OPERATING MANUAL

Model 3562A
Dynamic Signal Analyzer

WARNING

To prevent potential fire or shock hazard, do not expose equipment to rain or moisture.

Manual Part No. 03562-90001
Microfiche Part No. 03562-90201

8600 Soper Hill Rd., Everett, WA 98205-1298

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CERTIFICATION

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

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

HP software and firmware products which are designated by HP for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If HP receives notice of such defects during their warranty period, HP shall repair or replace software media and firmware which do not execute their programming instructions due to such defects. HP does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.

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The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

⚠	Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.
↯	Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).
⏚ OR (⏚)	Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.
(⏚)	Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.
⫫ OR ⊥	Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.
	Alternating current (power line).
⎓	Direct current (power line).
≂	Alternating or direct current (power line).
WARNING	The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.
CAUTION	The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.
NOTE:	The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

HOW THIS MANUAL IS ORGANIZED

This manual is divided into two major parts: the operating instructions and the operating reference. The instructions consist of Chapters 1 through 11; and the reference is in Chapter 12 and Appendixes A through E.

Chapter 1 — **Using the Linear Resolution Mode**
shows you how to set up and make linear resolution measurements.

Chapter 2 — **Using the Log Resolution Mode**
shows you how to set up and make log resolution measurements.

Chapter 3 — **Using the Swept Sine Mode**
shows you how to set up and make swept sine measurements.

Chapter 4 — **Using the Time Capture Mode**
shows you how to set up time captures and measure capture data.

Chapter 5 — **Using Demodulation**
shows you how to use demodulation with the linear resolution mode.

Chapter 6 — **Using Time Throughput**
explains the use of time throughput with the linear and log resolution modes.

Chapter 7 — **Input Setup**
covers input set up and is used with all four modes.

Chapter 8 — **Display Configuration**
covers display and marker features.

Chapter 9 — **Data Operations**
explains the data operations—math, auto math, frequency response synthesis and curve fitting.

Chapter 10 — **Auto Sequence Programming**
shows how to use auto sequences.

Chapter 11 — **HP-IB Functions**
shows how to use the instrument as an HP-IB system controller to plot the display, access disc memories and output command strings.

Chapter 12 — **Operating Reference**
describes each key, softkey, connector and indicator in the HP 3562A.

Appendix A — **General Information**
explains initial inspection, power requirements, operating environment, installation, performance verification, HP-IB connections, operator maintenance, and storage and shipment.

Appendix B — **Error Messages**
explains the error messages the HP 3562A displays in response to operator errors.

Appendix C — **Specifications**
provides the analyzer's specifications.

Appendix D — **Softkey Menu Diagrams**
shows the softkey menu diagrams for each hardkey in the instrument.

Appendix E — **The HP 3562A's Measurement Process**
explains the internal operation of the HP 3562A to help you better understand the measurements it makes.

The Index shows the location in the manual of all features and topics.

Notes On Using This Manual

1. To learn how to use a feature, use the operating instructions in Chapters 1 through 11. Using the curve fitter, for example, is explained in Chapter 9. To learn more about a particular key, softkey, connector or indicator—the **CURVE FIT** key, for example—use Chapter 12.

2. Hardkeys, the keys on the front panel with permanently etched labels, are shown in upper-case bold type and are referred to simply as "keys."

   MEAS MODE
   CURVE FIT

   Softkeys, the eight blank keys beside the display that are labeled on the screen itself, are shown in upper-case regular type:

   LINEAR RES
   FREQ RESP

3. The beginning of each chapter explains its organization and provides a table of contents. Chapters 1 through 6 also provide a fold-out setup checklist at the end of the chapter to guide you through setups that require several steps.

4. The User's Guide at the beginning of this manual set is the introduction to the HP 3562A; this operating manual assumes you are familiar with the concepts explained in the User's Guide. Use this manual to learn the complete details of all the analyzer's features.

5. Default conditions are shown for the menus in Chapters 1 through 11. For example, here's the **SELECT MEAS** menu from Chapter 1:

FREQ RESP

POWER SPEC

AUTO CORR

CROSS CORR

HIST

CH 1&2 ACTIVE

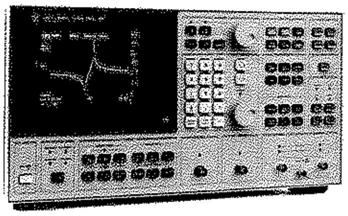
CH 1 ACTIVE

CH 2 ACTIVE

Softkey selections that are default conditions (appear at power-on and after RESET) are highlighted and underlined in the menus.

HP 3562A DYNAMIC SIGNAL ANALYZER

PRODUCT NOTE 3562A-1



PACKARD

OPERATOR'S INTRODUCTION TO THE

The Hewlett-Packard 3562A Dynamic Signal Analyzer represents a new standard in accuracy and versatility for dual-channel FFT analyzers. A full complement of measurement and analysis capabilities combined with outstanding specifications make the HP 3562A an invaluable tool for the test, analysis and design of dc-to-100 kHz electronic, electro-mechanical and mechanical systems.

This Product Note is an operator's introduction to the HP 3562A Dynamic Signal Analyzer. As an introduction, this note will explain the basic concepts and operation of the analyzer: detailed explanations are left to the HP 3562A Operating Manual. The body of the text is based on built-in Preset states and is designed to help you start making measurements quickly.

The information is organized as follows:

Chapter 1: General Operation. The HP 3562A is operated using front panel hardkeys and associated groups of softkeys. Chapter 1 defines the front panel concept and demonstrates a general set up sequence.

Chapters 2 through 4: Frequency Response Measurements. Wideband and narrowband measurements are demonstrated for the Linear Resolution (Chapter 2), Log Resolution (Chapter 3) and Swept Sine (Chapter 4) measurement modes.

Chapter 5: Spectrum Analysis with Demodulation. Spectrum analysis with Linear Resolution FFT analysis and the HP 3562A demodulation capability is demonstrated.

Chapter 6: Waveform Analysis with Time Capture. Waveform analysis in the time and frequency domains is possible with the HP 3562A. Waveform capture and analysis is described.

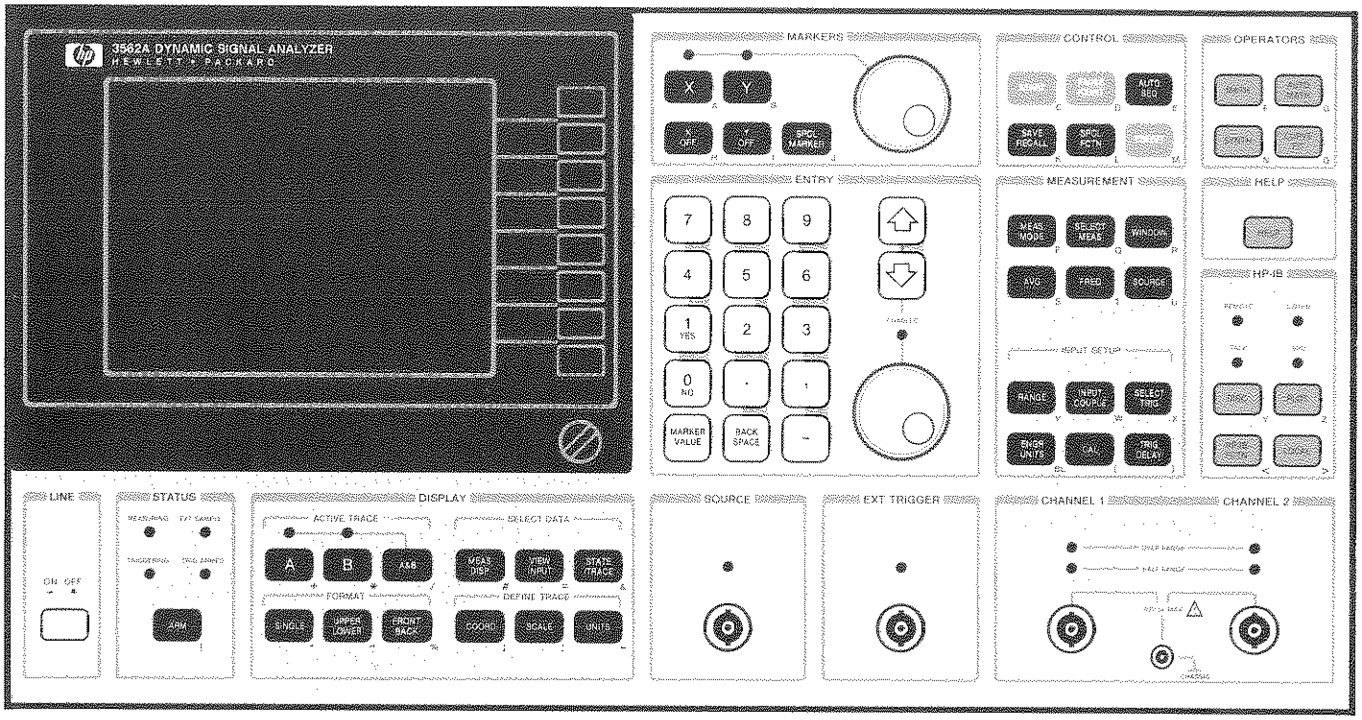
Chapter 7: Data Collection with Time Throughput. The HP 3562A can sample and digitize analog signals and store the data directly to an external disc drive. Configuration of a throughput session and recall and analysis of data is demonstrated.

Chapters 8 through 10: Analysis Capabilities. A full range of data analysis functions are built into the HP 3562A. Waveform Math (Chapter 8), Curve Fitting (Chapter 9) and Frequency Response Synthesis (Chapter 10) are demonstrated.

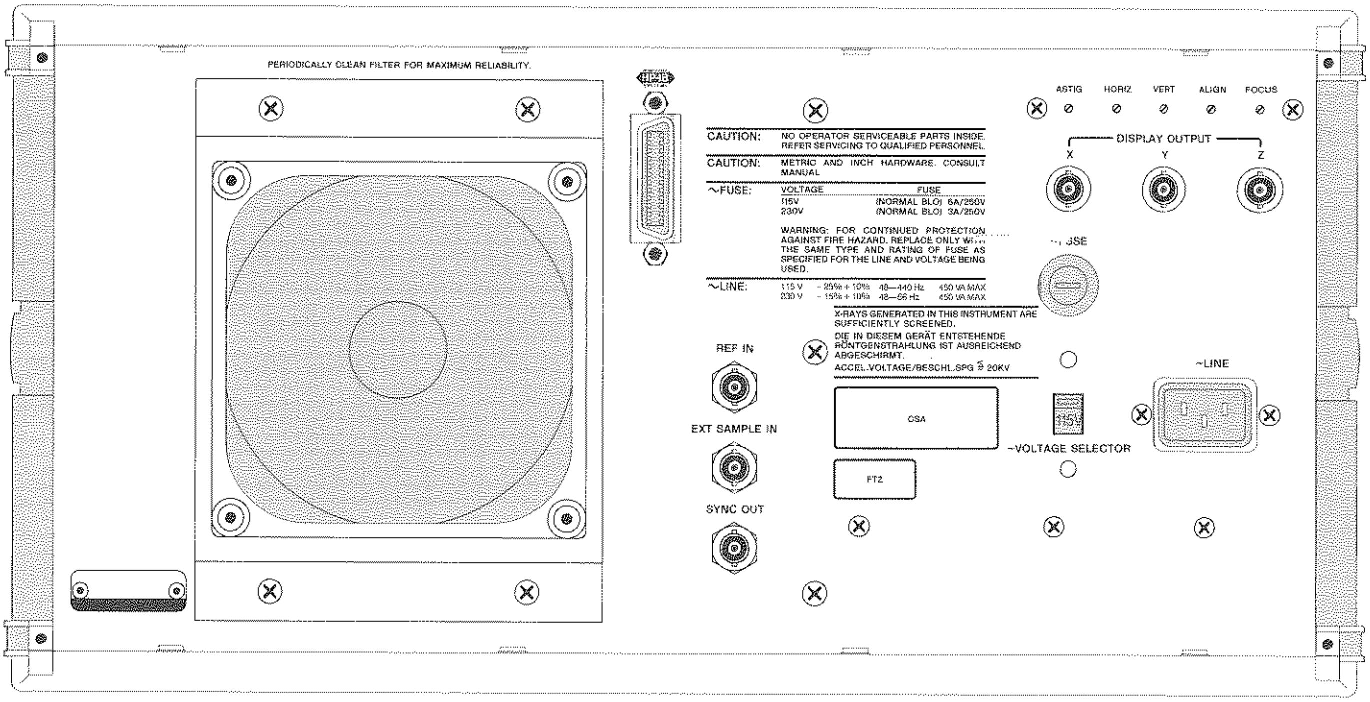
Chapter 11: Auto Sequence Programming. Measurement and analysis functions can be automated by entering the necessary key strokes into an Auto Sequence program. Entry, operation and editing of an Auto Sequence program is demonstrated.

Chapter 12: Documentation of Results. Results can be thoroughly documented with mass storage or hardcopy; the operation of plotters and disc drives is described.

Contents



HP 3562A Front View



HP 3562A Rear View

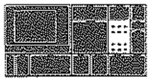
Chapter 1: General Operation

Introduction

Basic operation of the HP 3562A is performed through logically grouped front panel keys and a group of eight softkeys located to the right of the display. The front panel keys are grouped by function and can perform one of three operations: enable a direct action such as starting a measurement, enter data, or display a softkey menu. Softkeys also perform one of three functions: select a "1 of N" function such as measurement mode, define a parameter for data entry such as frequency span, and terminate the entry with the proper units such as "kHz" or "mHz".

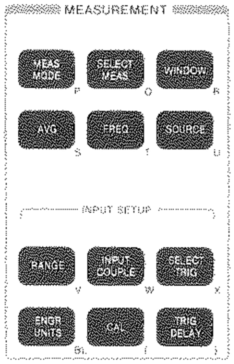
The following summaries are an introduction to the basic function of each front panel key group. These summaries are presented in the order that the key groups would typically be used when performing a measurement.

Measurement

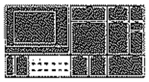


This group of keys is used to select the measurement mode and the measurement to be performed such as frequency response or power spectrum. All measurement parameters including frequency span and source level are selected in this group.

The bracketed group of keys is used to set up the input channels: ac or dc coupling, single-ended or differential operation and triggering parameters. Input ranges can be set manually or with autoranging.

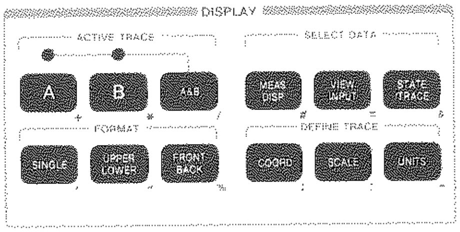


Display

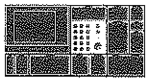


A wide choice of display formats and coordinates enhances the analysis of measurements. Magnitude can be displayed in dBV, dBm, volts or user-defined engineering units. Frequency can be displayed as hertz (Hz), log hertz, revolutions-per-minute (rpm) and orders (harmonics).

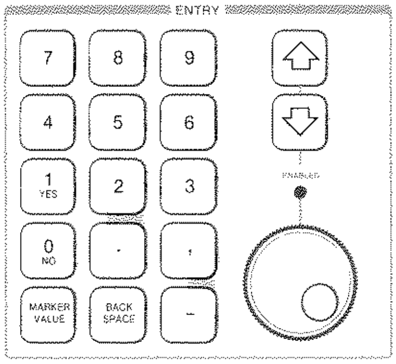
Depending on the measurement selected, several functions such as frequency response magnitude and phase, coherence, power spectrum, histogram and auto correlation can be displayed. Default, automatic and user-definable display scales ensure the presence of data on the screen.



Entry

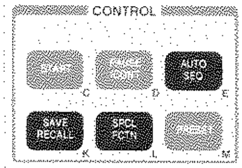


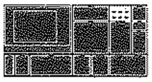
Discrete frequencies and levels can be entered using the numeric keypad. If the X-axis marker is active, the MARKER VALUE key enters the displayed marker frequency value for the active parameter.



The up/down arrow keys and the entry knob are also useful for fast entry of numerical parameters. For example, the knob makes it easy to scroll through the available frequency spans for rapid setup of zoom measurements; manual selection of input range is simplified with the arrow keys.

Control



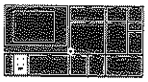


The SAVE/RECALL and PRESET keys can help save time when setting up a test by putting the analyzer into a known condition. Five user-defined states can be saved locally; a menu of special preset states can be accessed with the green PRESET key. In any of the four measurement modes (Linear Resolution, Log Resolution, Swept Sine and Time Capture) pressing PRESET will return the analyzer to the preset for that mode.

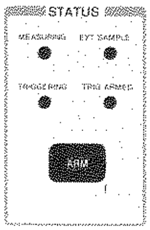
Once a measurement has been set up, the two yellow keys are used to start, pause and continue the test. If an averaged measurement is paused, the average count will resume where it was paused.

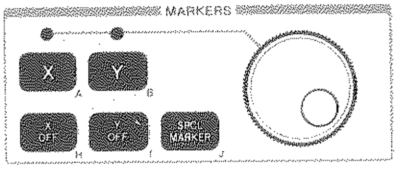
The built-in automation capability of the HP 3562A, Auto Sequence programming, is accessed through the AUTO SEQ key. Up to five separate programs can be stored in the analyzer at one time. A program can be started manually or automatically at a user-selected time—the internal clock is accessed with the special function (SPCL FCTN) key.

Status



The operating status of the analyzer is displayed by the LEDs in the Status group. Manually triggered measurements are initiated with the ARM key.



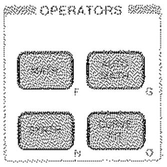


Markers

Analysis of on-screen data is simplified by the independent X- and Y-axis markers. Marker functions include single point and band cursor operation.

Special marker functions such as peak search, harmonic and sideband markers and slope readouts are time-saving aids for network and spectrum analysis.

Operators

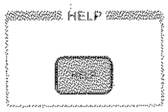


Advanced analysis of measurements is possible without transferring the data block to an external computer. Waveform Math provides a complete set of block operations including algebraic functions (+ , − , × , ÷), integration, differentiation, forward and inverse Fourier transforms, and more. Incoming data can be manipulated and displayed as it is taken using the AUTO MATH feature.

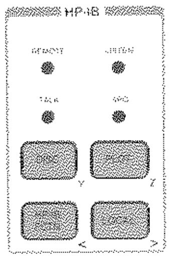
Laplace domain analysis is possible with the Curve Fit and Frequency Response Synthesis capabilities. A table of poles and zeroes can be extracted from a measured frequency response using the HP 3562A's advanced curve fitter. A model of a system can be transferred to a synthesis table from the Curve Fitter or entered manually in pole/zero, pole/residue or ratio of polynomials formats. Frequency response magnitude and phase can then be synthesized across a selected frequency span.

Help

The Help key provides instant assistance to the user on the display of the HP 3562A. When used as a prefix for any key or softkey, the Help key will display a detailed description of the selected key or softkey.



HP-IB



For documentation of measurement or analysis results, the HP 3562A provides direct control of external HP-IB plotters and disc drives. The HP-IB address for the analyzer is set using the HP-IB Function menu.

General Measurement Sequence

The power of the HP 3562A makes it a very versatile yet easy to use network, spectrum and waveform analyzer. Full span (100 kHz) frequency response, spectrum and waveform measurements can be obtained quickly using the general sequence described here. This general sequence is the starting point for the measurements shown in Chapters 2 through 7; however, users should feel free to modify this procedure to suit their particular application.

1. Select Mode *Start by pressing the* **MEAS MODE** *key and selecting a measurement mode: Linear Resolution, Log Resolution, Swept Sine or Time Capture.*

2. Preset *Press the green* **PRESET** *key: the analyzer will be in a default condition, performing and displaying a measurement. To display the state table for the active mode, press the* **STATE/TRACE** *key. The Linear Resolution, Log Resolution and Swept Sine presets share the following characteristics:*

Frequency Span = 100 kHz (Time Capture is 5 kHz)
Source Level = 0 V
Input Range = Autorange up only (both channels)
Averaging = Off
Triggering = Free Run

3. Set Up Source *For frequency response measurements, press the* **SOURCE** *key to activate the Source menu. When the* **SOURCE LEVEL** *softkey is selected, the Entry knob, arrow keys and keypad are enabled for setting the output level. The signal type is chosen from one of the bracketed choices (available signal types depend on the active measurement mode).*

4. Select Averaging *If the random noise source is selected, measurement averaging should be activated. Press the* **AVG** *(averaging) key: the* **ENABLED** *LED in the Entry group will turn on indicating that entry of the top menu item, number of averages, is active. Select the number of averages using the arrow keys, the entry knob, or the keypad. Select* **STABLE (MEAN)** *averaging.*

5. Connections *Connect the signal or device under test to the input BNC connectors (and the signal source if necessary). Press the* **INPUT COUPLE** *key: proper input coupling and grounding can be selected from this menu.*

6. Set Input Ranging *Press the* **RANGE** *key: select Autorange up for either or both channels, or adjust the ranges manually. When properly adjusted, the green* **HALF RANGE** *LEDs should be on and the red* **OVER RANGE** *LEDs should be off.*

7. Start *Press the yellow* **START** *key to begin the measurement.*

8. Configure Display *Configure the display to view the desired information. As an aid to analysis and comparison, results can be displayed in three formats with a wide selection of coordinates. Examples of typical display configurations are shown throughout this note.*

Chapter 2: Frequency Response Measurements with Linear Resolution

Introduction

Linear resolution is the measurement technique common to all fast-Fourier transform (FFT) based analyzers. Time data is sampled until a data buffer called the "time record" is filled with a fixed number of time samples. Once the time record is filled, the fast-Fourier transform of the record is computed and the frequency spectrum is displayed. For those unfamiliar with the operation of FFT-based analyzers, a good tutorial explanation is presented in Hewlett-Packard Application Note 243, "Fundamentals of Dynamic Signal Analysis".

Common applications of dual-channel FFT analyzers such as the HP 3562A include frequency response measurements of electronic networks and mechanical structures. Both of these applications can benefit from the measurement speed, resolution and versatility found in high-performance Dynamic Signal Analyzers.

Linear Resolution in the HP 3562A

The Linear Resolution mode in the HP 3562A provides 801 lines of frequency resolution per channel in single- or dual-channel operation. Resolution ranging from 125 Hz (100 kHz span) to 12.8 μHz (10.24 mHz span) can be obtained in baseband (0-start) mode. In zoom mode, resolution as narrow as 25.6 μHz (20.48 mHz span) can be obtained anywhere in the dc-to-100 kHz measurement range of the HP 3562A.

Given two high performance input channels and a built-in signal source, frequency response measurements are easy to implement with the HP 3562A. The remainder of this chapter is an introduction to frequency response measurements with the HP 3562A Linear Resolution mode. Baseband and zoom measurements on a low frequency electronic crystal resonator will be shown to demonstrate: (1) the general measurement sequence outlined at the end of Chapter 1, (2) quick configuration of a zoom measurement using the X-axis marker and the MARKER VALUE key and (3) a variety of informative display configurations.

The Linear Resolution Preset Measurement

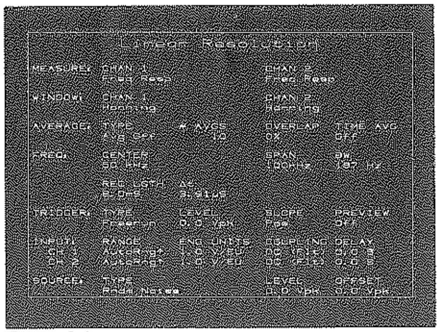
Given an unknown network, a good starting point is a full span baseband frequency response measurement. This can be done very quickly with the general measurement procedure and the Linear Resolution preset:

1. Select Mode *At turn-on the HP 3562A is set for Linear Resolution operation. If the analyzer is on, press the* **MEAS MODE** *key and select the* **LINEAR RES** *soft key.*

2. Preset *Press the green* **PRESET** *key. The Linear Resolution setup state can be displayed , as shown in Figure 2-1, by pressing the* **STATE/TRACE** *key.*

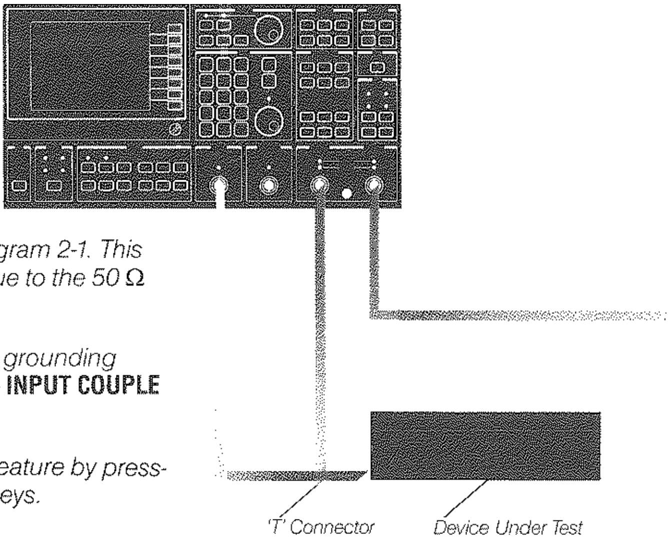
3. Set Source Level *Press the* **SOURCE** *key, then select the* **SOURCE LEVEL** *softkey. The Entry group arrow keys, knob and keypad will be active: select the desired output level for the signal source. The random noise source is the default selection.*

4. Averaging *Press the* **AVG** *key. The Entry group is active; select the number of averages to be taken. Since random noise will be used for this measurement, select* **STABLE (MEAN)** *averaging.*



```
                 Linear Resolution
MEASURE:  CHAN 1                      CHAN 2
          Freq Resp                   Freq Resp
WINDOW:   CHAN 1                      CHAN 2
          Hanning                     Hanning
AVERAGE:  TYPE        # AVGS          OVERLAP   TIME AVG
          AVG Off         10          0%        Off
FREQ:     CENTER                      SPAN      BW
          50 kHz                      100kHz    187 Hz
          REC LGTH    Δt
          8.0mS       3.91μS
TRIGGER:  TYPE        LEVEL           SLOPE     PREVIEW
          Freerun     0.0 Vpk         Pos       Off
INPUT:    RANGE       ENG UNITS       COUPLING  DELAY
  CH 1    AutoRng↑    1.0 V/EU        DC (Flt)  0.0 S
  CH 2    AutoRng↑    1.0 V/EU        DC (Flt)  0.0 S
SOURCE:   TYPE                        LEVEL     OFFSET
          Rand Noise                  0.0 Vpk   0.0 Vpk
```

Figure 2-1



5. **Connect D.U.T.** *Connect the device under test as shown in Diagram 2-1. This configuration is for high impedance networks due to the 50 Ω output impedance of the signal source.*

6. **Input Coupling** *If it is necessary to change the input coupling or grounding (summarized in the set up state table), press the* **INPUT COUPLE** *key to activate the required menu.*

7. **Input Ranging** *Press the* **RANGE** *key. Activate the autoranging feature by pressing the* **AUTO 1 RNG UP** *and* **AUTO 2 RNG UP** *softkeys.*

8. **Select Data** *Press the* **MEAS DISP** *key, then select the* **FREQ RESP** *(frequency response) softkey.*

9. **Start** *Press the yellow* **START** *key. The dc-to-100 kHz frequency response will be displayed automatically. Figure 2-2 shows the results for the low frequency crystal resonator.*

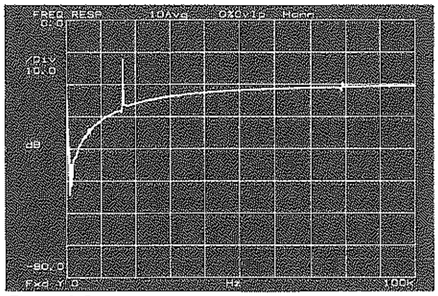


Figure 2-2

High Resolution Zoom Measurement

The full span measurement shows the location of the resonance but does not have sufficient resolution to show much detail. A zoom measurement makes it possible to concentrate the full 801 lines of resolution in a narrow band centered on the resonance. The X-axis marker combined with the Entry group **MARKER VALUE** key quickens and simplifies zoom measurement setup.

1. **Activate Marker** *To activate the X-axis marker, press the* **X** *key. The LED above the key will be illuminated indicating that the marker knob can be used to move the cursor. Position the marker on the resonant peak.*

2. **Band Marker** *In the X-marker softkey menu select* **HOLD X CENTER**. *This activates the "band marker" capability; turning the marker knob will adjust the width of the band while holding the center frequency constant. The crystal resonator response with the band cursor activated is shown in Figure 2-3.*

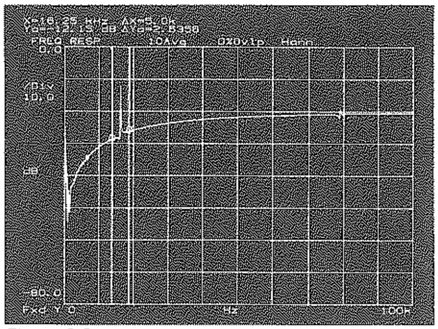


Figure 2-3

3. **Set Center and Span** *To set up the zoom measurement, the new center frequency and narrower span must be selected. Press the* **FREQ** *key. With the band marker set to the desired width, make the following selections:* **FREQ SPAN** *softkey and* **MARKER VALUE** *key (the center of the band marker will become the measurement center frequency; among the available zoom spans, the span equal to, or the next span greater than, the marker span will be entered as the measurement span).*

4. **Start** *Press the* **START** *key. The zoom measurement will be displayed. For better resolution, repeat the above process using the X-axis marker, or by numeric entry of a new frequency span. Figure 2-4 shows a zoom measurement of the crystal filter at a span of 800 Hz (1 Hz resolution).*

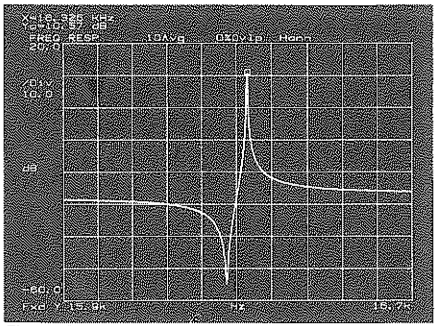


Figure 2-4

Analysis via Display Selections

While the frequency response magnitude display provides very useful information, thorough device characterization requires both magnitude and phase, perhaps with a logarithmic frequency scale. Additional information can be obtained from the impulse response and the coherence function.

When performing Linear Resolution frequency response measurements, the HP 3562A can display several functions with a variety of trace coordinates. Examples are shown using the results of the preceeding zoom measurement.

1. **Impulse Response** *To see the measurement choices available, press the* **MEAS DISP** *(measurement display) key in the Display group. The active measurement will be displayed at the upper left of the trace graticule.* **FREQ RESP** *should be displayed. Select* **IMPLS RESP** *(impulse response) to observe the time domain response of the network.*

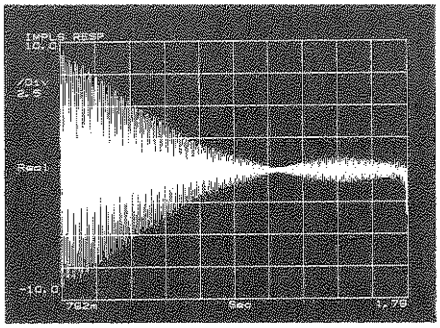


Figure 2-5

2. **Split Screen Display** *Refer back to the* **DISPLAY** *group. Press the* **UPPER LOWER** *key to create a split screen display. Press the* **B** *key to activate the lower trace.*

3. **Magnitude and Phase** *Select the* **FREQ RESP** *softkey. Press the* **COORD** *(coordinate) key. Several trace coordinates including phase and linear magnitude are available. The* **NEXT** *softkey displays the next level of coordinates which includes linear or logarithmic frequency axis. An example is shown in figure 2-6.*

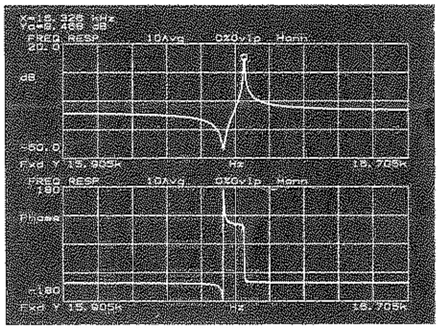


Figure 2-6

4. **Coherence** *Press the* **MEAS DISP** *key, then select the* **COHER** *softkey to display the coherence function. The display should be similar to Figure 2-7.*

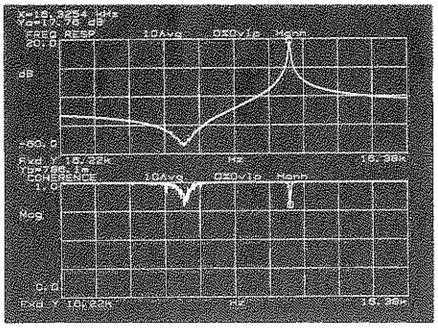


Figure 2-7

Internal Storage of Results

The frequency response and coherence function from this measurement will be used to demonstrate curve fitting in Chapter 9. To store these results:

1. **Activate Trace** *Press the* **A** *key to activate trace A.*

2. **Save Trace** *Press the* **SAVE RECALL** *key. Select the* **SAVE DATA #** *softkey, then the number* **1** *followed by the* **ENTER** *softkey. [Data register #1 has battery backup.]*

3. **Activate Trace** *Press the* **B** *key to activate trace B.*

4. **Save Trace** *Select the* **SAVE DATA #** *softkey, then the number* **2** *followed by the* **ENTER** *softkey. [Data register #2 does not have battery backup.]*

If you have a disc drive with your HP 3562A, refer to Chapter 12 for details regarding measurement storage on disc.

