output formats; ASCII type, IEEE 64-bit binary type, and IEEE 32-bit binary type.

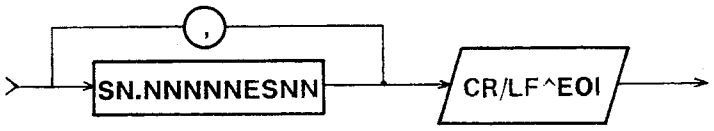
1. **ASCII Type: FMT1**

ASCII type (FMT1) is the default data output format. When FMT1 is active (**FMT1** command is entered), the 4195A transfers data in the ASCII format. Register data is represented in the following ASCII format.

a) Real Type (32-bit) Register Data

This data output format is used for registers which hold 32-bit floating point numbers. The syntax and the registers which use this data type are as follows.

SYNTAX:



S: Sign
N: Number
E: Exponential Sign

REGISTER:

A	B	C	D	E	F	G	H	I	J
RA	RB	RC	RD	RE	RF				
MA	MB								
MFOR	MFOI	MFSR	MFSI	MFLR	MFLI	MFTR	MFTI	MFIR	MFII
MROR	MROI	MRSR	MRSI	MRLR	MRLI	MRTR	MRTI	MRIR	MRII
ZSG	ZSB	ZOR	ZOX						
TFOR	TFOI	TFSR	TFSI	TFLR	TFLI				
TROR	TROI	TRSR	TRSI	TRLR	TRLI				
MKRA	MKRB	DMKRA	DMKRB	SMKRA	SMKRB	LCURS	DLCURS		
EQVR	EQVL	EQVCA	EQVCB						
REF	DIV	BTM							
NVAL	SMTHR	SMTHX	SMTHL	SMTHC	RLOSS	VSWR			
PER1	PER2	PET1	PET2	PEP1	PEP2				

b) Real Type (64-bit) Register Data

This format is used for the registers that hold 64-bit floating point numbers. (Leading zeros will be replaced by spaces.)

SYNTAX:

S: Sign
N: Number

REGISTER:

OSC1	OSC2				
START	STOP	STEP	CENTER	SPAN	
MANUAL	FREQ	BIAS	DFREQ	X	
MKR	DMKR	SMKR	LCURSL	LCURSR	WID

NOTE

When the oscillator level unit is V, the data of these registers is transmitted as Real type (32-bit).

SYNTAX:

S: Sign
N: Number
E: Exponential Sign

REGISTER:

Z	ST	RBW	QV	Rn (n= 0 to 99)

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:

#	A	**No. of bytes transfer** (2 bytes)	**binary data** (4 bytes)	**CR/LF^EOI**

DATA FORMAT:

SEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFF

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)

$$RN = (-1)^S \times 2^{(e-127)} \times \{ 1 + f/(2^{23}) \}$$

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 01000000000000000000000 (2^{21}), the real number (RN) is +1.25.

b) If S=1, e= 10000000 (128), and f= 10000000000000000000000 (2^{22}), 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

Code	Transfer Time with an HP 9000 series 300 computer	
	Using ENTER command	**Using TRANSFER command**
FMT1	700 msec	———
FMT2	120 msec	90 msec
FMT3	50 msec	40 msec

NOTE

1. The status byte is cleared, reset to 0, when the 4195A receives the **CLS** command.

2. The status byte is cleared by the controller's serial polling, while BIT 6 (Request Service: RQS) of the status byte is set to 1.

3. The status byte can be read by sending an **STB?** query command. The **STB?** query command does not clear the status byte.

2. Masking the Status Byte

The "**RQS**" command is used to mask the status byte. The syntax of the "**RQS**" command is:

RQS = n (n= 0 to 255)

Where **n** is a decimal number corresponding to the mask bit pattern used to enable/disable bits of the status byte. For example, if **n** is equal to 34 (00100010), bits 1 and 5 are enabled, as follows.

RQS= 34 (00100010):

Bit No. of Status Byte	**MSB** 7	6	5	4	3	2	1	**LSB** 0
Bit Pattern for RQS command	0	0	1	0	0	0	1	0

0= disable
1= enable

In this example, when a bit in the status byte is set, in this case either bit 1 or 5, a service request is generated. The default value of **RQS** is 0 (00000000: all bits disabled), no service request is generated.

Bit 6 (RQS) is non-maskable, and bits 2 and 7 are always 0, so masking these bits has no meaning. In other words, masking the status byte should be performed on the lower 6 bits (except for bit 2). All masking combinations can be covered by using a mask pattern between 0 and 63 for the value of **n** in the command **RQS= n**.

6-5-8. SENDING CHARACTERS BY HP-IB

To output a character string to an external device connected to the HP-IB bus, use the 4195A Device Dependent "**SEND**" command. The syntax of this statement is:

SEND	"	up to 88 ASCII characters except for " "
	'	up to 88 ASCII characters except for ' '

By entering this command to the 4195A, the characters between the two ' " (double quotation)' marks are transmitted on the bus. The 4195A must be configured as a TALKER, and externally connected devices are configured as LISTENERS.

NOTE

The "SEND" statement can be used in a multi-statement.

6-5-9. HP-IB INTERFACE RESTRICTIONS

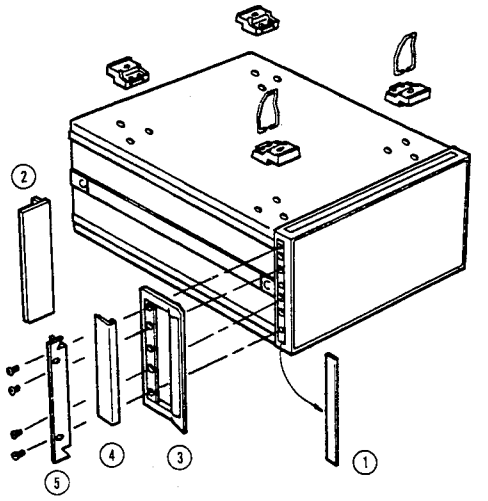
The following restrictions must be adhered to when using an HP-IB interface.

-- The total length of cable in one bus system must be less than or equal to two meters times the number of devices connected on the bus (the HP-IB controller counts as one device) and the total length of cable must not exceed 20 meters.

-- The maximum number of devices that may be connected on one bus system is 15.

-- There are no restrictions on how the cables are connected together. However, it is recommended that no more than four piggyback connectors be stacked together on one device. The resulting structure could exert enough force on the connector mounting to damage it.

For example, a system containing six devices can be connected together with cables that have a total length of less than or equal to 12 meters (six devices $\times$ 2m/device = 12 meters). The individual length of cable may be distributed in any manner desired as long as the total length does not exceed the allowed maximum. If more than ten devices are to be connected together, cables shorter than two meters must be used between some of the devices to keep the total cable length less than 20 meters.



Option	Description	Kit Part Number	
		Upper Unit	Lower Unit
Option 907	Handle Kit	5061-9689	5061-9691
Option 908	Rack Flange Kit	5061-9677	5061-9679
Option 909	Rack & Handle Kit	5061-9683	5061-9685

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.

CAUTION

When storing or moving the 4195A, be sure micro flexible disc is not in the disc drive. (Inserting the protective plastic dummy disc is recommended.)

7-8-2. ORIGINAL PACKAGING

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.

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.

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 15)

These specifications describe the instrument's warranted performance over the temperature range of 0 to 55°C (except where noted). The supplemental characteristics are intended to provide information useful in applying the instrument, these parameters are non-warranted performance parameters. These are denoted as "typical", "nominal", or "approximate".

--- 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, ≤10 ppm (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 (25 pin), TTL level

Table 7-1. Specifications (2 of 15)

--- 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:	$\pm 5 \times 10^{-6}$/day (23 ±5°C; Typical)
	$\pm 1 \times 10^{-8}$/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:	< -100 dBc/Hz at 20 kHz offset, SPAN ≤2.4 MHz

Sweep:

• Sweep Parameter:	Frequency, Power, and DC Bias Voltage
• Power Sweep Range:	Max. 26 dB at -50 to +15 dBm
• Power Sweep Linearity:	±0.2 dB/10 dB at -50 dBm to +10 dBm
• 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

Table 7-1. Specifications (3 of 15)

- Sweep Time: Depends on RBW and sweep time.

RBW	Measurement Time/point
30 kHz	approximately 3 msec
3 kHz	approximately 5.3 msec
300 Hz	approximately 36 msec
30 Hz	approximately 254 msec

DC Bias Level:

- Range: -40 to +40 V (Max. 20 mA)
- Resolution: 10 mV
- Accuracy: ±(0.12% + 5 mV) at 23 ±5°C

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.

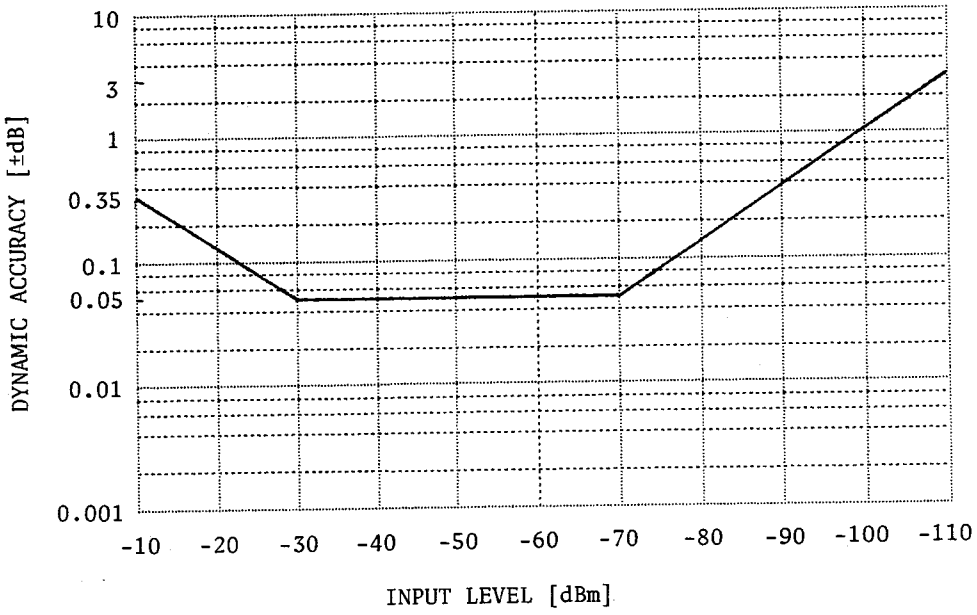
Attenuator	IF Range	
	Normal mode	High Sensitivity mode
0 dB	-10 dBm	-20 dBm
10 dB	0 dBm	-10 dBm
20 dB	10 dBm	0 dBm
30 dB	20 dBm	10 dBm
40 dB	20 dBm	20 dBm
50 dB	20 dBm	20 dBm

- 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 15)

