HP 8530A Microwave Receiver

User's Guide

HEWLETT PACKARD

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Edition 3

Notice

NOTE: Figure A-1 and Figure A-3 may be photocopied for use by the operator of the HP 8530A. These figures may not be reproduced in other documents.

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Printing History

New editions of this manual will incorporate all material updated since the previous editions. The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

Edition	Date
Edition 1	October 1991
Edition 2	May 1992
Edition 3	October 1993

Manual Applicability

This manual applies directly to HP 8530A Receivers having an HP 85102R IF detector with serial number prefix 3238A or higher, running firmware revision A.01.60

Safety, Warranty, Regulatory Information

Safety, warranty, and regulatory information is supplied in the *HP 8530A Operating and Programming Manual*.

Warning *Before this instrument is switched on*, **make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.**

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

Caution *Before this instrument is switched on*, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Instrument Overview

For more information on instrument controls, refer to “Front Panel Overview” in Chapter 1 and “Front and Rear Panel” (Chapter 3) in the *HP 8530A Operating and Programming Manual.*

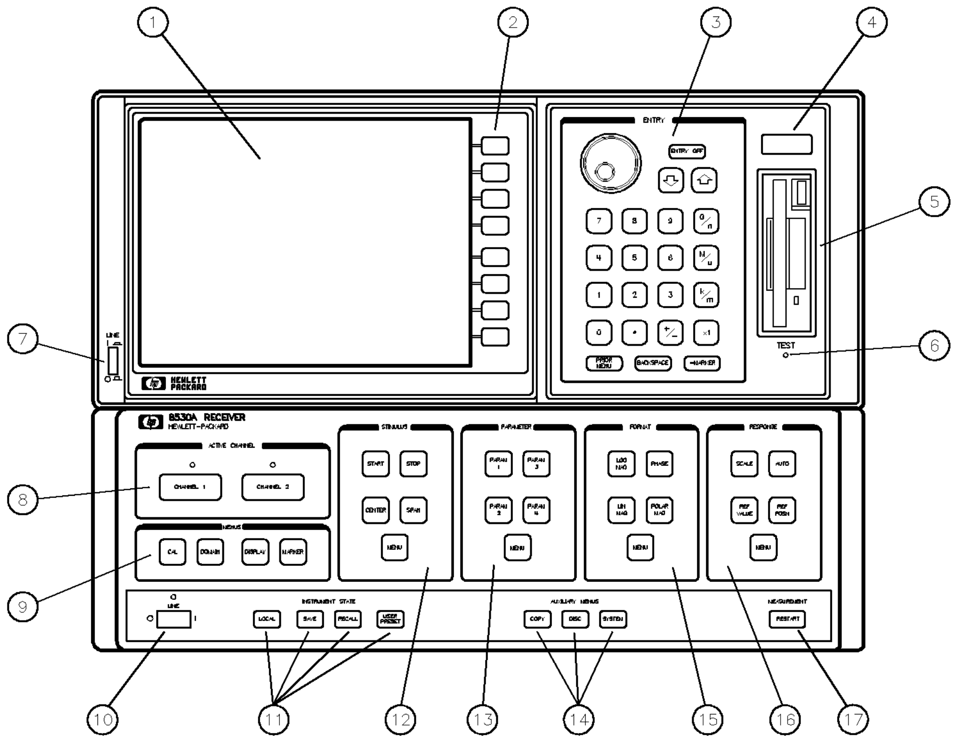


Figure 0-1. Instrument Overview

1. Display

The display shows measurement results and information messages. It also shows the names of display softkeys.

2. Softkeys

Many functions are controlled by softkeys. The title of each softkey is displayed on the display.

3. Entry Block

The entry block allows you to:

- Enter numeric values using the keypad 0 through 9, +/-.
- Terminate values with appropriate units G/n (giga or nano), M/u (mega or micro), k/m (kilo or milli), x1 (basic units),
- Increase or decrease values using the ▲ and ▼ keys, or using the rotary knob.
- Correct errors using the BACKSPACE key.
- Go up one level of softkey menus by pressing PRIOR MENU.
- Turn OFF the active function by pressing ENTRY OFF.

4. Status Display

This diagnostic/status display has the characters R L T S 8 4 2 1 in it. This display shows the HP-IB Remote (R), Listen (L), or Talk (T) status, or shows if a service request “SRQ” has been asserted (S). The numbers are self-test indicators.

5. Disc Drive

The disc drive accepts 3.5 inch DOS or Hewlett-Packard LIF format disks. Either 720 kB or 1.44 MB DOS disks can be used. The HP 8530A can show disc contents, format in DOS or LIF format, delete files, or undelete the last file deleted (undelete works on LIF format discs only).

6. TEST Button

Causes self tests to be performed on the receiver.

7. AC power switch

This switch applies AC power to the Display section (turn this ON after the power switch on the bottom box, see item 10).

8. Channel Select

The two channels make the same measurement, and then split the raw data results into two parallel data processing pathways. Each channel allows you to apply different instrument features independently of the other channel. The final results from each channel can be displayed separately, or they can be overlaid on the same graticule.

9. Menus

Contains several major functions

- [CAL] controls three different types of measurement calibration.
- [DOMAIN] selects Angle, Frequency, or Time Domain operation.
- [DISPLAY] selects how many different measurements to display on the screen at once.
- [MARKER] allows you to use the marker features of the instrument.

10. AC power switch

This switch applies AC power to the bottom section.

11. Instrument State

Contains several functions:

- (LOCAL) allows you to specify the HP-IB addresses of the receiver and "slave" instrument connected to the System Interconnect. (The System Interconnect is the HP 8530A's "personal" HP-IB bus. Any devices connected to it (printers, plotters, RF or LO sources) are controlled exclusively by the HP 8530A.
- (SAVE) and (RECALL) allow you to save current measurement settings to one of eight save/recall registers (for later recall).
- (USER PRESET) any setup you save in save register 8 becomes the "user preset" state. Any time you turn power ON or press (USER PRESET) the settings stored in register 8 are retrieved.

12. Stimulus Block

The stimulus block controls most of the functions associated with the basic measurement setup. Stimulus controls include:

- Measurement start/stop or center/span values for angle, frequency, or time.
- Power levels for RF and LO sources.
- Sweep type (single sweep, continuous sweeps, ramp sweep, step sweep, and more).
- Number of measurement points (in Frequency Domain), or increment angle (in Angle Domain).
- Frequency List mode setup.
- Trigger mode (internal, external, or HP-IB).
- HP 85370A Position Encoder controls.

13. Parameter Block

This block selects which HP 8530A inputs to measure. the main keys (PARAM 1) through (PARAM 4) select different "ratioed" measurements. "Ratio" means that a test and reference signal are measured, and then are mathematically divided together. This method provides very accurate measurement results. Softkey menus under this block's (MENU) key allows you to measure any of the four input lines without ratioing. (This feature allows you to check the signals on the a1, a2, b1, or b2 input lines.)

14. Auxiliary Menu

This area contains three control keys:

- (COPY) allows you to print or plot the measurement results.
- (DISC) allows you to use the disc drive to save or load files, format discs, and perform other disc-related functions.
- (SYSTEM) contains instrument configuration functions. Examples of the type of functions that are controlled are: phase lock, IF calibration, power leveling, and multiple-source setup (used when more than one source is connected to the HP 8530A). The system key also has service menus that are used when troubleshooting the instrument.

15. Format Block

This block allows you to select different display formats such as Cartesian or polar, in linear or log format.

16. Response Block

This block controls the following:

- Display scale
- Position and value of the reference line
- Automatic display scale (autoscale)
- Measurement averaging
- Trace smoothing
- Trace "normalization" (A specific point on the measurement trace is set to 0 dB, and other portions of the trace are displayed relative to that.)
- Magnitude slope and offset control
- Phase offset control
- Coaxial, waveguide, or user-definable electrical delay selection

17. (RESTART)

This key is used when you are making swept measurements. It aborts any measurement that is in progress. If you are using the single sweep mode, (RESTART) can start a new sweep.

Guide to this Manual

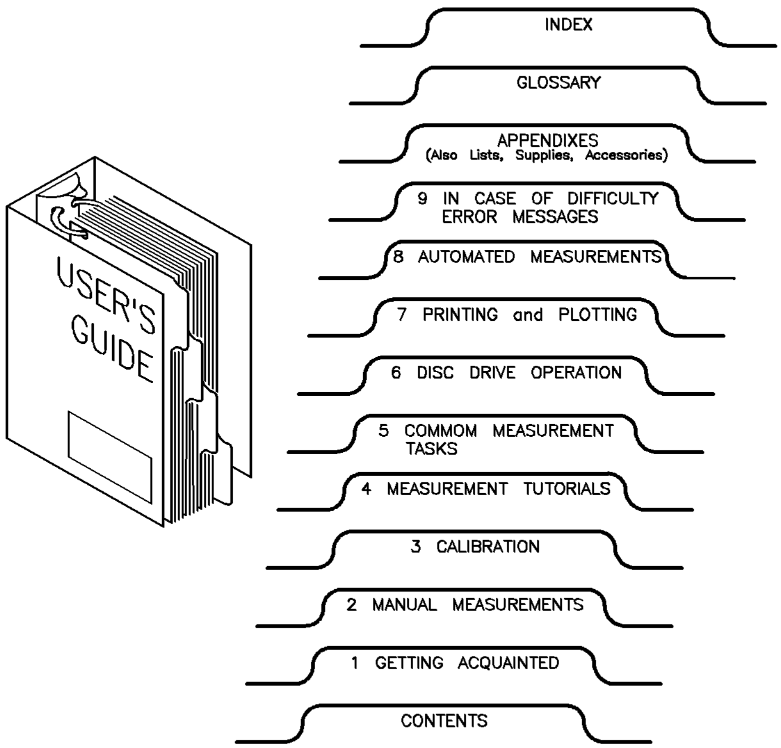


Figure 0-2. Sections in the HP 8530A User's Guide.

Chapter 1. Getting Acquainted with the HP 8530A receiver

Chapter 1 provides a quick overview of the front panel controls, display, rear panel, and HP 8530A features.

Chapter 2. Manual Measurement Examples

Chapter 2 shows very basic antenna and RCS measurement examples.

Chapter 3. Calibration

Chapter 3 describes the calibration features of the HP 8530A, and how to use them.

Chapter 4. Measurement Tutorials

This chapter gives more in-depth information on making measurements. Feature choices are explained so you can customize measurements to suit your needs. This chapter also explains how to use the HP 85370A Position Encoder.

Chapter 5. Common Measurement Tasks

Chapter 5 describes specific measurement tasks such as:

Finding boresight	Using Markers
Determining 3 dB beamwidth	Measuring depth of a null
Displaying data relative to the peak	Displaying more than one trace
Using averaging	Using frequency list mode

Chapter 6. Disc Drive Operation

Explains how to use the built-in disc drive to store and retrieve data, instrument state files, and other types of information.

Chapter 7. Printing and Plotting

Describes how to output screen “snapshots” or tabular data to printer or plotter. A wide range of HP printers and plotters are covered in detail.

Chapter 8. Making Automated Measurements

Chapter 8 explains how to measure up to 5,000 points per second using Fast CW mode, and how to use the Fast IF Multiplexing. (Fast IF multiplexing is similar to Fast CW, but allows the receiver to automatically switch between different input ratios at each angle or frequency point.)

Chapter 9. In Case of Difficulty

This chapter explains:

- How to solve common operation problems
- What to do when specific error messages are displayed on the screen.
- How to solve basic hardware problems.

Appendix A, Optimizing Dynamic Range

Configuring the system for optimum dynamic range entails using the highest RF power settings possible without overdriving the receiver. Appendix A explains how to configure your system so optimum dynamic range is available.

Appendix B, Compatible Instruments and Peripherals

Lists compatible RF and LO sources, frequency converters, positioner controllers, printers, plotters, and monitors.

Appendix C, Supplies, Accessories, After-Sale Options

Lists commonly-needed supplies (plotter pens, paper, discs) and after-purchase options (time domain option, rack-mount hardware, connector savers, and touch-up paint).

Appendix D, Connector Care

Explains connector care techniques and cleaning procedures.

Other Manuals that Come with the HP 8530A

The following manuals are supplied with the HP 8530A:

Operating and Programming Manual

The Operating and Programming manual serves two purposes:

- It provides in-depth reference information on front panel features, organized around the front panel functional blocks.
- It provides tutorial information on remote programming, with many HP BASIC examples.

Keyword Dictionary

The Keyword Dictionary explains:

- The function of each front panel key or display softkey, organized by key/softkey name.
- What each HP-IB programming code does, including syntax and programming sequence details.

Front panel key/softkey and programming code descriptions coexist in the same section, in alphabetical order.

On-Site Service Manual

The On-Site Service Manual contains:

- Installation
- Troubleshooting
- Performance tests and specifications

Typeface Conventions

Bold	Bold type is used for terms that are listed in the glossary.
Italics	Italic type is used for emphasis and for the titles of manuals and other publications. It is also used when describing a computer *variable*.
`Computer`	Computer type is used to depict HP-IB commands.
Display	Display type is used to show messages which are displayed on the receiver's display.
(Front Panel Keys)	Front panel keys are enclosed in boxes.
Soft Keys	Soft keys are the keys on the right-hand side of the display. The function of these keys changes depending on the menu you are in.

1

Getting Acquainted with the HP 8530A Receiver

Chapter Contents

- Product Description
- Receiver Performance
- Measurement Features
- Input/Output Features
- Principles of Operation
- Front Panel Overview

Product Description

The HP 8530A is a high-performance receiver that has been designed specifically for antenna and radar cross section (RCS) measurements.

The HP 8530A allows you to make angle-scan and frequency-scan measurements of antennas, or make RCS measurements using the time domain feature.

Very fast measurement speeds are possible with the HP 8530A. By using a computer controller, the receiver can measure up to 5,000 data points per second.

The receiver has very high sensitivity and dynamic range. The HP 8530A provides a large amount of measurement flexibility, providing the features you need for many different types of measurements.

The HP 8530A must be used with a frequency down converter. The following HP down converters are supported:

- HP 8511A/B frequency converter
- HP 85310A distributed frequency converter
- HP 85325 millimeter wave subsystems (the HP 85325A and HP 85309A, used together, make a complete frequency converter system).

These products down-convert microwave (or millimeter) signals to 20 MHz test and reference signals that are measured by the HP 8530A. Figure 1-1 shows the basic block diagram of an antenna measurement system.

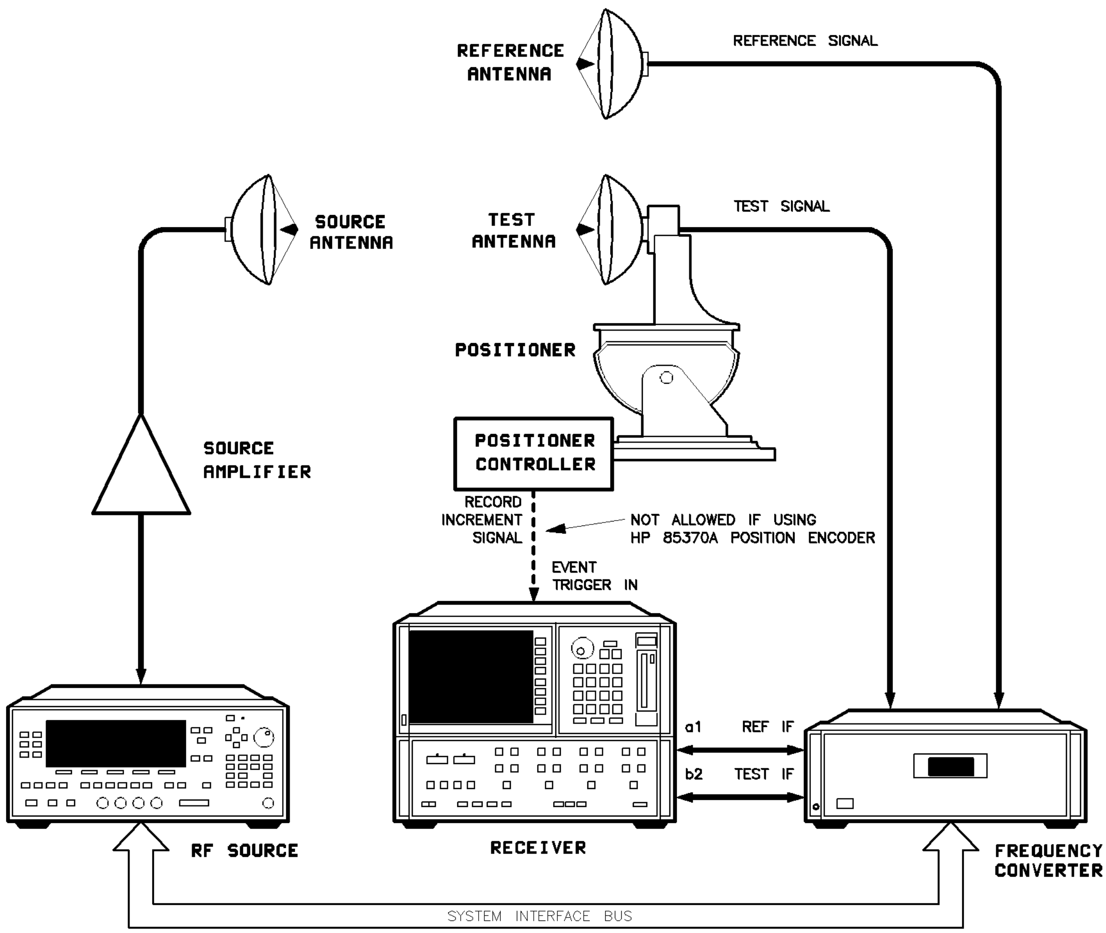


Figure 1-1. Basic Antenna Measurement Block Diagram

Receiver Performance

The most important feature of the HP 8530A is the accuracy and speed with which it makes measurements. The important performance features are:

- Excellent sensitivity.
- Excellent linearity over a wide dynamic range.
- High speed data acquisition capability.

Sensitivity

The foundation of good system performance and high speed is sensitivity—the ability to measure very small signals. Excellent sensitivity is only possible in systems that have very low noise. When used with the HP 85310A frequency converter, the HP 8530 can measure signals of −113 dBm from 3 to 18 GHz, and −96 dBm from 18 to 26.5 GHz. Excellent sensitivity improves the signal-to-noise ratio of your system, allowing you to measure smaller signals more quickly, and with greater accuracy.

Linearity over a Wide Dynamic Range

Accuracy errors can occur when the power from the test antenna varies in signal level. For example, assume that a test antenna has a bore-sight measurement of 0 dBi (−20 dBm) and an off-axis null of −50 dBi (−70 dBm). This is a difference of 50 dB. The HP 8530A receiver has 0.03 dB of error in this case. Even with a 60 dB difference the HP 8530A has less than 0.04 dB of error due to linearity. This specification is called "dynamic accuracy."

Fast Measurement Speed

The HP 8530 can measure 5000 points per second. As mentioned earlier, averaging slows measurement speed. Because of the HP 8530A's excellent performance, you will need less averaging, and can make faster measurements, than you would when using a receiver with less performance.

High speed measurements are performed using the "Fast CW" mode, and must be done through computer control.

Measurement Features

The major *operational* features of the HP 8530A are listed below:

Angle Domain

Allows you to make angle scan measurements at a single frequency. In Angle Domain mode, the x-axis of the display is angular degrees. You can measure a single angle, or a range of angles. If you DO NOT have an HP 85370A Position Encoder, use external triggering (HP-IB or TTL) in this mode. If you use the HP 85370A Position Encoder, use internal triggering mode.

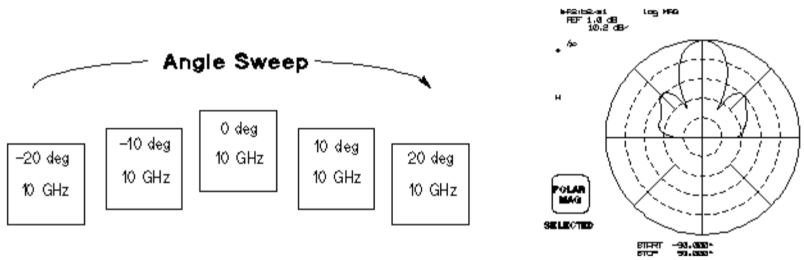


Figure 1-2. Angle Domain

Frequency Domain

Allows you to measure antenna magnitude and phase performance across one or more frequencies. Frequency Domain measurements must be made at a single *angle*. In Frequency Domain mode, the x-axis of the display is frequency. Internal triggering is commonly used when measuring frequency, but external triggering can be used as well. You can measure a single frequency, or choose from Ramp, Step or Frequency List sweep modes.

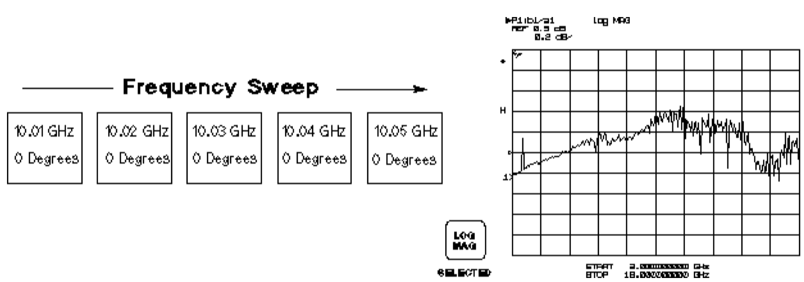


Figure 1-3. Frequency Domain

Time Domain

This optional feature allows you to make RCS measurements or see the time response of an antenna (time is shown on the displays x-axis). One use of time domain is when measuring multi-path range reflections. Internal triggering is usually used in this mode.

Time domain data is mathematically calculated from Frequency Domain data. This is done using the “chirp-Z” inverse Fourier transform. Therefore, the first step in time domain measurements is to make a measurement in the Frequency Domain.

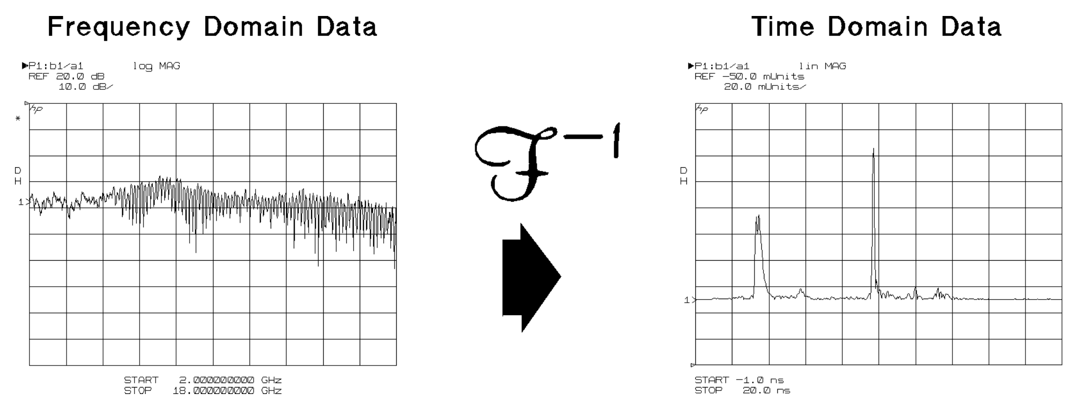


Figure 1-4. Time Domain

Calibration

Antenna calibration provides accurate gain and frequency response measurements by calibrating your range against a standard gain antenna. Also, the isolation calibration feature reduces measurement errors caused by signal crosstalk.

A “network analyzer” calibration is also provided. This calibration is used if you want to make network analyzer-type measurements. For example, assume you want to measure the impedance of an antenna input (or output). You would perform the network analyzer calibration so you could make very accurate measurements. In this example a directional coupler is required to measure the reflected signals.

Four Measurement Inputs

The receiver has four inputs for receiving signals (a1, a2, b1 and b2). You must input a reference signal into a1 or a2. Then, any other inputs can be used as test signal inputs. For example, assume you input the reference signal into a1. You could then use a2, b1, or b2 to carry test signals. The “PARAM” keys, described below, select which inputs to ratio together for your measurement.

Selectable Input Ratios

[PARAM 1], [PARAM 2], [PARAM 3], and [PARAM 4], select a specific pair of inputs to ratio and measure. (“PARAM” is short for “parameter.”) For example, [PARAM 1] mathematically divides (ratios) input b1 data by a1 data. You can redefine the PARAM keys so they ratio any two inputs you desire. You can also measure a single input without ratioing.

Flexible Triggering

The HP 8530A provides three ways of triggering measurements:

Internal	When in Internal trigger mode, the receiver does not require any external or HP-IB triggering. This is useful when making frequency measurements, or when using the HP 85370A Position Encoder.
External Triggering	Allows you to trigger measurements using a TTL increment signal produced by a positioner controller. This allows the receiver to take data when the positioner is aligned with each measurement angle.
HP-IB Triggering	Allows a computer to trigger a measurement by issuing a GET command over the HP-IB bus.

Save/Recall Registers

The receiver has eight Save/Recall registers. Each can save current measurement settings for instant recall at a later time. Register 8 is the "User Preset" register. Settings saved under register 8 become active whenever you turn the receiver ON, or when you press (USER PRESET).

Measure Performance Relative to the Peak of the Main Lobe

The Normalize Trace function sets the peak of the main lobe (the data point of highest amplitude) to 0 dB. You can then use markers to view trace magnitude values relative to this reference point. When data is saved, printed, plotted, or output to computer, magnitude values will be relative to the peak.

Remote Programming

The HP 8530A can be controlled remotely from any computer that can communicate using HP-IB. All front panel features are supported. You can query the analyzer to determine current modes of operation and current instrument or system status.

Data Presentation Features

The HP 8530A can show measurement results right on its display. It can display:

- Antenna patterns
- Frequency response measurements
- Time domain
- Radar Cross Section (RCS) frequency and time domain measurements

The HP 8530A allows you to print or plot measurement results.

Display Formats

You can select logarithmic or linear magnitude display formats (Cartesian or polar), or phase display format (Cartesian only). You can display one, two, or four parameters simultaneously on the screen.

Multiple Measurements Can be Shown Simultaneously

The HP 8530A allows you to view up to four parameters at once, in split or overlay presentation. Alternatively, you can display one parameter from each of the independent measurement channels (more on channels is explained later).

Trace Memory and Trace Math

The trace memory feature is similar to the storage feature in a storage oscilloscope. You can store the current data trace to memory, then compare it to subsequent measurement traces. Trace math features allow you to perform vector addition, subtraction, multiplication, and division. These operations are performed using the current data trace and the memory trace. Each parameter has independent trace memory/math operation. In addition, trace math in Channel 1 is independent from trace math in Channel 2.

Markers Display Precise Values for Any Point on display Traces

Five measurement markers give detailed information about any point on the measurement trace. Delta markers allow you to show the difference in amplitude, phase, angle, or time between any two points on the screen.

External Video Monitor

The HP 8530A can display results on an external multisync monitor. Refer to Appendix B for details.

Optional Network Analysis

Option 011 adds high-performance vector network analysis features (HP 8510C operation). This allows you to measure the transmission and reflection properties of microwave devices in frequency or optional time domains. These advanced calibration features provide optimum accuracy in S-Parameter network measurements.

Input/Output Features

The HP 8530A can control other instruments, and has many input/output capabilities using HP-IB, System Bus, RS-232, external monitor interface, and TTL BNCs.

Printing and Plotting Features

The HP 8530A can output data to a wide range of HP-IB or RS-232 printers or plotters. Laser printers are also supported.

Many Supported Peripherals

The HP 8530A can control RF and LO signal sources, frequency converters, and large external display monitors. Refer to Appendix B for details.

Built In Disc Drive

The built in disc drive allows you to save measurement data, data from memory, instrument configuration setups, save/recall registers, calibration data, or user-created graphics. Both DOS and LIF disc formats are supported, and both disc types are automatically recognized. DOS format is compatible with MS-DOS® based computers, such as IBM PCs and compatibles. LIF format is compatible with Hewlett-Packard computers, such as the HP 9000 Series 300 workstation family.

Principles of Operation

This information is provided so you can have a better understanding of how the HP 8530A makes measurements. If desired, you can skip this section and come back to it when convenient.

Description of the HP 8530A

A simplified block diagram of the HP 8530A receiver is shown in Figure 1-5. It is a high performance vector receiver with four inputs, two independent digital processing channels, and an internal microcomputer that controls measurement, digital processing, and input/output operations. Examples of "digital processing" are features such as averaging, time domain, calibration, and so on. A special System Bus gives the receiver complete control over the RF source and, if required, LO source. This interface allows the receiver to make hard copy outputs to HP-IB compatible printers or plotters. Two RS-232 ports are also supplied for printing or plotting.

The system must contain a frequency converter, which down converts the RF measurement frequencies to a 20 MHz IF. The HP 8530A requires this frequency for its inputs. To create the IF frequency, the HP 8511A/B frequency converter uses a built-in local oscillator. The built-in LO is digitally tuned by the HP 8530A. This digital tuning data is sent over the "Test Set Interconnect" that links the HP 8530A and the HP 8511A/B. The local oscillator mixes the measurement signals with a similar frequency that is offset by 20 MHz. The result is the 20 MHz IF signal. Other down converters, such as the HP 85310A, require another source to supply an LO signal. The HP 8530A tunes external LO sources with HP-IB commands sent over the System Bus.

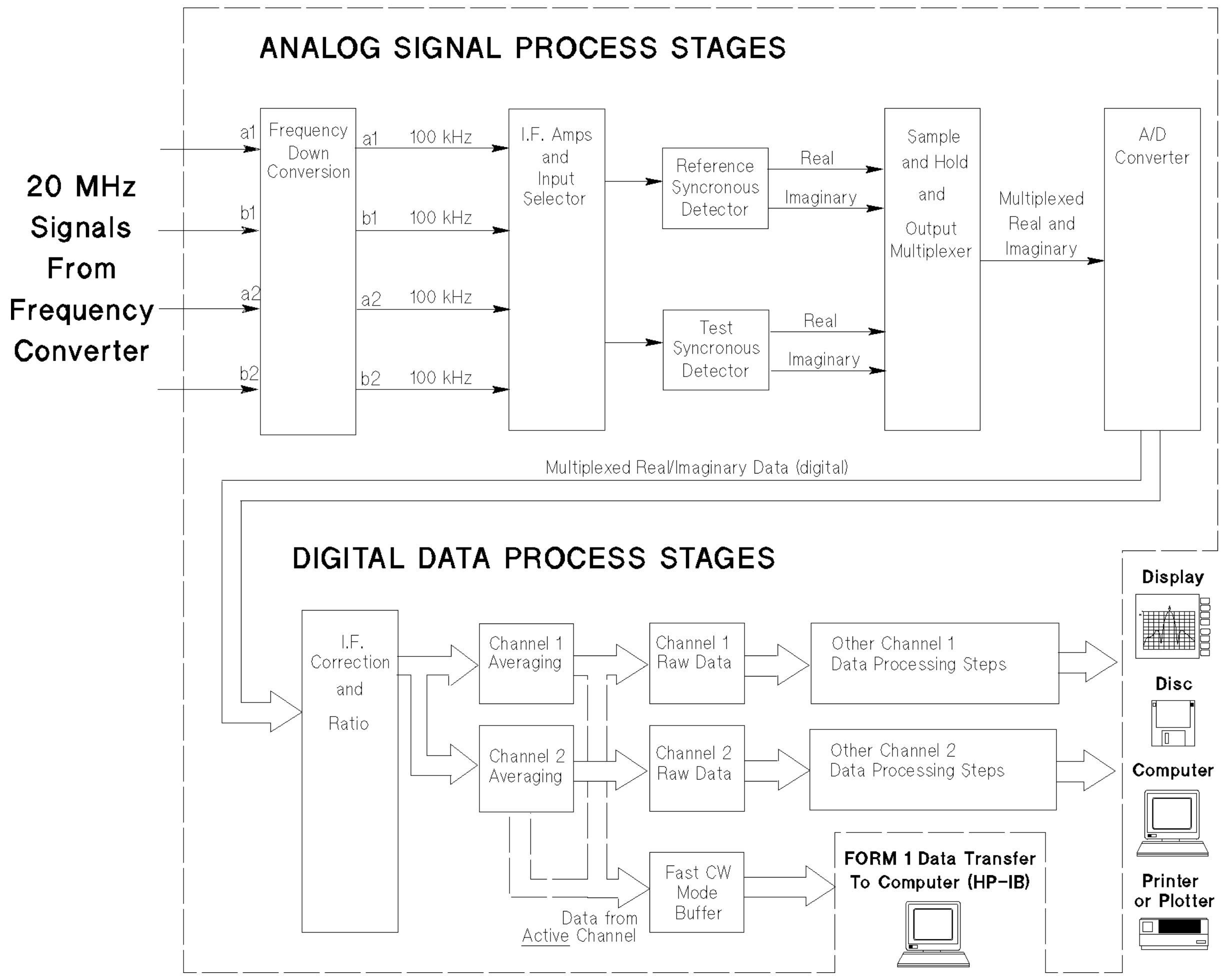


Figure 1-5. HP 8530A Measurement Data Flow Diagram

The HP 8530 has two main sections: Analog: In the first main section, analog circuitry detects the real (x) and imaginary (y) values of the input signals. The real,imaginary values are then converted into digital values.

Digital: In the second main section, the microprocessor takes the digital data and performs any desired data processing (averaging, calibration, time domain, and so on). The instrument then displays the results in any format you choose. You can then output the results to printer, plotter, disc, or external computer. There are two identical digital processing paths, called Channel 1 and Channel 2. You can have different features turned ON in the two channels, and view the different results. You can show the results of both channels on the screen at the same time.

Analog Signal Process Stages

During a typical Frequency Domain measurement, the test signal source is swept from a lower to a higher frequency.

During a typical Angle Domain measurement, a single frequency can be measured while the antenna-under-test is moved around one axis.

Initially, the HP 8530A receives up to four 20 MHz signals from the external frequency converter. The receiver separately down converts each signal to a 100 kHz IF carrier frequency that can be used by the detection circuitry. Because frequency conversions are phase coherent, and the IF signal paths are carefully matched, magnitude and phase relationships between the input signals are maintained throughout the frequency conversion and detection stages. Automatic, fully-calibrated autoranging IF gain stages maintain the IF signal at optimum levels for detection over a wide dynamic range.

Each measurement channel can use input a1 or a2 as the reference signal. The selected input is also used as the phase-lock reference.

Note In hardware gating applications, the pulsed reference signal may not be suitable for phase locking. In this case, you can use the other reference input for phase locking. For example, assume your pulsed reference is on input a1, you can use a2 as the phase lock reference. To accomplish this, press RESPONSE (MENU) `REDEFINE PARAMETERS` `PHASE LOCK` `a2`.

Any of the three remaining inputs can be used as test inputs.

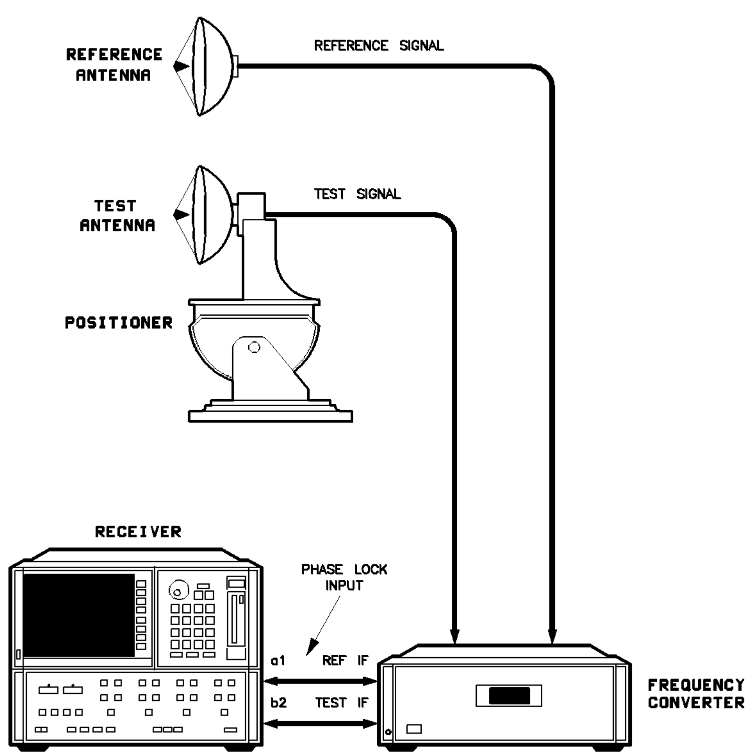


Figure 1-6. Phase Lock Reference

The input selector sends one test signal and one reference signal to the synchronous detectors. When these are measured the input selector sends the other test/reference signals.

The synchronous detectors develop the real (x) and imaginary (y) parts of the test or reference signal by comparing the input to an internally-generated 100 kHz sine wave. This method practically eliminates drift, offsets, and circularity errors as sources of measurement uncertainty. Each x,y pair is sequentially converted to digital values which are sent to the main microprocessor.

Digital Data Process Stages

Digital signal processing proceeds under the control of the receiver's firmware operating system executed by the main microprocessor.

About the Main Microprocessor

The main microprocessor is a 32-bit Motorola 68020 microprocessor running at a clock speed of 16 MHz. The firmware operating system takes advantage of multi-tasking software architecture and several distributed processors to provide very fast data acquisition and display update speed.

Raw Data Stages

The microprocessor accepts the digitized real and imaginary data, and corrects IF gain and quadrature errors before any other data processing is done. The calibration coefficients used in the IF correction stage are calculated periodically with an automatic self-calibration. This automatic feature is different from the user calibration features, and cannot be controlled in any way by the user.

Next, the inputs are ratioed together and identical copies of the data are sent to independent Channel 1 and Channel 2 data processing paths.

Now, any selected averaging is performed on Channel 1 or Channel 2. If the Fast CW mode is in use, data is sent to the Fast CW buffer from the *active channel*. If Fast CW mode is not being used, Channel 1 averaged data is stored in the Channel 1 raw data array. Similarly, Channel 2 averaged data is stored in the Channel 2 raw data array.

Data "arrays" are data holding locations. A data array holds one X,Y data pair in a special compressed data format called "Form 1." This format is described in the *HP 8530A Keyword Dictionary*. The Fast CW buffer can send data to computer if you are using the Fast CW mode. The buffer contains up to 100,000 X,Y data pairs in Form 1 format.

Other Digital Processing Stages

Channel 1 and 2 data processing proceeds independently through subsequent data processing steps. Different measurement features can be used in each channel, causing the measurement results to be processed and shown in different ways. These features are the "Other Data Processing" steps shown in Figure 1-5, and include calibration, Time Domain, display format, and so on. For example, you can select Time Domain in Channel 2, and select Frequency Domain in Channel 1. This allows you to make two different types of measurements on the same device, and display the results simultaneously.

More information on the "other" data processing steps is provided in "Standard Automated Operation," later in this guide.

Front Panel Overview

This section describes the receiver's display and the purpose of the major control blocks. Note that you can press any key, at any time, and in any sequence without fear of damaging the system.

Display

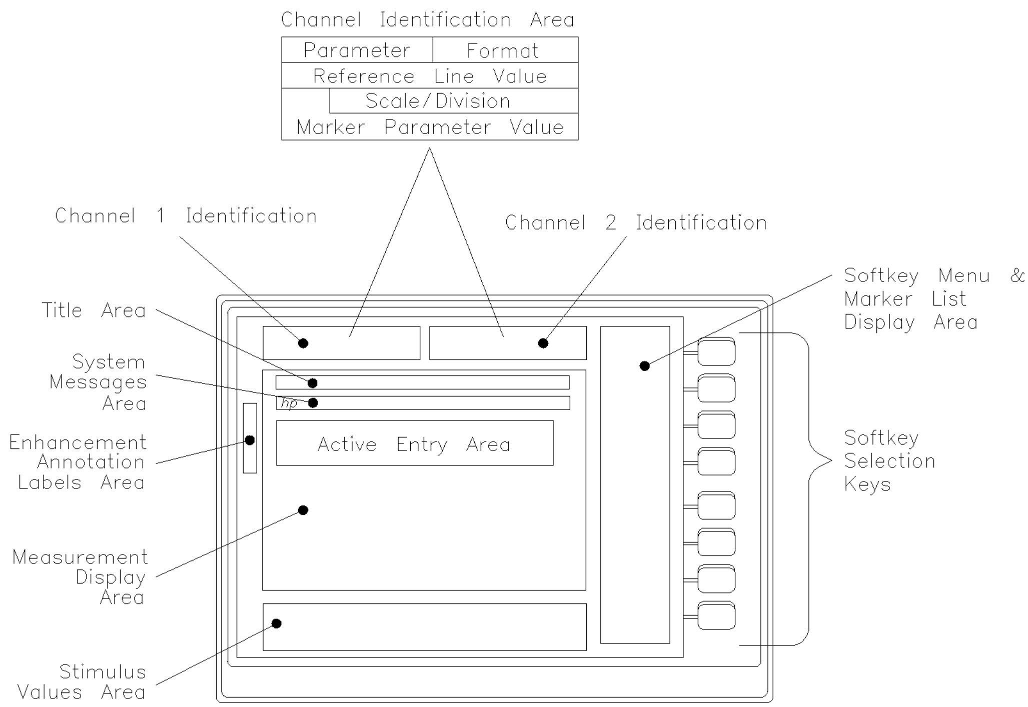
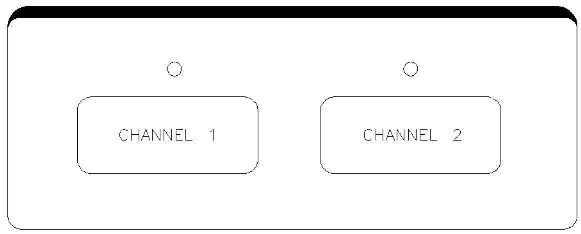


Figure 1-7.

The display shows measurement results and softkey menus. It also shows you the current measurement settings. Various types of screen messages always show up in the same areas on the display. Figure 1-7 shows the areas in which specific types of messages appear.

As you read this section press the described keys on the HP 8530A.

Channel Selection

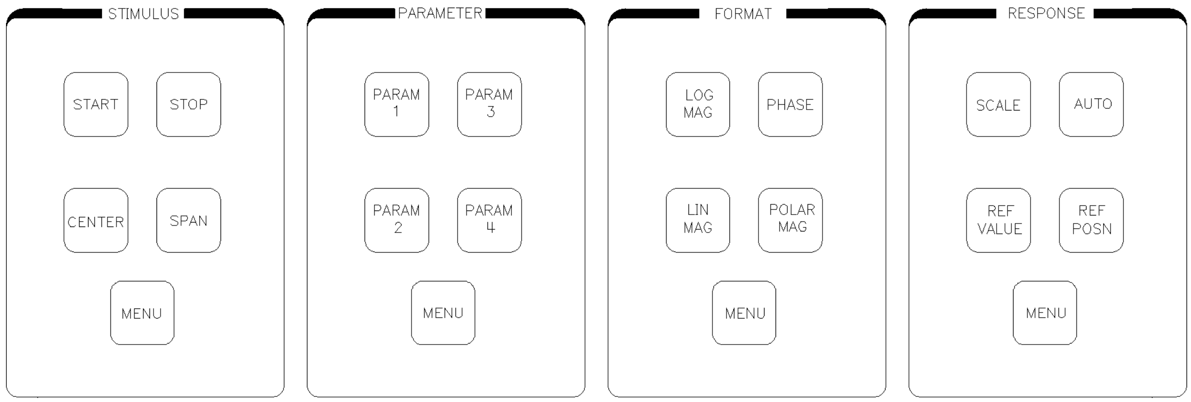


The receiver has two separate, identical measurement channels. The channel feature is much like having two HP 8530 receivers setting next to one another.

Channel 1 and 2 can have different PARAMETER, FORMAT, or RESPONSE settings, in addition, you can select Time Domain on one channel, and Frequency Domain on the other: *For example, you could set Channel 1 to Frequency Domain, PARAM 1. Then you could set Channel 2 to Time Domain, PARAM 2.* The receiver will measure each channel and display the data. You can view the data separately (by changing channel), or you can display both sets of data side-by-side (dual channel split) or superimposed (dual channel overlay).

Many "stimulus" settings (such as RF power; start, stop, increment angle; start, stop, or CW frequency, number of points, and so on) are "coupled." If a stimulus feature is "coupled," you cannot choose different settings for Channel 1 versus Channel 2. If a stimulus feature is "uncoupled," you can choose different settings in the two channels. If you want to know whether a specific feature is coupled or uncoupled, look it up in the keyword dictionary.

Basic Measurement Functions



Four of the main control blocks on the front panel are STIMULUS, PARAMETER, FORMAT, and RESPONSE. These are described below:

STIMULUS — This block lets you select RF power levels, and desired frequency and angle settings. It also controls how you can trigger the instrument to take each point of data. For example, you can trigger off the Record Increment pulses (coming into the receiver's EVENT TRIGGER jack from the positioner controller) by selecting EXTERNAL trigger. Alternatively, you can trigger over HP-IB using the GET command.

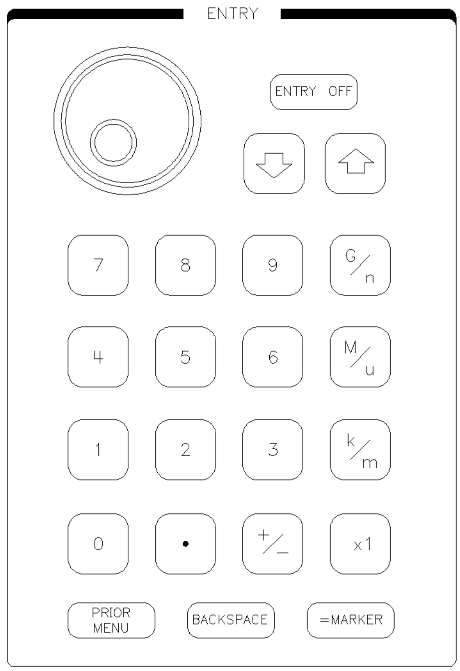
PARAMETER — The PARAMETER block contains the predefined input ratio keys (PARAM 1) (b1/a1), (PARAM 2) (b1/a2), (PARAM 3) (b2/a1), and (PARAM 4) (b1/a1). The normal measurement mode for the receiver is to mathematically ratio (divide) the data from the test and reference antennas. Ratioed measurements reduce most errors caused by the range, and shows the actual performance of the Antenna Under Test. You can redefine any of the parameter keys to ratio any two inputs you desire. You can also look at any single input using the SERVICE 1 a1 through SERVICE 4 b1 softkeys.

FORMAT — Format keys let you choose how the data is displayed on the screen. You can select logarithmic magnitude ((LOG MAG)), linear magnitude ((LIN MAG)), phase ((PHASE)), polar logarithmic magnitude ((POLAR MAG)), and polar linear magnitude (LINEAR ON POLAR, located under the FORMAT MENU key)

RESPONSE — The response block keys let you to set the display scale and reference line. Functions under the MENU key let you turn on averaging and normalization. (Normalization allows you to set the peak of the main lobe to 0 dBi and measure other parts of the trace relative to the peak.)

Each major control block has functions that are not mentioned here. Refer to Chapter 6, 7, 8, and 9 in the *HP 8530A Operating and Programming Manual* for descriptions of these features. Many features are described in this User's Guide.

ENTRY Block



In some cases it is necessary to supply numeric values for a specific function, such as angle or frequency. The 10 digit keypad is used to supply these values. The keys to the right of the digits terminate the value with the appropriate units. Use (G/n) (Giga/nano), (M/μ) (Mega/micro), (k/m) (kilo/milli) and (x1) (basic units: dB, dBm, degrees, seconds, Hz) as applicable. In addition to entering data with the keypad, the knob can be used to make continuous adjustments, while the ▲ and ▼ keys allow values to be changed in steps.

Changing Values Using the Numeric Keypad

To change a value using the numeric keypad:

1. Select the function (start angle, frequency, or any other function that requires a value). This function becomes the "active function."
2. Enter the new value using numeric, decimal, and the (+/−) toggle. (+/−) changes the sign of the number. If you make a mistake, press the (BACKSPACE) key. (If you have already pressed a terminator key, you must re-enter the entire value).
3. Terminate the entry with the appropriate units.

Table 1-1. Numeric Value Terminator Key Usage

Key Name	Angle	Frequency	Power	Power Slope	Time
G/n	–	GHz	–	–	ns
M/μ	–	MHz	–	–	μs
k/m	milli degrees	kHz	–	–	ms
x1[1]	degrees	Hz	dBm	dB/Ghz	s

1 (x1) always represents single units.

Other Keys in the Entry Block

(PRIOR MENU) takes you to the previous softkey menu.