Chapter 3: **Frequency Response Measurements with Logarithmic Resolution**

Introduction

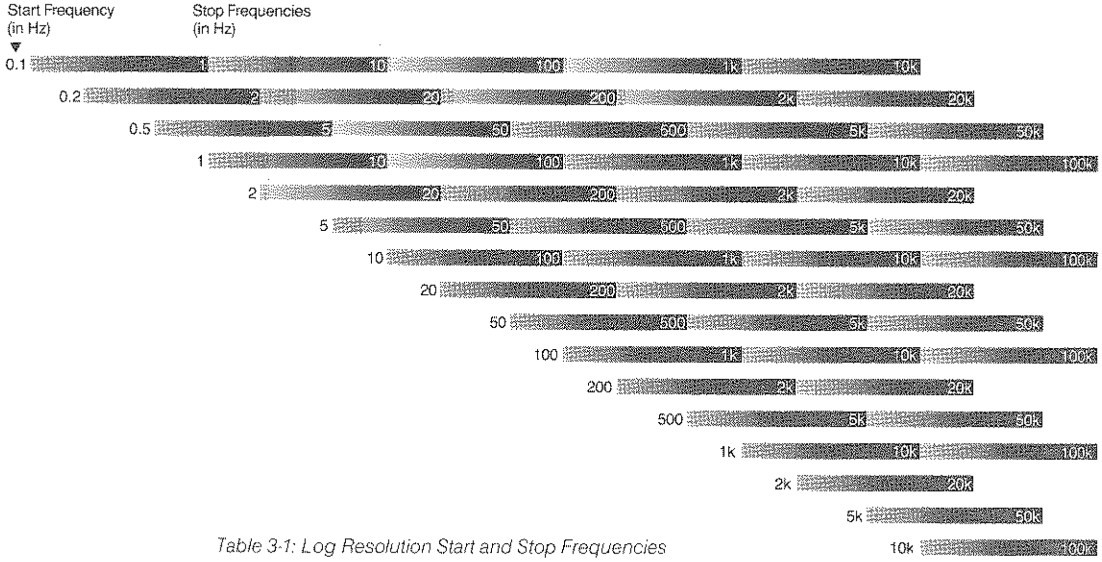
Logarithmic resolution is a measurement technique which uses linear resolution FFT measurements to create results similar to a log swept sine test. Linear resolution points are combined, rather than redistributed, to produce frequency response or power spectrum measurements with a true logarithmic frequency scale.

The key contribution of this technique is the combination of fast, high resolution FFT analysis with the proportional resolution of a log sweep measurement. Further, when applied to broadband testing of mechanical or electronic resonances, the log resolution technique provides reduced measurement variance (compared to linear resolution) and can save significant test time (when compared to log sweep tests with equal resolution).

Logarithmic Resolution in the HP 3562A

The Log Resolution mode in the HP 3562A provides 80-point-per-decade resolution over one to five integer decades. Available start and stop frequencies and combinations thereof are shown in Table 3-1. Frequency response magnitude and phase can be measured using stationary (i.e., non-transient) stimuli such as random noise or fixed sine signals from the built-in signal source. Input and output power spectra can also be measured and observed. For complete analysis of results, measurements can be manipulated with the built-in Waveform Math and Curve Fitting capabilities.

The following sections of this chapter introduce the basics of frequency response measurements with the Log Resolution mode. The 3-decade preset measurement and a second 1-decade measurement, with averaging, will be shown.



Start Frequency (in Hz)	Stop Frequencies (in Hz)				
0.1	1	10	100	1k	10k
0.2	2	20	200	2k	20k
0.5	5	50	500	5k	50k
1	10	100	1k	10k	100k
2	20	200	2k	20k	
5	50	500	5k	50k	
10	100	1k	10k	100k	
20	200	2k	20k		
50	500	5k	50k		
100	1k	10k	100k		
200	2k	20k			
500	5k	50k			
1k	10k	100k			
2k	20k				
5k	50k				
10k	100k				

Table 3-1: Log Resolution Start and Stop Frequencies

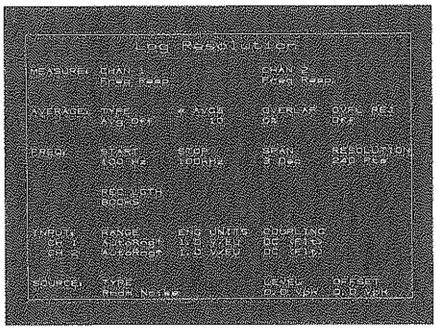
]

The Log Resolution Preset Measurement

As is the case in the Linear Resolution mode, a full span frequency response measurement is the preset condition.

1. Select Mode *Press the* **MEAS MODE** *key and select the* **LOG RES** *softkey.*

2. Preset *Press the green* **PRESET** *key to select the log resolution preset measurement. The Log Resolution setup state can be displayed, as shown in Figure 3-1, by pressing the* **STATE/TRACE** *key.*



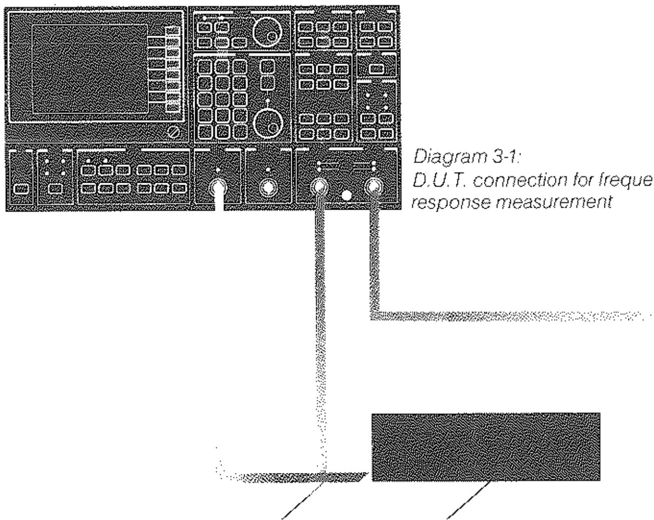
```
                Log Resolution
MEASURE:  CHAN 1                      CHAN 2
          Freq Resp                   Freq Resp

AVERAGE:  TYPE       # AVGS           OVERLAP    OVRL REJ
          Avg Off        10           0%         Off

FREQ:     START      STOP             SPAN       RESOLUTION
          100 Hz     100kHz           3 Dec      240 Pts

          REC LGTH
          800mS

INPUT:    RANGE      ENG UNITS        COUPLING
  CH 1    AutoRng↑   1.0 V/EU         DC (Flt)
  CH 2    AutoRng↑   1.0 V/EU         DC (Flt)

SOURCE:   TYPE                        LEVEL      OFFSET
          Rndm Noise                  0.0 Vpk    0.0 Vpk
```

Figure 3-1

3. Set Source Level *Press the* **SOURCE** *key, then select the* **SOURCE LEVEL** *softkey. The* **ENTRY** *group keys and knob will be active for selection of the signal source output level. Note that random noise and fixed sine (stationary signals) are the only choices in this mode: select* **RANDOM NOISE**.

4. Averaging *Press the* **AVG** *key; use the* **ENTRY** *group to select the number of averages to be taken. Since random noise is the test signal, select* **STABLE(MEAN)** *averaging.*

5. Connect D.U.T. *Connect the device under test as shown in Diagram 3-1. Since the output impedance of the source is 50 Ω, this configuration should be used for high input impedance devices.*



'T' Connector

Device Under Test

Diagram 3-1:
D.U.T. connection for frequency response measurement

6. Input Coupling *If it is necessary change the input coupling and grounding settings from the preset conditions, activate the* **INPUT COUPLE** *menu and enter the necessary changes.*

7. Input Ranging *Press the* **RANGE** *key. Activate input autoranging on both channels by pressing the* **AUTO 1 RNG UP** *and* **AUTO 2 RNG UP** *softkeys.*

8. Select Data *Press the* **MEAS DISP** *key, then select the* **FREQ RESP** *(frequency response) softkey.*

9. Start *Press the yellow* **START** *key. The 100 Hz-to-100 kHz frequency response will be displayed automatically. The result shown in Figure 3-2 is from the same crystal resonator used in the Linear Resolution example.*

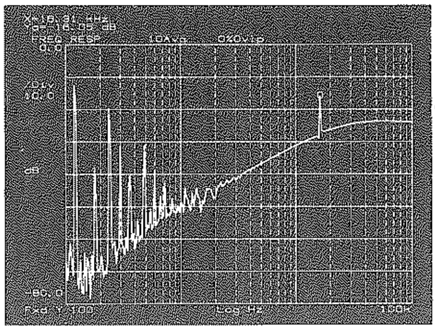


Figure 3-2

Single Decade Measurement

As mentioned previously, measurement spans of 1 to 5 decades can be selected in Log Resolution mode. To demonstrate entry of frequency parameters, a one decade measurement will be performed with the crystal resonator.

1. Set New Span *Press the* **FREQ** *key to activate the frequency selection menu. The start frequency and measurement span can now be entered with the corresponding softkeys. For this measurement, start frequency was selected to be 5 kHz and the span was set to 1 decade. Refer back to Table 3-1 for a summary of the available start, stop and span values.*

2. Check Input Ranges *With the narrower frequency span, the input ranges may need to be changed due to the band-limited, constant-power noise source. Autoranging will handle this quickly.*

3. Start *Press the yellow* **START** *key. The results for the crystal resonator are shown in Figure 3-3.*

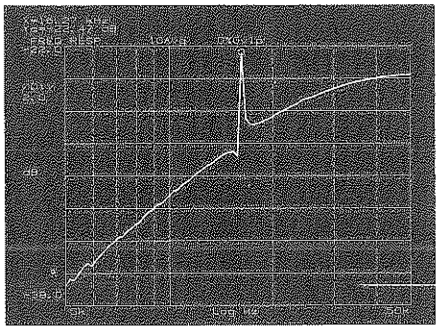


Figure 3-3

Analysis via Display Selections

In the Log Resolution mode the available measurement displays are: frequency response, coherence function, channel 1 power spectrum, channel 2 power spectrum and the cross power spectrum. Examples from the results of the preceding measurement are given to illustrate some of the available vertical trace coordinates.

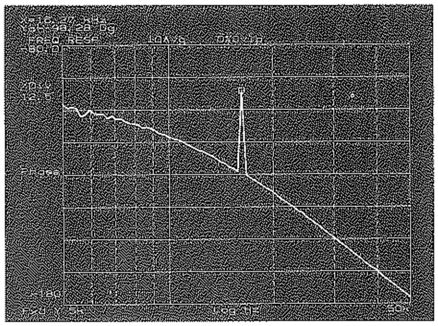


Figure 3-4: One-decade frequency response phase

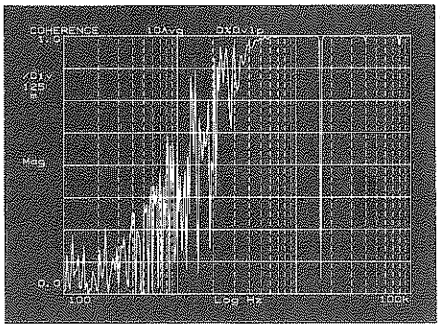


Figure 3-5: Three-decade coherence function

Chapter 4: Frequency Response Measurements with Swept Sine

Introduction

Low frequency network analysis has traditionally been addressed by a group of products known as frequency response analyzers. While these products perform the same measurements as a tuned network analyzer, the internal operation is quite different. Rather than use expensive low frequency (<1 Hz) tracking filters, a frequency response analyzer performs time domain integration of the input signals to mathematically filter signals at very low frequencies. Measurement results are usually displayed as point-by-point numerical values or on an X-Y plotter.

In many applications, notably closed loop control systems, detailed or final system evaluation is performed using a frequency response analyzer. During the development of such systems, when time is a critical factor, initial characterizations of the system are often performed using an FFT analyzer. The analysis capabilities built into many FFT analyzers, and typically not found in frequency response analyzers, can also play an important role in the development process. The HP 3562A combines all of these capabilities into a single product.

The HP 3562A Swept Sine Mode

When the Swept Sine measurement mode is activated, the HP 3562A is reconfigured as a full-function dc-to-100 kHz frequency response analyzer. Key enhancements include the built-in high resolution vector display, the ability to perform plotting operations during a measurement and mass storage of results in an external disc drive.

Source capabilities include increasing or decreasing linear or logarithmic sine sweeps as well as manual control of the sweep. Start and stop frequencies, as well as the sweep rate, are also user selectable. Input channel capabilities include user-selectable averaging and integration time; automatic integration and up-and-down autoranging of input ranges can be activated to enhance testing of high performance systems.

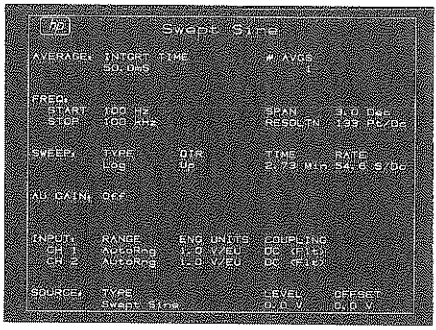
The remainder of this chapter introduces the full span preset swept sine measurement as well as a narrowband linear sweep.

The Swept Sine Preset Measurement

A typical testing technique involves the use of wideband logarithmic sweep measurements followed by narrowband linear sweep tests at frequencies of interest. The HP 3562A preset Swept Sine measurement is a good starting point: a 100 Hz-to-100 kHz log sweep frequency response.

1. Select Mode *Press the* **MEAS MODE** *key and select the* **SWEPT SINE** *mode.*

2. Preset *Press the green* **PRESET** *key. The Swept Sine setup state can be displayed, as shown in Figure 4-1, by pressing the* **STATE/TRACE** *key. All values shown are the default preset measurement conditions.*



```
                     Swept Sine
AVERAGE:   INTGRT TIME                  # AVGS
           50.0mS                          1

FREQ:
  START    100 Hz                       SPAN      3.0 Dec
  STOP     100 kHz                      RESOLTN   133 Pt/Dc

SWEEP:     TYPE        DIR              TIME      RATE
           Log         Up               2.73 Min  54.6 S/Dc

AU GAIN:   Off

INPUT:     RANGE       ENG UNITS        COUPLING
  CH 1     AutoRng     1.0 V/EU         DC (Flt)
  CH 2     AutoRng     1.0 V/EU         DC (Flt)

SOURCE:    TYPE                         LEVEL     OFFSET
           Swept Sine                   0.0 V     0.0 V
```

Figure 4-1

3. Set Source Level *Press the* **SOURCE** *key, then select the* **SOURCE LEVEL** *softkey. Set the sine wave output level using the Entry group keys or knob. Note that dc offset and sweep parameters such as direction and rate are selected in this menu.*

4. Connect D.U.T. *Connect the device under test as shown in Diagram 4-1. This configuration is for high impedance systems due to the 50Ω output impedance of the signal source.*

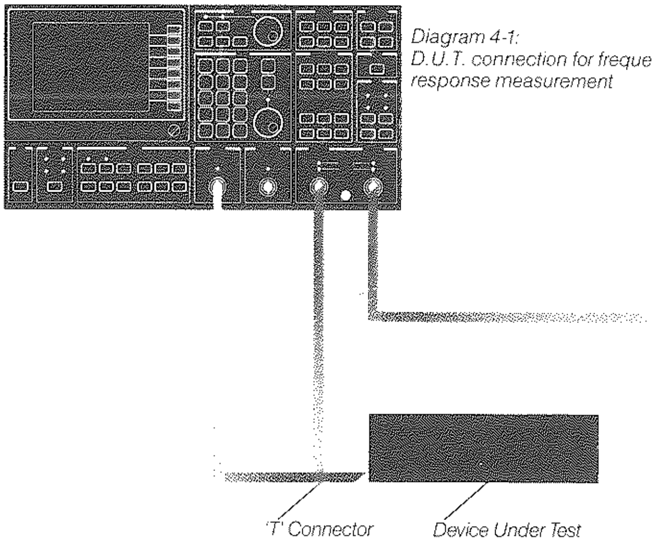


Diagram 4-1: D.U.T. connection for frequency response measurement

5. Input Coupling *Press the* **INPUT COUPLE** *key and select the proper input coupling and grounding parameters.*

6. Input Ranging *Press the* **RANGE** *key. Since the test signal is a sweeping sine wave rather than broadband noise, maximum input amplitude for the response channel will not be known until a resonance is reached. Up-and-down autoranging solves this problem by checking for under-half range and over range conditions at every measured point.*

7. Select Data *Press the* **MEAS DISP** *key, then select the* **FREQ RESP** *(frequency response) softkey.*

8. Start *Press the yellow* **START** *key. The 100 Hz-to-100 kHz frequency response is displayed as the sweep progresses across the screen. The final trace will be similar to Figure 4-2 (again, the crystal resonator). Notice the line of annotation at the top of the trace: "Y" is the instantaneous level and "F" is the instantaneous sweep frequency.*

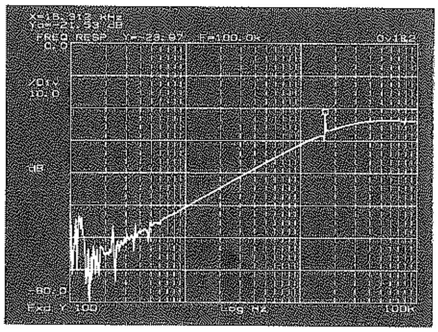


Figure 4-2

Narrowband Linear Sweep

The wideband log sweep frequency response may disclose resonances or other interesting characteristics that demand a more detailed measurement. A high resolution narrowband linear sweep is a good solution. To set up this measurement:

1. Linear Sweep *Press the* **MEAS MODE** *key, then select the* **LINEAR SWEEP** *softkey.*

2. Activate Band Marker *Activate the X-axis marker with the* **X** *key. Move the marker to a point of interest, then select the* **HOLD X CENTER** *softkey. Use the knob to spread the band marker.*

3. Set Start and Span *Press the* **FREQ** *key. Select* **FREQ SPAN** *and press the* **MARKER VALUE** *key to define the start and stop frequencies.*

4. Sweep Resolution *Select the* **RESLTN** *(sweep resolution) softkey. Measurement resolution can be selected as a fixed value in Hz/point or points/sweep (the automatic-resolution feature can also be activated; this feature increases or decreases resolution during the measurement as a function of relative changes in amplitude from point to point.)*

5. View State *To view the measurement state, press the* **STATE/TRACE** *key. Notice that the sweep rate and sweep time values are displayed: these values are set internally according to the selected sweep span and resolution.*

6. Input Ranging *Press the* **RANGE** *key. Activate autoranging for both channels with the* **AUTO 1 UP&DWN** *and* **AUTO 2 UP& DWN** *softkeys.*

7. Start *Press the yellow* **START** *key. The measurement will be displayed as the sweep progresses from start to stop. The linear sweep result will look like the display shown in Figure 4-3.*

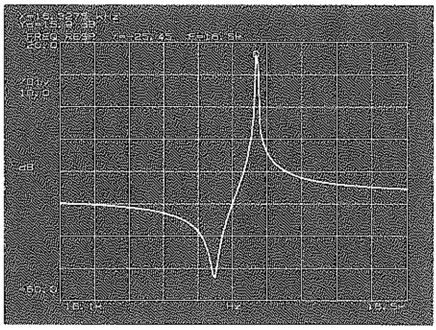


Figure 4-3

Introduction

Spectrum analysis can benefit from the speed, resolution and flexibility of single-channel Linear Resolution FFT measurements. Rapid baseband and high resolution zoom measurements lend themselves to detailed analysis of dynamic signals: rapidly changing frequency spectra and transient signals are typical examples. Additionally, the digital form of the time or frequency information lends itself to detailed analysis, such as AM, FM and PM demodulation, in external computers.

The frequency range of most dynamic signal analyzers, up to 25 kHz or 100 kHz, makes them ideal for analysis of audio, speech, noise control and machinery vibration signals. Measurements commonly made with dynamic signal analyzers include harmonic distortion, in-band power and phase noise.

Spectrum Analysis with the HP 3562A

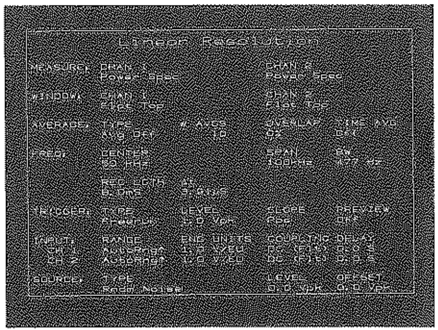
The HP 3562A Dynamic Signal Analyzer is fundamentally a dc-to-100 kHz spectrum analyzer with 801 lines of frequency resolution and 80 dB of dynamic range. A pair of input channels, flexible zoom analysis and a built-in demodulation function makes the HP 3562A a powerful spectrum analyzer. Signals can be monitored on either or both input channels with baseband or zoom analysis. A full span dc-to-100 kHz spectrum and a zoom spectrum of a signal can be displayed simultaneously. Zoom measurements (over 60 spans are available) can be AM, FM or PM demodulated; results are displayed as a frequency spectrum with the carrier at 0 Hz.

The rest of Chapter 5 is divided into two sections, basic spectrum analysis, and spectrum analysis with demodulation. In addition to the capabilities mentioned in the previous paragraph, enhancements such as signal averaging will also be demonstrated.

Baseband Analysis and Harmonic Markers

Spectrum analysis measurements can begin quickly using the special preset power spectrum measurement. As shown below, the Marker group contains many time-saving features.

1. Special Preset *Press the green* **PRESET** *key. Select the* **P SPEC LINRES** *softkey to activate the preset dc-to-100 kHz power spectrum measurement. The state is shown in Figure 5-1.*



```
                Linear Resolution
MEASURE:  CHAN 1                   CHAN 2
          Power Spec               Power Spec
WINDOW:   CHAN 1                   CHAN 2
          Flat Top                 Flat Top
AVERAGE:  TYPE       # AVGS        OVERLAP   TIME AVG
          Avg Off       10         0%        Off
FREQ:     CENTER                   SPAN      BW
          50 kHz                   100kHz    477 Hz
          REC LGTH   Δt
          8.0mS      3.91μS
TRIGGER:  TYPE       LEVEL         SLOPE     PREVIEW
          FreeRun    0.0 Vpk       Pos       Off
INPUT:    RANGE      ENG UNITS     COUPLING  DELAY
  CH 1    AutoRng↑   1.0 V/EU      DC (Flt)  0.0 S
  CH 2    AutoRng↑   1.0 V/EU      DC (Flt)  0.0 S
SOURCE:   TYPE                     LEVEL     OFFSET
          Rndm Noise               0.0 Vpk   0.0 Vpk
```

Figure 5-1

2. Connect Signal *Connect the signal to input channel 1. To change input coupling or grounding, press the* **INPUT COUPLE** *key and make the necessary choices in that menu.*

3. Start *Press the yellow* **START** *key to begin the measurement.*

The display will be similar to the results shown in Figure 5-2 (a square wave output from a function generator with powerline sidebands). To analyze the spectrum:

4. Activate Marker *Activate the X-axis marker with the* **X** *key. Move the marker to the fundamental frequency of the square wave.*

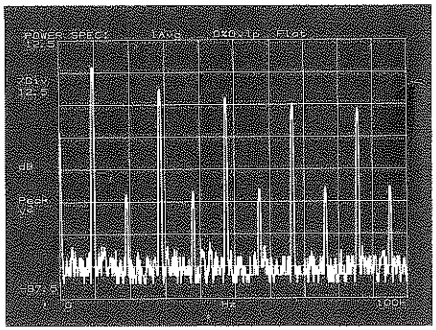


Figure 5-2

5. **Harmonic Marker** *Press the* **SPCL MARKER** *(special marker) key. Select the* **HMNC ON** *(harmonic on) softkey to activate the harmonic markers and the associated softkey menu. Twenty harmonic markers are displayed as shown in Figure 5-3.*

6. **Set Fundamental** *Select the* **FNDMTL FREQ** *(fundamental frequency) softkey. Press the* **MARKER VALUE** *key: this enters the X-marker value as the fundamental frequency.*

   The arrow keys or entry knob can be used to "fine tune" the fundamental frequency and position the markers precisely on the harmonic components.

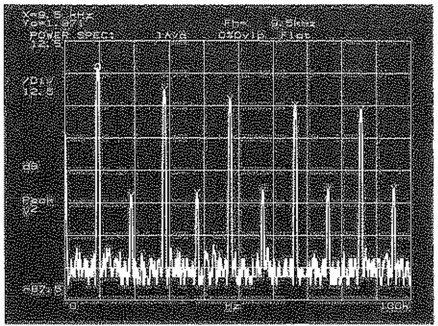


Figure 5-3

7. **Display T.H.D.** *Select the* **THD** *softkey to obtain a readout of total harmonic distortion for the displayed markers (the THD computation will exclude markers which are not displayed).*

   A readout of THD for a specific number of harmonics can be obtained with the X-axis marker. To measure the fundamental through the sixth harmonic:

   a. *Move the X-axis marker into the noise to the left of the fundamental.*
   b. *Press the* **X** *key to activate the marker menu. Select the* **HOLD X LEFT** *softkey. Spread the band marker to the right to include the sixth harmonic.*
   c. *Press the* **SPCL MARKER** *key. Select the* **HMNC ON** *softkey, then the* **THD** *softkey. The total harmonic distortion value will be displayed as shown in Figure 5-4.*
   d. *To prepare for the next example, turn off the band marker by pressing the* **X OFF** *key.*

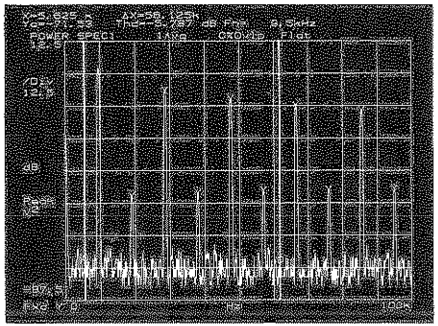


Figure 5-4

Zoom Analysis and Sideband Markers

Changing from baseband to high-resolution zoom analysis can be accomplished quickly with the frequency group (FREQ key) and the X-axis marker. Accurate characterization of sideband power can be performed with the sideband marker function. This example begins with the baseband spectrum from the previous section.

1. **Turn Off Special Markers** *Press the* **SPCL MARKER** *key. Select the* **X FCTN OFF** *softkey to turn off the harmonic markers.*

2. **Activate Marker** *Press the* **X** *key to activate the X-axis marker. Move the marker to the third harmonic.*

3. **Set Center and Span** *To set up the zoom measurement, press the* **FREQ** *key. Select the* **CENTER FREQ** *softkey, then press the* **MARKER VALUE** *key. The marker frequency is entered as the center of the zoom span.*

   Select the **FREQ SPAN** *softkey and enter the desired measurement span. For this example a span of 500 Hz was selected to include the first two powerline sidebands on either side of the third harmonic.*

4. **Averaging** *To make the sidebands easier to identify, averaging can be used to bring the noise floor to its mean value. Press the* **AVG** *key and enter 20 averages. Select the* **STABLE (MEAN)** *softkey.*

5. **Start** *Press the yellow* **START** *key. Figure 5-5 shows two spectra, one after two averages and another after twenty, to highlight the difference with averaging.*

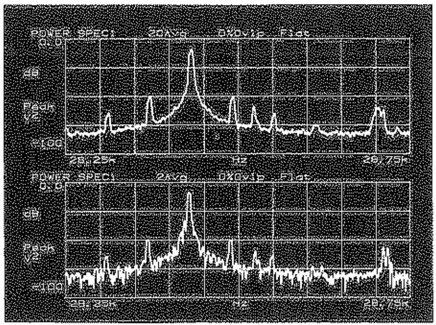


Figure 5-5

6. **Marker to Peak** *To analyze the sidebands in the measured power spectrum: Press the* **SPCL MARKER** *key. Select the* **MRKR → PEAK** *softkey to position the marker on the peak.*

7. **Sideband Markers** *Select the* **SBAND ON** *(sideband on) softkey, then* **CRRIER FREQ** *(carrier frequency). Press the* **MARKER VALUE** *entry key to enter the marker frequency as the carrier frequency.*

8. **Sideband Frequency** *Select the* **SBAND INCRMT** *(sideband increment) softkey and enter the powerline frequency (50, 60 or 400 Hz). The spectrum display should be similar to Figure 5-6.*

9. **Display Power** *Select the* **SBAND POWER** *softkey to display the sideband power value as shown in Figure 5-6.*

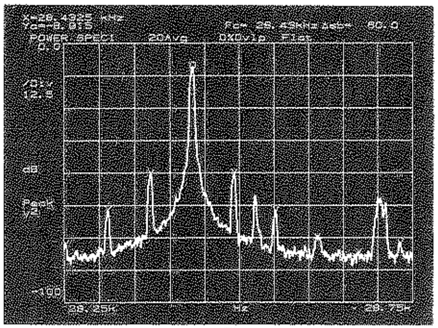
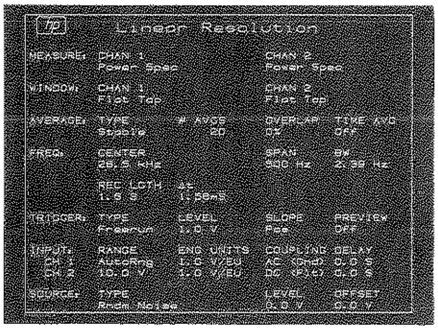


Figure 5-6

Demodulation of Zoom Measurements

This example begins with the modulated spectrum shown in Figure 5-6; the setup state for this zoom measurement is shown in Figure 5-7. The following procedure is a demonstration of AM demodulation of this signal with the HP 3562A.



```
        Linear Resolution

MEASURE:  CHAN 1                      CHAN 2
          Power Spec                  Power Spec

WINDOW:   CHAN 1                      CHAN 2
          Flat Top                    Flat Top

AVERAGE:  TYPE       # AVGS           OVERLAP     TIME AVG
          Stable         20           0%          OFF

FREQ:     CENTER                      SPAN        BW
          28.5 kHz                    500 Hz      2.39 Hz

          REC LGTH   Δt
          1.6 S      1.56mS

TRIGGER:  TYPE       LEVEL            SLOPE       PREVIEW
          Freerun    1.0 V            Pos         OFF

INPUT:    RANGE      ENG UNITS        COUPLING    DELAY
   CH 1   AutoRng    1.0 V/EU         AC (Gnd)    0.0 S
   CH 2   10.0 V     1.0 V/EU         DC (Flt)    0.0 S

SOURCE:   TYPE                        LEVEL       OFFSET
          Rndm Noise                  0.0 V       0.0 V
```

Figure 5-7

1. **Activate Demodulation** *Press the* **MEAS MODE** *key. Select the* **DEMOD ON/OFF** *softkey to turn on demodulation (the* **DEMOD SELECT** *softkey will appear).*

2. **Set Up Demod** *Select the* **DEMOD SELECT** *softkey to activate the demodulation menu.*

   Select demodulation on either or both input channels, then the type of demodulation (AM, FM or PM; for this example, **DEMOD CHAN1** *and* **AM CHAN1** *were selected).*

3. **Carrier** *After selecting the type of modulation, select the* **RETURN** *softkey. If the carrier frequency is known, select* **PM/FM CRRIER** *and enter the frequency (<100 kHz); if the carrier frequency is not known, select* **AUTO CRRIER**.

4. **Start** *Press the yellow* **START** *key. The demodulation results are displayed as a baseband spectrum as shown in Figure 5-8. Notice that the frequency span of the demodulated spectrum is one-half that of the initial zoom span (this is always the case in demodulation).*

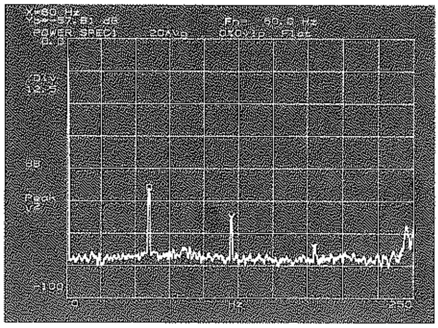


Figure 5-8

Chapter 6: **Waveform Analysis with Time Capture**

Introduction

Waveform analysis is typically performed with storage or digitizing oscilloscopes or a family of products known as waveform recorders. The basic technology in these devices is identical to the first stage of all FFT-based signal analyzers: analog signals are sampled, digitized and stored for later analysis. Consequently, many Dynamic Signal Analyzers such as the HP 3562A provide waveform recording capabilities as an extension of their frequency domain analysis functions.

While the sampling frequency of Dynamic Signal Analyzers is typically 80 times lower than typical waveform recorders (256 kHz versus 20 MHz), dynamic range is usually 20 to 40 dB better with a DSA. Also, most Dynamic Signal Analyzers provide complete filtering to prevent "aliased" frequency components, caused by input signals greater than 1/2 the sampling frequency; refer to HP Application Note 243 for further details.

Thus, the frequency and dynamic range of the application dictates which device provides the optimum solution. Waveform analysis applications such as speech recognition and synthesis, audio analysis, mechanical transients and electronic waveforms below 100 kHz can be addressed by properly equipped Dynamic Signal Analyzers.

Waveform Recording with the HP 3562A

The HP 3562A provides a 20,480-sample buffer for waveform recording with a 256 kHz sampling rate: real-time or "gap free" data can be recorded from either input channel for as many as 10 consecutive time records containing frequencies up to 100 kHz. Analysis can be performed in both the time and frequency domains with displayed and annotated results. The Time Capture mode is enhanced with complete triggering capabilities (including pre- and post-trigger delay) and post-capture zoom analysis with up to 10 times the original frequency resolution.

The example in this chapter demonstrates waveform analysis in the audio range; the actual measurement will be performed using the Time Capture preset state. Primary emphasis is given to analysis of the captured data in both the time and frequency domains, including post-measurement zoom analysis.