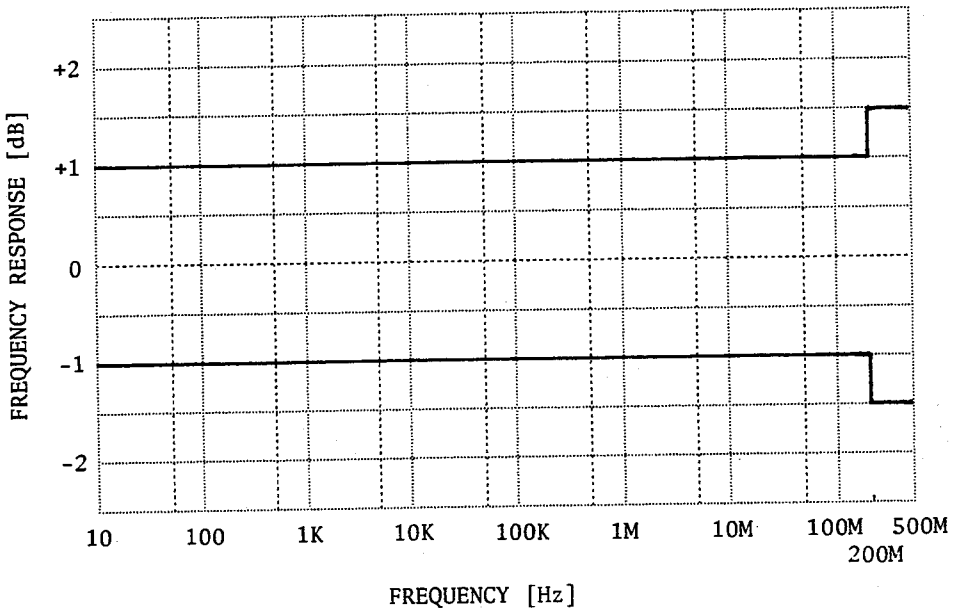
Magnitude Ratio (T/R):

- Dynamic Range: ≥ 100 dB
- Resolution: 0.001 dB
- Dynamic Accuracy (at 23 ±5°C):



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

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

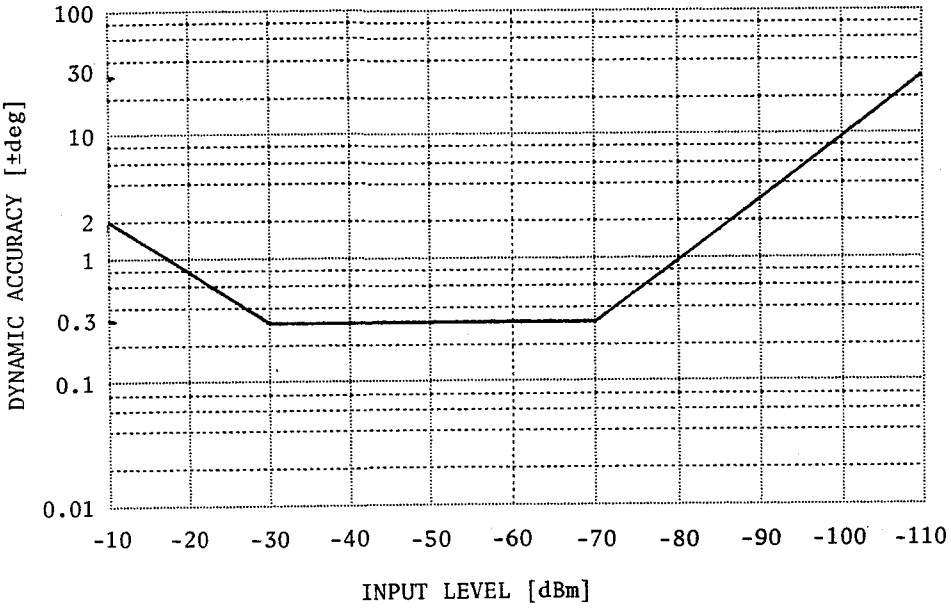


Where, the Input Attenuators for two inputs must be the same value, respectively.

Table 7-1. Specifications (5 of 15)

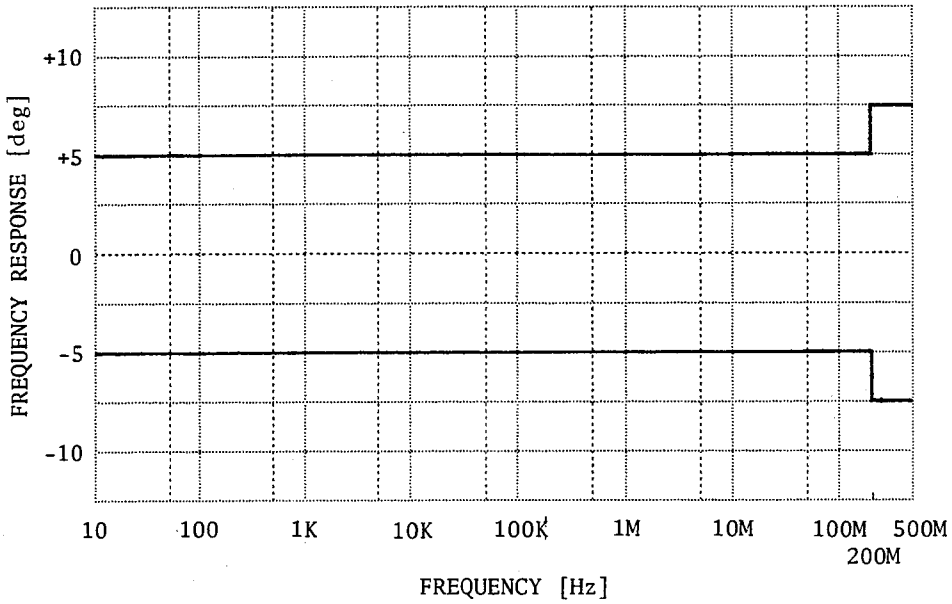
Phase:

- Range: ±180 deg
- Resolution: 0.01 deg
- Dynamic Accuracy (at 23 ±5°C):



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

- Frequency Response: (Deviation from linear phase. 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 (6 of 15)

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 ±5°C):	P/{360(|deg|) × 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 -999.99 to +999.99 cm with 0.01 cm resolution.

Table 7-1. Specifications (7 of 15)

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(3 dB): 3 Hz to 300 kHz, 1, 3, 10 steps
  Selectivity (60 dB/3 dB):

  <4.5 at RBW ≤ 30 Hz
  <9 at 100 Hz ≤ RBW ≤ 10 kHz
  <8.5 at RBW ≥ 30 kHz

  Band Width Accuracy: ±10%

- Standard Frequency Stability: $\pm 5 \times 10^{-6}$/day (23 ±5°C, Typical)
  $\pm 1 \times 10^{-8}$/day (23 ±5°C, with Option 001)

- Noise Sideband: <-100 dBc/Hz at 20 kHz offset, SPAN≤2.4MHz
  <-100 dBc/Hz at 1 kHz offset, SPAN≤2.4 MHz
  <-90 dBc/Hz at 100 Hz offset, SPAN≤2.4 MHz

- SSB Noise (Typical):

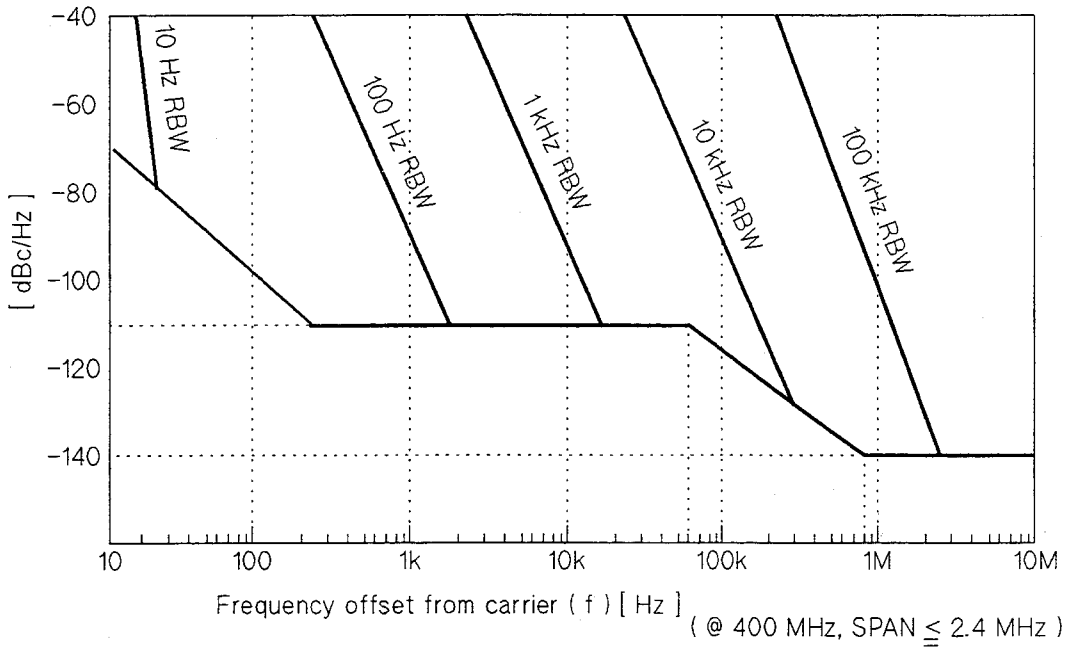


Table 7-1. Specifications (8 of 15)

Input Characteristics:

- Inputs: 4 Inputs (R1, T1, R2, T2)
- Impedance: Nominal 50Ω
  Return Loss ≥15 dB
- Attenuator: 0 to 50 dB, 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.

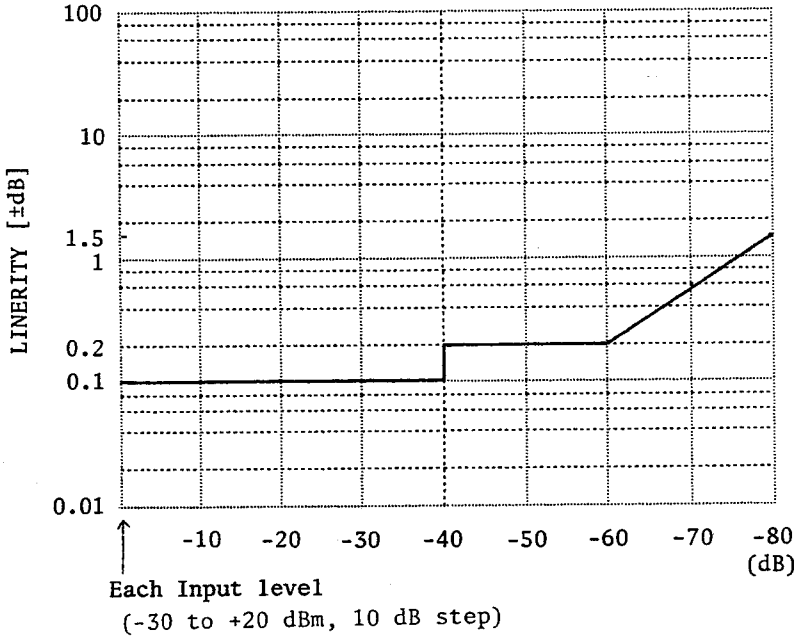
Attenuator	IF Range		
	Normal	Low Distortion	High Sensitivity
0 dB	-20 dBm	-30 dBm	-40 dBm
10 dB	-10 dBm	-20 dBm	-30 dBm
20 dB	0 dBm	-10 dBm	-20 dBm
30 dB	10 dBm	0 dBm	-10 dBm
40 dB	20 dBm	10 dBm	0 dBm
50 dB	20 dBm	20 dBm	10 dBm