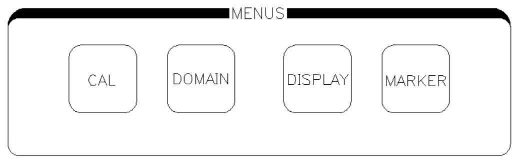
(=MARKER) can be useful when you are using markers. The easiest way to explain what (=MARKER) does is by example. Assume you are making a frequency response measurement, and the last marker you moved (the active marker) is sitting at 11 GHz. Now assume you want to change the start frequency to 11 GHz. All you need to do is press (START) (=MARKER). The marker position (11 GHz) will become the start frequency.

You could have set the stop frequency to 11 GHz by pressing (STOP) (=MARKER).

Another way to use (=MARKER) is to transfer the marker *value* to another function. As an example, assume you want to set the display reference line to the value of the active marker (for example, assume the marker value is −13.2 dB). Press (REF VALUE) (=MARKER), and the display reference line will change to the value of the active marker.

(ENTRY OFF) removes old error messages or active function text from the screen. "Active function text" are messages like START −90° that appear when you changed the value of a function.

MENUS Block



The four keys under MENUS are CAL, DOMAIN, DISPLAY, and MARKER:

CAL
: Softkeys under CAL allow you to perform an antenna, radar cross section (RCS) or limited network analyzer calibration.

DOMAIN
: The HP 8530 has three modes of operation, called domains. These are the Frequency, Angle, and optional Time Domain.

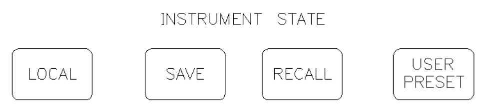
DISPLAY
: Softkeys under DISPLAY:

- Place one, two, or four parameter measurements on the screen at once.
- Saves the data trace to temporary storage memory.
- Displays memory traces.
- Performs trace math functions on memory traces.
- Allows you to change display intensity or colors.
- Allows you to choose video settings for an external monitor.

MARKER
: Softkeys under MARKER allow you to activate up to five markers. Each marker shows amplitude or phase values for a desired point on the measurement trace. Marker Functions are:

- Simple markers on the display trace.
- $\triangle$ marker mode.
- Marker search modes.
- Marker list modes.

INSTRUMENT STATE Block



The four keys in the INSTRUMENT STATE block are LOCAL, SAVE, RECALL, and USER PRESET.

The LOCAL key has two uses:

- If you are controlling the receiver with a computer, the front panel keys will not respond to touch. Pressing LOCAL returns control to you.
- LOCAL also allows you to examine or change HP-IB addresses the receiver uses to control peripherals and other instruments.

SAVE and RECALL allow you to save and recall up to eight different measurement setups ("instrument states"). You can also save your current setup as the "USER PRESET" state by saving it to register 8. The receiver will return to that state whenever the instrument is turned on, or if you press USER PRESET.

A **state** is defined as the condition of all current measurement settings, including all domain, stimulus, parameter, format, and response settings.

AUXILIARY MENUS Block

The "AUXILIARY MENUS" contain the (COPY), (DISC), and (SYSTEM) keys.

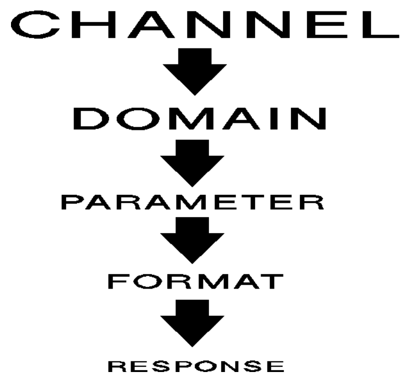
(COPY) controls hardcopy output, either printing or plotting.

(DISC) controls saving, loading, viewing, or deleting disc files. You can also format floppy discs, or select an external disc drive.

(SYSTEM) menus control internal functions of the HP 8530. For example, you can select normal or wide IF bandwidth, or control phase locking.

If using remote mixers, you can control the RF-to-LO frequency ratio (to select the desired harmonic mode) using the Multiple-Source menu.

Automatic Recall of Instrument Settings



The receiver *automatically* remembers most measurement settings. When you switch back and forth between channels, domains, parameters, or display formats, the receiver automatically remembers all the lower-level settings you used last. (This feature remembers all measurement settings *except* stimulus settings.) This feature is automatic, and does not require you to use the Save or Recall functions. This ability to remember previous settings is called "limited instrument state memory."

This feature works by assigning a hierarchy to the instrument settings. Here is the hierarchy:

- Channel (1 or 2)
- Domain (Frequency, Angle, or Time)
- Parameter (1, 2, 3, or 4)
- Format (any display format)
- Response (scale and reference line)

Every mode in the above list *remembers* all settings you make that are lower in the hierarchy. For example, assume you choose the following measurement settings.

Channel 1
Angle Domain
Parameter 3
Log mag (format)
Reference −10 dB
Scale 5 dB/div

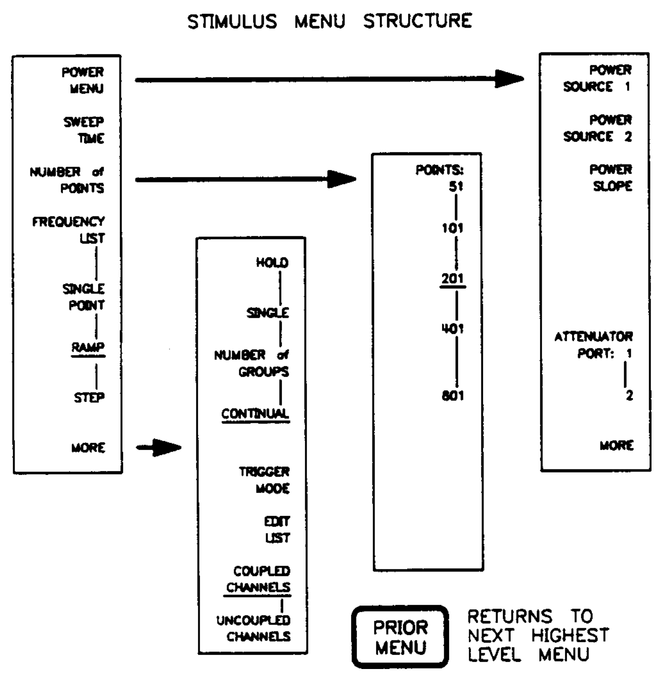
Now you go to Channel 2 and make completely different settings.

When you reactivate Channel 1, the settings shown above will automatically resume. This hierarchical memory applies to all the controls in the above list.

The Added Benefit of the SAVE/RECALL feature

Stimulus settings are not part of the hierarchical memory explained above. To save stimulus settings along with all the other settings, you must use the SAVE/RECALL feature. Another advantage is that saved instrument states can be stored to disc.

Typical Softkey Menu Structure



Each of the function blocks contain a (MENU) key that presents softkey menus on the screen. Each menu contains up to eight selections, each corresponding to one of the unlabeled keys on the side of the display. Press the softkey to the right of the function you want to select. Every softkey, when pressed, either activates the function, or presents the next level of menu choices.

2

Manual Measurement Examples

This chapter gives basic examples of antenna and RCS measurements. The intent is to show you the overall steps involved in making a measurement, but not to go into great depth on measurement choices. This chapter also explains simple (but very useful) tasks such as using markers, finding depth of a null, determining beam width, and displaying more than one parameter.

After you become familiar with the concepts presented in this chapter, you can read Chapter 4 to learn more advanced measurement skills.

Chapter Contents

Definitions of Important Terms

It is important that you understand the definition of the following terms *as they relate to the HP 8530A*.

Channel The receiver has two separate, identical measurement **channels**. The channel feature is like having two HP 8530 receivers setting next to one another. When the receiver measures raw data, it makes two identical copies. Each copy is sent through parallel (identical) data processing paths. Such features as calibration, Time Domain, display formatting, and trace math can be performed on one or both paths. Each of the two channels correspond to one of the data processing paths (refer to Figure 1-5). When you press the (CHANNEL 1) or (CHANNEL 2) key, you make that channel the "active channel." Any subsequent changes you make to measurement settings will affect that channel.

Input Refers to the four HP 8530A signal inputs (a1, a2, b1, and b2). The term "input" is also used when referring to the signal inputs of the frequency converter (HP 8511A/B, 85310A, or other.)

Ratio Most often, users want to divide the measured signal of the *test* input by the signal of the *reference* input. This is called a **ratio**, or ratioed, measurement. (For example, selecting b1/a1 would divide the test signal at b1 by the reference signal at a1.) A ratioed measurement provides common-mode rejection of errors caused by the transmitter, transmit antenna, or drift.

Parameter The parameter is the input, or input ratio, that you have selected for a measurement. The front panel keys (PARAM 1), (PARAM 2), (PARAM 3), and (PARAM 4) are set at the factory to select different input ratios (b1/a1, b2/a1, and so on). For example, (PARAM 1) divides (ratios) input b1 by a1. You can redefine the PARAM keys so they ratio any two inputs you desire. To view a single input, use the SERVICE 1 a1, SERVICE 2 b2, SERVICE 3 a2, SERVICE 4 b1 softkeys, located under PARAMETER (MENU) SERVICE PARAMETERS.

Antenna Measurements

The first part of this chapter describes the two supported types of antenna measurements:

Angle Scan — The HP 8530A can make single-axis angle scan measurements at a single frequency. You can measure a single angle, or an angle sweep.

Frequency Response — This is a measurement at a single angle over a range of frequencies. When selecting frequencies, you can:

- Specify a list of specific frequencies.
- Select the start and stop frequencies, and the number of points. The receiver will pick the individual frequency points in-between.
- Select a frequency center point, a frequency *span*, and the number of points. The receiver will pick the individual frequency points throughout the span. This method is useful when you want to look closely at a smaller portion of the frequency band.

  In frequency measurements, triggering should usually be set to internal triggering.

Note When this manual instructs you to press one of the four (MENU) keys, it will give the name of the functional block first. For example, STIMULUS (MENU) refers to the (MENU) key located in the STIMULUS functional block.

Softkeys are shown LIKE THIS .

Angle Scan Measurements

This tutorial will show you how to make a typical angle scan (pattern) measurement.

Notes Regarding Angle Scan Measurements

The HP 8530 does not send commands to the positioner controller. You must set the start, stop, and increment angles on the positioner controller directly. The only exception to this is if your positioner controller is completely manual. To make the measurement, use the positioner controls to rotate the antenna.

What Triggers Measurements at Each Angle?

On systems NOT equipped with the HP 85370A Position Encoder: The receiver, using External Trigger, measures one data point every time a Record Increment trigger is sent by the positioner controller. The receiver uses the Record Increment trigger to:

- Know when the antenna is at an angle where a data point is to be taken.
- Keep track of how many angular data points have been measured, and thus, when the measurement is finished.

On systems that ARE equipped with the HP 85370A Position Encoder: The HP 85370A Position Encoder automatically knows the selected increment angle. It causes the receiver to trigger each time the positioner reaches an increment angle (an angle where a data point is to be taken). Receivers that use the position encoder use internal triggering. More on this subject is explained in “External Triggering” in Chapter 4.

Example Measurement

The example measurement will use the following settings:

Display:	Single
Measured Parameter:	Param 1 (b1/a1)
Start Angle:	−90°
Stop Angle:	+90°
Increment Angle:	1°
Frequency:	10 GHz (X-band)

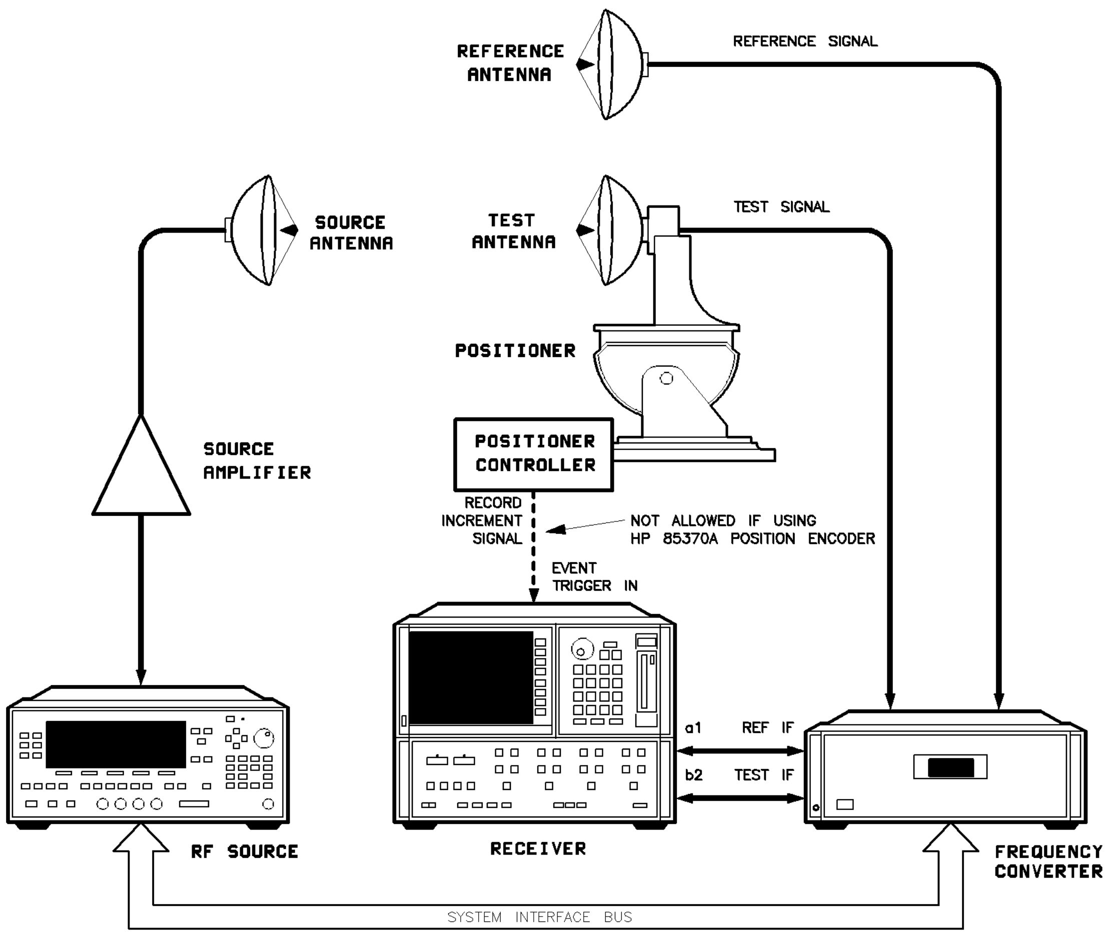


Figure 2-1. Typical Antenna Measurement Setup

Typical Test Setup

Figure 2-1 shows a typical antenna measurement setup.

You must not connect a signal to the Event Trigger BNC if your system uses the HP 85370A Position Encoder. Connections to Event Trigger could cause false triggers to the Position Encoder.

Calibrate

If you want to make calibrated gain measurements, or reduce crosstalk errors, refer to Chapter 3.

Make Measurement Settings

1. Press (RECALL) MORE FACTORY PRESET.
2. Select angle measurements by pressing (DOMAIN) ANGLE.
3. Determine an appropriate RF power level for your setup. Change RF power by pressing STIMULUS (MENU) POWER MENU, POWER SOURCE 1. Then enter the desired value using the entry keys, for example (-) (1) (0) (x1) would select −10 dBm.

Angle Scan Measurements

4. Select angle and frequency settings by pressing the following keys:

   (START) −90 (x1)

   (STOP) 90 (x1)

   STIMULUS (MENU), INCREMENT ANGLE 1 (x1)

   FREQUENCY of MEAS. 10 (G/n)

   (PARAM 1)

5. Set the receiver for the correct triggering mode:

   Press: MORE TRIGGER MODE

   a. If your system *is* equipped with the HP 85370A Position Encoder, press TRIG SRC: INTERNAL.

   b. If your system *is not* equipped with the HP 85370A Position Encoder, and gets its record increment triggering directly front the positioner controller, press EXTERNAL.

6. Press (PRIOR MENU) CONTINUAL.

7. Perform the following sub-steps *only* if you have the HP 85370A Position Encoder:

   a. Press (PRIOR MENU) ENCODER FUNCTIONS AXIS A MORE.

   b. If Axis A on your positioner uses a single synchro, press: SYNCHRO SINGLE

   c. If Axis A on your positioner uses a dual synchro, press: DUAL

   d. If you prefer ±180° display, press: +/-180

   e. If you prefer 0 to 360° display, press: ANG POL 0 to 360

8. On the positioner controller:

   a. Select manual (local) operation.

   b. Some positioner controllers can be "manually programmed" from the front panel for a semi−automatic measurement. Such units may require you to enter a start, stop, and increment angle. If you have a controller of this type, enter start, stop, and increment angle values now. Use the same values you entered into the receiver. Refer to the instruction manual for the positioner controller if necessary. If you use a completely-manual positioner controller skip this step.

   c. Set the positioner controller to Axis A.

Note Some positioner controllers express angles from 0 to 360 degrees, rather than −180 to +180 degrees. If you have a 0 to 360 degree controller, set the positioner to the *equivalent* start angle. For example, to get −90° you would set the positioner to 270°. This is not a problem if you have the HP 85370A Position Encoder.

Choose Display Format

The next step is to choose the way you want data to be displayed. The keys and softkeys in the FORMAT block control the display format. Choose one of the following:

[LOG MAG]	displays logarithmic magnitude in Cartesian format.
[LIN MAG]	displays linear magnitude in Cartesian format.
[PHASE]	displays phase in Cartesian format.
[POLAR MAG]	displays logarithmic magnitude versus angle.
FORMAT [MENU] LINEAR on POLAR	displays linear magnitude versus angle.

Note that in Angle Domain, 0 degrees is at the top of the display in polar formats. Refer to [POLAR MAG] and LINEAR on POLAR in the *HP 8530A Keyword Dictionary* for details.

Choose Display Scale and Reference Line Settings

One step 40 dB or 60 dB patterns

You can set the display up for 40 dB or 60 dB patterns in one step:

Press RESPONSE MENU 40 dB PATTERN or 60 dB PATTERN .

Individual scale and reference controls

[SCALE] sets the vertical graticule scale in dB/division. When making a measurement for the first time, you should estimate (roughly) the maximum and minimum power levels. Then you can choose values for display scale. After the measurement is done you can readjust display scale to suit the actual data.

Press [SCALE] [4] [x1]. This selects 4 dB/division, which provides 40 dB from the top of the display to the bottom.

The display has a reference line. This line represents a specific power level, which you can specify. Change the value of the reference line to −10 dB as follows:

Press [REF VALUE] −10 [x1].

If you had pressed 40 dB PATTERN or 60 dB PATTERN , the reference line is now at the top of the display. You can place the reference line anywhere you wish by pressing:

[REF POSN] n [x1], where n is a number from 0 (bottom of the display) to 10 (top).

Measure the Antenna

To measure the antenna under test:

1. Press MEASUREMENT `RESTART`. This step ensures that the measurement starts at the beginning of the angle scan. Press this key before making every angle scan measurement.

Hint This note applies to systems that are NOT equipped with the HP 85370A Position Encoder.

Sometimes positioner controllers "skip" a trigger pulse during the measurement. If this happens, the measurement will stop near the end of the scan, waiting for the final trigger pulse (or pulses). If you try to make another angle scan, the receiver will measure the "missing" points and then stop taking data. MEASUREMENT (RESTART) forces the receiver to abandon the previous measurement, and starts the next scan properly (at the start angle). This is never a problem if you are using the HP 85370A Position Encoder.

---

2. Using the positioner controller front panel controls, move the antenna to the start angle. *You should always move the positioner about 3° in front of the start angle. When the receiver displays* `MOVE POSITIONER ANGLE FORWARD` *you have gone far enough.* In this example the start angle is –90°, so move the positioner to about –93°.
3. Move the antenna from –90° to +90°. The receiver will measure the antenna pattern as the positioner turns.

   Results for an example antenna are shown below:

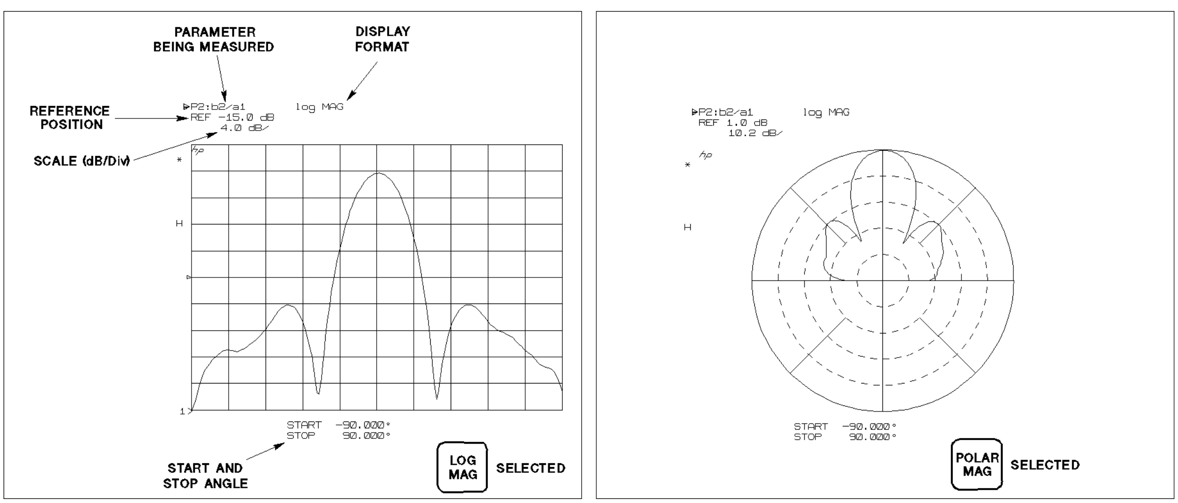


Figure 2-2. Example Antenna Measurement Results

Aborting a Measurement

The MEASUREMENT (RESTART) key tells the receiver to abort the current measurement and start over. When you are in Frequency Domain you can press this key whenever you want. However, you should be careful when pressing this key in the ANGLE domain. Always follow this procedure:

1. Stop the positioner controller and prepare it for a new scan. *Move it back to the start angle.*
2. Press (RESTART). This will abort the current measurement and return the HP 8530A to the start of the next scan.

Frequency Response Measurements (at a Fixed Angle)

This tutorial will show you how to make a typical frequency response measurement. The example measurement will use the following settings:

Measured Parameter:	Param 1 (b1/a1)
Start Frequency:	8.2 GHz
Stop Frequency:	12.4 GHz
Number of Frequency Points:	201
Angle:	0°

Calibrate

If you want to make calibrated gain measurements, or reduce crosstalk errors, refer to Chapter 3.

Choose Measurement Settings

1. Select Frequency Domain measurements: Press (DOMAIN) FREQUENCY.
2. Set the frequency sweep to Step mode: Press STIMULUS (MENU) STEP.

   NOTE: Ramp mode is faster than step, but requires two BNC cable interconnections between the RF source and receiver. This is not possible in many ranges. Step mode has better frequency-accuracy than Ramp mode, because Step mode phase locks at each frequency point. Refer to the Ramp Sweep description in Chapter 4 for more information.
3. Press MORE CONTINUAL.
4. If your system has an HP 8511 and a compatible HP 836xx source, you can use Quick Step phase locking mode to speed up Step measurements. Refer to the list of compatible HP 836xx sources in "Fast measurement speed and Quick Step mode" in Appendix B.

   If your RF source is compatible, turn Quick Step mode ON by pressing:

   (SYSTEM) MORE SYSTEM PHASELOCK STEP TYPE: QUICK
5. Make sure triggering is set to internal by pressing:

   STIMULUS (MENU) MORE TRIGGER MODE TRIG SRC INTERNAL

   With internal triggering turned ON, the receiver will not wait for outside trigger pulses before measuring data points. Instead, it will measure each point at the fastest possible speed.
6. Select number of points and frequency settings by pressing the following keys:

   (START) 8.2 (G/n)

   (STOP) 12.4 (G/n)

   STIMULUS (MENU) NUMBER of POINTS 201

Note When you select different frequency values for your measurement, HP 836xx RF sources use the first sweep to accurately phase lock the RF frequencies. If your application demands high measurement speed, use subsequent sweeps for the actual measurement.

7. Select the parameter you want to view, for example, press (PARAM 1).

8. Determine an appropriate RF power level for your setup.

   To change RF power, press:

   STIMULUS (MENU) POWER MENU , POWER SOURCE 1 . Then enter the desired value.

9. Set the positioner controller so the antenna is at the desired angle.

Choose Display and Reference Settings

Choose a data presentation format, scale, and reference value/position as explained in "Angle Scan Measurements". The two polar display keys, (POLAR MAG) and LINEAR on POLAR , operate differently in Frequency Domain than they do in Angle Domain. Refer to (POLAR MAG) and LINEAR on POLAR in the *HP 8530A Keyword Dictionary* for details.

Choose Sweep Type

The receiver will already be measuring data. By default, the receiver will measure the frequency band repeatedly. You can save data to a disc at any time, refer to Chapter 6 for instructions.

If you want to measure one sweep at a time:

Press STIMULUS (MENU) MORE SINGLE . The receiver will take one sweep, then stop. The receiver will underline the HOLD softkey when the measurement is finished. This means the receiver is in Hold mode, and is not making measurements. The letter H will appear on the left-hand side of the display when the receiver is in Hold mode.

Choosing the Best Sweep Mode for Your Measurements

The different sweep modes under STIMULUS (MENU) are:

- Single Point mode
- Ramp Sweep mode
- Step Sweep mode
- Frequency List mode

These modes are explained in "Frequency Domain Measurement Tutorial" in Chapter 4.

Choosing Single or Continual Measurements

You can also choose between single or continual measurements, using STIMULUS (MENU) MORE : SINGLE or CONTINUAL .

SINGLE — makes a single measurement. When the measurement is done the receiver switches to Hold mode, and the letter H appears on the display.

CONTINUAL — repeats the measurement continuously.

Radar Cross Section Measurements

This section describes how to make manual Radar Cross Section (RCS) measurements. The HP 8530A can be used to perform these basic RCS measurements directly, using only the front panel controls:

Frequency Domain	This measurement domain will determine the reflection from a stationary target versus frequency. You can measure the reflection over a frequency sweep, at a CW frequency, or a specific list of frequencies.
Time Domain	Time domain (optional) can be used to measure the reflections of the target over time, giving the down range RCS response. The HP 8530A will first measure in the Frequency Domain and then compute the Time Domain response using an inverse Fourier Transform.
Software Gating	Time domain gating can be used to remove unwanted RCS responses in both time and Frequency Domain RCS measurements. The gating function can “filter out” various RCS error signals such as feed coupling, monostatic antenna return loss, chamber reflections and range clutter.
Angular CW Measurements	An angle domain measurement can be made showing RCS of a target versus rotation angle at a CW frequency. This is done by using a positioner system to move the target and trigger the receiver at each measurement angle. This measurement is similar in concept, and hardware set up, to an angle domain measurement of an antenna radiation pattern except the positioner moves the target, rather than the receive antenna.

Since the Time Domain response is calculated from the Frequency Domain measurement, the following tutorial starts with a Frequency Domain RCS measurement. Each of the following tutorials builds upon the previous example.

The following procedures also assume that you have read and become familiar with the antenna measurement section earlier in this chapter.

In this section we will use some of the skills and procedures discussed earlier.

Frequency Domain Measurements

The following tutorial will show you how to make a typical Frequency Domain RCS measurement. The example measurement will use the following settings:

Measurement Parameter:	Param 1 (b1/a1)
Start Frequency:	8.2 GHz
Stop Frequency:	12.4 GHz
Number of Frequency Points:	801
Target Angle:	0°

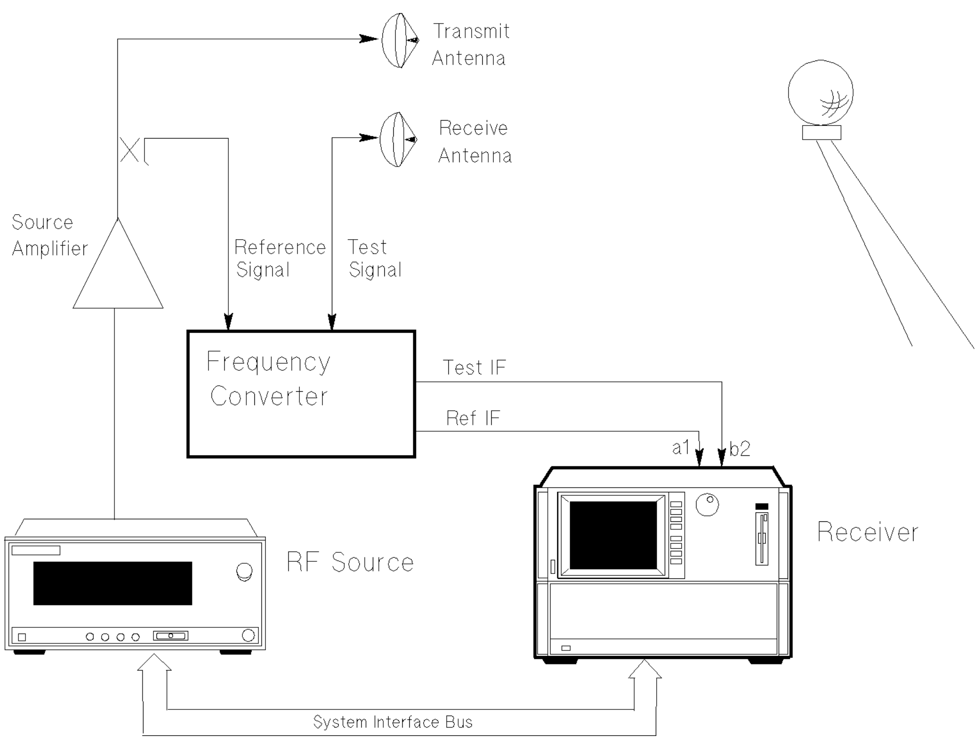


Figure 2-3. Typical RCS Measurement Setup

Typical Test Setup

Figure 2-3 shows a typical RCS setup. Notice that the reference signal is coupled from the RF source rather than using a reference antenna as in an antenna measurement. This is a normal configuration for a quasi-monostatic and bistatic antenna range. A dual directional coupler is used for a monostatic range.

Calibrate

Calibrate using the instructions provided in “RCS Calibration” in Chapter 3.

Choose Measurement Settings

1. Select Frequency Domain measurements: Press (DOMAIN) FREQUENCY.
2. Set the frequency sweep to Step mode: Press STIMULUS (MENU) STEP.

   The RAMP sweep mode may be used with some frequency converters such as the HP 8511A/B if the proper rear panel connects are made. Refer to the Ramp Sweep mode description in Chapter 4 for more information.
3. Press MORE CONTINUAL.
4. Make sure the triggering is set to internal by pressing:

   STIMULUS (MENU) MORE TRIGGER MODE TRIG SRC INTERNAL

   With the trigger set to internal the receiver will not wait for an external trigger signal before taking any data points. Instead, it will measure each point at the fastest possible speed.

   Also make sure that the STIMULUS key is underlined, but the PARAM 1, PARAM 2, PARAM 3, and PARAM 4 are not.
5. Select the measurement frequency range and the number of points by pressing the following keys:

   (START) 8.2 (G/n)
   (STOP) 12.4 (G/n)
   STIMULUS (MENU) NUMBER OF POINTS 801

Note When using an HP 8360 family RF source, the first sweep after any frequency change is used to accurately phase lock the RF frequencies. If high measurement accuracy is required, use the second sweep for your measurement.

---

6. Select the parameter you wish to measure, press:

   (PARAM 1)
7. Determine an appropriate RF power level for your range. Most RCS setups use the maximum available power. To change RF power: Press STIMULUS (MENU) POWER MENU, POWER SOURCE: 1. Then enter the desired value, or use the knob.
8. Set the target in place, at the desired positioner angle.

Choose Display Format

Choose a data presentation format, scale, and reference value/position as explained in "Angle Scan Measurements".

Measure the Target

The receiver will already be measuring RCS data. By default, the receiver will measure the frequency band repeatedly. After the target has been measured, you can stop taking data by pressing:

STIMULUS (MENU) MORE HOLD

or

You can make a single sweep measurement by pressing:

STIMULUS (MENU) MORE SINGLE

You can now remove the target or make other changes while performing other functions and data processing on the RCS measurement. An example of a Frequency Domain RCS measurement is shown in Figure 2-4.

After the measurement is finished you can save the data to disc, refer to Chapter 6 for instructions.

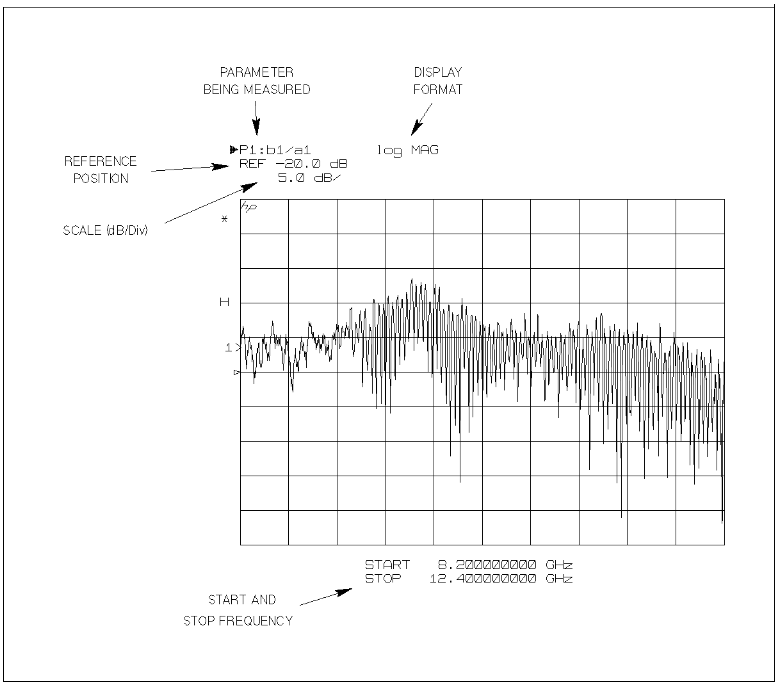


Figure 2-4. Typical RCS Frequency Domain Measurement

If you want to measure one sweep at a time:

Press STIMULUS (MENU) MORE SINGLE. The receiver will take one sweep, then stop. The receiver will underline the HOLD softkey when the measurement is finished. This means the receiver is in Hold mode, and is not making measurements. The letter H will appear on the left-hand side of the display when the receiver is in Hold mode.

Choose the Best Sweep Mode for Your Measurements

The different sweep modes under STIMULUS (MENU) are:

- Single Point mode
- Ramp Sweep mode

Manual RCS Measurements

- Step Sweep mode
- Frequency List mode

Refer to "Frequency Domain Measurement Tutorial" in Chapter 4 for information on these modes.

Choose Single or Continual Measurements

You can also choose between single or continual measurements, using STIMULUS (MENU) MORE: SINGLE or CONTINUAL.

SINGLE makes a single measurement. When the measurement is done the instrument switches to Hold mode.

CONTINUAL repeats the measurement continuously.

Using Markers

Markers can be used to give detail of specific points on the trace. For example, to show the largest RCS response, press:

(MARKER) MARKER 1 MORE MARKER to MAXIMUM

Time Domain Measurements

The previous Frequency Domain measurement can now be converted into Time Domain. Thus, the down range RCS response can be seen.

Converting to Time Domain

To convert to the Time Domain, press:

(DOMAIN) TIME BAND PASS

For detailed information on Time Domain, see the *HP 8530 Operating and Programming Manual*. This manual discusses important factors that affect a Time Domain measurement, such as: *Alias-Free Range*, *Range Resolution*, *Response Resolution*, and *Impulse Waveforms*.

Choose the Display Format

You may wish to set the display format. The most common formats for Time Domain are: (LIN MAG), (LOG MAG) or FORMAT (MENU) REAL.

Since you are now in the Time Domain, the X-axis of the data display is now showing time, rather than frequency. This means that the following keys now affect the Time Domain, and adjust or measure in time:

(START)
(STOP)
(CENTER)
(SPAN)
(MARKER)

As an example of an RCS measurement, the Figure 2-4 Frequency Domain measurement has been converted into a Time Domain measurement and shown in Figure 2-5.

Measure the Target

The display is now showing the measured Time Domain response. Markers can be used to find the magnitude and the location of each reflection.

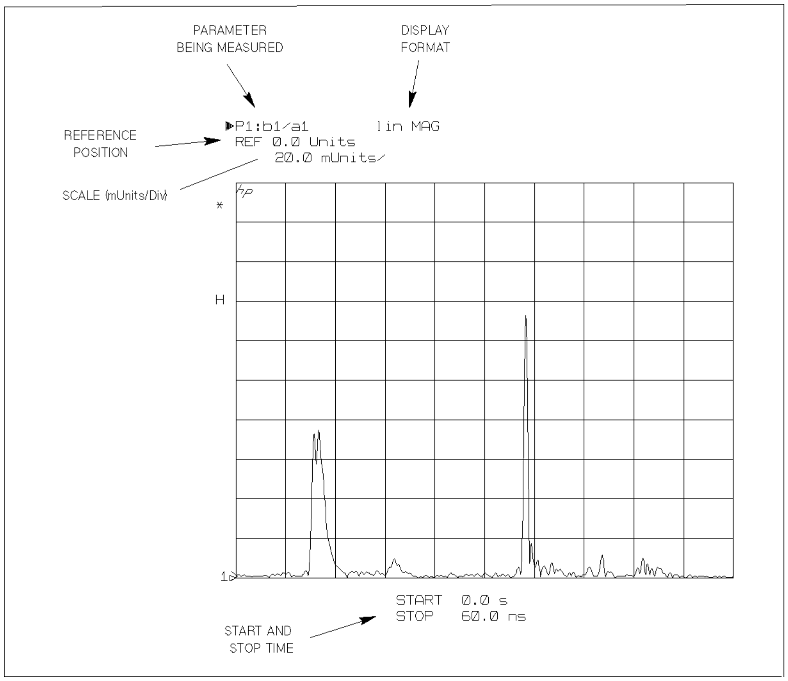


Figure 2-5. Typical RCS Time Domain Measurement

Using the Markers

Markers can now be used to measure each of the responses. See "Using Markers" in Chapter 5 earlier in this chapter to learn how to use this markers. The markers work the same if the display is in the Angle, Frequency, or Time domain.

A Quick Display Adjustment

If the Time Domain display has not already been adjusted in an earlier measurement, the following is a quick method to get a good data display.

To adjust the magnitude response so that you can see the data, press:

(AUTO)

To make sure that you are getting all of the data on the time axis, set the STOP time well beyond the last time response. A good example is:

(STOP) 300 (G/n) for a 150 foot range.

Press (AUTO) again to make sure all of the response data can be seen on the display.

Look for the first point at which the response starts repeating itself (this is due to aliasing). Figure 2-6 shows an example of this. Adjust the stop time to this point by:

(MARKER)

Use the knob to move the marker to just before the start of the repeating response, or to the last point that there is an RCS response.

Press: (STOP) (=MARKER).

The Display will now be showing the full RCS response. You can now adjust the (START), (STOP), (SCALE), (REF VALUE), and others as desired.

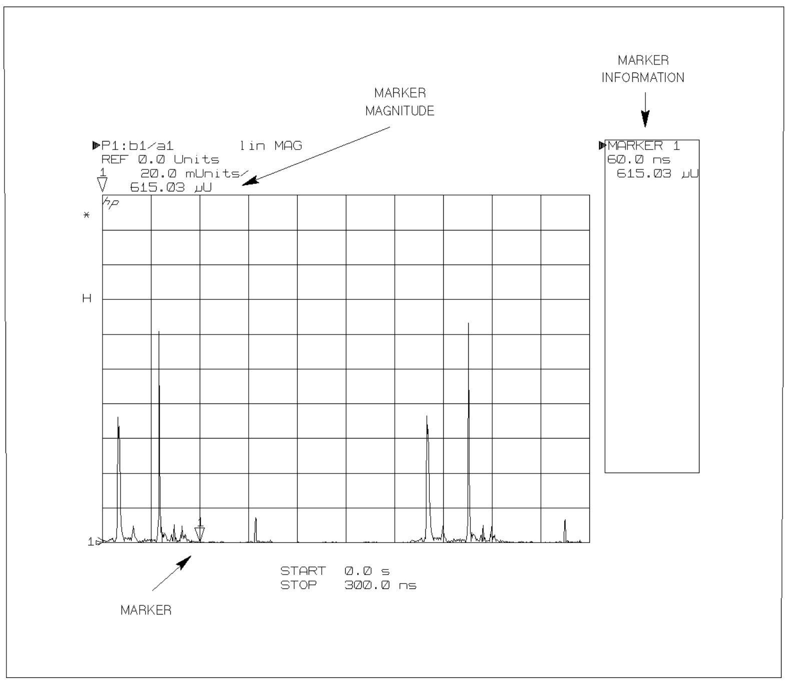


Figure 2-6. Time Domain Measurement Showing Aliasing

Improving RCS Measurement Accuracy

Many of the RCS responses are due to error signals and not due to the target response. Some of the error signals are; coupling, monostatic antenna return loss, chamber reflections and feed clutter. An RCS calibration can remove or reduce some of these errors. Time domain *Gating* can also be used to reduce some of the errors, such as bistatic coupling, antenna return loss, and chamber reflections.

Gating works like a Time Domain "band pass" filter. The gate is placed around the response that you wish to keep, the gate is turned "ON", and the responses outside of the gate are filtered out. Just like a frequency band pass filter, gating has time response sidelobes, filter skirt, and in-band ripple. For detailed information on gating, see the Time Domain section in the *HP 8530 Operating and Programming Manual*.

Using Gating

To show how to use the gate, we will use the earlier RCS Time Domain example. To get to the gating softkeys, press:

(DOMAIN) `TIME BANDPASS` `SPECIFY GATE`

Use the `GATE: START` and `STOP` keys or the `CENTER` and `SPAN` keys to center the gate flags around the response that you wish to keep (normally the target response).

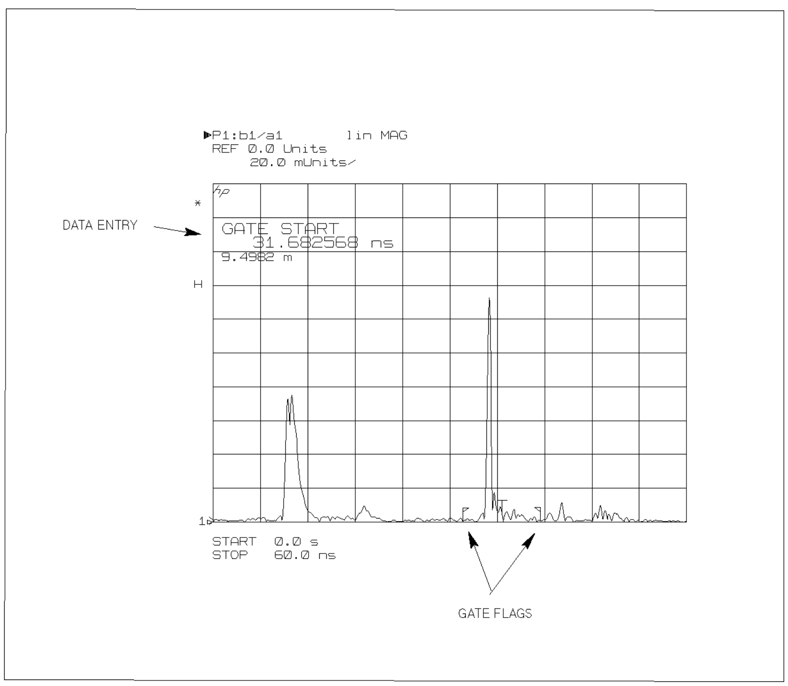


Figure 2-7.
A Measurement Showing the Gate Placed Around the Response

Now turn the gate "ON" by pressing:

`GATE ON`

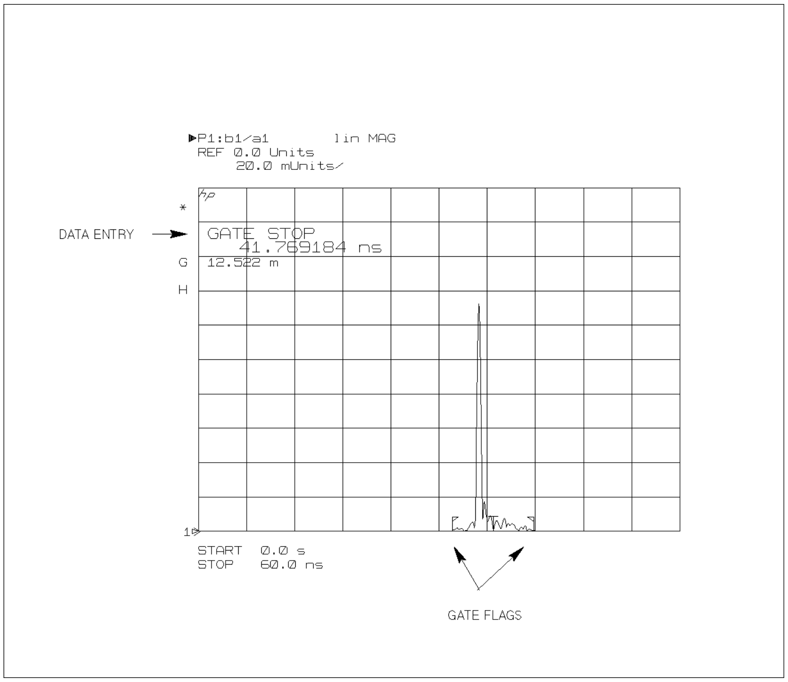


Figure 2-8. The Gate Turned ON

Notice that the responses outside of the gate have been removed.

Gating will also work in the Frequency Domain to reduce response errors too. The next section shows how use both receiver channels to show the differences made by using the gate.

Viewing Frequency and Time Domain Gating

To show the differences between a gated signal and an un-gated signal we are going to use both measurement channels of the receiver. The two measurement channels allow independent adjustment of the various display parameters, such as; scale, format, domain (except angle), parameter, and more.

To set up for this example, return to the basic RCS measurement by turning gating off, markers off, and selecting Frequency Domain.

Press:

(DOMAIN) SPECIFY GATE GATE OFF

(PRIOR MENU) FREQUENCY

(MARKER) all OFF

To display both measurement channels, press:

(DISPLAY) DISPLAY MODE DUAL CHANNEL

You can also press GRATICULE OVERLAY or SPLIT, to view the two traces superimposed, or side by side.

Currently channel 1 is the active channel (notice the lit LED above the (CHANNEL 1) key), and any changes you make will affect that channel. To make channel 2 the active channel press: (CHANNEL 2).

Now make the channel 2 display just like the channel 1 display. To do this use the (PARAM), (SCALE), (REF VALUE), (REF POSN), and (FORMAT) keys. If you press the GRATICULE OVERLAY key you will notice that both channels display the same information.

Now change both channels to the Time Domain. Notice that you can change the domain in both channels separately. This allows you to display the frequency response on one channel and the time response on the other.

Press:

(CHANNEL 1) (DOMAIN) TIME BANDPASS

(CHANNEL 2) (DOMAIN) TIME BANDPASS

Also notice that channel 1's Time Domain display is set for the same settings that were made earlier. Now make channel 2's Time Domain response display the same as channel 1.

Now turn on the gating around the target response in channel 2. Again notice that the gate is still in the same place we left it earlier in this example.

Press:

SPECIFY GATE GATE ON

You can now compare the difference between the gated and ungated responses. Figure 2-9 shows an example of this.

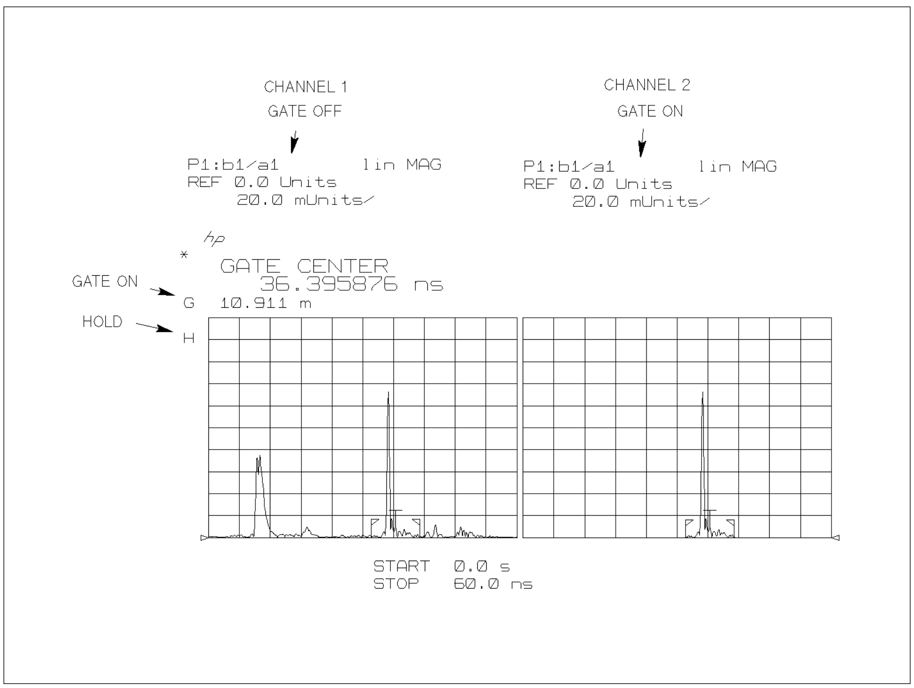


Figure 2-9. Dual Display with Time Domain

Now change both channels back to the Frequency Domain, leaving the gate ON in channel 2, press:

(CHANNEL 2) (DOMAIN) FREQUENCY

(CHANNEL 1) FREQUENCY

Notice the changes in channel 2 as compared with channel 1. Channel 2 has many of the RCS responses reduced by using the gating capability of the receiver. An example of this is in Figure 2-10.