The Time Capture Preset Measurement

To become familiar with the operation of Time Capture, a good starting point is the capture and analysis of a non-transient signal such as the human voice:

1. **Select Mode** *Press the* **MEAS MODE** *key, then select the* **TIME CAPTUR** *softkey.*

2. **Preset** *Press the green* **PRESET** *key.*

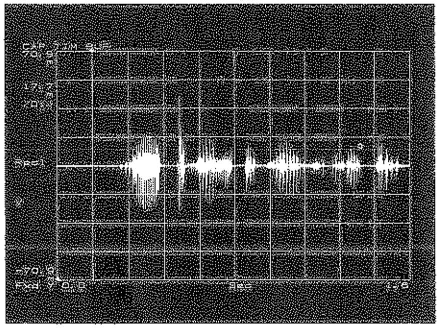
3. **Connect Channel 1** *Channel 1 is active. Connect the signal or transducer to the* **CHANNEL 1** *input (for this example a microphone was connected to the input).*

4. **Input Range** *Press the* **RANGE** *key, then select the* **CHAN 1 RANGE** *softkey. Enter the input range such that the green* **HALF RANGE** *light is on and the red* **OVER RANGE** *light is off when the signal is present.*

5. **Start the Capture** *Press the* **MEAS MODE** *key, select the* **TIME CAPTUR** *softkey, then select the* **CAPTUR SELECT** *softkey to display the Time Capture control menu.*

   Select the **START CAPTUR** *softkey to initiate the capture (the preset capture is 1.6 seconds in duration—speak quickly if you are using a microphone!). When the capture record is complete, the compressed buffer containing 10 time records will be displayed as shown in Figure 6-1*

Figure 6-1



Time Domain Analysis

The X-axis marker provides several features which are very useful when analyzing a captured waveform:

1. **Activate Marker** *Press the* **X** *key to activate the marker. The marker will appear at the point of maximum amplitude on the waveform.*

2. **Band Marker** *Select the* **HOLD X CENTER** *softkey; use the marker knob to spread the band marker about a portion of the waveform. Select the* **HOLD X OFF** *softkey to hold the band width (with "hold off" active, the band marker can be moved across the display with the marker knob).*

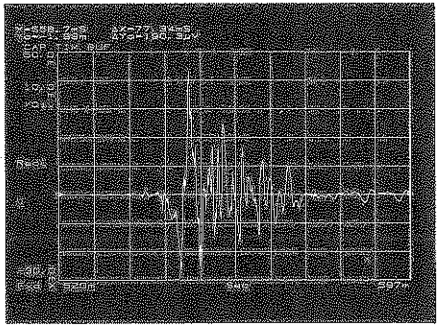
3. **Expand Display** *To expand the portion of the waveform in the band select the* **X MRKR SCALE** *(X-marker band to scale) softkey. The expanded display will be similar to Figure 6-2.*

4. **Data Scrolling** *Select the* **SCROLL ON/OFF** *softkey. Use the marker knob to scroll the waveform through the expanded "window".*

5. **Return to Full View** *To return to a view of the entire capture record select the* **X AUTO SCALE** *softkey.*

   Note: the display amplitude can also be scaled via the **SCALE** *key. Press the* **SCALE** *key, then select the* **Y AUTO SCALE** *softkey.*

Figure 6-2



Frequency Domain Analysis

Captured time waveforms can also be analyzed in the frequency domain with Linear Resolution power spectrum, auto correlation and histogram measurements. Measurement configuration for input from the capture buffer proceeds as it would for data on either input channel:

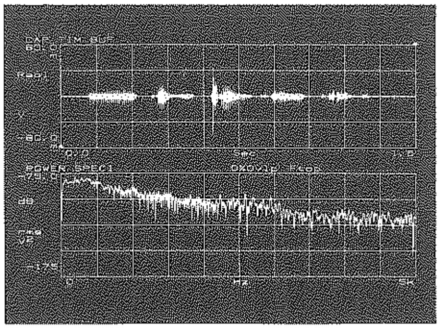


Figure 6-3

1. **Display Whole Record** *Before starting the measurement, display the entire capture buffer. Press the* **SCALE** *key and select the* **X AUTO SCALE** *softkey.*
2. **Select Measurement** *Press the* **SELECT MEAS** *key, then select the* **POWER SPEC** *softkey.*
3. **Select Window** *Press the* **WINDOW** *key. Select* **FLAT TOP** for non-transient signals (voice) or **UNIFRM** *(uniform) for transients.*
4. **Split Screen Display** *Press the* **UPPER LOWER** *key to activate the split screen display.*
5. **Start** *Press the yellow* **START** *key. The power spectrum for the first 2048 points in the capture buffer is displayed in the lower trace, as shown in Figure 6-3.*
6. **Averaging** *To average all 10 records together press the* **AVG** *key. Press* **10** *on the keypad followed by the* **ENTER** *softkey.*

   Select the **STABLE (MEAN)** *softkey.*
7. **Start Average** *Press the yellow* **START** *key. The averaged power spectrum will be displayed in the lower trace as shown in Figure 6-4. A feature called the "capture pointer" can be used to select the beginning of a new block to be analyzed:*
8. **Capture Pointer** *Press the* **AVG** *key, then select the* **AVG OFF** *softkey.*

   Press the **MEAS MODE** *key followed by the* **TIME CAPTUR** *softkey then the* **CAPTUR SELECT** *softkey.*

   Select the **CAPTUR POINTR** *softkey. Use the arrow keys or the entry knob to change the starting point: the default increment is 2048 points (one time record). Pressing the* **START** *key will produce the power spectrum for the selected time record.*

   The **CAPTUR INCRMT** *(capture increment) softkey can be used to set a new pointer increment as a number of records, points, revolutions, minutes, seconds, milliseconds or microseconds.*

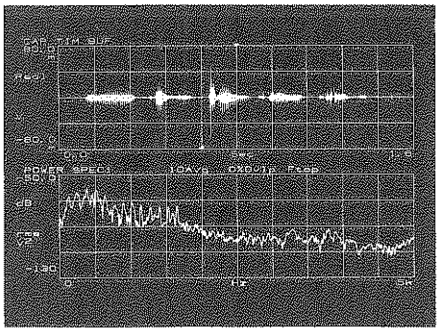


Figure 6-4

Chapter 7: **Data Collection with Time Throughput**

Introduction

A common testing technique is the gathering of data for later analysis in a lab or office. Typical recording devices include portable instrumentation tape recorders, high speed tape drives and large-capacity disc drives. Data is played back into a spectrum analyzer or oscilloscope for detailed analysis.

Within the realm of computer-based Fourier analysis systems, this technique is referred to as data throughput or ADC throughput (where ADC stands for analog-to-digital converter). Analog input signals are sampled, digitized and then transferred to a disc drive for storage on a magnetic disc. The stored data is recalled from the disc as discrete time records for detailed analysis in the time or frequency domains. This technique is often used in applications where short test times are critical: access to the system-under-test is limited, or destructive testing is being performed.

Time Throughput with the HP 3562A

Through direct control of external HP-IB disc drives and the Time Throughput capability, data throughput can be implemented with the HP 3562A and an HP disc drive. Each time throughput is called a "session": a session is stored in a file (named by the user) on a disc for later recall. More than 32,000 time records (>134 Megabytes) can be gathered in any session—thus, the amount of data which can be gathered in a session is typically limited by the capacity of the disc. Real-time or "gap free" data can be collected for frequency spans as wide as 10 kHz (with Command Set-80 disc drives such as the HP 7941).

Analysis can be performed with Linear or Log Resolution and proceeds exactly as it would with analog input data. Measurements are configured using the steps outlined in Chapters 2 and 3, including averaging; if Time Throughput is active when the START key is pressed, data will be recalled from the selected disc file and loaded into the time record for processing.

Preparing a Disc for Throughput

Before starting the throughput session, **the disc drive must be connected and the disc media initialized** as described in Chapter 12, "Documentation of Results." When the disc is connected and a disc initialized, the next step is the creation of the throughput file or files (although files are reuseable, each session or test requires a new file).

1. Disc Functions *Press the* **DISC** *key, then the* **DISC FCTN** *(disc functions) softkey.*

2. Create Throughput File *Select the* **THRUPT SIZE** *(throughput size) softkey and enter the length as a period of time, a number of points or a number of time records. For this example* **40 RECORD** *(40 time records) was entered. This entry sets the total size of the throughput file: 40 time records means up to 40 time records from a single channel or 20 from each input for dual-channel measurements.*

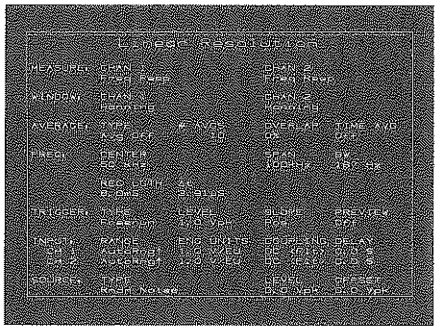
Select the **CREATE THRUPT** *softkey. The alphanumeric entry menu will be activated and the front panel keys are redefined as alpha keys (notice the blue letters and characters at the lower right of every key except Help). For disc files, up to eight letters and numbers (no characters, math symbols or punctuation marks) can be combined to name the throughput file. In this example the file name USER1 was used.*

Setting Up the Session

Measurement set up proceeds as described in Chapters 2 and 3: Linear Resolution and Log Resolution measurements can be used with Time Throughput. For this example the Time Throughput preset measurement will be used.

1. Special Preset *Press the green* **PRESET** *key. In the preset menu, select the softkey labelled* **TIME THRUPT.** *A dc-to-100 kHz Linear Resolution frequency response measurement will be set up as shown in Figure 7-1.*

2. Set Up Measurement *As described in Chapter 2, set up the signal source (* **SOURCE** *key) and measurement averaging (***AVG** *key); connect the device under test as shown in Figure 7-2; set up the input coupling (* **INPUT COUPLE** *key).*



```
                 Linear Resolution
MEASURE:  CHAN 1                   CHAN 2
          Freq Resp                Freq Resp
WINDOW:   CHAN 1                   CHAN 2
          Hanning                  Hanning
AVERAGE:  TYPE       # AVGS        OVERLAP   TIME AVG
          Avg Off        10        0%        Off
FREQ:     CENTER                   SPAN      BW
          50 kHz                   100kHz    187.5 Hz
          REC LGTH   Δt
          8.0mS      3.91μS
TRIGGER:  TYPE       LEVEL         SLOPE     PREVIEW
          FreeRun    1.0 Vpk       Pos       Off
INPUT:    RANGE      ENG UNITS     COUPLING  DELAY
  CH 1    AutoRng↑   1.0 V/EU      DC (Flt)  0.0 S
  CH 2    AutoRng↑   1.0 V/EU      DC (Flt)  0.0 S
SOURCE:   TYPE                     LEVEL     OFFSET
          Rndm Noise               0.0 Vpk   0.0 Vpk
```

Figure 7-1

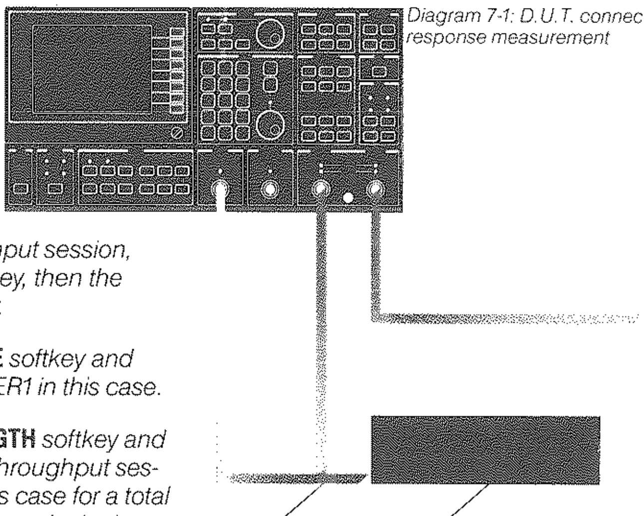


Diagram 7-1: D.U.T. connection for frequency response measurement

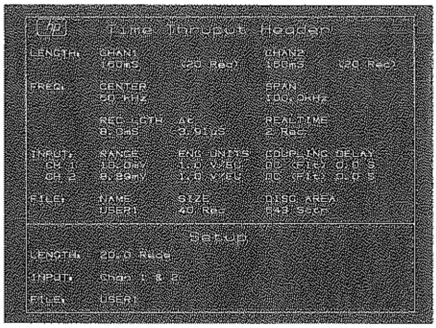
3. Throughput Select *To start the throughput session, press the* **MEAS MODE** *key, then the* **THRUPT SELECT** *softkey.*

4. Enter Active File *Select the* **ACTIVE FILE** *softkey and enter the file name, USER1 in this case.*

5. Set Length *Select the* **THRUPT LENGTH** *softkey and enter the length of the throughput session (20 RECORD in this case for a total of 40—frequency response is dual-channel).*

6. Start Throughput *Select the* **START THRUPT** *softkey to start the throughput session. The 'THROUGHPUT IN PROGRESS' message is displayed at the lower right of the trace. The* **STATUS** *group LEDs indicate measurement status; interaction with the disc is indicated by the* **HP-IB** *group LEDs.*

7. View Header *When the throughput is completed the* **HP-IB** *and* **STATUS** *LEDs will indicate no disc or measurement activity. Select the* **THRUPT HEADER** *softkey to display the disc file header for the session. The header for this example is shown in Figure 7-2.*



```
          Time Thruput Header
LENGTH:   CHAN1                    CHAN2
          160mS      (20 Rec)      160mS      (20 Rec)
FREQ:     CENTER                   SPAN
          50 kHz                   100.0kHz
          REC LGTH   Δt            REALTIME
          8.0mS      3.91μS        2 Rec
INPUT:    RANGE      ENG UNITS     COUPLING DELAY
  CH 1    10.0mV     1.0 V/EU      DC (Flt) 0.0 S
  CH 2    8.89mV     1.0 V/EU      DC (Flt) 0.0 S
FILE:     NAME       SIZE          DISC AREA
          USER1      40 Rec        843 Sctr
                     Setup
LENGTH:   20.0 Recs
INPUT:    Chan 1 & 2
FILE:     USER1
```

Figure 7-2

Measurements with Throughput Data

For recall and analysis of the throughput data, set up measurement parameters in the same manner described in Chapters 2 or 3 (with the exception of the source, input coupling and input range—these steps were performed when the throughput session was set up). To analyze the data with the preset full span frequency response:

1. Verify Mode *Press the* **MEAS MODE** *key to verify that Time Throughput is active: the* **THRUPT ON/OFF** *softkey should be set for* **THRUPT ON**.

2. Enter Active File *Select the* **THRUPT SELECT** *softkey, then the* **ACTIVE FILE** *softkey. The active throughput file name is displayed at the lower right of the trace. If the displayed file is correct, select the* **CANCEL ALPHA** *softkey; if not, enter the active file name using the alphanumeric entry keys.*

3. Start *Press the yellow* **START** *key. Time records are recalled from the disc and the measurement proceeds using the digitized data.*

4. Zoom Measurement *For real-time throughput sessions (up to 10kHz span in single-channel or 5kHz span in dual-channel), zoom measurements can be performed. Use the* **FREQ** *(frequency) key and the X-marker to configure a zoom measurement. Measurement averaging, with overlap, can be selected with the averaging menu (***AVG** *key). Press the yellow* **START** *key to perform the new measurement.*

Chapter 8: Block-Operation Waveform Math

Introduction

Once measurements have been taken, mathematical manipulation of test results may be required to put the information into a more useful form. To speed and simplify this process the measurement results must be in a form that is easy to manipulate. Within Dynamic Signal Analyzers such as the HP 3562A, digitized analog signals form finite blocks of time data (time records) or frequency spectra (the FFT result) which lend themselves readily to block manipulation.

Several powerful analysis functions are built into the HP 3562A including display formatting, marker functions and block-operation Waveform Math. Since the marker functions and display formatting capabilities have been emphasized in earlier chapters, Chapter 8 will focus on the Waveform Math capabilities of the HP 3562A.

Waveform Math Concepts

While data within the HP 3562A exist in relatively large blocks (2048-point time records and 801-line FFT results), using the Waveform Math keys to manipulate data is very similar to using a handheld calculator. Operations such as square root, inverse FFT or division by a constant can be performed on a displayed trace; operations such as +, −, × and ÷ can be performed between displayed traces or between a displayed trace and a trace stored internally. Results are displayed graphically in the appropriate domain (time or frequency).

Math with a Constant

Division by a constant (resistance) can be used to convert a measurement of voltage versus frequency or time to a plot of current versus frequency or time. In this example a sine wave is connected to the Channel 1 input and the waveform display is converted from voltage to current:

1. **Special Preset** *Press the green* **PRESET** *key, then select the* **P SPEC LINRES** *(power spectrum) softkey.*
2. **Connect Source** *Connect the HP 3562A* **SOURCE** *output BNC to the Channel 1 input BNC.*
3. **Set Source Level** *Press the* **SOURCE** *key, then the select* **SOURCE LEVEL** *softkey. To enter the source level, press 1 on the keypad then select the* **V** *(volt) softkey.*
4. **Enter Frequency** *Select the* **FIXED SINE** *softkey. To enter the output frequency, press 1 on the keypad, then select the* **kHz** *softkey.*
5. **Pause** *Press the yellow* **START** *key; then press the yellow* **PAUSE/CONT** *(pause/continue) key once to pause the measurement.*
6. **Display Time Record** *To display the last time record, press the* **MEAS DISP** *key, then select the* **FILTRD INPUT***(digitally filtered input) softkey. Select the* **TIME REC 1** *softkey to display the last time record. The display will be similar to Figure 8-1.*
7. **Activate Math** *To divide the voltage versus time trace by the 1 MΩ* input impedance, press the **MATH** *key.*
8. **Divide** *Select the* **DIV** *(divide) softkey then, to enter 1 × E6: press* **1** *on the keypad, select the* **EXP** *(exponent of 10) softkey, press* **6** *on the keypad and select the* **ENTER** *softkey.*

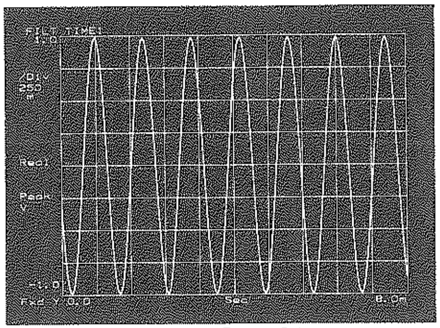


Figure 8-1

9. Activate Marker *Press the* **X** *key to activate the X-axis trace marker. Notice that the marker readout is in terms of time (msec) and (voltage) ÷ (1 × E6) as shown in Figure 8-2.*

[While the preceding technique is useful for introducing Waveform Math, the voltage-to-current conversion can be done in real time using the "engineering units", or "EU", input calibration feature. An EU label for current can also be entered for the display. For details, please refer to Chapter 7 of the HP 3562A Operating Manual.]

10. Display FFT *To compute and display the fast-Fourier transform of the time record: press the* **MATH** *key, the* **NEXT** *softkey, then another* **NEXT** *softkey. Select the* **FFT** *softkey; to reverse the transform, select the* **FFT^{-1}** *softkey.*

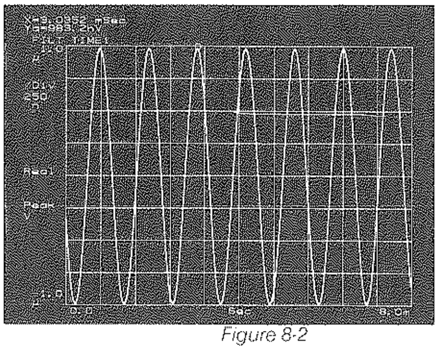


Figure 8-2

Math with Measured or Synthesized Data

Removal of system errors is often necessary in frequency response measurements. The test setup, including cabling and transducers, may induce a phase shift or amplitude response rolloff in the frequency response measurement. To compensate for these external effects:

1. Calibration Measurement *Perform a frequency response measurement (as described in Chapters 2, 3 or 4) without the device under test. In electronic network measurements this means replacing the D.U.T. with a through connection as shown in Diagram 8-1; for a mechanical shaker test, the response accelerometer would be attached directly to the driving point load cell, as shown in Diagram 8-2.*

2. Verify Span *The calibration measurements must be made at the same frequency span and start, center or stop frequency which will be used in the actual measurements. If any of the frequency parameters (span, start, center or stop) are changed, a new calibration measurement must be performed.*

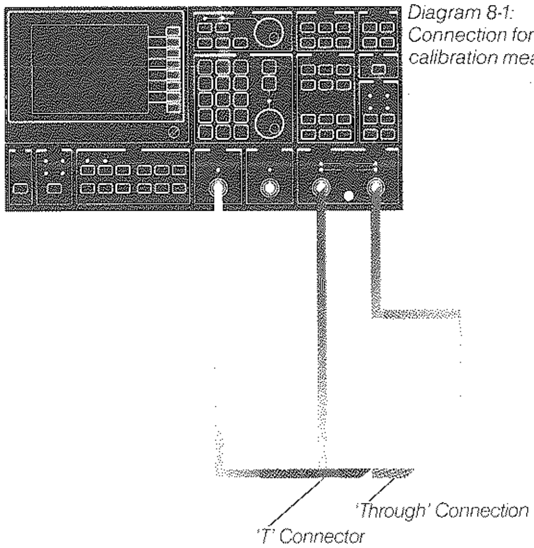


Diagram 8-1: Connection for frequency response calibration measurement

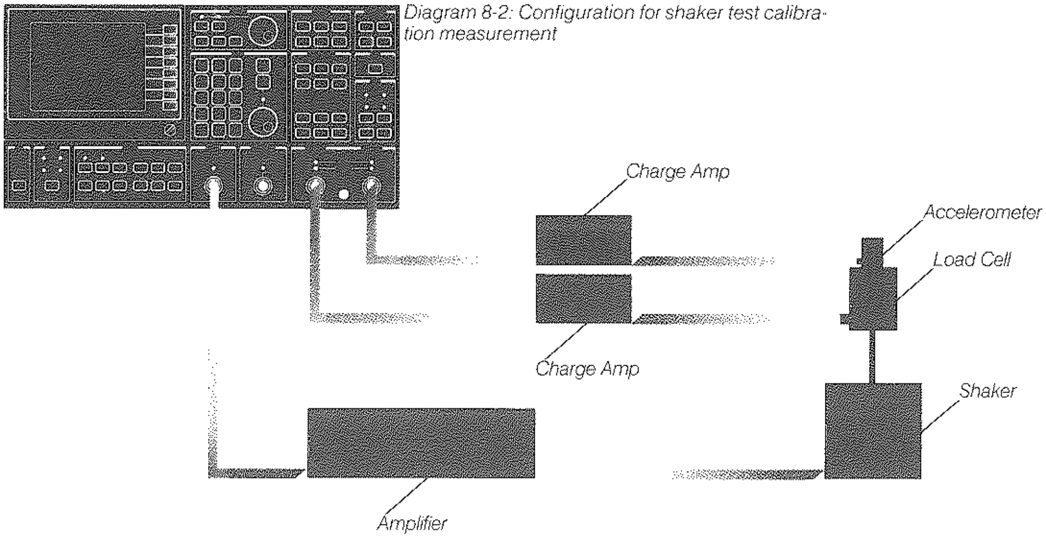


Diagram 8-2: Configuration for shaker test calibration measurement

3. **Store Cal Trace** *Store the calibration measurement in one of the two internal storage registers or in an external disc drive (see Chapter 12; if the calibration measurements are stored on disc, time can be saved by recalling the needed calibration trace and then storing it one of the internal registers).*

4. **Perform Measurement** *Set up and perform the frequency response measurement with the device under test in the circuit as described in Chapter 2, 3 or 4.*

5. **Display Response** *Press the* **UPPER LOWER** *key to create a split screen display. Display the frequency response log magnitude on trace A and the phase response on trace B:*

   a. *Press the* **A&B** *key to activate both traces.*

   b. *If frequency response is not displayed, press the* **MEAS DISP** *key, then select the* **FREQ RESP** *softkey.*

   c. *Press the* **A** *key to activate trace A. Press the* **COORD** *key, then select the* **MAG (dB)** *softkey.*

   d. *Press the* **B** *key to activate trace B. Select the* **PHASE** *softkey in the* **COORD** *menu.*

6. **Activate Traces** *Press the* **A&B** *key to activate both traces again.*

7. **Divide** *To divide the measurement by the calibration measurement, press the* **MATH** *key. In the* **MATH** *menu select the* **DIV** *(divide) softkey, then the* **SAVED 1** or **SAVED 2** *softkey, depending on which register contains the calibration measurement. The corrected frequency response magnitude and phase traces will be displayed.*

Introduction

Frequency response magnitude and phase plots, including Bode, Nyquist and Nichols charts, provide informative representations of a system response in the frequency domain; the impulse response provides an equally important perspective in the time domain. However, in applications such as closed loop control system design and analysis, complete system characterization often requires detailed information about the location of system poles and zeroes in the complex-valued s-plane (the Laplace domain).

A technique known as curve fitting can be used to convert frequency response measurements into a detailed listing of system poles and zeroes. Conceptually, curve fitting is an iterative mathematical algorithm which "fits" a math model to a measured frequency response "curve". As part of the analysis process, the resulting pole and zero values can be used in a root locus analysis of the measured system.

The HP 3562A Curve Fitter

The curve fitting process begins with a frequency response measurement and its accompanying coherence function (refer to Chapters 2, 3 or 4 for frequency response measurement procedures; all three types of frequency response measurements in the HP 3562A, Linear Resolution FFT, Log Resolution and Swept Sine, are compatible with the Curve Fitter). Although the coherence function is not required for an accurate curve fit, the "best fit" is usually obtained when the coherence function is available.

As many as 40 poles and 40 zeroes can be extracted from a measurement with the HP 3562A Curve Fitter. You can specify the order of the system or let the fitter find it automatically (fastest results are obtained if you provide an approximation of the system order). For detailed analysis, the curve fit results can be transferred to the Frequency Response Synthesis pole/zero table for editing and modification, followed by synthesis of the new response (refer to Chapter 10 for details regarding Frequency Response Synthesis).

Using the Curve Fitter

This example uses the zoom measurement from Chapter 2, the crystal filter, to demonstrate the curve fitting process. The frequency response measurement should be displayed in trace A and the coherence function in trace B. Set up the display as follows:

1. **Active Trace** *Press the* **A** *key to make trace A active.*
2. **Display Response** *Press the* **MEAS DISP** *(measurement display) key, then select the* **FREQ RESP** *(frequency response) softkey. If the measurement data is stored internally or on disc, it should be recalled at this point.*
3. **Activate Trace** *Press the* **B** *key to activate trace B.*
4. **Display Coherence** *Select the* **COHER** *(coherence) softkey (in the* **MEAS DISP** *menu). If the coherence data is stored internally or on disc, it should be recalled at this point.*
5. **Perform Measurement** *If stored data is not being used, a frequency response measurement should be performed following the methods described in Chapters 2, 3 or 4.*
6. **Activate Traces** *Press the* **A&B** *key to activate both traces (be sure that the frequency response is in trace A and the coherence function is in trace B).*
7. **Select Data** *Press the* **CURVE FIT** *key. If recalled data is being used, select the* **A&B TRACES** *softkey; if the current measurement is being used, select the* **LAST MEAS** *softkey.*
8. **Number of Poles** *Select the* **NUMBER POLES** *softkey and enter an approximate number of poles (3 poles were selected for this example).*
9. **Number of Zeroes** *Select the* **NUMBER ZEROS** *softkey and enter an approximate number of zeroes (3 zeroes were selected for this example).*
10. **User Order** *Select the* **FIT FCTN** *(fit functions) softkey; select the* **USER ORDER** *softkey, then the* **RETURN** *softkey.*
11. **Start the Fit** *Select the* **CREATE FIT** *softkey to start the curve fit operation. The message CURVE FIT IN PROGRESS will be displayed at the lower right of the trace; intermediate results will be displayed in trace B as the fit progresses.*
12. **View Results** *When the curve fit is completed, the message "Fit Complete" is displayed. The display will appear as shown in Figure 9-1; trace A shows the original measurement and trace B the curve fit result.*
13. **View Table** *Select the* **EDIT TABLE** *softkey to display the pole/zero table for the curve fit. The table for this example is shown in Figure 9-2.*

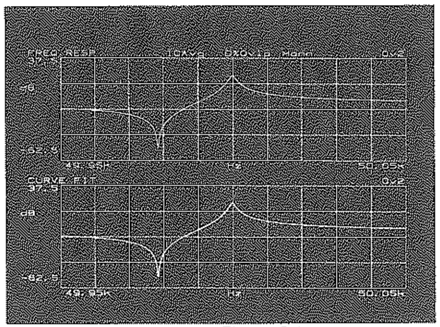
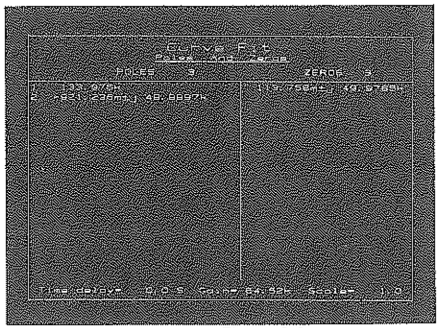


Figure 9-1



Curve Fit
Poles And Zeros

POLES 3 ZEROS 3

1 133.975k
2 -821.236m±j 48.8897k

119.758m±j 49.9769k

Time delay= 0.0 S Gain= 64.52k Scale= 1.0

Figure 9-2

Introduction

Within the development of an electronic or electromechanical system, product specifications become the design parameters. Once the system has been designed on paper, the predicted response of the system can be modeled in a computer and the design refined to meet the intent of the specifications. Prototypes are then built and tested; measured responses are compared to the predicted response and necessary changes are made to the model, the system, or both.

The Frequency Response Synthesis capability in the HP 3562A makes it possible to create a system model in the same device which will be used to test the actual system. System models can be entered in pole/zero, pole/residue and ratio-of-polynomial formats and then be synthesized over a linear or logarithmic frequency span. Curve Fit results can also be transferred to a synthesis table for editing or for conversion to other formats.

Chapter 10 is an introduction to entering, creating and editing a synthesized frequency response. Transformation between the three formats is also demonstrated.

Using Frequency Response Synthesis

As an Example A 20 Hz low pass filter with 80 dB/decade rolloff and a gain of 10 will be synthesized. Additional design constraints include a 60 dB notch at 60 Hz to remove powerline signals; passband ripple less than ± 3 dB.

The design for the filter produced the equation

$$\frac{10(s + 6)(s + 4 + j60)(s + 4 - j60)}{(s + 2)[(s + 5 + j20)(s + 5 - j20)]^2}$$

To begin the frequency response synthesis, specify the mode (linear or log) and the frequency span. For this example:

1. Press the **MEAS MODE** key. Select the **LOG RES** softkey.
2. Press the **FREQ** key.
3. Select the **START FREQ** softkey and enter **500 mHz**.
4. Select the **SPAN** softkey and enter **3 Decade**.

Creating a Synthesis Table

To enter the function into the synthesis table:

1. Select Pole/Zero *Press the* **SYNTH** *key. Select the* **POLE ZERO** *softkey to display the pole/zero synthesis table.*

2. Clear Table *Any values in the table can be cleared with the* **CLEAR TABLE** *softkey (push twice to clear).*

3. Enter Poles *Poles will be entered first. Select the* **EDIT POLE #** *and* **ADD VALUE** *softkeys.*

Enter the pole values with the real and imaginary parts separated by a comma. For example, the complex pole pair is entered as −5, 20; the entry is terminated with the "Hz" softkey. Thus, the pole values are entered as −2,0 Hz, −5, 20 Hz and −5, 20 Hz.

4. Enter Zeros *System zeroes are entered in the same manner. Select the* **EDIT ZERO #** *and* **ADD VALUE** *softkeys. The example parameters are entered as −6, 0 Hz and −4, 60 Hz.*

The synthesis table should appear as shown in Figure 10-1. If you made any errors, select the **EDIT POLE #** *or* **EDIT ZERO #** *softkey followed by the number of the pole or zero (each active line of the table is numbered). Select the* **CHANGE VALUE** *softkey and enter the correct values.*

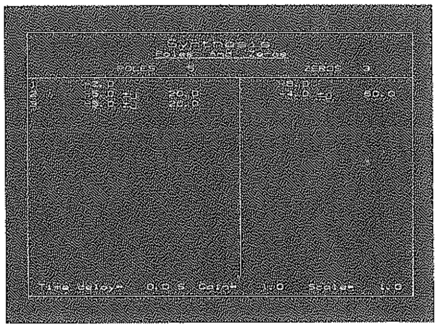


Figure 10-1

Chapter 10: System Modeling with Frequency Response Synthesis

5. Enter Gain Factor *To enter the system gain (10), select the* **SYNTH FCTN** *(synthesis functions) softkey.*

Select the **GAIN FACTOR** *softkey and enter the value* **1 0**. *Select the* **RETURN** *softkey to return to the editing menu.*

6. Return *Select the edit menu* **RETURN** *softkey to return to the main synthesis menu.*

7. Create Response *Select the* **CREATE TRACE** *softkey to activate the frequency response synthesis; the message "SYNTHESIS IN PROGRESS" is displayed. The results for this example are shown in Figure 10-2.*

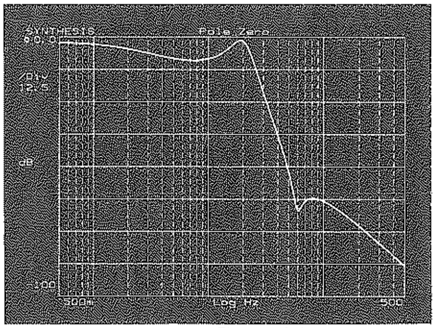


Figure 10-2

Editing the Synthesis Table

A quick inspection with the Y-marker shows that the passband flatness is not within the specifications due to the peak at 20 Hz (as shown in Figure 10-2). One possible solution is to move one of the complex pole pairs farther from the jω axis:

1. Edit Table *Press the* **SYNTH** *key; select the* **POLE ZERO** *softkey.*

Select the **EDIT POLE #** *softkey; enter the pole number or use the arrow keys or entry knob to highlight one of the pole pairs.*

2. Change Pole *Select the* **CHANGE VALUE** *softkey and enter the trial value: – 10, 20 Hz.*

3. Create Response *Select the* **RETURN** *softkey; select the* **CREATE TRACE** *softkey. The trial response magnitude and phase traces are shown in Figure 10-3.*

Another quick inspection with the Y-marker indicates that the passband flatness is within the ± 3 dB tolerance.