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

Table 7-1. Specifications (9 of 15)

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):



Where: IF Range: Low Distortion mode
Resolution Band Width: 10 Hz

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

Table 7-1. Specifications (10 of 15)

Dynamic Range: (at 23 ±5°C)

- Spurious Response: ≤-70 dBc
  (at the frequency offset from carrier ≥100 kHz when SPAN > 2.4 MHz)

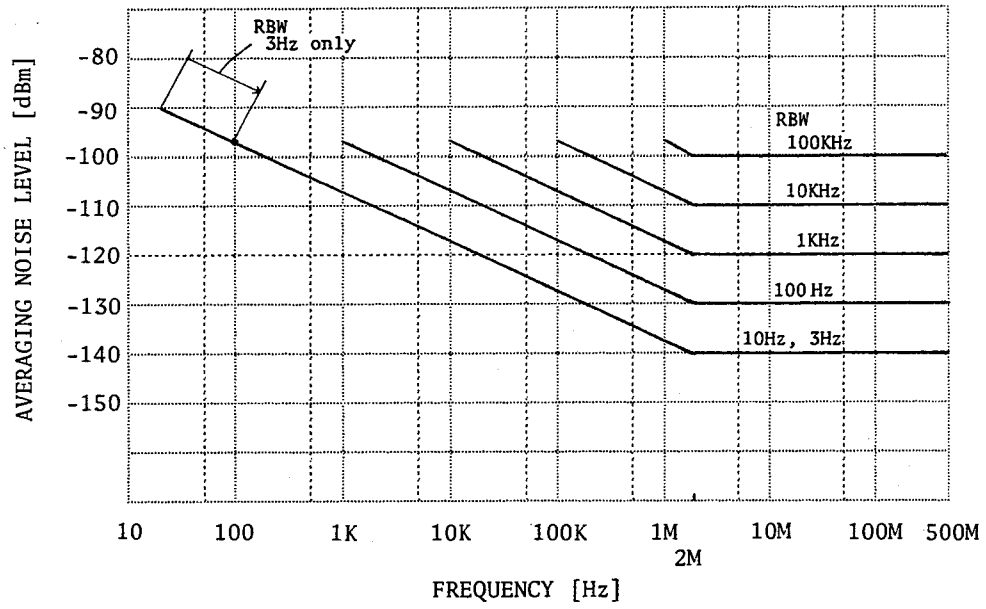
- 2nd Harmonics Distortion: ≤-70 dBc referenced to the sinusoidal signals (≥2 MHz) which is equal to every Input Ranges

  (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)

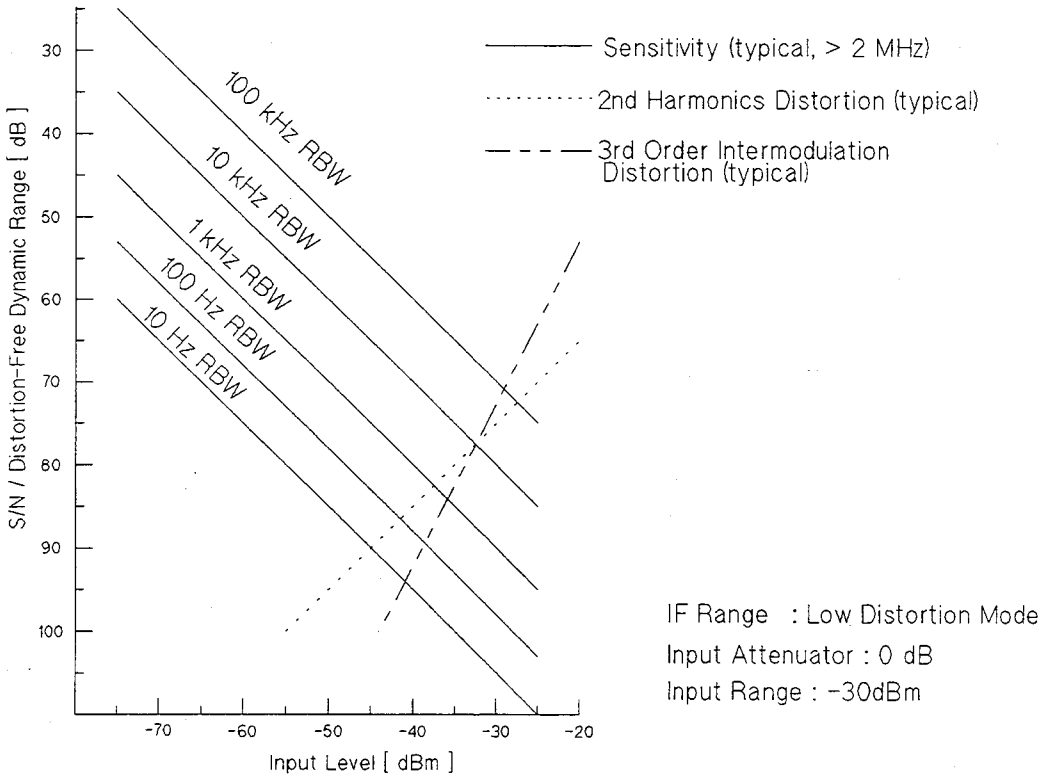
- Averaging Noise Level (Typical):



Where: IF Range: High Sensitivity mode
Attenuator: 0 dB

Table 7-1. Specifications (11 of 15)

- Dynamic Range Chart:



Sweep:

- Sweep Type: Liner, Log, CW, Programmed Points, and Partial
- Sweep Mode: Continuous, Single, and Manual
- Trigger Mode: Internal, External, and Manual
- Sweep Time: (where Display points : 401 points)

Span	RBW	Measurement Time/point
500 MHz	300 kHz	approximately 3.5 sec
100 MHz	300 kHz	approximately 750 msec
50 MHz	300 kHz	approximately 350 msec
1 MHz	3 kHz	approximately 1 sec
100 kHz	300 Hz	approximately 11 sec

Table 7-1. Specifications (12 of 15)

IMPEDANCE MEASUREMENT

The following specifications are applied only when the 4195A is used with the HP 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 50Ω load

DC Bias Level: ±40 V (Max. 20 mA)

Measurement Range: 30 mΩ to 30 kΩ
(Typical, after a 1 Port Calibration)

Measurement Basic Accuracy: (Typical,at 23 ±5°C, after a 1 Port Calibration)

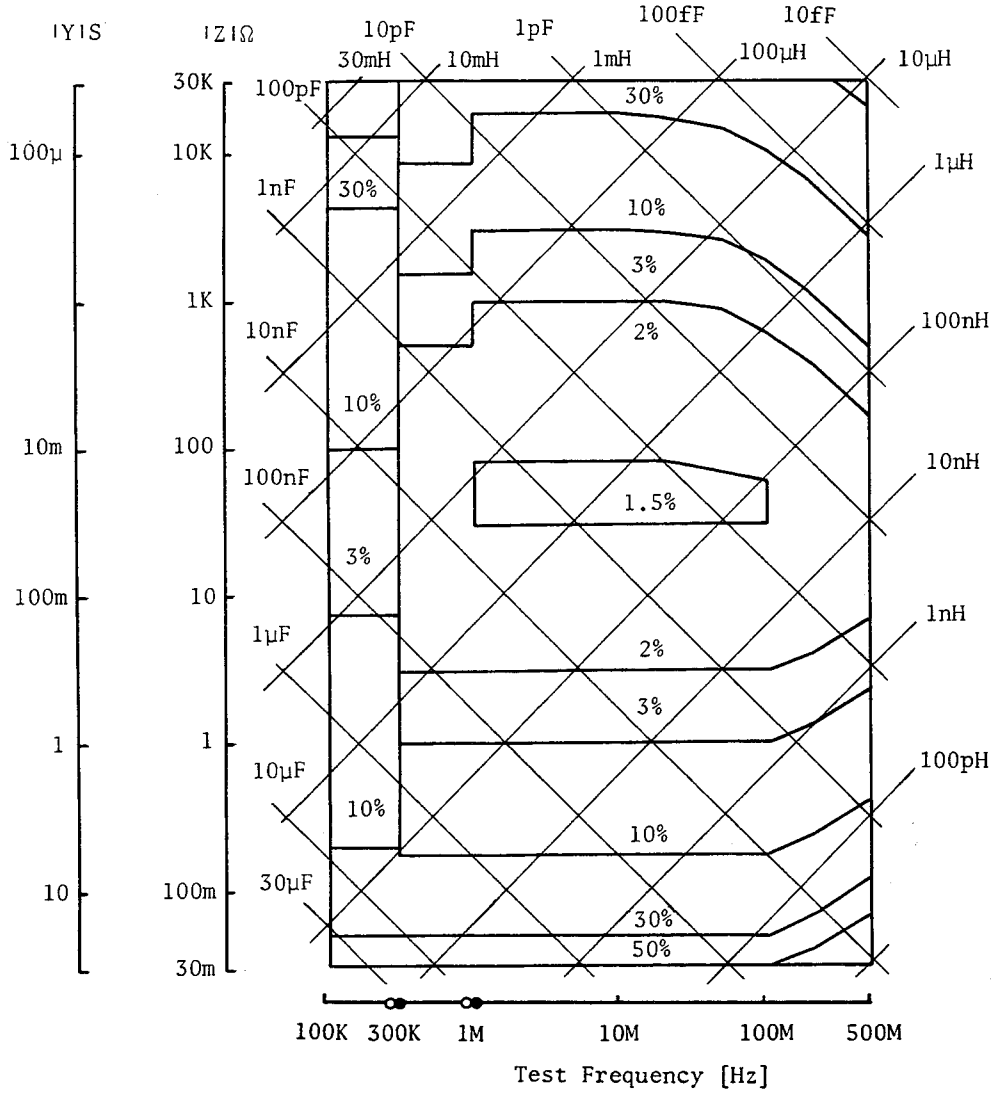


Table 7-1. Specifications (13 of 15)

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 (14 of 15)

--- 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→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 (15 of 15)

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.
Color DUMP Graphics mode:	Copy the CRT display on a color graphics printer (fixed color).
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, 401 point data.