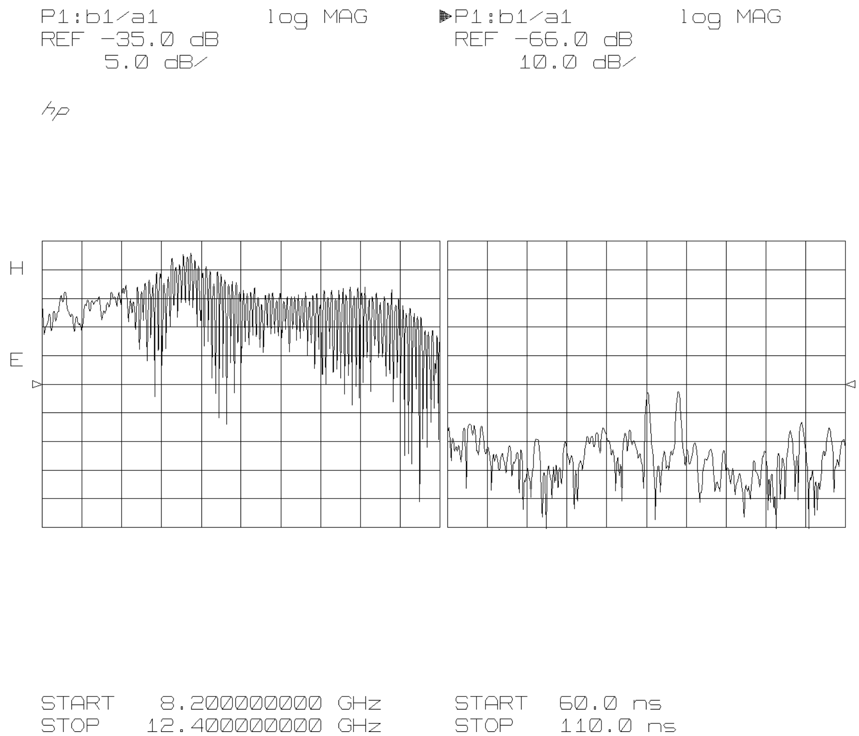


Figure 2-10. Dual Display with Time Domain

You don't have to go into Time Domain to turn ON the gate if you are only measuring in the Frequency Domain. Set the gate at the proper location, either by adjusting the gate in Time Domain, or by a prior knowledge of where the start and stop point would be for the gate. Then, whenever you wish to turn on the gate, press:

(DOMAIN) SPECIFY GATE GATE ON

without ever going into the Time Domain.

3

Antenna and RCS Calibration

This chapter explains antenna and RCS calibration features of the HP 8530A. Network analyzer calibration features are documented in the *HP 8530A Operating and Programming Manual*.

Chapter Contents

Information Pertaining to All Calibration Types

What is Calibration?

Calibration, regardless of the exact type, reduces repeatable systematic errors caused by the system, the chamber, or the antenna range. To achieve this, the receiver measures one or more standards of known characteristics. During calibration, the receiver:

1. Measures the standard.
2. Compares the results to the known characteristics of that standard.
3. Calculates the exact amount of inaccuracy, and how much the measurement data must be adjusted to compensate for it. The adjustment values are called "error coefficients."
4. Stores the error coefficients in memory.

When actual measurements are made, the calibration feature subtracts the error coefficient values, making the measurement much more accurate.

The HP 8530A can perform three types of calibration:

Antenna Calibration	Antenna calibration allows measured data to be expressed in dBi (dB relative to an isotropic radiator). A standard gain antenna with known or defined gain values at specific frequencies is used as a transfer standard to calibrate the system.
RCS Calibration	Response and Background calibration reduces range errors using a calibration target of known radar cross section. The Response portion of the calibration measures the reflections of the calibration target. The Background portion measures the empty antenna chamber to characterize and compensate for clutter. After performing an RCS calibration, measurements are expressed in dBsm (decibels per square meter).
Network Analyzer Calibration	Network analyzer calibration greatly reduces repeatable systematic errors during network analysis measurements. A network analyzer calibration transfers the accuracy of your calibration standards to the measurement of your device. Network analyzer calibration standards are supplied in a "calibration kit" which must be purchased separately. Calibration kits are made for specific frequency ranges and connector types.

Calibration Requirements

Calibration issues become much simpler if you calibrate using the same equipment and instrument settings that you plan to use during the measurement.

Use the Same Equipment Setup in the Measurement

You *must* calibrate using the same adapters and cables that will be used for the measurement. If the adapters or cables are changed between calibration and measurement, unpredictable errors will result due to the fact that the error coefficients determined during calibration are incorrect for the altered setup. Even disconnecting and reconnecting the same adapter can cause inaccuracy. If you change the setup, you must perform the measurement calibration procedure again to calculate appropriate error terms for the new setup.

Settings You Can Change after Performing a Calibration

1. You can perform a network analyzer calibration in the frequency Domain, then change to time domain, and the calibration will remain valid.
2. You can calibrate using a specific number of points, then make a measurement using a *smaller* number of points.
3. You can perform an antenna calibration in the frequency domain, then change to the Angle or Time Domain, and the calibration will still be valid. (If you change to the Angle Domain, some HP 8530 receivers turn the calibration OFF. You must manually turn the calibration ON again.)
4. You can perform a swept frequency calibration (in Ramp or Step sweep mode), then select a Single frequency measurement. (Some HP 8530 receivers require you to turn the calibration ON again.)
5. You can change start and stop angle while in Angle Domain.

Setting Changes that Require Special Consideration

Other settings can be changed, but require special consideration.

Changing Parameter

The HP 8530A automatically turns calibration OFF if you change parameter. However, it allows you to turn the calibration ON again for the new parameter. If you are not careful, this can result in invalid data. There are situations (explained below) where you can change parameter and get valid measurement results. The important thing to remember is that you must know when the results are valid, and avoid situations where invalid data would result. The instrument will not warn you.

To understand the considerations involved, remember that *a calibration applies to a specific hardware setup (a specific collection of cables, adapters, and so forth, connected in one specific way)*. As long as the parameter you select will measure that equipment as it was originally set up, the calibration will be valid.

For example, assume you originally connected the equipment to inputs b1 and a1, and performed the calibration using b1/a1 ratio. You can select any parameter key that is currently defined as b1/a1 and the calibration will be valid. (You can redefine any parameter key to be b1/a1.)

Changing Stimulus Values

Changing any of the following settings will cause the message CAUTION: CORRECTION MAY BE INVALID to be displayed. Calibration remains ON.

- Source Power
- Power Slope
- Dwell Time
- Sweep Time
- Sweep Modes
- Trim Sweep Value

Settings that should not be changed

Selecting a Different Frequency Range

If you have performed any type of calibration across a frequency range, and then change frequencies, calibration is automatically turned Off, and CORRECTION RESET is displayed.

Selecting a Greater Number of Points

If you calibrate using a certain number of points, you cannot perform a measurement using a greater number of points. If you attempt to select a greater number of points, calibration is automatically turned Off, and CORRECTION RESET is displayed.

Using Averaging

For all calibrations, use the same or greater averaging factor than will be used for the device measurement. In general, use an averaging factor of 8 or 16 for most measurements. Hewlett-Packard recommends that you increase the averaging factor for the isolation portion of the calibration (in RCS calibration this is the background calibration). This can be easily accomplished by turning Averaging ON before beginning the calibration, then leaving averaging factor as the active function during the calibration.

If you are using averaging

If averaging is ON during calibration, then the correct number of measurements needed to provide fully averaged data are automatically taken. For Ramp sweeps this means that n+1 sweeps, where n is the current averaging factor, are taken. For Step, Single Point, or Frequency List, each data point is averaged n times (where n is the selected number of averages).

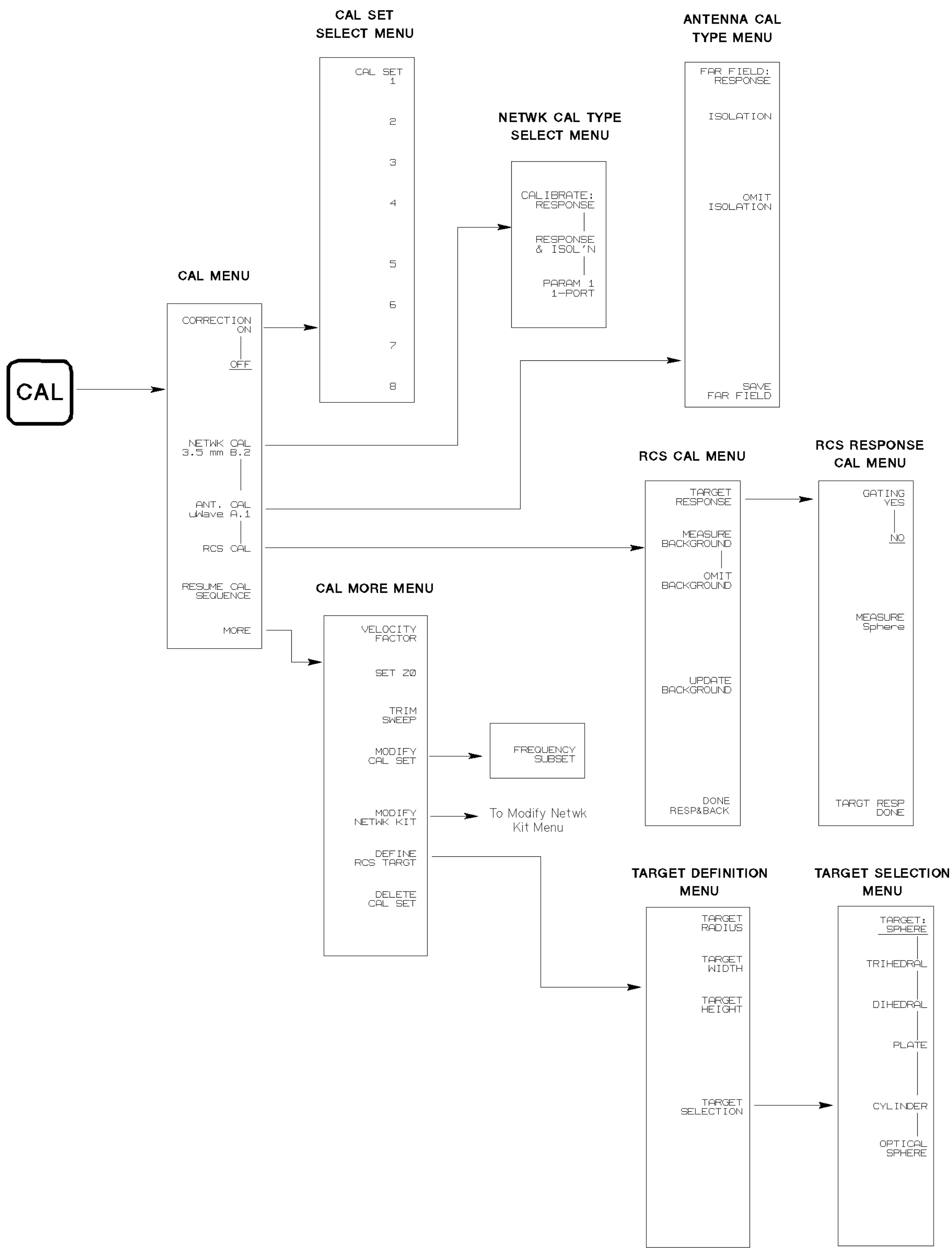


Figure 3-1. Cal and Cal Type Menus

Specific Calibration Procedures

The following pages contain information about specific types of calibration, including step-by-step procedures on performing calibrations.

The receiver provides the following calibration types:

- Antenna Calibration
- RCS Calibration
- Network Analyzer Calibration (only described in the operating and programming manual)
  - Response Calibration
  - Response and Isolation Calibration
  - 1-Port Calibration

Antenna Calibration

Antenna calibration allows measured data to be expressed in dBi (dB relative to an isotropic radiator). A standard gain antenna with known or defined gain values at specific frequencies is used as a transfer standard to calibrate the system.

Calibrating with a standard gain antenna corrects for the transmission response errors.

An optional part of antenna calibration is an “isolation calibration.” This calibration reduces crosstalk errors between input channels. The isolation cal requires a high quality RF load as a calibration standard. The load you need is determined by the connector type and frequency range of your system.

Important Terms

Cal	“Cal” is an abbreviation for “Calibration.”
Cal Definition	A cal definition is an ASCII file you create using a text editor. It contains theoretical or measured frequency and gain values for the standard gain antenna. You can create the file using any computer-based text editor which can save text in plain ASCII format. The file can then be loaded into the receiver from a DOS or LIF disc. A cal definition contains up to seven “antenna definitions.”
Antenna Definition	The gain data for a specific standard gain antenna is called an “antenna definition.”
Cal Set	A finished calibration data file. During the calibration, the standard gain antenna is measured and its performance is compared to one or more antenna definitions. Any differences are stored in an internal “cal set register.” These differences are the error coefficients which, when subtracted from the measurement, result in calibrated results. In antenna calibration, the final measurement data is expressed in units of antenna gain (dBi). Cal sets can be stored in internal registers or to disc.

Angle Domain and Frequency Domain Calibrations

If you perform a calibration while in angle domain, the calibration will be at one frequency. (Angle Domain makes measurements at only one frequency.)

If you perform a calibration while in Frequency Domain, you can calibrate over a range of frequencies.

Using a Frequency Domain Calibration in Angle Domain.

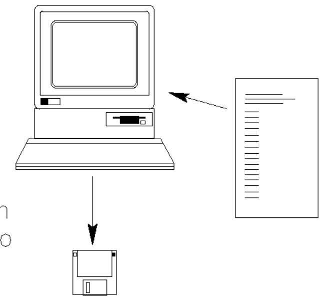
HP recommends that you calibrate using Frequency Domain, which calibrates over a range of frequencies. You can then switch to Angle Domain, and pick any of the frequencies from the Frequency Domain calibration. This gives you instant access to many calibrated frequencies (one at a time) when in Angle Domain.

Only one limitation applies; the frequency you want to measure (in angle domain) must exist in the original calibration. The receiver does not interpolate between calibrated frequencies.

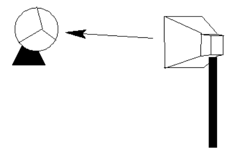
Here are the basic steps involved in antenna calibration:

Antenna Calibration Overview

Note Steps 1 and 2 are not necessary if you use one of the supplied standard gain antenna definitions, or if you have already created your own definition.

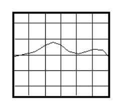


1. Create an ASCII file with Standard Gain Antenna Data (a definition). Save the file to HP 9000 Series 300 (LIF) or DOS compatible disc (filename must begin with AC_). LIF filenames can have up to seven additional characters: AC_XXXXXXX, DOS filenames can have up to five additional characters, plus an extender: AC_XXXXX.XXX
2. Load the Standard Antenna Definition into the HP 8530A from the disc.
3. Mount the standard gain antenna and find boresight.

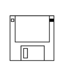


4. Choose Angle Domain or Frequency Domain. DOMAIN
5. If using Angle Domain, choose the calibration frequency using the **FREQUENCY of MEAS.** softkey.

   If using Frequency Domain, choose calibration frequencies using start, stop, and number of points, or use frequency list mode to enter specific frequencies.
6. Start the calibration. The receiver creates calibration data based on the standard gain antenna.



7. If you are making a calibration using two or more standard antennas, mount the next standard gain antenna, find boresight, and calibrate.
8. If desired, perform an isolation calibration to reduce channel crosstalk.
9. Save the calibration to a Cal Set Register.
10. If desired, store the calibration to disc.



Standard Gain Antenna Definitions

To perform a calibration, the receiver must know the published gain values of the standard gain antenna. HP has supplied a file containing data for seven Narda standard gain horns.

If You Are Using a Narda Standard Gain Horn that is Already Defined:

Data for Narda models 638, 639, 640, 642, 643, 644, and 645 are supplied in a single cal definition file. This file, `AC_NAR1`, is supplied on the `Antenna/RCS Cal Disc` which was shipped with the HP 8530A. If you are using one of these horns, load `AC_NAR1` as explained below:

1. Insert the `Antenna/RCS Cal Disc` into the HP 8530A's disc drive.
2. Press (DISC) `LOAD` `CAL KITS` `ANTENNA CAL DEF`, the receiver will display a file directory showing `AC_NAR1`. Since it is the only cal definition on that disc, it will already be highlighted.
3. Press `LOAD FILE`.

When you perform the antenna calibration you will see the Narda horns listed in a softkey menu. Information on the Narda horns is provided at the end of the calibration section. Please note that your Narda standard gain horn calibration data may be different than the data on file `AC_NAR1`.

If You Are Not Using One of the Pre-Defined Narda Horns:

Create your own cal definition file as explained in "Creating a Standard Gain Antenna Definition", at the end of this chapter. You will need a personal computer and a text editor that can save text in plain ASCII format.

Note If you calibrate over a wide frequency range, you may need to use two or more standard gain antennas. Some users have asked us: "When calibrating, what happens when two of the standard gain antennas have overlapping frequencies?" The answer is: Where the frequencies overlap, the receiver uses the calibration data for the standard gain antenna that was measured last.

Performing an Antenna Calibration

Frequency Domain Calibration

Initial Setup, Finding Boresight

1. Mount the standard gain antenna on the proper antenna mount and connect it to your system.
2. Press: (RECALL) `MORE` `FACTORY PRESET`.
3. Press: (DOMAIN) `FREQUENCY`.
4. Press: STIMULUS (MENU) `SINGLE POINT`.
5. Press (CENTER) and enter a frequency in the approximate center of the calibration frequency range.
6. Press (MARKER).
7. Select the desired axis on the positioner controller.

8. Move the positioner so the antenna is somewhere near its boresight position (a rough approximation is fine).
9. Move the positioner until the flat line reaches maximum amplitude (or minimum amplitude if your antenna has a null at boresight). It is helpful to watch the marker value readout (in the upper-left portion of the display). This digital readout of the amplitude makes it easy to observe small (0.1 dB) changes.
10. Boresighting is usually interactive between axes, so repeat steps 5, 6, and 7 for each axis until true boresight is found.

Choosing Calibration Stimulus Settings

1. Perform step a or b below, depending on if you want to calibrate at one or more frequency points.
   a. If you only want to calibrate at a single frequency press STIMULUS (MENU) `SINGLE POINT`. Press (CENTER) followed by the desired frequency, proceed to *Antenna Calibration Steps*, below.
   b. To calibrate over a range of frequencies, you must choose a sweep mode. Any mode will work *but the Frequency List mode is strongly recommended.* The Frequency List `STEP SIZE` function allows you to enter a *known increment frequency*. This is why the Frequency List mode is better when performing a calibration. Ramp and step sweep modes only allow you to choose a `NUMBER of POINTS`, and *the receiver* chooses the increment frequency. This limits flexibility in the calibration and often results in inconvenient increment values (like 17.67 MHz). STEP SIZE allows *you* to choose a step size that is *convenient*.

Note Ramp Sweep mode is not always usable, depending on how your system is configured. Ramp Sweep mode will not function is systems that use an LO source. In addition, Ramp Sweep requires two BNC connections between the receiver and the RF source.

Sometimes wide frequency ranges require you to use two or more standard gain antennas to cover the whole frequency range. If this is the case, enter the entire frequency range during the procedure below.

To use Frequency List mode, as recommended, perform the following sub steps:

i. Press STIMULUS (MENU) `MORE` `EDIT LIST`.

ii. Press `EDIT` `SEGMENT: START` and enter the desired start frequency (for example, 8.2 GHZ).

iii. Press `STOP` and enter the desired stop frequency (for example, 12.4 GHz).

iv. Press `STEP SIZE` and enter the desired frequency increment value. Assume for a moment that your standard gain antenna has documented gain values every 50 MHz. You can choose smaller increments (for example, 25 MHz), and the receiver will interpolate between known gain points. (Straight-line interpolation is performed.)

v. Press `DONE`. The receiver will display the number of points it will use in the measurement, based on the selected step size.

vi. Press `DONE` again.

vii. Press `FREQUENCY LIST` to select Frequency List mode.

Antenna Calibration Steps

2. Press the (CAL) key (located in the MENUS block), then press:

   `ANT. CAL uWave A.1` `FAR FIELD:RESPONSE`

   A menu will appear with seven standard gain antenna definitions to choose from.

3. Select the definition for your standard gain antenna. If you must create a definition for your standard gain antenna, refer to "Creating a Standard Gain Antenna Definition", at the end of this chapter.

   The receiver will now measure the standard gain antenna, and create a list of offsets called a "Cal Set."

   If you only want to measure one standard gain antenna, press `DONE RESPONSE` and proceed to "Finishing the Gain Calibration," below.

Note If you see the error message: `CAUTION: ADDITIONAL STANDARDS NEEDED`, the standard gain antenna does not cover the entire frequency range of the calibration. You should do one of the following things:

a. Measure an additional standard gain antenna to cover the additional frequencies.
b. Use a standard gain antenna that covers the entire frequency range. *If your antenna is specified to cover the selected frequency range:* Make sure the standard gain antenna *definition* really has entries for the entire frequency range of that antenna. *The person who created the "definition" file for that antenna may not have entered values for its entire range.* Refer to the section on creating standard gain antenna definitions, in this chapter.
c. Select a calibration frequency span that is within the frequency range of the standard gain antenna and do the calibration over again.

---

4. If you are calibrating for a wide frequency range, requiring more than one standard gain antenna:

   a. Mount the next standard gain antenna.
   b. If necessary, boresight the antenna. You must stay in the current Domain and Sweep Mode. For example, if you are currently in Frequency List mode, the receiver must remain in this mode during boresighting or the calibration will be ruined. With a marker still ON, turn the antenna until boresight (for that axis) is found. Turn the antenna in small steps because of the delay between completed sweeps. Do this for each axis until boresight is found.
   c. Select the appropriate standard gain antenna definition from the softkey menu.
   d. Repeat these sub-steps for each standard gain antenna you need to measure.
   e. Press `DONE RESPONSE` when you are done.

   If the error message: `CAUTION: ADDITIONAL STANDARDS NEEDED` appears, then the definitions for your standard gain antennas do not cover the entire frequency range you have selected. There are either gaps between adjacent definitions, or they do not provide full coverage near the beginning or end of the frequency range.

Finishing the Gain Calibration

5. You are now done with the gain portion of the calibration. Now you should decide if you want to perform an "isolation calibration." An isolation calibration reduces crosstalk between inputs (either reference-to-test or test-to-test), and requires a high-quality 50Ω load.

a. If you *do not* want to perform an Isolation Calibration, press OMIT ISOLATION and proceed to "Saving the Cal Set to a Cal Set Register."

b. If you want to perform an isolation calibration, refer to "Isolation Calibration," below.

Isolation Calibration

6. Replace the standard gain antenna with a 50 Ω load. Make sure the load's connector is torqued as shown in Table 3-1 to prevent RF leakage.

Table 3-1. Proper Connector Torque

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench Part Number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8720-1765
SMA	5.7	56	5	8710-1582
2.4 mm	9.2	90	8	8720-1765

7. Press ISOLATION. The receiver will perform the isolation calibration.

Saving the Cal Set to a Cal Set Register

8. Press SAVE FAR FIELD. A menu of eight cal set registers will appear. Press any of the eight register softkeys and the cal set will be saved to that register.

   The receiver will now turn calibration ON, so any measurement you make will be calibrated.

Angle Domain Calibration

Initial Setup, Finding Boresight

1. Mount the standard gain antenna on the proper antenna mount and connect it to your system.
2. Press (RECALL) MORE FACTORY PRESET .
3. Press (DOMAIN) ANGLE .
4. Press STIMULUS (MENU) SINGLE ANGLE .
5. Press FREQUENCY OF MEAS , then enter the desired calibration frequency.
6. Press MORE CONTINUAL .
7. Press TRIGGER MODE TRIG SRC FREE RUN .
8. Select the desired parameter, (PARAM 1), (PARAM 2), (PARAM 3), or (PARAM 4).
9. Turn on Marker 1 by pressing (MARKER) MARKER 1 .
10. Now use the positioner controls to move the antenna. Watch the data readout for Marker 1. When the marker reaches peak value you have found the boresight for that particular axis.
11. Repeat for each axis, if necessary. Boresighting is iterative so you may have to measure back and forth between axes until the true boresight is found.

Antenna Calibration Steps

1. Press the (CAL) key (located in the MENUS block), then press:

   ANT. CAL uWave A.1 FAR FIELD:RESPONSE

   A menu will appear with seven standard gain antenna definitions to choose from.
2. Select the definition for your standard gain antenna. If you must create a definition for your standard gain antenna, refer to "Creating a Standard Gain Antenna Definition", at the end of this chapter.

   The receiver will now measure the standard gain antenna, and create a list of offsets called a "Cal Set."

   Press DONE RESPONSE and proceed to "Finishing the Gain Calibration," below.

   Finishing the Gain Calibration
3. You are now done with the gain portion of the calibration. Now you should decide if you want to perform an "isolation calibration." An isolation calibration reduces crosstalk between inputs (either reference-to-test or test-to-test), and requires a high-quality 50Ω load.
   a. If you *do not* want to perform an Isolation Calibration, press OMIT ISOLATION and proceed to "Saving the Cal Set to a Cal Set Register."
   b. If you want to perform an isolation calibration, refer to "Isolation Calibration," below.

Isolation Calibration

4. Replace the standard gain antenna with a 50 Ω load. Make sure the load's connector is torqued as shown in Table 3-2 to prevent RF leakage.

Table 3-2. Proper Connector Torque

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench Part Number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8720-1765
SMA	5.7	56	5	8710-1582
2.4 mm	9.2	90	8	8720-1765

5. Press ISOLATION. The receiver will perform the isolation calibration.

Saving the Cal Set to a Cal Set Register

6. Press SAVE FAR FIELD. A menu of eight cal set registers will appear. Press any of the eight register softkeys and the cal set will be saved to that register.

   The receiver will now turn calibration ON, so any measurement you make will be calibrated.

Important Note On Antenna Measurements

Before you make actual measurements (with calibration ON), IT IS VITAL THAT YOU READ THE FOLLOWING:

The frequencies you measure must exactly match the frequencies in the cal set file.

For example, assume you have calibrated from 10 GHz to 11 GHz with a step size of 100 MHz. The calibrated frequencies in the cal set are:

10.0 GHz	10.6 GHz
10.1 GHz	10.7 GHz
10.2 GHz	10.8 GHz
10.3 GHz	10.9 GHz
10.4 GHz	11.0 GHz
10.5 GHz	

You can measure any of these frequencies during the actual measurement. You cannot, however, measure *any other* frequencies. For example, you cannot measure 10.55 GHz. *The receiver does not interpolate between frequencies in the cal set.*

This is another reason why Frequency List mode is so useful when performing calibrations. *Entering a known, convenient step size makes it easy to know what frequencies are in the cal set. Thus, you know precisely which frequencies you can measure with that calibration.*

Things to Try

Assume you created a calibration in the Frequency Domain, using the Frequency List mode, and you save the cal set to Cal Set Register 1. Now go to the Angle Domain. Some HP 8530A receivers will now display the message CAUTION: CORRECTION RESET. Simply press [CAL] CORRECTION ON CAL SET 1 to turn the calibration ON again. The Frequency Domain calibration is still valid, even though you are now in the Angle Domain. You can select any of the frequencies in the original Frequency Domain calibration, and the calibration will remain valid.

Now change the start and stop angle, notice that the calibration remains valid.

RCS Calibration

RCS Calibration Description

This section explains how to perform an RCS calibration. RCS Response and Background calibration reduce range errors using a calibration target of known radar cross section. The Response portion of the calibration reduces phase and amplitude discrepancies between the test and reference channels (tracking errors). The Background portion measures the empty antenna chamber to reduce undesired reflections (clutter). After performing an RCS calibration, log magnitude measurements are expressed in decibels per square meter (dBsm).

You should become familiar with concepts presented in the Time Domain chapter before performing an RCS calibration.

Important Information about Gating During the Calibration

Keep the following in mind if using gating during RCS calibration:

- After the RCS calibration is completed, the calibrated response of the Calibration Target will move, and the gate will no longer be centered around it. To make sure that you do not accidentally leave the gate around the old (now incorrect) position, the receiver turns gating OFF once calibration is done. When you perform actual RCS measurements, turn gating back ON and center it around the response of your measurement target. Usually the target will be at 0.00 seconds.
- Remember, gating has limitations. Do not use gating if:
  - You are measuring a limited frequency span or number of points.
  - If using a frequency list where the points are not evenly spaced.

RCS Calibration Overview

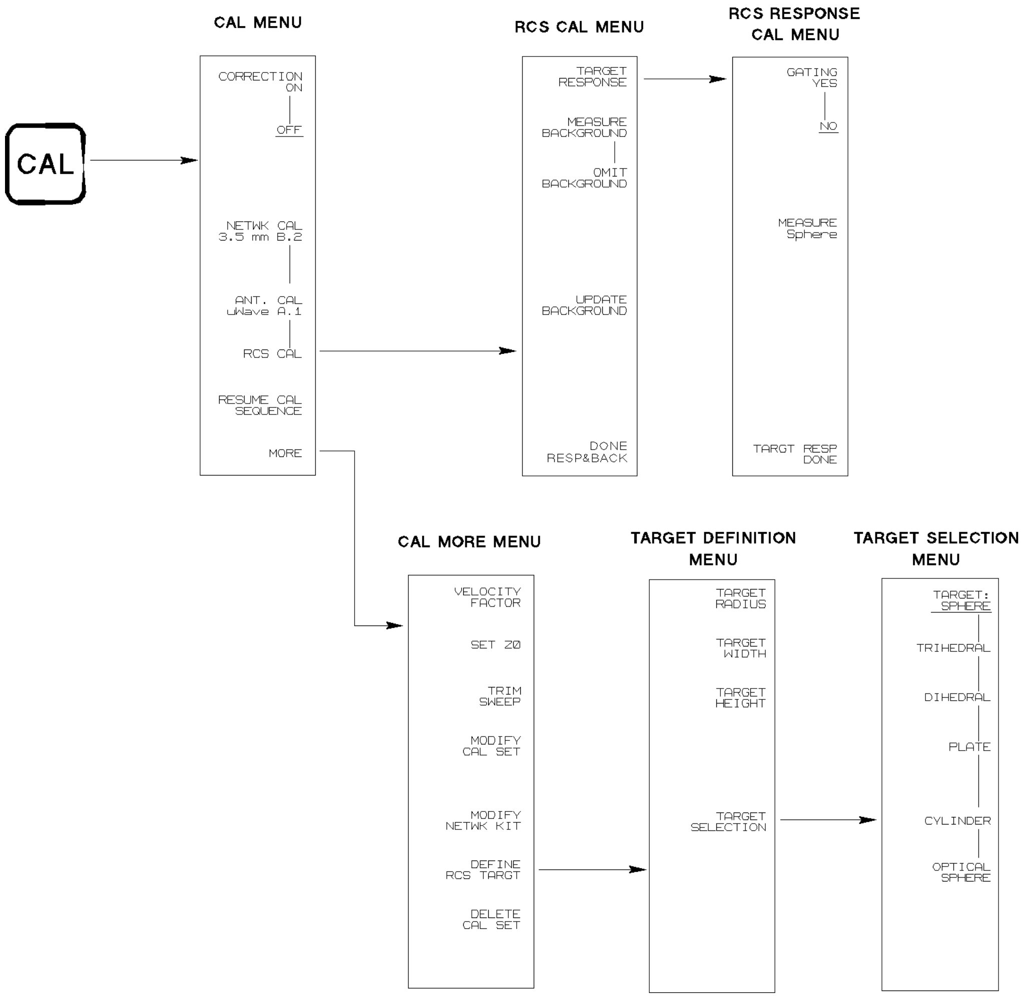


Figure 3-2. Menus Associated with RCS Calibration

1. Determine the requirements of your measurement, including:
   a. Stimulus Settings
   b. Range Resolution
   c. Alias Free Range
   d. Gating Requirements

   These requirements will determine the stimulus, window, and gate settings you should use.
2. Select Frequency Domain
3. Select stimulus settings, using one of the following methods:
   - Set start and stop frequency and number of points. This method is acceptable if you are performing RCS calibrations for use in the Time Domain.
   - Use Frequency List mode with a start frequency, stop frequency, and a specific frequency step value. This method allows you to know the exact frequencies represented in the calibration. This method is preferable if you are going to make RCS measurements in the Angle Domain. Why? Because you can then make calibrated measurements at any

frequency that exists in the calibration. (Remember, when making actual measurements, the receiver cannot interpolate between calibrated frequencies.)

4. If desired, turn ON gating.
5. If desired, turn ON Averaging.
6. Specify RCS target type and its physical dimensions.
7. Perform the actual RCS calibration.
8. After the calibration, use UPDATE BACKGROUND if you change target mounts or if other changes occur to the background. This updates the calibration so it is accurate given the new background conditions.

RCS Calibration Procedure

As mentioned above, first determine the needs of your measurement, then use the information in Chapter 13, Time Domain Measurements, to calculate required start frequency, stop frequency, and number of points, or the Frequency List mode settings required.

Select Stimulus Values

1. Enter the required frequency values using Start, Stop, and Number of Points, or by using the Frequency List mode.

Select Gating (if Desired)

Gating is explained in the Time Domain chapter.

2. Use Gating as explained below:

   a. If you are going to perform a gated calibration, make sure any previous calibrations are OFF. THIS IS VERY IMPORTANT.

      Press (CAL) CORRECTION OFF

   b. Next, determine the location and width of the target response. An easy way to do this is to use display math:

      i. Remove the RCS target and allow the receiver to measure one full frequency sweep.

      ii. Save the measurement to memory by pressing:

         (DISPLAY) DATA -> MEMORY

      iii. Select math subtraction mode by pressing:

         SELECT DEFAULTS MATH OPERATIONS MINUS (-)

      iv. Place the target on the mount, and allow another full measurement sweep.

      v. Select Data minus Memory mode by pressing:
         (DISPLAY) MATH (-)

      vi. Only the target response will appear on the screen.

   c. Press (DOMAIN) TIME BAND PASS SPECIFY GATE.

   d. Choose the gate position and size using the gate START and STOP, or CENTER and SPAN softkeys.

   e. Select gate shape by pressing GATE SHAPE, then either MAXIMUM, WIDE, NORMAL, or MINIMUM. In most circumstances, the factory default (Normal) is the best choice.

f. Turn Gating ON by pressing (PRIOR MENU) GATE ON .

g. Position the gate around the target response.

If your target is a sphere, the placement of the gate is critical. Spheres produce a secondary reflection caused by RF energy propagating around the back of the sphere, which ultimately arrives back at the receive antenna. This produces the secondary reflection, known as a "creeping wave."

- If the creeping clearly separate from the main target response, place the gate around just the main response. In this case make sure you select the OPTICAL SPHERE model when you define the RCS target (the next step).
- If the main target response and the creeping wave are not clearly distinct and separate, position the gate around both of them. In this case make sure you select the TARGET: SPHERE model when you define the RCS target (the next step).

Do not attempt to gate out very large background reflections, or subsequent measurements will not be accurate.

Define the RCS Target

The next step is to select they type of RCS target you use during calibration, and enter its physical dimensions.

3. Press (CAL) MORE DEFINE RCS TARGT TARGET SELECTION .
4. Select the type of calibration target by pressing one of the following:

TARGET: SPHERE	PLATE
TRIHEDRAL	CYLINDER
DIHEDRAL	OPTICAL SPHERE

If You are Using a Sphere:

If you are NOT using gating during the calibration, *always* select TARGET: SPHERE .

The Difference between Sphere and Optical Sphere

The top selection, SPHERE , computes the exact solution for the radar cross section of a perfectly conducting sphere.

The OPTICAL SPHERE selection computes the radar cross section of the sphere based on geometric optics - in which the RF signal is treated as "optical rays" according to physical principles of reflection and refraction. The optical sphere selection is best used when the wavelength of the RF energy is large enough that it approximates the behavior of light. This is called the "optical region" of the sphere. The RF energy is in the sphere's "optical region" when the following relationship between wavelength and sphere radius is true:

$(2\pi r \div \lambda) > 10$

Where λ is wavelength and r is the radius of the sphere.

NOTE: Radar Cross Section data for all target types except SPHERE are based on geometric optics.

5. Press (PRIOR MENU).
6. Enter the required (metric) dimensions of the target using the appropriate dimension softkeys for each type of target:

TARGET RADIUS

TARGET HEIGHT

TARGET WIDTH

Figure 3-3 shows the dimensions required for each type of target.

To specify dimensions in meters, terminate the value with (x1). To specify dimensions in millimeters, use (k/m).

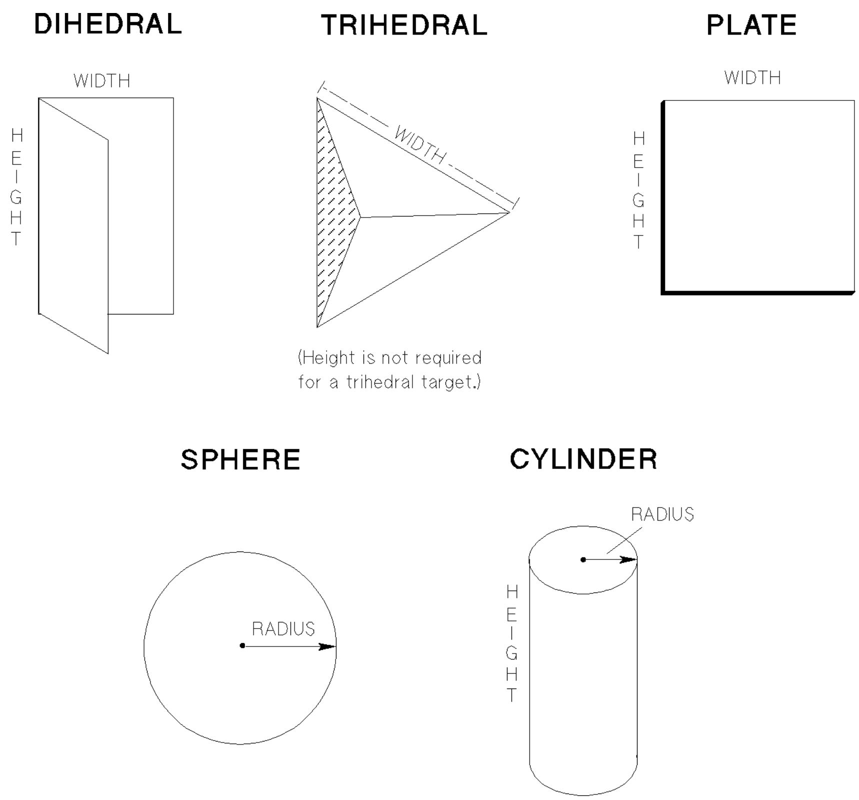


Figure 3-3. Dimensions Required by Different Target Types

Note On Dihedral and Plate targets, height and width are interchangeable. Trihedral and sphere targets only require one dimension to be specified.

Select Averaging (if Desired)

7. If desired, turn Averaging ON and set it to the required value. For example, press:

   RESPONSE (MENU) AVERAGING ON/restart *n* [x1]]. Where *n* is the desired averaging factor.

Perform the Calibration

8. Make sure the RCS target is on the mount.
9. Press (CAL) RCS CAL TARGET RESPONSE .
10. If gating is ON, you can select whether it will affect the calibration. To make current gating settings affect the calibration, press GATING YES . If GATING NO is selected, current gating settings will not affect the calibration.

11. Measure the calibration target by pressing MEASURE target name. (This softkey displays the name of the currently-selected target.)

    At this time the receiver performs a response calibration on the target. This part of the calibration reduces magnitude and phase discrepancies between the test and reference channels (tracking errors).

12. Press TARGT RESP DONE

Optional Background Calibration

The next step is to measure the background. The background consists of the chamber and mount without the RCS calibration target. This part of the calibration is an isolation calibration. It reduces the effects of undesired chamber reflections (clutter).

If you do not want to perform the background portion of the calibration, press OMIT BACKGROUND DONE RESP&BACK. Now select one the of eight cal set registers to hold the calibration data.

To perform the background calibration:

13. Remove the RCS target.
14. Press MEASURE BACKGROUND
15. Press DONE RESP&BACK. Now select one the of eight cal set registers to hold the calibration data.
16. Now proceed with normal RCS measurements.

    If you used single sweep mode to find the target response (earlier in this procedure), remember to change sweep mode back to the type needed for actual measurements. Most often this is the Continual mode.

Updating the Background

Once calibration is done, if you change the RCS mount, or the background changes, you should update the background. To do this:

1. Make sure the appropriate RCS calibration is ON.
2. Press: (CAL) RCS CAL UPDATE BACKGROUND
3. Press DONE RESP&BACK. Now select one the of eight cal set registers to hold the calibration data:
    a. You can store the updated calibration to the register which holds the original version, or:
    b. If you change mounts regularly, you can store the updated calibration to a different cal set register. Then you can recall the register appropriate for each RCS mount.

Network Analyzer Calibration

Network analyzer calibration features are documented in the *HP 8530A Operating and Programming Manual.*

Creating a Standard Gain Antenna Definition

Introduction

If you use different standard gain antennas than those already defined, you must create a "cal definition." To do this, you must:

- Create an ASCII text file on a computer.
- Save the file to disc
- Load the file into the HP 8530A.

This section explains how to create your own definitions.

Important Terms

Cal Definition	A cal definition is an ASCII file you create using a text editor. It contains theoretical or measured frequency and gain values for one or more standard gain antennas. You can create the file using any computer-based text editor which can save text in plain ASCII format (which can save the file to an MS DOS® or HP LIF disc). The file can then be loaded into the receiver from the disc. The cal definition file can contain up to seven "antenna definitions."
Antenna Definition	The gain data for a specific standard gain antenna is called an "antenna definition." As mentioned above, a *cal definition* contains up to seven antenna definitions.

The Supplied Cal Definition

The HP 8530A is *not* shipped with a cal definition in memory. However, a pre-defined cal definition (`AC_NAR1`) is supplied on the `Antenna RCS/Cal Disc`, which was shipped with the receiver. You can load `AC_NAR1`, or a cal definition you create, by following the instructions in "Loading the Cal Definition into the HP 8530A". Details on `AC_NAR1` are provided at the end of this section.

Required Hardware

A cal definition is a simple ASCII text file. You can create a cal definition using:

- Any computer that can save ASCII files to MS-DOS compatible discs.
- Any computer that can save ASCII files to discs formatted in Hewlett-Packard Logical Interchange Format (LIF).

You MUST use a text editor that can save plain ASCII files!

Creating an Antenna Definition

A cal definition is composed of up to seven individual antenna definitions. Each antenna definition applies to a specific standard gain antenna. Use the following instructions to create an antenna definition.

Choosing the Number of Frequency Points to Define

If the performance of the standard gain antenna is linear, you only need to define a few frequency points across the frequency band. Most standard gain antennas are not very linear, so a greater number of frequency points are recommended. You can define up to 201 frequency points.

Covering a Wide Frequency Range

You can define antenna definitions for up to seven standard gain antennas. This provides continuous coverage over a wide frequency range. The calibration feature allows you to measure up to seven antenna definitions for a single calibration.

Determine Required Stimulus Values

Determine the exact frequencies you want to use in the antenna definition. Hewlett-Packard recommends that you choose frequencies that cover the entire range of your standard gain antenna, even if you only make measurements at single frequencies.

- Start frequency of your standard.
- Stop frequency of your standard.
- Difference between frequency points (the frequency increment).
- Number of frequency points.

The start and stop frequencies you already know from the published data.

Choosing the Number of Points

The more points you use the more accurate the calibration will be. The limiting factor is usually the published data for the standard antenna. The accuracy and resolution of the standard gain antenna graphs or tables will be the limiting factor in calibration accuracy.

Determining the Frequency Increment

To determine the frequency increment, divide the *frequency span* by the (*number of points − 1*).

For example:

- Start frequency = 2 GHz
- Stop frequency = 4 GHz

The frequency span is 2 GHz

Assume the standard gain antenna's graph or table provides 21 decipherable data values across the 2 GHz frequency span:

Divide the frequency span by *number of points − 1*:

$2 \times 10^9 / (21 - 1) = 100$ MHz

The first frequency in your antenna definition is the start frequency (2 GHz in this example). From there, 20 *additional* points exist, each spaced 100 MHz apart. The first three frequencies would be:

2,000,000,000 Hz
2,100,000,000 Hz
2,200,000,000 Hz

The last frequency point would be the stop frequency.

Determining Gain Values at Each Frequency Increment (Graph Format)

Next, you must determine the gain values at each frequency increment. Figure 3-4 shows a typical graph-style data sheet for a standard gain antenna.

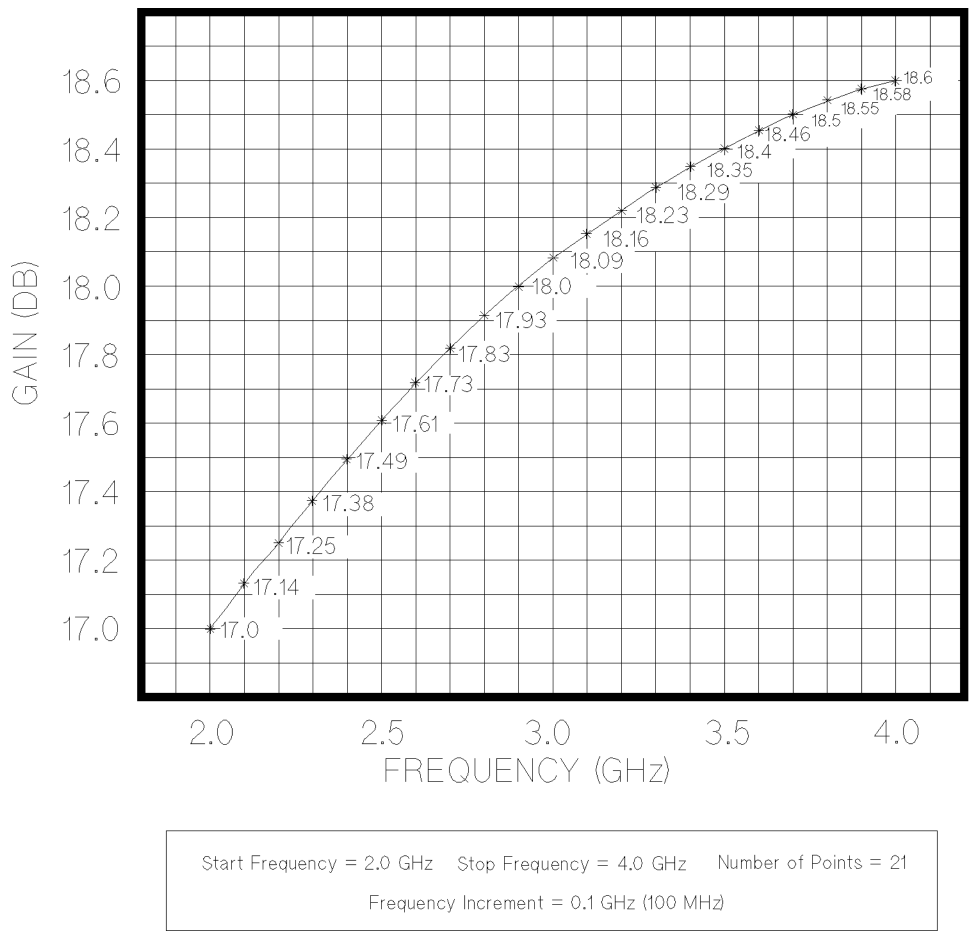


Figure 3-4. Typical Standard Gain Antenna Performance Graph

1. Choose the start and stop frequencies. Examples shown in Figure 3-4 are 2 and 4 GHz, respectively.

2. Mark the graph at each frequency increment. In the example graph an increment frequency of 100 MHz is used. You MUST use evenly-spaced frequency points, "Even Frequency Increments" explains why.
3. On the graph for *your* standard antenna, determine the gain at each frequency increment. Figure 3-4 shows example gain values for 21 frequencies spaced 100 MHz apart.
4. Write down each gain value in ascending order corresponding to the frequencies they represent.