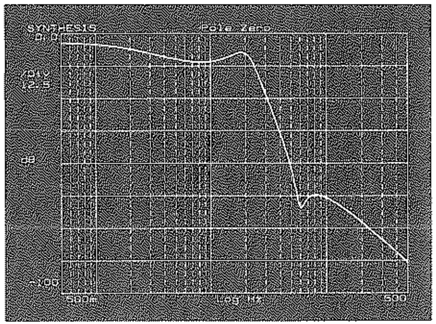


Figure 10-3

Conversion to Other Formats

To convert the pole/zero table to pole/residue or ratio-of-polynomials format:

1. Convert *Select the* **CONVRT TABLE** *softkey, then the* **TO → POL RESIDU** *softkey.*

2. Display Table *To display the new table select the* **POLE RESIDU** *softkey. The table will appear as shown in Figure 10-4.*

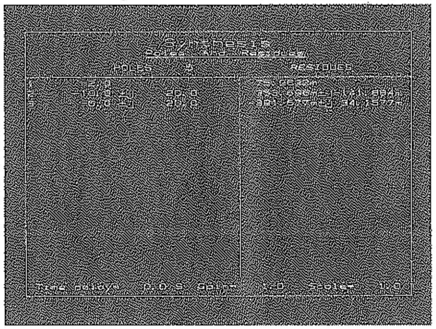


Figure 10-4

3. Convert *Select the* **RETURN** *softkey; again select the* **CONVRT TABLE** *softkey followed by the* **TO → POLY** *softkey.*

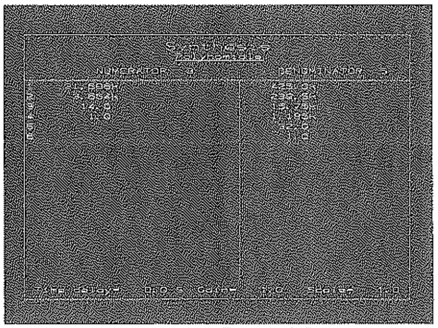


Figure 10-5

4. Display Table *The polynomial synthesis table will appear as shown in Figure 10-5.*

Labelling an Auto Sequence Program
Creating and Running an Auto Sequence Program
Editing an Auto Sequence Program

Introduction

High performance test instruments such as the HP 3562A derive much of their versatility and flexibility from the power of microprocessors. Beyond impressive data handling and measurement capabilities, enhancements such as direct programming of front panel key sequences without a computer have been made possible by microprocessors.

In the HP 3562A, the Auto Sequence programming capability lets you create as many as five separate key sequence programs for the automation of measurements, analysis computations, plotting and mass storage. Additional Auto Sequence programs can be stored on an external disc for manual recall or recall by another Auto Sequence program.

This chapter introduces labelling, creating and editing of an Auto Sequence program. Advanced features such as run-time pauses and program looping will also be described.

Labelling an Auto Sequence Program

This example uses the frequency response function that you synthesized in the previous chapter. The Auto Sequence program developed here will display the synthesized response in various formats. To start:

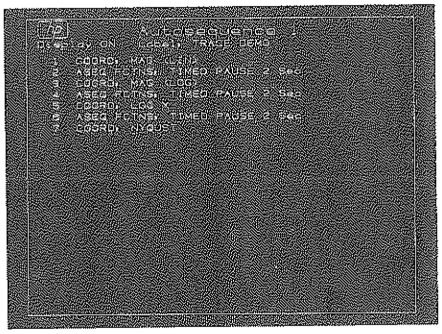
1. **Pause the Measurement** *If the analyzer is making a measurement, press the yellow* **PAUSE/CONT** *key once to pause the test.*

2. **Activate Editor** *Press the* **AUTO SEQ** *key, then select the* **SELECT ASEQ #** *softkey. Press* **1** *on the keypad followed by the* **EDIT** *softkey.*

3. **Create Labels** *Select the* **LABEL ASEQ** *softkey. The alphanumeric entry menu is activated and the front panel keys are redefined as alpha keys (notice the blue letters and characters at the lower right of every key, except Help).*

   Press the alpha keys for the letters **T R A C E**; *press the comma (,) key in the entry group; press the alpha keys for the letters* **D E M O**. *Select the* **ENTER** *softkey. (Note: an Auto Sequence label can be two lines of up to six characters. The comma indicates the separation between the first and second lines.)*

4. **View Label** *The label appears at the top of the Auto Sequence entry area, as shown in Figure 11-1, and on the Auto Sequence menu.*



```
               Autosequence 1
Display ON   Label: TRACE DEMO
   1  COORD: MAG (LIN)
   2  ASEQ FCTNS: TIMED PAUSE 2 Sec
   3  COORD: MAG (LOG)
   4  ASEQ FCTNS: TIMED PAUSE 2 Sec
   5  COORD: LOG Y
   6  ASEQ FCTNS: TIMED PAUSE 2 Sec
   7  COORD: NYQUIST
```

Figure 11-1

Creating and Running an Auto Sequence Program

The Auto Sequence editor should still be active from the previous section. Keystrokes can now be entered directly into the Auto Sequence program:

1. **Select Coordinate** *Press the* **COORD** *key followed by the* **MAG (LIN)** *softkey.*

2. **Set Timed Pause** *To program a timed delay into the program, select the* **ASEQ FCTN** *(Auto Sequence functions) softkey. Select the* **TIMED PAUSE** *softkey; press* **2** *on the keypad, then the* **SEC** *(seconds) softkey. Notice how the editor moves the new entry to the next line in the table (this is automatic when the* **ADD LINE** *softkey is active).*

3. **Select Coordinate** *Press the* **COORD** *key then select the* **MAG (LOG)** *softkey.*

4. **Set Timed Pause** *Repeat step 2 to enter another 2 second pause.*

5. **Select Coordinate** *Press the* **COORD** *key, the* **NEXT** *softkey, then the* **LOG X** *softkey (this will produce a log frequency scale).*

6. **Set Timed Pause** *Repeat step 2 above to enter another 2 second pause.*

7. **Select Coordinate** *Press the* **COORD** *key, then select the* **NEXT** *softkey. Select the* **NYQUST** *(Nyquist—real versus imaginary) softkey.*

8. **End Edit** *Select the* **END EDIT** *softkey to end editing the Auto Sequence program. The Auto Sequence menu will be displayed and the top softkey should be labelled* **TRACE DEMO**.

9. **Select Mode** *To display the synthesized frequency response, press the* **MEAS MODE** *key, then select the* **LINEAR RES** *softkey.*

10. **Set Span** *Press the* **FREQ** *key, then select the* **ZERO START** *softkey. Select the* **FREQ SPAN** *softkey, then press* **5 0 0** *on the keypad followed by the* **Hz** *softkey. This sets up a 0-500 Hz frequency span.*

11. **Create Response** *Press the* **SYNTH** *key, then the* **CREATE TRACE** *softkey; to start the trace demo Auto Sequence program, press the* **AUTO SEQ** *key, then the softkey labelled* **TRACE DEMO**. *The synthesized frequency response will be displayed in the programmed formats with a 2-second delay between each format.*

Editing an Auto Sequence Program

To make the demo more interesting, the timed pauses will be lengthened and the program will be put into a loop:

1. **Activate Editor** *Press the* **AUTO SEQ** *key. Select the* **SELECT ASEQ #**, *then press* **1** *on the keypad followed by the* **EDIT** *softkey. The listing of the* **TRACE DEMO** *program will be displayed with the last line highlighted.*

2. **Select Line** *Select the* **EDIT LINE #** *softkey. Use the arrow keys or the entry knob to move the pointer and highlight to line number 2.*

3. **Select 'Change' Function** *Select the* **CHANGE LINE** *softkey.*

4. **Change Pause** *To change the pause to 4 seconds, select the* **ASEQ FCTN** *softkey. Select the* **TIMED PAUSE** *softkey, then press* **4** *on the keypad followed by the* **SEC** *softkey.*

5. **Select Line** *Select the* **EDIT LINE #** *softkey and position the pointer on line 4.*

6. **Change Pause** *Repeat step 4 above to change the length of the pause.*

7. **Select Line** *Select the* **EDIT LINE #** *softkey and position the pointer on line 6.*

8. **Change Pause** *Repeat step 4 above to change the length of the pause.*

9. **Select 'Add' Function** *Select the* **ADD LINE** *softkey: the program lines to "initialize" the display and loop the program will be added on after line 7.*

10. **Set Timed Pause** *Repeat step 4 above to add another 4 second pause.*

11. **Select Coordinate** *Press the* **COORD** *key. Select the* **MAG (dB)** *softkey.*

12. **Select Coordinate** *Press the* **COORD** *key. Select the* **NEXT** *softkey, then the* **LIN X** *softkey.*

13. **Create Loop** *To loop the program, press the* **AUTO SEQ** *key, then the* **TRACE DEMO** *softkey. This causes the program to restart itself every time line 11 is reached.*

14. **End Edit** *Select the* **END EDIT** *softkey.*

15. **Start Auto Sequence** *Select the* **TRACE DEMO** *softkey to start the modified program. To stop the program select the* **PAUSE ASEQ** *softkey.*

Chapter 12: Documentation of Results

Introduction

Another benefit of microprocessor-based test instrumentation has been the ability to control high speed digital plotters for fast hardcopy of test results. A logical extension of the "system controller" capability is direct control of external disc drives for mass storage of results for future reference.

For complete documentation of test results, direct control of Hewlett-Packard Graphics Language (HP-GL) digital plotters and HP-IB disc drives is built into the HP 3562A. Enhancements such as automatic page advance (for plotters with paper feeders) and a complete disc catalog have been added to further simplify the documentation process. The remainder of this chapter introduces many of the plotting and disc interface capabilities of the HP 3562A. [Please refer to the HP 3562A Ordering Information Guide for details regarding compatible plotters and disc drives.]

Plotter Operations

When connecting a plotter, the first step is to set the power switch of both devices to the "OFF" position. Next, connect the Hewlett-Packard Graphics Language (HP-GL) compatible digital plotter to the HP 3562A rear panel HP-IB connector with an interface cable (HP model 10833A, B, C or D). [Please refer to the plotter operating manual for proper connection of line voltage.] Set the line switch on each device to the "ON" position.

Getting Ready to Plot

1. **Plotter Address** *Check the plotter address. Set the address to 5 (0101 on the address switch). If you change the plotter address, power may have to be turned "OFF" then "ON" for the change to be accepted in the plotter.*

2. **Enter Plotter Address** *Refer to the HP 3562A front panel. Press the* **HP-IB FCTN** *(HP-IB functions) key. Select the* **SELECT ADDRES** *softkey; select the* **PLOT ADDRES** *(plotter address) softkey. The current plotter address will be shown as PLOT ADDRESS = at the lower left of the display. If the plotter address is not 5, press* **5** *on the keypad followed by the* **ENTER** *softkey. Select the* **RETURN** *softkey.*

3. **System Controller** *Finally, also in the* **HP-IB FCTN** *menu, select the* **SYSTEM CNTRLR** *(system controller) softkey if it is not already highlighted.*

   The plotter and the HP 3562A are now ready for direct digital plotting.

Plotting the Display

Data traces, setup state tables, curve fit tables and disc catalogs are among the displays that can be plotted. Display a measurement or table on the HP 3562A then proceed:

1. **Activate Menu** *Press the* **PLOT** *key.*
2. **Set Pen Colors** *Select the* **SELECT PENS** *softkey. Different colored pens can be chosen for the data grid, each data trace (A and B) and the annotation for each trace. Multi-pen plotters are supported by this feature—pens are selected as a number between 0 and 32767.*
3. **Return** *Select the* **RETURN** *softkey.*
4. **Paging Control** *If a plotter with automatic paper feed is being used, select the* **PAGING CONTRL** *(paging control) softkey. Select the* **PAGE FORWRD** *and, if necessary,* **CUT PG ON** *(cut page on) softkeys.*
5. **Return** *Select the* **RETURN** *softkey.*
6. **Set Plot Speed** *Select either fast (F) or slow (S) plotting speed with the* **SPEED F S** *softkey.*
7. **Load Paper** *If a plotter with manual paper loading is being used, load a piece of plotter paper.*
8. **Start Plot** *Select the* **START PLOT** *softkey—a hardcopy of the display will be produced.*

As an enhancement to testing, the HP 3562A can perform plotting operations while a measurement is underway (this capability is known as "plot on the fly"). For additional details regarding plotting operations please refer to the HP 3562A Operating Manual.

Disc Drive Operations

When connecting a disc drive, the first step is to set the power switches on both devices to the "OFF" position. Next, connect the disc drive to the HP 3562A rear panel HP-IB connector with an interface cable (HP model 10833A, B, C or D). [Please refer to the disc drive operating manual for proper connection of line voltage.] Set the line switches of all devices to the "ON" position.

Getting Ready for Disc Access

1. **Disc Address** *Check the address setting on the rear panel of the disc drive. Set the address to 1.*
2. **Enter Disc Address** *Refer to the HP 3562A front panel. Press the* **HP-IB FCTN** *(HP-IB functions) key. Select the* **SELECT ADDRES** *softkey; select the* **DISC ADDRES** *(disc drive address) softkey. The current disc address will be shown as DISC ADDRESS = at the lower left of the display. If the address is not 1, press* **1** *on the keypad followed by the* **ENTER** *softkey.*
3. **Enter Unit Number** *For disc drives with more than one unit, select the* **DISC UNIT** *softkey. The disc unit number will be shown as DISC UNIT = at the lower left of the display. Use the keypad and the* **ENTER** *softkey to select the unit number. Select* **RETURN.**
4. **System Controller** *Finally, also in the* **HP-IB FCTN** *menu, select the* **SYSTEM CNTRLR** *(system controller) softkey if it is not highlighted already.*

Initializing a Disc

Please refer to the disc drive operating manual for instructions regarding proper care of disc media. Also refer to the disc operating manual for proper insertion of removable floppy or cartridge media. To initialize the disc via the HP 3562A:

1. Activate Menu *Press the* **DISC** *key on the front panel of the HP 3562A.*

2. Disc Functions *Select the* **DISC FCTN** *(disc functions) softkey, then the* **FORMAT** *softkey.*

3. Initialize Disc *Select the* **INIT DISC** *(initialize disc) softkey. The alphanumeric entry menu is activated and the front panel keys are redefined as alpha keys (notice the blue letters and characters at the lower right of each key except Help). Enter a name of one to six characters for the disc (disc names can be made up of letters and numbers only, no punctuation marks, special characters or math symbols).*

Disc initialization will take a few minutes depending on the capacity of the disc. When the initialization process is finished, the disc is ready to accept data from the HP 3562A.

Saving Data on Disc

To save a measurement on disc:

1. Select Trace *Press either the* **A** *or* **B** *key: only one trace at a time can be stored on disc (if both traces are active, only trace A will be saved).*

2. Save File *Press the* **DISC** *key, then select the* **SAVE FILE** *softkey. The alphanumeric entry menu is displayed and the front panel keys are redefined as alpha keys (notice the blue letters and characters at the lower right of every key except Help).*

3. Name the File *Name the file with up to eight letters, numbers or underscores (blanks, special characters, math symbols and punctuation marks cannot be used in a disc file name) and select the* **ENTER** *softkey. The* **TALK** *and* **LISTEN** *LEDs will flash while data is transferred between the analyzer and the disc.*

Saving Tables on Disc

To save a state table, curve fit table, synthesis table, Auto Sequence program or Auto Math program, the first step must be modified.

State Tables

1. Select State *Press the* **STATE/TRACE** *key to display the setup state. Follow steps 2 and 3 above.*

Curve Fit Tables

1. Select Curve Fit *Press the* **CURVE FIT** *key. Select the* **EDIT TABLE** *softkey to display the curve fit table. Follow steps 2 and 3 above.*

Synthesis Tables

1. Select Synthesis *Press the* **SYNTH** *key. Select the* **POLE ZERO**, **POLE RESIDU** *or* **POLYNOMIAL** *softkey. Follow steps 2 and 3 above.*

Auto Sequence Programs

1. Select Auto Sequence *Press the* **AUTO SEQ** *key. Select the* **SELECT ASEQ #** *softkey, then press the appropriate number (1 through 5) on the keypad followed by the* **VIEW** *softkey (this will display the program listing). Follow steps 2 and 3 above.*

Auto Math Programs

1. Select Auto Math *Press the* **AUTO MATH** *key. Select the* **VIEW MATH** *softkey. Follow steps 2 and 3 above.*

Recalling a File

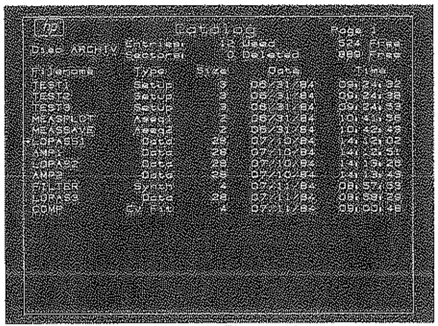
The fastest way to recall files from the disc is with the disc catalog and the catalog pointer. To recall the catalog and display it with the pointer:

1. View Catalog *Press the* **DISC** *key, then select the* **VIEW CATLOG** *softkey.*

2. Activate Pointer *Select the* **CATLOG POINTR** *softkey to activate the catalog pointer. The catalog with pointer is displayed as shown in Figure 12-1 (the line indicated by the pointer is also highlighted).*

3. Recall File *Use the arrow keys or the entry knob to move the pointer to the desired file (the* **NEXT PAGE** *and* **PREV PAGE** *softkeys may also be necessary, depending on the number of files in the catalog). Select the* **RECALL FILE** *softkey, then the* **AT POINTR** *softkey.*

[Note: if you know the name of the file you want to recall, the name can be entered directly. Select the **RECALL FILE** *softkey—the alphanumeric entry menu is active. Press the appropriate alpha keys, then select the* **ENTER** *softkey.]*



```
 hp                  Catalog                 Page 1
Disc ARCHIV  Entries:     12 Used        524 Free
             Sectors:      0 Deleted     888 Free
Filename       Type     Size    Date       Time
TEST1          Setup      3   05/31/84   09:24:32
TEST2          Setup      3   05/31/84   09:24:38
TEST3          Setup      3   05/31/84   09:24:53
MEASPLOT       Aseq1      2   05/31/84   10:41:56
MEASSAVE       Aseq2      2   05/31/84   10:42:49
→LOPASS1        Data     28   07/10/84   14:12:02
AMP1            Data     28   07/10/84   14:12:51
LOPASS2         Data     28   07/10/84   14:13:26
AMP2            Data     28   07/10/84   14:13:49
FILTER         Synth      4   07/11/84   08:57:59
LOPASS3         Data     28   07/11/84   08:58:23
COMP          Cv Fit      4   07/11/84   09:00:48
```

Figure 12-1

Displayed measurement data is stored on disc as real or complex values, depending on the measurement. Thus, when data is recalled from disc it can be displayed using all applicable choices in the **COORD** *(coordinate) menu.*

To display a recalled table or program, follow the same steps you would normally use to display the table or listing.

Recalling an Auto Sequence Program

When recalling an Auto Sequence program, the program will be placed where it was created— location 1, 2, 3, 4 or 5. However, this can be avoided with the following procedure:

1. View Catalog *Press the* **DISC** *key, then select the* **VIEW CATLOG** *softkey.*

2. Recall File *Select the* **RECALL FILE** *softkey—the alphanumeric entry menu will be activated.*

3. Select Location *To recall the program into a specific Auto Sequence location, enter the filename as [filename],[location number]. For example, if you wanted to recall the file DEMO into location 3: select the* **RECALL FILE** *softkey, then enter the filename and location as* **DEMO,3**.

USING THE LINEAR RESOLUTION MODE

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you the details of using the HP 3562A's linear resolution mode. Please refer to the User's Guide at the beginning of this manual for an introductory description of the mode and a discussion of its uses.

This chapter shows you how to:

1. select measurements and displays
2. set the frequency span
3. set up the source
4. select windowing
5. set up averaging
6. view the input signals

To keep track of where you are while setting up measurements, fold out the measurement setup checklist at the end of this chapter.

GETTING STARTED IN THE LINEAR RESOLUTION MODE

To put the HP 3562A in the linear resolution mode, press **MEAS MODE;** when its menu appears, press LINEAR RES. This configures the analyzer to the linear resolution mode.

SELECTING LINEAR RESOLUTION MEASUREMENTS

To select measurements in the linear resolution mode, press **SELECT MEAS** to display the following menu:

FREQ RESP	Selects the frequency response measurement.
POWER SPEC	Selects the power spectrum measurement.
AUTO CORR	Selects the auto correlation measurement.
CROSS CORR	Selects the cross correlation measurement.
HIST	Selects the histogram measurement.
CH 1&2 ACTIVE	Activates both input channels.
CH 1 ACTIVE	Activates input Channel 1.
CH 2 ACTIVE	Activates input Channel 2.

First choose the measurement, then the active channel(s). For example, to measure a power spectrum on Channel 1, press POWER SPEC, then CH 1 ACTIVE. Keep in mind that for averaged measurements these two selections must be made before the measurement is started. If you want to change either selection, you must restart the measurement. The two dual-channel measurements, FREQ RESP and CROSS CORR, automatically activate both channels when they are selected.

The next five sections of this chapter discuss these five measurements and their associated displays. Each measurement in the linear resolution mode offers several displays derived from the measurement data. Displays can be selected before, during or after the measurement.

THE FREQUENCY RESPONSE MEASUREMENT

The frequency response measurement, often called the "transfer function," is the ratio of a system's output to its input and yields both gain and phase as a function of frequency. (The phase response can be viewed by pressing PHASE in the **COORD** menu.) In the HP 3562A, the signal on Channel 1 is assumed to be the system's input, and the signal on Channel 2 is assumed to be its output. To select the frequency response measurement, press **SELECT MEAS,** followed by the FREQ RESP softkey.

To select a display for this measurement, press **MEAS DISP** to display the following menu:

FREQ RESP	Displays the frequency response. When default units and coordinates are active, this displays frequency on the X-axis and gain on the Y-axis.
COHER	Calculates and displays the coherence of the frequency response. (This softkey does not appear if time averaging is selected—see "Averaging in the Linear Resolution Mode" later in this chapter.)
POWER SPEC1	Displays the power spectrum measured on Channel 1.
POWER SPEC2	Displays the power spectrum measured on Channel 2.
CROSS SPEC	Displays the cross spectrum.
IMPLS RESP	Displays the impulse response.
AUTO MATH	Selects the display calculated with the auto math routine; see "Auto Math" in Chapter 9. Note that this label might be replaced by a user-defined label.
FILTRD INPUT	Displays the filtered input menu, which provides time record and linear spectrum displays; see "Filtered Input Displays" later in this chapter.

The Frequency Response Display

Frequency response in the HP 3562A is calculated as the ratio of the cross spectrum to the Channel 1 power spectrum:

$$H(f) = \frac{G_{xy}}{G_{xx}}$$

where: G_{xy} is the cross spectrum
G_{xx} is the Channel 1 power spectrum

Figure 1-1 shows the response of a typical filter as characterized with the frequency response display. This example used the default coordinates and units; refer to Chapter 8 for information on selecting other coordinates or units for the display. To select this display, press **MEAS DISP,** followed by the FREQ RESP softkey.

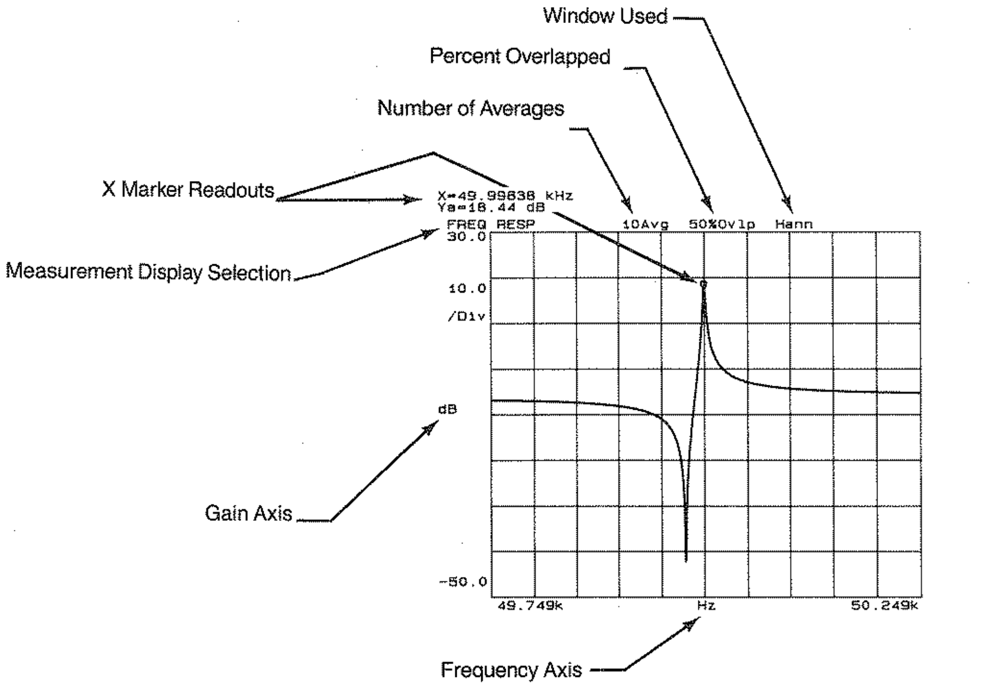


Figure 1-1 The Frequency Response Display

The Coherence Display

Coherence shows the portion of the output power spectrum related to the input spectrum, according to the following formula:

$$\gamma^2 = \frac{G_{xy}G_{xy}^*}{G_{xx}G_{yy}}$$

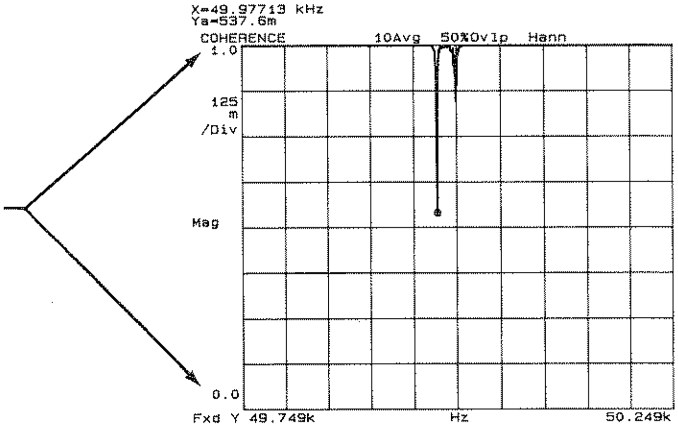
where: G_{xy} is the cross spectrum
G_{xy}^* is the cross spectrum's complex conjugate
G_{xx} is the Channel 1 power spectrum
G_{yy} is the Channel 2 power spectrum

It is an indication of the statistical validity of a frequency response measurement. Coherence is measured on a scale of 0.0 to 1.0, where 1.0 indicates perfect coherence. Coherence values less than unity are caused by poor resolution, system nonlinearities, extraneous noise and uncorrelated input signals. Because coherence is normalized, it is independent of the shape of the frequency response function. To select this display, press **MEAS DISP,** followed by the COHER softkey.

NOTE

The coherence function is valid only for averaged measurements.

Figure 1-2 shows the coherence of the frequency response function shown in figure 1-1.



Coherence Scaled from 0.0 to 1.0

Figure 1-2 The Coherence Function Display

The Power Spectrum Displays

These displays show the power spectrum of the input signal. The power spectrum is the FFT of the signal multiplied by its complex conjugate. For an example of this display, please refer to figure 1-5. To select this display, press **MEAS DISP,** followed by the POWER SPEC1 or POWER SPEC2 softkeys.

The power spectrum displays are offered here as a convenient means of viewing the spectra after taking a frequency response measurement. If you want only the power spectrum magnitude display, use the power spectrum measurement because it is faster. (See "The Power Spectrum Measurement" later in this chapter.) The single-channel measurement also has greater maximum real time bandwidth (10 kHz versus 5 kHz). The power spectrum measurement does not, of course, yield the phase information provided by the frequency response measurement.

The Cross Spectrum Display

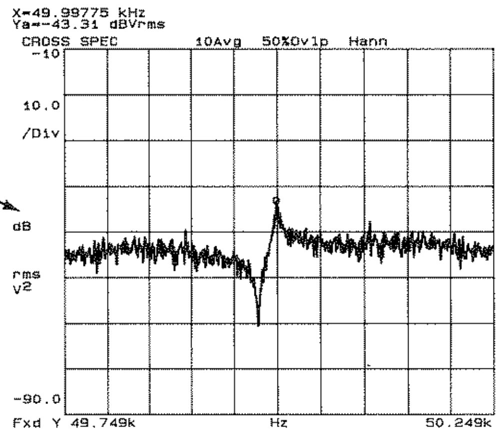
This display is computed by multiplying the complex conjugate of the linear spectrum on Channel 1 by the linear spectrum on Channel 2:

$$G_{yx} = (F_y)(F_x{}^*)$$

where: $F_x{}^*$ is the Channel 1 linear spectrum's complex conjugate
F_y is the Channel 2 linear spectrum

The cross spectrum shows the amplitude product of the two spectra and the phase difference between them. It is often used in acoustic intensity measurements. To select this display, press **MEAS DISP,** followed by the CROSS SPEC softkey.

Figure 1-3 shows an example of the cross spectrum display.



Scaled in dB Referenced to 1V²rms

Figure 1-3 The Cross Spectrum Display

The Impulse Response Display

This display is the inverse FFT of frequency response; it shows response as a function of time:

$$h(t) = F^{-1}[H(f)]$$

where: H(f) is the frequency response

It is useful for studying transient behavior and measuring time delay. To select this display, press **MEAS DISP,** followed by the IMPLS RESP softkey. Impulse response is valid only for baseband measurements.

Figure 1-4 shows an example of the impulse response display.

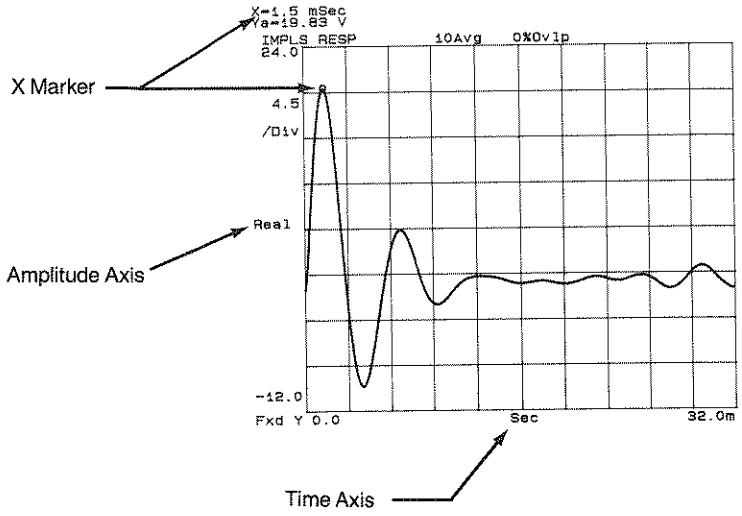


Figure 1-4 The Impulse Response Function

THE POWER SPECTRUM MEASUREMENT

The power spectrum measurement shows the input signal in the frequency domain. It is computed by multiplying the FFT of the signal by its complex conjugate:

$$G_{xx} = F_x F_x^*$$

where: F_x is the linear spectrum
F_x^* is its complex conjugate

This measurement is provided in addition to the frequency response measurement because the single-channel power spectrum is faster than the dual-channel frequency response measurement. Single-channel measurements also provide greater maximum real-time bandwidth (10 kHz for single-channel; 5 khz for dual-channel). The power spectrum provides no phase information. To select the power spectrum measurement, press **SELECT MEAS,** followed by the POWER SPEC softkey.

To select a display for this measurement, press **MEAS DISP** to display the following menu:

POWER SPEC1	Displays the power spectrum measured on Channel 1. (This softkey appears if Channel 1 is active.)
POWER SPEC2	Displays the power spectrum measured on channel 2. (This softkey appears if Channel 2 is active.)
AUTO MATH	Displays the trace calculated with the auto math table; see "Auto Math" in Chapter 9.
FILTRD INPUT	Displays the filtered input menu, which provides time record and linear spectrum displays; see "Filtered Input Displays" later in this chapter.

The Power Spectrum Display

The power spectrum display is selected by pressing **MEAS DISP,** followed by the POWER SPEC1 or POWER SPEC2 softkeys. Figure 1-5 shows an example of the power spectrum measurement and display.

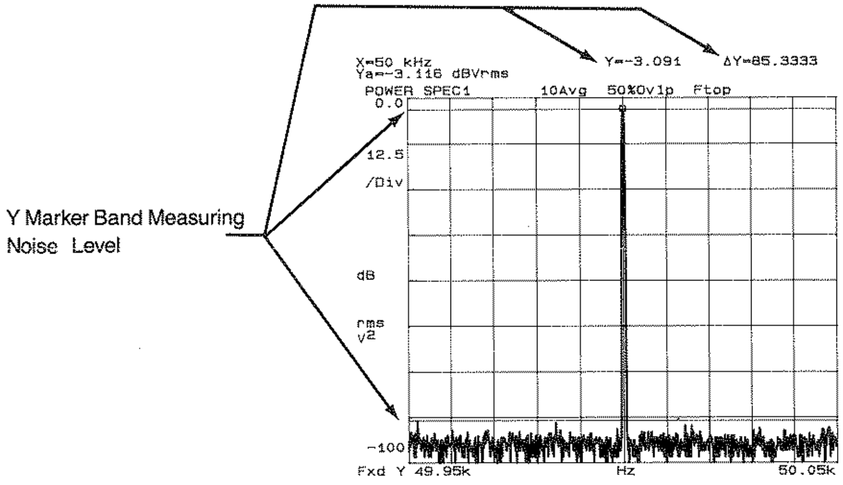


Figure 1-5 The Power Spectrum Display

THE AUTO CORRELATION MEASUREMENT

The auto correlation measurement indicates periodicity in time domain signals. It multiplies the signal by a progressively time-shifted version of itself; this emphasizes periodic parts of the signal and de-emphasizes non-periodic parts. In the HP 3562A it is computed using the inverse FFT of the power spectrum:

$$R_x(\tau) = F^{-1}[Gxx]$$

where: Gxx is the power spectrum

To avoid wrap-around error, both correlation measurements discard the last half of the time record. The measurement display is therefore half the length of the time record. If some signal of interest is present in the last half of the record, use delayed triggering to move the deleted portion of the record.

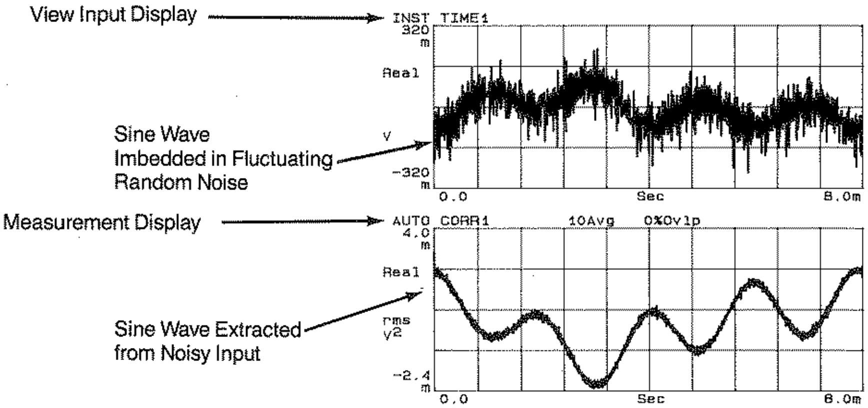
Some uses of auto correlation are detecting periodicity and measuring impulsive signals, such as gear chatter. Auto correlation is especially useful for extracting a periodic signal buried in noise when a synchronized trigger is not available. To select this measurement, press **SELECT MEAS,** followed by the AUTO CORR softkey.