Data Format	Transfer Rate
ASCII	Approximately 700 msec
Binary 32-bit	Approximately 40 msec
Binary 64-bit	Approximately 90 msec

Table 7-2. Options

Option Number	Description
001	High Stability Frequency Reference Test Frequency Accuracy: ±1 ppm (23 ±5°C) Stability: ±1 × 10^{-8}/day (23 ±5°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
Maintenance Manual	1 ea.	04195-90100
User's Guide	1 ea.	5950-2942

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

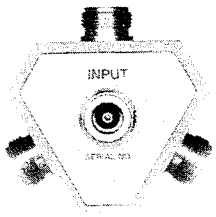
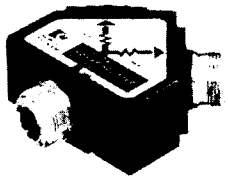
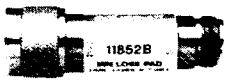
Model	Description
11850C/D 	Three-Way Power Splitters The 11850C/D are used with the 4195A for the transmission measurement from 10 Hz to 500 MHz. Insertion Loss (Nominal): 11850C: 9.5 dB + 1 dB/GHz 11850D: 7.8 dB Equivalent Source Match: 30 dB at 1.3 GHz Input Port Match: 20 dB at ≤1.3 GHz Maximum Operating 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 7)

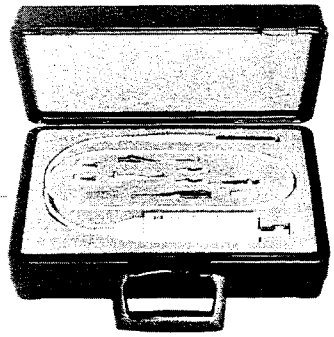
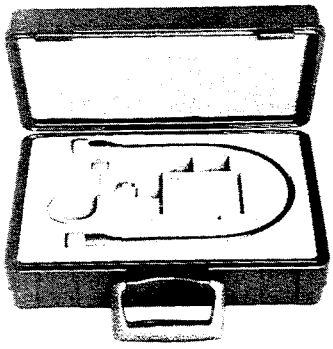
Model	Description
41800A 	Active Probe The 41800A is high impedance probe used to perform probing measurements when using the 4195A from 5 Hz to 500 MHz. Probe Gain: 0 dB ±0.5 dB, at 50 MHz Input Resistance/Capacitance (Typical): 100 kΩ, 3 pF Frequency Response: ±1 dB, at 50 Hz to 200 MHz Average Noise Level (Typical): 10 nV/√Hz, at ≥300 kHz Accessories: HP 10218A Probe-BNC(m) Adapter 10:1 / 100:1 Divider Slip-on Spanner Ground Tip Ground Clip (flexible) Probe Tip Nut Driver HP 10229A Hook Tip Adapter Spare Probe Pin Set Operation Note, Carrying Case
41952A/B 	Transmission/Reflection Test Set The 41952A/B are used with the 4195A to measure the transmission/reflection characteristics from 100 kHz to 500 MHz. Impedance: 41952A: 50 Ω 41952B: 75 Ω Directivity: 41952A: 40 dB, at 300 kHz to 200 MHz 41952A: 35 dB, at 300 kHz to 200 MHz Insertion Loss (Nominal, Input to Test Port): 41952A: 13 dB 41952B: 19 dB Effective Source Match (Test Port): ≥20 dB, at ≥300 kHz Connector (Test Port): 41952A: 50 Ω, type N(f) 41952B: 75 Ω, type N(f) Accessories: 50 Ω N(m)-N(m) Cable 11852B Minimum Loss Pad (41952B only) Operation Note, Carrying Case Option: Option 009 (41952B only): Delete N(m)-N(m) cable and 11852B

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

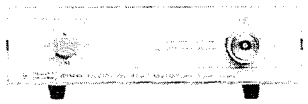
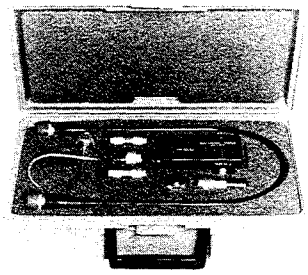
Model	Description
85044A/B 	Transmission/Reflection Test Set The 85044A/B are used with the 4195A to measure the transmission/reflection characteristics from 300 kHz to 500 MHz. Directivity: 35 dB at ≤1.3 GHz Insertion Loss: (Nominal, Input to Test Port) 85044A: 12.5 dB + 0.5 dB/GHz 85044B: 22 dB + 1 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: 75 Ω type N(f) Accessories: 85044A: 7 mm-50 Ω type N(f) Adapter (1 ea.) 85044B: 11852B Minimum Loss Pad (1 ea.)
35676A/B 	50/75 Ω 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: 50 Ω ±2% 35676B: 75 Ω ±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 (4 of 7)

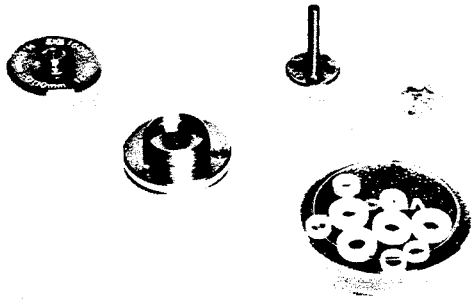
Model	Description
11851B	RF Cable Kit 610 mm 50 Ω cable (3 ea.), 810 mm cable (1 ea.)
11857B	75 Ω Type N Test Port Extension Cables 610 mm cable (2 ea.)
11853A	50 Ω Type N Accessory Kit
11854A	50 Ω BNC Accessory Kit
11855A	75 Ω Type N Accessory Kit
11856A	75 Ω BNC Accessory Kit
85031B	7 mm Calibration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

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

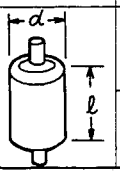
<table>
<tr><th>Model</th><th>Description</th></tr>
<tr><td>41951A
  </td><td>Impedance Test Kit

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.

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</td></tr>
<tr><td>16091A
  </td><td>Coaxial Fixtures

Test Fixtures (coaxial termination type) for holding a piece of sample holders accommodate a cylindrical sample in their respective inner chambers. Two kinds of fixtures fit samples dimensions given below:

<table>
<tr><th>Sample</th><th>Fixture</th><th colspan="2">Max. dimensions</th></tr>
<tr><td rowspan="4">  </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">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 16091A fixture of 7 mm inner diameter (P/N 04191-85302) is the 0S standard termination furnished with the HP 41951A. Thus, this fixture is not supplied with the 16091A fixture set since the 0S termination can be used.</td></tr>
</table>

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

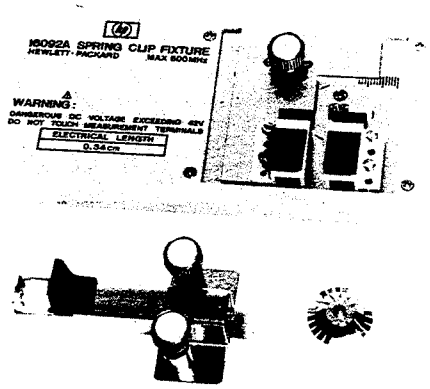
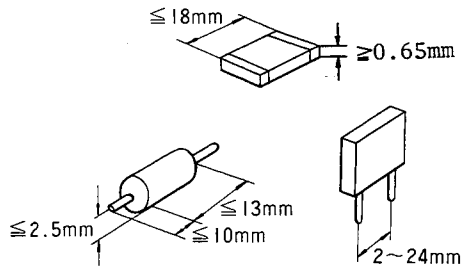
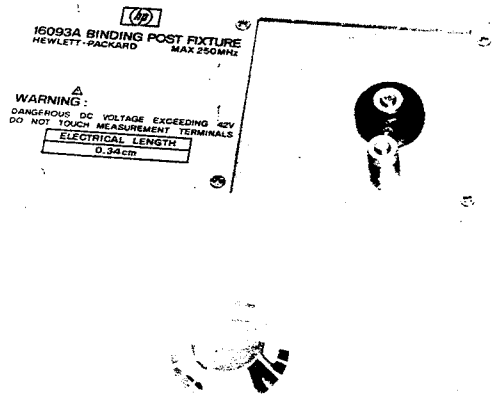
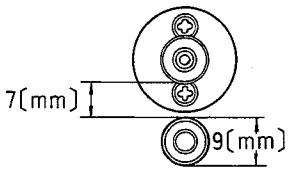
Model	Description
16092A 	Spring Clip Fixture Test Fixture (direct attachment type) for measurement of both axial and radial lead components and leadless chip elements. Spring clip contacts are capable of holding samples of dimensions given below:  A combined slide gauge provides direct read-out of the 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: ± 40V.

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

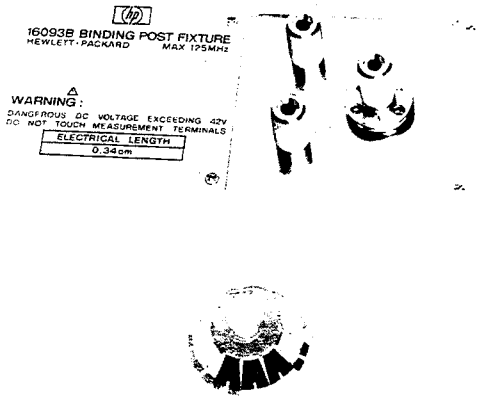
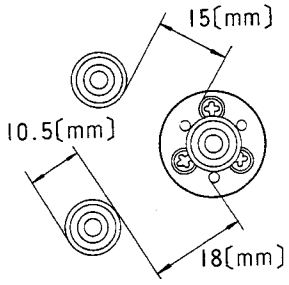
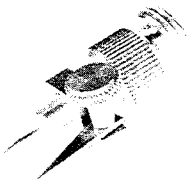
Model	Description
16093B 	Binding Post Fixture Test Fixture (direct attachment type) for general measurement of both axial and radial lead components. Three binding post terminals are located on the terminal deck as shown below:  Usable frequency range: dc to 125 MHz Electrical length: 0.34 cm typical 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		41952A 35676A	41952A*[1] 35676A*[1]		41952B 35676B	41952B*[1] 35676B*[1]
Cable	11851B	11851B		11851B 11857B	11857B	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 sets of the same model (Option 009 for 41952B) 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.

- 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.
► **Allowed only in Z-θ/Y-θ/R-X/G-B**	**'EQV CKT'** or **'SIMULATE f-char'** softkey was pressed when the impedance measurement parameter was not $\|Z\|$-θ, $\|Y\|$-θ, R-X, or G-B. When in impedance configuration, the equivalent circuit frequency response simulation can be performed only for the $\|Z\|$-θ, $\|Y\|$-θ, R-X, or G-B parameters. When in the S11 or S22 configuration any measurement parameter may be used.

A/B data stored into C/D	The **'STORE A,B→C,D'** softkey was pressed. Trace data in A and B registers is stored in registers C and D.
► **A:RAM R/W err, adrs=***dddddd***H err-bit=***dddd***H**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **A:ROM allocation error**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **A:ROM check sum error, ID=***dd*	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **A:ROM combination mismatch**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.

- B -

Message	Description
► **Back up RAM data lost**	The data in the battery back up RAM has been destroyed, and the RAM was initialized. The rechargeable battery may be discharged. Leave the 4195A on for two full days to allow the battery to fully recharge. If this message appears frequently at turn on, the battery or the charging circuit may be faulty. Contact your nearest Hewlett-Packard office.
► **Bias must be -40 to +40 V**	Attempted to enter a voltage value greater than ±40 V. The DC source voltage must be less than or equal to ±40 V.
BTM value has changed	Appears when a reference (top of scale) value less than or equal to the bottom value is entered. The bottom value was automatically changed in order to keep it less than the reference value.
► **B:RAM R/W err, adrs=***dddddd***H err-bit=***dddd***H**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **B:ROM allocation error**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **B:ROM check sum error, ID=***dd*	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.