If Using Data in Table Format

Table 3-3 shows an example performance specification table:

Table 3-3. Example Standard Gain Antenna Performance Table

FREQ. (GHz)	GAIN dB	FREQ. (GHz)	GAIN dB	FREQ. (GHz)	GAIN dB
12.4	13.82	14.3	15.02	16.2	16.21
12.5	13.88	14.4	15.08	16.3	16.28
12.6	13.95	14.5	15.14	16.4	16.34
12.7	14.01	14.6	15.20	16.5	16.41
12.8	14.07	14.7	15.26	16.6	16.46
12.9	14.14	14.8	15.33	16.7	16.52
13.0	14.21	14.9	15.39	16.8	16.59
13.1	14.27	15.0	15.45	16.9	16.65
13.2	14.33	15.1	15.52	17.0	16.71
13.3	14.40	15.2	15.58	17.1	16.76
13.4	14.46	15.3	15.65	17.2	16.81
13.5	14.52	15.4	15.71	17.3	16.87
13.6	14.58	15.5	15.77	17.4	16.93
13.7	14.65	15.6	15.83	17.5	16.99
13.8	14.71	15.7	15.89	17.6	17.05
13.9	14.77	15.8	15.95	17.7	17.11
14.0	14.84	15.9	16.02	17.8	17.18
14.1	14.90	16.0	16.09	17.9	17.24
14.2	14.96	16.1	16.15	18.0	17.30

The example graph has 57 evenly spaced frequency points that are 100 MHz apart. You will simply enter these gain values into the ASCII data file. You MUST use evenly-spaced frequency points, "Even Frequency Increments" explains why.

Even Frequency Increments

The frequency increments in the antenna definition must be evenly spaced. If you look at the example on the next page you will see why: The lines between `BEGIN` and `END` hold the gain values. Notice that these lines do *NOT* specify the frequency of each gain value. Because of this, the calibration feature must calculate the actual frequencies given the defined start frequency, stop frequency and number of points. For this reason the antenna definition gain values must represent evenly spaced frequency values.

When you perform the actual calibration you can choose any frequency points you wish. A *calibration* can be performed at any frequencies you choose. The frequencies used in the cal do *not* have to be the same as the frequencies in the antenna definition. (When calibrating, the receiver will interpolate between frequency points in the definition.) Remember, however, that a *calibration* must contain *all* the frequencies required by your measurements. When *making measurements*, the receiver *does not* interpolate between *calibration points*.

Required ASCII File Format

The ASCII file must follow the CITIfile format supported by the HP 8530A. Figure 3-5 shows an example file for the data in Figure 3-4. At first the file looks complicated. However only the items pointed out in Figure 3-5 are variable. To save time, start by editing an existing calibration definition file. One is supplied on the `Antenna RCS/Cal Disc`, which was supplied with the receiver. The file name of the file is `AC_NAR1`.

The cal definition shown in Figure 3-5 contains only one antenna definition. A cal definition with *two* antenna definitions is shown in “Creating a Cal Definition with Multiple Antenna Definitions”, later in this chapter.

```
CITIFILE A.01.01
#NA VERSION HP8530A.01.00
NAME ANTENNA_DEF
#NA DEF_LABEL uWaveA.1               <-- Defines the antenna calibration softkey label.
#NA STANDARD 1                       <-- This is cal definition #1 (of seven possible).
#NA STANDARD_LABEL SASGH-1.10        <-- Defines softkey label for this definition.
VAR FREQ MAG 21                      <-- Enter Number of Points here.
DATA GAIN[1] DB
SEG_LIST_BEGIN
SEG 2000000000 4000000000 21         <-- Enter Start stimulus value. / Enter Stop stimulus value. / Enter Number of Points (again).
SEG_LIST_END
BEGIN
1.70E1
1.714E1
1.725E1
1.738E1
1.749E1
1.761E1
1.773E1
1.783E1
1.793E1
1.80E1
1.809E1                              } Enter gain values for each stimulus point.
1.816E1                                "E1" indicates 10^1.
1.823E1
1.829E1
1.835E1
1.84E1
1.846E1
1.85E1
1.855E1
1.858E1
1.86E1
END
```

Figure 3-5. Typical Standard Gain Antenna Performance Graph

In-Depth Description of a Cal Definition

The example below is of a cal definition that contains one antenna definition. The top four lines are the header for the entire file. These lines must only occur once, at the top of the file.

```
CITIFILE A.01.01
#NA VERSION HP8530A.01.00
#NAME ANTENNA_DEF
```

These three lines should be included exactly as shown. The firmware revision on line 2 "HP8530A.01.00" does *not* need to be changed if your HP 8530A has a later firmware revision. Keeping line 2 exactly as shown above is acceptable. These lines are part of the file header.

```
#NA DEF_LABEL uWaveA.1
```

This line defines the title for the antenna calibration softkey. You can change the label "uWaveA.1" to any label you want, up to the limit of ten characters. This line is part of the file header.

```
#NA STANDARD 1
```

This line starts defining the antenna definition. When creating several antenna definitions, the number "1" should be incremented (2, 3, and so on) for each successive antenna definition. "Creating a Cal Definition with Multiple Antenna Definitions" shows an example of this.

```
#NA STANDARD_LABEL SASGH-1.10
```

This defines the softkey label for this antenna definition. You can change the label "SASGH-1.10" to any label you want, up to a maximum of ten characters. It is recommended the label be changed to reflect the type and frequency range of the standard gain antenna.

```
VAR FREQ MAG 21
```

Enter the number of frequency points at the end of this line (where the number 21 is located in this example). The rest of this line always stays the same.

```
DATA GAIN [1] DB
```

This line does not affect the antenna definition in any way, but we recommend you leave it in. (Future firmware revisions may require this line.)

```
SEG LIST BEGIN
SEG 2000000000 4000000000 21
SEG LIST END
```

These three lines define the start frequency, stop frequency, and the number of points (again). Frequencies must be expressed in Hertz. Never change the first or third line.

```
BEGIN
1.70E1
1.714E1
1.725E1
.
```

```
.
.
1.855E1
1.858E1
1.86E1
END
```

The commands "BEGIN" and "END" must surround the gain values for each frequency. Enter each gain value on a separate line. Gain values must be in ascending order corresponding to the frequencies they represent.

Saving the Cal Definition File

Save the ASCII file to MS DOS or HP LIF disc.

Note The filename must begin with the three characters: AC_

(The two letters AC followed by an underscore character.)

Loading the Cal Definition into the HP 8530A

To load a cal definition file:

1. Insert the disc into the HP 8530A's drive.
2. Press [DISC] LOAD CAL KITS ANTENNA CAL DEF, the receiver will display a file directory of all cal definition files on that disk.
3. Use the knob to select the desired cal definition and press LOAD FILE.

Press [CAL]. Notice that the key ANT. CAL contains the name you chose for that cal definition.

Press ANT. CAL FAR FIELD: RESPONSE. You will see your antenna definition names next to the softkeys buttons.

Creating a Cal Definition with Multiple Antenna Definitions

You can create up to seven antenna definitions in a single cal definition file. To do this, simply add one antenna definition right after another in the file. Do not repeat lines 1 through 4. Change "STANDARD 1" to "STANDARD 2" in the second antenna definition, to "STANDARD 3" in the third, and so on.

Change the label in the "#NA STANDARD LABEL" line in each antenna definition. Use labels that are appropriate for each standard gain antenna. Do not use underscore _ characters in labels. To avoid problems use keys A through Z, numbers 0 through 9, and dashes (-).

Here is an example of two antenna definitions in one file.

```
CITIFILE A.01.01
#NA VERSION HP8530A.00.26
NAME ANTENNA_DEF
#NA DEF_LABEL uWave A.1
#NA STANDARD 1
#NA STANDARD_LABEL SASGH-1.10
VAR FREQ MAG 10
DATA GAIN[1] DB
SEG_LIST_BEGIN
SEG 1100000000 1700000000 10
SEG_LIST_END
BEGIN
1.63E1
1.64E1
1.65E1
1.66E1
1.67E1
1.68E1
1.685E1
1.69E1
1.7E1
1.71E1
END
#NA STANDARD 2
#NA STANDARD_LABEL SA12-1.70
VAR FREQ MAG 10
DATA GAIN[1] DB
SEG_LIST_BEGIN
SEG 1700000000 2600000000 10
SEG_LIST_END
BEGIN
1.61E1
1.62E1
1.64E1
1.65E1
1.67E1
1.68E1
1.69E1
1.7E1
1.71E1
1.72E1
END
```

When you load this file into the receiver, these two antenna definitions will go into top two Far-Field:Response menu positions.

Details on the Supplied Antenna Definitions

The supplied cal definition contains seven Narda antenna definitions. This cal definition is *not* loaded into receiver memory at the factory. Refer to Table 3-4. Only one cal definition file can be loaded into the receiver at one time.

The Narda cal definition file is supplied on the `Antenna/RCS Cal Disc`, under the file name: `AC_NAR1` The `Antenna/RCS Cal Disc` is DOS compatible. The file `AC_NAR1` has two uses:

- You can load `AC_NAR1` into the HP 8530A.
- You can make copies of the file and modify them to create your own definitions.

Table 3-4. Antenna Definitions in the Supplied Cal Definition

Definition Name	Manufacturer	Model Number	Frequency Range
NAR 645	Narda	645	1.70 to 2.60 GHz
NAR 644	Narda	644	2.60 to 3.95 GHz
NAR 643	Narda	643	3.95 to 5.85 GHz
NAR 642	Narda	642	5.40 to 8.20 GHz
NAR 640	Narda	640	8.20 to 12.40 GHz
NAR 639	Narda	639	12.40 to 18.00 GHz
NAR 638	Narda	638	18.00 to 26.50 GHz

The most recently-loaded cal definition is saved in non-volatile memory, and is retained when you turn AC power OFF.

4

Measurement Tutorials

This chapter gives more in depth information on making measurements. Feature choices are explained so you can customize measurements to suit your needs. The following subjects are covered:

Chapter Contents

For information on common measurement tasks such as boresighting, averaging, finding depth of null, and so on, refer to Chapter 5.

Angle Domain Measurement Tutorial

The following explains how you can customize angle domain measurements to suit your specific needs.

Note If you have the HP 85370A Position Encoder, and have not configured the receiver to use it, make the appropriate configuration settings as explained in "HP 85370A Position Encoder Operation" before proceeding.

Step 1. Choose Internal, External, or HP-IB Triggering

Selecting HP-IB or TTL Trigger

The HP 8530A provides three trigger modes for use with antenna measurements. Press STIMULUS (MENU) MORE TRIGGER MODE, then one of the following:

TRIG SRC INTERNAL In Angle Domain, internal triggering is appropriate when using the HP 85370A Position Encoder. If you *do not* use the Position Encoder, use External Trigger or HP-IB Trigger (described below). Internal triggering causes the receiver to trigger itself automatically.

TRIG SRC HPIB HP-IB Trigger. In this mode a computer controller must issue a GET command over the HP-IB bus to start a measurement. The receiver pulls the rear panel STOP SWEEP BNC line (TTL) HIGH when ready to take data. More information on HP-IB triggering is supplied under "TRIG SRC HPIB" in the keyword dictionary.

TRIG SRC EXTERNAL This mode is appropriate if your system *does not* use the HP 85370A Position Encoder. This trigger mode starts a measurement when a negative-edge TTL signal arrives at the rear panel EVENT TRIGGER input BNC. The trigger pulse usually comes from the positioner controller's INCREMENT Trigger output. This allows the positioner to trigger a measurement at each increment angle. The receiver pulls the rear panel STOP SWEEP BNC line (TTL) HIGH when ready to take data.

The annotation E appears on the left-hand side of the display if you are using external or HP-IB triggering.

Step 2. Choose a Measurement Frequency

Press STIMULUS (MENU) FREQUENCY of MEAS., then enter the desired CW test frequency.

Step 3. Choose a Single Angle or Swept Angle Measurement

Next, select whether you want to measure a single angle or an angle scan (swept angle). An angle sweep takes a number of data points across a range of angles. For example, you might sweep from −90 degrees to +90 degrees.

The following choices are available (under STIMULUS (MENU)) when using the Angle Domain.

Single Angle This mode is useful when boresighting an antenna when you are in the Angle Domain. Pressing SINGLE ANGLE measures a single antenna angle. Allowable angular coordinates on the HP 8530A are −360 to +360 degrees. If you select Single Angle, the display will show a flat line that represents the value of the measured signal. Continual measurement mode (described below) and internal triggering are suggested when using the Single Angle mode.

SWEPT ANGLE Pressing SWEPT ANGLE measures a range of angles. Use the START and STOP keys to enter the desired start and stop angles. Use INCREMENT ANGLE to choose the desired angular increment.

Note Remember that the HP 8530A does not control the positioner, and it does not send commands to the positioner controller. If your positioner system allows you to "program" a manual measurement from its front panel, set it for the desired start, stop, and increment angle. Now enter these values into the HP 8530A.

If your positioner system is completely manual, just enter start, stop, and increment angles into the HP 8530A.

Step 4. Choose Single or Continual Measurements

While in the Stimulus Menu, press MORE and choose one of the following:

SINGLE In this mode, the receiver measures a single pattern measurement. When the measurement is done, the receiver goes into Hold mode (it stops making measurements). The receiver will wait in hold mode until SINGLE is pressed again, or until you press MEASUREMENT RESTART.

Single mode is recommended whenever your system is in external trigger mode. The advantage of using single mode is that, when the measurement is done, the receiver goes into "hold mode" and ignores any subsequent trigger pulses. This keeps the system from responding to false triggers. (This also ensures that the receiver will not start a measurement accidentally when you are just moving the antenna positioner around.) Pressing SINGLE or RESTART prepares the receiver to make another single sweep measurement.

CONTINUAL is recommended when making SINGLE ANGLE measurements, or if you are using the HP 85370A Position Encoder. In Angle Domain, CONTINUAL allows the receiver to make a measurement any time you move the positioner forward past the selected starting angle.

Note If you are using Continual measurements with external triggering, HP recommends that you set "automatic IF correction" to manual mode. Refer to "External Triggering", later in this chapter, for more information.

Step 5. Choose which Parameters to Measure

The receiver measures parameter that are displayed on the screen. The receiver *does not* measure parameters that *are not* displayed on the screen.

The number of parameters to be measured is selected by pressing DISPLAY DISPLAY MODE, then one of the following softkeys:

SINGLE PARAMETER causes the receiver to measure and display one parameter. Choose the desired parameter by pressing PARAM 1, PARAM 2, PARAM 3, or PARAM 4.

TWO PARAMETER	causes the receiver to measure and display PARAM 1 and PARAM 2 for the active channel.
THREE PARAMETER	causes the receiver to measure and display PARAM 1, PARAM 2, and PARAM 3 for the active channel.
FOUR PARAMETER	causes the receiver to measure and display all four parameters for the active channel.
DUAL CHANNEL	causes the receiver to measure and display one parameter (of your choice) in each channel. For each channel, choose the desired parameter by pressing (PARAM 1), (PARAM 2), (PARAM 3), or (PARAM 4) keys.

Step 6. Make a Swept Measurement

Making Swept Measurements Using Single Sweep Mode

1. If your positioner controller requires it, enter the start, stop, and increment angle using its front panel controls. If you can move the antenna using a simple knob, skip this step.
2. Enter start, stop, and increment angles into the receiver.
3. Press: STIMULUS (MENU) MORE SINGLE or simply press MEASUREMENT (RESTART).
4. Move the positioner about 3° *in front of* the start angle. When the receiver displays MOVE POSITIONER ANGLE FORWARD it is ready to make the measurement.
5. Move the antenna to the stop angle.

To measure another sweep

6. Press SINGLE or MEASUREMENT (RESTART) again.
7. Move the positioner about 3° in front of the start angle.
8. Move the antenna to the stop angle.

Making Swept Measurements Using Continual Sweep Mode

1. If your positioner controller requires it, enter the start, stop, and increment angle using its front panel controls. If you can move the antenna using a simple knob, skip this step.
2. Enter start, stop, and increment angles into the receiver.
3. Move the positioner about 3° *in front of* the start angle. When the receiver displays MOVE POSITIONER ANGLE FORWARD it is ready to make the measurement.
4. Move the antenna to the stop angle.

To measure another sweep

5. Move the positioner about 3° in front of the start angle.
6. Move the antenna to the stop angle.

External Triggering

Before You Use External Trigger Modes

Read this if you are using Continual or Number of Groups mode, and the receiver is externally triggered:

Before you select an external trigger mode, you should disable the automatic IF Correction feature of the HP 8530A. (Remember do this *only* if you are using Continual or Number of Groups mode, and the receiver is externally triggered). IF Correction is a feature that periodically calibrates the IF stages of the receiver. When this "invisible" calibration occurs, there is a small interruption in the measurement. In internal triggering, this delay is not a problem. However, in external triggering applications (such as angle scan antenna measurements), this delay can disrupt the measurement. You can avoid this problem in either of the following ways:

- You can use single mode by pressing: STIMULUS (MENU) MORE SINGLE.

  or

- You can turn automatic IF correction OFF by pressing: (SYSTEM) IF CORRECTION IF CORRECT MANUAL.

  If you select IF CORRECT MANUAL, you will get greatest IF gain accuracy if you perform a RESET IF CORRECTION command before starting each measurement. RESET IF CORRECTION causes the receiver to perform an IF correction.

Note If sweep mode is set to Single (STIMULUS (MENU) MORE SINGLE, you can leave the IF Correction feature set to AUTO.

After making Continual measurements, if you go back to single sweep mode, or leave external trigger mode, remember to turn IF correction back to AUTO.

Using External Trigger Modes

TTL or HP-IB triggering can be modified to suit your needs. By default triggering works as follows:

- If you are displaying a single parameter, each trigger causes the receiver to:
  1. Measure the selected parameter at the current angle or frequency.
  2. If in Frequency Domain, the receiver advances to the next frequency. If in Angle Domain, the analyzer advances its internal increment angle counter. The positioner must be moved by the operator or computer controller.
  3. Wait for another trigger (see Figure 4-1).

External Triggering

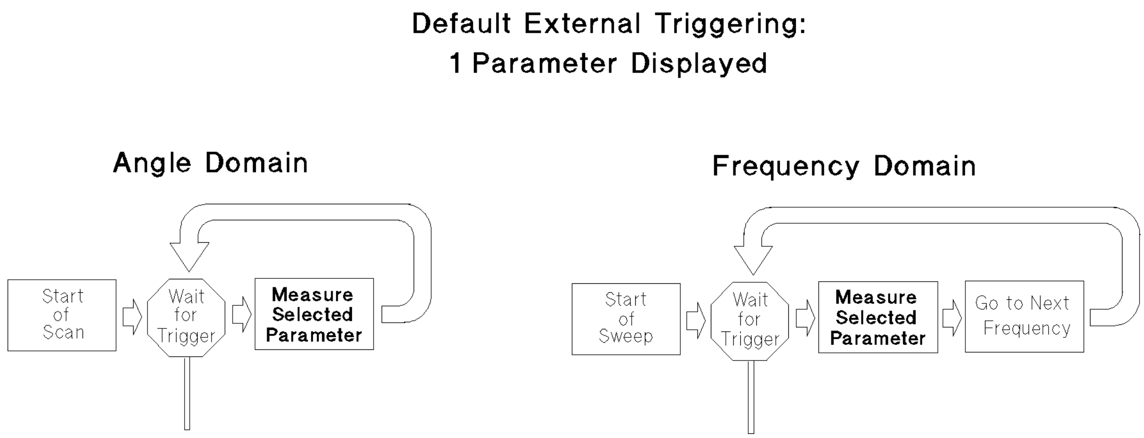


Figure 4-1. Default External Triggering Flowchart (single parameter)

- If you are displaying four parameters, each trigger causes the receiver to:
  1. Measure all four parameters at the current angle or frequency.
  2. If in Frequency Domain, the receiver advances to the next frequency. If in Angle Domain, the analyzer advances its internal increment angle counter. The positioner must be moved by the operator or computer controller.
  3. Wait for another trigger (see Figure 4-1).

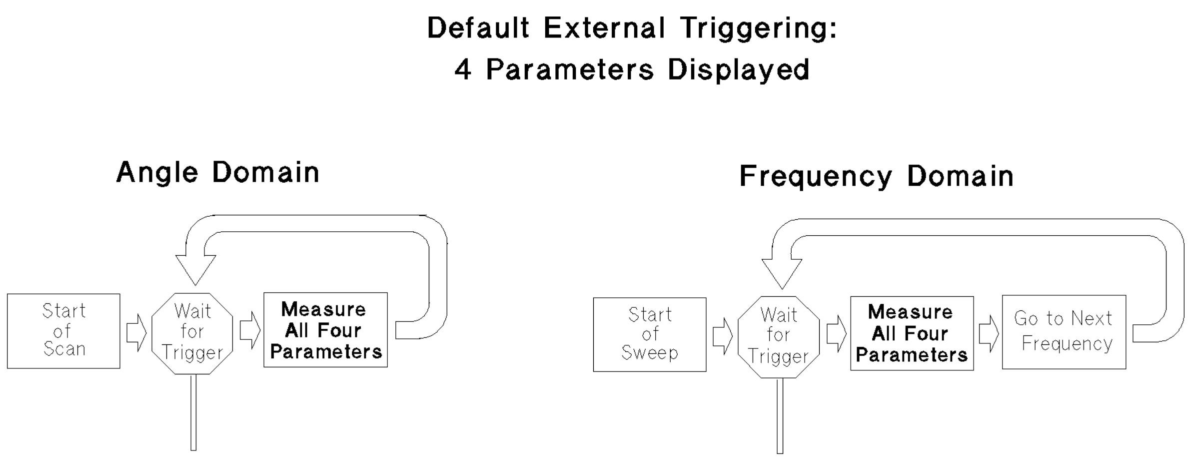


Figure 4-2. Default External Triggering Flowchart (four parameters)

Advanced Triggering Features

The Trigger menu softkeys (under STIMULUS (MENU) MORE TRIGGER MODE) provide greater triggering flexibility. They instruct the receiver to wait for a trigger before measuring specific parameters or before it advances to the next stimulus point. (This is the next angle in Angle Domain, or the next frequency in Frequency Domain.)

Here is a description of each custom triggering softkey:

TRIGGER: STIMULUS — When turned ON (underlined), TRIGGER: STIMULUS forces the receiver to wait for a trigger before moving to the next stimulus point. TRIGGER: STIMULUS allows you to use RF sources that are not compatible with the HP 8530A System Bus.

TRIGGER: PARAM 1 — When turned ON, the receiver to waits for a trigger pulse before measuring parameter 1.

TRIGGER: PARAM 2 — When turned ON, the receiver to waits for a trigger pulse before measuring parameter 2.

TRIGGER: PARAM 3 — When turned ON, the receiver waits for a trigger pulse before measuring parameter 3.

TRIGGER: PARAM 4 — When turned ON, the receiver waits for a trigger pulse before measuring parameter 4.

Each of these softkeys is an ON/OFF toggle, and you can turn them on or off in any combination. When a softkey title is underlined, that function is ON. When the title is not underlined, the function is OFF.

How these Functions Work when One Parameter is Being Measured

The TRIGGER: STIMULUS function can always be used. However, the TRIGGER: PARAM functions work differently. If you are only displaying (measuring) one parameter, only the TRIGGER: PARAM softkey for *that* parameter will have an effect on triggering.

For example, if you are viewing parameter 2, as shown in Figure 4-3, only the TRIGGER: PARAM 2 softkey will work. The other parameter-related softkeys TRIGGER: PARAM 1 , TRIGGER: PARAM 3 , and TRIGGER: PARAM 4 will be ignored, because these parameters are not being measured.

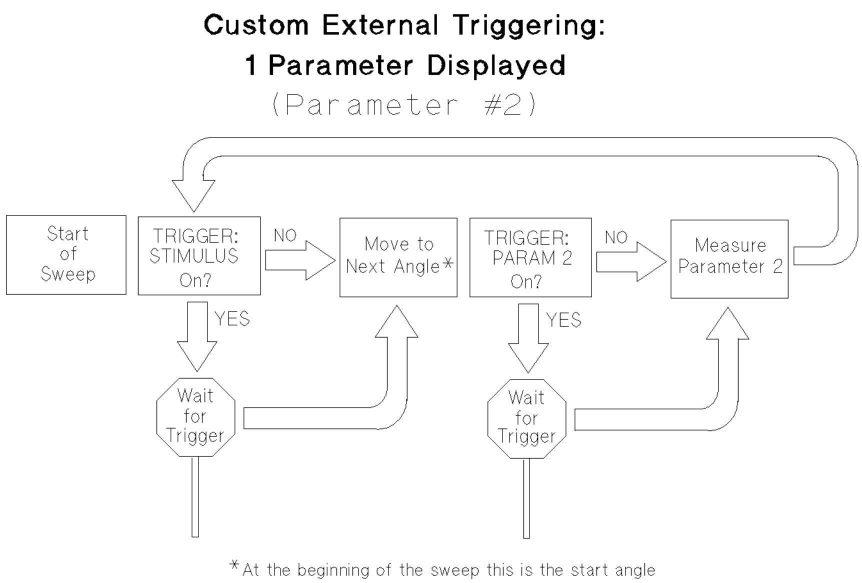


Figure 4-3. Custom External Triggering Flowchart (one parameter)

How these Functions Work when Four Parameters are Being Measured

If four parameters are being measured, the receiver will check the ON/OFF condition of each softkey (TRIGGER: PARAM 1 , TRIGGER: PARAM 2 , TRIGGER: PARAM 3 , and TRIGGER: PARAM 4) before it measures them. Refer to Figure 4-4. If TRIGGER: PARAM 1 is on, for example, the receiver will wait for a trigger before it measures parameter 1. This process repeats for each parameter.

EXAMPLE 1

TRIGGER: STIMULUS	ON
TRIGGER: PARAM 1	OFF
TRIGGER: PARAM 2	OFF
TRIGGER: PARAM 3	OFF
TRIGGER: PARAM 4	OFF

In this example, the receiver will:

1. In Angle Domain: Wait for one trigger before *internally* selecting the start angle (or the next angle in the measurement). This only affects internal receiver circuitry, it does not move the positioner!

   In Frequency Domain: Wait for one trigger before it commands the RF source (and LO source, if used) to switch to the start frequency (or the next frequency in the measurement).

2. When the trigger arrives:

   In Angle Domain: The receiver internally selects the start angle, or the next angle in the measurement.

   In Frequency Domain: The receiver commands the RF source (and LO source, if used) to switch to the start frequency, or the next frequency in the measurement.

3. The receiver measures *all four* parameters.
4. This process repeats for each successive trigger.

Note that only one trigger is required per stimulus point. Thus, the receiver can trigger off the Record Increment output from a positioner controller.

The most common use for TRIGGER: STIMULUS is when using an RF source that is not controlled by the HP 8530. TRIGGER: STIMULUS allows you to move the source to the next stimulus point, then have the receiver make the measurement.

EXAMPLE 2

TRIGGER: STIMULUS	OFF
TRIGGER: PARAM 1	ON
TRIGGER: PARAM 2	OFF
TRIGGER: PARAM 3	OFF
TRIGGER: PARAM 4	OFF

In this example, the receiver will:

1. In Angle Domain: Internally select the start angle (or the next angle in the measurement). This only affects internal receiver circuitry, it does not move the positioner! Notice that this occurs before the trigger arrives.

   In Frequency Domain: Commands the RF source (and LO source, if used) to switch to the start frequency (or the next frequency in the measurement). Notice that this occurs before the trigger arrives.

2. Wait for a trigger pulse before measuring parameter 1.
3. When the trigger arrives, the receiver will measure *all four* parameters. Why? Since the other three "wait for a trigger" softkeys are OFF, they will be measured along with parameter 1.
4. This process then repeats for each successive trigger.

This configuration is the default external trigger setup, and will work if using the Record Increment from a positioner controller.

EXAMPLE 3:

TRIGGER: STIMULUS	OFF
TRIGGER: PARAM 1	ON
TRIGGER: PARAM 2	OFF
TRIGGER: PARAM 3	ON
TRIGGER: PARAM 4	OFF

In this example, the receiver will:

1. In Angle Domain: Internally select the start angle (or the next angle in the measurement). This only affects internal receiver circuitry, it does not move the positioner! Notice that this occurs before the trigger arrives.

   In Frequency Domain: Commands the RF source (and LO source, if used) to switch to the start frequency (or the next frequency in the measurement). Notice that this occurs before the trigger arrives.
2. Wait for a trigger pulse before measuring parameter 1.
3. When the trigger arrives, the receiver will measure parameters 1 and 2, then it will stop and wait for another trigger.
4. When the second trigger arrives, the receiver will measure parameters 3 and 4.
5. This process then repeats for each successive trigger.

This setup could be used if you need to measure two parameters, then switch inputs using external hardware before measuring the second two parameters.

Note If you are in External Trigger mode, and you turn all five softkeys OFF, the receiver will never wait for any triggers. Instead, it will "free run" as if it were in the Internal Trigger mode. *However*, the HP 85370A Position Encoder will not work properly in this situation. The Encoder requires that you select the actual Internal Trigger mode (TRIG SRC INTERNAL) or it will not operate properly.

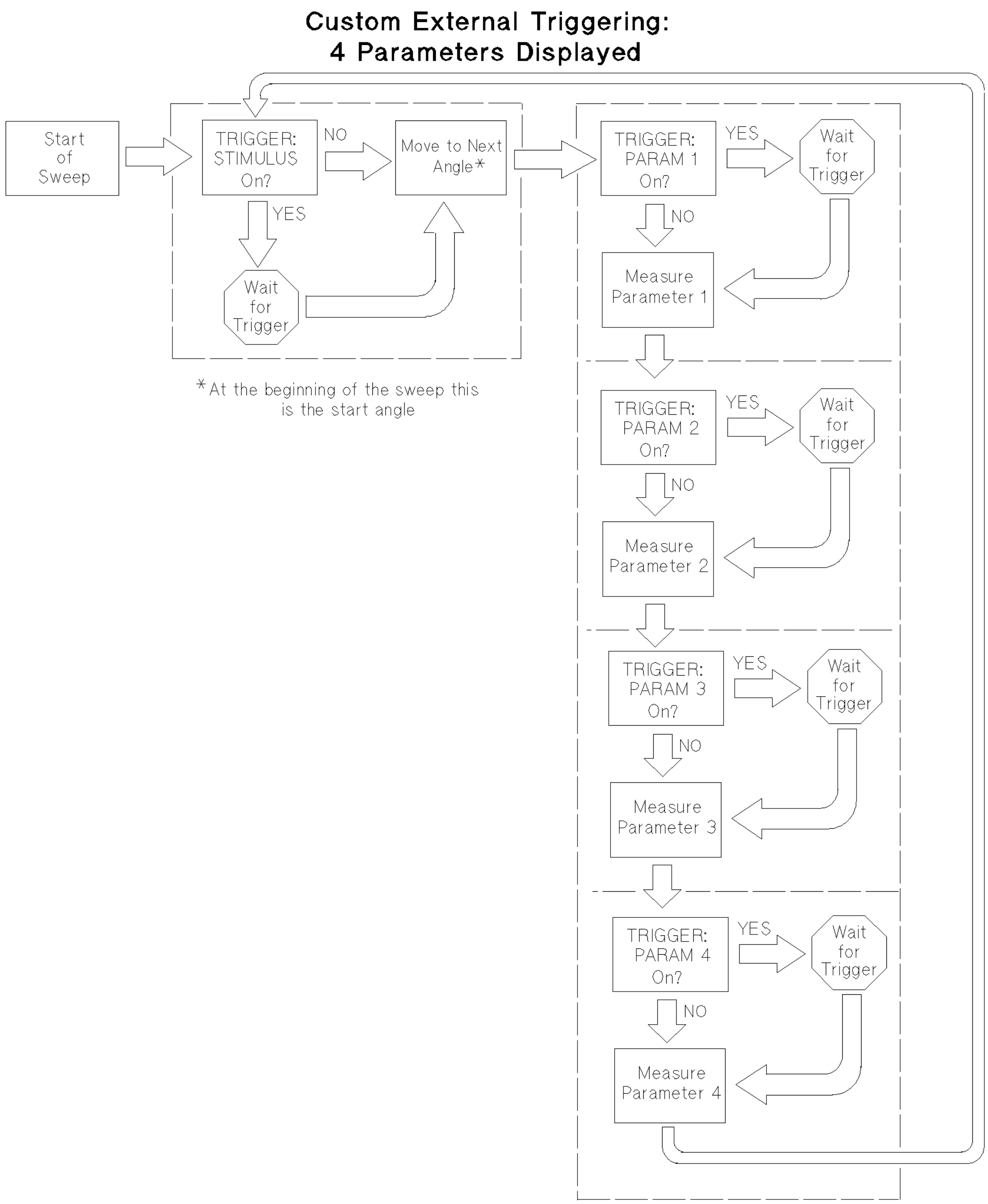


Figure 4-4. Custom External Triggering Flowchart (four parameters)

HP 85370A Position Encoder Operation

Introduction

This chapter explains how to operate the HP 8530A softkeys that control the HP 85370A Position Encoder. Remember, the HP 85370A only works when the HP 8530A is equipped with option 005, "Position Encoder Interface." This chapter assumes that the positioner encoder is installed and configured as explained in the *HP 85370A Position Encoder Installation and Service Manual*.

Position Encoder Softkeys

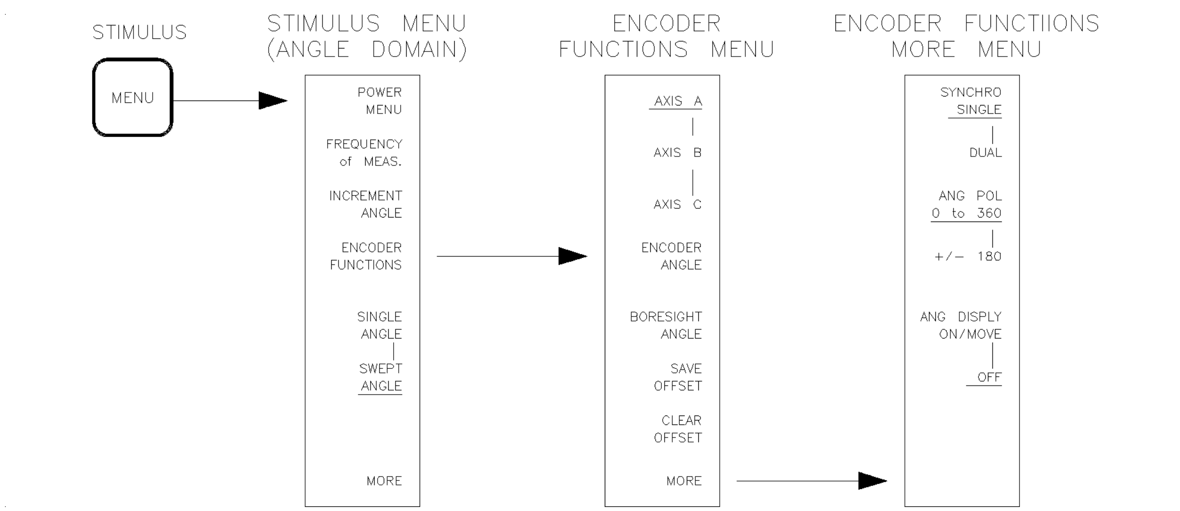


Figure 4-5. Position Encoder (option 005) Softkeys

To access the Position Encoder menus, press:

(DOMAIN) ANGLE

STIMULUS (MENU) ENCODER FUNCTIONS

The position encoder softkeys are listed below:

- Position encoder operation functions:

  AXIS A , AXIS B , or AXIS C

  BORESIGHT ANGLE

  SAVE OFFSET and CLEAR OFFSET

- Position encoder configuration functions (press MORE to see these functions):

  SYNCHRO SINGLE or DUAL

  ANG POL 0 to 360 or +/-180

  ANG DISPLY ON/MOVE or OFF

Configuration Functions

Single and Dual Synchro

The single and dual synchro control softkeys are:

SYNCHRO SINGLE — Selects single synchro (1:1) operation. This is also referred to as coarse resolution mode. This setting is applied independently to each axis.

DUAL — Selects dual synchro (1:1 and 36:1) operation. This is also referred to as fine resolution mode. This setting is applied independently to each axis.

Selecting single and dual synchro mode for any axis. Note: Select single and dual settings independently for each axis.

1. Press: (DOMAIN) ANGLE
   STIMULUS (MENU) ENCODER FUNCTIONS
2. Select the desired axis by pressing: AXIS A, AXIS B, or AXIS C
3. Press: MORE SYNCHRO SINGLE or DUAL
4. Repeat the last two steps for each axis.

Angle Display Modes

The angle display mode softkeys are:

ANG POL 0 to 360 — Causes the HP 8530A and the position encoder to display angles in 0 to 360° format.

+/-180 — Causes the HP 8530A and the position encoder to display angles in ±180° format.

ANG DISPLY ON/MOVE — This softkey performs two functions:

1. If angle display is already turned ON, this softkey moves the angle readout to a different position on the display. There are five different positions.

2. It turns the angle readout ON if it was previously OFF. This affects the HP 8530A display.

From the Encoder More menu, press ANG DISPLY ON/MOVE. The position of the angle readout changes. There are five possible positions. One of the positions is above the Time/Date box, in the lower right-hand corner of the screen. This position cannot be seen if softkeys are being displayed. Press (PRIOR MENU) until the softkey menus disappear, and you will be able to see the angle readout.

OFF — Turns the HP 8530A angle display OFF.

Operational Functions

Axis Controls

AXIS A, AXIS B and AXIS C select the axis that is currently in use. Angles are displayed for the selected axis on the HP 8530A and on the position encoder. When you change between axes, the receiver recalls any previously-used offset (described later), and whether single or dual synchro mode was selected.

Boresight Angle

BORESIGHT ANGLE places the active marker at the peak of the antenna pattern. This is the first step during boresighting. Once the active marker is at the peak, you can save this value as an offset. Subsequent measurements will show the peak at 0°. BORESIGHT ANGLE turns OFF any delta markers that are in use.

You can also use the normal marker features to place an active marker on boresight. An example of this is provided in "Finding Boresight" in Chapter 5. It is easiest to find boresight using normal marker functions if your antenna has a non-symmetrical shape. Refer to "Using Markers" in Chapter 5 for instructions.

Offset Functions

The softkeys that control angle offset are shown below:

SAVE OFFSET — For use after boresighting. SAVE OFFSET "zeros" the angle readout on the receiver and position encoder. *The offset does not take effect until the next angle scan of the positioner.* You would perform this step after using the BORESIGHT ANGLE key. (You could also move the active marker to boresight manually, then use SAVE OFFSET.)

For example, assume boresight for axis A is at +7 degrees. Assume you have placed the active marker at that position (using normal marker functions or BORESIGHT ANGLE). Pressing SAVE OFFSET (and taking another sweep) would cause boresight to appear at 0°. All angle readings will be displayed relative to that angle (for that axis only).

CLEAR OFFSET — Clears the offset memory completely and eliminates any offset currently in use.

Details about Save Offset

Offsets are axis-independent. Save Offset operates independently for each of the three axes. The receiver also remembers the offsets you used last for each axis.

Adding incremental offsets. If conditions cause the boresight to change, move the active marker to the new boresight (manually or with BORESIGHT ANGLE), and press SAVE OFFSET again. (NOTE: you *must* take another sweep before pressing SAVE OFFSET a second time.) The incremental change will be added to the offset. SAVE OFFSET remembers the first offset you use, and adds or subtracts subsequent SAVE OFFSET values incrementally to the original value. You must take a sweep between each press of the SAVE OFFSET softkey.

Here is an example of how Save Offset works. Assume boresight for axis A is at +7°. You move the active marker to that angle (by whatever means) and you press SAVE OFFSET. Now you measure another sweep. Boresight will now appear to be at 0° (angle readings are offset by 7°).

Later in the day you change antennas, and boresight moves 1° in a positive direction. If you place a marker at that point, and press SAVE OFFSET again, the offset will change by 1°, for a total offset of 8°. Remember, the change will not take effect until the next angle scan.

CLEAR OFFSET clears the offset memory, so you can enter a new starting offset. Offset is actually cleared on the next angle scan.

The offset value is saved with the instrument state when you use the (SAVE) and (RECALL) keys. This allows you to save different offsets in the Save/Recall registers for later use.

Using offset functions. The Offset function is shown in "Finding Boresight" in Chapter 5.

Encoder Settings and Save/Recall Registers

All the encoder configuration and operational settings are saved when you use Save/Recall registers.

Frequency Domain Measurement Tutorial

The following explains how you can customize frequency domain measurements to suit your specific needs.

Step 1. Select Internal Triggering

Press STIMULUS (MENU) MORE TRIGGER MODE TRIG SRC INTERNAL

In internal trigger mode, the receiver makes measurements without requiring any external triggering.

Step 2. Choose a Single Point or Swept Measurement

Next, select whether you want to take a single point of data or a "sweep." A sweep takes a number of data points across the frequency range. Use (START), (STOP), or (CENTER) and (SPAN) keys to enter the desired sweep range. Use NUMBER of POINTS to select the number of frequency points to measure.

The following choices are available (under STIMULUS (MENU)) when using the Frequency or Time Domain.

- Single Point mode
- Ramp sweep mode
- Step sweep mode
- Frequency List mode

Single Point mode

Single Point mode measures a single frequency. This mode is useful when boresighting an antenna or RCS target when you are in the Frequency Domain.

Step Sweep mode

Step Sweep mode measures each stimulus point separately. Step mode is slower than Ramp mode, but provides synthesized frequency accuracy (it phase locks at each frequency point). Use the (START) and (STOP), or (CENTER) and (SPAN) keys to enter the desired sweep range. NUMBER of POINTS specifies the number of frequency points measured. The receiver chooses evenly-spaced measurement points within the selected sweep. This mode is available only with synthesized sources.

To Increase Step Sweep and Frequency List Mode Measurement Speeds

Method 1, check RF (and LO) source versions. Using a newer HP 8360 source, or one that is upgraded as shown in Table B-2, will provide significant speed increases (compared to measurements made with HP 8340/41 or older HP 8360 sources). HP has observed speed increases *up to* a factor of 5 by using the newer HP 8360 sources. After being upgraded, some systems may have speed increases that are less than this, however.

Use Quick Step mode, if possible =steptype>. There is a fast phase-locking mode, called "Quick Step," which increases the speed of Step Sweep measurements *up to* a factor of six. After being upgraded, some systems may have speed increases that are less than this, however. There are two system requirements when using Quick Step mode:

- The RF source must be an HP 836xx-family source with a firmware revision that is compatible with Quick Step Mode. A list of these sources is provided in “Fast measurement speed and Quick Step mode” in Appendix B. Specifically, refer to Table B-2.
- Two BNC connections must be made between the RF source and the Receiver. This means that far-field ranges (where the RF source is a great distance away from the receiver) will not be able to use Quick Step mode.

To use Quick Step mode:

1. Connect the receiver’s TRIGGER IN BNC to the source’s TRIGGER OUT BNC.
2. Connect the receiver’s STOP SWP BNC to the source’s STOP SWEEP BNC.
3. Press [SYSTEM] MORE SYSTEM PHASELOCK STEP TYPE: QUICK

The important facts about the quick-step phaselock method are:

- Each data acquisition point is fully synthesized.
- The source is “tuned” from point-to-point; it does not break phaselock.
- The receiver remains phaselocked to the source except at the source bandcross points or when the test VTO needs to reset.
- Averaging factors above 128 affects Quick Step speed.

The HP 8530A uses STEP TYPE: NORMAL if the source is not compatible with quick step. HP 8340/41 sources are NOT compatible with quick step.

Frequency List mode

Frequency List mode allows you to enter a list of specific frequencies that you want to measure. The receiver phase-locks to each frequency. Instructions on creating a frequency list are provided in “Creating a Frequency List” in Chapter 5.

Ramp Sweep mode

Ramp Sweep mode sweeps using an analog or digital frequency-tracking signal from the RF source. Ramp Sweep mode is much faster than Step Sweep or Frequency List mode, but it is not as frequency accurate. (Ramp mode does not phase lock at each frequency, Step and Frequency List modes do.)

To use Ramp mode, BNC cables must be connected between the RF source and the receiver (refer to Figure 4-6). This is why ramp mode is not used in some RCS ranges. In addition, systems that use an LO source cannot use Ramp mode.

Use the [START] and [STOP], or [CENTER] and [SPAN] keys to enter the desired sweep range. Use NUMBER of POINTS to enter the desired number of points. The receiver chooses evenly-spaced measurement points within the selected sweep. A larger number of points provides more accuracy, but takes more time to measure.

Figure 4-6. BNC Connection Required when Using Ramp Sweep or Quick Step Modes

In Ramp mode, averaging is performed by repeating entire sweeps (a running average). When using averaging with Ramp mode, you must allow the receiver to sweep a number of times before the data is fully averaged. To determine how many sweeps must be taken, add 1 to the selected averaging factor. For example, if averaging is set to 16, the receiver must take 17 sweeps.

If you are in Continual mode, allow the receiver to sweep the required number of times before using the data. If you are controlling the receiver with a computer, you can set NUMBER of GROUPS to the required value. The receiver will take the specified number of sweeps and stop.

In Ramp mode, an HP 836xx-family synthesized source is much more frequency-accurate than a sweep-oscillator source.

Sweep Time

The SWEEP TIME softkey in the stimulus menu allows the amount of time it takes to complete a frequency sweep to be changed. If step sweep or frequency list mode is selected, sweep time changes to dwell time and the softkey label changes to DWELL TIME. Dwell time is the amount of time the analyzer waits after the source is settled at the frequency point in the frequency list to make a measurement.

To change the sweep time:

1. Press STIMULUS (MENU), SWEEP TIME. The current value appears in the active entry area.
2. Use the ENTRY block controls to set the new sweep time. (The unit terminator keys (x1) = seconds and (k/m) = milliseconds.)

If the sweep/dwell time selected is faster than the response time of the DUT, a distorted measurement response is obtained. Distortion of the trace or an error message indicates the sweep is too fast. In general, the optimum sweep time can be determined using the following formula:

$$SweepTime(s) > \frac{[Span(Ghz)][GroupDelay(ns)]}{100}$$

The length of the dwell time can be determined as follows:

$$DwellTime(ms) = \frac{SweepTime(ms)}{NumberofPoints - 1}$$

Select the fastest possible sweep time or the shortest possible dwell time that does not result in a distortion of the trace. In the ramp sweep mode, the standard preset state selects a sweep time of 166.0 ms per sweep for 51, 101, 201, and 401 points, or 184.0 ms per sweep for 810 points.

Step 3. Choose Single or Continual Measurements

Press STIMULUS (MENU) MORE. The top four function keys control how many complete measurements should me taken at a time. Here is a description of each:

Single: SINGLE instructs the receiver to measure one “group” (a complete measurement). When the measurement is done, the receiver goes into Hold mode. (Hold mode is a state where the receiver performs no measurements.) The receiver will wait in hold mode until SINGLE is pressed again.

In Step or Frequency List modes, with external triggering, Single measures one frequency point each time a trigger pulse is received. If two or more parameters are measured on each trigger, one data point *for each parameter* is measured.

If you are using internal triggering, Single measures one entire sweep.

Continual — Pressing CONTINUAL causes the receiver to repeat the measurement continuously.

Step 4. Choose which Parameters to Measure

Press (DISPLAY) DISPLAY MODE, then one of the following softkeys:

- SINGLE PARAMETER
- TWO PARAMETER
- THREE PARAMETER
- FOUR PARAMETER
- DUAL CHANNEL

The function performed by each of these keys is explained earlier in this chapter.

GRATICULE OVERLAY is available when viewing dual channel or four parameter displays. This function superimposes the measurement traces on the same graticule.

SPLIT is also available when viewing dual channel or four parameter displays. This function places data for each channel or parameter on a separate grid.

5

Common Measurement Tasks

This chapter explains how to perform specific tasks with the HP 8530A. The following subjects are explained:

Chapter Contents

Saving and Recalling Instrument States (Measurement Settings)

The Instrument State contains virtually all instrument settings, including the controlled functions of the source and the frequency converter. The contents of calibration and trace memories are not saved. HP-IB address settings are not saved either. (HP-IB addresses and other configuration-related settings can be stored to a "Hardware State" file. Refer to the *HP 8530A Operating and Programming Manual* for details.

There are eight storage registers for Instrument States, numbered from 1 to 8. After saving several Instrument States, you can instantly change between measurement setups by selecting the desired register. Only one Instrument State is active at any given time.

Saving and Recalling Instrument States

The following steps explain how to store instrument settings to an Instrument State register. They also explain how to recall saved states.