To select a display for the auto correlation measurement, press **MEAS DISP** to display the following menu:

AUTO CORR1	Displays the auto correlation of the signal on Channel 1. (This softkey appears if Channel 1 is active.)
AUTO CORR2	Displays the auto correlation of the signal on Channel 2. (This softkey appears if Channel 2 is active.)
AUTO MATH	Displays the trace calculated with the auto math table; see "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.
FILTRD INPUT	Displays the filtered input menu, which provides time record and linear spectrum displays; see "Filtered Input Displays" later in this chapter.

The Auto Correlation Display

Figure 1-6 shows an example of the auto correlation display. To select this display, press **MEAS DISP,** followed by the AUTO CORR1 or AUTO CORR2 softkeys.



(Note: input display was plotted after measurement, so it doesn't represent actual input data)

Figure 1-6 The Auto Correlation Display

THE CROSS CORRELATION MEASUREMENT

The cross correlation measurement indicates time domain similarity between the signal on Channel 1 and the signal on Channel 2. It multiplies the Channel 1 signal by a progressively time-shifted version of the Channel 2 signal; this emphasizes similarities between the two while de-emphasizing differences. In the HP 3562A it is computed as the inverse FFT of the cross spectrum:

$$R_{xy}(\tau) = F^{-1}[G_{xy}]$$

where: G_{xy} is the cross spectrum

To avoid wrap-around error, the cross correlation measurement discards the last half of the Channel 2 time record. The measurement display is therefore half the length of the time record. If some signal of interest is present in the last half of the record, use delayed triggering to move the deleted portion of the record.

A major application is measuring system time delays since the maximum value of the function occurs at a time delay equal to the time delay in the system under test. To select this measurement, press **SELECT MEAS,** followed by the CROSS CORR softkey.

To select a display for the cross correlation measurement, press **MEAS DISP** to display the following menu:

CROSS CORR	Displays the cross correlation function.
AUTO CORR 1	Displays the auto correlation function of the signal on Channel 1.
AUTO CORR 2	Displays the auto correlation function of the signal on Channel 2.
AUTO MATH	Displays the trace calculated with the auto math table; refer to "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.
FILTRD INPUT	Displays the filtered input menu, which provides time record and linear spectrum displays; see "Filtered Input Displays" later in this chapter.

The Cross Correlation Display

Figure 1-7 shows an example of the cross correlation display. To select this display, press **MEAS DISP,** followed by the CROSS CORR softkey.

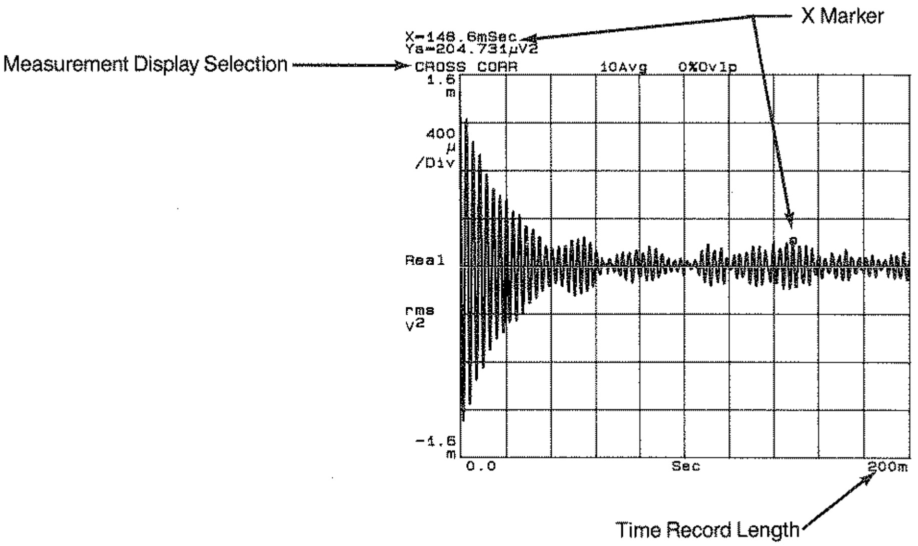


Figure 1-7 The Cross Correlation Display

The Auto Correlation Displays

If you are interested only in auto correlation, the auto correlation measurement described earlier in this chapter is faster because it is a single-channel measurement. Please refer to figure 1-6 for an example of the auto correlation display. To select one of these, press **MEAS DISP,** followed by the AUTO CORR1 or AUTO CORR2 softkeys.

THE HISTOGRAM MEASUREMENT

The histogram measurement shows how the amplitude of the input signal is distributed between its maximum and minimum values. Some of its uses are determining the statistical properties of noise and monitoring the performance of electromechanical positioning systems. Note that the number of averages for a histogram determines how many records are measured; the records are not "averaged." If exponential averaging is selected, the measurement continues indefinitely. Keep in mind that the accuracy of the histogram is dependent on frequency span, record length and number of averages. To select this measurement, press **SELECT MEAS,** followed by the HIST softkey.

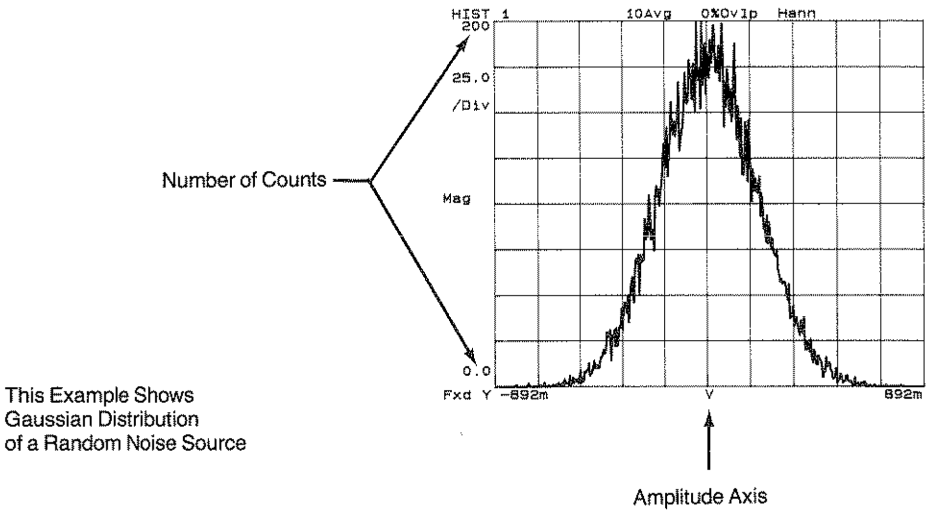
To select a display for the histogram measurement, press **MEAS DISP** to display the following menu:

HIST 1	Displays the histogram of the signal on Channel 1.
HIST 2	Displays the histogram of the signal on Channel 2.
PDF 1	Displays the probability density function of the signal on Channel 1.
PDF 2	Displays the probability density function of the signal on Channel 2.
CDF 1	Displays the cumulative density function of the signal on Channel 1.
CDF 2	Displays the cumulative density function of the signal on Channel 2.
AUTO MATH	Displays the trace calculated with the auto math table; see "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.
FILTRD INPUT	Displays the filtered input menu, which provides the time record and linear spectrum displays; see "Filtered Input Displays" later in this chapter.

The softkeys that actually appear in this menu depend on the active channel selection. For example, if only Channel 1 is active, HIST 2, PDF 2 and CDF 2 do not appear. Although the **WINDOW** menu remains active, windows have no affect on histograms.

The Histogram Display

Figure 1-8 shows an example of the histogram display. To select this display, press **MEAS DISP**, followed by the HIST1 or HIST2 softkeys.



Number of Counts

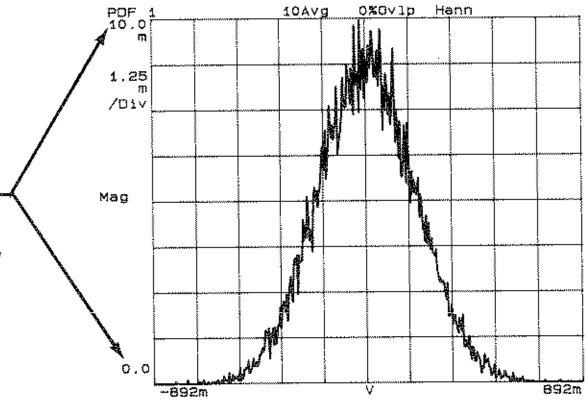
This Example Shows Gaussian Distribution of a Random Noise Source

Amplitude Axis

Figure 1-8 The Histogram Display

The Probability Density Function (PDF)

The probability density function, computed by normalizing the histogram, is a statistical measure of the probability that a specific level occurred. To select this display, press **MEAS DISP,** followed by the PDF1 or PDF2 softkeys. The PDF is normalized by multiplying the number of averages by 2048 (the number of points in the time record; 1024 for zoom measurements), dividing the histogram by this value, then dividing by the ΔV spacing on the X-axis. The probability of an input signal falling between two points is equal to the integral of the curve between those points. Figure 1-9 shows an example of the PDF display.

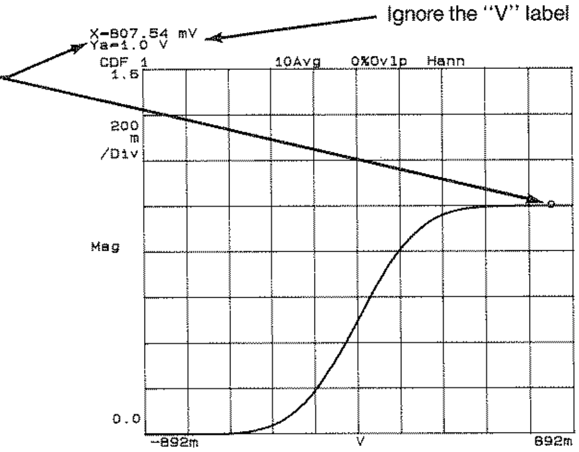


Similar to Histogram, with # of Counts Divided by Record Length and # of Averages (in this example, 200 ÷ 2048 ÷ 10)

Figure 1-9 The PDF Display

The Cumulative Density Function (CDF)

The cumulative density function, computed by integrating the PDF, shows the probability that a level equal to or less than a specific level occurred. Figure 1-10 shows an example of the CDF display. To select this display, press **MEAS DISP,** followed by the CDF1 or CDF2 softkeys.



Ignore the "V" label

X Marker Indicates Cumulative Level of Random Noise Source (from histogram in figure 1-8)

Figure 1-10 The CDF Display

FILTERED INPUT DISPLAYS

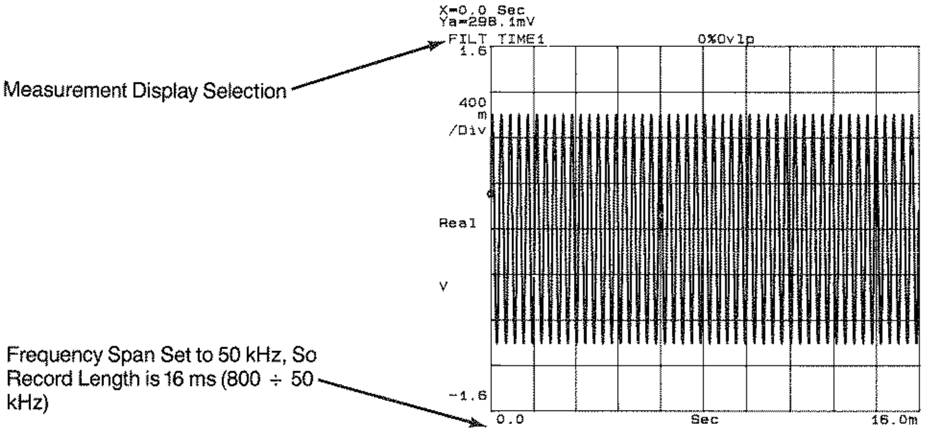
The filtered input menu provides both time and frequency domain displays of the input signals after they have been digitized and filtered to the current frequency span. Appendix E explains how these displays are derived and how they differ from measurement and view input displays. Pressing FILTRD INPUT on any of the **MEAS DISP** menus in the linear resolution mode displays the following menu:

TIME REC 1	Displays the Channel 1 time record.
TIME REC 2	Displays the Channel 2 time record.
LINEAR SPEC 1	Displays the linear spectrum on the signal on Channel 1. This is the FFT of the time record.
LINEAR SPEC 2	Displays the linear spectrum of the signal on Channel 2. This is the FFT of the time record.
ORBITS T1vsT2	Displays the orbits diagram. (This softkey may be replaced with DEMOD POLAR if demodulation is active—in this case, please refer to Chapter 5 for information.)
→ INST WNDOWD	Shows the effect of exponential windowing on the filtered input displays; see "Selecting Windows" later in this chapter.
→ INST	Selects the most recent time record for the filtered input displays.
→ AVRG	Selects the cumulative average of all time records acquired with the current measurement for the filtered input displays.
RETURN	Redisplays the previous **MEAS DISP** menu.

→ The appearance of these three softkeys depends on the status previewing and time averaging. Please refer to the menu diagrams in Appendix D for a complete explanation.

The Time Record Displays

The "time record" is the amount of time domain data required to perform one FFT. The "time record length" is the length of time required to fill the time record. Figure 1-11 shows an example of the time record display. To select one of these displays, press **MEAS DISP,** followed by the FILTRD INPUT softkey, followed by the TIME REC 1 or TIME REC 2 softkeys. For an explanation of the time record length, see "Frequency Spans in the Linear Resolution Mode" later in this chapter. Time records displays are not calibrated for zoom measurements (start frequency ≠ 0 Hz); the displayed amplitude is approximately one-half the actual amplitude. Also, calibration is not applied to time record displays.



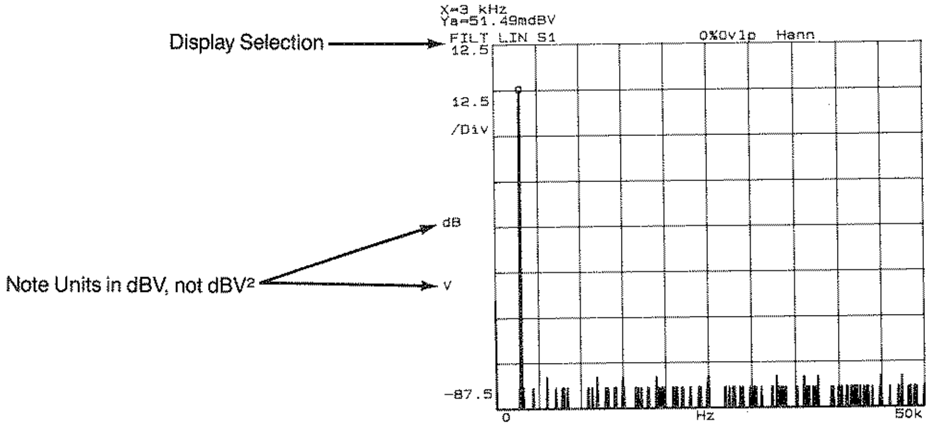
Measurement Display Selection

Frequency Span Set to 50 kHz, So Record Length is 16 ms (800 ÷ 50 kHz)

Figure 1-11 The Time Record Display

The Linear Spectrum Displays

The linear spectrum displays show the input signals after they have been filtered by the current frequency span and transformed to the frequency domain. The linear spectrum is the FFT of the time record. To select one of these displays, press **MEAS DISP,** followed by the FILTRD INPUT softkey, followed by the LINEAR SPEC 1 or LINEAR SPEC 2 softkeys. Figure 1-12 shows the linear spectrum of the time record displayed in figure 1-11. The message "Uncalibrated" is displayed with the linear spectra to indicate that these displays have not been corrected for time delays with respect to a trigger.



Display Selection

Note Units in dBV, not dBV²

Figure 1-12 The Linear Spectrum Display

The Orbits Diagram

The orbits diagram, often referred to as a Lissajous pattern, compares the two input time waveforms, Channel 1 versus Channel 2. One of its uses is detecting asymmetries in rotating machinery. The orbits diagram has special scaling characteristics; refer to "Scaling the Display" in Chapter 8 for details. To select this display, press **MEAS DISP,** followed by the FILTRD INPUT softkey, followed by the ORBITS T1vsT2 softkey. Figure 1-13 shows an example of the orbits diagram. Note that this display cannot be used with complex time data (when the measurement start frequency is greater than 0 Hz), and the time records are downsampled to 1024 points by selecting every other point. The **COORD** menu is disabled for the orbits diagram.

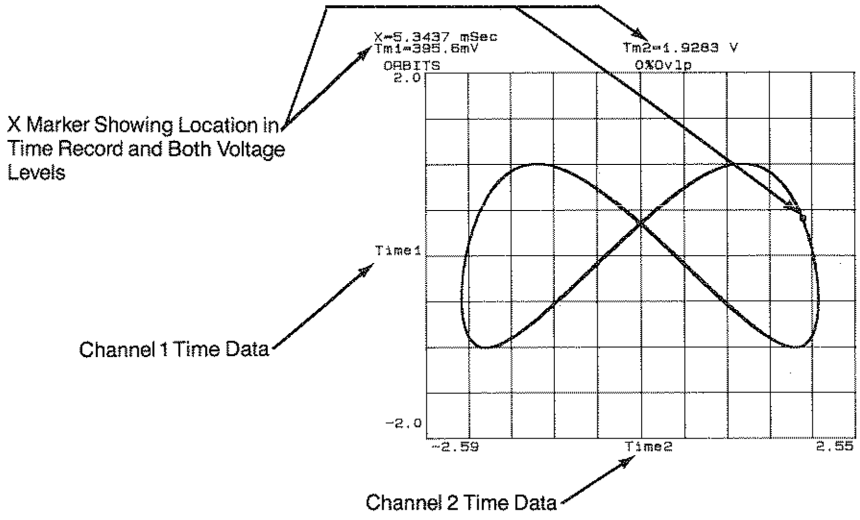


Figure 1-13 The Orbits Diagram

FREQUENCY SPANS IN THE LINEAR RESOLUTION MODE

The HP 3562A's frequency span in the linear resolution can be set from 10.2 mHz to 100 kHz. Frequency spans in this mode are predefined; if a value other than one of these is entered for the span, the analyzer selects the next higher available value. Table 1-1 shows the available spans for the linear resolution mode. Note that when the span is changed, the new span does not appear on the display until the next measurement is started.

Table 1-1 Frequency Spans in the Linear Resolution Mode

Span	**Resolution**	**Record length**	**Availability**
10.24 mHz	12.8 uHz	78,125s	baseband
20.48 mHz	25.6 uHz	39,062.5s	zoom
25.6 mHz	32 uHz	31,250s	baseband
51.2 mHz	64 uHz	15,625s	both
64 mHz	60 uHz	12,500s	baseband
102.4 mHz	128 uHz	7,812.5s	zoom
128 mHz	160 uHz	6,250s	both
160 mHz	200 uHz	5,000s	baseband
256 mHz	320 uHz	3,125s	both
320 mHz	400 uHz	2,500s	both
400 mHz	500 uHz	2,000s	baseband
512 mHz	640 uHz	1,562.5s	zoom
640 mHz	800 uHz	1,250s	both
800 mHz	1 mHz	1,000s	both
1.0 Hz	1.25 mHz	800s	baseband
1.28 Hz	1.6 mHz	625s	both
1.6 Hz	2.0 mHz	500s	both
2.0 Hz	2.5 mHz	400s	both
2.5 Hz	3.125 mHz	320s	baseband
2.56 Hz	3.2 mHz	312.5s	zoom
3.2 Hz	4 mHz	250s	both
4.0 Hz	5 mHz	200s	both
5.0 Hz	6.25 mHz	160s	both
6.25 Hz	7.81 mHz	128s	baseband
6.4 Hz	8 mHz	125s	both
8.0 Hz	10 mHz	100s	both
10.0 Hz	12.5 mHz	80s	both
12.5 Hz	15.625 mHz	64s	both
12.8 Hz	16 mHz	62.5s	zoom
15.625 Hz	19.531 mHz	51.2s	baseband
16.0 Hz	20 mHz	50s	both
20.0 Hz	25 mHz	40s	both
25.0 Hz	31.25 mHz	32s	both
31.25 Hz	39.0625 mHz	25.6s	both
32.0 Hz	40 mHz	25s	both
39.0625 Hz	48.828 mHz	20.48s	baseband
40.0 Hz	50 mHz	20s	both
50.0 Hz	62.5 mHz	16s	both
62.5 Hz	78.125 mHz	12.8s	both
64.0 Hz	80 mHz	12.5s	zoom
78.125 Hz	97.656 mHz	10.24s	both
80.0 Hz	100 mHz	10s	both
97.65625 Hz	122.0625 mHz	8.192s	baseband
100.0 Hz	125 mHz	8s	both
125.0 Hz	156.25 mHz	6.4s	both
156.25 Hz	195.31 mHz	5.12s	both
160.0 Hz	200 mHz	5s	both
195.3125 Hz	244.14 mHz	4.096s	both
200.0 Hz	250 mHz	4s	both
250.0 Hz	312.5 mHz	3.2s	both
312.5 Hz	390.62 mHz	2.56s	both
320.0 Hz	400 mHz	2.5s	zoom
390.625 Hz	488.28 mHz	2.048s	both
400.0 Hz	500 mHz	2s	both
500.0 Hz	625 mHz	1.6s	both
625.0 Hz	781.25 mHz	1.28s	both
781.25 Hz	976.56 mHz	1.024s	both
800.0 Hz	1 Hz	1s	both

Table 1-1

Span	**Resolution**	**Record Length**	**Availability**
1.0 kHz	1.25 Hz	800 ms	both
1.25 kHz	1.5625 Hz	640 ms	both
1.5625 kHz	1.9531 Hz	512 ms	both
1.6 kHz	2 Hz	500 ms	zoom
2.0 kHz	2.5 Hz	400 ms	both
2.5 kHz	3.125 Hz	320 ms	both
3.125 kHz	3.906 Hz	256 ms	both
4.0 kHz	5 Hz	200 ms	both
5.0 kHz	6.25 Hz	160 ms	both
6.25 kHz	7.8125 Hz	128 ms	both
8.0 kHz	10 Hz	100 ms	zoom
10.0 kHz	12.5 Hz	80 ms	both
12.5 kHz	15.625 Hz	64 ms	both
20.0 kHz	25 Hz	40 ms	both
25.0 kHz	31.25 Hz	32 ms	both
40.0 kHz	50 Hz	20 ms	zoom
50.0 kHz	62.5 Hz	16 ms	both
100.0 kHz	125 Hz	8 ms	baseband

Some spans are available in zoom only, and some are available in baseband only.

Setting Frequency Span and Time Record Length

To set the frequency span or time record length, press **FREQ** to display the following menu:

FREQ SPAN	Used to set the frequency span; the span may also be entered immediately after pressing **FREQ.**
START FREQ	Used to set the start frequency, using the Entry group.
CENTER FREQ	Used to set the center frequency, using the Entry group.
ZERO START	Sets the starting frequency to 0 Hz (dc).
MAX SPAN	Sets the frequency span to maximum (100 kHz).
TIME LENGTH	Used to set the time record length, using the Entry group.
E SMPL ON **OFF**	Selects external sampling, activates the EXT SAMPLE indicator in the Status group, and displays the SAMPLE FREQ softkey.
SAMPLE FREQ	Used to enter the external sampling frequency (appears only when E SMPL ON OFF is pressed ON).

Use FREQ SPAN with either START FREQ or CENTER FREQ when entering a span other than 100 kHz. To look for the first five harmonics of a 1 kHz signal, you could enter a span of 6 kHz and a start frequency of 1 kHz. To look for 100 Hz sidebands on a 50 kHz carrier, you could enter a span of 250 Hz and a center frequency of 50 kHz.

The analyzer uses the current span and start or center (whichever you last entered) to calculate the third variable. If the start or center frequencies are set to values that would cause some part of the span to exceed the 0 Hz and 100 kHz limits, the span is reduced.

To simplify frequency entries, you can press FREQ SPAN, START FREQ or CENTER FREQ then enter the start and stop frequencies separated by a comma. For example, to set up span from 100 to 200 Hz, you can press FREQ SPAN followed by 100 , 200 Hz.

Frequency Span versus Time Record Length

The HP 3562A allows you to set either the frequency span or the time record length in a measurement. The two are related by this formula:

$$\text{time record length (in s)} = \frac{800}{\text{span (in Hz)}} = \frac{1}{\Delta f \text{ (in Hz)}}$$

For example, a frequency span of 0 to 100 kHz has a time record length of 8 milliseconds (800 ÷ 100 000). Note that the two are inversely proportional; a narrow span and increased resolution result in a slower measurement. Setting the frequency span automatically sets the time record, and vice versa. Because record is determined by span, the available time record lengths are also predefined. Refer to table 1-1 for the predefined spans.

Zoom Measurements

Zooming, also known as band selectable analysis (BSA), allows you to concentrate the full measurement power of the HP 3562A on any portion of the 100 kHz frequency span. Say you are characterizing a filter with a resonant frequency of 15.0 kHz. With zoom, you can set the center frequency to 15.0 kHz and then set a very narrow span. A span of 50 Hz would give you a measurement from 14 975 Hz to 15 025 Hz. Now you can accurately measure and analyze around this point of interest.

To demonstrate the higher resolution zooming provides, press **WINDOW** and select the uniform window by pressing UNIFRM (NONE). This sets the bandwidth equal to Δf. Next, press **STATE TRACE** until the state information is displayed. Set the span to 100 kHz and look under FREQ: BW. You can see that the measurement bandwidth in this span is 125 Hz. Change the span to 50 Hz. The bandwidth is now 62.5 mHz, offering a much more precise characterization of a narrow part of the signal.

Real Time Bandwidth

The real time bandwidth (RTBW) is the maximum frequency span you can measure without missing input data. At spans greater than the RTBW, the instrument's processing time exceeds its data collection time and part of input signal is ignored while the previous time record is processed. When measuring periodic signals, the RTBW is not important because any data lost in one record will be repeated in the next record. However, RTBW is very important when measuring nondeterministic signals. The HP 3562A's maximum real time bandwidths in the linear resolution mode are 10 kHz for single-channel measurements and 5 kHz for dual-channel.

To achieve the greatest possible RTBW, you need to limit the number of display calculations required. The less you require of the display, the faster the measurement can run. For example, fast averaging and the single display format provide a greater RTBW than normal display updating and two active traces. One simple way of minimizing display time is to display a table, such as instrument state, before starting the measurement. The message "Real Time" is displayed at the end of the measurement if there were no gaps in the data.

NOTE

The HP 3562A double-buffers the input signals, so 1- and 2-average measurements are always in real time.

External Sampling

The external sampling capability of the HP 3562A allows you to synchronize the instrument's data acquisition rate to an external signal. For example, external sampling frequency can be derived from the rotational speed of the device under test. To select external sampling, press **FREQ,** then press E SMPL ON OFF to ON. Press the SAMPLE FREQ softkey and enter the external sampling frequency. Then connect your external sampling signal (TTL level only) to the EXT SAMPLE IN rear panel connector. To ensure accuracy, the frequency entered with SAMPLE FREQ must match the frequency of the signal applied at EXT SAMPLE IN. The span defaults to maximum when entering or exiting external sampling and when the sampling frequency is changed. Note that the analyzer's frequency spans and source output are tied to the external sampling frequency.

Sampling can be either fixed or variable. If internal sampling is selected (E SMPL ON OFF is OFF), the sampling rate is fixed at 256 kHz. If external sampling is on and the sampling frequency is entered in Hertz, sampling is assumed to be also fixed; the frequency of the sampling signal should be constant. However, if external sampling is on and the sampling frequency is entered in pulses/revolution, the sampling frequency may vary without affecting accuracy. External sampling frequencies cannot be greater than the internal sampling frequency, which is nominally 256 kHz.

The horizontal display units depend on the type of sampling. If the external sampling frequency is entered in Hertz, the display shows Hertz as well. If the sampling frequency is entered in pulses/rev and the display is currently showing Hertz, the units change to orders. Orders are displayed when variable sampling is selected. Use the Orders (Revs) softkey in the **UNITS** menu to select orders for the horizontal axis.

Note that the HP 3562A's anti-aliasing protection, which is complete at the 256 kHz sampling frequency, decreases as you decrease the sampling frequency. To avoid aliasing problems, you should use a ratio synthesizer or some other device to keep the sampling frequency close to 256 kHz or make sure there are no frequency components in the input greater than ½ the sampling frequency. The maximum span at a given sampling rate is 2.56 times the value entered with SAMPLE FREQ. There is no trigger delay correction for external sample frequencies below 0.6 Hz. Measurement results are uncalibrated when using external sampling.

THE SOURCE OUTPUT IN THE LINEAR RESOLUTION MODE

The source is used to stimulate devices under test. The HP 3562A offers five source outputs in the linear resolution mode: random noise, burst random, periodic chirp, burst chirp, and fixed sine. The source is band-limited (at spans ≥ 160 mHz) to maintain constant power with respect to the frequency span selected and minimize out-of-band excitations.

Selecting a Source Output

The source outputs are described and compared after the following discussion of the source menu. To select a source output and set its amplitude level, press **SOURCE** to display the following menu:

SOURCE LEVEL	Allows you to set the amplitude level of the source Use the Entry group to set the level between 0V and +5V. Note that the combined ac plus dc level is limited to ±10V. The default level is 0V.
DC OFFSET	Allows you to add a positive or negative offset to the source output signal. The offset is limited to 10V minus the source level; the combined ac and dc level is limited to ±10V.
SOURCE OFF	Turns the source output off. If source protection is on, the source ramps off gradually. See "Source Protection" following this menu.
RANDOM NOISE	Selects the random noise output; this is the default selection at power-on and after resetting.
BURST RANDOM	Selects the burst random output and allows you to enter the burst percentage from 1 to 99%. The default is 70%.
PRIODC CHIRP	Selects the periodic chirp output.
BURST CHIRP	Selects the burst chirp output and allows you to enter the percentage of the record containing the burst from 1 to 99%. The default is 70%.
FIXED SINE	Selects the fixed sine output and allows you to enter the frequency from 64 μHz to 100 kHz; the default is 125 Hz.

Why Five Different Source Outputs?

Selection of a source output depends on the nature of the device under test, time versus accuracy trade-offs, and your measurement objectives. The following paragraphs describe each of the outputs, and their advantages and disadvantages are summarized in table 1-2.

NOTE

For a general discussion of stimulus signals, leakage and windowing, please refer to Hewlett-Packard Application Note 243. Contact your HP Sales Representative to obtain a copy.

Random noise supplies true random noise at the selected level across the selected frequency span. Random noise is often used to obtain a fast, linear estimate of a system's frequency response at the current operating point. Because it is not periodic in the time record, random noise requires a window (usually the Hanning—see "Selecting Windows" later in this chapter) to reduce leakage. Random noise does not characterize nonlinearities because the device under test is excited differently each time record, so averaging over a number of time records tends to reduce the effects of nonlinear distortion in the measurement. Note that entering a source level in volts peak sets the maximum noise peak that is likely to occur.

Burst random supplies random noise during the specified percentage of the time record and no output for the remainder of the record. Because the burst signal is not on for the entire time record, the leakage problems associated with continuous random noise can be avoided. If the system's response decays to zero between the end of the burst and the end of the time record, a window is not required. Consequently, leakage and the distortion introduced by windowing are avoided. As with random, burst random does not characterize nonlinearities because the effects of distortion are reduced by averaging. Note that the random bursts are gated on and off instantaneously.

Periodic chirp supplies a fast sine sweep over the current frequency span that repeats with the same period as the time record. Because it is periodic in the time record, no windowing is required. The periodic chirp can characterize nonlinearities because the device under test is excited in exactly the same manner every time record, and the nonlinear distortion averages to its mean value (it does not average to zero). The periodic chirp is similar to pseudo-random noise sources, except it has a much higher rms-to-peak ratio. The periodic chirp sets the center frequency to the nearest integer multiple of Δf. Chirps cannot be used at spans narrower than 160 mHz (baseband) and 320 mHz (zoom).

Burst chirp supplies the frequency chirp for the specified percentage of the time record, then no output for the remainder of the record. Because it is periodic in the time record, no windowing is required if the device's response decays inside the time record. The burst chirp characterizes nonlinearities for the same reason as the periodic chirp.

Fixed sine supplies a constant frequency sine wave at the specified source level. A fixed sine is used to excite a device under test at a single frequency. If the output is not exactly periodic in the time record, the fixed sine requires a window (usually the flat top—see "Selecting Windows" later in this chapter) to reduce leakage.

NOTE

The burst source signals are present at the source output only when the trigger is armed and the trigger conditions have been met. Source triggering (see Chapter 7) is the easiest way to do this.

Table 1-2 Summary of Source Output Characteristics

	Random Noise	Burst Random	Periodic Chirp	Burst Chirp	Fixed Sine
Need window?	yes (HANN)	no (UNIFRM)	no (UNIFRM)	no (UNIFRM)	sometimes (FLAT TOP, HANN)
Characterizes nonlinearities?	no	no	yes	yes	yes
Reduces effects of nonlinear distortion on measurement?	yes	yes	no	no	no
Signal-to-noise ratio?	fair	fair	high	high	very high
Peak-to-rms ratio?	fair	fair	high	high	very high

Source Protection

Switching source types or changing the output level can potentially damage devices under test. To help you avoid this, the HP 3562A offers source protection. Protection causes the source to ramp from its current level to the desired level, rather than changing instantaneously. When active, ramping occurs whenever the source level is changed or its effective output power can potentially change: if the source is turned on or off or the measurement mode, source output type, frequency span, source level, or dc offset is changed.

To activate source protection, press the **SPCL FCTN** key followed by the SOURCE PROTCT softkey to display the following menu:

PROTCT ON **OFF**	Activates source protection.
RAMP TIME	Allows you to enter the ramp time for the source to turn off or change levels. Ramp time is stored in nonvolatile memory and is not affected by power-down or reset.
RETURN	Redisplays the **SPCL FCTN** menu.

The state of PROTCT ON OFF and the value of RAMP TIME are not affected by reset or power-down. If source protect is active during a calibration, the source is turned off and remains off.