► **B:ROM combination mismatch**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.

- C -

Message	Description
Cal completed (TURN ON "CORR" KEY)	Is displayed when all data for calibration has been taken. Turn the '**CORRECTCN on off**' softkey to set the calibration function to on.
Compen completed (TURN ON "CORR" KEY)	Is displayed when all data for compensation has been is taken. Turn the '**CORRECTCN on off**' softkey to set the compensation function to on.
CAL must be done at first	Attempted to perform the **0S/0** Ω compensation data measurement before the calibration data measurement.
Calculating CAL coefficient	Is displayed when the **'CORRECTN on off'** softkey was pressed, and is displayed until the calculation of the calibration coefficient is completed.
Calculating EQV parameters	Appears when the **'CALC EQV para'** softkey was pressed, and is displayed until the equivalent circuit approximation value calculation is completed.
Calculating f characteristics	Appears when **'SIMULATE f-char'** softkey was pressed, and is displayed until the equivalent circuit simulation calculation is completed.
Calculation complete	Appears when the equivalent circuit approximate value calculation or simulation calculation is completed.
Calibration aborted	Appears when the **'ABORT CAL'** softkey was pressed during calibration. The aborted calibration will not affect any previously taken calibration data.
Calibration data are interpolated	Appears when error compensation was performed with calibration data which was calculated using interpolation.
Calibration not allowed in SPECTRUM	Appears when the **CAL** key was pressed in the spectrum configuration. The Spectrum configuration does not have Calibration capability.

► **Calibration type mismatched**

Appears when an unselected calibration was attempted.

► **Can't calculate EQV parameter**

Appears when equivalent circuit parameters such as R, L, Ca, or Cb cannot be calculated.

► **Can't change in smith/polar display**

Appears when you have attempted to change the display scale to Log when the display format was for a Smith or polar chart. Scale type (lin/log) cannot be changed while using the Smith and polar formats.

► **Can't change scale >20 times /sweep**

Appears when you attempt to change scale parameters such as REF, DIV, or BTM more than 20 times in a sweep. Scale parameter can not be changed more than 20 times during a single sweep.

► **Can't change while data exist**

Appears when an attempt was made to change the sweep point parameter when the sweep points had already been entered into the Program Point Table. Clear the table before changing it.

► **Can't measure τ in prog. point meas.**

Appears when you have attempted to select the Group delay measurement while in a program point table measurement, or when a programmed point table measurement was attempted while making a group delay measurement. Group delay measurements cannot be performed using a program point table.

► **Can't print data on this display**

The **'COPY start'** softkey was pressed while the Equivalent Circuit Analysis display was on the screen and the PRINT mode was selected. The equivalent circuit analysis display can be dumped, but cannot be printed.

► **Can't select manual sweep**

The **'MANUAL mode'** softkey was pressed while in the Group Delay measurement mode. Manual sweep mode cannot be used for group delay measurements.

► **Change parameter to Z-θ/Y-θ**

The **'CALC EQV para'** softkey was pressed when the configuration was impedance and the measurement parameter selected was not |Z|-θ or |Y|-θ. Equivalent circuit approximate value calculation can be performed only for the |Z|-θ and |Y|-θ parameters.

► **Change sweep to frequency**	Attempted to use Equivalent Circuit Analysis when the sweep parameter was not frequency. Equivalent Circuit Analysis can only be used when the sweep parameter is frequency.
► **Command syntax error**	Command syntax used is not correct. Refer to the command syntax diagram.
► **Compen allowed only in impedance**	An offset compensation command was executed when the configuration was not impedance. Offset compensation may be used only in the impedance configuration.
► **Compen type mismatched**	Appears when an attempt was made to perform an unselected compensation. For example, the **ZOCMP** command was executed when the **'COMPEN NONE'** softkey was selected.
Compensation aborted	Appears when the **'ABORT COMPEN'** softkey was pressed during compensation. The aborted compensation will not affect any previously taken compensation data.
Copy aborted	Appears when **'COPY abort'** softkey was pressed while a hardcopy was in progress.
• Copy completed	Appears when a hardcopy operation was completed.

- D -

Message	Description
► **Delay aperture 0.5 to 100 %**	A delay aperture value out of settable range was entered. The delay aperture must be set between 0.5 and 100.
► **Directory overflow**	Although there may have been room on the the media for the file, there was no room in the directory for another file name. A maximum of 192 files may be stored on a disc.
► **Disc not in drive**	One of the disc drive access softkeys was pressed when there was no disc is in the drive. Insert a 3-1/2 inch micro flexible disc.
► **DISP syntax error**	Syntax error existed in the **DISP** command executed.

DIV value has changed	Appears when display scale division has changed automatically in order to keep the REF/BTM relation.
► **Divide by zero error**	Divide by zero math error.
► **Down sweep not allowed in SPECTRUM**	The **'DIRECTN up down'** softkey was pressed to select down sweep direction while in the spectrum configuration.
► **Duplicate file name**	The specified file name already exists in the directory. It is illegal to have two files with the same name on the same volume.

- E -

Message	Description
► **EEPROM check sum error**	Hardware failure. The 4195A needs to be repaired. Contact your nearest Hewlett-Packard office.
► **END statement not found**	Appears when an User Program (ASP) execution reached the last line without finding the BASIC **END** statement.
ENTER to execute ALL CLEAR	Appears when the **'TABLE ALL CLR'** softkey was pressed. Confirm that you really want to clear the table, then press **ENTER/EXECUTE** key to complete this operation.
ENTER to execute FORMAT DISC	Appears when the **'format DISC'** softkey was pressed. Confirm that you really want to initialize the disc, then press **ENTER/EXECUTE** key to initiate this operation.
Exit editor	Appears when the **'QUIT editor'** softkey was pressed to notify you that you have exited the User Program (ASP) editor.
Exit programmed points table	Appears when the **'set end'** softkey was pressed to notify you that you have exited the Programmed Point Table editor.
Exit UDF editor	Appears when the **'EXIT UDF edit'** softkey was pressed to notify you that you have exited the User Defined Function or Sweep End Function.

- F -

Message	Description
► **File name is undefined**	The specified file name does not exist in the directory. Check the contents of the disc with the **CAT** (catalog) command.
► **FOR NEXT syntax error**	User Program (ASP) BASIC statement construct, **FOR...TO...NEXT** syntax error. If this construct is nested more than ten deep, this error will also occur.
► **FORMAT failed**	Too many bad tracks found. The disc was defective, damaged, or dirty. Appears when disc formatting (initialization) failed.
► **Fractional N loop unlocked**	Hardware failure. The 4195A will need to be repaired. Contact your nearest Hewlett-Packard office.
► **Freq. must be 0.001 to 500M Hz**	Attempted to enter a frequency value lower than 1 mHz or higher than 500 MHz. The range of frequenies which may be entered is 1 mHz to 500 MHz.
Frequency span is out of calibrated range	Appears when the frequency setting is out of the calibrated frequency range.

- G -

Message	Description
► **Get failed**	Check sum error occurred while attempting to **GET** a file.
► **GOSUB RETURN syntax error**	User Program (ASP) BASIC statement construct, **GOSUB...RETURN** syntax error. If this construct is nested more than 10 deep, this error message will also occurred.
► **GOTO syntax error**	User Program (ASP) BASIC statement, **GOTO** syntax error.

- H -

Message	Description
► **HP-IB char string too long**	The character string sent via HP-IB was greater than the 2048 Byte limit.

- I -

Message	Description
► **IF THEN syntax error**	User Program (ASP) BASIC statement, **IF...THEN** syntax error. If this construct is nested more than 10 deep, this error message will also occur.
► **Improper definition in sweep end fctn**	The sweep end function definition was improper.
► **Improper delimiter**	Syntax error. Delimiters such as semicolon (;), carriage-return/line-feed (CR/LF), or comma (,) were used improperly or no delimiter was detected.
► **Improper entry unit**	Setting error. Unit key such as Hz, V, dBm, or dBμV is used improperly.
► **Improper file name.(A→Z & _ only)**	Improper file name was used when getting or saving the file from/to flexible disc. Only upper-case characters (A to Z), numbers, and underscores (_) may be used.
► **Improper file type**	The 4195A can only **GET** ASP, PPT, DATA, STATE type files from a disc. Some ASCII and BDAT files can be read from the disc, if they are identical to ASP and DATA files, respectively. The file type can be determined by executing the **CAT** command.
► **Improper math definition**	The user defined math definition was improper.
► **Improper numeric expression**	Numeric expression is improper. For example, **CENTER=1.0.0MHZ** was executed.
► **Improper scale value**	Scale value setting error. For example, negative value was used for DIV, or zero was used for the log scale.
Input buffer full	The character string entered on the keyboard input line exceeded 88 characters.
► **INPUT syntax error**	Syntax error existed in the INPUT command executed.
► **Integer overflow**	Appears when the result of integer calculation overflows. The integer value range is from -2147483648 to +2147483647. Refer to descriptions of binary math operators.

► **Invalid LOG/LN argument**	The **LOG** or **LN** math operator was used improperly.
► **Invalid mass storage volume label**	Usually indicates that the media was not initialized on a compatible system. Could also be a bad disc.
► **Invalid parameter range**	Attempted to enter an out of range value. For example, 100 was entered as an input attenuator setting.
► **Invalid prog. points table**	Program points table is turned on or program table number was changed when the table was invalid. For example, the oscillator level selected for program points and -15 dBm and +15 dBm was registered in the same table.
► **Invalid select code number**	Input error. The number selected was wrong for the type of command selected. For example, selecting a number greater than or equal to 8 for the Configuration Select Command (FNC1 through FNC7) is executed.
► **Invalid SIN/COS argument**	Math operator **SIN** or **COS** was improperly used.
► **Invalid SQR argument**	Math operator **SQR** was improperly used.
Invalid step parameter	The up or down arrow key was pressed when the changeable parameter was not displayed on the keyboard input line.
ISOLATION CAL required	Appears when isolation calibration data measurement is required.

- J -

There are no messages beginning with J.

- K -

There are no messages beginning with K.

- L -

Message	Description
► **Line cursor not displayed**	A command that uses the line cursor was executed when the line cursor was not displayed.
► **Line number not found**	Branch destination of User Program (ASP) **GOTO**, **GOSUB**, or **THEN** statement was not found.

► **Line number syntax error**	Syntax error found related to the line number in the User Program (ASP). For example, no character space between the line number and the statement.
LOAD CAL required	Appears when the load calibration data measurement is required.
► **LOG sweep not allowed in OSC_dB**	Log sweep type cannot be selected for oscillator level (dBm or dBμV) sweep.