1. Press (SAVE) to bring the Instrument State select menu onto the display.
2. Press the 1 2 3 4 5 6 7 or 8 softkey to save the Instrument State in the corresponding storage register (1 through 8).
3. Press RECALL 1 through 8 to recall an Instrument State that you saved earlier.

User Preset

If you save an Instrument State to register 8, that state will be recalled whenever:

- The instrument is turned ON.
- (USER PRESET) is pressed.
- You load a Machine Dump file.

Loading Instrument States From Disc

The receiver has eight Instrument State registers. When you load an Instrument State from disc, you must select the destination register.

Note Simply loading a state from disc *does not* make it the active Instrument State. You must (RECALL) the Instrument State before it will go into effect.

Refer to the next section, Chapter 6, for actual instructions on how to load Instrument States from disc.

Using Markers

Markers show quantitative stimulus and magnitude (or phase) values for a chosen spot on the displayed trace. In typical antenna measurements, markers show the magnitude and angle at the marker's current position. This information is displayed in the *marker data readout*, which is located top-center portion of the display. The most recent marker selected is the *active marker*. Only the active marker can be moved.

Press (MARKER) MARKER 1 to activate Marker 1. You can move the marker with the knob, step keys, or by entering a specific stimulus value (a specific angle in this case).

Moving the Marker to the Peak

Move the marker to the peak of the main lobe by:

1. Turn a marker ON as explained above.
2. Press MORE MAXIMUM.

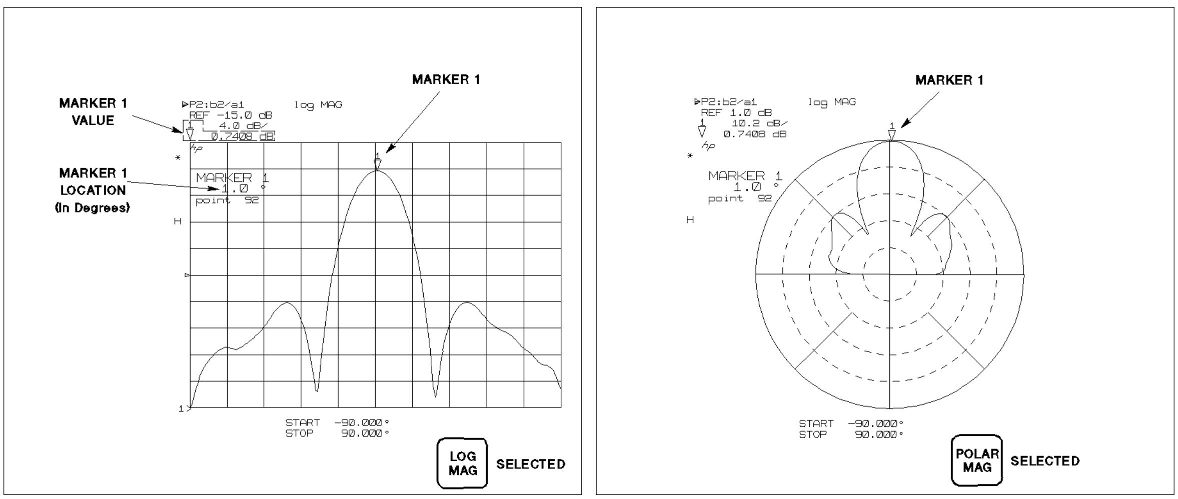


Figure 5-1. Typical Measurement with One Marker

If your receiver is equipped with the HP 85370A Position Encoder, you can find the peak from within the Encoder Functions menu (STIMULUS (MENU) (ENCODER FUNCTIONS)). Simply press (BORESIGHT ANGLE).

Discrete and Continuous Marker Modes

Move marker 1 slowly using the knob. You might notice that it moves in small steps. By default, markers hop from one measurement point to another. This is called the "discrete" marker mode. In discrete mode, markers display actual measurement data for each data point (no interpolation).

You can make the markers move smoothly between points by pressing (MARKER) MORE MORE CONTINUAL. In the continuous mode, markers show straight-line interpolated data values between measurement points. Please set the markers to Continuous mode now.

Turning On Another Marker

Activate a second marker by pressing (MARKER) 2. Did you notice that the Marker 1 screen symbol (▽) changed to a different symbol (△)? The ▽ symbol is only used by the active marker, which is now marker 2.

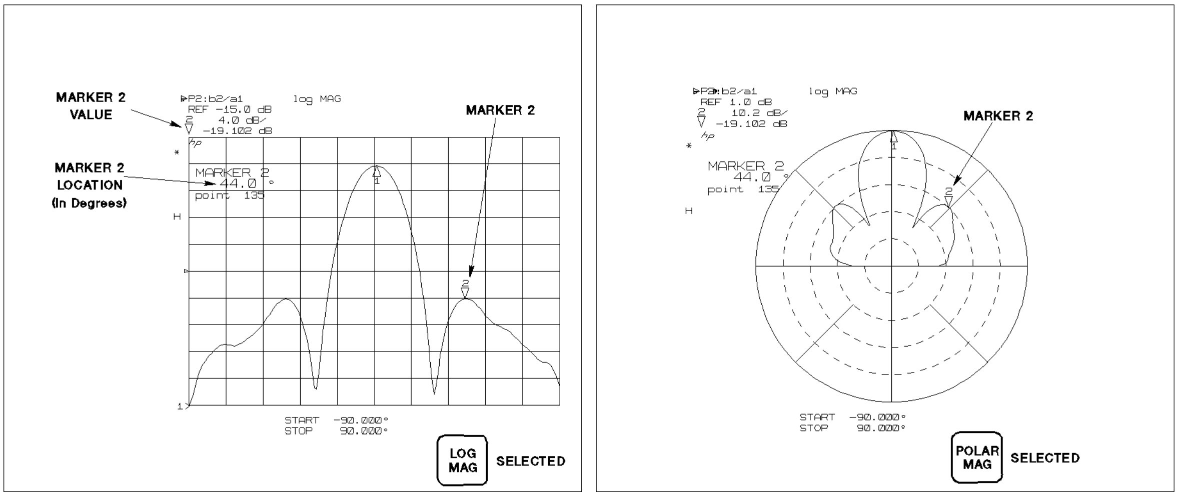


Figure 5-2. Typical Measurement with Two Markers

Marker List Mode

Marker List mode displays four or five marker data readouts simultaneously. To turn Marker List mode ON, press (MARKER) MORE MORE MKR LIST ON. Now, press the (PRIOR MENU) key until no softkey menus are on the screen. You will now see the marker list on the right-hand side of the display.

There are two softkeys that affect what is displayed in the marker list box. Press (MARKER) MORE MORE again. Note the softkeys ALL PARAM 1 MARKER/ and 5 MARKERS. These two functions toggle between each other.

If you are displaying one parameter:

These two softkeys do not have any affect on the marker list. The marker list will always show data for *all five* markers, for the *displayed parameter*. (Data is only displayed for markers that are turned ON.)

If you are displaying dual channels:

These two softkeys do not have any affect on the marker list. The marker list will always show data for *all five* markers, for the *active channel*. (Data is only displayed for markers that are turned ON.)

If you are displaying multiple parameters:

ALL PARAM 1 MARKER/ shows four marker values; the value of the *active marker* for *each parameter*. For example, if Marker 2 is active, the trace values for Marker 2 will be displayed for Parameter 1, 2, 3, and 4.

5 MARKERS shows the values for *all five* markers, for the *active parameter only*. (Data is only displayed for markers that are turned ON.)

Using Delta Markers, Target Markers, Marker Search

The △ (delta) marker mode displays the difference in trace and stimulus values between the active marker and any other marker. An example of delta marker operation is provided in "Finding Depth of a Null".

Finding Depth of a Null

There are two ways to find the depth of a null. Both methods show the value of the null relative to the peak of the main lobe. However, the first method shows angles as relative to the peak, the second method shows actual angles. Here is a description of each method:

Delta Markers — The delta marker feature shows relative stimulus and magnitude values between any two markers. This feature can easily be used to find the depth of a null. This feature shows angles as relative to the reference marker. If the *actual* angle of the null is important to you, use the "normalize peak" method.

Normalize — The normalize function sets the peak of the main lobe to 0 dB. Marker readouts will show amplitude values relative to the peak, and actual angle values.

Delta Marker Method

1. Move Marker 2 to a null using the knob. (Marker 2 should still be the active marker, you should be able to move it by turning the knob.) The power level at Marker 2 is displayed in the upper-left corner of the screen.
2. Make sure Marker 1 is ON, and is at the peak of the main lobe.
3. To find the depth relative to the peak, press:

   (MARKER) `△ MODE MENU` `△ REF = 1`

   The command `△ REF=1` selects marker 1 as the reference marker. The active marker (marker 2) will now show magnitude *and angle* values relative to marker 1. This is illustrated in Figure 5-3.

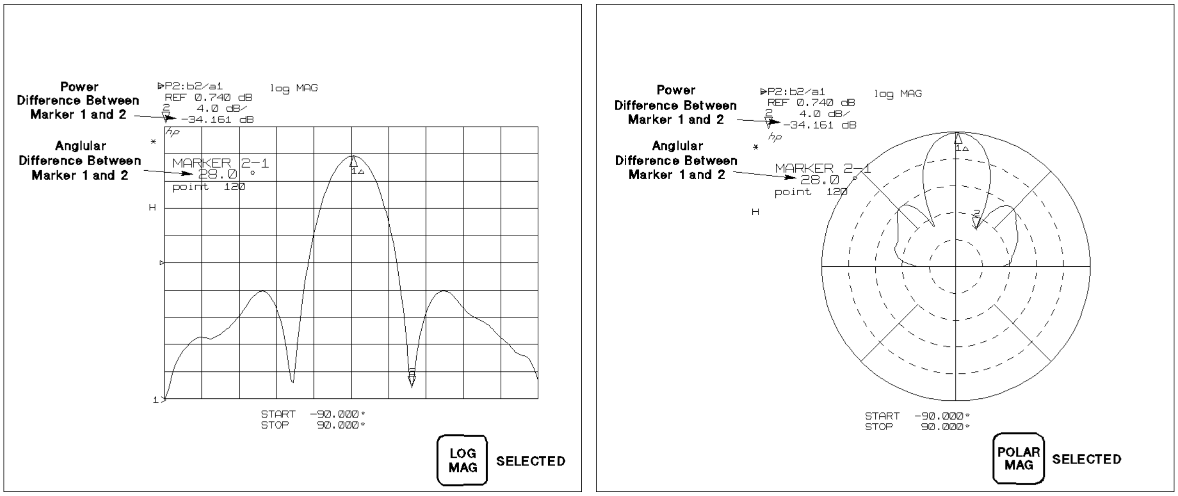


Figure 5-3. Finding Depth of Null Using Delta Markers

Now take the instrument out of delta marker mode by pressing `Δ MODE MENU` `Δ OFF`.

Normalize Method

1. Make sure delta marker mode is OFF. (Press (MARKER) `Δ MODE MENU` `Δ OFF`.)
2. Press RESPONSE (MENU), `NORMALIZE MENU`, `NORMALIZE: ACT. TRACE`.
3. Turn on any marker and move it to the null. The marker data readout will show the amplitude of the null relative to the peak.

Determining Beamwidth or Bandwidth

The receiver can determine beamwidth automatically using the Beam/Band Width function. If the instrument is in Angle Domain, the BEAM/BAND WIDTH key determines beamwidth. If the instrument is in Frequency Domain, the BEAM/BAND WIDTH key determines bandwidth.

The default "target value" is for beamwidth or bandwidth at −3 dB. The "target value" specifies the dB value (below the peak) where beam width is measured. To set the target value to a different number, press (MARKER) MORE TARGET VALUE (+/-) *n* (x1). Where *n* is the target value in dB. The (+/-) key is required because the target value is most likely a negative value (−6 dB, and so on).

Press (MARKER) MORE BEAM/BAND WIDTH, the value is now displayed on the screen.

This function uses markers 3, 4, and 5 and automatically turns ON delta markers.

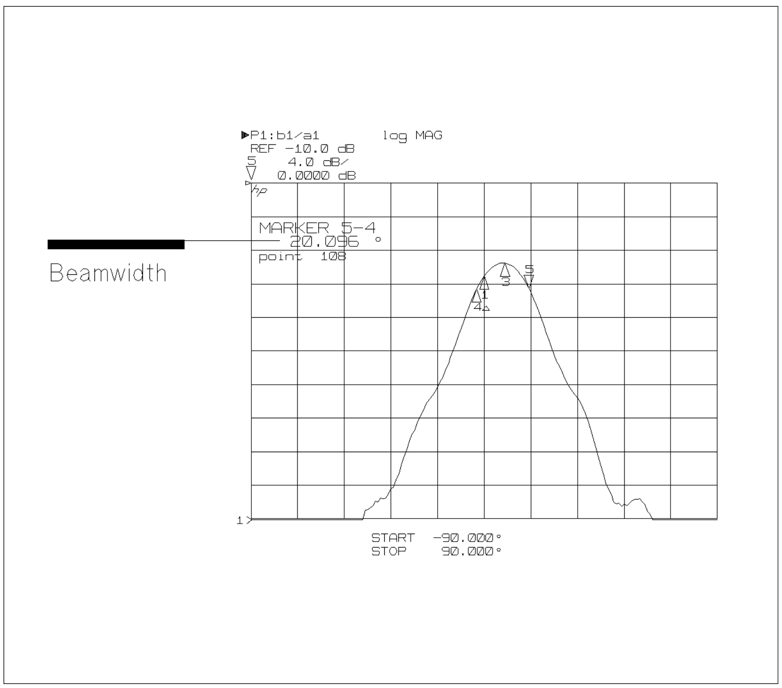


Figure 5-4. Typical Beamwidth Measurement (Angle Domain)

Displaying Multiple Channels or Parameters

The receiver can show more than one measurement on the screen at once. The following modes are provided:

- Single channel showing one, two, three, or four parameters.
- Dual channel showing a single parameter for each channel.

It is important to understand the difference between a "channel" and a "parameter." Each channel acts like a separate receiver: While in Channel 1 you can choose one combination of measurement settings, then you can select Channel 2 and set up a different combination of settings. There are some restrictions, but this is the basic purpose of the two channels.

A Parameter is simply a choice of the input ratio you are measuring (b2/a1, and so on).

Viewing Two Channels at Once

Assume you make a frequency response measurement on Channel 1. Then you select Channel 2 and select Time Domain. You can view the results separately by pressing (CHANNEL 1) or (CHANNEL 2).

You can also view both channels at the same time. To do this press (DISPLAY) DISPLAY MODE DUAL CHANNEL, followed by one of the following softkeys:

GRATICULE OVERLAY — superimposes the two measurements on top of one another. This method provides a bigger display size, so details are easier to see.

SPLIT — creates two side-by-side display graticules; one containing Channel 1 data, the other containing Channel 2 data.

You can change display format, scale, and reference settings independently for each channel. For example, Channel 1 could be set to log mag format with a scale of 4 dB/div, while Channel 2 could be polar format with a scale of 10 dB/div.

Figure 5-5 shows two examples of dual channel display. The example on the left shows split screen mode, the example on the right shows overlay mode. Notice that one marker is turned ON, and that it is present on both channels.

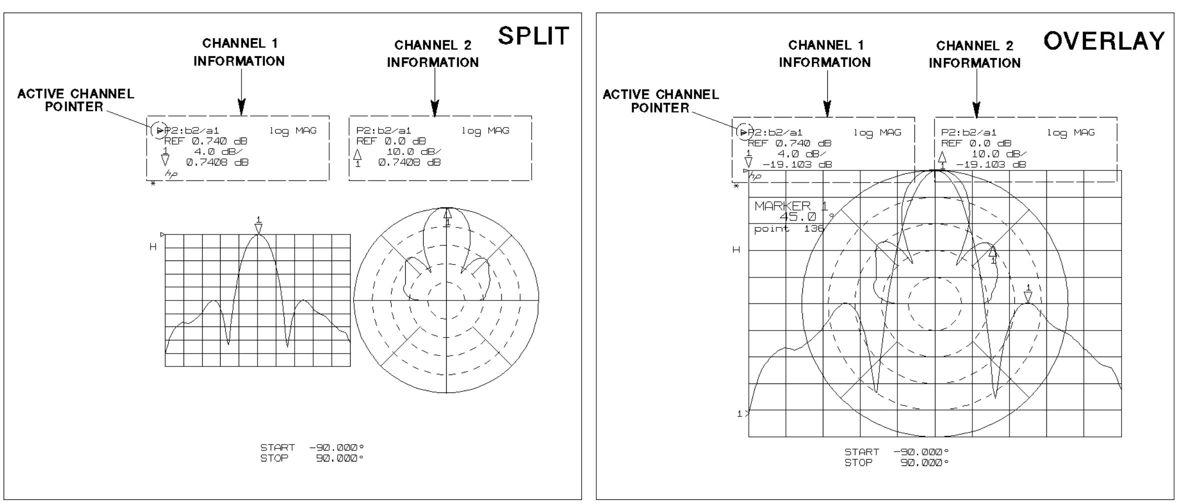


Figure 5-5. Dual Channel Display Options

Viewing Multiple Parameters

You can display two, three, or four parameters on the screen at the same time. To do this:

Press (DISPLAY) DISPLAY MODE, then either TWO PARAMETER, THREE PARAMETER, or FOUR PARAMETER.

- To select overlay format, press GRATICULE OVERLAY.
- To show each parameter in its own graticule box, press SPLIT.

The receiver does not measure a parameter unless it is displayed on the screen.

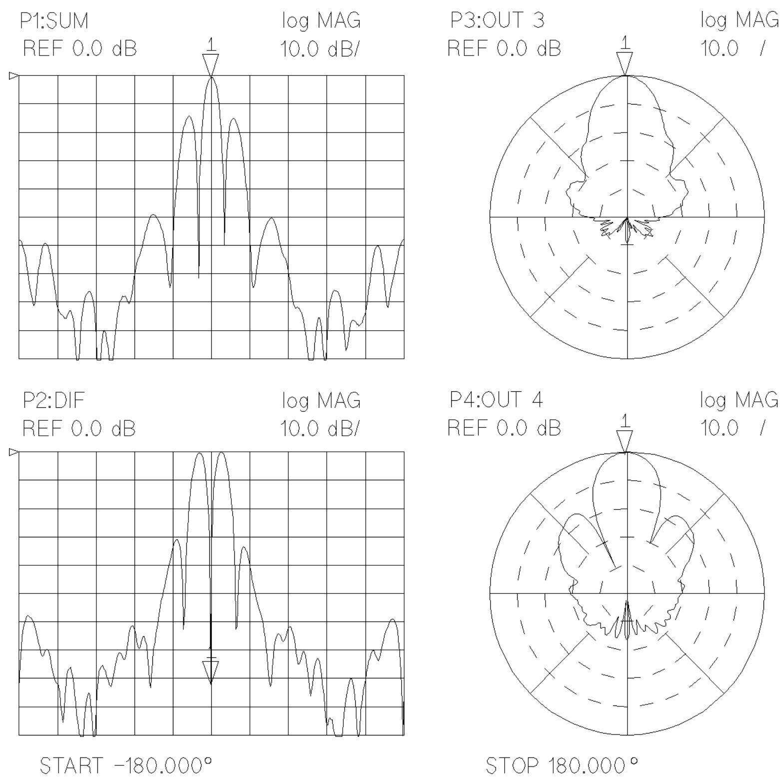


Figure 5-6. Four Parameter Split Display

You can make any parameter the active parameter by pressing (PARAM 1), (PARAM 2), (PARAM 3), or (PARAM 4).

Important Information about Polar Format

"Polar display format" in Angle Domain is completely different from polar format in Frequency Domain. Refer to Figure 5-7.

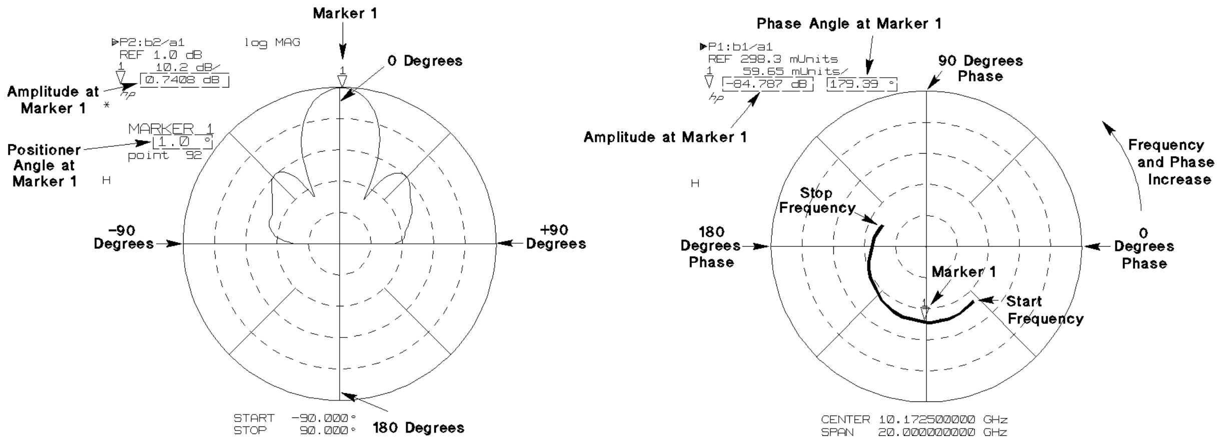


Figure 5-7. Differences in Angle and Frequency Domain Polar Formats

In the Angle Domain	the Polar display shows the radiation pattern of the antenna. The magnitude of the data (in dB or dBi) is displayed versus angle. 0 degrees is located at the top-center part of the display. Increasing angle values proceed clockwise.
In Frequency Domain	the display shows the magnitude and phase response of the antenna or device under test. 0° phase angle is at the right-hand side of the polar graticule, and increasing phase angles proceed counter-clockwise from zero.

Displaying a Single Input (Non-Ratioed Measurement)

Often one must view a single (non ratioed) input. This is often done when troubleshooting system connections.

Press: (DOMAIN) FREQUENCY

Press: PARAMETER (MENU) SERVICE PARAMETERS

Press SERVICE 1 a1, SERVICE 2 b2, SERVICE 3 a2, or SERVICE 4 b1 to view the desired input.

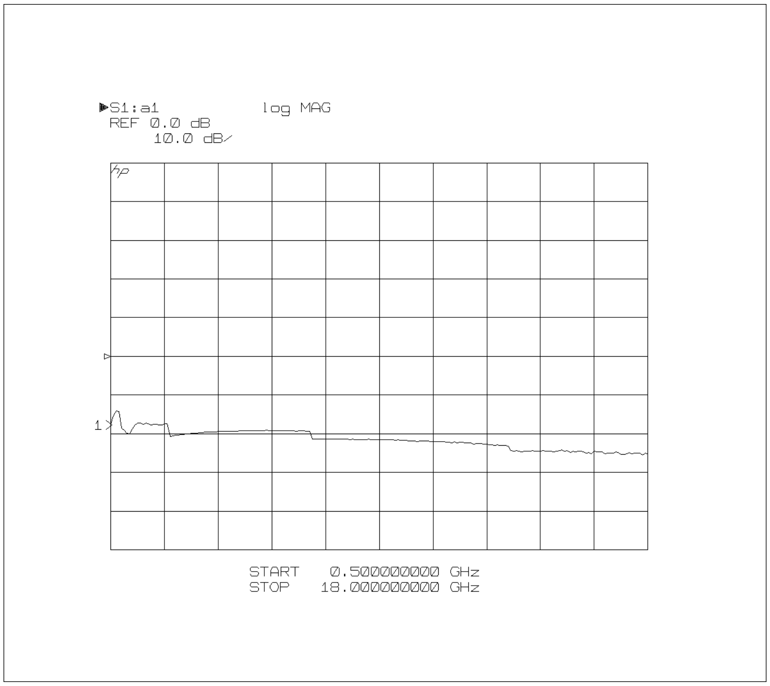


Figure 5-8. Typical Non-Ratioed Measurement of the a1 Receiver Input

Displaying Data Relative to the Peak (Normalizing Data)

Often, one must measure side-lobes relative to the peak of the main lobe. The HP 8530A calls this *normalizing*. To use this feature:

1. Press RESPONSE (MENU).
2. If you want to see measurement results in a convenient 40 dB format, press 40 dB PATTERN. This softkey:
   - Sets the reference line to 0 dB.
   - Moves the reference line to the top of the display.
   - Sets display scale so you can see down to −40 dB.
3. Press NORMALIZE MENU NORMALIZE: ACT. TRACE.

   The peak of the active trace will be set to 0 dB, and marker readouts will be relative (in magnitude) to the peak.

If you are displaying multiple parameters, you can normalize the active parameter, and have all the *other* parameters be shown *relative to the active parameter*. To do this press ALL TO ACT. TRACE. The normalized peak of the active parameter becomes the reference point of all four parameters.

Finding Boresight

When you have the HP 85370A Position Encoder, you can offset the angular position so that boresight appears to be at 0°. This is done with the SAVE OFFSET softkey.

There are two ways to find boresight:

Method 1 This method displays a flat line across the screen. The line represents signal strength. As you move the positioner, the line moves up or down. This method works in Frequency or Angle domain.

Method 2 This method measures the antenna pattern, and allows you to:

1. Automatically find the peak, or:
2. Manually place a marker where you want the boresight to be (useful if boresight is a null).

Boresight Method 1 (Flat Line Method)

To find antenna boresight:

1. Press: (DOMAIN) ANGLE
2. Press: (MARKER) MARKER 1
3. Press: STIMULUS (MENU) SINGLE ANGLE
4. Press FREQUENCY OF MEAS. and enter the desired measurement frequency.
5. Press MORE CONTINUAL (PRIOR MENU)
6. If your system has the HP 85370A Position Encoder, press ENCODER FUNCTIONS, then press AXIS A, AXIS B, or AXIS C.
7. Select the desired axis on the positioner controller.
8. Move the positioner so the antenna is somewhere near its boresight position (a rough approximation is fine).
9. Move the positioner until the flat line reaches maximum amplitude (or minimum amplitude if your antenna has a null at boresight). It is helpful to watch the marker value readout (in the upper-left portion of the display). This digital readout of the amplitude makes it easy to observe small (0.1 dB) changes. Refer to Figure 5-9.
10. If your system has the HP 85370A Position Encoder, you can press SAVE OFFSET. Subsequent measurements will be relative to boresight. This step is not required if you are boresighting for gain calibration purposes.
11. Repeat steps 6 through 10 for each axis. Boresighting is usually interactive between axes, so repeat the boresight procedure for all axes until true boresight is found.

Boresight Method 2 (Pattern Display Method)

1. Press: (DOMAIN) ANGLE
2. Press: STIMULUS (MENU) SWEPT ANGLE MORE CONTINUAL
3. Set up start, stop and increment angle on the receiver and, if necessary, the positioner controller.
4. If the system is equipped with the HP 85370A Position Encoder, press:

   (PRIOR MENU) ENCODER FUNCTIONS

   Then select the desired axis with AXIS A, AXIS B, or AXIS C.
5. Select the proper axis on the positioner controller.
6. Move the positioner to the start angle.
7. Move the positioner to the Stop Angle. The measurement trace should progress across the receiver's display.
8. Perform this step if your system *has* the HP 85370A Position Encoder:

   Press BORESIGHT ANGLE. The active marker will be placed at the peak of the measured trace. Usually this is boresight. If this feature chooses a peak that is *not* true boresight, press (MARKER) and move the marker to true boresight. You can now press SAVE OFFSET to make the boresight 0°. *Notice that the offset does not take effect until the next sweep*
9. Perform this step if your system *does not* have the HP 85370A Position Encoder:

   Press (MARKER) MORE MAXIMUM.
10. Repeat steps 4 through 8 or 9 for each axis. Boresighting is usually interactive between axes, so repeat the boresight procedure for all axes until true boresight is found.

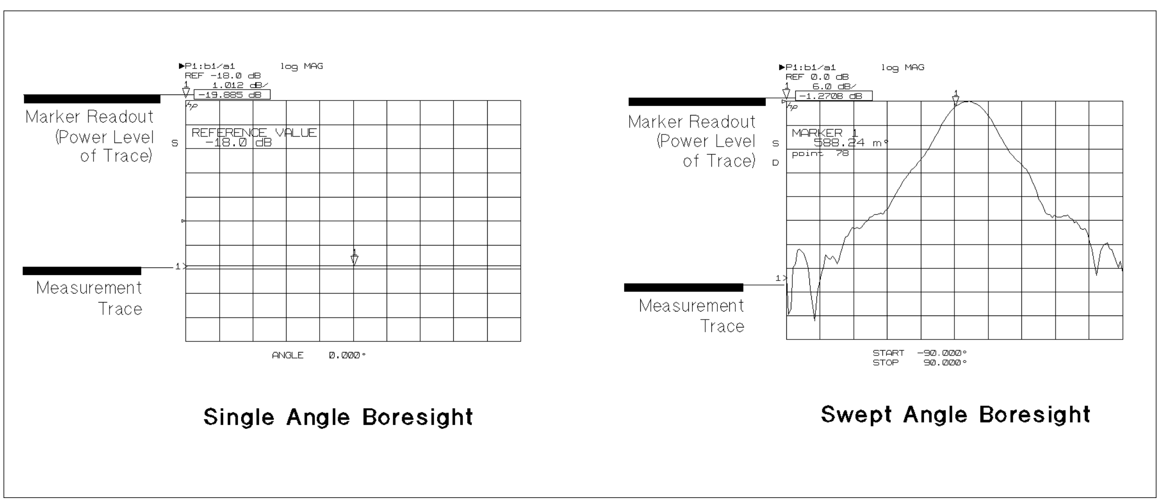


Figure 5-9. Single Angle Boresight (at left) and Swept Boresight (at right)

Using Averaging

Averaging reduces the effects of noise on your measurement. The HP 8530 only uses averaging values in factors of 2^n (2, 4, 8, 16, and so on). You can enter any value you want, but the analyzer will round the value down to the closest factor of 2^n.

For every factor of 2 increase in averaging, you lower effective noise by 3 dB. Averaging is therefore very useful, but it has disadvantages as well. Averaging works by measuring each data point multiple times. (If you select an averaging factor of 16, the instrument has to repeat the measurement at each point 16 times.

To turn averaging ON, press RESPONSE (MENU) AVERAGING ON/restart, now enter the desired averaging factor and terminate with (x1).

Table 5-1 shows the theoretical sensitivity improvement caused by valid averaging factors.

Table 5-1. Averaging Factor versus Theoretical Sensitivity Improvement

Averaging Factor	Theoretical Sensitivity Improvement
2	3 dB
4	6 dB
8	9 dB
16	12 dB
32	15 dB
64	18 dB
128	21 dB
256	24 dB
512	27 dB
1024	30 dB
2048	33 dB
4098	36 dB

Creating a Frequency List

Frequency list only applies to Frequency Domain. It provides the capability to measure specific frequencies of interest. The frequency list is made up of segments and each segment may consist of a single CW frequency or a frequency span. The span may be specified using start/stop or center/span frequencies and either a frequency step or number of points.

To use frequency list mode, first create a frequency list (as explained below), then select frequency list mode from the Stimulus softkey menu.

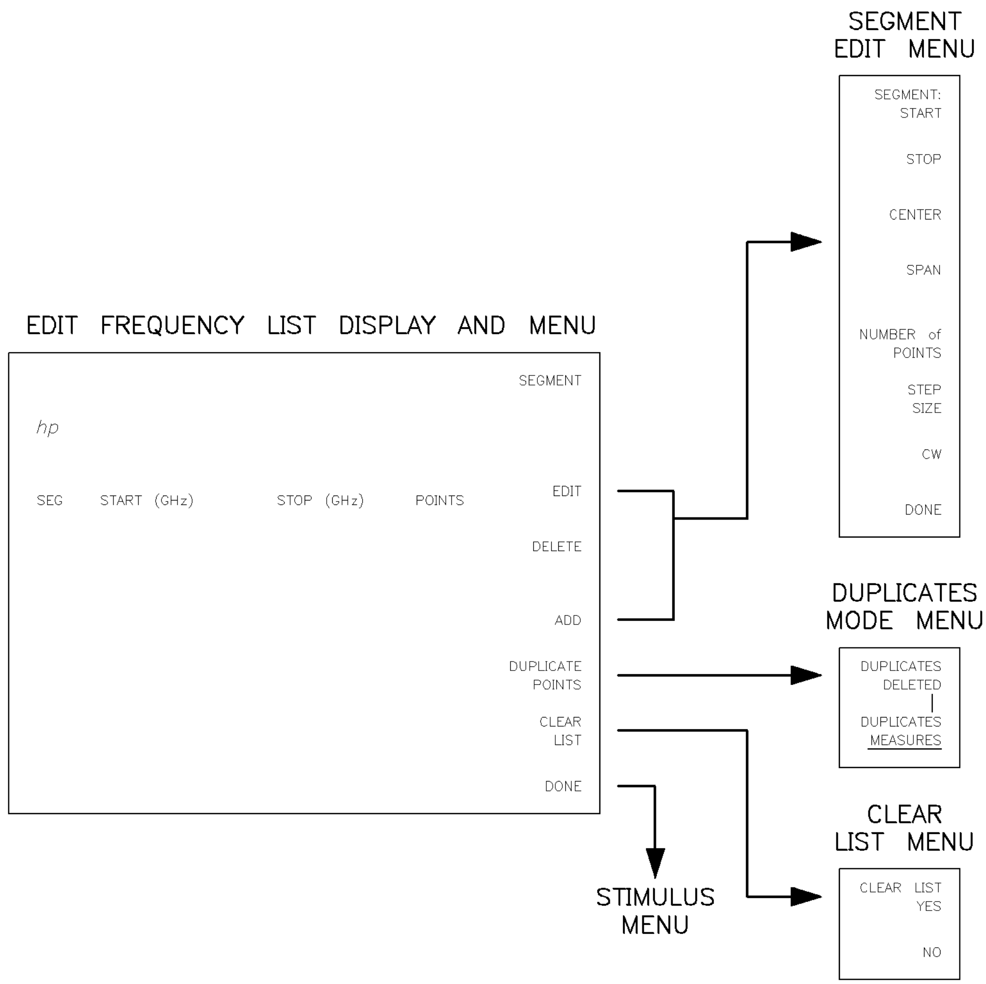


Figure 5-10. Frequency List Menu Structure

Entering the First Segment

To create a frequency list:

1. Press (DOMAIN) FREQUENCY.
2. Press STIMULUS (MENU), MORE, then EDIT LIST. The display appears as shown in Figure 5-10.
3. Press ADD. The first segment appears as shown in Figure 5-11.

4. Press SEGMENT: START and enter the start frequency of the first segment.
5. Press SEGMENT: STOP and enter the stop frequency of the segment.
6. Press SEGMENT: STEP SIZE and enter the desired increment frequency.
7. Press SEGMENT: DONE. Now press DONE again to return to the main stimulus menu, then press FREQUENCY LIST. The frequency list mode is now ON. The next sweep will use the frequencies from the list.

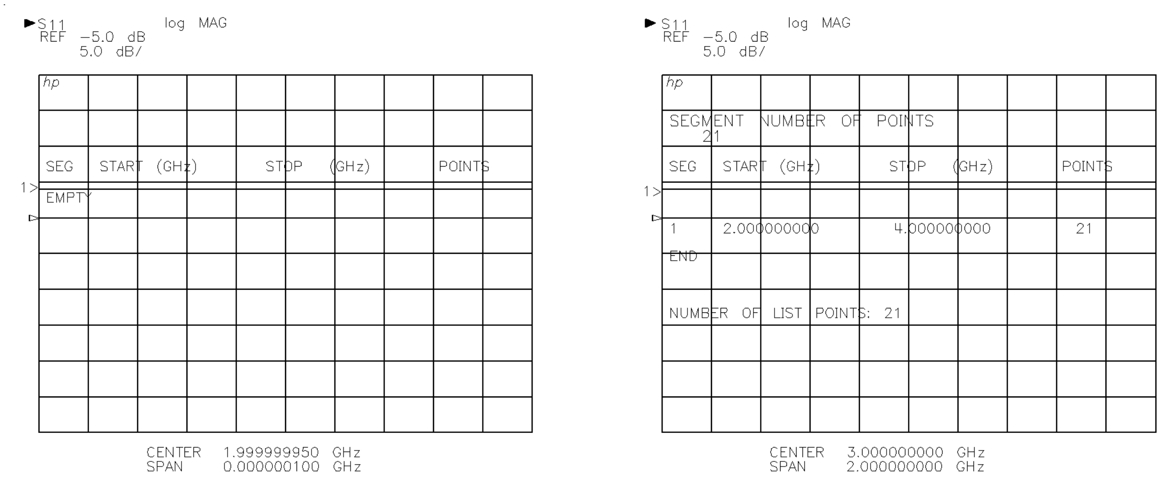


Figure 5-11. Enter the First Segment

Add Segments

To add a segment to the list:

1. Press EDIT LIST, then press ADD. Each time you press ADD the current segment is duplicated.
2. Enter new segment values by following the instructions given previously, then press SEGMENT: DONE.

The segments do not have to be entered in any particular order, they are sorted automatically by start or CW frequency each time you press SEGMENT: DONE. If you try to add more than the maximum allowed number of segments or frequency points, a warning message is displayed.

Editing the Frequency List

The following section explains how to change or delete an existing segment, or add new segments to an existing frequency list.

Changing a Segment

To change the contents of the list, press EDIT LIST to display the edit frequency list menu, press SEGMENT to choose a segment, then press EDIT.

The SEGMENT key determines the segment to be edited or deleted. Press SEGMENT then enter the number of the segment in the list or use the knob or step keys to scroll the pointer > to the segment number. Press EDIT to edit the current segment. The segment edit menu appears, allowing you to change any of the segment characteristics.

Please note that the START, STOP, CENTER, and SPAN keys in the STIMULUS block are not used during the frequency list editing process.

For example, enter a frequency list as follows:

1. Press STIMULUS MENU, MORE EDIT LIST.
2. Press the following keys:
   a. ADD SEGMENT: START 2 G/n.
   b. SEGMENT: STOP 4 G/n.
   c. SEGMENT: STEP SIZE 100 M/μ.
   d. SEGMENT: DONE DONE FREQUENCY LIST.

The frequency list sweep starts.

In the frequency list mode, you may edit, add, and delete the segments while making a measurement. When you press SEGMENT: DONE, the frequency list segments are arranged in ascending order, and the measurement restarts using the new frequencies.

Deleting a Segment

When you press DELETE the current segment is deleted.

Adding a Segment

Now add a segment to the list as follows:

1. Make sure the receiver is in Frequency Domain.
2. Press STIMULUS MENU MORE EDIT LIST.
3. Press the following:
   a. ADD SEGMENT: START 4 G/n
   b. SEGMENT: STOP 8 G/n
   c. SEGMENT: STEP SIZE 200 M/μ
   d. SEGMENT: DONE

The sweep restarts and the new list is measured.

Duplicate Points

If you followed the above sequence, notice that the point at 4 GHz is brighter. This is because it is being measured and plotted twice. Later, in Chapter 7, you will see that you can print the list of measured frequencies and values in tabular format. If you performed this operation you would see that 4 GHz is listed twice. If this is an undesired duplication, press DUPLICATE POINTS, then DUPLICATES DELETED. On the next measurement, each point is measured and displayed only once (duplicates are ignored).

Selecting All Segments or a Single Segment

When you press FREQUENCY LIST with more than one segment defined, the menu allows selection of either ALL SEGMENTS or SINGLE SEGMENT. Pressing SINGLE SEGMENT causes the currently-selected segment to become the active segment. The receiver will begin to measure that segment (assuming the receiver is not in HOLD mode). Use the step keys, knob, or numeric entry to select the segment for measurement.

Figure 5-12 shows the display when the complete frequency list is swept, then after a single segment is selected. The current listing of frequency list segments is displayed with the arrow pointing to the current segment. If you do not want the frequency list displayed, press STIMULUS (MENU) and it disappears - but segment number remains the active function. Note that the Stimulus values at the bottom of the display show the actual frequency range being measured.

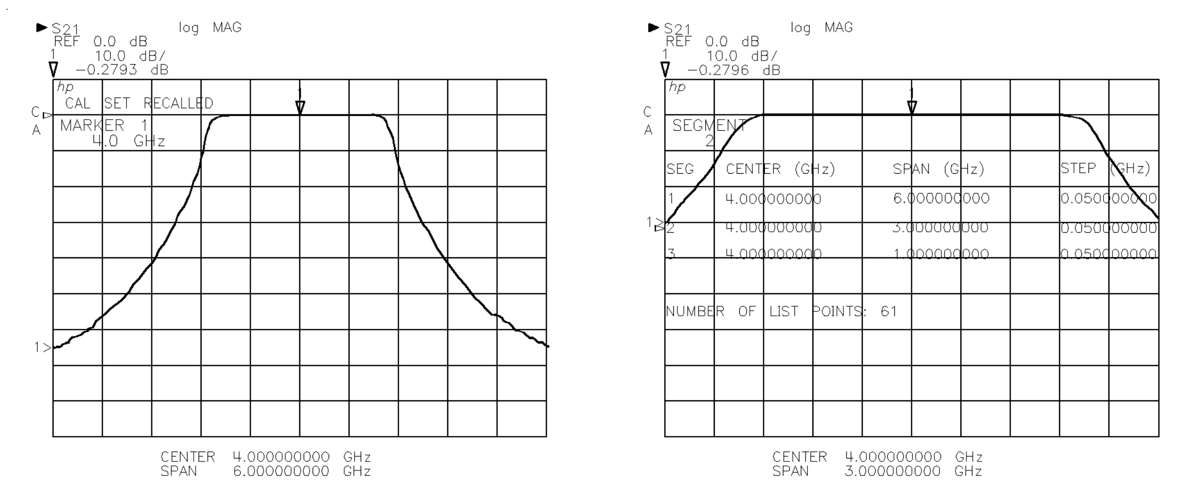


Figure 5-12. Frequency List, Display of Single Segment

Frequency List Save and Recall

You can save the current frequency list in the same way as any Instrument State is saved, by using the (SAVE) and (RECALL) keys.

Exit Frequency List

To exit the frequency list mode, press STIMULUS (MENU), then press RAMP, STEP, or SINGLE POINT. The frequency endpoints of the frequency list are used for the ramp or step sweep.

FACTORY PRESET clears the frequency list.

Switching Between HP 8530 and 8510 Operation

HP 8530As with Option 011 can be switched back and forth between HP 8530 and HP 8510 operation. To switch "modes" you must reload the appropriate operating system from disc. Hewlett-Packard recommends that you make copies of the original operating system discs, and place the originals in a safe place. Refer to "Copying the Operating System Discs".

Changing between Operating Systems

1. Press (SYSTEM) MORE SERVICE FUNCTIONS TEST MENU.
2. Insert your working copy of the operating systems, press (1) (9) (=MARKER). A disc directory will appear, listing the operating system files on the disc.
   a. Use the (▼) key (if necessary) to select the desired operating system.
   b. Press LOAD FILE.

   Once the operating system loads the instrument will preset.

How Changing Operating Systems Affects Instrument Registers

When you load a different operating system, all the following registers are erased (or are filled with default values):

- Instrument State registers.
- Memory registers.
- Cal sets.
- User-Loaded cal kit definitions.
- Delay table.
- User display graphics.

Here is a helpful suggestion for those who switch between HP 8510 and 8530 operation often: You can save all of the above registers to a single disc file (called a "machine dump" file). Here is how:

1. Set up the instrument the way you want it.
2. Save the setup to Save Register 8 (this is important).
3. Save the machine dump file to disc by pressing:

   (DISC) STORE MORE MACHINE DUMP, enter a title, then press STORE FILE.

   Later, when you load the desired operating system, you can also load the appropriate machine dump file. The instrument will return to the exact state it was in before.

Note Be sure to use different file names for the two machine dump files.

One high-capacity disc can hold two operating system files plus two machine dump files. One low-capacity disc can hold one operating system with one machine dump file.

Copying the Operating System Discs

HP recommends that you create a copy of each operating system on blank discs. When you load an operating system, use the copies. This is especially important in systems that must be switched between HP 8510 and 8530 operation often.

This procedure assumes that the HP 8530A operating system is currently loaded.

Copying the HP 8530A Operating System to Disc

This procedure assumes you are using high-capacity 1.44 Mbyte discs (Black HP discs). High-Capacity discs let you save both HP 8510 and 8530 operating systems on a single disc.

1. Press (SYSTEM) MORE SERVICE FUNCTIONS TEST MENU.
2. Make sure the disc is not write-protected. The write-protect window must be *fully closed*.
3. Insert the disc into the drive slot (the label-side of the disc must face left). Initialize the disc by pressing (2) (1) (=MARKER).

Note You can skip the previous step if the disc is already initialized. *However, the disc must be initialized using LIF format. The HP 8530A cannot store operating system files to DOS-format discs.*

---

4. Save the current operating system by pressing (2) (0) (=MARKER).
5. The "label maker" menu now appears. The proper file name prefix "PG_" is already entered for you. Use the character-selector controls to add "8530" to the file name.

   Press STORE FILE. The instrument will preset when the file is stored. Remove the disc and label it.

Copying the HP 8510C Operating System to Disc

1. Press (SYSTEM) MORE SERVICE FUNCTIONS TEST MENU.
2. Insert the HP 8510C operating system disc, press (1) (9) (=MARKER).
3. Press LOAD FILE to load the default file (the operating system file). Once the operating system loads the instrument will preset.
4. Press (SYSTEM) MORE SERVICE FUNCTIONS TEST MENU.
5. Insert the disc you used to store the HP 8530A operating system.
6. Save the new operating system by pressing (2) (0) (=MARKER).
7. Press DEFAULT TITLE STORE FILE. The instrument will preset when the file is stored. Remove the disc and label it.

Use this "working copy" of the operating systems whenever you have to reload.

6

Disc Drive Operation

This chapter explains how to use the built-in disc drive to save and load files. More in-depth information is provided in the *HP 8530A Operating and Programming Manual*.

Chapter Contents

Features

Features under the (DISC) key allow you to save measurement, calibration, or instrument state information to disc. This information can be retrieved when desired. You can use the built-in internal disc drive, or compatible external disc drives. External drives must be connected to the system bus. You can control these devices using the (DISC) key in the AUXILIARY MENUS block, and its associated menus.

The (DISC) key and related menus allow you to:

- Store files (save various types of data to internal or external disc).
- Load files (load a disc file containing data).
- Delete files from internal or external disc.
- Un-Delete the last file you deleted.
- View a directory of files
- Initialize new discs.
- Use internal or external disc drives.

Disc Drive Operation

Both internal disk and SS/80 type external disc drives can provide data storage for instrument states, calibration error coefficient sets, calibration kit definitions, measurement data, memory data, hardware states, user display memory, delay table, or machine dump (these terms are defined later in this chapter).

Compatible Disc Types, Disc Storage Capacity

The receiver can initialize floppy discs using DOS format or Logical Interface Format (LIF). DOS format is used by PC compatibles, LIF is used by HP 9000 series 200/300 workstations. The HP 8530 uses high-density or low-density 3.5 inch discs. *Use only certified double-sided discs or you may cause excessive wear to the disc drive.*

Table 6-1. Disc Storage Capacities

Disc Type	LIF Capacity	DOS Capacity
Low Density	622 KB	720 KB
High Density	1.244 MB	1.44 MB

DOS Subdirectories

The HP 8530A can only access files on the “root” directory of a disc. Files cannot be accessed in DOS subdirectories.

Disc Menu

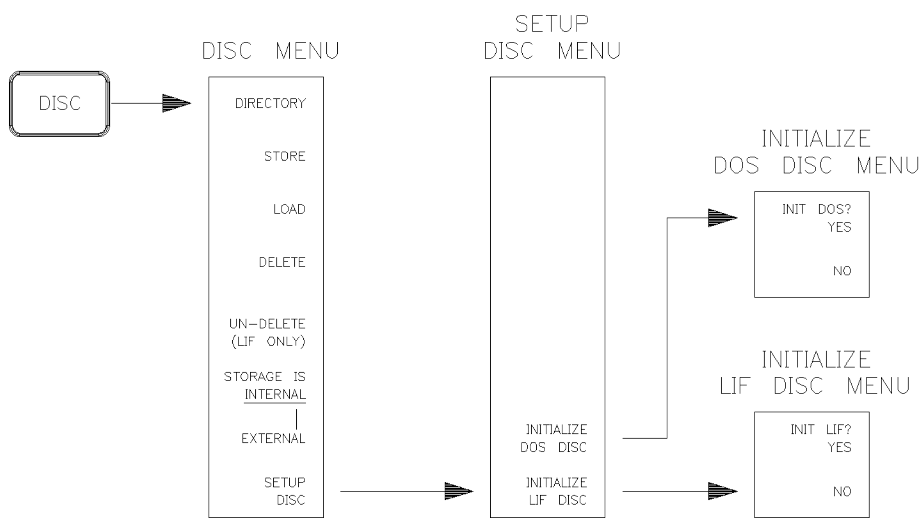


Figure 6-1.
Disc Menu, Data Type Select Menu, Setup Disc Menu, and Initialize Disc Menu

ASCII and Binary File Types

The receiver can save some file types in binary file format, and others in ASCII format. The format used for each type of data cannot be changed by the user, and are listed in Table 6-2.