When you change source types with protection activated, you must reenter the source level. This extra step, together with the ramp time, prevents you from supplying an unexpected excitation to a device under test. Note that changing the source level with the Entry knob overrides source protection.

SELECTING WINDOWS

Windows are time domain functions that reduce the effects of leakage, the smearing of energy across the frequency spectrum. Leakage is caused by signals that are not periodic in the time domain; the FFT assumes all inputs are periodic. For more details about leakage and windowing, please obtain a copy of Hewlett-Packard Application Note 243 from your HP Sales Representative.

The HP 3562A offers six windows: Hann, flat top, uniform, force, exponential, and user-defined. These windows are described after the following discussion of the windowing menu. To select a window, press **WINDOW** to display the following menu:

HANN	Selects the Hann window for both channels.
FLAT TOP	Selects the flat top window for both channels.
UNIFRM (NONE)	Selects the uniform window for both channels.
FORCE EXPON	Displays the FORCE/EXPON menu, which is used to select the force and exponential windows.
USER SAVD 1	Selects the user-defined window (stored in the SAVED 1 memory location) for both channels.

The Hann, flat top, uniform, and user-defined windows are applied to both channels. The force and exponential windows may be applied individually.

Pressing FORCE/EXPON displays the following menu:

FORCE CHAN 1	Selects the force window for Channel 1; enter the width using the Entry group.
EXPON CHAN 1	Selects the exponential window for Channel 1; enter the decay using the Entry group.
FORCE CHAN 2	Selects the force window for Channel 2; enter the width using the Entry group.
EXPON CHAN 2	Selects the exponential window for Channel 2; enter the decay using the Entry group.
RETURN	Redisplays the **WINDOW** menu.

The Hann Window

The Hann window attenuates the input signal at both ends of the time record, which forces the signal to appear periodic. The disadvantage of the Hann window is some amplitude inaccuracy for sinusoidal signals (up to −1.5 dB), as compared to the flat top window. Its advantage is greater frequency resolution.

1. Narrow band
   correction factor = 1.5
   (area under square of line shape)
2. Amplitude accuracy
   uncertainty up to 1.5 dB
3. Normalized in frequency domain

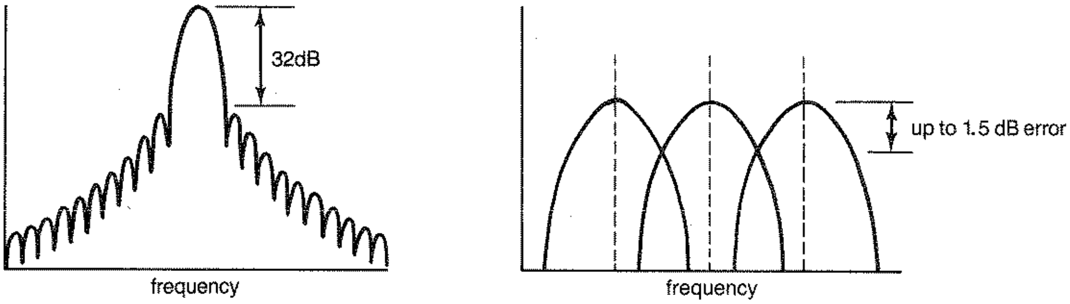


Figure 1-14 The Hann Window

The Flat Top Window

The flat top window compensates for the amplitude inaccuracy of the Hann with its slightly flatter shape, as shown in figure 1-15. The trade-off is the loss of some resolution due to its width.

1. Narrow band
   correction factor = 3.82
2. Amplitude accuracy
   uncertainty up to 0.1 dB
3. Normalized in frequency domain

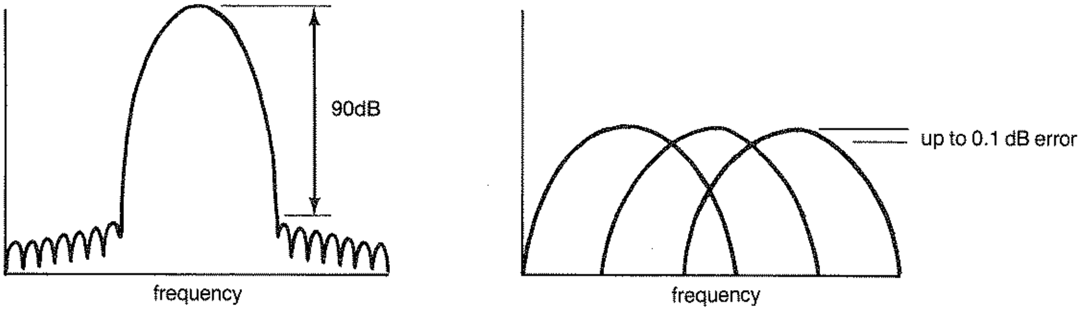


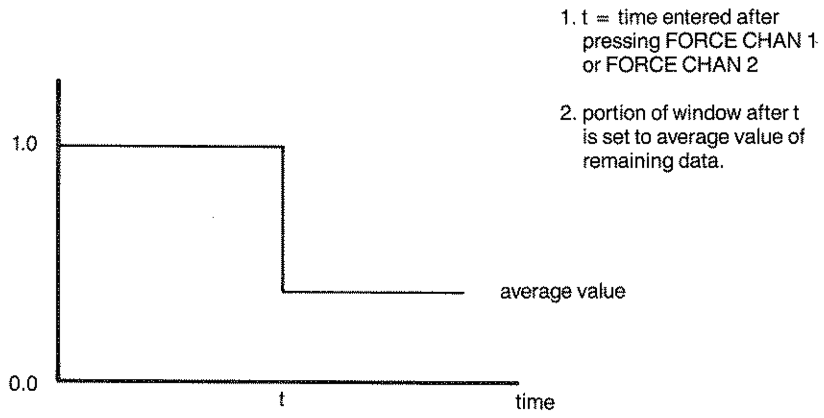
Figure 1-15 The Flat Top Window

The Uniform Window

The uniform window has a rectangular shape that weights all parts of the time record equally. Because it does not force the signal to appear periodic in the time record, it is normally used only with functions that are self-windowing, such as transients and bursts. The uniform window has amplitude accuracy uncertainty up to 3.9 dB.

The Force Window

The force window passes the first part of the time record and attenuates the last part, as shown in figure 1-16. The width you enter after pressing FORCE CHAN 1 or FORCE CHAN 2 determines how much of the signal is passed and how much is attenuated. Note that the width must be narrower than the time record for the force window to have any effect. The force window is helpful in impact testing because it removes stray oscillations in lightly damped systems.



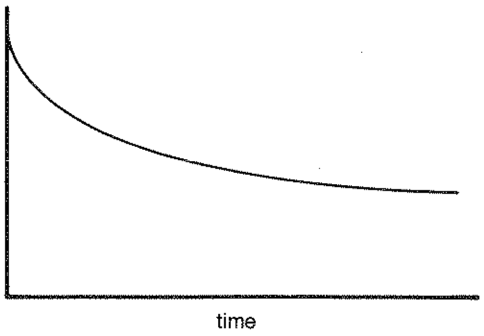
1. t = time entered after pressing FORCE CHAN 1 or FORCE CHAN 2
2. portion of window after t is set to average value of remaining data.

Figure 1-16 The Force Window

If you are using delayed trigger and you want to set the force window width using the markers, remember that the time record starts in negative time for pre-triggering. You may have to adjust the window width to allow for this.

The Exponential Window

The exponential window attenuates the input signal at a decaying exponential rate determined by the time constant you entered after pressing EXPON CHAN 1 or EXPON CHAN 2. The general shape of the exponential window is shown in figure 1-17.

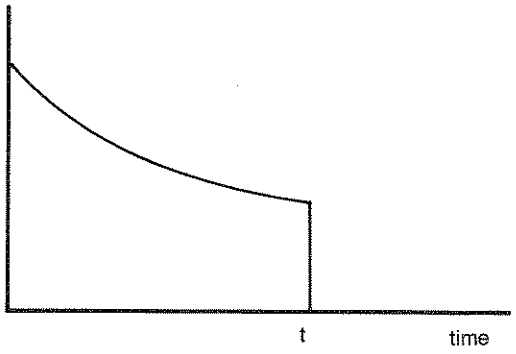


1. Calculation used to create window is $e^{-t/\tau}$

When τ = value entered after pressing EXPON CHAN 1 or EXPON CHAN 2 softkeys; t is time record length.

Figure 1-17 The Exponential Window

If you have selected a frequency response measurement with the force window on one channel and the exponential on the other, the channel with the force window selection is multiplied by both the force and the exponential window. Figure 1-18 shows the resulting function.



1. t determined by force window on channel 1.
2. decay determined by exponential window on channel 2.
3. the exponential window is still applied to the mean value level after the force window.

Figure 1-18 The Combined Force and Exponential Windows

The User-defined Window

Selecting USER SAVD 1 forces the HP 3562A to use the time waveform stored in the SAVE DATA #1 data block as the window. This feature allows you to apply your own waveform as a window. There are three ways to store a waveform in the SAVE DATA #1 memory block:

1. Measure a time waveform then store it using the **SAVE RECALL** menu. For information on this technique, please refer to "Saving and Recalling States and Traces" in Chapter 8.
2. Synthesize a frequency response curve, transform it to the time domain using FFT^{-1}, then store it using **SAVE RECALL.** Chapter 9 explains how to synthesize the frequency response, and Chapter 8 shows how to use the FFT^{-1} math function.
3. Create a waveform on an external controller and transmit it over the HP-IB. For information on this technique, please refer to the *HP 3562A Programming Manual.*

The user window is multiplied by the time record in the time domain. To normalize the window, use the X marker and the DIV math function.

Viewing Windowed Data

The HP 3562A allows you to view the effects of the force and exponential windows on time records. To do this, select either of these windows, select an averaging type then activate previewing (in the **AVG** menu). Next select the TIME REC 1 or 2 display in the FILTRD INPUT menu (under **MEAS DISP**). Press INST WNDOWD to view the windowed data or INST to view the data before the window is applied.

To adjust the exponential window, use INST to display the dotted line representing the window. When it is ready, press TIME REC 1 or 2 again, then press INST WNDOWD to show the effect of the window. Then press **YES** to accept the record. Be careful when making numeric entries while previewing: the **1** and **0** keys represent **YES** and **NO** if the analyzer is not specifically looking for a numeric entry.

AVERAGING IN THE LINEAR RESOLUTION MODE

Averaging improves the measurement and analysis of signals that are purely random or mixed random and periodic. Averaged measurements can yield either higher signal-to-noise ratios or improved statistical accuracy (see "Linear versus Power Spectrum Quantity Averaging" later in this section).

Both stable (often called rms) and exponential averaging are available in the linear resolution mode, as well as the peak hold and peak continuous functions. A comparison of these four functions and descriptions of all the averaging features are provided after the following discussion of the **AVG** menu.

Setting Up Averaging

To set up averaging, press **AVG** to display the following menu:

NUMBER AVGS	Allows you to set the number of averages, from 1 to 32 767, using the Entry group. The number of averages can also be entered immediately after **AVG** is pressed. This number is the weighting factor for exponential averaging, which is limited to 16 384.
AVG OFF	Turns off all averaging functions. If this is pressed while an averaged measurement is in progress, the measurement pauses. See "Measurements with Averaging Off" following this menu.
STABLE (MEAN)	Selects stable averaging.
EXPON	Selects exponential averaging.
PEAK HOLD	Selects the peak hold function.
CONT PEAK	Selects the continuous peak function.
TIM AV ON **OFF**	When pressed ON, time domain (linear) averaging is selected. When pressed OFF, powers spectrum quantity averaging is selected.
NEXT	Displays the next level of the **AVG** menu.

If a non-averaged measurement is in progress, selecting an averaging type starts the measurement. Pressing NEXT displays the next level of the menu:

OVLRP%	Allows you to set the overlap percentage from 0 to 90%, using the Entry group. The default is 0%.
OV REJ ON **OFF**	Selects automatic overload rejection.
FST AV ON **OFF**	Selects fast averaging.
PRVIEW **OFF**	Turns the preview functions off.
MANUAL PRVIEW	Selects manual previewing.
TIMED PRVIEW	Selects timed previewing; enter the preview delay in seconds using the Entry group.
RETURN	Redisplays the first level of the **AVG** menu.

Measurements with Averaging Off

When averaging is off (the AVG OFF softkey is active), the analyzer makes continual measurements with one average, erasing the result of each measurement. The overlap processing achieves the greatest possible overlap percentage, regardless of the percentage you may have entered. Overload rejection and previewing are ignored.

Why Four Averaging Functions?

Stable averaging weights old and new data records equally to yield the arithmetic mean for the number of averages selected. It displays the result of each intermediate average (if fast averaging is off) and stops the measurement after the selected number of averages have been calculated. Stable averaging is calculated with the following formula:

$$A_n = \frac{\Sigma D_n}{n}$$

where A_n = cumulative average
D_n = quantity*
n = number of averages

*quantity is time record when time averaging is on; power spectrum, frequency response or correlation when time averaging is off.

Exponential averaging weights new data more than old to maintain a moving average, rather than the cumulative result provided by stable averaging. It displays the result of each intermediate average (if fast averaging is off). Exponential averaging continues until the measurement is paused. The number of averages is still important with exponential averaging because the weighting of new versus old data is dependent on the number entered with NUMBER AVGS. As the number of averages increases, new time records are weighted less. Note also that exponential averaging selects the next highest power of two (e.g., 2, 4, 8, 16) as the exponential averaging constant. For example, if 25 averages are requested, the measurement uses 32 (2^5). Exponential averaging is calculated with the following formula:

$$A_n = (1 - 2^{-n})A_n + 2^{-n}D_n$$

where: A_n = cumulative average
D_n = time quantity*
n = number of averages

*quantity is time record when time averaging is on; power spectrum, frequency response or correlation when time averaging is off.

The analyzer uses stable averaging to acquire the first 2^n averages.

The peak hold function differs from stable and exponential averaging by showing the maximum values that occurred at each of the 801 display lines during the measurement period, rather than the average values. It stops after the selected number of measurements have been made. The peak hold function is applicable only to frequency domain measurements, with time averaging off.

The peak continuous function performs the same operation as peak hold except it continues indefinitely until paused by the user. The peak continuous function is also applicable only to frequency domain measurements, with time averaging off.

Selecting an averaging type depends on your input data and what you need to learn from the measurement. For example, exponential averaging may be selected to track a varying input signal because it weights new data more than old, while the peak continuous function could be used to monitor and record noise peaks or frequency drift.

If **PAUSE CONT** is pressed while the measurement is in progress, the measurement stops at the completion of the current average. If **PAUSE CONT** is pressed again, the measurement continues with the next average. If the measurement is restarted rather than continued, it begins with the first average.

Linear versus Power Spectrum Quantity Averaging

The HP 3562A offers both linear and power spectrum quantity averaging processes for stable and exponential averaging. For linear averaging (TM AVG ON), the averaged quantity is the time record. For power spectrum quantity averaging (TM AVG OFF), the averaged quantity is the power spectrum, frequency response or correlation, depending on the measurement. Table 1-3 summarizes the advantages and disadvantages of the two types.

Table 1-3 Linear versus Power Spectrum Function Averaging

Power Spectrum Quantity	**Linear**
Statistical spectral estimate (broadband noise)	No statistical spectral estimate (deterministic signals only)
Applicable to both pure random and mixed random/periodic signals	Signal must have periodic component
Does not improve S/N ratio	Improves S/N ratio (random components average to their mean values
Does not require a synchronized trigger	Requires a synchronized trigger in fixed relation to the signal

If you need to extract a small periodic signal (in the time domain) from noise but don't have a synchronous trigger, see "The Auto Correlation Measurement" earlier in this chapter.

Overlap Processing

As the frequency span you select decreases, the corresponding time record length increases. At some point, the time record length and the amount of time the analyzer needs to process each record are equal. If you continue to increase the record length, the FFT processor sits idle after processing the record while it waits for the next record to fill. However, overlap processing allows you to overlap time records and compute the FFT from old and new data.

This offers the advantages of a better statistical estimate with fewer averages, reducing the effects of windowing on statistical variance and providing faster measurements. For a detailed discussion of overlap processing and real time bandwidth, please refer to Hewlett-Packard Application Note 243. Copies can be obtained from your HP Sales Representative.

The HP 3562A allows overlap processing from 0 to 90% of the time record. The default at power-on and after reset is 0%. Overlap processing is applicable only to free run triggering (see "Setting Up Triggering" in Chapter 7). To make the selection, press **AVG,** followed by the NEXT softkey, followed by the OVRLP% softkey, then enter the percentage using the Entry group and the ENTER softkey. For unaveraged measurements, the analyzer measures at maximum possible overlap.

The percentage you enter is the maximum *potential* overlap. As the time record length is decreased, less and less overlap can be achieved. For example, if you enter an overlap of 50% and a frequency span of 2 kHz (400 ms record length), the analyzer can achieve 50% overlap. However, if you then change the span to 10 kHz (80 ms record length), the analyzer may achieve only 22% overlap. (These are example values only.)

Several instrument setup parameters affect potential overlap percentages, including fast averaging and display format. At a given span, the greatest overlap can be achieved with fast averaging on and the single display format. For any particular instrument state, read the top of the display to verify the achieved overlap percentage. In any case, the actual percentage is less than or equal to the selected percentage. Note that the percentage shown applies to the last two records only.

Overlap processing is easy to understand if you relate it to real time bandwidth (RTBW). The RTBW is the frequency span at which the FFT processing time equals the time record length, and all input data are included in the average. However, if you increase the span past the RTBW, the record length becomes shorter than the FFT processing time. Time records are no longer contiguous, and some input data is missed. Therefore, you can overlap records only when measuring below the RTBW, because the time record length must be longer than the FFT processing time to achieve any overlap.

Overload Rejection

If the magnitude of a signal exceeds the input range (see Chapter 7 under "Setting the Input Range"), the time record containing this signal distorts the measurement if it is included in the average. To avoid this, the HP 3562A can automatically reject any time records containing such data. To select overload rejection, press **AVG,** followed by the NEXT softkey, then press the OV REJ ON OFF softkey to ON. The message "Data Rejected" is displayed when a record is rejected. If records are rejected, the analyzer continues to measure and average until it collects the requested number of undistorted records.

Fast Averaging

Fast averaging causes the HP 3562A to measure and average as fast as possible without stopping to update the display every time an intermediate average is calculated. The display is not updated until the specified number of averages have been calculated. The message "Fast Averaging" is displayed in the lower right corner of the screen to advise that fast averaging is in effect. To select fast averaging, press **AVG,** followed by the NEXT softkey, then press the FST AV ON OFF softkey to ON. Fast averaging can be activated and deactivated during a measurement, allowing you to check the measurement's progress. Fast averaging can be used only with stable and peak hold averaging.

NOTE

Fast averaging must be enabled to ensure maximum real time bandwidths.

Previewing

Previewing gives you the option of approving each time record before it is included in the average. The HP 3562A offers both manual previewing, which pauses indefinitely until you answer with the **YES (1)** or **NO (0)** keys; and timed previewing, which pauses for a specified time then automatically includes each record if you do not reject it. To select previewing, press **AVG,** followed by the NEXT softkey. To select manual previewing, press the MANUAL PRVIEW softkey; to select timed previewing, press the TIMED PRVIEW softkey and enter the number of seconds you wish the instrument to pause while you decide on each record. Note that you must select an averaging type to use previewing (i.e., previewing cannot be used with unaveraged measurements).

VIEWING THE INPUT SIGNALS

The **VIEW INPUT** key allows you to look at the input signals before they are filtered or measured. Appendix E explains how these displays are derived and how they differ from measurement and filtered input displays. These displays can be viewed at any time, even if the measurement is completed or the instrument is waiting for a trigger. The input displays can be used to verify the presence of input signals or to compare an input signal with a measurement display. The view input displays are also helpful when manually setting the input range. To select these displays, press **VIEW INPUT** to display the following menu:

INPUT TIME1	Displays the time domain data on Channel 1.
INPUT TIME2	Displays the time domain data on Channel 2.
INPUT SPEC1	Displays the full-span frequency spectrum (FFT) of the Channel 1 time domain data.
INPUT SPEC2	Displays the full-span frequency spectrum (FFT) of the Channel 2 time domain data.
VIEW OFF	Disables updating of the view input displays.

These are instantaneous displays of the input signals; the data they show are not necessarily included in a measurement. The window used to compute linear spectra is labeled at the top of the trace.

Here are the steps to set up linear resolution measurements:

1. Select linear resolution mode: press **MEAS MODE** followed by LINEAR RES. (page 1-1)
2. Select measurement and active channel(s): use the **SELECT MEAS** menu. Displays can also be selected now in the **MEAS DISP** menu. (page 1-2)
3. Set the frequency span: use the **FREQ** menu. (page 1-20)
4. Set up the source: use the **SOURCE** menu. If necessary, set up source protection in the **SPCL FCTN** menu. (page 1-24)
5. Select a window: use the **WINDOW** menu. (page 1-27)
6. Set up averaging: use the **AVG** menu. (page 1-32)
7. View the input signals (if necessary): use the **VIEW INPUT** menu. (page 1-38)
8. Set up the inputs: refer to Chapter 7 for range, triggering, calibration, coupling and engineering units.
9. Start the measurement: press **START.** (The measurement will have been in progress already if averaging is off.)
10. Select other displays (if necessary): use the **MEAS DISP** menu. (page 1-2)
11. Use the display and marker features (if necessary): refer to Chapter 8 for instructions.

USING THE LOG RESOLUTION MODE

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you the details of using the HP 3562A's log resolution mode. For an introductory discussion of the uses of this mode, please refer to the User's Guide at the beginning of this manual.

This chapter shows you how to:

1. select measurements and displays
2. set frequency spans
3. set up the source
4. set up averaging
5. view the input signals

To keep track of where you are while setting up measurements, fold out the measurement setup checklist at the end of this chapter.

GETTING STARTED IN THE LOG RESOLUTION MODE

To put the HP 3562A in the log resolution mode, press **MEAS MODE.** When its menu appears, press LOG RES. No menu appears after you press this softkey, but the instrument configures itself to the log resolution mode.

Several differences between this mode and linear FFT measurements should be noted:

Frequency spans are limited to 1, 2, 3, 4 or 5 decades, and the resolution is always 80 lines/decade.

Log resolution uses a predefined windowing function for all measurements, so windows are not selectable.

Overall measurement time is determined by the time required to measure the lowest decade.

Triggering and time averaging are not applicable to log resolution. (Delayed triggering can be used when measuring throughput files from disc; see Chapter 6 for more information.)

Filtered time and filtered spectrum displays are not available.

The log resolution mode is optimized for wide-band frequency response measurements. The trade-off required is a loss of accuracy in power spectra of discrete frequencies.

HOW LOG RESOLUTION IS MEASURED

This section gives a brief overview of the log resolution measurement process. While it is not necessary to read this section, it is important to understand the measurement process when interpreting overlap processing and real time bandwidth in the log resolution mode.

To understand how the HP 3562A measures with log resolution, start with a one-decade example, at the 10 Hz to 100 Hz span. The analyzer's first step is to make an 801-point linear resolution measurement from 0 to 100 Hz. (This 0 Hz start frequency is important for multi-decade measurements.) It then takes the 720 points from 10 Hz to 100 Hz and combines these to produce 80 logarithmically-spaced lines for the decade. The number of linear points combined to produce one log point increases logarithmically from log line 1 to log line 80. The shape of the log resolution window varies from the beginning of the decade to the end; figure 2-1 shows a representative window.

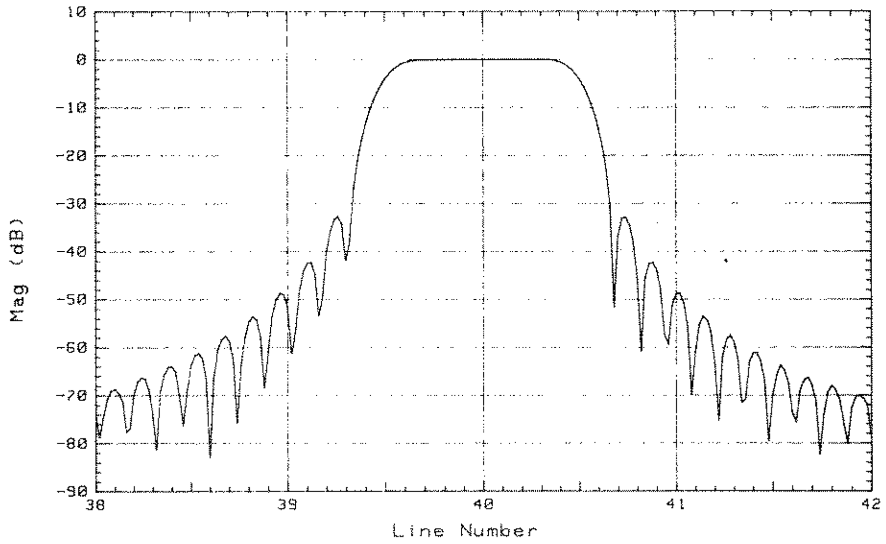


Figure 2-1 The Log Resolution Window

When we increase the span to perform multi-decade measurements, the log resolution mode measures decades in parallel. The analyzer's digital filter has two channels for each input channel: one side for real and another for imaginary. However, if our start frequency is 0 Hz, the data are all real and we have one side of the filter available for other tasks. (This explains why the initial linear resolution measurement always starts at 0 Hz.) Log resolution takes advantage of the available channel by sending the first decade through one side of the filter and all higher decades through the other side.

In a 3-decade measurement, for example, the first decade is measured on one side, and the second and third decades are measured on the other side. (This description applies to a single input channel; it is repeated on the other input channel if both Channel 1 and Channel 2 are active.) It is possible to measure more than one of the higher decades in parallel with the lowest decade because the lowest decade has the longest time record length, and several higher spans (having shorter time records) can be measured in less time than the lowest. Figure 2-2 illustrates this action on a 3-decade span from 10 Hz to 10 kHz.

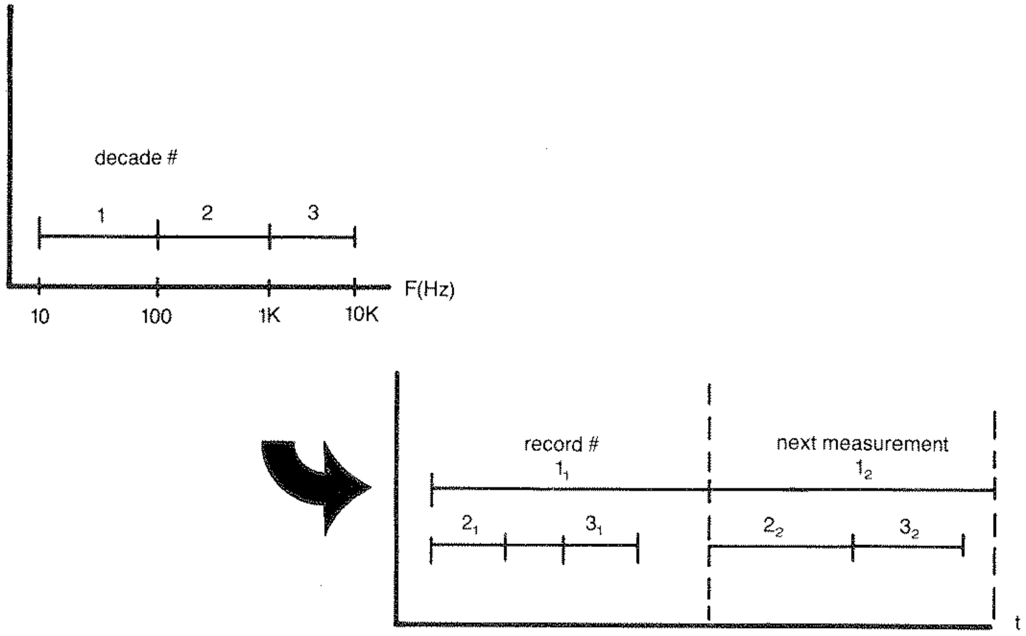


Figure 2-2 Log Resolution Parallel Processing

This parallel processing is important to understand when interpreting overlap processing and real time bandwidth (RTBW) in the log resolution mode. It is obvious from figure 2-2 that overlap processing in the usual sense can be achieved only on one-decade spans. You can still overlap in multi-decade measurements, but only the first decade is overlapped.

The same constraint applies to RTBW. In log resolution, only one-decade measurements can be made in real time. Referring to figure 2-2 again, any portion of the input signal above the first decade would be missed in the interval between the end of decade 3_1 and the beginning of decade 2_2. Furthermore, decade 2 is ignored while decade 3 is processed and vice versa.

Overlap processing and RTBW are discussed individually in "Frequency Spans in the Log Resolution Mode" later in this chapter.

SELECTING LOG RESOLUTION MEASUREMENTS

To select measurements in the log resolution mode, press **SELECT MEAS** to display the following softkey menu:

FREQ RESP	Selects the frequency response measurement.
POWER SPEC	Selects the power spectrum measurement.
CH 1&2 ACTIVE	Activates both channels.
CH 1 ACTIVE	Activates Channel 1.
CH 2 ACTIVE	Activates Channel 2.

First choose the measurement, then the active channel(s). For example, to measure a power spectrum on Channel 1, press POWER SPEC, then CH 1 ACTIVE. Keep in mind that for averaged measurements these two selections must be made before the measurement is started. If you want to change either selection, the measurement must be restarted. The dual-channel FREQ RESP measurement automatically selects CH 1&2 ACTIVE.

The next two sections of this chapter discuss these two measurements and their associated displays. Each measurement offers additional displays derived from the measured data. Displays can be selected before, during or after measurements.

THE FREQUENCY RESPONSE MEASUREMENT

The frequency response measurement, often called the "transfer function," is the ratio of a system's output to its input and provides both magnitude and phase information as a function of frequency. (The phase response can be viewed by pressing PHASE in the **COORD** menu.) In the HP 3562A, the signal on Channel 1 is assumed to be the system's input, and signal on Channel 2 is assumed to be its output. To select the frequency response measurement, press **SELECT MEAS** followed by the FREQ RESP softkey.

To select a display for this measurement, press **MEAS DISP** to display the following menu:

FREQ RESP	Displays the frequency response. When default and coordinates are active, this displays frequency on the X-axis and gain on the Y-axis.
COHER	Calculates and displays the coherence of the frequency response measurement.
POWER SPEC1	Displays the power spectrum measured on Channel 1.
POWER SPEC2	Displays the power spectrum measured on Channel 2.
CROSS SPEC	Displays the cross spectrum.
AUTO MATH	Displays the trace calculated with the auto math table; see "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.

The following accuracy specifications apply to log resolution fequency response measurements:

Amplitude:	± 0.2 dB
Phase:	± 0.5 degrees

The Frequency Response Display

Frequency response in the HP 3562A is calculated as the ratio of the cross spectrum to the Channel 1 power spectrum:

$$H(f) = \frac{G_{xy}}{G_{xx}}$$

where: G_{xy} is the cross spectrum
G_{xx} is the Channel 1 power spectrum

Figure 2-3 shows the response of a filter as characterized with the frequency response display. This example used the default coordinates and units; refer to Chapter 8 for information on selecting other coordinates or units for the display. To select this display, press **MEAS DISP,** followed by the FREQ RESP softkey.

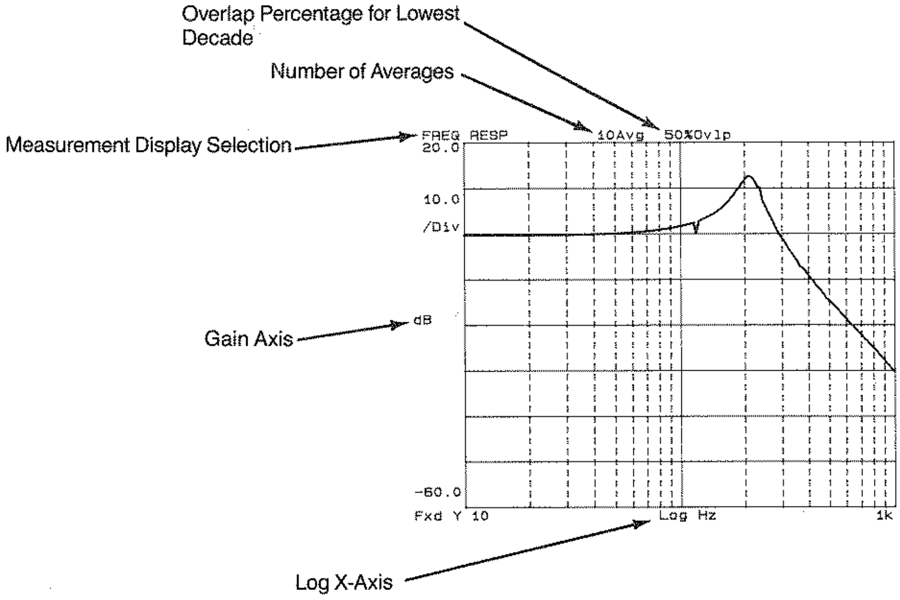


Figure 2-3 The Frequency Response Display

The Coherence Display

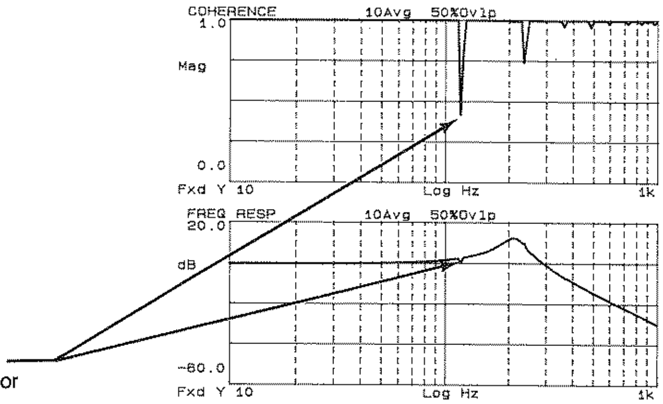
Coherence shows the portion of the output power spectrum related to the input spectrum, according to the following formula:

$$\gamma^2 = \frac{G_{xy}G_{xy}^{\;*}}{G_{xx}G_{yy}}$$

where: G_{xy} is the cross spectrum
$G_{xy}{}^{*}$ is its complex conjugate
G_{xx} is the Channel 1 power spectrum
G_{yy} is the Channel 2 power spectrum

It is an indication of the statistical validity of a frequency response measurement. Coherence is measured on a scale of 0.0 to 1.0, where 1.0 indicates perfect coherence. Coherence values less than unity are caused by system nonlinearities, extraneous noise and uncorrelated inputs. Because coherence is normalized, it is independent of the shape of the frequency response function. To select this display, press **MEAS DISP,** followed by the COHER softkey.