- M -

Message	Description
► **Markers not displayed**	A command that uses a marker was executed when no marker was displayed.
► **Mass storage hardware failure**	The disc drive hardware failure was detected during disc access. Also occurs when the disc was pinched and not turning. Try reinserting the disc.
► **Mass storage medium overflow**	There is not enough contiguous free space for the specified file size. The disc is full.
Measured data are stored in MA reg.	Appears when **'DEFINE MATH A'** softkey is pressed.
Measured data are stored in MB reg.	Appears when **'DEFINE MATH B'** softkey is pressed.
Measuring ISOLATION	Appears during isolation calibration data measurement.
Measuring LOAD	Appears during load calibration data measurement.
Measuring OPEN	Appears during open calibration data measurement.
Measuring THRU	Appears during through calibration data measurement.
Measuring SHORT	Appears during short calibration data measurement.
Measuring 0S	Appears during 0S offset compensation data measurement.
Measuring 0Ω	Appears during a 0 Ω offset compensation data measurement.
Memory full	Appears when the total number of program lines in the User Program (ASP) work area exceeds 300 lines.

▶ **Memory full(all boxes used)**	Attempted to fill another program point table when there was no room for the program points table.
Memory test in progress	Appears during the power on memory test.
▶ **Min. Resolution<=STEP<=SPAN**	An attempt was made to enter a step value less than the settable minimum resolution or greater than the current set span value.
▶ **Multi statement not allowed**	Command or User program (ASP) BASIC statement designed as single statement type was used in the multi statement form.
▶ **Must be 0<= SPAN <=full range**	Attempted to enter a span value less than 0 or more than the full range (for example, 499 999 999.999 Hz in frequency sweep mode).

- N -

Message	Description
▶ **Negative data exists in A_REG**	The **'CALC EQV para'** softkey was pressed when one or more negative data exist in the A resister. When performing the equivalent circuit approximate value calculation, data in A register must be non-negative. (Normally measured |Z| or |Y| values are stored in the A register. So never enter negative values for the circuit parameters.)
▶ **N must be >= 2 in ana. range**	The **'STORE ANA RNG'** softkey was pressed when the o and * markers are at the same point. The number of points for the partial analysis range (between o & * markers) must be greater than or equal to 2.
▶ **N must be >= 3 in ana. range**	An attempted was made to use Equivalent Circuit Analysis when the number of points in the analysis range was less than 3.
▶ **N must be >= 2 in sweep range**	The **'STORE SWP RNG'** softkey was pressed when the o and * markers were at the same point. Number of measurement points for partial sweep range (between o & * markers) must be greater than or equal to 2.

No action has taken	Key other than the **ENTER/EXECUTE** key was pressed when **ENTER to execute ALL CLEAR** or **ENTER to execute FORMAT DISC** was displayed on the system message line.
► **No ASP program in memory**	Attempted to **RUN** or **SAVE** a program, when no program was in the User Program (ASP) work area.
► **No calibration type selected**	The **'CORRECTN on off'** softkey was pressed to turn on the correction when **'CAL NONE'** or **'COMPEN NONE'** wasis selected.
► **NOISE allowed only in SPECTRUM**	The **'NOISE on off'** softkey was pressed to turn on the noise mode when in other than the spectrum configuration.
► **NOP must be 2 to 401**	An attempt was made to enter a number of measurement points (NOP) value less than 2 or more than 401.
► **Not allowed in ASP**	A invalid User Program (ASP) command was used the program. For example, UDF1 is programmed in a User Program (ASP).
► **Not allowed in LOG scale**	Scale division cannot be set when the display is set to the Log scale mode.
► **Not allowed in LOG sweep**	The CENTER, SPAN, or STEP values cannot be set when Log sweep is selected.
► **Not allowed in manual sweep**	The **'θ DISP expand'** softkey was pressed while in the Manual sweep mode.
► **Not allowed in present state**	A command that cannot be use in the current settings is executed.
► **Not allowed in prog. measure**	A command that will change the sweep parameter settings was executed while a programmed points measurement was being performed.
► **Not allowed in SMITH display**	The **'MKR→REF'** softkey was pressed while the Smith display format was selected.
Not allowed in user define function	A softkey in the User Program editor (except for the **DISP** command) was pressed.

► **Not allowed in Zero Span**	**The 'MKRS→SPAN'** softkey was pressed or an attempt to use Equivalent Circuit Analysis when a zero span measurement was being made.
Not calculate τ in Zero span	Group delay measurement cannot be selected while in the zero frequency span mode.
► **Not continuable**	The **'CONT'** softkey was pressed while a User Program (ASP) was in the STOP status. This command is effective only during the PAUSE state.
► **Not in o & * MKRS mode**	A command which uses the o and * markers was executed when the o and * markers were not displayed.
Not in PLOT mode	Appears when **'PLOT menu'** softkey was pressed when the hardcopy mode was not set to the PLOT mode.
► **Number of points full**	Number of sweep points set in a programmed points table exceeded 401.

- O -

Message	Description
► **Only FREQ & LIN swp allowed in τ meas**	Group delay measurement can be performed only when the sweep parameter is frequency and the sweep type is linear.
Open CAL required	Appears when an open calibration data measurement is required.
► **Osc must be -50 thru +15 dBm**	Attempted to enter an oscillator level value of less than -50 dBm or greater than +15 dBm. Setting error, the source amplitude must be set between -50 dBm and +15 dBm.
► **Osc must be 57 to 122 dBμV**	Attempted to enter an oscillator level value of less than 57 dBμV or greater than 122 dBμV. The source amplitude must be set between +57 dBμV and +122 dBμV.
► **Osc must be 707μ to 1.26 V**	Attempted to enter an oscillator level value of less than 707 μV or greater than 1.26 V. The source amplitude must be set between 707 μVrms and 1.26 Vrms.
Out of line numbers	Appears when a program line number less than 1 or greater than 32767 was used.

► **Out of range in SWEEP POINTS**	Sweep point set in the programmed points table was out range.
► **Out of range (1E-37 → 9.99999E+37)**	Setting error. Setting range for the registers must be 0 or ±1E-38 to ±9.99999E+37. Check the register setting range listed in Appendix F.
► **OUTPUT syntax error**	Syntax error existed in the OUTPUT command.
► **Overload on R1 input**	Input signal amplitude at R1 input connector exceeds the input range value.
► **Overload on R2 input**	Input signal amplitude at the R2 input connector exceeds the input range value.
► **Overload on T1 input**	Input signal amplitude at T1 input connector exceeds the input range value.
► **Overload on T2 input**	Input signal amplitude at T2 input connector exceeds the input range value.

- P -

Message	Description
► **Plot allowed X-A&B/A-B/SMITH/POLAR**	Plot mode hardcopy cannot be made other than X-A&B, A-B, Smith, and polar display format.
Press ENTER to start isolation calibration	Appears when the **'ISOLATN'** softkey was pressed. Confirm that isolation connection has been made and then press the **ENTER/EXECUTE** key.
Press ENTER to start load calibration	Appears when the **'LOAD'** softkey was pressed. Confirm that load connection has been made and then press the **ENTER/EXECUTE** key.
Press ENTER to start open calibration	Appears when the **'OPEN'** softkey was pressed. Confirm that open connection has been made and then press the **ENTER/EXECUTE** key.
Press ENTER to start short calibration	Appears when the **'SHORT'** softkey was pressed. Confirm that short connection has been made and then press the **ENTER/EXECUTE** key.
Press ENTER to start thru calibration	Appears when the **'THRU'** softkey was pressed. Confirm that through connection has been made and then press the **ENTER/EXECUTE** key.

Press ENTER to start 0S compensation	Appears when the **'0S'** softkey was pressed. Confirm that the 0S connection has been made and then press the **ENTER/EXECUTE** key.
Press ENTER to start 0Ω compensation	Appears when the **'0Ω'** softkey was pressed. Confirm that the 0 Ω connection has been made and then press the **ENTER/EXECUTE** key.
► **Programmed points table empty**	Attempted to use program point measurement, when no sweep points are entered in the programmed points table.
Prog.points measure aborted	Appears when the programmed points measurement was aborted by changing the settings in the program point table.
► **Protect code violation**	Appears when an attempt was made to get a protected file from a disc.

- Q -

There are no messages beginning with Q.

- R -

Message	Description
► **Read data error**	The media is physically or magnetically damaged, and the data cannot be read.
► **Real math overflow**	Overflow has occurred during a 64-Bit floating point computation.
► **Real math underflow**	Underflow has occurred during a 64-Bit floating point computation.
► **Record address error**	Usually indicates a problem with the storage media.
► **Record not found**	Usually indicates that the storage media has not been initialized.
► **RECOVER failed**	Failed to recover a purged file, or there is no file that can be recovered.
► **Recursive call not allowed**	Appears when an attempt is made to recursively call a User Defined Function.
REF value has changed	Display scale REF value was automatically changed order to keep it greater than thee BTM value.

- S -

Message	Description
► **Select o marker mode**	A command which uses the o marker was executed while the o marker is not displayed.
Send P1,P2 to PLOTTER	Appears when the **'SEND P1,P2'** softkey is pressed and the data has been transferred to the plotter.
Short CAL required	Appears when a **short** calibration data measurement is required.
► **Sign must be same in LOG sweep**	Attempted to enter the LOG sweep mode when the START and STOP values are of different polarity.
► **Smith/polar display not allowed**	**'SMITH'** or **'POLAR'** softkey is pressed while in the Spectrum or Impedance configuration.
► **SPAN must be within 26dB in OSC sweep**	Attempted to enter a SPAN value greater than 26 dB (or approximately 20 times) when in the oscillator level sweep mode. When in the oscillator level sweep mode, the sweep span must be less than or equal to 26 dB.
► **Statement too complex**	The statement used in an User Program (ASP) was too complex to calculate.
► **STEP > SPAN error**	Setting error. The STEP value was set larger than the SPAN value while in the Linear sweep mode.
► **String buffer full**	While in an ASP program the number of characters on a program line exceeded 88 characters.
► **Subscript out of range**	An element number less than 1 or greater than 401 was specified when specifying an element of an array register. For example, A(0) is executed on the keyboard input line.
► **Sweep parameter mismatching**	The **'X REG DMP to TBL'** or **'X REG dump'** softkey was pressed when sweep parameter in the X register and the currently set program point sweep parameter are not the same.

► **Sweep point required in freq table**	Appears only when resolution bandwidth data was entered using the **POINT=** command while the program point sweep parameter is frequency. For example, **POINT=,300K** is executed. This syntax can be used for other than frequency sweep.
► **Syntax error in RBW value**	Syntax error existed in the resolution bandwidth entry for the programmed points table.
► **Syntax error in SWEEP POINTS**	Syntax error existed in the sweep point entry for the programmed points table.

- T -

Message	Description
The same sweep point exists	Appears when an attempt is made to enter the same sweep point into a programmed points table. Resolution Bandwidth value is updated, if it is entered.
THRU CAL required	Appears when a **through** calibration data measurement is required.
Toggle type (DEG & RAD appears alternately)	Appears when the **'PHS UNIT deg rad'** softkey was pressed in the program editor mode.
Toggle type (MHZ & V appears alternately)	Appears when the **MHz/V** key was pressed in the program editor mode.
Toggle type (KHZ & DBM appears alternately)	Appears when the **kHz/dBm** key was pressed in the program editor mode.
Toggle type (HZ & DBUV appears alternately)	Appears when the **Hz/µV** key was pressed in the program editor mode.