All other types of data are saved as shown in Table 6-2.

Binary data files require less disc space and the file transfer is faster. If the cal set file is to be read by a computer, use ASCII format.

Table 6-2 shows the information you can store to internal or external disc drives, and the data format the receiver uses when saving it (ASCII or binary).

Table 6-2. Information You Can Store To Disc, and How it is Saved

Files Saved in ASCII Format	Files Saved in Binary Format
Memory data	Network Analyzer Calibration Kit
RAW measurement data	Calibration kit definitions
DATA (corrected) measurement data	The user portion of the display memory
FORMATTED measurement data	Hardware state
The electrical delay table	Instrument states
Calibration error coefficient sets	Machine dump
Antenna Calibration Definition	

The ASCII data is saved in the CITIfile ASCII format. CITIfile adds informative headers to the information in the file, and allows data to be exchanged with the Hewlett-Packard Microwave Design System. Complete information on the CITIfile format is provided at the end of this chapter.

Changing between DOS and LIF Discs

When you insert a formatted disc, the receiver can automatically tell whether it is LIF or DOS format. The only time you must choose between LIF and DOS is when you initialize discs.

Initializing Discs

1. Before you initialize a floppy disc make sure the write-protect tab is completely shut.
2. Insert the disc with the label-side facing left.
3. Press (DISC) SETUP DISC.
4. To initialize the disc using DOS format, press INITIALIZE DOS DISC INIT DOS? YES.
5. To initialize the disc using LIF format, press INITIALIZE LIF DISC INIT LIF? YES.

The initialization process takes about 2 minutes 20 seconds per disc.

Note The disc drive has a light that comes ON when the disc is being accessed. Do not eject the disc when this light is ON or you could lock-up the receiver. If this occurs, simply place the disc back into the drive.

Storing Disc Files

Files that are associated with *internal instrument operation* (instrument states, hardware states, machine dumps, and so on) are stored in binary format. *Measurement data* is always stored in "CITIfile" ASCII format. The "CITIfile" format has informative headers, and allows data to be exchanged with other programs. Complete information on the CITIfile format is provided at the end of this chapter.

1. Insert an initialized disc.
2. Press (DISC) STORE.
3. Choose the type of file by pressing one of the following keys:

INST STATE 1-8	Press this softkey, then select the instrument state register you want to store to disc.
INST STATE ALL	Press this softkey to store all eight instrument states to one file.
MEMORY 1-8	Press this softkey, then select the memory register you want to store to disc.
MEMORY ALL	Press this softkey to store all eight memories to one file.
CAL SET 1-8	Press this softkey, then select the cal set you want to store to disc.
CAL SET ALL	Press this softkey to store all eight cal sets to one file.
CAL KITS	Press this softkey, then select the cal kit definition you want to store to disc (Network Cal Kit or Antenna Cal Definition). RCS cal definitions cannot be stored to disc.

Press `MORE` to see the following choices:

`DATA: RAW` Press this softkey to store the raw data array for the active channel.

`DATA` Press this softkey to store the calibrated data array for the active channel.

`FORMATTED` Press this softkey to store the formatted data array for the active channel.

`DELAY TABLE` Press this softkey to store the electrical delay table to disc.

`USER DISPLAY` Press this softkey to store User Display graphics to disc.

`HARDWARE STATE` Press this softkey to store multiple source mode settings, HP-IB settings for external hardware, and test set (frequency converter) states.

`MACHINE DUMP` Press this softkey to store the following instrument registers to a single disc file:

a. Current instrument state
b. Instrument states 1–8
c. Cal sets 1–8
d. Cal kits
e. Hardware state
f. Memories 1–8

When you load a machine dump from disc, the contents of these internal registers are replaced with the data from the machine dump file.

Note: Before saving a machine dump file, store your current measurement setup in Save Register 8 (the user preset/power ON register). Later, when that machine dump is loaded, the receiver will wake up in that state. When a machine dump file is loaded, the receiver wakes up with whatever is in Register 8. The machine dump does not automatically remember your desired setup *unless* it is stored in Register 8.

4. A "label maker" menu will appear. Notice that the menu has a list of alpha-numeric characters and a selector arrow. The file name prefix for the selected type of data will already be entered for you.

   If you want to overwrite an existing file, press `REPLACE FILE`. A list of the current disc files will appear on screen. (The receiver will only list the type of files selected in step 3. For example, if you are storing a Raw data file, only raw data files will be shown in the directory listing).

   Use the knob or ▲ ▼ keys to select the file you want to replace, then press `REPLACE FILE`. The instrument will now store the file to disc.

5. If you are creating a new file enter the desired file name as follows:

   a. Using the rotary knob, place the cursor under the first desired letter or number. Press `SELECT LETTER`. If you make a mistake press `BACK SPACE`. Continue until you have selected all desired characters. You can enter up to seven characters. Note: If saving to DOS discs, the sixth and seventh characters will become a file name extender. For example: RD_12345.67

b. When you are done entering file name characters, press STORE FILE to store the file to disc.

The error message CAUTION: DISC IS WRONG FORMAT, INITIALIZE TO USE means:
A. The disc has never been initialized.
B. The disc is not a compatible format. Apple Macintosh's (GCR) format is not compatible, for example. Use a DOS or LIF compatible disc, or copy any important files off the disc and initialize it in DOS or LIF format.

Loading Disc Files

You can load files in any sequence with the following considerations:

- Before loading measurement data, turn on hold mode by pressing:

  STIMULUS (MENU) MORE HOLD

  Otherwise the data you load will be immediately overwritten with new data.

- In Frequency Domain, the currently-selected number of points must match the number of points in the data file. For example, if you want to load a Frequency Domain data file with 801 points, make sure you set the HP 8530A to Frequency Domain mode, and select STIMULUS (MENU) NUMBER of POINTS 801.

- In Angle Domain, the current Start, Stop, and Increment Angle settings must result in a number of measurement angles that matches those in the disc file.

  For Example. You currently have Start Angle set to −90°, Stop Angle to +90°, and Increment Angle to 1°. This results in 181 measurement angles. You could load any disc file that has 181 angles in it.

  To load a file with a different number of measurement angles, set the Start, Stop, and Increment Angle to values that will result in the appropriate number of angles.

  Note: The Start Angle, Stop Angle, and Increment Angle do *not* have to match those in the disc file. The only requirement is that the *current number of measurement angles* must match the *number of angles in the file*. Assume you are using the settings listed in the above example. You could load a file with a Start Angle set to −45°, Stop Angle to +45°, and Increment Angle to 0.5°. In both cases the number of angles in the measurement is 181.

  If you do not perform these initial steps, the current "number of points" may not match the number of data values in the disc file. If this occurs, an error message similar to the following with appear:

  CAUTION: UNABLE TO LOAD 181 POINTS

- If you load Raw data, the receiver places it in the Raw data array, and performs all subsequent data processing functions on it. This includes calibration (if turned on) as well as all display formatting. After all processing is done the data appears on the screen.

- If you load "Data" data (corrected data), the receiver places the data in the Corrected data array, performs all display formatting. After all processing is done the data appears on the screen.

- Calibration must be turned OFF when you load cal sets.

- If the display memory feature is ON (a memory trace is displayed on the screen), you can only load memory data files into *empty* memory registers. If the display memory feature is OFF, you can load memory data files into *any* memory register.

Loading a File

Perform the following steps to load a disc file.

1. Press (DISC) LOAD.
2. Now choose the type of file you want to load.
3. If you choose to load an instrument state, memory, cal set, or cal kit.
   a. Choose the specific destination register. For example, if you choose CAL SET 1-8 the receiver now displays CAL SET 1 through 8 register choices. Select the desired register to hold the cal set data.

   If you select any other data type you do not have to select a destination register.
4. A "file selector" box now appears on the screen. The file selector shows a directory of all files of the desired type. For example, if you chose CAL SET 1-8, the file selector lists only the *cal set files* on the disc.
5. Use the ▲ ▼ keys or knob to highlight the desired file, then press LOAD FILE. The file will now load from disc.

Viewing a Directory of Files

Press (DISC) DIRECTORY to display a directory of all the files on the inserted disc. Each disc can hold many files in each data type. There are often more files on the disc than can be seen at one time. Use the knob to scroll through the file listing.

Each HP 8530A data file type has a three-character prefix. The prefix is convenient for two reasons:

- It allows the HP 8530A to show only the files of a specific type. When you are loading a Cal Set file, it is convenient to see a listing that only includes that type of file.
- If you are performing a directory listing of the disc, the prefixes show the exact type of each file.

Table 6-3. File Types and Prefixes

File Type	Prefix	File Type	Prefix
Cal Kit	CK_	Instrument State All	IA_
Cal Set	CS_	Raw Data	RD_
Cal All	CA_	Data	DD_
Memory File	DM_	Formatted	FD_
Memory All	MA_	Display	UD_
Inst State	IS_	Delay Table	DT_
Hardware State	HS_	Machine Dump	MD_
Program	PG_	Antenna Definition	AC_

Deleting Disc Files

DELETE eliminates the specified file from the disc. To delete a file:

1. Press (DISC) DELETE.
2. Now, select the type of file you wish to delete.
3. A File Selector box will now appear on the screen, listing all disc files of the selected type. Place the box-shaped cursor over the file you wish to delete (using the knob or ▲ ▼ keys).
4. Press DELETE FILE. The file will be deleted. If you made a mistake and really did not want to delete the file, un-delete the file as explained below:

Un-deleting Disc Files

This feature only works on discs that have been formatted in the Logical Interchange Format (LIF).

Press UN-DELETE to restore the most recently deleted file. You cannot retrieve a deleted file if any of the following actions occur:

- If you store another file on the disc after the deletion.
- If you remove the disc and then reinsert it.
- If you delete a second file. (The un-delete feature only works on the *last* file you deleted.)

Using an External Disc Drive

Compatible Disc Drives

An external disc drive must be HP-IB compatible. It must be able to use the Hewlett-Packard SS/80 protocol, and be capable of being formatted to 256 bytes per sector.

You can use a floppy disc, hard disc, or combination hard/floppy drive.

Disc Unit Number and Disc Volume

The softkeys DISC UNIT NUMBER and DISC VOLUME only apply to external disc drives.

Connections and Configuration Settings

Install the drive using the installation portion of the disc drive's operating manual, and the following instructions. If you have a hard drive, read about setting up "volumes" in the drive's manual. Hewlett-Packard hard discs can be partitioned into two or more volumes, which act like separate drives.

1. Connect the external drive to the receiver's System Bus.
2. Select the number of desired hard disc volumes using the hard disc's rear panel selector.
3. Make sure the external drive's HP-IB address matches the address in the receiver's HP-IB address menu (press (LOCAL) MORE DISC). You can change the address shown in the address

menu by entering the actual address followed by the (x1) key. Alternatively, you can change the HP-IB address switches on the external disc drive. Turn the disc drive Off, then On if you change its HP-IB switch settings.

4. Press (DISC) STORAGE IS EXTERNAL then SET UP DISC to select the unit and volume number (explained below).
5. If using a disc drive that has more than one drive mechanism (unit), you must select the specific drive you want to use. The default is 0 (usually the left drive on a dual floppy drive, or the hard disc in a floppy/hard disc combination drive).

   If you want to use the right-hand drive (in a dual floppy system), or the floppy drive in a hard disc/floppy drive:

   Press (DISC) SET UP DISC DISC UNIT NUMBER (1) (x1)

   Refer to the disc drive's operating manual to verify the unit numbers used by your drive.
6. Hard drives can be partitioned into one or more "volumes." Volumes act like separate drives, even though they are, in fact, part of the same physical disc. A control wheel on the back of the hard disc selects the number of volumes that can be used. Select the specific volume you want to address by pressing:

   (DISC) SET UP DISC DISC VOLUME, then enter the desired volume number and press (x1). Volume 0 through 7 may be specified. Factory Preset selects volume 0.

Note You must initialize each hard disc volume before use. Refer to "Initializing a Hard Disc" later in this section.

If the disc drive does not respond to subsequent commands the message NO DISC is displayed. Check the disc address again (both on the unit itself and in the receiver's (LOCAL) Menu), Also check and the unit and volume number again.

Initializing a Hard Disc

If using a hard disc for the first time you must initialize each volume. You can do this using a computer, or using the HP 8530A. To initialize the hard disc using the HP 8530A, follow these steps:

1. Set the volume number to 0 by pressing: (DISC) SET UP DISC DISC VOLUME (0) (x1).
2. Press: INITIALIZE LIF DISC
3. Press INIT LIF? YES. Depending on the size of that volume it will take between 10 to 30 minutes to initialize.
4. Select the next volume number (if using a multi-volume drive), repeat steps 1, 2, and 3.
5. Repeat the above steps for each volume.

Guide to Saving Data

This section explains two common applications for saving data.

First of all, a more in-depth description of the different file types will be helpful in this discussion:

Instrument States

These states contain front panel settings, including:

- Instrument settings
- Frequency list segments
- Whether calibration was On or Off
- Whether the Delay table was On or Off
- Whether user display was on or off
- The cal set in use (if any) for that state
- Whether electrical delay was On or Off

The instrument state does *not* keep track of calibration data, cal kit definitions, user delay table contents, or any settings that control external hardware.

Memory

These store a display data trace. These stored traces can be viewed next to current data. Memory trace data can be used as an addend, subtrahend, multiplicand, or dividend of current data using trace math features.

Cal Sets

A cal set contains all the error coefficients for a calibration you have performed.

Cal Kit

Contains the mathematical models for the precision standards in a calibration kit.

Note: In the following descriptions, data is described as being affected by various features (averaging, calibration, and so on). Such user-selected features only affect the data when turned On.

Raw Data

Raw data is averaged, but no other processing is performed. This data is stored in an internal memory array called the “Raw Data Array.” Raw data is composed of complex data pairs (real,imaginary) for each stimulus point.

“Data” Data

This is measurement data that has been processed by calibration, electrical delay, the user-defined delay table, and time domain. “Data” data is stored in an array in complex data pairs.

Formatted Data

This is measurement data that has been processed by trace math, smoothing, and has been formatted according to any display settings. If you have selected a Cartesian display format, formatted data is no longer a complex value, but is scaler (magnitude only). If you have selected Polar format, formatted data is a complex value.

Delay Table

The delay table allows you to mathematically change each raw data point with a complex (real,imaginary) multiplier of your own choosing. The result is saved in the “Data” data array. The receiver multiplies each measurement data pair with the corresponding number pair in your delay table.

User Display

Contains user-defined graphic elements drawn on the display.

Hardware State

These are mostly settings found under the [SYSTEM] or [LOCAL] keys. These settings control HP-IB addresses, multiple source settings, and other hardware-related settings. The hardware state also controls the default RF source power.

Machine Dump Stores the following registers:

- All eight Instrument States
- The Hardware State
- All eight Memory registers
- All eight Cal Sets
- All Antenna Cal Definitions and Network Analyzer Cal Kits
- Delay Table
- User Display graphics

Sharing a System

Often several users must share the receiver. When you finish your session it is useful to save your setup so you can begin working quickly during your next session.

In this application you should:

1. Store one or more instrument state files to disc, as needed. If you have saved many different instrument states you may want to store them all at once using the `INSTR STATE ALL` softkey.
2. If you have performed one or more calibrations, store them to disc. If you used many different calibrations, you may want to save them all at once using the `CAL SET ALL` softkey. Save an instrument state for each cal set. This will ensure that you can recall the settings that are applicable for each calibration.

   Calibrations are sensitive to ambient temperature and humidity, and therefore have a limited life span. In addition, a cal set's life can be limited because of changes to the system's components (including wear). You can use "old" calibrations if you measure a well-known device and compare the data to expected data. You can then decide whether or not the old calibration is still useful.
3. If using a special calibration kit, store the cal kit definition to disc too.
4. It is a good idea to save the hardware state to disc, especially if your receiver is controlling more than one source. The hardware state saves all multiple source settings. The hardware state also saves various HP-IB settings for external hardware. You can skip this if the hardware setup rarely or never changes.
5. If using a user-generated delay table, store it to disc.
6. If you created special graphic elements, store them to disc.

Saving Everything

If you use a large number of states, cal sets, memories, and so on, you may find that storing using `Machine Dump` is easier. This takes longer than saving one or two individual types of data, and takes up more disc space. However, this may be the best method in complex situations.

When you load a Machine Dump from disc, the contents of applicable internal registers are replaced with the data from the machine dump file.

A Machine Dump file *does not* automatically save the current *measurement settings*. Before saving a Machine Dump, always save the current measurement setup to save register 8. If you do this, the instrument will return to a known setup when you load the Machine Dump file.

Viewing or Plotting Old Data

If you know you want to plot, analyze, or view data at a later date, store the Raw, “Data,” or “Formatted” data to disc.

7

Printing and Plotting

8

Making Automated Measurements

This chapter introduces you to HP 8530A automated measurements. Automated operation consists of two major categories:

Remote Programming	This is an introduction to controlling the receiver with a computer.
High Speed Operation	(Fast CW mode) This section explains how to acquire data at up to 5,000 points per second using the 100,000 point data buffer. This material is written for programmers, and contains programming examples.

Chapter Contents

Remote Programming

What is Remote Programming?

"Remote programming" describes computer-controlled receiver operation. The receiver can be ordered to make measurements, change settings, send data to the computer, or accept data from the computer. Data that can be sent back and forth includes measurement data, calibration coefficient sets, and so on. You can remotely use all front panel features, and more.

Remote programming is often called "HP-IB operation" or "HP-IB programming." Commands should be given in the same order as the equivalent front panel keystrokes.

What this Section Explains

This section briefly describes the main features of remote programming. "HP-IB Programming" in the *HP 8530A Operating and Programming Manual* explains remote programming in detail. The *HP 8530A Keyword Dictionary* lists all programming (HP-IB) codes, and explains each command in detail.

Transferable Data

After making a measurement, you can send **raw**, **corrected**, or **formatted** measurement data to the computer. These arrays represent different stages of data processing, illustrated in Figure 8-1. There are two entirely different, parallel, data processing paths. One path is for Channel 1 and one is for Channel 2. Each channel has raw, corrected, and formatted data arrays. In fact, you can modify the data using the computer, and send it back into the array. The receiver will process the modified data through all following stages.

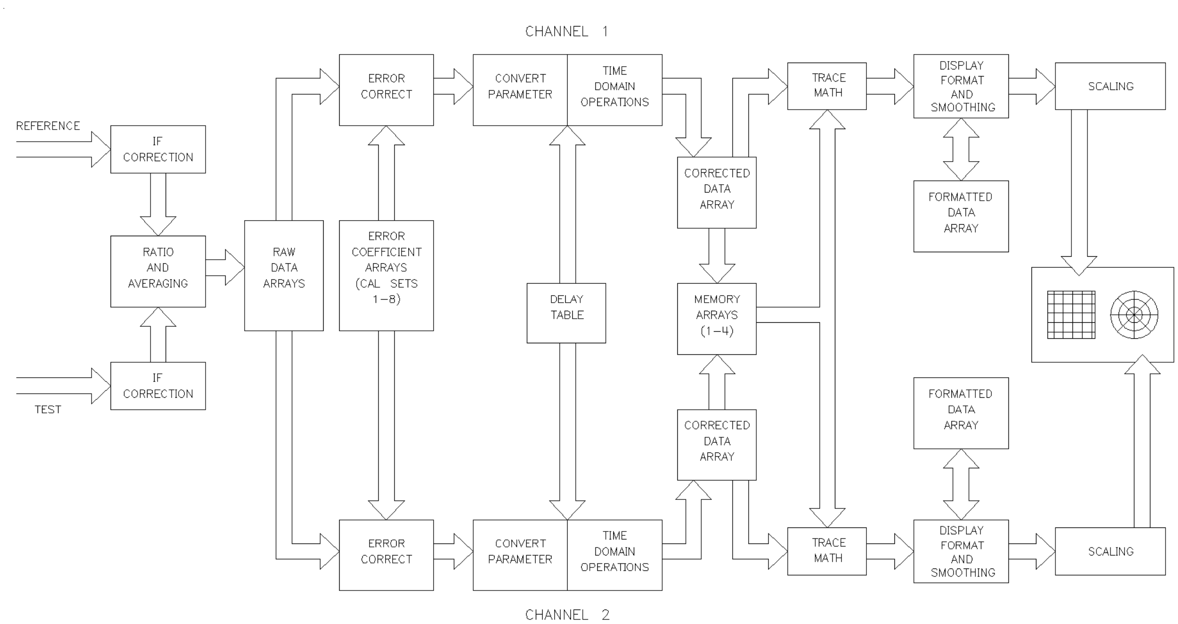


Figure 8-1. Data Processing Stages in the Receiver

The following data arrays can be read by an external computer:

Raw Data This data array contains the ratioed and averaged measurement data results. (Note: In Fast CW mode, raw data is the only available format.) To transfer the data from this array to the computer, use the HP-IB command OUTPRAW*n*, where *n* is the desired parameter (1, 2, 3 or 4). The INPURAW*n* command sends data from the computer into the desired raw array. The raw array data is in real,imaginary pairs. Refer to the *HP 8530A the Keyword Dictionary* for syntax and other information on this command, and the commands mentioned below.

Corrected Data In addition to ratioing and averaging, corrected data has been through time domain and calibration processing. Remember that these features must be ON to affect the data. To transfer data from this array to the computer, use the HP-IB command OUTPDATA*n*, where *n* is the desired parameter (1 to 4). The INPUDATA*n* command sends data from the computer into the desired corrected data array. The corrected data array is in real,imaginary pairs.

Formatted Data This data is scalar (magnitude-only) and reflects display format, scaling, and trace math processing. To transfer data from this array to the computer, use the HP-IB command OUTPFORM*n*, where *n* is the desired parameter (1 to 4). The INPUFORM*n* command sends data from the computer into the desired corrected data array. Formatted data is a simple integer that represents the data units shown on the display.

Calibration Coefficients These are the error correction coefficients created during calibration (also called a "Cal Set"). The error coefficient arrays can be read from, or sent to a computer, just like the arrays described above. Refer to the descriptions for the OUTPCALC and INPUCALC commands in the *HP 8530A the Keyword Dictionary*.

Delay Table Each parameter has its own special array called a "delay table." The table can be retrieved by external computer, modified, then returned to the receiver. The receiver will process the modified data as if it were actual measured data. The table contains real/imaginary data pairs in the internal Form 1 compressed format. A typical use is to modify frequency domain data to synthesize a special window shape for use in time domain RCS measurements. Refer to the descriptions for the OUTPDELA and INPUDELA commands in the *HP 8530A the Keyword Dictionary*.

Memory Data Valid data can be read from this array *if* data has been stored to memory. Refer to the descriptions for the OUTPMEMO command in the *HP 8530A the Keyword Dictionary*. (There is no command to send data directly into a memory from the computer. However, you can send data to the raw or corrected array, then save it to memory using DATI)

Available Data Transfer Formats

In remote programming you can choose among four *binary* data formats, or one *ASCII* data format. The formats are listed below:

Form 1 This is the native internal data format of the receiver. Each point of data contains a header byte, followed by three, 16-bit words. Form 1 offers very fast transfer speeds, and Form 1 data can be converted to floating point data in the computer.

If you use Fast CW mode, the only data format available is Form 1. In fast CW mode, Form 1 *does not* have the header information.

Form 2 32-bit IEEE 728 format. This format is not commonly used.

Form 3 This is the recommended format for use with HP 9000 Series 200/300 workstations. It consists of a header, a two-byte number indicating how many bytes follow, then the real and imaginary data pairs for each stimulus point. Form 3 follows the 64-bit IEEE 728 standard format.

Form 4 This format is ASCII.

Form 5 This is the recommended format for use with IBM PCs and compatibles. This is a 32-bit DOS-compatible floating point format.

Summary

- The HP 8530A can be controlled by computer using HP-IB commands. These commands are usually entered in the same sequence as front panel keystrokes.
- Data can be transferred from the receiver to the computer. You can also send data back into the receiver's arrays. The data can be from different stages of data processing, or from various arrays that manipulate the measurement data.
- Five different binary/ASCII data transfer formats are available.
  - If you use an HP 9000 Series 200/300 workstation (or any computer based on the Motorola 68000 family processor), use Form 3.
  - If you use an IBM-compatible PC (or any computer based on Intel's 286, 386, or 486 processors), use Form 5.
- Fast CW operation only allows the use of raw data, and Form 1 transfer format. You can transfer Form 1 data back into the receiver's raw data array at a later time, and then have the receiver process and output data in Form 2, 3, 4, or 5. Or the computer can process the data into another form.
- Raw data is averaged (if averaging is ON).

High Speed Automated Operation

The HP 8530A provides two modes which allow extremely fast antenna, RCS, or CW frequency measurements:

- Fast CW mode (there are three types of Fast CW mode to choose from)
- Fast IF Multiplexing

Both of these features are explained in this section.

Note If you are making computer-controlled measurements using “normal” sweep modes (Frequency List, Single Point, Ramp, Step, Single Angle, or Swept Angle); measurement speed will increase with markers turned OFF.

Markers will *not* slow down Fast CW measurements.

What is Fast CW Mode?

Fast CW mode is a feature that optimizes HP 8530A data acquisition speed. There are actually three “Fast CW” modes:

- Standard Fast CW
- Fast Data Collection
- Autoranged Data Collection

Fast CW mode is only available when you are controlling the receiver with a computer. This mode buffers measurement data in a 100,000 point (First-In First-Out) data buffer. Each of these modes is explained below.

The Three Fast CW Modes

All the Fast CW modes can be externally triggered, using the TTL EVENT TRIGGER input. There are three Fast CW modes:

- Standard Fast CW: Measures at rates of up to 5,000 data points per second. The allowable point-to-point amplitude variation of the measured signal is ±12 dB. If you have point-to-point variations greater than ±12 dB, use the Autoranged Data Collection feature, described below.
- Fast Data Collection: This mode is similar to the Fast CW mode, but has one more feature: It pulls the STOP SWEEP line (rear panel BNC) LOW during data acquisition. STOP SWEEP goes HIGH when the receiver is ready to take more data. Trigger pulses are ignored when STOP SWEEP is LOW. This “handshake” allows external hardware to coordinate measurements. The STOP SWEEP handshake allows an external multiplexer to switch measurement inputs.

  This mode is recommended when measuring signals that make sudden changes in amplitude, with an upper limit of ±12 dB between two adjacent measurement data points. (A typical application for this mode is when a multiplexer is used to switch between antennas.)
- Autoranged Data Collection: Use this mode if signal levels vary by more than ±12 dB between adjacent points. This mode allows you to accurately measure signals across the full dynamic range of the receiver.

  NOTE: Measurement speed in this mode is limited to 2,500 points per second. Autoranged mode has STOP SWEEP handshaking.

  This mode is recommended when measuring signals that make sudden changes in amplitude between adjacent measurement points. The signal can change any amount, up to the maximum dynamic range of the receiver. (A typical application for this mode is when an external PIN multiplexer is used to switch between antennas. Or when measuring multiple inputs from a co-polarized and cross-polarized antenna.)

To use high speed operation you must have a basic understanding of instrument HP-IB programming.

Which Parameter is Measured in Fast CW Mode?

If you have HP 8530A firmware revision 1.40, you can measure 1 to 4 different input ratios in Fast CW Mode. Measuring more than one parameter is called “Fast Multiplexing,” and is described later in this section.

How to Transfer Fast CW Data

There are two ways to transfer data when using Fast CW mode:

- You can fill the buffer, partially or completely, then transfer it using the HP BASIC `ENTER` command. The receiver can measure up to 5,000 points per second while the buffer is being filled. Data can then be transferred out of the receiver at an HP-IB rate of approximately 5,000 points per second.
- Alternatively, you can transfer data to your computer continuously using the HP BASIC `TRANSFER` command. This allows the receiver to measure and transfer data at 3,333 points per second. At this rate, data can be taken for as long as desired with out ever filling up the data buffer.

The receiver and the computer can limit data transfer speed:

- The receiver’s continuous data transfer rate is 3,333 points per second.
- The computer’s data transfer rate may be slower than the receiver. If you plan to use continuous transfer, do some tests to see if your computer slows down the transfer process. (If fewer than 3,333 points/second are transferred, your computer is the limiting device.)

Limitations

Fast CW operation allows you to measure data at very fast rates. The following measurement limitations apply when measuring 5,000 points per second:

- If you have firmware revisions below 1.40, only one parameter in the receiver may be measured (the active parameter). For multiple parameters, an external PIN multiplexer must be used, or you must upgrade the firmware. Firmware upgrades are easy to arrange, simply contact your local HP representative.
- Only raw data is available (raw data includes averaging) in Form 1 data format.
- To take advantage of 5,000 points/second, data must be stored in the 100,000 point buffer.
- The allowable point-to-point magnitude variation is ±12 dB, otherwise you must use Autoranged Data Collection mode (2,500 points/second). Autoranged Data Collection is often needed if you externally multiplex between different antennas or antenna outputs. This is due to the sudden amplitude changes that often occur in such systems.

How Averaging Works with the Buffer

Averaging occurs before data is stored in the buffer. Only the final, averaged, values are stored. Therefore, using averaging does not increase the amount of data stored in the buffer, nor does it increase required transfer time.

Example: Assume you are measuring a ±90° angle scan with an increment angle of 0.5 degrees (a total of 361 angles measured). Averaging is set to 16.

Because averaging is set to 16, the receiver must measure each angle 16 times. This means 5,776 individual measurements must be made (16 x 361). However, the data buffer does NOT store each *averaging measurement*, it only stores the *final averaged value for each angle*. Therefore, only 361 buffer points are used in the measurement.

In buffer mode, 5,776 points of measured data require 1.16 seconds to take. This data is averaged, and the 361 resultant data points are stored in the buffer. It will take 0.08 seconds to transfer 361 data points (remember, this time estimate can be affected by the speed of your computer).

Fast IF Multiplexing

Fast IF multiplexing mode can measure up to four different input ratios at each stimulus point. Signal switching is performed inside the receiver. This mode is similar to the fully autoranged Fast CW mode (FASAD), but is faster, measuring 4,000 points per second. The advantage of this mode (in many antenna measurement systems) is that it can eliminate the need for external PIN switches, or the VXI controllers that drive them.

This mode is also useful in millimeter wave systems, where good external PIN switches are difficult to obtain. Fast IF multiplexing switches the signals at IF frequencies, rather than at millimeter frequencies.

Using Fast IF Multiplexing Mode

When using this mode the first step is to set up the receiver to make a measurement. Set up the instrument as follows:

(PARAM 1)
TRIGGER INTERNAL
SINGLE POINT
CENTER FREQUENCY xx (x1) xx GAIN:AUTO
AVERAGING xx (x1)

The receiver should be making a measurement before entering FASMD mode.

The next step is to select the type of Fast IF Multiplexing measurement you want to make. The HP-IB command is `FASMUXMODE` *n*. Where *n* is an integer that selects the specific type of measurement. The code number *n* selects the specific configuration of the Fast Multiplexing measurement, described in Table 8-1. The different configuration numbers select:

- The number of ratioed measurements that will be made (two, three, or four).
- The specific ratios (b1/a1, b2/a1, and so on).
- The number of triggers required to complete the measurement (a single trigger measures all ratios, or one trigger is required for each ratio).

You should be aware of the following:

- The measurement is made at the falling edge of the trigger pulse. The trigger must not remain low longer than 100 μs.
- Use a negative trigger pulse that is normally high. A positive trigger that is normally low will block further triggers.
- A specific amount of time must elapse between trigger signals. The required time delay between trigger pulses must be >(# of parameters) × FASPARMTIME xx.

  For example, in FASMUXMODE 10 the time between trigger pulses must be greater than (2) × 400 μs = 800 μs.
- Monitor the STOP SWEEP the same way as when in the FASAD mode. Do not send trigger signals when STOP SWEEP is low.

  Note that in mode 2, 4, 8, 10, 12, and 14 the STOP SWEEP will go high for 100 ns between each parameter. Ignore this high and do not send a trigger during this time. Do not pull STOP SWEEP low while in the FASMD mode.

To select the desired configuration, enter one of the code numbers for the `FASMUXMODE` *n* command, shown in Table 8-1.

This mode transfers data using FORM1 transfer format.

Note When you are using FASMD mode, FORM1 data transfers do not have the normal “#A bytea byteb” header. Refer to “FORM1” in the *HP 8530A Keyword Dictionary*.

Table 8-1. Fast Multiplexing Mode Select Numbers

FASMUXMODE *n* *n* =	**Parameters Measured**	**Trigger Pulses Required**
0	No Multiplexing	Not Applicable
1	b1/a1, b2/a1	One trigger is required to measure each ratio.
3	b1/a2, b2/a2	
5	b1/a1, b1/a2	
6	b2/a1, b2/a2	
7	b1/a1, b2/a2	
9	b1/a2, b2/a1	
11	b1/a1, b2/a1, a2/a1	
13	b1/a1, b2/a1, b1/a2, b2/a2	
2	b1/a1, b2/a1	One trigger measures all ratios.
4	b1/a2, b2/a2	
8	b1/a1, b2/a2	
10	b1/a2, b2/a1	
12	b1/a1, b2/a1, a2/a1	
14	b1/a1, b2/a1, b1/a2, b2/a2	Two triggers are required to measure all of the ratios. The first trigger measures the first two parameters. The second trigger measures the next two parameters.

Note: The ratios are measured in the order shown in the table. Data points in the Fast CW buffer are stored in the same order as the data was measured. Remember, the buffer is the First In First Out (FIFO) type.

Set the FASPARMTIME if necessary.

Now, activate the Fast IF Multiplexing mode by sending the `FASMD` command.

Example: `FASMUXMODE 10;FASMD`

A complete programming example for Fast IF Multiplexing mode is shown at the end of Chapter 8 in the *HP 8530A User's Guide*.

To turn off the fast IF multiplexing mode, issue these commands:

`ABORT7`
`CLEAR7`
`SING` (or any other sweep mode command)

Instead of placing the receiver in a single sweep mode (`SING`), you could place it in any other sweep mode, or simply recall an instrument state.

High Speed Automated Operation

Once you select one of the `FASMUXMODE` codes, that selection stays valid, even if you take the receiver out of fast IF multiplexing mode. If you later turn fast IF multiplexing ON again, the previous `FASMUXMODE` code will still be in effect. The only exceptions to this are when:

- You perform a User or Factory Preset.
- AC Power is turned OFF.

Timing Considerations

If you are using `TRIG SRC EXTERNAL` triggering, a trigger pulse at least 1 μs wide must be sent to the rear panel EVENT TRIGGER input. The pulse width must be less than 100 μs. A 1μs pulse is recommended. The receiver triggers on the falling edge of the trigger pulse. The trigger pulse should be a negative pulse that is normally high. See Figure 8-2. If a positive pulse is used the receiver will not trigger until the falling edge of the trigger is detected. This will cause a delay in the trigger as shown in Figure 8-3.

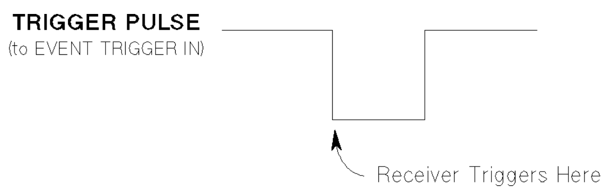


Figure 8-2. Negative Trigger Pulse

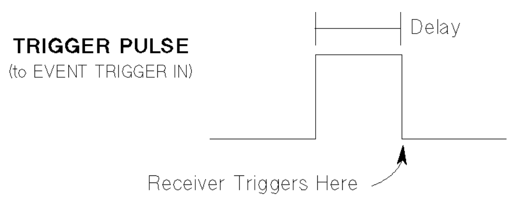


Figure 8-3. Positive Trigger Pulse

When the STOP SWEEP is low in the FASD, FASAD and FASMD modes the signal level being measured must remain at a constant level after the trigger is sent to the receiver. The FASC mode requires the signal level remain constant for 200 μs after the trigger is received.

If averaging is turned ON the measurement time will be increased by 200 μs for each average. For example, in FASD mode with eight averages, the total measurement time will be 1600 μs. The STOP SWEEP will remain low for the entire measurement time.

Standard Fast CW Mode Timing (HP-IB Command FASC)

Standard Fast CW will measure data at rates up to 5,000 points per second. The allowable point-to-point amplitude variation of the measured signal is ±12 dB.

Refer to Figure 8-4. When the trigger is received, the receiver waits 70μs, which is equal to the IF delay of the receiver, and then latches (measures) the data. The receiver is ready to take another data point after 200 μs. There is no handshaking performed on the STOP SWEEP output. Any trigger received before the HP 8530A is ready will be ignored.

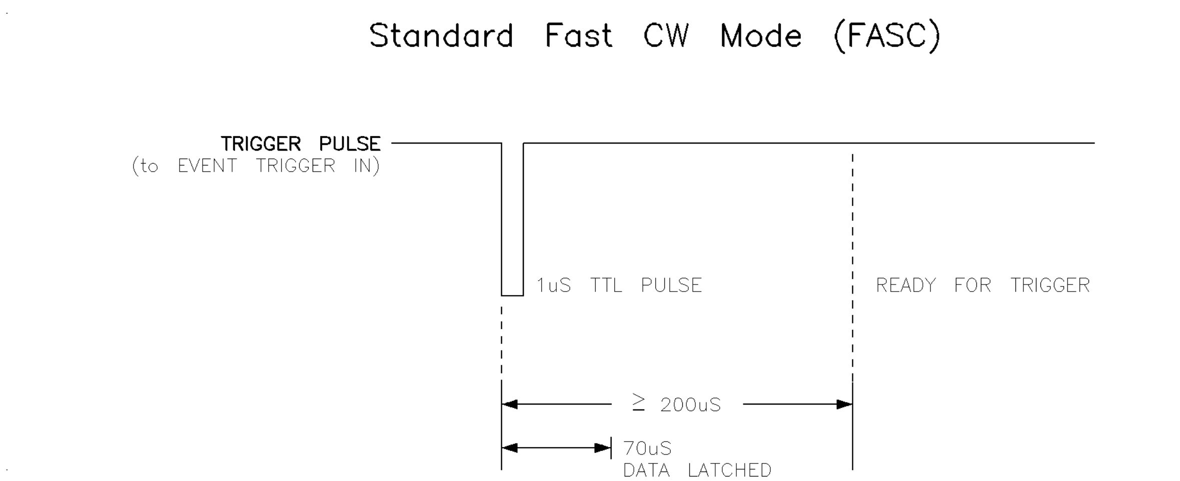


Figure 8-4. Standard Fast CW Mode Timing

Fast Data Collection Mode (HP-IB Command FASD)

This mode is similar to the Fast CW mode, but has one more feature: It pulls the STOP SWEEP line (rear panel BNC) LOW during data acquisition. STOP SWEEP goes HIGH when the receiver is ready to take more data. Any trigger pulses received when STOP SWEEP is LOW causes a "TRIGGER TOO FAST" error message. This "handshake" allows external hardware to coordinate measurements. The STOP SWEEP handshake allows external multiplexers to switch measurement inputs. Do not pull the STOP SWEEP "LOW" during the measurement.

Figure 8-5 shows the timing relationships in this mode. STOP SWEEP starts HIGH, indicating that the receiver is reading to measure data. When the trigger arrives, STOP SWEEP goes LOW.

The receiver latches (measures) the data 60 μs before the STOP SWEEP goes high. After 200 μs STOP SWEEP goes HIGH, indicating the receiver is ready to measure another data point. The STOP SWEEP delay may be changed by using the FASPARMTIME command.

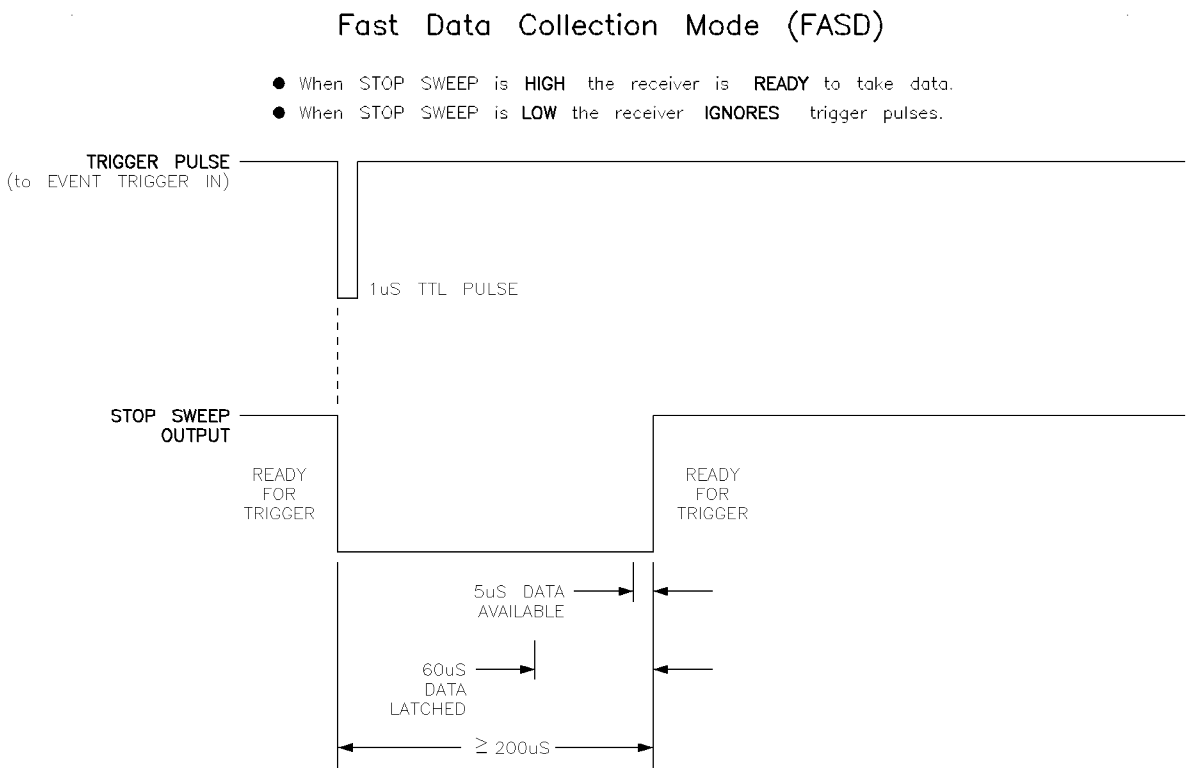


Figure 8-5. Fast Data Collection Mode Timing

Autoranged Data Collection Mode (HP-IB Command FASAD)

Use this mode if signal levels vary by more than ±12 dB between adjacent points. Wide swings in amplitude often occur when measuring signals from an external multiplexer. This mode allows you to measure signals across the full dynamic range of the receiver.

This mode is similar to the FASD mode: It pulls the STOP SWEEP line (rear panel BNC) LOW during data acquisition. STOP SWEEP goes HIGH when the receiver is ready to take more data. Any trigger pulses received when STOP SWEEP is LOW causes a "TRIGGER TOO FAST" error message. This "handshake" allows external hardware to coordinate measurements. The STOP SWEEP handshake allows external multiplexers to switch measurement inputs. Do not pull the STOP SWEEP "LOW" during the measurement. Figure 8-6 shows the timing relationships in this mode. STOP SWEEP starts HIGH, indicating the receiver is ready to measure data. When the trigger arrives, STOP SWEEP goes LOW.

The receiver latches (measures) the data 60 μs before the STOP SWEEP goes HIGH. After 400 μs STOP SWEEP goes HIGH, indicating the receiver is ready to measure another data point. The STOP SWEEP delay may be changed by using the FASPARMTIME command. If the signal levels vary more than ±12 dB reducing the FASPARMTIME time to less than 400 μs will reduce the measurement accuracy.

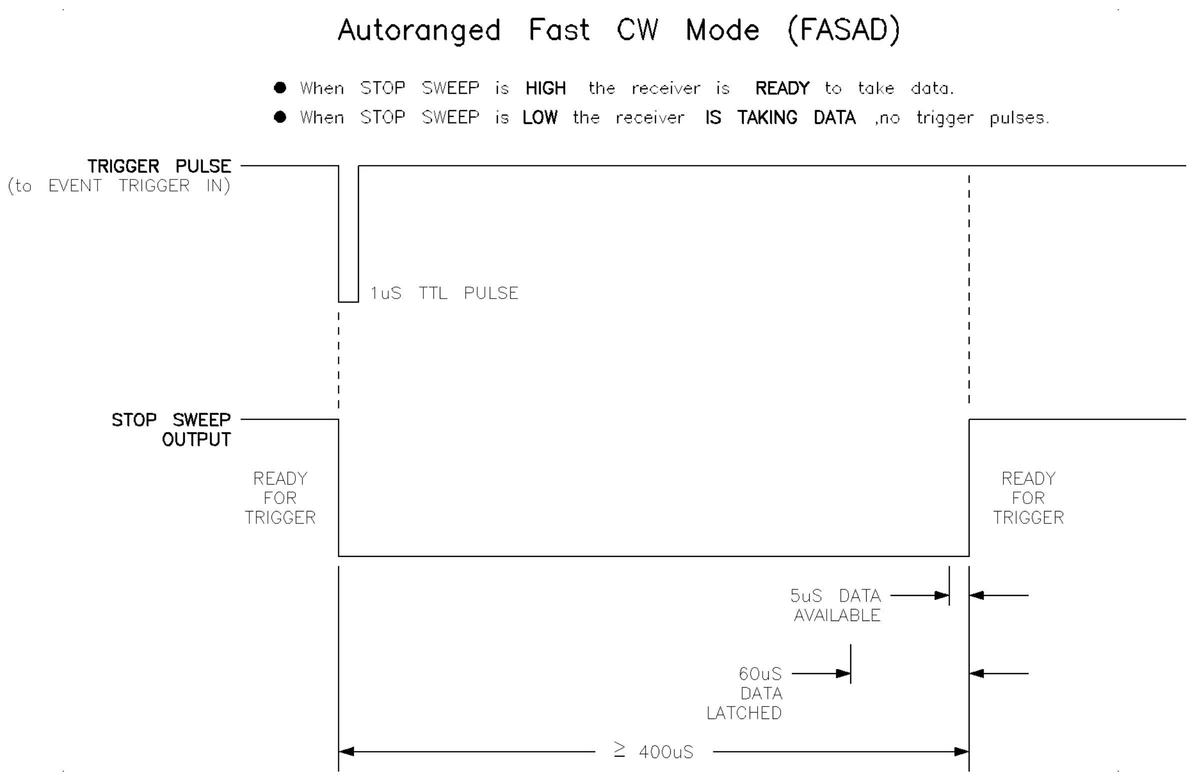


Figure 8-6. Autoranged Data Collection Mode Timing

Fast IF Multiplexing Mode (HP-IB Command FASMD)

This mode is similar to the autoranged FASAD mode, but it also adds the capability of IF multiplexing. Use a negative trigger pulse that is normally high. A trigger signal that is normally low will prevent further triggering.