Figure 2-4 shows the coherence of the frequency response function shown in figure 2-3.



Uncorrelated Noise Injected into Measurement Showed Up as Poor Coherence

Figure 2-4 The Coherence Function Display

The Power Spectrum Display

This display shows the power spectrum of the input signal. The power spectrum is the FFT of the input signal multiplied by its complex conjugate. For an example of this display, please refer to figure 2-6. To select this display, press **MEAS DISP,** followed by the POWER SPEC1 or POWER SPEC2 softkeys.

The power spectrum displays are offered here as a convenient means of viewing the spectra after taking a frequency response measurement. If you want only the power spectrum magnitude display, the power spectrum measurement is faster; see "The Power Spectrum Measurement" later in this chapter.

The Cross Spectrum Display

This display is computed by multiplying the complex conjugate of the spectrum on Channel 1 by the spectrum on Channel 2:

$$G_{yx} = (F_y)(F_x{}^*)$$

where: $F_x{}^*$ is the Channel 1 linear spectrum's complex conjugate
F_y is the Channel 2 linear spectrum

The cross spectrum shows the amplitude product of the two spectra and the phase difference between them. To select this display, press **MEAS DISP,** followed by the CROSS SPEC softkey. Figure 2-5 shows an example of the cross spectrum display.

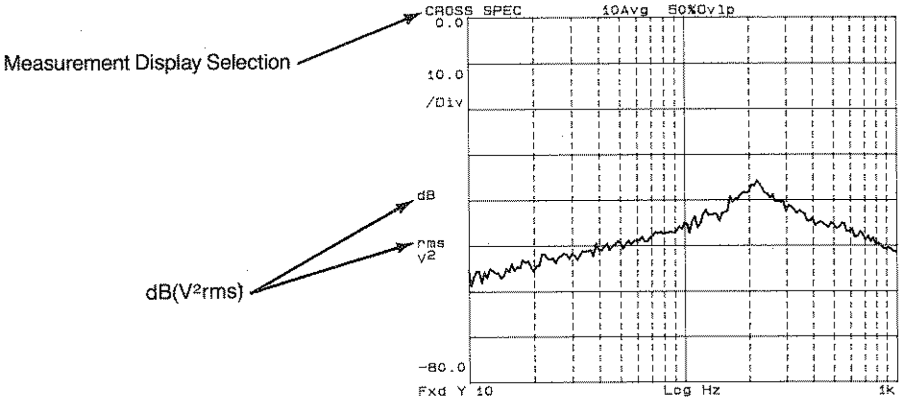


Figure 2-5 The Cross Spectrum Display

THE POWER SPECTRUM MEASUREMENT

The power spectrum measurement shows the input signal in the frequency domain. It is computed by multiplying the FFT of the signal by its complex conjugate:

$$G_{xx} = F_xF_x{}^*$$

where: F_x is the linear spectrum
$F_x{}^*$ is its complex conjugate

This measurement is provided in addition to the frequency response measurement because the power spectrum does not require the cross spectrum calculation and is therefore faster. To select the power spectrum measurement, press **SELECT MEAS,** followed by the POWER SPEC softkey.

To select a display for this measurement, press **MEAS DISP** to display the following menu:

POWER SPEC1	Displays the power spectrum measured on Channel 1. (This softkey appears if Channel 1 is active.)
POWER SPEC2	Displays the power spectrum measured on channel 2. (This softkey appears if Channel 2 is active.)
AUTO MATH	Displays the trace calculated with the auto math table; see "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.

Several accuracy specifications apply to log resolution power spectrum measurements. The initial measurement accuracy is +0, −0.2 dB. Added to this are the Hann window used in the next stage of the measurement, which has amplitude errors up to +0, −1.5 dB, and the process used to combine linear resolution lines can contribute up to +0, −1.76 dB error. Next, the adjustment needed to compensate for the fact that the discrete frequency lines do not always coincide with ideal log bandwidths can contribute up to +1.72, −2.30 dB. The maximum overall potential error is +1.72, −5.76 dB.

These specifications apply only to log resolution power spectrum measurements. This error in the power spectrum measurement occurs because the log resolution mode is optimized for broadband frequency response measurements. The log resolution frequency response measurement has amplitude accuracy to ±0.2 dB and phase accuracy to ±0.5 degrees. If you need to measure power spectra accurately, use the linear resolution mode.

The Power Spectrum Display

The power spectrum display is selected by pressing **MEAS DISP,** followed by the POWER SPEC1 or POWER SPEC2 softkeys. Figure 2-6 shows an example of the power spectrum measurement and display.

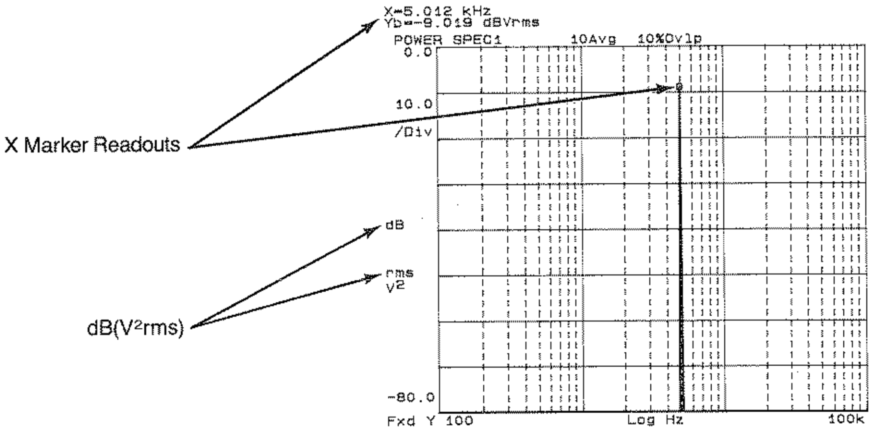


Figure 2-6 The Power Spectrum Display

FREQUENCY SPANS IN THE LOG RESOLUTION MODE

The log resolution mode offers 50 frequency spans covering the range of 0.1 Hz to 100 kHz. The width of the frequency span is entered as an integer number of decades from one to five. The span's location in the frequency spectrum is determined by the start and stop frequencies.

Setting the Frequency Span

Pressing **FREQ** displays the following menu:

FREQ SPAN	Allows you to set the frequency span, from 1 to 5 decades, using the Entry group. You can also enter the span immediately after pressing **FREQ.**
START FREQ	Allows you to set the start frequency, from 0.1 Hz to 10 kHz, using the Entry group.

Table 2-1 Frequency Spans in the Log Resolution Mode

Span (in decades)	1	2	3	4	5
Start Frequencies	**Stop Frequencies**				
0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz
0.2 Hz	2 Hz	20 Hz	200 Hz	2 kHz	20 kHz
0.5 Hz	5 Hz	50 Hz	500 Hz	5 kHz	50 kHz
1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz
2 Hz	20 Hz	200 Hz	2 kHz	20 kHz	—
5 Hz	50 Hz	500 Hz	5 kHz	50 kHz	—
10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	—
20 Hz	200 Hz	2 kHz	20 kHz	—	—
50 Hz	500 Hz	5 kHz	50 kHz	—	—
100 Hz	1 kHz	10 kHz	100 kHz	—	—
200 Hz	2 kHz	20 kHz	—	—	—
500 Hz	5 kHz	50 kHz	—	—	—
1 kHz	10 kHz	100 kHz	—	—	—
2 kHz	20 kHz	—	—	—	—
5 kHz	50 kHz	—	—	—	—
10 kHz	100 kHz	—	—	—	—

Real Time Bandwidth

The real time bandwidth (RTBW) is the maximum frequency span you can measure without missing input data. At spans greater than the RTBW, the instrument's processing time exceeds its data collection time and part of input signal is ignored while the previous time record is processed. When measuring periodic signals, the RTBW is not important because any data lost in one record will be repeated in the next record. However, RTBW is very important when measuring nondeterministic signals. In the log resolution mode, only one-decade measurements can be made in real time. To achieve the greatest possible RTBW, activate fast averaging (in the **AVG** menu) and select the single display format (the **SINGLE** key). The message "Real Time" is displayed at the end of the measurement if there were no gaps in the data.

NOTE

The HP 3562A double-buffers the input signals, so 1- and 2-average measurements are always in real time.

THE SOURCE OUTPUT IN THE LOG RESOLUTION MODE

The source is used to stimulate devices under test. The HP 3562A offers two source outputs in the log resolution mode: random noise and fixed sine. Because the noise source is band-limited (at spans ≥ 160 mHz), the power remains constant with respect to the frequency span selected and out-of-band excitation is minimized.

Selecting a Source Output

Pressing **SOURCE** displays the following menu:

SOURCE LEVEL	Allows you to set the amplitude level of the source Use the Entry group to set the level between − 5V and + 5V. Note that the combined ac plus dc level is limited to ± 10V. The default level is 0V.
DC OFFSET	Allows you to add a positive or negative offset constant to the source output signal. The offset is limited to 10V minus the source level; the combined ac and dc level is limited to 10V.
SOURCE OFF	Turns the source output off. If source protection is on, the source ramps off gradually. See "Source Protection" following this menu.
RANDOM NOISE	Selects the random noise output; this is the default selection at power-on and after resetting.
FIXED SINE	Selects the fixed sine output and allows you to enter the frequency from 64 μHz to 100 kHz; the default is 125 Hz.

Why Two Different Source Outputs

Random noise supplies true random noise at the selected level across the selected frequency range. Random noise is often used to obtain a fast estimate of a system's frequency response at the current operating point. Random noise does not characterize nonlinearities because the device under test is excited differently each measurement, so averaging over a number of time records tends to reduce the effects of nonlinear distortion in the measurement. Note that entering a source level in volts peak sets the maximum noise peak that is likely to occur.

Fixed sine supplies a constant frequency sine wave at the specified source level. A fixed sine output is used to excite a device under test at a single frequency.

Selection of a source output depends on the nature of the device under test, time versus accuracy trade-offs, and your measurement objectives. For example, if you want a fast measurement covering the entire frequency range of the network simultaneously, random noise should be used. If you want an accurate response measurement at one particular frequency, fixed sine should be used. In general, select the source stimulus that most nearly approximates the device's normal input.

Source Protection

Switching source types or changing the output level can potentially damage devices under test. To help you avoid this, the HP 3562A offers source protection. Protection causes the source to ramp from its current level to the desired level, rather than changing instantaneously. When active, ramping occurs whenever the source level is changed or its effective output power can potentially change: if the source is turned on or off or the measurement mode, source output type, frequency span, source level, or dc offset is changed.

To activate source protection, press the **SPCL FCTN** key followed by the SOURCE PROTCT softkey to display the following menu:

PROTCT ON **OFF**	Activates source protection.
RAMP TIME	Allows you to enter the ramp time for the source to turn off or change levels. Ramp time is stored in nonvolatile memory and is not affected by power-down or reset.
RETURN	Redisplays the **SPCL FCTN** menu.

The state of PROTCT ON OFF and the value of RAMP TIME are not affected by reset or power-down.

When you change source types with protection activated, you must reenter the source level. This extra step, together with the ramp time, prevents you from supplying an unexpected excitation to a device under test. Note that changing the source level or dc offset with the Entry knob defeats source protection.

AVERAGING IN THE LOG RESOLUTION MODE

Averaging improves the measurement and analysis of signals that are purely random or mixed random and periodic. Both stable (often called rms) and exponential averaging are available in the log resolution mode, as well as the peak hold and peak continuous functions. A comparison of these four functions and descriptions of all the averaging features are provided after the following discussion of the **AVG** menu.

Setting Up Averaging

To set up averaging, press **AVG**, which displays the following menu:

NUMBER AVGS	Allows you set the number of averages you want, from 1 to 32 767, using the Entry group. The number of averages can also be entered immediately after **AVG** is pressed.
AVG OFF	Turns off all averaging functions. If this is prssed while an averaged measurement is in progress, the measurement pauses.
STABLE (MEAN)	Selects stable averaging.
EXPON	Selects exponential averaging.
PEAK HOLD	Selects the peak hold function.
CONT PEAK	Selects the continuous peak function.
NEXT	Displays the next level of the **AVG** menu.

Selecting an averaging type starts the measurement.

Pressing NEXT in the **AVG** menu displays the next level of the menu:

OVLRP%	Allows you to set the overlap percentage from 0 to 90%, using the Entry group. The default is 0%.
OV REJ ON **OFF**	Selects automatic overload rejection.
FST AV ON **OFF**	Selects fast averaging.
RETURN	Redisplays the first level of the **AVG** menu.

Measurements with Averaging Off

When averaging is off (the AVG OFF softkey is active), the analyzer makes continual measurements with one average, erasing the previous display. The overlap processing achieves the greatest possible overlap percentage, regardless of the percentage you may have entered. Overload rejection is ignored when averaging is off.

Why Four Averaging Functions?

Stable averaging weights old and new data records equally to yield the arithmetic mean for the number of averages selected. It displays the result of each intermediate average (if fast averaging is off) and stops the measurement after the selected number of averages have been calculated. Stable averaging is calculated with the following formula:

$$A_n = \frac{\Sigma D_n}{n}$$

where A_n = cumulative average
D_n = current quantity
n = number of averages

Exponential averaging weights new data more than old to maintain a moving average, rather than the cumulative result provided by stable averaging. It displays the result of each intermediate average (if fast averaging is off). Exponential averaging continues until 32 767 averages have been taken or the measurement is paused. The number of averages is still important with exponential averaging because the weighting of new versus old data is dependent on the number entered with NUMBER AVGS. As the number of averages increases, new time records are weighted less. Note also that exponential averages selects the next highest power of two (2, 4, 8, 16 etc.) as the number of averages. For example, if 25 averages are requested, the measurement uses 32 (2^5). Exponential averaging is calculated with the following formula:

$$A_n = (1 - 2^{-n})A_n + 2^{-n}D_n$$

where: A_n = cumulative average
D_n = current quantity
n = number of averages

The peak hold function differs from stable and exponential averaging by showing the maximum values that occurred at each of the display lines during the measurement period, rather than the average values. It stops after the selected number of measurements have been made.

The peak continuous function performs the same operation as peak hold except it continues indefinitely until paused by the user.

Selecting an averaging type depends on your input data and what you need to learn from the measurement. For example, exponential averaging may be selected to track a varying input signal because it weights new data more than old, while the peak continuous function could be used to monitor and record noise peaks or frequency drift.

If **PAUSE CONT** is pressed while the measurement is in progress, the measurement stops at the completion of the current average. If **PAUSE CONT** is pressed again, the measurement continues with the next average. If the measurement is restarted rather than continued, it begins with the first average.

Overlap Processing

Overlap processing analyzes data in segments containing part old data and part new data. It offers the advantage of a better statistical estimate with fewer averages by reducing the effects of windowing and leakage. The HP 3562A allows overlap processing from 0 to 90% of the time record. The default at power-on and after presetting is 0%. In the log resolution mode, overlap processing applies only to the lowest decade in multiple-decade measurements. To select overlap processing, press **AVG,** followed by the NEXT softkey, followed by the OVRLP% softkey, then enter the percentage using the Entry group and the ENTER softkey. For unaveraged measurements, the analyzer measures at the maximum possible overlap.

In some cases, the analyzer cannot achieve requested overlap percentages (this is a function of time record length). The actual percentage achieved is displayed at the completion of each average. In any case, the actual percentage is less than or equal to the selected percentage.

NOTE

For a detailed discussion of overlap processing and real time bandwidth, please refer to Hewlett-Packard Application Note 243. Copies may be obtained from your HP Sales Representative.

Overload Rejection

If the magnitude of a signal exceeds the input range (see Chapter 7 under "Setting the Input Range"), the time record containing this signal will distort the measurement if it is included in the average. To avoid this, the HP 3562A can automatically reject any time records containing such data. To select overload rejection, press **AVG,** followed by the NEXT softkey, then press the OV REJ softkey to ON. The message "Data Rejected" is displayed when a record is rejected. If records are rejected, the analyzer continues to measure and average until it collects the requested number of undistorted records.

Fast Averaging

Fast averaging causes the HP 3562A to measure and average as fast as possible without stopping to update the display every time an intermediate average is calculated. The display is not updated until the specified number of averages have been calculated; the message "Fast Averaging" is displayed in the lower right corner of the screen to advise that fast averaging is in effect. To activate fast averaging, press **AVG,** followed by the NEXT softkey, then press the FST AV softkey to ON. Fast averaging can be activated and deactivated during a measurement, allowing you to check the measurement's progress.

NOTE

Fast averaging must be enabled to ensure maximum real time bandwidths.

VIEWING THE INPUT SIGNALS

The **VIEW INPUT** key allows you to look at the input signals before they are filtered or measured. These displays can be viewed at any time, even when the measurement is in progress. The input displays can be used to verify the presence of input signals or to compare an input signal with a measurement display. The view input displays are also helpful when manually setting the input range. To select these displays, press **VIEW INPUT** to display the following menu:

INPUT TIME1	Displays the time domain data on Channel 1.
INPUT TIME2	Displays the time domain data on Channel 2.
INPUT SPEC1	Displays the full-span frequency spectrum (FFT) of the Channel 1 time domain data.
INPUT SPEC2	Displays the full-span freuency spectrum (FFT) of the Channel 2 time domain data.
VIEW OFF	Disables updating of the view input displays.

If you are unable to obtain a measurement display, it is helpful to select the input time displays to see if a signal is actually reaching the instrument. In the log resolution mode, the input spectrum displays show the full-bandwidth signals transformed to the frequency domain with the FFT using the Hann window. Note that these are displayed in linear resolution.

Here are the steps to set up log resolution measurements:

1. Select log resolution mode: press **MEAS MODE** followed by LOG RES. (page 2-1)
2. Select measurement and active channel(s): use the **SELECT MEAS** menu. Displays can also be selected now in the **MEAS DISP** menu. (page 2-2)
3. Set the frequency span: use the **FREQ** menu. (page 2-11)
4. Set up the source: use the **SOURCE** menu. If necessary, set up source protection in the **SPCL FCTN** menu. (page 2-14)
5. Set up averaging: use the **AVG** menu. (page 2-16)
6. View the input signals (if necessary): use the **VIEW INPUT** menu. (page 2-20)
7. Set up the inputs: refer to Chapter 7 for range, calibration, coupling and engineering units.
8. Start the measurement: press **START.** (The measurement will have been in progress already if averaging is off.)
9. Select other displays (if necessary): use the **MEAS DISP** menu. (page 2-2)
10. Use the display and marker features (if necessary): refer to Chapter 8 for instructions.

Chapter 3

USING THE SWEPT SINE MODE

PURPOSE OF THIS CHAPTER

This chapter shows you the details of using the HP 3562A's swept sine mode. In this mode, the analyzer outputs a sine wave which is stepped across the frequency span. You can set the number of steps, or measurement points, by specifying the sweep resolution. Because the sweep is phase-continuous, the measurement accurately characterizes phase response. For an introductory discussion of swept sine, please refer to the User's Guide at the beginning of this manual.

This chapter shows you how to:

1. set up the swept sine receiver
2. set the frequency span and resolution
3. set up the swept sine source
4. set up averaging and integration
5. use the four automatic features in swept sine
6. select measurement displays
7. view the input signals

To keep track of where you are while setting up measurements, fold out the measurement setup checklist at the end of this chapter.

GETTING STARTED IN THE SWEPT SINE MODE

To put the HP 3562A in the swept sine mode, press **MEAS MODE** then SWEPT SINE. This selects the swept sine mode and displays the menu used to set up the swept sine receiver, as explained in the next section.

SETTING UP THE SWEPT SINE RECEIVER

The swept sine receiver measures the output of the system under test and compares it to the input applied by the source. To set up the receiver, press SWEPT SINE in the **MEAS MODE** menu. This displays additional softkeys at the bottom of the **MEAS MODE** menu:

LINEAR SWEEP	Selects a linear sweep. See "Linear and Log Sweeps" following this menu.
LOG SWEEP	Selects a logarithmic sweep.
A GAIN ON **OFF**	Activates auto gain; see "Auto Gain" following this menu. This also displays the A GAIN SELECT softkey.
A GAIN SELECT	Displays the auto gain functions menu; see "Auto Gain" following this menu. (This softkey appears only when A GAIN ON OFF is ON.)

Linear and Log Sweeps

The choice between LINEAR SWEEP and LOG SWEEP must be made before the measurement is started. (Any time you press the yellow **START** key the sweep starts again.) If a trace is originally measured or synthesized with linear resolution then converted to a log scale using the LOG X coordinates, points in the resultant trace will not be distributed proportionately. To achieve true log distribution, the original trace must have log resolution. The reverse is true for converting log traces to linear scale using the LIN X coordinate. See "Selecting Display Coordinates" in Chapter 8 for more information on the LOG X and LIN X coordinates. Note that the sweep rate and resolution values are converted to linear or log values (i.e., Hertz or octaves/decades) when the sweep type is changed.

Auto Gain

CAUTION

The HP 3562A's auto gain feature is designed to exclude distorted data from the measurement. Because it sweeps past each point before determining whether the source level is appropriate, it may not protect the system under test from damage caused by excessive signal levels. Use extreme caution when exciting systems with potentially high output levels.

The auto gain feature causes the HP 3562A to vary the source level in order to maintain a constant amplitude on one of the input channels. You can select either Channel 1 or Channel 2 as the reference. In addition, you can specify the reference level for the selected channel. Figure 3-1 shows the operation of the auto gain feature.

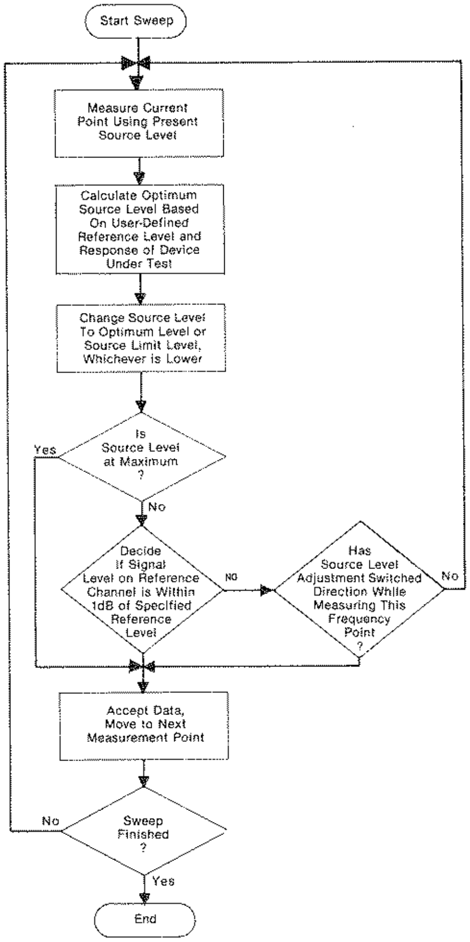


Figure 3-1 Auto Gain

Press A GAIN ON OFF to ON to display the A GAIN SELECT softkey. Pressing A GAIN SELECT displays the following menu:

REF <u>CHAN 1</u>	Selects Channel 1 as the reference channel; see "The Reference Channel" following this menu.
REF CHAN 2	Selects Channel 2 as the reference channel; see "The Reference Channel" following this menu.
REF LEVEL	Used to enter the reference level for the reference channel; see "The Reference Channel" following this menu.
SOURCE LIMIT	Used to enter the source limit value; see "Limiting the Source Output" following this menu.
RETURN	Redisplays the **MEAS MODE** menu.

The Reference Channel When auto gain is active, the HP 3562A adjusts the level of the swept sine source output to maintain the specified reference level (entered with REF LEVEL). By selecting Channel 1 as the reference, a constant input signal level can be maintained to the system under test. By selecting Channel 2 as the reference, a constant signal level can be maintained at the output of the system under test. The reference level can be set from 5 mV to 31.5 Vpk.

Limiting the Source Output Because auto gain can adjust the source output level to maintain the reference level, it is sometimes necessary to place a limit on the source level. This may be needed to limit input levels (to prevent damage to the system under test) or output levels (to prevent distortion caused by overloading the HP 3562A's inputs). The source can be limited from 5 mV to 5V; the default value is 5 mV. (The source level changes in 5 mV increments.)

FREQUENCY SPANS IN THE SWEPT SINE MODE

The HP 3562A's frequency span in the swept sine mode ranges from 64 µHz to 100 kHz. Unlike the other three measurement modes, there are no preset spans in swept sine. Pressing **FREQ** displays the following menu:

FREQ SPAN	Used to enter the frequency span, using the Entry group. You can also enter the span immediately after pressing **FREQ.**
START FREQ	Used to enter the start frequency, not less than 64 µHz, using the Entry group. Note that the start frequency cannot be specified higher than stop frequency.
CENTER FREQ	Used to enter the center frequency, using the Entry group.
STOP FREQ	Used to enter the stop frequency, not greater than 100 kHz, using the Entry group. Note that the stop frequency cannot be specified lower than the start frequency.
RESLTN	Used to set the sweep resolution; see "Sweep Rates and Resolution" following this menu.
RESLTN AU **FIX**	Selects auto or fixed resolution; see "Sweep Rates and Resolution" following this menu.
SWEEP RATE	Used to set the sweep rate. This softkey is duplicated in the **SOURCE** menu so that you can change the sweep rate while the sweep is in progress. See "Sweep Rates and Resolution" following this menu.

The frequency softkeys are easy to use if you treat start/stop and span/center as separate pairs. Specify the frequency by entering start and stop frequencies or by entering center frequency and span. Note that these four softkeys are interrelated; changing one may affect some or all of the others.

To simplify frequency entries, you can press FREQ SPAN, START FREQ, CENTER FREQ or STOP FREQ then enter the start and stop frequencies separated by a comma. For example, to set up span from 100 Hz to 200 Hz, you can press FREQ SPAN followed by 100, 200 Hz.

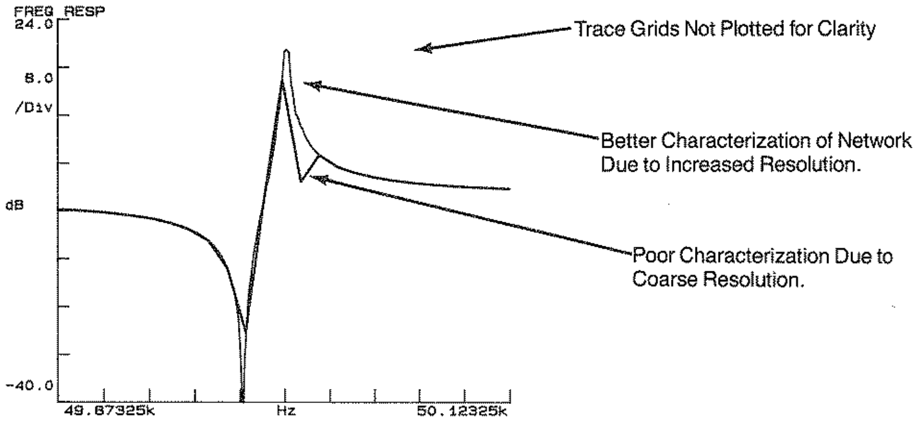
Sweep Rates and Resolution

The sweep rate determines the speed at which the measurement sweeps across the given frequency span. The resolution defines the distance between measurement points in the frequency domain. The rate and the resolution are inversely proportional, resulting in a trade-off between measurement time and resolution. Consequently, fast measurements risk losing data that fall between measurement points. Note that defining resolution in Hz/point or in points/sweep are two ways of accomplishing the same result. For example, a frequency span of 500 Hz with 100 points/sweep yields 5 Hz/point. Table 3-1 shows the available resolution settings.

Table 3-1 Resolution Settings in Swept Sine Mode (points/sweep)

10	100	4000	10400
16	160	4800	11200
20	200	5600	12000
25	400	6400	12800
32	800	7200	13600
40	1600	8000	14400
50	2400	8800	15200
80	3200	9600	16000

Figure 3-2 shows a band-pass filter measured with 1 Hz/point resolution and again with 10 Hz/point resolution. Note the differences in the traces and sweep times. The overall sweep time, as indicated in the instrument state display, is equal to the span divided by the sweep rate.



Trace Grids Not Plotted for Clarity

Better Characterization of Network Due to Increased Resolution.

Poor Characterization Due to Coarse Resolution.

Figure 3-2 Effect of Changing the Resolution

The SWEEP RATE softkey in the **SOURCE** menu is identical to the one in this menu. It is repeated because the **SOURCE** menu is generally used while the measurement is in progress, giving you the option of changing the sweep rate (and, indirectly, the resolution) during the sweep.

Auto Resolution

Auto resolution, selected by pressing RESLTN AU FIX to AU, causes the HP 3562A to increase the resolution during rapidly changing portions of the measurement. This reduces the possibility of skipping over a narrow resonance, for example, without slowing the overall measurement with a resolution not required for the entire sweep. Figure 3-3 explains the operation of the auto resolution feature. The minimum resolution is set with the RESLTN softkey.

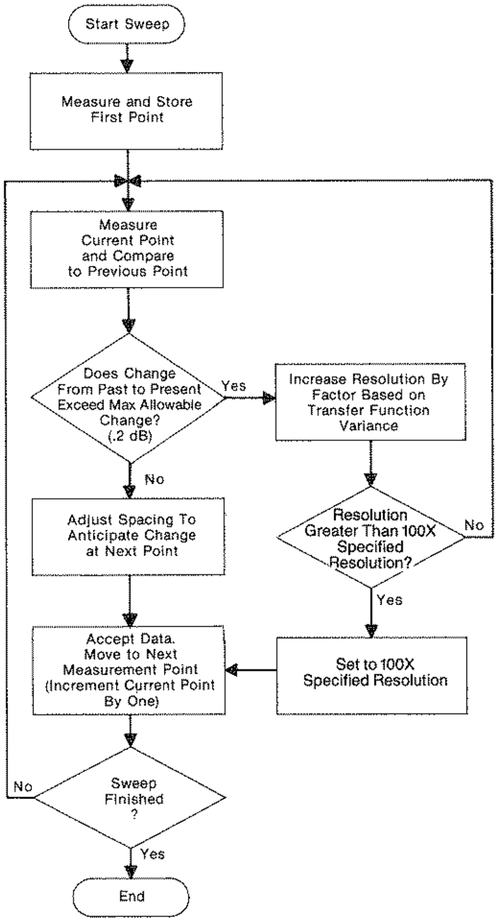


Figure 3-3 Auto Resolution

SETTING UP THE SWEPT SINE SOURCE

The source menu controls the level and direction of the sweep. Any of the source parameters may be changed while the sweep is in progress. You can change the sweep rate or direction, put the sweep on hold, or use manual sweep without degrading the quality of the measurement. (Changing the source level or dc offset may degrade the measurement, however.) Pressing **SOURCE** displays the following menu:

SOURCE LEVEL	Used to enter the amplitude level of the source. Use the Entry group to set the level between −5V and +5V.
DC OFFSET	Allows you to add a positive or negative dc offset to the source output. The offset is limited to 10 volts minus the source level; the combined ac and dc level is limited to ±10 volts.
SOURCE **ON** OFF	Disables the source output. If source protection is on, the source ramps off gradually. See "Source Protection" following this menu.
SWEEP UP	Causes the measurement to sweep up in frequency, from the current sweep position to the specified stop frequency.
SWEEP DOWN	Causes the measurement to sweep down in frequency, from the current sweep position to the specified stop frequency.
SWEEP HOLD	Stops the sweep at the current measurement point. The instrument continues to measure and display the measured value, but the sweep does not continue until SWEEP UP or SWEEP DOWN is pressed. See "Sweep Hold versus Manual Sweep" following this menu.
MANUAL SWEEP	Allows you to move the measurement point with the Entry group knob. The instrument then measures at the point you selected. See "Sweep Hold versus Manual Sweep" following this menu.
SWEEP RATE	Allows you to set the sweep rate. This softkey is identical to SWEEP RATE in the **FREQ** menu and is duplicated here because this is the menu normally active while the sweep is in progress. Changing the sweep rate also changes the resolution; see "Sweep Rates and Resolution" earlier in this chapter for more information.

Sweep Hold versus Manual Sweep

The sweep hold feature allows you to pause the sweep at any point while continuing to measure the input signals. It measures the signal at the given point, calculates the specified number of averages, then takes a new measurement at the same point. This cycle continues indefinitely. Keep in mind that sweep hold does not accumulate averaged data; each measurement is replaced when the next measurement is completed.

The manual sweep feature allows you to move the sweep point using the arrow keys or the knob in the Entry group. Manual sweep also provides much higher resolution than sweep hold. Contrary to sweep hold, manual sweep does accumulate measurement data in one continuous average. You can also enter a measurement frequency for manual sweep directly using the **0-9** keys.

Source Protection

Switching source types or changing the output level can potentially damage devices under test. To help you avoid this, the HP 3562A offers source protection. Protection causes the source to ramp from its current level to the desired level, rather than changing instantaneously. When active, ramping occurs whenever the source level is changed or its effective output power can potentially change: if the source is turned on or off or the measurement mode, source output type, frequency span, source level, or dc offset is changed.

To activate source protection, press the **SPCL FCTN** key followed by the SOURCE PROTCT softkey to display the following menu:

PROTCT ON **OFF**	Activates source protection.
RAMP TIME	Allows you to enter the ramp time for the source to turn off or change levels. Ramp time is stored in nonvolatile memory and is not affected by power-down or reset.
RETURN	Redisplays the SPCL FCTN menu.

The state of PROTCT ON OFF and the value of RAMP TIME are not affected by reset or power-down.

When you change source types with protection activated, you must reenter the source level. This extra step, together with the ramp time, helps prevent you from supplying an unexpected excitation to a device under test.

AVERAGING AND INTEGRATION IN THE SWEPT SINE MODE

The HP 3562A allows you to control both the integration time and the number of averages per point. Pressing **AVG** displays the following menu:

NUMBER AVGS	Used to enter the number of averages per point, from 1 to 32 767. See "Selecting the Number of Averages" following this menu.
INTGRT TIME	Used to enter integration time, from 1 ms to 32 767 s. Default is 50 ms. See "Setting the Integration Time" following this menu.
AUTO INTGRT	Activates auto integration and is used to enter variance threshold. See "Auto versus Fixed Integration" following this menu. This value is saved with the state but is not shown in the display.
FIXED INTGRT	Deactivates auto integration.