- U -

Message	Description
UDF editor aborted	Appears when **'EXIT UDF edit'** softkey was pressed while in the User Defined Function Editor mode.

UDF EDITOR (Press ENTER to end definition)	Appears when you enter the User Defined Function editor. Press the **ENTER/EXECUTE** key to complete the definition and exit from the editor. Press the **'EXIT UDF edit'** softkey to not update the definition and exit from the editor.
► **Undefined symbol**	Undefined symbol was detected. Check the 4195A commands, register manes, suffix or math operators.
Unit is cm	Appears when one of the port extension length entry softkeys is pressed.
Unit is msec	Appears when the **'WAIT'** softkey was pressed. The WAIT time is set in units of milliseconds.
Unit is % of frequency span	Appears when the **'APERTURE entry'** softkey was pressed.

- V -

Message	Description
► **Value range error**	Setting error. Value set for math operator was improper.

- W -

Message	Description
► **WAIT syntax error**	User Program (ASP) BASIC statement, **WAIT** syntax error.
► **Write protected**	Attempted to write to a write-protected disc.
► **Write to read only resistor**	Attempted to write to a read-only type register.

- X -

There are no messages beginning with X.

- Y -

There are no messages beginning with Y.

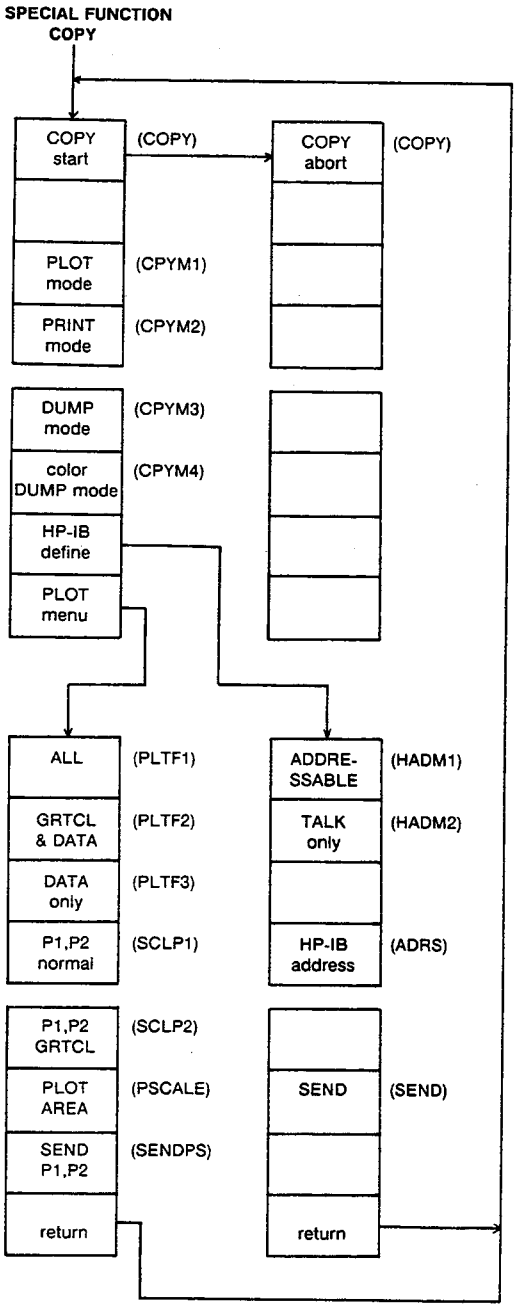
- Z -

Message	Description
► **Zero to negative power**	Exponentiation error, tried to perform a **0**(negative value)** calculation.

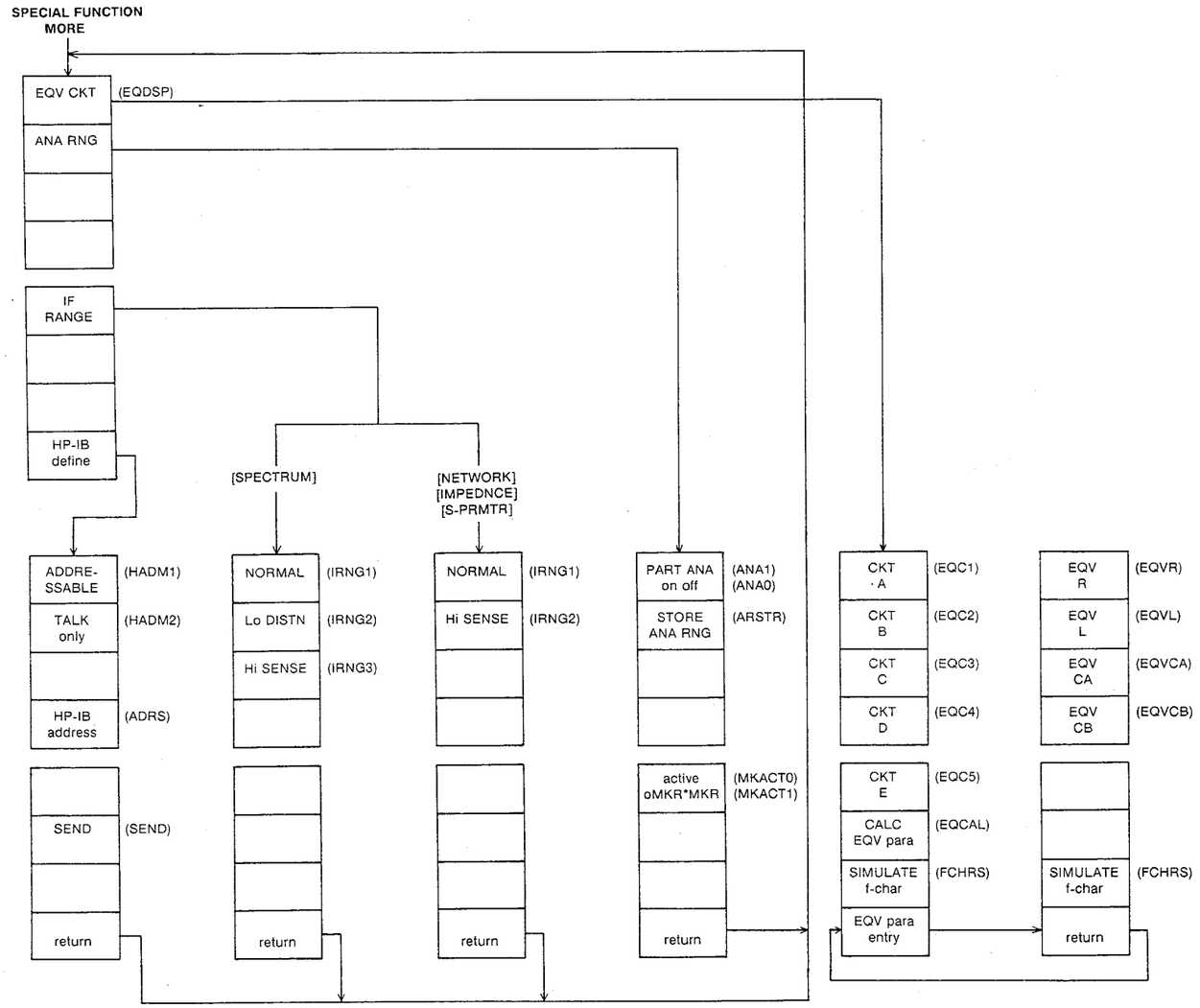
- Others -

Message	Description
0S compen required	Appears when an **0S** compensation data measurement is required.
0Ω compen required	Appears when an **0Ω** compensation data measurement is required.
50Ω=1, 75Ω=2	Appears when the **'Z0 50Ω 75Ω'** softkey was pressed while in the program editor mode.
θ expand mode has released	Appears when the manual sweep mode was selected while in the phase scale expansion mode. The phase expansion measurement mode cannot be selected in the manual sweep mode.
oMKR=1 , LCRS=0	Appears when the **'active oMKRLCURS'** softkey was pressed while in the program editor mode.
oMKR=1 , *MKR=0	Appears when the **'active oMKR*MKR'** softkey was pressed while in the program editor mode.

NOTES



SPECIAL FUNCTION COPY Softkey Tree



SPECIAL FUNCTION MORE Softkey Tree

	CALT3	9	'ONE PORT FULL CAL'	When in Network, S11, or S22 configuration, selects one port full calibration type.
	CALT4	9	'NORMLIZE (THRU)'	When in Network configuration, selects normalize (THROUGH) calibration type.
	CALT5	9	'NORM&ISN CAL'	When in Network configuration, selects normalize & isolation calibration type.
•	CAT	1	'CAT'	Displays micro flexible disc contents file catalog.
►	CHRZ1	9	'Z0 **50Ω** 75Ω'	Selects 50Ω characteristic impedance.
	CHRZ2	9	'Z0 50Ω **75Ω**'	Selects 75Ω characteristic impedance.
	CLS	1	---	Clears the HP-IB status byte.
►	CMPT0	9	'COMPEN NONE'	Turns off impedance compensation.
	CMPT1	9	'0S OFFSET'	Selects only 0S offset compensation.
	CMPT2	9	'0Ω OFFSET'	Selects only 0Ω offset compensation.
	CMPT3	9	'0S&0Ω OFFSET'	Selects both 0S and 0Ω offset compensation.
	CMT	6	'COMMENT'	Displays a character string in the comment area of the CRT.
	CMT?	1	---	Stores the comment contents into the HP-IB output buffer.
•	CONT	1	'CONT'	Continues a paused user program (ASP).
•	COPY	1	'COPY start' 'COPY abort'	Starts or aborts the hard copy operation.
►	CORR0	9	'CORRECTN on **off**'	Turns off correction.
	CORR1	9	'CORRECTN **on** off'	Turns on correction.
	CPL0	9	**AUTO** off	RBW setting is fixed at a specified bandwidth.
►	CPL1	9	**AUTO** on	RBW setting is automatically selected by other settings.

CPYM1	9	'PLOT mode'	Selects plot hard copy mode.
CPYM2	9	'PRINT mode'	Selects print hard copy mode.
► CPYM3	9	'DUMP mode'	Selects raster graphics dump hard copy mode.
CPYM4	9	'color DUMP mode'	Selects color graphics dump hard copy mode.
CRAV	1	'LCURS→ AVRG'	Moves the line cursor to the average value.
CRMN	1	'LCURS→ MIN'	Moves the line cursor to the minimum data value.
CRMX	1	'LCURS→ MAX'	Moves the line cursor to the maximum data value.

- D -

Command	Syntax	Key	Description
DCOFF	1	**OFF/ABORT**	Turns off the dc source.
► DEG	1	'PHS UNIT **deg** rad'	Selects the degree angle mode.
► DELT0	9	'Δmode on **off**'	Turns off the Δmode.
DELT1	9	'Δmode **on** off'	Turns on the Δmode.
DF1	6	'fctn 1'	Defines user defined function #1.
DF2	6	'fctn 2'	Defines user defined function #2.
DF3	6	'fctn 3'	Defines user defined function #3.
DF4	6	'fctn 4'	Defines user defined function #4.
DF5	6	'fctn 5'	Defines user defined function #5.
DFA	6	'fctn A'	Defines the sweep end function #A.
DFB	6	'fctn B'	Defines the sweep end function #B.
DFC	6	'fctn C'	Defines the sweep end function #C.
DISP	7	'DISP'	Displays a character string, **Rn** register data or both on the system message line of the CRT.