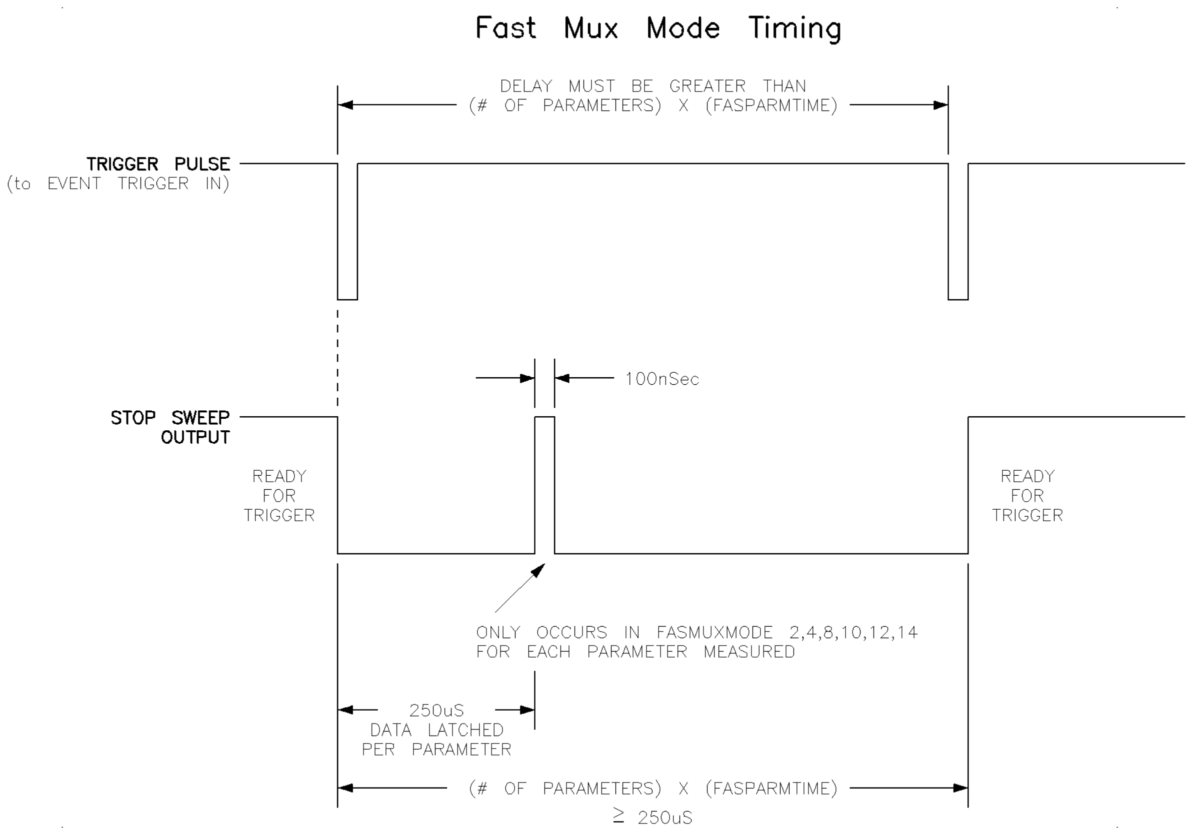


Figure 8-7. Fast MUX Mode Timing

Figure 8-7 shows the timing relationships in this mode. STOP SWEEP starts HIGH, indicating the receiver is ready to measure data. When the trigger arrives, STOP SWEEP goes LOW.

After 250 μs the receiver latches (measures) the data. After 400 μs STOP SWEEP goes HIGH, indicating the receiver is ready to measure another data point. The STOP SWEEP delay may be changed by using the FASPARMTIME command. If the signal levels vary more than $\pm$12 dB reducing the FASPARMTIME time to less than 250 μs will reduce the measurement accuracy.

Changing Minimum Re-Trigger Time

To change the default re-trigger time for Fast CW modes FASD, FASMD, and FASAD, send the HP-IB command `FASPARMTIME` n, where n is the desired time interval (in microseconds) before STOP SWEEP goes HIGH. The minimum time allowed in this command is 200 μs, maximum time is 1360 μs.

HP BASIC Fast CW Programming Examples

The following programming examples show how to use a computer to make Fast CW measurements. There are two HP-IB commands used to read measurement data:

`ENTER` reads the entire buffer.

`TRANSFER` performs continuous transfer, reading one data point at a time.

The examples use an HP Series 300 computer, running HP BASIC revision 5.0 or greater. If you are using a different computer or operating system, then use these programming example as a guide for your programming.

Each example is set up to run as an independent program. The programs are self documenting. Each line's function is explained in the BASIC comment field.

Fast CW measurements output the measurement data in `FORM 1`. Both examples convert the output data from `FORM 1` to `FORM 3` in the computer. The `SUB Build_table` creates the exponents used in the conversion.

Fast CW Using the ENTER Command

This example uses the `ENTER` command to read the data from the receiver into the computer. The `ENTER` command reads the entire contents of the buffer. Use this command after all the measurement data has been taken. Be sure that the receiver's data buffer does not fill up.

```
10    ALLOCATE REAL Exp_tbl(0:255)
20    GOSUB Build_table
30   !
40   !           USING FAST DATA WITH AUTO-RANGING AND ENTER STATEMENTS. THIS
50   !           WILL READ ALL THE DATA FROM THE RECEIVER AND THEN CONVERT
60   !           THE DATA TO REAL AND IMAGINARY PAIRS.
70   !
80    Points=181                              ! NUMBER OF DATA POINTS TO BE TAKEN.
90    ALLOCATE INTEGER Data_f1(1:Points,0:2)  ! DATA FROM RECEIVER IN FORMAT FORM1.
100   ALLOCATE Data_f3(1:Points,1:2)          ! DATA FROM RECEIVER IN FORMAT FORM3 (REAL
110                                           ! AND IMAGINARY PAIRS).
120   !
130   ASSIGN @Rec TO 716          ! ASSIGN RECEIVER HPIB.
140   !
150   !
160 Set_up:                       ! SET UP RECEIVER FOR FAST DATA.
170   !
180   OUTPUT @Rec;"SINP;"         ! SET RECEIVER TO SINGLE POINT.
190   !
200   ! OUTPUT @REC; commands to set FREQUENCY, AVERAGES, PARAMETER, etc.
210   !
220   OUTPUT @Rec;"FASAD;"        ! SET THE RECEIVER TO FAST DATA w/ AUTO-RANGE,
230                               ! OR "FASD;" OR "FASC;".
240   !
250   REPEAT                      ! WAIT UNTIL THE RECEIVER IS READY TO
260     WAIT .001                 ! TO TAKE DATA.
270   UNTIL BIT(SPOLL(@Rec),2)    !
280   TRIGGER @Rec                ! ISSUE HPIB TRIGGER TO BEGIN FAST DATA MODE.
290   !
300   ASSIGN @Rec;FORMAT OFF      ! ASSIGN COMPUTER HPIB FOR FORM1 DATA.
310   !
320   !
330 Trigger_monitor:              ! MONITOR THE RECEIVER UNTIL READY FOR TRIGGER.
340   !
350   ! monitor receiver STOP SWEEP
360                               ! IF "FASAD;" OR "FASD;", THEN MONITOR THE RECEIVER'S
370                               ! STOP SWEEP.  WHEN STOP SWEEP IS HIGH, THEN OK TO
380                               ! ISSUE EXTERNAL TRIGGERS.  CONTINUE TO MONITOR STOP
```

```
390                            ! SWEEP BEFORE EACH TRIGGER IS ISSUED FOR HIGHEST
400                            ! DATA TAKING SPEED.
410                            !
420                            ! IF "FASC;", THEN MONITOR IS NOT NEEDED.  INSTEAD
430                            ! WAIT 1 SECOND UNTIL EXTERNAL TRIGGERS ARE ISSUED.
440   !
450   ! issue EXTERNAL TRIGGERS
460   !
470   !
480 Read_data:                 !
490   !
500   ENTER @Rec;Data_f1(*)      ! READ ALL THE DATA FROM RECEIVER.
510   !
520   ASSIGN @Rec;FORMAT ON      ! ASSIGN COMPUTER HPIB FOR ASCII DATA.
530   OUTPUT @Rec;"SINP;"        ! TURN FAST DATA OFF.
540   !
550   !
560 Convert_data:              ! CONVERTS DATA FROM FORM 1 TO FORM 3.
570   FOR N=1 TO Points
580     Exp=Exp_tbl(BINAND(Data_f1(N,2),255))
590     Data_f3(N,1)=Data_f1(N,1)*Exp          ! REAL DATA
600     Data_f3(N,2)=Data_f1(N,0)*Exp          ! IMAGINARY DATA
610   NEXT N
620   !
630   !
640 Print_data:                ! PRINT MEASURED DATA.  THIS IS NOT REQUIRED.
650   !
660   FOR N=1 TO Points
670     PRINT Data_f3(N,1),Data_f3(N,2)
680   NEXT N
690   !
700   !
710   STOP
720   !
730   !
740 Build_table:                               ! BUILDS TABLE FOR FORM 1 TO FORM 3
750                                            ! CONVERSION.
760   !
770   Exp_tbl(0)=2^(-15)
780   FOR N=0 TO 126
790     Exp_tbl(N+1)=Exp_tbl(N)+Exp_tbl(N)
800   NEXT N
810   Exp_tbl(128)=2^(-143)
820   FOR N=128 TO 254
830     Exp_tbl(N+1)=Exp_tbl(N)+Exp_tbl(N)
840   NEXT N
850   RETURN
860   !
870   END
```

Fast CW Using the TRANSFER Command

This example uses the TRANSFER command to read the data from the receiver. This performs continuous transfer of data. TRANSFER can read the data as soon as it is available at the receiver. Use this method when there will be more data points measured than the receiver's data buffer can store.

The TRANSFER command can also allow other HP BASIC tasks to be performed when data is not being transferred.

```
10    ALLOCATE REAL Exp_tbl(0:255)
20    GOSUB Build_table
30    !
40    !            USING AUTORANGED FAST CW AND TRANSFER STATEMENTS. THIS
50    !            WILL READ THE DATA FROM THE RECEIVER AND THEN CONVERT
60    !            THE DATA TO REAL AND IMAGINARY PAIRS AFTER EACH POINT
70    !            IS READ FROM THE RECEIVER.
80    !
90    Points=18000                       ! NUMBER OF DATA POINTS TO BE TAKEN.
100   INTEGER Data_f1(1:18000,0:2) BUFFER ! DATA FROM RECEIVER IN FORMAT FORM1.
110   ALLOCATE Data_f3(1:Points,1:2)     ! DATA FROM RECEIVER IN FORMAT FORM3 (REAL
120                                      ! AND IMAGINARY PAIRS).
130   !
140   ASSIGN @Rec TO 716                 ! ASSIGN RECEIVER HPIB.
150   ASSIGN @Buffer TO BUFFER Data_f1(*) ! ASSIGN INPUT BUFFER.
160   !
170   !
180 Set_up:                      ! SET UP THE RECEIVER FOR FAST DATA.
190   !
200   OUTPUT @Rec;"SINP;"        ! SET THE RECEIVER TO SINGLE POINT.
210   !
220   ! OUTPUT @Rec commands to set FREQUENCY, AVERAGES, PARAMETER, etc.
230   !
240   OUTPUT @Rec;"FASAD;"       ! SET THE RECEIVER TO AUTORANGED FAST CW,
250                              ! "FASD;" OR "FASC;" CAN BE USED.
260   !
270   REPEAT                     ! WAIT UNTIL THE RECEIVER IS READY TO
280     WAIT .001                ! TO TAKE DATA.
290   UNTIL BIT(SPOLL(@Rec),2)   !
300   TRIGGER @Rec               ! ISSUE HPIB TRIGGER TO BEGIN FAST DATA MODE.
310   !
320   !
330 Transfer_data:               ! TRANSFER DATA FROM RECEIVER
340   !
350   TRANSFER @Rec TO @Buffer;RECORDS Points,EOR (COUNT 6)
360   !
370   N=1                        ! N IS THE CURRENT POINT.
380   !
390   !
400 Tigger_monitor:              ! MONITOR THE RECEIVER WHEN READY FOR TRIGGERS.
410   !
420   ! monitor receiver STOP SWEEP
430                              ! IF "FASAD;" OR "FASD;", THEN MONITOR THE RECEIVER'S
440                              ! STOP SWEEP.  WHEN STOP SWEEP IS HIGH, THEN OK TO
450                              ! ISSUE EXTERNAL TRIGGERS. CONTINUE TO MONITOR
460                              ! STOP SWEEP BEFORE EACH TRIGGER IS ISSUED FOR
470                              ! HIGHEST DATA TAKING SPEED.
480                              !
490                              ! IF "FASC;", THEN MONITOR IS NOT NEEDED.  INSTEAD
500                              ! WAIT 1 SECOND UNTIL ISSUE EXTERNAL TRIGGERS.
510   !
520   ! issue EXTERNAL TRIGGERS
530   !
540   REPEAT
550     !
```

```
560     ! do something here if you wish
570     !
580     STATUS @Buffer,4;R4                ! READ NUMBER OF BYTES IN BUFFER.
590     IF R4>=6*N THEN GOSUB Convert_data ! IF A NEW POINT EXISTS IN BUFFER THEN
600                                        ! CONVERT DATA TO FORM 3.
610     !
620   UNTIL N>Points
630   !
640   CONTROL @Buffer,8;0         ! TERMINATE TRANSFER.
650   OUTPUT @Rec;"SINP;"         ! TURN FAST DATA OFF.
660   !
670   !
680 Print_data:                   ! PRINT MEASURED DATA.  THIS IS NOT REQUIRED.
690   !
700   FOR N=1 TO Points
710     PRINT N,Data_f3(N,1),Data_f3(N,2)
720   NEXT N
730   !
740   !
750   STOP
760   !
770   !
780 Convert_data:                 ! CONVERTS FROM FORM 1 TO FORM 3.
790   !
800   Exp=Exp_tbl(BINAND(Data_f1(N,2),255))
810   Data_f3(N,1)=Data_f1(N,1)*Exp        ! REAL DATA
820   Data_f3(N,2)=Data_f1(N,0)*Exp        ! IMAGINARY DATA
830   N=N+1
840   RETURN
850   !
860   !
870 Build_table:                  ! BUILDS TABLE FOR FORM 1 TO FORM 3 CONVERSION.
880   !
890   Exp_tbl(0)=2^(-15)
900   FOR N=0 TO 126
910     Exp_tbl(N+1)=Exp_tbl(N)+Exp_tbl(N)
920   NEXT N
930   Exp_tbl(128)=2^(-143)
940   FOR N=128 TO 254
950     Exp_tbl(N+1)=Exp_tbl(N)+Exp_tbl(N)
960   NEXT N
970   RETURN
980   !
990   END
```

HP BASIC Fast IF Multiplexing Mode Programming Example

The following programming examples show how to use a computer to make a Fast IF multiplexing measurement.

```
10    SUB Fast_mux
20 Fast_mux:  !   This is a stand alone sub-program which demonstrates
30            !   8530 fast mux operation
40            !
50      INTEGER Data_buffer(1:30000) BUFFER
60      INTEGER Setup
70      REAL Set_pointer,Param_pt,Data_pt,Reps,I,Old_pointer
80      REAL Log_mag(1:2),Phase(1:2)
90      REAL Exp_tbl(0:255),Exp,Data_16bit(0:800,0:1)
100     DIM Display$[80],Report$[200]
110     COMPLEX Data_set(1:2)
120     ASSIGN @A8530_data TO 716;FORMAT OFF
130     ASSIGN @A8530_control TO 716;FORMAT ON
140     Setup=0
150     Dwell_time=250  !FAST PARAMETER PER POINT MEASUREMENT TIME IN MICROSECONDS (NO AVERAGING)
160     !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
170     !  DISPLAY INITIALIZATION AND INSTRUCTIONS
180     !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
190     PRINTER IS CRT
200     DEG
210     GRAPHICS OFF
220     PRINT USING "@"
230     PRINT "This example demonstrates the FAST IF MULTIPLEXING feature of "
240     PRINT "the HP 8530A.  It requires firmware rev 1.2 or higher.  An external"
250     PRINT "trigger source should be connected to the 8530A Event Trigger input"
260     PRINT "on the rear panel.  The STOP SWEEP input should be disconnected for"
270     PRINT "this test.  During the test, the 8530A will be in MUX MODE 2 in which"
280     PRINT "both b1/a1 and b2/a1 measurements are taken upon the receipt of each"
290     PRINT "event trigger.  The trigger should be a negative going TTL pulse with"
300     PRINT "a pulse width between 1uS and 100uS.  For this example, the minimum "
310     PRINT "period between two triggers is 500 us (ASSUMES NO AVERAGING)."
320     DISP " PREPARE SYSTEM FOR TEST AS DESCRIBED AND CONTINUE (OR EXIT)"
330     FOR N=0 TO 4
340       ON KEY N LABEL "CONTINUE" GOTO Setup
350       ON KEY N+5 LABEL " EXIT " GOTO No_go
360     NEXT N
370     LOOP
380     END LOOP
390 Setup: !
400     DISP "SETTING UP 8530 FOR MEASURMENT"
410     FOR N=0 TO 9
420       OFF KEY N
430     NEXT N
440     GOSUB Setup_fastmux     ! INITIALIZATION ROUTINE PUTS 8530A INTO FAST MUX MODE 2
450 No_go:IF Setup=0 THEN
460       PRINT USING "@"
470       DISP ""
480       OUTPUT @A8530_control;"RECA8"
490       LOCAL @A8530_control
500       SUBEXIT
510     END IF
520     GOSUB Build_table       ! CREATES ARRAY EXP_TBL(*) USED TO CONVERT COMPRESSED DATA
530                             ! TO BASIC REAL VALUES
540 Take_data: !
550     WAIT 1
560     Reps=0
570       !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
580       ! DATA DISPLAY
590       !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
600     PRINT TABXY(1,13)
610     PRINT " ________________________________________________________________________"
620     PRINT "|         b1/a1         ||         b2/a1         |  MEASUREMENT  COUNT  |"
630     PRINT "|                       ||                       |                      |"
640     PRINT "|  MAGNITUDE    PHASE   || MAGNITUDE     PHASE   |                      |"
650     PRINT "|    (dB)   |   (DEG)   ||    (dB)   |   (DEG)   |                      |"
660     PRINT "|           |           ||           |           |                      |"
670     PRINT "|           |           ||           |           |                      |"
680     PRINT "|           |           ||           |           |                      |"
690     PRINT "|___________|___________||___________|___________|______________________|"
700     DISP "TRIGGER MEASUREMENTS, PRESS SOFTKEY LABELED 'EXIT' WHEN FINISHED"
710       !
720       !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
730       ! CONTINUOUS TRANSFER DATA LOOP. USING TRANSFER ALLOWS FOR RAPID INPUT OF DATA
740       ! FROM THE 8530A. DATA IS DISPLAYED DURING COMPUTERS "SPARE TIME"
750       !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
760     LOOP
770       ASSIGN @Buffer TO BUFFER Data_buffer(*)      ! INITIALIZE TRANSFER BUFFER
780       Old_pointer=0
790       Set_pointer=1
800         !
810         !! TRANSFER STATEMENT: EACH MEASUREMENT IS TRANSFERED IN THREE INTEGERS, OR 6 BYTES,
820         !! SO COUNT 6 ALLOWS TRACKING OF THE BUFFER AS IT COLLECTS DATA FROM THE INSTRUMENT.
830       TRANSFER @A8530_data TO @Buffer;RECORDS 10000,EOR (COUNT 6)
840       FOR N=0 TO 10
850         ON KEY N LABEL " EXIT ",15 GOTO Finished
860       NEXT N
870       LOOP
880         STATUS @Buffer,4;Data_pt
890         !! SINCE WE ARE MAKING TWO MEASUREMENTS AT A TIME, THE DISPLAY IS ONLY UPDATED WHEN
900         !! THE DATA POINTER IS POINTING TO THE END OF A NEW PAIR OF MEASUREMENTS.  THIS
910         !! TECHNIQUE SKIPS A LOT OF DATA DURING FAST MEASUREMENTS, BUT ALLOWS THE DISPLAY
920         !! TO KEEP UP WITH THE DATA FLOW.
930         IF Data_pt MOD 12=0 THEN
940           IF Data_pt>Old_pointer THEN
950             Old_pointer=Data_pt
960          !!
970          !!! THE FOLLOWING LOOP CONVERTS TWO MEASUREMENTS FROM THE 8530 COMPRESSED FORMAT
980          !!! TO BASIC COMPLEX VALUES.  IT THEN CALCULATES THE MAGNITUDE AND PHASE OF EACH
990          !!! MEASUREMENT AND UPDATES THE DISPLAY
1000         !!
1010            FOR Param_pt=1 TO 2
1020              Data_pt=Old_pointer-6*(2-Param_pt)
1030              Exp=Exp_tbl(BINAND(Data_buffer(Data_pt/2),255))
1040              Data_set(Param_pt)=CMPLX(Data_buffer(Data_pt/2-1)*Exp,Data_buffer(Data_pt/2-2)*Exp)
1050              Log_mag(Param_pt)=20*LGT(ABS(Data_set(Param_pt)))
1060              Phase(Param_pt)=ARG(Data_set(Param_pt))
1070              OUTPUT Display$ USING """|"",2(2X,S3D.2D,2X,""|""),#";Log_mag(Param_pt),Phase(Param_pt)
1080              PRINT TABXY(1+25*(Param_pt-1),20),Display$
1090            NEXT Param_pt
1100            Data_pt=Old_pointer
1110         !!
1120         !! NOW PRINT THE CURRENT MEASUREMENT COUNT
1130         !!
1140            PRINT TABXY(5+25*(Param_pt-1),20);Data_pt/12+5000*Reps
1150          END IF
1160        END IF
1170      EXIT IF Data_pt/12=5000     ! THE BUFFER IS RE-INITIALIZED TO PREVENT OVERFLOW
1180      END LOOP
1190      Reps=Reps+1
1200      ASSIGN @Buffer TO *
1210    END LOOP
1220 Finished:   !
1230    DISP "CLEARING I/O CHANNEL AND RE-SETTING 8530A"
1240    ABORTIO @A8530_data                  ! TURN OFF THE TRANSFER
1250    ASSIGN @Buffer TO *
```

```
1260    OUTPUT @A8530_control;"SING"         ! TURN OFF FAST MUX MODE
1270    OUTPUT @A8530_control;"RECA8"        ! PUT 8530A IN STANDARD STATE
1280    FOR N=0 TO 9
1290      OFF KEY N
1300    NEXT N
1310    WAIT 1
1320    ABORT 7
1330    CLEAR 7
1340    LOCAL @A8530_control                  ! PUT 8530A IN LOCAL
1350    PRINT USING "@"
1360    DISP ""
1370    SUBEXIT
1380 Build_table: !  USED FOR DATA CONVERSION
1390    !
1400    Exp_tbl(0)=2^(-15)
1410    FOR I=0 TO 126
1420      Exp_tbl(I+1)=Exp_tbl(I)+Exp_tbl(I)
1430    NEXT I
1440    Exp_tbl(128)=2^(-143)
1450    FOR I=128 TO 254
1460      Exp_tbl(I+1)=Exp_tbl(I)+Exp_tbl(I)
1470    NEXT I
1480    RETURN
1490 Setup_fastmux:   !
1500    Setup=0
1510    ABORT 7
1520    CLEAR 7
1530    PRINT TABXY(1,30),"                                                           "
1540    PRINT "                                                                       "
1550    PRINT "                                                                       "
1560    OUTPUT @A8530_control;"RECA8"         !  START IN KNOWN WORKING STATE
1570    WAIT 3
1580    OUTPUT @A8530_control;"HOLD;SINP"     ! GO TO HOLD MODE, SINGLE POINT
1590    INPUT "ENTER FREQUENCY OF MEASUREMENT (IN GHz)",Freq
1600    OUTPUT @A8530_control;"OUTPERRO"      ! CLEAR THE MESSAGE LINE
1610    ENTER @A8530_control;Report$
1620    OUTPUT @A8530_control;"CENT"&VAL$(Freq)&"GHz;SING" ! SET TO SELECTED FREQUECY, MAKE A CW MEASUREMEN
1630    OUTPUT @A8530_control;"FASPARMTIME "&VAL$(Dwell_time) ! SET FAST MUX DELAY TIME (250 uS)
1640    OUTPUT @A8530_control;"FASMUXMODE 2;FASMD" ! SET UP FAST MUX MODE 2 (SEE O&P MANUAL FOR OTHERS)
1650    OUTPUT @A8530_control;"OUTPERRO"    ! CHECK FOR ERRORS DURING SET UP
1660    ENTER @A8530_control;Report$
1670    IF VAL(Report$)<>0 THEN
1680      PRINT TABXY(1,30),"THE FOLLOWING PROBLEM OCCURED DURING 8530A SETUP:"
1690      PRINT ""
1700      PRINT Report$
1710      DISP "RESOLVE PROBLEM AND CONTINUE ( OR EXIT )"
1720      FOR N=0 TO 4
1730        ON KEY N LABEL "CONTINUE" GOTO Setup_fastmux
1740        ON KEY N+5 LABEL "EXIT" GOTO Setup_failed
1750      NEXT N
1760 Wait_for_key:GOTO Wait_for_key
1770    END IF
1780    REPEAT                                  ! WAIT FOR 8530A SRQ MASK BIT
1790      WAIT .01
1800    UNTIL BIT(SPOLL(716),2)
1810    TRIGGER @A8530_control    ! DROPS 8530A INTO THE SELECTED FAST DATA MODE
1820    Setup=1                                 ! (FAST MUX MODE 2)
1830 Setup_failed:   !
1840    PRINT TABXY(1,30),"                                                           "
1850    PRINT "                                                                       "
1860    PRINT "                                                                       "
1870    RETURN
1880    SUBEND
```

9

In Case of Difficulty

This chapter explains:

- How to solve common operation problems.
- What to do when common error messages are displayed on the HP 8530A.
- How to solve basic hardware problems.

Chapter Contents

Common Operation Problems

The following problems are listed in this section:

- Receiver will not Sweep
- IF Signal Level Problems
- LO Signal Level Problems
- Rotary Joint Problems

Receiver will not Sweep

First, look at the "annotation" area of the display (on the far left-hand side). See if any of the following annotation letters are displayed:

H — This indicates that Hold mode is On. The instrument will not sweep in hold mode. Take the receiver out of Hold mode by pressing:

STIMULUS (MENU) MORE, then select SINGLE, NUMBER of GROUPS, or CONTINUAL.

E — This indicates that External Trigger or HP-IB Trigger mode is On. If you want perform measurements that are internally triggered, press:

STIMULUS (MENU) MORE TRIGGER MODE TRIG SRC INTERNAL

Check the Selected Sweep Mode

If you are trying to use Ramp mode, make sure the required BNC cables are connected between the RF source and the receiver. These connections are explained in the Ramp sweep mode description in Chapter 6 (refer to the index under "ramp sweep mode" for the exact page number).

Check the System Phase Lock Setting

The phase lock controls are available under:

(SYSTEM) MORE SYSTEM PHASELOCK

There are three settings, which should be used as explained below:

EXTERNAL — Select this mode if the system uses a distributed frequency converter such as the HP 85309A *and an HP 8350B LO source*. Make sure the receiver's L.O. PHASELOCK OUT connector is connected to the HP 8350B FM IN jack.

INTERNAL — Select this mode if the system uses an HP 8511 or S-Parameter (network analyzer) test set.

NONE — Select this mode if the system uses a distributed frequency converter such as the HP 85309A *and a synthesized LO source*.

IF Signal Level Problems

To check the HP 8530A's IF signal levels, press PARAMETER (MENU) SERVICE PARAMETERS, then press one of the following:

- SERVICE 1 a1 to check the a1 Reference channel IF signal level.
- SERVICE 2 b2 to check the b2 Test channel IF signal level.
- SERVICE 3 a2 to check the a2 Test channel IF signal level.
- SERVICE 4 b1 to check the b1 Test channel IF signal level.

On Systems Using the HP 85309A Frequency Converter

a1 *Reference Channel Level*

If the LO source is synthesized there is no minimum reference channel level, since phase lock is not used. The maximum signal level is −10 dBm. It is recommended, but not required, that the reference channel signal level be greater than −45 dBm. This will keep the reference channel signal above the noise floor, improving measurement accuracy.

If the LO source is not synthesized, the reference channel signal level must be greater than −45 dBm at the HP 8530A reference input.

To calculate the reference channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range," located the Operation chapter of the HP 85301C or 85310A manual. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

b2, b1, a2 *Test Channel Level*

To calculate the test channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range," located the Operation chapter of the HP 85301C or 85310A manual. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

On Systems Using the HP 8511A/B Frequency Converter

a1 *Reference Channel Level*

The reference channel level must be between −45 and −10 dBm. The signal level must remain at, or above the −45 dBm level (at the receiver's reference input) to maintain phase lock.

To calculate the reference channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range," located the Operation chapter of the HP 85301C or 85310A manual. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

b2, b1, a2 *Test Channel Level*

To calculate the test channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range," located the Operation chapter of the HP 85301C or 85310A manual. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

Possible Solutions

No IF Signal

1. Make sure the receiver system is installed correctly, or has not been changed. Refer to the *HP 8530A Installation Guide.*
2. Make sure test and reference antennas are connected to the frequency downconverter. Make sure the transmit antenna are pointing toward them.

3. Perform one of the following sub steps, depending on the frequency converter in your system:

   a. If your system uses the HP 85309 frequency converter:

      Make sure that the IF signal cables from the LO/IF unit's IF OUT to the HP 8530A's J1 TEST SET INTERCONNECT are connected to the correct channels.

      Make sure the HP 85309A and LO source are turned ON.

   b. If your system uses the HP 8511A/B frequency converter:

      Make sure the Test Set Interconnect cable is connected between the receiver and the HP 8511A/B.

      Make sure that the HP 8511A/B is turned on.

Incorrect IF Signal Level

1. Double-check the calculation in "Configuring the System for Optimum Dynamic Range," located the Operation chapter of the HP 85301C or 85310A manual. Check the receiver system using a standard gain antenna to double-check the calculations.
2. Check the output power level of the transmitter source (and optional amplifier) for the correct level, especially at high frequencies.
3. Make sure the receiver system is installed correctly, or has not been changed. Refer to the *HP 8530A Installation Guide*.
4. If using the HP 85309A frequency converter: Check the detector voltage on the front panel. The voltage should be approximately the value on the reference mixer module label.

LO Signal Level Problems (applies to the HP 85309A only)

LO Signal Is Too Low

If the LO signal level is too low, check the following items:

1. Adjust the LO signal level as shown in the *HP 85301B* or *HP 85310A Operating and Service Manual*.
2. Check the LO signal cables for damage, or high RF insertion loss.
3. Check the rotary joint for high RF insertion loss.

HP 85309A "LO POWER OUT OF RANGE" light is ON During Measurement

If this light is flashing, make sure the HP 85309A `POS Z BLANK` is connected to `POS Z BLANK` on the LO source.

If the light is still blinking, or is ON continuously, refer to the service chapter in the *HP 85310A Operating and Service Manual*.

Rotary Joint Problems

Rotary joints must operate at microwave frequencies, and they must physically rotate around a center axis. Because of this, rotary joints are a common source of problems. All of these problems cause measurement error and should be corrected immediately. Some common problems are:

- *Wow* is a fluctuation in the test signal level as the antenna positioner rotates. This causes measurement error at certain antenna positions.
- *High insertion loss* can reduce the LO signal level to the mixers modules. This can increase the mixers conversion loss, making the measurement system unusable. When the rotary joint is worn out, it will often have this problem.
- *Drop outs* are caused by the rotary joint having a high insertion loss at certain frequencies or angular positions. This can cause measurement error only at certain frequencies.
- *Intermittent* rotary joints can cause the test signal to fade randomly. This can cause random measurement errors.
- *Noise on the signal* is caused by an intermittent rotary joint with very fast intermittent fading. This can look like noise on the test signal.

Most of the above problems can be solved by cleaning the rotary joint. If the rotary joint cannot be cleaned, or if cleaning does not solve the problem, replace the rotary joint.

Common Error Messages

The following is a list of HP 8530A error messages. This is not a comprehensive list, and shows messages that are caused by simple procedural errors. If the error message continues to occur then use check for proper installation and setup. Refer to the "Caution/Tell Messages" chapter in the *HP 8530A Keyword Dictionary* for a complete list of error messages.

A

"ABORTED ENCODER TRIGGERED SWEEP"

This message is displayed if you change modes in the middle of a sweep. For example, if you select frequency domain instead of angle domain, or if you select a different sweep mode in the middle of a sweep.

"ADDITIONAL STANDARDS NEEDED"

In Antenna Calibration

The antenna definitions you used during the calibration do not cover the entire frequency range of the cal. There are either gaps between adjacent antenna definitions, or they do not provide full coverage at the beginning or end of the frequency range. You must measure one or more additional standards to cover the entire frequency range.

In Network Analyzer Calibration

The calibration standards you used during the calibration do not cover the entire frequency range of the cal. The standards you have measured do not provide full coverage over the selected frequency range. You must measure one or more additional standards to cover the entire frequency range.

C

"CALIBRATION RESET"

Occurs when you change settings such that the calibration is incompatible with the measurement. Calibration goes OFF if this message is displayed.

"CORRECTION MAY BE INVALID"

Occurs when you change settings and the receiver is not sure if the calibration is still valid. Calibration remains ON.

E

"ENCODER NOT FOUND"

The HP 85370A Position Encoder is not connected to the back of the HP 8530A.

"ENCODER OFFSET ANGLE ALREADY SAVED"

The receiver does not allow you to press SAVE OFFSET twice *in the same sweep*, unless you clear the first offset. If you want to change the offset value (without taking another sweep), press CLEAR OFFSET, then SAVE OFFSET.

F

"FREQUENCY CONVERTER IS TOO HOT!"

Occurs if the fan on the HP 8511A/B frequency converter is blocked with paper or other object. Items on top of the frequency converter or around the system may also impede the air flow. The test set *will not* shut down if it becomes too hot!

I

"IF OVERLOAD"

This occurs if the power going to any receiver input is greater than -10 dBm. You should lower the power level going to the inputs.

System cables can have less power loss at lower frequencies. Long cables can cause significant losses at high frequencies. If you turn RF power up, you might overdrive the receiver inputs at lower frequencies. Solve this problem using the Power Slope feature. Power Slope increases RF power as the sweep progresses. This feature is explained near the end of Chapter 6, Stimulus.

N

"NO IF FOUND"

The usual cause is inadequate power at the reference input of the HP 8530A (a1 is usually used as the reference input). Verify that the appropriate power levels are available, especially at the reference phase lock input by pressing:

PARAMETER (MENU) SERVICE PARAMETERS

SERVICE 1 a1

The signal level should be between −45 and −10 dBm.

If you are using an HP 85309A frequency converter, make sure you are *not* using Ramp sweep mode. Use Step sweep mode instead.

O

"OPTION #005 NOT INSTALLED"

The position encoder functions cannot be used unless the HP 8530A is equipped with option 005. This message is displayed if your HP 8530A does not have option 005 installed. Option 005 adds a new PC (printed circuit) board to the HP 8530A, and adds a new rear panel connected (ENCODER INTERCONNECT). Contact your HP representative for more information.

"OVERSPEED ERROR - BACKUP"

You are moving the positioner so fast that the HP 85370A Position Encoder cannot track the measurement. Overspeed conditions may occur when the measurement uses high averaging factors with small increment angles. To correct the error:

1. Stop forward movement.
2. Move the positioner backwards until the receiver beeps.
3. Continue with the measurement either at a slower rate, with a larger increment angle, or with a smaller averaging factor.

P

"PHASE-LOCK LOST"

This error message occurs when the HP 8530A is not receiving a signal at the reference input while a measurement is in process. The reference input is usually a1, but this can be changed to the a2 input by the user. The usual cause of this problem is inadequate power at the reference input of the HP 8530A. Verify that the reference input receives between −45 dB and −10 dB.

Phase Lock Problems when using Hardware Gating

Do not attempt to phase lock to a signal that is sent through a hardware gate. Use a separate phase lock signal. For example: Assume you use hardware gating and your test and reference signals pass through a hardware gate. You are using b1 as the test input and a1 as the reference input. By default, phase lock is set to a1. However, the gated signal arriving at a1 is essentially a pulsed signal with a low duty cycle. The result is an average power level that is too low to use for phase locking. To solve the problem, split off the test signal before it gets to the hardware gate, and connect it to the a2 input. Select the a2 input as the phase lock reference by pressing:

PARAMETER (MENU) REDEFINE PARAMETER PHASE LOCK a2

S

"SOURCE (1 or 2) FAILURE - RF UNLOCKED"

This error often occurs if the RF or (if used) LO source do not have anything connected to their STOP SWP connectors. You can solve this problem in either of two ways:

- You can connect the STOP SWP line to the STOP SWP connector on the back of the receiver.
- You can connect a BNC short to the source's STOP SWP connector.

"SWEEP SYNC ERROR"

This error may occur if the HP 8530A is in the *RAMP* mode, and the appropriate BNC connections have not been made. Refer to the Ramp sweep mode description in Chapter 6 (refer to the index under "ramp sweep mode" for the exact page number).

"SYSTEM BUS ADDRESS ERROR"

NOTE: References to an LO source, below, only applies to systems that use the HP 85309A frequency converter.

The receiver cannot communicate with the RF or LO source, or the CONVERTER address in the HP-IB menu is set improperly.

1. Make sure the RF and LO source HP-IB cables are connected to the receiver's System Bus (directly or through HP-IB extenders).
2. Make sure the SOURCE 1 (RF) and SOURCE 2 (LO) addresses shown in the receiver's HP-IB menu match the actual addresses of the RF and LO sources.)

3. If using the HP 85309A, make sure CONVERTER in the receiver's HP-IB menu is set to 31.
4. If using the HP 8511A/B, make sure CONVERTER in the receiver's HP-IB menu is set as explained below:

   A. *If using an HP 8511A with option 001*, make sure it is connected to the receiver's System Bus. The factory default HP-IB address is 20. Set the CONVERTER address (in the Receiver's HP-IB menu) to match the address setting on the HP 8511A.

   B. *If using an HP 8511A that does not have option 001*, then you do *not* need it to the System Bus.

      If the HP 8511A is *not* connected to the System Bus, enter address 31 for the CONVERTER address of the receiver's HP-IB menu.

      If you decide you want the HP 8511A connected to the System Bus (though this connection is not required), enter the HP-IB address of the HP 8511 in the receiver's HP-IB menu.

   C. *If using an HP 8511B*, make sure it is connected to the receiver's System Bus. The factory default HP-IB address is 20. Set the CONVERTER address (in the Receiver's HP-IB menu) to match the address setting on the HP 8511.

5. If using the HP 85309A frequency converter, check multiple source settings on the receiver. Refer to the HP 85310A or 85301B documentation for details.
6. Check HP-IB extenders by performing these steps:

   A. Make sure the extenders are set to SLOW mode. NORMAL mode can cause errors.

   B. Make sure the extenders are plugged in, and that their switches are set properly.

   C. Check the extender cables for breaks or damage.

7. Disconnect the extender from the receiver.

   Turn the receiver OFF, then ON.

   Reconnect the extender.

8. If all the above is correct:

   A. Suspect a failure in one of the extenders (if applicable). Connect the source directly to the receiver System Bus and check operation.

   B. Suspect a bad HP-IB cable, or a bad extender coaxial cable.

   C. After checking all other items, suspect a failure in one of the instrument's HP-IB circuits. Check each unit to see if it can communicate with other devices.

T

"TEST SET IS TOO HOT!"

Occurs if the fan on the HP 8511A/B frequency converter is blocked with paper or other object. Items on top of the frequency converter or around the system may also impede the air flow. The test set *will not* shut down if it becomes too hot!

U

"UNABLE TO RAMP THIS DUAL SOURCE SETUP"

This message only applies if you are using the HP 85309A frequency converter. The caution message will occur if you try to put the HP 8530A in *RAMP* mode with two synthesized sources. The HP 8530A should be in *STEP* mode.

V

"VTO FAILURE"

If Using the HP 8511A/B

If you are using an HP 8511A/B frequency downconverter:

1. Make sure the HP 8511A/B is turned ON.
2. Make sure the TEST SET-IF INTERCONNECT is connected between the receiver and the HP 8511A/B.
3. Make sure the HP 8530A is set for internal phase lock by pressing:
   a. (SYSTEM) MORE
   b. SYSTEM PHASELOCK LOCK TYPE: INTERNAL

If Using the HP 85309A

The following steps apply if you are using the HP 85309A frequency converter, and then only if you are using a non-synthesized LO source (such as a HP 8350B).

- Make sure a BNC cable is connected between the HP 8530A's *LO PHASELOCK OUT* and the LO source's *FM INPUT*.
- Make sure the HP 8530A is set for external phase lock by pressing:
  1. (SYSTEM) MORE
  2. SYSTEM PHASELOCK EXTERNAL

Hardware Problems

This section is not intended to be a comprehensive hardware troubleshooting guide. Instead this section discusses common problems and how to fix them. Refer to the HP 8530A service manual (or the service documentation for the frequency converter) for detailed information on troubleshooting and repair of the measurement system. The following problems are discussed:

- HP 8530A Locks Up
- An Instrument will not Respond
- HP 85309 (LO/IF Unit) Problems

HP 8530A Locks Up

"Lock up" is a condition where the HP 8530A refuses to operate and will not respond to front panel keystrokes, including (LOCAL).

If Your System Uses the HP 8511A/B

Use a straightened paper clip or other small diameter object to press the HP 8530A TEST button (this is a recessed button located under the disc drive, use a straightened paper-clip to press it). The receiver should re-initialize itself and operate properly.

If Your System Uses the HP 85309A

When you turn on external phase lock mode ((SYSTEM) MORE SYSTEM PHASELOCK EXTERNAL), the HP 8530A expects to find an HP 8350 connected as the LO source. The HP 8530A can lock up under the following circumstances:

- The HP 8350 is not connected to the System Bus.
- The HP 8350 is connected, but is turned off.
- The HP 8350 is connected, but its HP-IB address does not match the "SOURCE #2" address set in the HP 8530A Local menu.
- A synthesizer (such as an HP 8340/41 or 836xx-series) is connected to the System Bus instead of an HP 8350. If a synthesizer is used as the LO source, phase lock should be set to NONE. (press (SYSTEM) MORE SYSTEM PHASELOCK NONE.)

If any of the above problems existed, correct it and press the TEST button on the HP 8530A. It should now operate properly.

An Instrument will not Respond to Computer Control

This section applies to instruments that will not respond to remote computer control.

1. Make sure each instrument is plugged in and is turned ON. If an instrument's display is dark, check its line fuse. On a HP 836xx series source with no front panel display, make sure the green AC power LED is ON.
2. Make sure the computer software is using the correct address for that device.
3. Set the instrument to local mode and try to operate it manually.

If the instrument operates manually

1. Make sure the instrument's HP-IB cable is connected to the computer's HP-IB bus (directly or through HP-IB extenders).
2. Make sure the instrument is set to the correct HP-IB address.

3. Check HP-IB extenders by performing these steps:
   a. Make sure the extenders are set to SLOW mode. NORMAL mode can cause errors.
   b. Make sure the extenders are plugged in, and that their switches are set properly.
   c. Check the extender cables for breaks or damage.
4. Disconnect the extender from the receiver.

   Turn the receiver OFF, then ON.

   Wait 20 seconds.

   Reconnect the extender.
5. If all of the above is correct:
   a. Suspect a failure in one of the extenders. Connect the source directly to the receiver System Bus and check operation.
   b. Suspect a bad HP-IB cable, or a bad extender coaxial cable.
   c. After checking all other items, suspect a failure in one of the instrument's HP-IB circuits.

If the instrument does not operate manually

Suspect a failure within the instrument itself.

A System Bus Instrument will not Respond

This section applies to instruments on the System Bus that will not respond to remote HP 8530A or computer control.

1. Make sure each instrument is plugged in and is turned ON. If an instrument's display is dark, check its line fuse. On a HP 836xx series source with no front panel display, make sure the green AC power LED is ON.
2. If controlling the system with a computer:
   a. Make sure the software is using the right address for that device. If using the Pass-Through feature, make sure you are using it as explained in Chapter 18, HP-IB Programming.
   b. Press (LOCAL) on the HP 8530A. Try to control the System Bus instrument from the HP 8530A front panel.

      If the HP 8530A can control the instrument, suspect an improper HP-IB connection between the HP 8530A and the computer. (If the connection looks good, try replacing the HP-IB cable.)
   c. If the HP 8530A cannot control the instrument, set the instrument to local mode and try to operate it manually.

If the instrument operates manually

1. Make sure the instrument's HP-IB cable is connected to the receiver's System Bus (directly or through HP-IB extenders).
2. Make sure the instrument is set to the correct HP-IB address. (Make sure the address shown in the receiver's HP-IB menu matches the actual address of the instrument.) When using the HP 85309A, the receiver's CONVERTER address should always be set to 31 . For instructions on setting the HP-IB menu for an HP 8511A/B frequency converter, refer to the "SYSTEM BUS ADDRESS ERROR" error message description.

Hardware Problems

3. If you are using the HP 85309A frequency converter, and the problem is with one of the sources: check multiple source settings on the receiver. Refer to the HP 85310A documentation for details. Also refer to the description of Multiple Source Mode operation in Chapter 17, Using System Functions.
4. Check HP-IB extenders by performing these steps:
   a. Make sure the extenders are set to SLOW mode. NORMAL mode can cause errors.
   b. Make sure the extenders are plugged in, and that their switches are set properly.
   c. Check the extender cables for breaks or damage.
5. Disconnect the extender from the receiver.

   Turn the receiver OFF, then ON.

   Wait 20 seconds.

   Reconnect the extender.
6. If all of the above is correct:
   a. Suspect a failure in one of the extenders. Connect the source directly to the receiver System Bus and check operation.
   b. Suspect a bad HP-IB cable, or a bad extender coaxial cable.
   c. After checking all other items, suspect a failure in one of the instrument's HP-IB circuits.

If the instrument does not operate manually

Suspect a failure within the instrument itself.

HP 85309A (LO/IF Unit) Problems

This section only applies to HP 85309A frequency converters.

LO/IF Unit Does Not Turn ON

If the DETECTOR VOLTAGE display on the front panel does not light up when the unit is turned on, check the following:

1. Make sure the instrument is plugged into an operating AC power outlet.
2. Check the instrument's line voltage selector. Is it set to your AC power voltage?
3. Check the HP 85309A's fuse.
4. Check the power supply as explained in the service chapter of the HP 85301B or HP 85310A operating and service manual.

The LO POWER OUT OF RANGE Light is ON

This can be caused by the following:

- The LO source is not set to output enough power, increase power output (if possible) to +13 dBm. Make sure your LO source can output enough power at the highest LO frequency.
- The LO source's RF OUTPUT is not connected to the HP 85309A, or if the LO source is turned off. This can also happen if the LO source is on, but its RF output is turned off.
- The LO source cannot supply the requested amount of power in the measurement frequency range. Make sure your LO source is specified to produce +10 dBm in the desired frequency range. If the LO cannot produce enough power at high frequencies, the LO POWER OUT OF

RANGE light will come on during the high-frequency portion of the measurement. During this time LO power will not be correct.

- The reference mixer is not connected to the REFERENCE LO OUTPUT of the HP 85309.
- The reference mixer's Detector Output is not connected to the HP 85309A.
- There is a failure of the HP 85309A's ALC circuitry. An ALC failure will usually cause the light to come on permanently, though all equipment is connected properly.

A

Optimizing Dynamic Range

List of Appendixes

The following appendixes are in this section:

- **A** Optimizing Dynamic Range
- **B** Compatible Instruments and Peripherals
- **C** Supplies, Accessories, and After-Sale Options
- **D** Connector Care

Introduction to Appendix A

Configuring the system for optimum dynamic range entails using the highest RF power settings possible without overdriving the receiver. If you are using remote mixers, then overdriving the mixers must also be avoided. The procedure for optimizing dynamic range is different depending on whether you use the HP 8511A/B or HP 85310A frequency converters.

This appendix contains two procedures:

- Optimizing Dynamic Range for HP 85310A Frequency Converter.
- Optimum Dynamic Range for HP 8511A/B Frequency Converter.

Optimizing Dynamic Range for HP 85310A Frequency Converter

There are two methods you can use to optimize dynamic range:

- Simple Method for Improving Dynamic Range.
- Calculating Maximum Dynamic Range.

Simple Method for Improving Dynamic Range

The following steps provide a fast, easy way to improve the dynamic range of the system. A more complex method is provided below. The complex method takes longer to perform, but provides the highest measurement dynamic range.

1. Make all necessary settings on the HP 8530A (such as frequency range).
2. Make sure the receiving antenna is at boresight.
3. Make a continuous swept-frequency measurement over the entire frequency range of interest.
4. Increase the RF source `Source 1` power to maximum, or until *IF OVERLOAD* is displayed.
5. If the HP 8530A displays an *IF OVERLOAD* error:
   a. Decrease the RF source power by 2 dB. Press (ENTRY OFF) on the HP 8530A. The *IF OVERLOAD* should go away.
   b. Measure your antenna over its full frequency range. If *IF OVERLOAD* comes on again decrease power another 2 dB and press (ENTRY OFF). Repeat steps a and b until the entire frequency range can be measured without an IF overload occurring.

Calculating Maximum Dynamic Range

This method of improving the dynamic range provides the highest measurement dynamic range. Photocopy the worksheet in Figure A-1 for general use.

Set RF Source Power Level

Initially set the RF source power level to 0 dBm. This power level is a convenient starting point.

Enter Known Measurement System Gain/Loss Values

Figure A-1 shows attenuation and gain values required for later calculations. Read the following before using Figure A-1.

This procedure mentions “wide” and “narrow” frequency ranges. These terms have very specific meanings in this procedure:

- Wide: A frequency range is called “wide” when system performance at the start frequency is different than system performance at the stop frequency.

  Each box in Figure A-1 has two entry blanks. For example, look at Box E, Source Antenna Gain. When making “wide” frequency range measurements, enter the antenna’s gain at the start frequency on one line, and its gain at the stop frequency on the other line. Do this for each box in Figure A-1.

- Narrow: There is no noticeable change in system performance between start and stop frequencies. Use only one entry blank in each box of Figure A-1.