APPENDIX F

REGISTER LIST

The HP 4195A's internal registers are listed in this appendix. Data can be read from all of the registers listed here. A black triangle (►) indicates that the resisters are read-only registers.

NOTE

The Multiple Registers are not listed in this appendix but are listed in appendix E. Data cannot be read from the Multiple Registers, so they are treated as commands rather than as registers.

ARRAY REGISTERS

1) DISPLAY/MEASUREMENT REGISTERS

Register	Description
A	The **A** register is a measurement data register and is displayed on the CRT as a bright yellow trace. When the 4195A is making a measurement, the data in register A is updated automatically.
B	The **B** register is a measurement data register and is displayed on the CRT as a bright cyan trace. When the 4195A is making a measurement, the data in register B is updated automatically.
C	The **C** register is a superimpose data register and when selected is displayed on the CRT as an unintensified yellow trace.
D	The **D** register is a superimpose data register and when selected is displayed on the CRT as an unintensified cyan trace.
► **MA**	The **MA** register is a measurement data register for data A. This register is used by the User Math function. This is a **read-only** register.
► **MB**	The **MB** register is a measurement data register for data B. This register is used by the User Math function. This is a **read-only** register.
► **X**	The **X** register stores the sweep point data. Because the data in this register is calculated data, the X register is a **read-only** register.

2) GENERAL PURPOSE REGISTERS

Registers **E, F, G, H, I, J, RA. RB, RC, RD, RE** and **RF** are general purpose registers.

3) CALIBRATION DATA REGISTERS

3-1) S11 and Network-Reflection Calibration

Register	Description
MFOR	The **MFOR** register is used to store the real components of the OPEN termination calibration measurement results.
MFOI	The **MFOI** register is used to store the imaginary components of the OPEN termination calibration measurement results.
MFSR	The **MFSR** register is used to store the real components of the SHORT termination calibration measurement results.
MFSI	The **MFSI** register is used to store the imaginary components of the SHORT termination calibration measurement results.
MFLR	The **MFLR** register is used to store the real components of the LOAD termination calibration measurement results.
MFLI	The **MFLI** register is used to store the imaginary components of the LOAD termination calibration measurement results.
TFOR	The **TFOR** register is used to store the real components of the OPEN termination theoretical calibration data.
TFOI	The **TFOI** register is used to store the imaginary components of the OPEN termination theoretical calibration data.
TFSR	The **TFSR** register is used to store the real components of the SHORT termination theoretical calibration data.
TFSI	The **TFSI** register is used to store the imaginary components of the SHORT termination theoretical calibration data.
TFLR	The **TFLR** register is used to store the real components of the LOAD termination theoretical calibration data.
TFLI	The **TFLI** register is used to store the imaginary components of the LOAD termination theoretical calibration data.

ATT2 The **ATT2** register is used to store the attenuation value for the Channel 2 test input. The range of values which can be stored in this register in an integer from 0 to 50 in steps of 10.

BIAS The **BIAS** register is used to store the value for the dc source output voltage. The range of values which can be stored in this register is from -40 to +40 in steps of 0.01.

BTM The **BTM** register is used to store the bottom of display scale. The range of values which can be stored in this register is from -9.999E+37 to +9.998E+37.

CENTER The **CENTER** register is used to store the sweep parameter's CENTER value. The value range depends on the type of sweep parameter. For example, when in the frequency sweep mode, the range of values for this register is from +0.001 to +500E+06.

DFREQ The **DFREQ** register is used to store the group-delay measurement aperture frequency. The aperture frequency is stored as a percent of frequency span. The range of values which can be stored in this register is from 0.5 to 100.0 in steps of 0.5.

DIV The **DIV** register is used to store the display scale division value. The range of values which can be stored in this register is from +5.000E-36 to +9.999E+37.

DLCURS The **DLCURS** register is used to store the difference value between the o marker (for A or B) and the Line Cursor position (height). The range of values which can be stored in this register is 0 and values between ±1E-37 to ±9.99999E+37.

DMKR The **DMKR** register is used to store the difference value (in the **X** register domain) between the o Marker and the * Marker. The range of values which can be stored in this register is from 0 to the SPAN value.

► **DMKRA** The **DMKRA** register is used to store the difference value (in the **A** register domain) between the o Marker and the * Marker. This is a **read-only** register.

► **DMKRB** The **DMKRB** register is used to store the difference value (in the **B** register domain) between the o Marker and the * Marker. This is a **read-only** register.

EQVCA The **EQVCA** register is used to store the Equivalent Circuit Analysis **Ca** capacitance value. The range of values which can be stored in this register is 0 and the values from ±1E-37 to ±9.99999E+37.

EQVCB The **EQVCB** register is used to store the Equivalent Circuit Analysis **Cb** capacitance value. The range of values which can be stored in this register is 0 and the values from ±1E-37 to ±9.99999E+37.

EQVL The **EQVL** register is used to store the Equivalent Circuit Analysis **L** inductance value. The range of values which can be stored in this register is 0 and the values from ±1E-37 to ±9.99999E+37.

EQVR The **EQVR** register is used to store the Equivalent Circuit Analysis **R** resistance value. The range of values which can be stored in this register is 0 and values from ±1E-37 to ±9.99999E+37.

► **ERR** The **ERR** register is used to store the error number. This is a **read-only** register.

FREQ The **FREQ** register is used to store the measurement frequency value for the DC Bias or OSC Level sweeps. The range of values which can be stored in this register is from +0.001 to +500E+06.

LCURS The **LCURS** register is used to store the line cursor position (height) value. The range of values which can be stored in this register is 0 and values from ±1E-37 to ±9.99999E+37.

►**LCURSL** The **LCURSL** register is used to store the value of the left most intersect point (in the **X** register domain). This is a **read-only** register.

►**LCURSR** The **LCURSR** register is used to store the value of the right most intersect point (in the **X** register domain). This is a **read-only** register.

MANUAL The **MANUAL** register is used to store the manual sweep point value. The range of values which can be stored in this register is from the START value to the STOP value.

MKR The **MKR** register is used to store the value of the o marker position (in the **X** register domain). The range of values which can be stored in this register is from the START value to the STOP value.

► **MKRA** The **MKRA** register is used to store the data A value specified with the o marker. This is a **read-only** register.

► **MKRB** The **MKRB** register is used to store the data B value specified with the o marker. This is a **read-only** register.

NOP The **NOP** register is used to store the number of sweep points. The range of values which can be stored in this register is an integer from 2 to 401.

► **NVAL** The **NVAL** register is used to store the noise value. This is a **read-only** register.

OSC1 The **OSC1** register is used to store the Channel 1 source amplitude value. The range of values which can be stored in this register depends on the amplitude level unit specified. For example, when the unit is dBm, the value range is -50 to +15 in steps of 0.1.

OSC2 The **OSC2** register is used to store the Channel 2 source amplitude value. The range of values which can be stored in this register depends on the amplitude level unit specified. For example, when the unit is dBm, the value range is from -50 to +15 in steps of 0.1.

PEP1 The **PEP1** register is used to store the Channel 1 port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

PEP2 The **PEP2** register is used to store the Channel 2 port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

PER1 The **PER1** register is used to store the Channel 1 reference input port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

PER2 The **PER2** register is used to store the Channel 2 reference input port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

PET1 The **PET1** register is used to store the Channel 1 test input port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

PET2 The **PET2** register is used to store the Channel 2 test input port extension length value in cm. The range of values which can be stored in this register is from -999.99 to +999.99.

► **PI** The **PI** register is used to store the approximate value for π, 3.141 592 653 59. This is a **read-only** register.

PTN The **PTN** register is used to store the program point table number. The range of values which can be stored in this register is an integer from 1 to 4.

► **QV** The **QV** register is used to store the Q value. This is a **read-only** register.

RBW The **RBW** register is used to store the resolution bandwidth setting. The values which can be stored in this register is 3, 10, 30, 100, 300, 1000, 3000, 10000, 30000, 100000, and 300000.

REF The **REF** register is used to store the top of the display scale. The range of values which can be stored in this register is from -9.998E+37 to +9.999E+37.

► **RLOSS** The **RLOSS** register is used to store the Return Loss value displayed on the Polar format display. This is a **read-only** register.

RQS The RQS register is for storing the bit mask data of the HP-IB status byte. The value range is 0 to 255 integer number.

Rn The **Rn** registers are general purpose single registers. Where **n** is 0 to 99. The range of values which can be stored in these registers is 0 and values from ±1E-37 to ±9.99999E+37.

SMKR The **SMKR** register is used to store the value of the ***** marker position (in the **X** register domain). The range of values which can be stored in this register is from the START value to the STOP value.

► **SMKRA** The **SMKRA** register is used to store the data A value specified with the ***** marker. This is a **read-only** register.

► **SMKRB** The **SMKRB** register is used to store the data B value specified with the ***** marker. This is a **read-only** register.

► **SMTHC** The **SMTHC** register is used to store the C (capacitance) value displayed on the Smith Chart display. This is a **read-only** register.

► **SMTHL** The **SMTHL** register is used to store the L (inductance) value displayed on the Smith Chart display. This is a **read-only** register.

► **SMTHR** The **SMTHR** register is used to store the R (resistance) value displayed on the Smith Chart display. This is a **read-only** register.

► **SMTHX** The **SMTHX** register is used to store the X (reactance) value displayed on the Smith Chart display. This is a **read-only** register.

SPAN The **SPAN** register is used to store the sweep parameter SPAN value. The range of values which can be stored in this register depends on the type of sweep parameter selected. For example, when the frequency sweep parameter is selected, the range of values which can be stored in this register is from +0.002 to +499 999 999.999.

ST The **ST** register is used to store the sweep time value.

START The **START** register is used to store the sweep parameter's START value. The range of values which can be stored in this register depends on the sweep parameter selected. For example, when the frequency sweep parameter is selected, the range is from +0.001 to +500E+06.

STEP The **STEP** register is used to store the sweep parameter's STEP value. The range of values which can be stored in this register depends on the sweep parameter selected, and the values previously set for START, STOP, CENTER, SPAN, and NOP.

STOP The **STOP** register is used to store the sweep parameter's CENTER value. The range of values which can be stored in this register depends on the sweep parameter selected. For example, when the frequency sweep parameter is selected, the value range is from +0.001 to +500E+06.

► **VSWR** The **VSWR** register is used to store the VSWR value displayed on the Polar format display. This is a **read-only** register.

► **WID** The **WID** register is used to store the width value (LCURSR minus LCURSL). This is a **read-only** register.

Z The **Z** register is used to store the numeric data value for display on the system message line.

APPENDIX G

INDEX

This appendix lists the keywords described in this manual in alphabetical order, and provides the page **paragraph** numbers where the keyword is explained.

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