- CW: Measurements occur only at single CW frequencies. Use only one entry blank in each box of Figure A-1.

Photocopy the dynamic range worksheet (illustration and calculations) from Figure A-1 and fill it out. Item A is located in the lower-left hand corner of Figure A-1. The other items (B through I) proceed clockwise from item A. Each entry box is explained after Figure A-1.

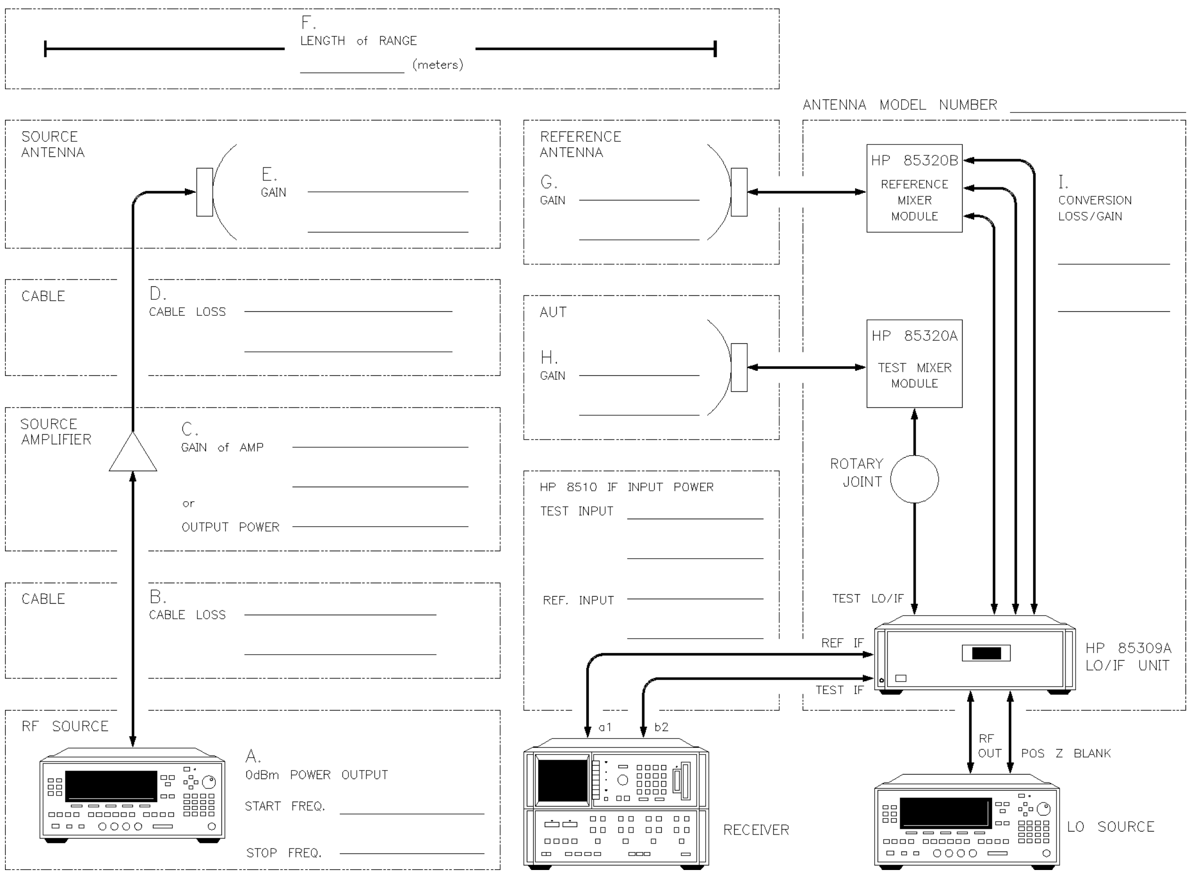


Figure A-1. Known System Gain and Loss Values (with HP 85310A Frequency Converter)

A. Enter the start and stop frequencies, or CW frequency, that will be used in the antenna measurement.

   If you are using a source amplifier, perform steps B and C. If not, proceed directly to step D.

B. Enter the loss of the cable connecting the RF source to the source amplifier. Refer to Figure A-2.

Optimum Dynamic Range (HP 85310A Frequency Converter)

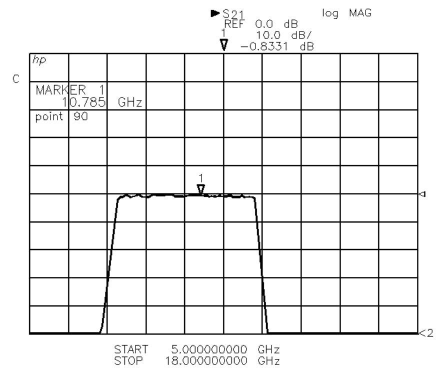


Figure A-2. HP 85381A/C/D Typical Insertion Loss at 25° C

C. Enter the actual gain of the amplifier in box C. Make sure you enter the actual gain of the amplifier (it is usually greater than the specified gain).

Hint If you are using a source amplifier that shows actual output power (for example, an HP 8349B), write the actual power in box C. Use this value directly when calculating power levels in later steps.

D. Enter the loss of the cable that goes to the source antenna.

E. Enter the gain of the source antenna.

F. Enter the length of the test range (in meters). A meter is 3.28 feet.

G. Enter the gain of the reference antenna.

H. Enter the expected gain of the AUT (antenna under test) at boresight.

I. Enter the conversion gain of the HP 85310A system. Refer to the "Specifications" section in the "General Information" chapter of the frequency converter manual. Remember that conversion efficiency varies with frequency and mixer mode (fundamental or third harmonic mode). Conversion loss (or gain) is a typical performance characteristic; it is not a warranted specification.

Calculate Unknown Measurement System Gain/Loss Values

Use the data entered in the worksheet illustration to calculate the following values. Write calculated values in the spaces provided.

If making *wide* frequency range measurements, perform each calculation twice, once with values applicable at the start frequency and once with values applicable at the stop frequency. If making *narrow* frequency range measurements, or CW measurements, perform each calculation once.

- *Effective Radiated Power (E_{RP})*

  E_{RP} (dBm) = RF source output power − source cable losses (+ source amplifier gain, if present) + source antenna gain. Alternatively, E_{RP} (dBm) = Actual source amplifier output power − cable losses + source antenna gain

  E_{RP} (at start frequency) = ______________________________
  E_{RP} (at stop frequency) = ______________________________

- *Power Dispersion*

P_D (dB) = 32.45 + 20 log Frequency + 20 log R, where frequency is in GHz and R is the length of the antenna range (in meters).

P_D (at start frequency) = ____________________

P_D (at stop frequency) = ____________________

- *Power at Mixers*
  - ☐ Reference Mixer

    P_{RM} (power at reference mixer) = E_{RP} − P_D + Gain of Reference Antenna

    P_{RM} (at start frequency) = ____________________

    P_{RM} (at stop frequency) = ____________________

    This value must not exceed the "Compression Level" specified in the "General Information" chapter of the frequency converter manual. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.
  - ☐ Test Mixer

    P_{TM} (power at the test mixer) = E_{RP} − P_D + Gain of AUT

    P_{TM} (at start frequency) = ____________________

    P_{TM} (at stop frequency) = ____________________

    This value must not exceed the recommended "Compression Level" specified in the frequency converter's manual. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.

The following calculations allow you to estimate actual IF levels at the HP 8530A a1 and b2 inputs. These calculations are optional.

- *Power at HP 8530A a1 IF Input*
  - ☐ P_{a1} (power at a1) = P_{RM} + conversion gain

    P_{a1} (at start frequency) = ____________________

    P_{a1} (at stop frequency) = ____________________

    This value must not exceed the maximum input power level of the HP 8530A (−10 dBm). Reduce the power level of the RF source if necessary. If you are using and HP 8350 LO source, the power at the HP 8530A a1 reference channel cannot be lower than −45 dBm or phase lock can be lost.
- *Power at HP 8530A b2 IF Input*
  - ☐ P_{b2} (power at b2) = P_{TM} + conversion gain

    P_{b2} (at start frequency) = ____________________

    P_{b2} (at stop frequency) = ____________________

    This value must not exceed the maximum input power level of the HP 8530A (−10 dBm). Reduce the power level of the RF source if necessary.

Increase RF Source Power if Possible

You may increase the power output of the RF source if BOTH of the following conditions are met:

Optimum Dynamic Range (HP 85310A Frequency Converter)

- The power arriving at the mixers is below the maximum specified RF input power.
- *IF OVERLOAD* is not displayed on the HP 8530A.

Power may be increased until an *IF OVERLOAD* error is displayed on the Receiver. Then decrease the RF source power by 2 dB, and press (ENTRY OFF). The *IF OVERLOAD* error should not reoccur.

Perform a continuous sweep measurement over the entire frequency range. If *IF OVERLOAD* comes on again, reduce power by 2 dB and press (ENTRY OFF) again. Repeat this step until *IF OVERLOAD* does not come on.

Optimizing when the Mixers Receive Different Power Levels

Optimize the system for the path (test or reference) with greater gain. Set the RF source output power to the highest setting possible without over driving the respective mixer or HP 8530A input.

If the test channel has less gain than the reference channel, the dynamic range of the test channel can be improved by adding an attenuator to the reference mixer's RF input. This attenuator value can be as large as the difference between the reference and test channel gain. Now you can increase the transmitter power to increase dynamic range.

Check Actual IF Power Levels

Now that power levels have been estimated for the HP 8530A test and reference IF inputs, check the actual input power levels to see if they meet expectations.

The instructions below assume you are using the HP 8530A a1 input as the reference channel and b2 as the test channel.

On the receiver, press PARAMETER (MENU) USER 1 a1 . Observe the power level of a1 (reference input).

If you are using an HP 8350 LO, the reference input limits are −10 to −45 dBm. The limits for a synthesized LO are −10 to the noise floor. Power levels near the noise floor will reduce measurement accuracy.

Suspect a problem if the actual value is not within ±6 dB of the calculated value. Double-check the calculation first, then check the system for attenuators or other equipment which may have been added (without your knowledge). Next, check all system connections. Refer to "In Case Of Difficulty" if all this fails.

Press PARAMETER (MENU) USER 2 b2 . Observe the power level of the b2(test) input. Power to the test input cannot exceed −10 dBm. The minimum power level is equal to the sensitivity specification of the test mixer. Suspect a problem if the actual value is not within ±6 dB of the calculated value.

Optimum Dynamic Range for HP 8511A/B Frequency Converter

Configuring the system for optimum dynamic range entails using the highest RF power settings possible without overdriving the receiver. The optimum dynamic range may be different for different measurements. Two methods are provided for improving dynamic range:

- Simple Method for Improving Dynamic Range.
- Calculating Maximum Dynamic Range.

Simple Method for Improving Dynamic Range

The following steps provide a fast, easy way to improve the dynamic range of the system. A more complex method is provided below. The complex method takes longer to perform, but provides the highest measurement dynamic range.

1. Make all necessary settings on the receiver (such as frequency range).
2. Make sure the receiving antenna is at boresight.
3. Make a continuous measurement over the entire frequency range of interest.
4. Increase the RF source `Source 1` power to maximum, or until *IF OVERLOAD* is displayed.
5. If the receiver displays an *IF OVERLOAD* error:
    a. Decrease the RF source power by 2 dB. Press (ENTRY OFF) on the receiver. The *IF OVERLOAD* should go away.
    b. Measure your antenna over its full frequency range. If *IF OVERLOAD* comes on again decrease power another 2 dB and press (ENTRY OFF). Repeat steps a and b until the entire frequency range can be measured without an IF overload occurring.

Calculating Maximum Dynamic Range

This method of improving the dynamic range provides the highest measurement dynamic range. Photocopy the worksheet in Figure A-3 for general use.

Set RF Source Power Level

Initially set the RF source power level to 0 dBm. This power level is a convenient starting point.

Enter Known Measurement System Gain/Loss Values

Figure A-3 shows attenuation and gain values required for later calculations. Read the following before using Figure A-3.

This procedure mentions "wide" and "narrow" frequency ranges. These terms have very specific meanings in this procedure:

- Wide: A frequency range is called "wide" when system performance at the start frequency is different than system performance at the stop frequency.

  Each box in Figure A-3 has two entry blanks. For example, look at Box E, Source Antenna Gain. When making "wide" frequency range measurements, enter the antenna's gain at the start frequency on one line, and its gain at the stop frequency on the other line. Do this for each box in Figure A-3.

- Narrow: There is no noticeable change in system performance between start and stop frequencies. Use only one entry blank in each box of Figure A-3.

Optimizing Dynamic Range (HP 8511A/B Frequency Converter)

- CW: Measurements occur only at single CW frequencies. Use only one entry blank in each box of Figure A-3.

Photocopy the dynamic range worksheet (illustration and calculations) and fill them out. Item A is located in the lower-left hand corner of Figure A-3. The other items (B through I) proceed clockwise from item A. A description of each entry box is provided after Figure A-3.

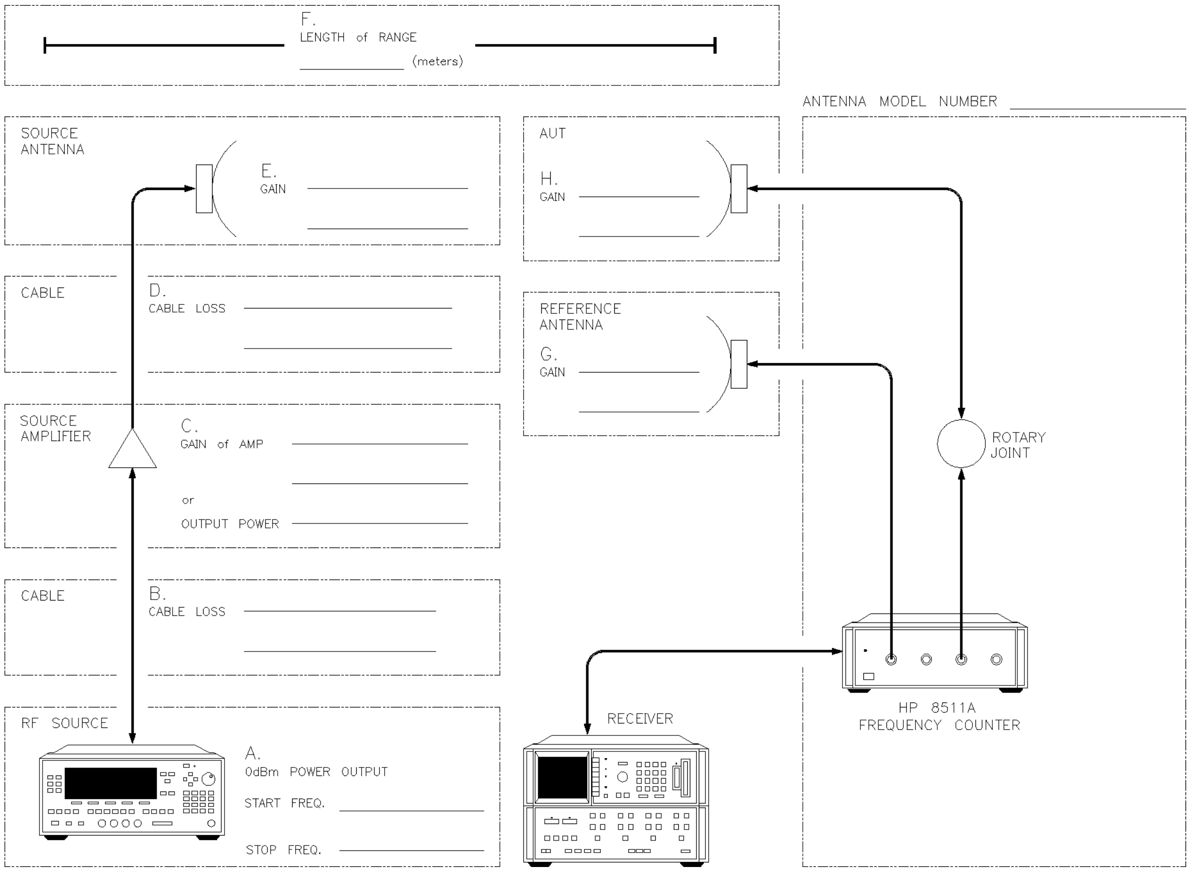


Figure A-3. Known System Gain and Loss Values (with HP 8511A/B Frequency Converter)

A. Enter the start and stop frequencies, or CW frequency, that will be used in the antenna measurement.

   If you are using a source amplifier, perform steps B and C. If not, proceed directly to step D.

B. Enter the loss of the cable connecting the RF source to the source amplifier. Refer to Figure A-2.

C. Enter the actual gain of the amplifier in box C. Make sure you enter the actual gain of the amplifier (it is usually greater than the specified gain).

Hint If you are using a source amplifier that shows actual output power (for example, an HP 8349B), write the actual power in box C. Use this value directly when calculating power levels in later steps.

D. Enter the loss of the cable that goes to the source antenna.

E. Enter the gain of the source antenna.

F. Enter the length of the test range (in meters). A meter is 3.28 feet.

G. Enter the gain of the reference antenna.

H. Enter the expected gain of the AUT (antenna under test) at boresight.

Calculate Unknown Measurement System Gain/Loss Values

Use the data entered in the worksheet illustration to calculate the following values. Write calculated values in the spaces provided.

If making *wide* frequency range measurements, perform each calculation twice, once with values applicable at the start frequency and once with values applicable at the stop frequency. If making *narrow* frequency range measurements, or CW measurements, perform each calculation once.

- *Effective Radiated Power (E_{RP})*

  E_{RP} (dBm) = RF source output power − source cable losses (+ source amplifier gain, if present) + source antenna gain. Alternatively, E_{RP} (dBm) = Actual source amplifier output power − cable losses + source antenna gain

  E_{RP} (at start frequency) = ______________________________

  E_{RP} (at stop frequency) = ______________________________

- *Power Dispersion*

  P_D (dB) = 32.45 + 20 log Frequency + 20 log R, where frequency is in GHz and R is the length of the antenna range (in meters).

  P_D (at start frequency) = ______________________________

  P_D (at stop frequency) = ______________________________

- *Power at a1 and b2*

  - Reference Channel a1

    P_{a1} (power at a1) = E_{RP} − P_D + Gain of Reference Antenna

    P_{a1} (at start frequency) = ______________________________

    P_{a1} (at stop frequency) = ______________________________

    This value must not exceed the recommended "Compression Level" specified in the frequency converter's manual. Add attenuation between the antenna and the HP 8511A, if necessary, or reduce the power of the RF source.

- ☐ Test Channel b2

  P_{b2} (power at b2) = $E_{RP} - P_D$ + Gain of AUT

  P_{b2} (at start frequency) = ______________________________

  P_{b2} (at stop frequency) = ______________________________

  This value must not exceed the recommended "Compression Level" specified in the frequency converter's manual. Add attenuation between the antenna and the HP 8511A, if necessary, or reduce the power of the RF source.

Increase RF Source Power if Possible

You may increase the power output of the RF source if BOTH of the following conditions are met:

- The power arriving at the receiver is below the maximum specified RF input power.
- *IF OVERLOAD* is not displayed on the receiver.

Power may be increased until an *IF OVERLOAD* error is displayed on the Receiver. Then decrease the RF source power by 2 dB, and press (ENTRY OFF). The *IF OVERLOAD* error should not reoccur.

Perform a continuous sweep measurement over the entire frequency range. If *IF OVERLOAD* comes on again, reduce power by 2 dB and press (ENTRY OFF) again. Repeat this step until *IF OVERLOAD* does not come on.

Optimizing when a1 and b2 Receive Different Power Levels

Optimize the system for the path (test or reference) with greater gain. Set the RF source output power to the highest setting possible without over driving the receiver's input.

If the test channel has less gain than the reference channel, the dynamic range of the test channel can be improved by adding an attenuator to the HP 8511A reference channel input (a1). This attenuator value can be as large as the difference between the reference and test channel gain. Now you can increase the transmitter power to increase dynamic range.

Check Actual IF Power Levels

Now that power levels have been estimated for the receiver's test and reference IF inputs, check the actual input power levels to see if they meet expectations.

The instructions below assume you are using the receiver's a1 input as the reference channel and b2 as the test channel.

On the receiver, press PARAMETER (MENU) USER 1 a1. Observe the power level of a1 (reference input).

Suspect a problem if the actual value is not within ±6 dB of the calculated value. Double-check the calculation first, then check the system for attenuators or other equipment which may have been added (without your knowledge). Next, check all system connections. Refer to "In Case Of Difficulty" if all this fails.

Press PARAMETER (MENU) USER 2 b2. Observe the power level of the HP 8511A b2 (test) input. Power to the test input cannot exceed −10 dBm. The minimum power level is equal to the sensitivity specification of the HP 8511A. Suspect a problem if the actual value is not within ±6 dB of the calculated value.

B

Compatible Instruments and Peripherals

The following instruments are compatible with the HP 8530A.

Compatible LO Sources

The LO source firmware revision must be compatible with the receiver.

HP 8350 Plug-Ins

HP 83525A HP 83592A HP 83540A
HP 83592B HP 83590A

HP 8360 Family Sources

Table B-1. Required options for HP 85360 LO sources

Model	Recommended Options	Special Option Requirements
HP 83620A	008	HP 83620A's with a serial prefix less than 3103A require option H87. If cable length between the LO source and HP 85309A is greater than 7 meters, contact your local HP representative.
HP 83621A	None	HP 83621A's with a serial prefix less than 3103A require option H87.
HP 83622A	008	HP 83622A's with a serial prefix less than 3103A require option H87. If cable length between the LO source and HP 85309A is greater than 7 meters, contact your local HP representative.
HP 83623A	008	HP 83623A's with a serial prefix less than 3103A require option H87.
HP 83624A	008	HP 83624A's with a serial prefix less than 3103A require option H87.
HP 83630A	008	
HP 83631A	None	HP 83631A's with a serial prefix less than 3103A require option H87.
HP 83640A	008	None
HP 83642A	008	None
HP 83650A	008	None
HP 83651A	None	None

Fast measurement speed and Quick Step mode

Older sources such as HP 8340/41 or early HP 8360s had slower frequency switching speeds than newer HP 8360 sources. Typically, these slower sources limited the receiver to Frequency Domain measurement speeds of 35 to 70 ms per frequency point. "fast measurement speed" refers to receiver operation with a newer, faster, HP 8360 source.

The following table shows the hardware and firmware requirements for fast measurement speed and Quick Step mode. Any source with firmware *not* listed on this table will have Frequency Domain measurement speeds similar to an HP 8340-family source, and it will not be compatible with the Quick Step mode. Both RF and LO sources must be equipped as shown below to attain fast measurement speed. Some older sources cannot be upgraded.

Table B-2. Compatible Sources for Fast Measurement Speeds

HP Model	Hardware Serial Prefix	Firmware Revision[1]	Upgrade Kit
83630A, 83650A, or 83651A	All	≥March 8, 1991[2]	Compatible—None required
83621A or 83631A	< 3103A	≥March 8, 1991[2]	Requires HP 83601A hardware kit[3]
	3103A	≥March 8, 1991[2]	Requires 08360-60167 firmware kit
	3104A to 3111A	≥March 8, 1991[2]	Requires 08360-60201 firmware kit
	≥3112A	≥March 8, 1991[2]	Compatible-None required
83620A, 83622A, 83623A, 83624A, or 83640A	<3145A	≥Nov 14, 1991[2]	Not Compatible[4]
	≥3145A	≥Nov 14, 1991[2]	Compatible—None required
83642A	Not Compatible		Not Compatible[4]

1 For millimeter wave band "W" compatibility, Firmware revision date must be ≥October 23, 1992

2 If the firmware revision is dated earlier than March 8, 1991, it is *not* compatible, even if the hardware *is* compatible.

3 Includes installation.

4 Cannot be upgraded.

Compatible RF Sources

- Any HP 8340/41 synthesized source (see note below).
- Any HP 8360 (836xx) family synthesized source.

Note Although any HP 8340 or 8341 will function with this receiver, units with firmware dated 11 May 1988 (and later) allow you to make faster Step Sweep measurements than earlier units. The firmware date is displayed whenever you turn the HP 8340/41 ON. To utilize the faster measurement capability, you must either:

Connect the HP 8340/41 STOP SWEEP BNC to the receiver's STOP SWEEP BNC.

or

Place a BNC short on the HP 8340/41 STOP SWEEP connector.

If you do not have this firmware revision, and wish to upgrade, you can order the HP 11875A upgrade kit. Contact your local sales office for details.

Fast Measurement Speeds and Quick Step Mode

Refer to “Fast measurement speed and Quick Step mode”, earlier in this section.

Compatible Frequency Converters

A frequency converter is required to downconvert RF frequencies to the 20 MHz IF frequency required by the HP 8530A. The following frequency converters are available:

HP 85310A Distributed Frequency Converter.

The standard HP 85310A allows the receiver to measure microwave frequencies from 2 to 26.5 GHz. The remote mixers allow the reference and test antennas to be separated by up to 30 meters (100 feet).

The HP 85310A is comprised of an HP 85309A LO/IF Unit and HP 85320A/B external mixers. The advantage to the HP 85310 is high sensitivity. External mixers mount on the reference and test antenna masts.

HP x85325A Millimeter Wave Subsystem

When you use the HP 85325A MM-Wave mixer system, the HP 85310A allows you to measure MM-Wave frequencies in the R, Q, U, V or W bands.

HP 8511A/B Frequency Converter (Test Set)

The HP 8511A frequency converter covers RF/microwave frequencies from 45 MHz to 26.5 GHz. The HP 8511B frequency converter covers RF/microwave frequencies from 45 MHz to 50 GHz. The HP 8511A or B offers simple setup and low cost frequency conversion. The HP 8511A or B can also be used as a network analyzer test set during optional HP 8510C operation. In this configuration the HP 8511 requires an external signal separation device (such as a directional coupler).

Compatible Printers

The HP 8530A can print to the printers listed below. RS-232 or HP-IB models can be used in each category. RS-232 printers work with the internal printer/plotter spooler, HP-IB printers do not.

- HP Laser printers and compatibles (RS-232 supplied, HP-IB not supported)
- HP DeskJet, DeskJet Plus and DeskJet 500 printers (RS-232 supplied, HP-IB not supported).
- HP DeskJet 500C is supported *for black printouts only. Color printouts are currently NOT supported with this printer*.
- HP PaintJet (order option 001 for RS-232, option 002 for HP-IB)
- HP PaintJet XL printers (order option 1AX for RS-232, option 1A8 for HP-IB)
- HP ThinkJet printer (HP 2225D provides RS-232, HP 2225A provides HP-IB)
- HP QuietJet or QuietJet Plus printers (HP 2227A with standard width carriage, RS-232 supplied, HP-IB not supported)

Compatible Plotters

RS-232 plotters work with the internal printer/plotter spooler, HP-IB plotters do not. The following HP-IB or RS-232 plotters are supported:

- HP 7550A/B or Plus (requires HP 24542H cable for RS-232 use. Order option 005 for HP-IB use)
- HP 7470A (out of production)
- HP 7475A (option 1 provides RS-232, option 002 provides HP-IB)
- HP 7440A ColorPro (option 1 provides RS-232, option 002 provides HP-IB)

Compatible External Monitors

The HP 8530 is designed to work with monitors that meet these four specifications:

- Horizontal scan rate of 25.5 kHz must be supported.
- Vertical scan rate of 60 Hz must be supported.
- The monitor must accept separate R G B signals.
- The monitor must accept RGB signals at .7 volts.

Multisync monitors commonly meet all these requirements. The monitor can have one or two sync inputs (composite sync or separate H, V sync), and positive and negative sync is supported.

Some of the monitors that can be run with the HP 8530A are listed below:

Table B-3. External Monitors

Manufacturer	Model
NEC	Multisync XL
NEC	Multisync II
NEC	Multisync Plus
Nanao	Flexscan 8060
Concorde Technologies	CT 5117 Multiflat Plus 17
	CT 5121 Multiflat Plus 21
IIYAMA Electric Co	MF 5117 Multiflat Plus 17

At the time this manual was published, the only compatible HP monitor was the HP 35741BM. This monitor has no sync connections as such. Sync pulses are superimposed on the green video signal.

The HP 8530A *cannot* drive dedicated-format monitors such as CGA, EGA, VGA or SVGA.

C

Supplies, Accessories, After-Sale Options

This appendix lists:

- Often-needed supplies and accessories.
- Options that are available after purchase.
- Touch-Up paint.

Supplies and Accessories

The supplies listed below can be obtained by calling *HP DIRECT* at 1-800-538-8787. All orders from *HP DIRECT* are shipped the same day. There are many other accessories available in the *HP DIRECT Computer Users Catalog*, available free upon request.

Diskettes

In addition to discs, many types of disc holders are available in the HP DIRECT catalog, and are not listed here.

The disc part numbers below are for boxes of 10 discs.

Item	Part Number
Low Capacity Discs	92192A
High Capacity Discs	92192S

HP DeskJet Printer Supplies

Item	Part Number
Black Ink Cartridge	51608A
Double-Capacity black ink cartridge	51626A

The double capacity ink cartridge is the same size as the standard cartridge, and will fit in any HP DeskJet family printer.

HP PaintJet Printer Supplies

HP PaintJet paper provides sharp, crisp printouts that are clearly better than standard paper. The part numbers listed for paper contain 250 sheets each.

Item	Part Number
Black Ink Cartridge (PaintJet and XL)	51606A
Color Ink Cartridge (PaintJet only)	51606C
Cyan Ink Cartridge (PaintJet XL only)	51606B
Magenta Ink Cartridge (PaintJet XL only)	51606R
Yellow Ink Cartridge (PaintJet XL only)	51606Y
Z-Fold PaintJet Paper, 8.5 x 11 inch	51630P
Cut Sheet PaintJet Paper, 8.5 x 11 inch	51630Y
Z-Fold PaintJet Paper, Metric A4	51630R
Cut Sheet PaintJet Paper, Metric A4	51630Z[1]

1 Also for HP Paintjet XL printer

HP ThinkJet and QuietJet Printer Supplies

Item	Part Number
Plain Paper Ink Cartridge, Black	51604A
JetPaper Ink Cartridge, Black	92261A
Z-Fold JetPaper, 8.5 x 11 inch 500 sheets	51630A
Z-Fold JetPaper, 8.5 x 11 inch 2500 sheets	92261K
Z-Fold JetPaper, Metric A4 500 sheets	51630C
Z-Fold JetPaper, Metric A4 2500 sheets	92261N

Plotter Supplies

HP plotter paper produces better definition than standard paper and prevents pen skipping. The part numbers listed for paper contain 250 sheets each.

Item	Part Number
Plotter Paper, 8.5 x 11 inch	17801P
Plotter Paper, Metric A4	17803P

Plotter Pens (for paper)

Color	Part Number 0.3 mm	Part Number 0.7 mm
Black	17825P	17826P
Red	17841P	17842P
Orange	17839P	17840P
Yellow	17837P	17838P
Green	17827P	17828P
Lt. Blue	17829P	17830P
Blue	17831P	17832P
Violet	17833P	17834P

HP-IB Cables

Item	Part Number
.5m (1.6 ft.)	10833D
1.0m (3.3 ft.)	10833A
2.0m (6.6 ft.)	10833B
4.0m (13.2 ft.)	10833C
6.0m (19.8 ft.)	8120-3448
8.0m (26.4 ft.)	8120-3449

Connector Savers

A "connector saver" is an adapter or short cable that saves wear-and-tear on the mixer input connectors. Hewlett-Packard recommends that you use connector savers on the RF inputs of the mixers. This is especially important on the input of the test mixer, because the test antenna is often changed. Use an appropriate connector saver from the following list:

Type	HP Part Number
3.5 mm male to 3.5 mm female	85027-60006
3.5 mm female to 3.5 mm female	85027-60005 (supplied with HP 85320A/B)
type N male to 3.5 mm female	1250-1744
type N female to 3.5 mm female	1250-1745

If you need a short cable, order a 0.5 meter cable such as the HP 85381C with 3.5 mm connector on one end. Choose a connector for the other end that will mate with the antennas you test.

A cable has an additional benefit: It allows you to mount the mixer a short distance away from the test antenna. This provides more flexibility when mounting the modules.

Touch Up Paint

Touch up paint is shipped in spray cans. Spray a cotton swab with paint and apply it to the damaged area.

Table C-1. Touch Up Paint

Color	Where the Color is Used	Part Number
Dove Gray	Front panel frames, portions of front handles, mixer modules	6010-1146
French Gray	Side, top, and bottom covers	6010-1147
Parchment Gray	Rack mount flanges, front panels	6010-1148

After-Sale Options

HP 85396A Upgrade Kit — Adds HP 8510C Network Analyzer capability to the HP 8530A Receiver.

HP 85012D Upgrade Kit — Adds option 010 time domain operation to the HP 8530A.

Rack Mount Kits — To obtain a rack mount kit designed for use *without handles* order 5062-3977.

To obtain a rack mount kit designed for use *with existing handles* order 5062-4071.

Option 005 Upgrade — This return-to-factory upgrade adds HP 85370A Position Encoder compatibility. This product allows the HP 8530A to function with virtually any positioner system. The HP 85370A Position Encoder must be ordered as option 001 or option 002:

Option 001 is for Scientific Atlanta positioner systems. NOTE: if you DO NOT use the S.A. synchro display unit, also order a reference adapter cable, HP part number 85370-60017.

Option 002 is for Flamm & Russell or Orbit positioner systems.

Calibration and support services are also available, contact your local HP office for information.

D

Connector Care

Introduction

This appendix explains:

- The importance of proper connector care and maintenance.
- How to take care of connectors.
- How to clean connectors when necessary.

The condition of system connectors has a serious affect on measurement accuracy. Worn, out-of-tolerance, or dirty connectors degrade measurement accuracy. For more information on connector care, please see *Application Note 326 Coaxial Systems Principles of Microwave Connector Care*.

Recommended Practices

HP strongly recommends that you use a “connector saver” on the RF input of the mixers. This is especially important on the test mixer, which is connected and disconnected often. A “connector saver” is an adapter or short cable. This practice has two important advantages:

- The “connector saver” receives daily wear, the mixer input connector does not. This greatly extends the life of the mixer’s input connector.
- It is the connector saver that gets dirty with use, not the mixer connector.

When you must clean the connector saver, remove it from the mixer. This protects the mixer from static discharge.

Caution The HP 8530A and HP down converters contain static sensitive devices. Do not touch the center conductor of any connector, or the center conductor of any cable connected to the HP 8530A or its down converter. Wear a grounded anti-static strap when cleaning connectors.

How to Inspect Connectors for Wear

Look for metal particles from the connector threads and other signs of wear (such as discoloration or roughness). Visible wear can affect measurement accuracy. Discard or repair any device with a damaged connector. A bad connector can ruin a good connector on the first mating.

Use caution when mating SMA connectors to the mixer's precision 3.5 mm RF input. SMA connectors are not precision devices, and are often out of mechanical tolerances, even when new. An out-of-tolerance SMA connector can ruin the mixer's RF input connector on the first mating. If in doubt, gage the SMA connector before connecting it to the mixer. The center conductor must NEVER extend beyond the mating plane.

How to Clean Connectors

Part numbers for cleaning supplies are provided after the procedure.

1. Blow particulate matter from connectors using an environmentally-safe aerosol such as Ultrajet. This product is recommended by the United States Environmental Protection Agency, and contains chlorodifluoromethane. You can order this aerosol from Hewlett-Packard.
2. Next, use an alcohol wipe to wipe connector surfaces. It is best to wet a small swab with alcohol (from the alcohol wipe) and clean the connector with the swab.
3. Allow the alcohol to evaporate off the connector before making connections

Caution DO NOT ALLOW EXCESSIVE ALCOHOL TO RUN INTO THE CONNECTOR! Excessive alcohol entering the connector collects in pockets in the connector's internal parts. The liquid will cause random changes in the connector's electrical performance. If excessive alcohol gets into a connector, lay it aside to allow the alcohol to evaporate. This takes up to 3 days. If you attach that connector to another device it can take much longer for trapped alcohol to evaporate.

Cleaning Supplies

- Ultrajet: 9310-6395
- Alcohol wipes: 92193N
- Lint-Free cloths: 9310-4242
- Small foam swabs: 9300-1270
- Large foam swabs: 9300-0468

Glossary

Active

The term “active” has two special meanings in HP 8530A documentation:

- “Active function” refers to the last feature you activated *that requires a numeric value*. When you turn the front panel knob, use the step keys, or enter a numeric value, the HP 8530A changes the *active function*.

  For example, pressing (START) makes it the active function. Any value changes or entries will affect that function. Start will remain the active function until you select another function *that requires a numeric value*. Pressing (ENTRY OFF) causes the receiver to remove the function from active status. The knob, step keys, and numeric entry keys will no longer have any effect. (ENTRY OFF) protects the instrument from accidental value changes. Such changes occur most commonly when someone accidentally moves the knob.

- When the term “active” is used next to multiple-choice functions (“active parameter,” “active channel,” “active marker,” and so on), it is referring to the *most recently used choice* in that multiple-choice function. Thus, “active parameter” refers to the most recently used parameter.

  Here is an example: Assume you want to use the Redefine Parameter feature to modify a parameter. Redefine Parameter affects the “active” parameter. Thus, you should activate PARAM 1 before using the Redefine Parameter feature.

The terms “active” and “currently-selected” mean the same thing in HP 8530A documentation.

AUT

AUT is an acronym which stands for Antenna Under Test.

Antenna Definition

An antenna definition is one of seven individual data sets inside a **cal definition**. Each antenna definition has the gain values for a specific standard gain antenna. See “Cal Definition,” below.

Cal

“Cal” is an abbreviation for calibration.

Cal Definition

A “cal definition” is a data set that contains the published gain data for up to seven standard gain antennas. A cal definition is composed of a four-line header, and up to seven individual data sets called **antenna definitions**. See “Antenna Definition,” above.

Calibration, Antenna

Antenna calibration using a standard gain antenna allows measured data to be expressed in dBi (dB relative to an isotropic radiator). A standard gain antenna with known or defined gain values at specific frequencies is used as a transfer standard to calibrate the system. Calibrating with a standard gain antenna corrects for the transmission response error.

Isolation calibration is also available, which corrects measurement errors caused by receiver cross-talk.

Calibration Coefficients

An internal data array. This is the correction data that was created during calibration (also called "Cal Sets"). You can retrieve the active Cal Set register over HP-IB.

Cal Definition

A calibration definition is an ASCII file you create using a text editor. It contains frequency and gain values that were published for the standard gain antenna.

Cal Set

A finished calibration data file. During the calibration, the standard gain antenna is measured and its response is compared to the cal definition. Any differences are stored in an internal "cal set register." These differences are the measurement offsets that are used to compute the correct gain value, expressed in dBi. Cal sets can be stored to, or loaded from disc.

When you press (CAL) CORRECTION ON, and then choose one of the eight cal sets, the selected calibration data is placed in the Calibration Coefficient Array for that channel.

Channel

The receiver measures the performance of the antenna under test and converts the results into digital data. This data is then duplicated into two identical copies. Once copy becomes "Channel 1" data and the other becomes "Channel 2" data.

When you press (CHANNEL 1) on the front panel, most instrument settings you make afterward will affect only the Channel 1 data. When you press (CHANNEL 2) most settings you make afterward will affect only the Channel 2 data. This feature allows you to view two versions of the same measurement at the same time. Each version can use different instrument features, but still represents the same basic measurement data. For example: One version might be calibrated, while the other is uncalibrated. Or, one version might display frequency data, while the other displays Time Domain data.

Such features as calibration, time domain, display formatting, and trace math can be performed independently on the two channels. When you press the (CHANNEL 1) or (CHANNEL 2) key, you make that channel the "active channel." Any subsequent changes you make to measurement settings will affect that channel.

Some instrument settings are always the same in both channels. Such features are "coupled." Other settings can be changed in one channel versus the other. Such features are "uncoupled."

Corrected Data

There are two internal data arrays that hold "corrected data," one array for Channel 1, and one for Channel 2. In addition to ratioing and averaging, corrected data has been through time domain and calibration processing (if these features are ON at the time). Also, a user-definable "delay table" can affect corrected data, if used. Refer to the index of the Operating and Programming manual under "delay table" to find more information.

Delay Table

The HP 8530A has a delay table for each channel. When four parameter display is ON, there is a delay table for each parameter in each channel (a total of eight). The delay table allow users to grab, modify, and return measurement data to the instrument. Uses are primarily in RCS applications, where users want to modify the time domain response window. Refer to the index of the Operating and Programming manual under "delay table" to find more information.

DOS

Disc Operating System, the disc format used by IBM PCs and compatible computers.

Form 1

An HP-IB data transfer format. Form 1 is the native internal data format of the receiver. It consists of a header byte, followed by three, 16 bit data words for each stimulus point. Form 1 offers very fast transfer speeds, and it can be converted to floating point data. (High Speed Fast CW only offers Form 1 output.)

Form 2

An HP-IB data transfer format. Form 2 is a 32 bit IEEE 728 format. This format is not commonly used.

Form 3

An HP-IB data transfer format. Form 3 is the recommended format for use with HP 9000 Series 200/300 workstations. It consists of a header, a two-byte number indicating how many bytes follow, then the real and imaginary data pairs for each stimulus point. Form 3 follows the 64 bit IEEE 728 standard format.

Form 4

An HP-IB data transfer format. Form 4 is ASCII, originally used for PCs before Form 5 was created.

Form 5

An HP-IB data transfer format. Form 5 is the recommended format for use with IBM PCs and compatibles. This is a 32 bit DOS-compatible floating point format.

Formatted Data

There are two internal data arrays that hold "formatted data," one array for Channel 1, and one for Channel 2. This data is scalar (magnitude-only) and reflects display format, scaling, and trace math processing.

Hardware State

The Hardware State stores multiple source mode settings, HP-IB settings for external hardware, and frequency converter or test set states. The hardware state can be stored to disc. This feature allows you to quickly reconfigure the receiver for different test setups.

Input

Refers to the four HP 8530A signal inputs (a1, a2, b1, and b2). This word is also used when referring to the signal inputs of the frequency down converter.

LIF

Logical Interchange Format, the disc format used by HP 9000 Series 200/300 computers.

Machine Dump

A Machine Dump stores the following register contents to a single disc file:

- Current instrument state
- Instrument states 1 - 8
- Cal sets 1 - 8
- Cal kits
- Hardware state
- Memories 1 - 8

Machine dump files allow you to change between different test configurations quickly. This feature is useful if you have an HP 8530A with optional HP 8510C operation. Here's why: When you change between HP 8530A and HP 8510C operation, the receiver reverts to factory-default settings, and the contents of all registers is lost. A machine dump can store all these settings to a single disc file, so you can reload the machine dump and restore your setups immediately. NOTE: Before saving a machine dump file, make sure you save the current settings to Save Register 8 (the user preset register). When you later load the machine dump file, the machine will wakes up in the desired state.

Measurement

A "measurement" is a completed data collection activity. What constitutes a measurement depends on the mode you are in.

Measurement Definition when Using Ramp Sweep Mode

In Ramp sweep mode, a "measurement" is a complete sweep spanning the start and stop frequencies. One sweep must be measured if averaging is OFF. If averaging is ON, $n + 1$ sweeps must be measured, where n is the selected averaging factor.

For example, assume you select four parameters, ramp mode, and averaging is set to 4. To take a fully averaged measurement:

- If using Continual mode, allow five sweeps to complete. After five sweeps the data is fully averaged.
- If controlling the receiver by computer, set Number of Groups (NUMG) to 5.

When the measurement starts, the receiver starts measuring 5 complete sweeps of parameter 1. When it finishes, it starts taking 5 complete sweeps of parameter 2. This continues until all four parameters have been measured.

Ramp mode is most often used with internal triggering. And is almost always used in the Frequency or Time Domains.

Measurement Definition when Using Single Point Mode

In Single Point mode, a measurement is finished when the current frequency point has been measured. If you want to measure more than one parameter, the receiver measures that frequency point for each parameter. This mode is used in the Frequency or Time Domains. Continual sweep and internal triggering are usually used with Single Point mode.

Measurement Definition when Using Step or Frequency List Mode

In Step and Frequency List modes, a measurement is finished when all points between the start and stop frequencies have been measured.

External Triggering:

External Pulse or HP-IB triggering can be modified to suit your needs. By default triggering works as follows:

- If you are displaying a single parameter, each external trigger will measure the AUT at one frequency point, then advance to the next frequency and wait for another trigger.
- If you are displaying four parameters, each trigger will measure all four parameters at one frequency point, then advance to the next frequency and wait for another trigger.

The Trigger Mode feature of the HP 8530A (under STIMULUS (MENU) MORE TRIGGER MODE) provides more flexibility. You can make the receiver wait for a trigger before measuring any specific parameter. You could measure one parameter per trigger, measure two parameters per trigger, or *any* combination. The only limitation is that you must measure the parameters in numeric sequence (1, 2, 3, 4). You can also make the receiver wait for a trigger before advancing to the next stimulus point. This is helpful if you are using a RF source that is not compatible with the HP 8530A, if using unusual RF multipliers, and so on.

Internal Triggering:

If a single parameter is displayed, the receiver measures one frequency point, advances to the next frequency point, and measures it. This continues automatically until the whole frequency range is measured.

If you are displaying four parameters, each trigger will measure all four parameters at one frequency point, then advance to the next frequency and measure all four parameters again. This continues automatically until the whole frequency range is measured.

Measurement Definition when Using Single Angle Mode

In Single Angle mode, a measurement is finished when the current angle has been measured. Continual measurement mode and internal triggering is recommended when using Single Angle mode.

Measurement Definition when Using Swept Angle Mode

In Swept Angle mode, a measurement is finished when all points between the start and stop angles have been measured. External or HP-IB triggering are almost always used with Swept Angle mode.

External Triggering:

External TTL or HP-IB triggering can be modified to suit your needs. By default triggering works as follows:

- If you are displaying a single parameter, each external trigger will measure the AUT at one angle, then advance to the next angle and wait for another trigger.
- If you are displaying four parameters, each trigger will measure all four parameters at one angle, then advance to the next angle and wait for another trigger.

The Trigger Mode feature of the HP 8530A (under STIMULUS (MENU) MORE TRIGGER MODE) provides more flexibility. You can make the receiver wait for a trigger before measuring any specific parameter. You could measure one parameter per trigger, measure two parameters per trigger, or *any* combination. The only limitation is that you must measure the parameters in numeric sequence (1, 2, 3, 4). You can also make the receiver wait for a trigger before advancing to the next angle.

Internal Triggering:

If a single parameter is displayed, the receiver measures the AUT at one angle, advances to the next angle, and measures it. This continues automatically until the whole pattern is measured.

If you are displaying four parameters, each trigger will measure all four parameters at one angle, then advance to the next angle and measure all four parameters again. This continues automatically until the whole pattern is measured.

More information on how the various sweep modes work is provided in the Keyword Dictionary, under the title of each mode.

Memory Data

An internal data array. Valid data can be read from this array (over HP-IB) *if* data has been stored to one of the memory registers. Various trace math functions are possible when using the memory data feature.

Parameter

The input, or input ratio, that you have selected for the measurement. The front panel keys (PARAM 1), (PARAM 2), (PARAM 3), and (PARAM 4) are set at the factory to select different input ratios (b1/a1, b2/a1, and so on). For example, (PARAM 1) divides (ratios) input b1 by a1. You can redefine the PARAM keys so they ratio any two inputs you desire. You can also configure any PARAM key to measure a single input.

Ratio

Most often, users want to divide the test signal input by the reference signal input. This is called a ratio, or ratioed, measurement. (For example, selecting b1/a1 would divide the test signal at b1 by the reference signal at a1.) A ratioed measurement provides common-mode rejection of errors caused by the transmitter or transmit antenna.

Raw Data

A data array that contains the ratioed and averaged measurement data results. There are four raw data arrays, one for each parameter. If dual channel display is selected, the receiver creates eight raw data arrays, four for the parameters in Channel 1, and four for the parameters in Channel 2.

Snapshot

A "snapshot" is an exact copy of the data presented on the HP 8530A display. Screen snapshots can be printed or plotted. This term is borrowed from American English, it means "photograph," but implies that the photograph was taken quickly and without any required preparation.

State

A "state" is defined as the condition of all current measurement settings, including all domain, stimulus, parameter, format, and response settings.

Stimulus

Stimulus is the X-axis of the receiver, it is the range of frequency, time, or angle over which you are making a measurement.

- If you are in Frequency Domain, the measurement stimulus is frequency (kHz, MHz, or GHz).
- If in Time Domain, the actual stimulus is frequency, but this is converted to an X-axis display of time (seconds).
- In Angle Domain, stimulus is angular (degrees).

The HP 8530 measures individual points along the selected "stimulus." In other words, if you have selected Frequency Domain, the receiver measures a specific number of frequency points. The maximum number of points you can measure is 801, regardless of whether you are measuring frequency, time, or angle.

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