Selecting the Number of Averages

Averaging calculates the arithmetic mean of all the measurements made at a given measurement point. For example, if 5 is the selected number of averages, each point in the sweep is measured 5 times, and the results at each point are averaged (the 5 results added together then divided by 5).

Averaging helps to decrease the variance in a measurement and enables the HP 3562A to make a good coherence estimate (see "The Coherence Display" later in this chapter). Selecting the number of averages is a trade-off between noise reduction and measurement time: increasing the number of averages increases the overall measurement time.

NOTE

In order to get a good coherence estimate, a minimum of 5 to 10 averages must be made. If only 1 average (the default number) is made, the coherence estimate is meaningless.

Auto versus Fixed Integration

Because it is often difficult to select optimum integration time for an entire sweep (integration increases needed at one point may unnecessarily slow the sweep at other points), the HP 3562A offers auto integration. This feature causes the sweep to adjust integration so that variance is maintained below a user-set threshold. When auto integration is on (AUTO INTGRT is active), integration time can vary between a set minimum of about 500 ms to the maximum time you enter with INTGRT TIME. Figure 3-4 shows the operation of auto integration.

Enter the variance threshold with AUTO INTGRT. Auto integration will continue to integrate at each point until that variance is met or the maximum integration time (value of INTGRT TIME) is reached.

Note that excessive marker activity during auto integration may force the integration routine to take more time than is necessary. Also, if auto integration is active and more than one average is selected, the auto integration routine will be performed for each average.

Setting the Integration Time

Integration time is the amount of time that each point is measured. Because the HP 3562A uses Fourier integration to transform time data to the frequency domain, increasing integration time effectively narrows the bandwidth at each measurement point. The result is greater harmonic rejection and increased signal-to-noise ratios.

Integration time and the frequency at a given measurement point determine the number of cycles of the input signal integrated at that point. For example, an integration time of 100 ms at 50 Hz yields 5 cycles (100 ms times 50 Hz). The integration time at each measurement point is rounded to the closest integral number of cycles equal to or greater than one. Due to settling considerations, if the algorithm detects a significant change in variance between points, it discards the last point, then remeasures it.

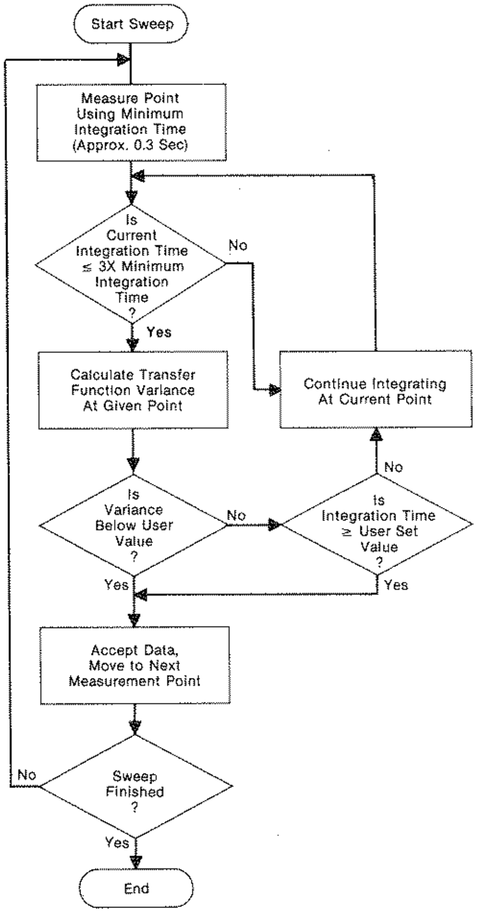


Figure 3-4 Auto Integration

USING THE AUTOMATIC SWEPT SINE FEATURES

This chapter has discussed three of the automatic swept sine features: gain, integration and resolution. In addition, the HP 3562A's autoranging feature operates differently in the swept sine mode, as shown in figure 3-5.

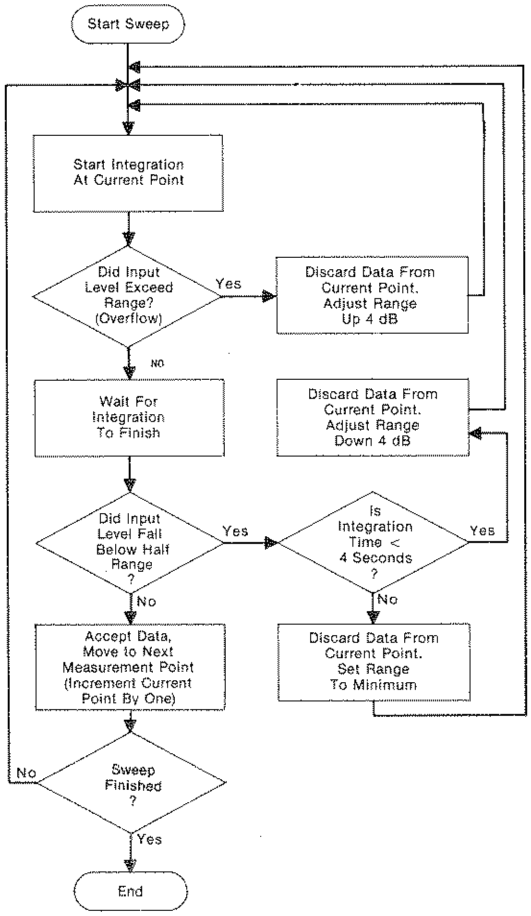


Figure 3-5 Autoranging in the Swept Sine Mode

These four auto features are arranged in a hierarchy of operation. At each measurement point, the auto features are performed in the following order:

1. range
2. integration
3. gain
4. resolution

(This assumes, of course, that you have activated all four features. Inactive features are bypassed in the hierarchy.) If any of the features cause an adjustment to the instrument, the current measurement point is discarded and the hierarchy starts over. For example, assume the instrument is measuring a given point in the sweep. If the range, integration time and gain are acceptable (do not require adjustment), but the resolution is found to be too coarse, that measurement point is discarded. The resolution is then adjusted, the point is remeasured, and the hierarchy starts over again at autorange. When the measurement passes all four automatic checks, it proceeds to the next point in the sweep.

THE SWEPT SINE FREQUENCY RESPONSE MEASUREMENT

The swept sine mode offers the frequency response measurement, commonly known as the "transfer function." This is the ratio of a system's output spectrum to its input spectrum and yields both magnitude and phase as a function of frequency. In the HP 3562A, Channel 1 monitors the input (stimulus), and Channel 2 monitors the output (response).

Because this is the only measurement in this mode, FREQ RESP is the only softkey that appears when **SELECT MEAS** is pressed in the swept sine mode. Five display choices are derived from the data acquired with the frequency response measurement. To select one of these, press **MEAS DISP** to display the following menu:

FREQ RESP	The default display when the frequency response measurement is selected; see "The Frequency Response Display" following this menu.
COHER	Calculates and displays the coherence of the frequency response function; see "The Coherence Display" following this menu.
POWER SPEC 1	Displays the power spectrum of the signal on Channel 1; see "The Power Spectrum Displays" following this menu.
POWER SPEC 2	Displays the power spectrum of the signal on Channel 2; see "The Power Spectrum Displays" following this menu.
CROSS SPEC	Displays the cross spectrum; see "The Cross Spectrum" following this menu.
AUTO MATH	Displays the trace calculated with the auto math table; please see "Auto Math" in Chapter 9. Note that this softkey label might be replaced by a user-defined label.

The Frequency Response Display

Figure 3-6 shows the response of a typical band-pass filter characterized by the frequency response display.

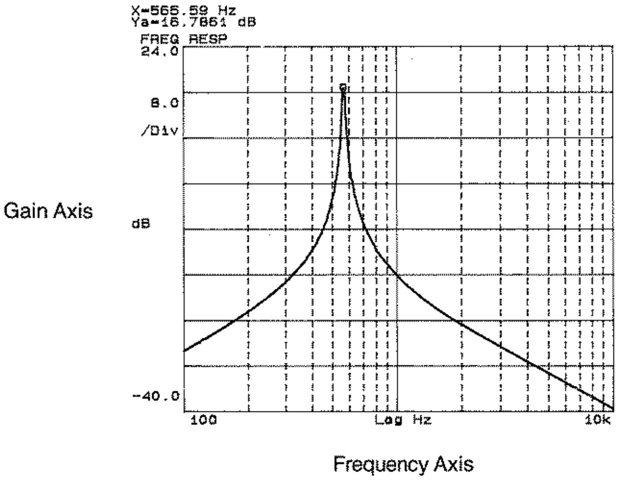


Figure 3-6 The Frequency Response Display

The Coherence Display

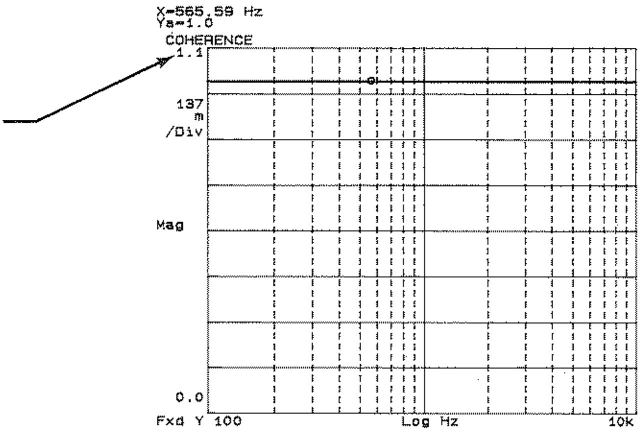
This display shows the portion of the output power spectrum related to the input spectrum, according to the following formula:

$$\gamma^2 = \frac{G_{xy} G_{xy}^*}{G_{xx} G_{yy}}$$

where: G_{xy} is the cross spectrum
G_{xy}^* is its complex conjugate
G_{xx} is the Channel 1 power spectrum
G_{yy} is the Channel 2 power spectrum

It is an indication of the statistical validity of a frequency response measurement. Coherence is measured on a scale of 0.0 to 1.0, where 1.0 indicates perfect coherence. Coherence values less than unity are caused by system nonlinearities and extraneous noise (mostly the latter in swept sine because with a single input frequency there is little interference from intermodulation distortion). Because coherence is a statistical measure of the variance between two or more averaged values, at least two averages must be taken to yield a valid estimate (see "Averaging and Integration in the Swept Sine Mode" earlier in this chapter to set up averaging).

Figure 3-7 shows the coherence of the frequency response function shown in figure 3-6.

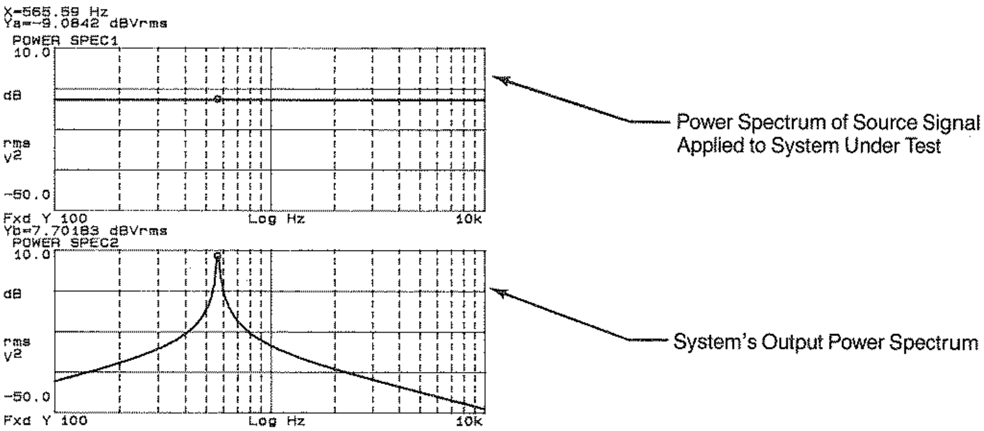


(Scaled past 1.0 to clearly show trace)

Figure 3-7 The Coherence Display

The Power Spectrum Display

This display shows the auto power spectrum, defined as the power level of the incoming signal at the measurement frequency for each point measured during the sweep. Figure 3-8 shows the individual power spectra used to calculate the frequency response display in figure 3-6. The upper trace is the power spectrum of the Channel 1 signal, and the lower trace is the power spectrum of the Channel 2 signal.



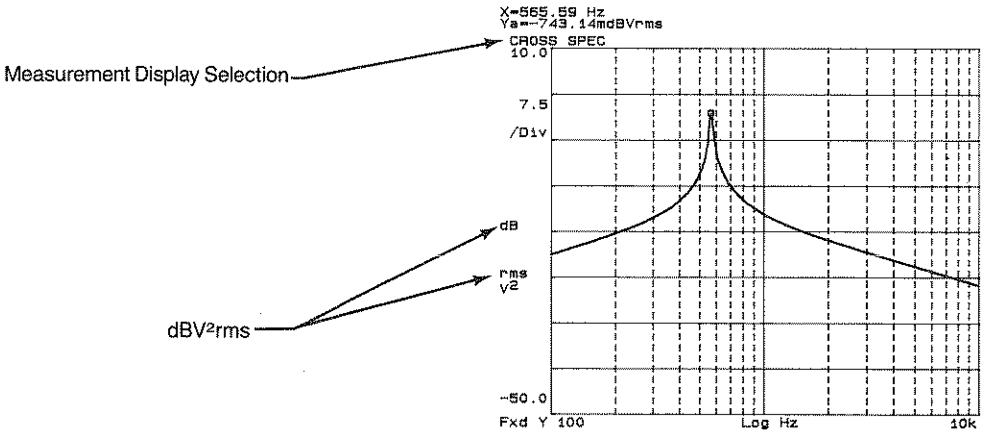
Power Spectrum of Source Signal Applied to System Under Test

System's Output Power Spectrum

Figure 3-8 The Power Spectrum Display

The Cross Spectrum Display

This display is computed by multiplying the complex conjugate of the linear spectrum of the signal on Channel 1 by the linear spectrum of the signal on Channel 2. The cross spectrum shows propagation velocity as a function of frequency and is often used in acoustic intensity measurements. Figure 3-9 shows an example of the cross spectrum display.



Measurement Display Selection

dBV²rms

Figure 3-9 The Cross Spectrum Display

VIEWING THE INPUT SIGNALS

The **VIEW INPUT** key allows you to look at the input signals before they are filtered or measured. Appendix E explains how these displays are derived and how they differ from measurement displays. These displays can be viewed at any time, even if the measurement is in progress, or the instrument is waiting for a trigger. The input displays can be used to verify the presence of input signals or to compare an input signal with a measurement display. The view input displays are also helpful when manually setting the input range. To select these displays, press **VIEW INPUT** to display the following menu:

INPUT TIME1	Displays the time domain data on Channel 1.
INPUT TIME2	Displays the time domain data on Channel 2.
INPUT SPEC1	Displays the full-span frequency spectrum (FFT) of the Channel 1 time domain data.
INPUT SPEC2	Displays the full-span frequency spectrum (FFT) of the Channel 2 time domain data.
VIEW OFF	Disables updating of the view input displays.

If you are unable to obtain a measurement display, it is helpful to view the input time displays to see if a signal is actually reaching the instrument. In the swept sine mode, the input spectrum displays show the full-bandwidth signals transformed to the frequency domain with the FFT using the flat top window.

MEASUREMENT SETUP CHECKLIST

Here are the steps to set up swept sine measurements:

1. Select swept sine mode: press **MEAS MODE** followed by SWEPT SINE. (page 3-1)
2. Set up the receiver: select linear or log sweep and set up auto gain, if necessary, in the **MEAS MODE** menu. (page 3-2)
3. Set the frequency span and resolution: use the **FREQ** menu. (page 3-5)
4. Set up the source: use the **SOURCE** menu. (page 3-8) To set up source protection, see page 3-9
5. Set up averaging and integration: use the **AVG** menu. (page 3-10)
6. Select a display: use the **MEAS DISP** menu. (page 3-13)
7. View the input signals (if necessary): use the **VIEW INPUT** menu. (page 3-18)
8. Set up the inputs: refer to Chapter 7 for range, calibration, coupling and engineering units.
9. Start the sweep: press **START.**
10. Select other displays, if desired: use the **MEAS DISP** menu. (page 3-13)
11. Use marker and display features, if desired: refer to Chapter 8 for instructions.

Chapter 4

USING THE TIME CAPTURE MODE

PURPOSE OF THIS CHAPTER

This chapter shows you the details of using the HP 3562A's time capture mode. For an introductory discussion of time capture, please refer to the User's Guide at the beginning of this manual. Note that several of the instrument's features (the source, for example) operate identically in the linear resolution and time capture modes. In such cases, this chapter refers you to Chapter 1, "Using the Linear Resolution Mode," for further details.

This chapter is divided into three parts:

1. set up the time capture
   —select capture channel
   —set capture length
   —set frequency span
   —set up the source
   —view input signals
   —set up the inputs
   —start capture
   —view the captured data
   —view capture header

2. measure and analyze the data block
   —select measurement
   —select window
   —reset frequency span
   —set up averaging
   —set starting point
   —start measurement

3. use capture blocks as throughput files

To keep track of where you are while setting up captures, fold out the capture setup checklist at the end of this chapter. Note that synthesis and curve fit cannot be performed in the time capture mode.

OVERVIEW OF TIME CAPTURE

Figure 4-1 shows the concept of time capture in the HP 3562A.

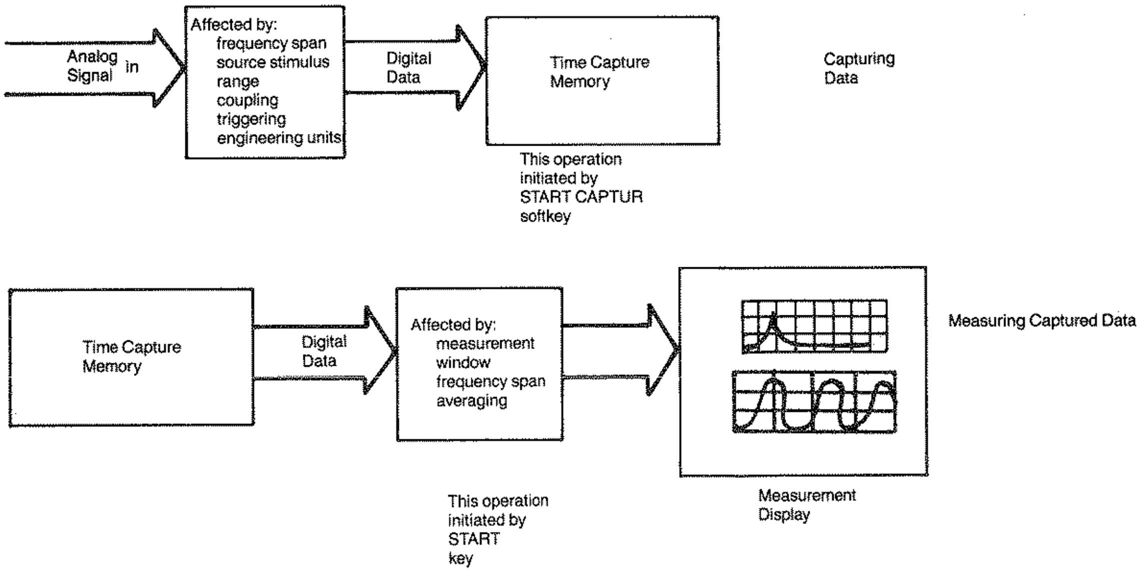


Figure 4-1 Overview of Time Capture

SETTING UP THE TIME CAPTURE

This mode allows you to capture a block of data (up to ten time records long) on one channel, then measure and analyze the block after the input signal has been removed. Time capture is used to record waveforms and to increase the effective real time bandwidth (RTBW) to 100 kHz. Captured data can then be measured and analyzed at narrower spans.

There are nine steps to setting up a time capture:

1. Select the capture channel
2. Set the capture length
3. Set the frequency span
4. Set up the source (optional)
5. View the input signals (optional)
6. Set up the inputs
7. Start the capture
8. View the capture data
9. View the capture header (optional)

NOTE

When you exit time capture by selecting another mode, the time capture buffer is erased.

To put the HP 3562A in the time capture mode, press **MEAS MODE**. Next, press the TIME CAPTUR softkey to display the CAPTUR SELECT softkey. Press this to display the following menu:

START CAPTUR	Starts the time capture.
ABORT CAPTUR	Aborts time captures in progress. Note that at least one complete record is required for a measurement.
CAPTUR POINTR	Enables the Entry group to move the capture pointer. This is used when measuring and analyzing captured data. The measurement section of this chapter gives instructions for its use.
POINTR INCRMT	Used to enter the knob increment for the capture pointer. This is also covered in the measurement section.
CAPTUR LENGTH	Used to enter the length (up to 10 records) of the capture. See "Setup Step 2: Set the Capture Length."
CAPTUR HEADER	Displays the time capture header, which shows both the current capture setup and a partial instrument state display for the data captured. See figure 4-3 for an example.
RETURN	Redisplays the **MEAS MODE** menu.

Setup Step 1: Select the Capture Channel

Either channel can be selected as the capture channel; make the selection with the CH 1 ACTIVE or CH 2 ACTIVE softkey in the **SELECT MEAS** menu.

Setup Step 2: Set the Capture Length

The capture can be up to ten records (20,480 samples) long; the length can be set as time or as a number of revolutions, points or records. If a value greater than the length of ten records is entered, the instrument uses the length of ten records. The capture header shows the time length that was entered in the lower "Setup" section and the length that was actually used in the upper section.

For example, if the frequency span is 100 kHz, the record length is 8 ms (800 ÷ 100 kHz). The length of ten of these records is 80 ms. If a capture length of 90 ms is entered, 80 ms is used; 90 ms is displayed as the capture length in the header "Setup" section. The current record length can be found in the instrument state display or in the capture header under FREQ: REC LGTH.

Setup Step 3: Set the Frequency Span

The frequency span is set before the data block is captured. However, it can be reset when the block is retrieved from memory and measured (this is Measurement Step 3 later in this chapter). Pressing **FREQ** displays the following menu:

FREQ SPAN	Used to set the frequency span. The span can also be entered immediately after FREQ is pressed.
START FREQ	Used to set the start frequency for zoom measurements.
CENTER FREQ	Used to set the center frequency.
ZERO START	Sets the starting frequency at 0 Hz (dc).
MAX SPAN	Sets the frequency span at 0 to 100 kHz.
TIME LENGTH	Used to set the time record length.
E SMPL ON **OFF**	Selects external sampling, activates the EXT SAMPLE indicator in the Status group, and displays the SAMPLE FREQ softkey.
SAMPLE FREQ	Used to enter the external sampling frequency (This softkey appears only when E SMPL ON OFF is pressed ON).

This menu is the same one used to set the frequency span in the linear resolution mode. Please refer to "Frequency Spans in the Linear Resolution Mode" in Chapter 1 if you need more information.

Setup Step 4: Set Up the Source (Optional)

The HP 3562A offers five source outputs in the time capture mode: random noise, burst random, periodic chirp, burst chirp, and fixed sine. To select a source output and set its amplitude level, press **SOURCE**, which displays the following menu:

SOURCE LEVEL	Used to set the amplitude level of the source. Use the Entry group to set the level between −5V and +5V. Note that the combined level plus dc offset is limited to ±10V. At power-on and after reset the level defaults to 0V.
DC OFFSET	Used to add a positive or negative offset constant to the source output signal. The offset is limited to 10V minus the source level; the combined ac and dc level is limited to 10V.
SOURCE OFF	Turns the source off. If source protection is active, the source ramps off gradually; see Chapter 1 for details.
RANDOM NOISE	Selects the random noise output; this is the default at power-on and after reset.
BURST RANDOM	Selects the burst random output and allows you to enter the burst percentage from 1 to 99%. The default is 70%.
PRIODC CHIRP	Selects the periodic chirp output.
BURST RANDOM	Selects the burst chirp output and allows you to enter the percentage containing the burst from 1 to 99%. The default is 70%.
FIXED SINE	Selects the fixed sine output and allows you to enter the frequency from 64 µHz to 100 kHz. The default is 125 Hz.

The source features in the time capture mode are the same as those in the linear resolution mode. Please refer to "The Source Output in the Linear Resolution Mode" in Chapter 1 if you need more information.

Setup Step 5: View the Input Signals (Optional)

The inputs may be viewed to verify a signal's presence, compare the input signal with the measurement display, or to determine the signal level for setting the input range. Pressing **VIEW INPUT** displays the following menu:

INPUT TIME 1	Displays the time data present on Channel 1.
INPUT TIME 2	Displays the time data present on Channel 2.
INPUT SPEC 1	Displays the Fourier transform of the signal on Channel 1, using the Hanning window.
INPUT SPEC 2	Displays the Fourier transform of the signal on Channel 2, using the Hanning window.
TIME RECORD	Displays one time record outlined in the time buffer display by the capture pointer. (This softkey is used after the capture and is discussed in Setup Step 8 later in this section.)
LINEAR SPEC	Displays the linear spectrum of one time record outlined by the capture pointer. (This softkey is used after the capture and is discussed in Setup Step 8 later in this section.) The linear spectrum display uses the currently-selected window.
TIME BUFFER	Displays the captured time data. Regardless of the number of records captured, this display shows the entire capture block. The length of the block equals the length of the captured data. (This softkey is used after the capture and is discussed in Setup Step 8 later in this section.)
VIEW OFF	Disables updating of the view input displays.

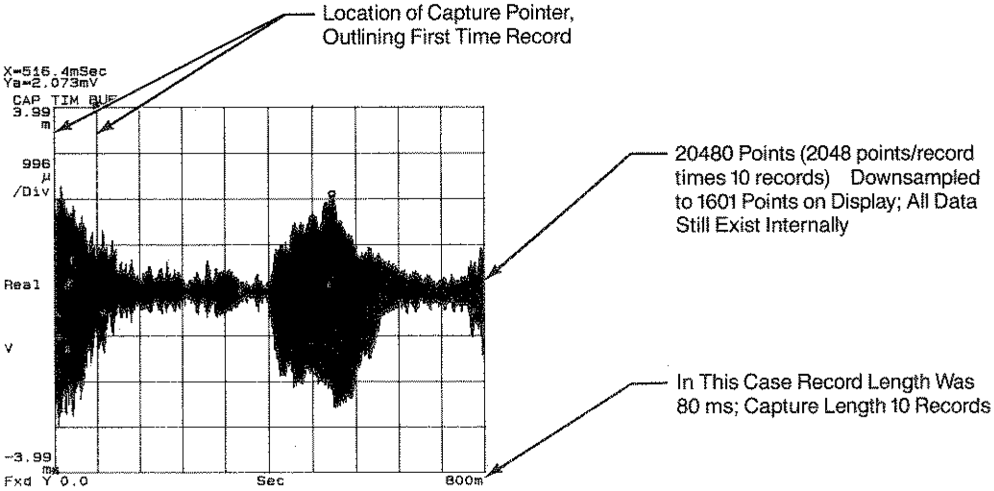
The message "Uncalibrated" that appears with the INPUT SPEC 1 and 2 displays indicates that these traces have not been corrected by the HP 3562A's calibration routine.

Setup Step 6: Set up the Inputs

Please refer to Chapter 7 for information on triggering, calibrating, coupling, input range and engineering units. Delayed triggering in time capture defines the start of the entire time capture, not of each record. For the time capture mode only, pre-triggering can extend up to 20,479 points (10 records minus one point). The post-trigger limit remains fifty records.

Setup Step 7: Start the Capture

When the capture is set up and the input signal is ready, press START CAPTUR. The entire data block is displayed when the capture is completed; an example is shown in figure 4-2. At frequency spans less than or equal to 2 kHz, the instrument displays the incoming data while the capture is in progress.



Location of Capture Pointer, Outlining First Time Record

20480 Points (2048 points/record times 10 records) Downsampled to 1601 Points on Display; All Data Still Exist Internally

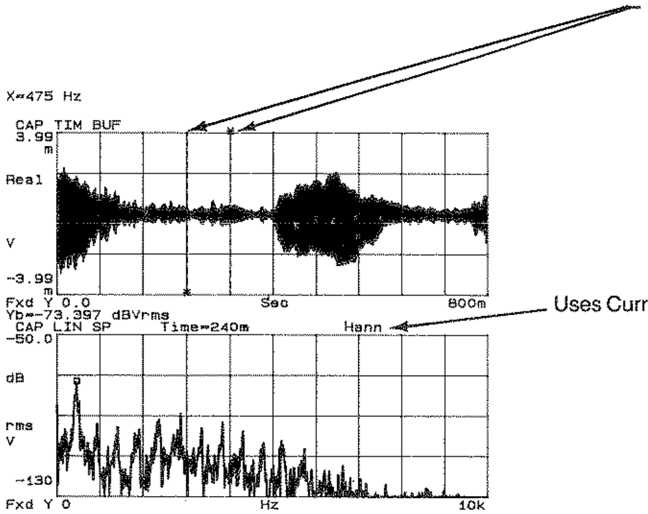
In This Case Record Length Was 80 ms; Capture Length 10 Records

Figure 4-2 The Time Capture Display

When the capture is finished, the screen shows the entire capture block compressed to one display. The analyzer compresses the display by selecting the points containing the most information. This is the "time buffer" display, and it also can be displayed by pressing TIME BUFFER in the **VIEW INPUT** menu.

Setup Step 8: View the Captured Data

The capture pointer allows you to view data in the capture block after the capture is completed. The pointer outlines one time record in the time buffer display (the display that appears when the capture is finished). The record it outlines can be viewed in the time domain using TIME RECORD and in the frequency domain using LINEAR SPEC. These two softkeys and the TIME BUFFER softkey are in the **VIEW INPUT** menu. Figure 4-3 shows the linear spectrum display of the fourth time record of the TIME BUFFER display in figure 4-2.



Location of Capture Pointer Indicated by Pair of Asterisks and Pair of Dotted Vertical Lines

Uses Currently Selected Window

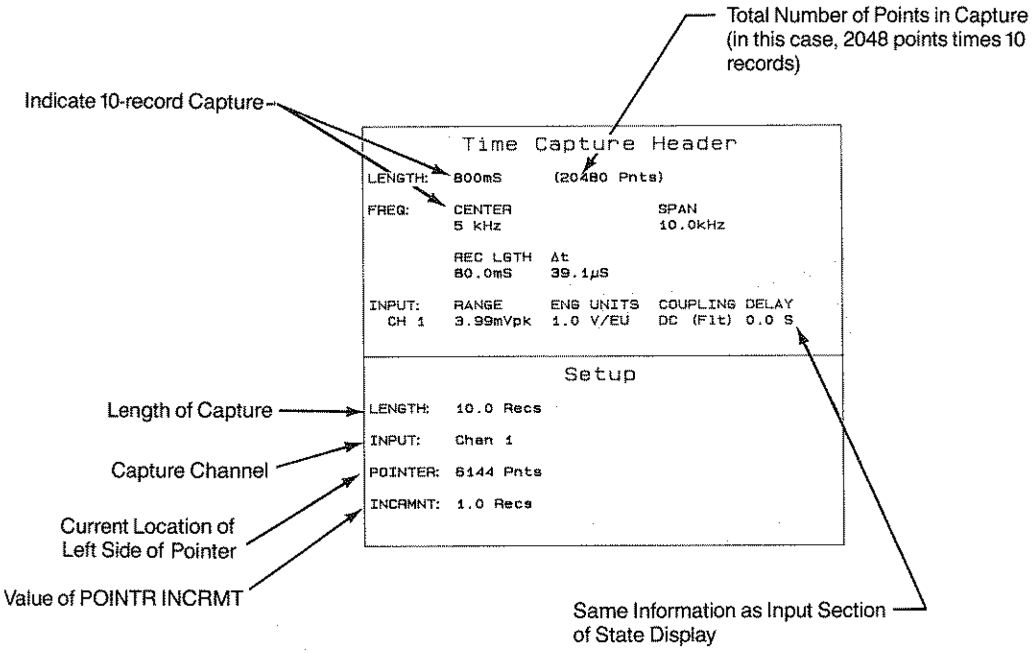
Trace B is Linear Spectrum of the Time Record Outlined by the Pointers in Trace A

Figure 4-3 The Linear Spectrum Display

The linear spectrum of the fourth record is displayed by moving the capture pointer to the fourth record in time buffer. Access the capture select menu by pressing **MEAS MODE**, TIME CAPTUR, then CAPTUR SELECT. POINTR INCRMT allows you to set the increment in which the pointer moves through the time buffer. Enter the increment, then press CAPTUR POINTR to allow the Entry group to move the pointer. To move the pointer, rotate the knob, press the up/down arrows, or enter an value using the **0** - **9** keys. The time you enter is the beginning of the time record (i.e., the left side of the capture pointer band). Note that you cannot move the pointer closer than one record to the end of the time buffer.

Setup Step 9: View the Capture Header

The time capture header shows the setup information for the current capture block. To display the header, press CAPTUR HEADER. As shown in figure 4-4, the top of the header displays a subset of the instrument's setup state. The bottom, labeled "Setup," shows the current capture setup.



```
           Time Capture Header
LENGTH:   800mS       (20480 Pnts)

FREQ:     CENTER                    SPAN
          5 kHz                     10.0kHz

          REC LGTH  Δt
          80.0mS    39.1µS

INPUT:    RANGE     ENG UNITS  COUPLING DELAY
  CH 1    3.99mVpk  1.0 V/EU   DC (Flt) 0.0 S

                  Setup

LENGTH:   10.0 Recs

INPUT:    Chan 1

POINTER:  6144 Pnts

INCRMNT:  1.0 Recs
```

Figure 4-4 The Time Capture Header

MEASURING AND ANALYZING CAPTURED DATA

Once a data block has been captured, it can be measured and analyzed in the same manner as a "live" signal. The HP 3562A offers the power spectrum, auto correlation and histogram measurements in the time capture mode. The remainder of this chapter discusses the steps needed to make measurements on captured data blocks. To analyze measured data using the display and marker features, please refer to Chapter 8. The steps covered here are:

1. Select the measurement
2. Select the window
3. Reset frequency (optional)
4. Set up averaging
5. Set the starting point
6. Start the measurement

Measurement Step 1: Select the Measurement

To select one of the three measurements offered for time capture data, press **SELECT MEAS**, which displays the following menu:

POWER SPEC	Selects the power spectrum measurement.
AUTO CORR	Selects the auto correlation measurement.
HIST	Selects the histogram measurement.
CH 1 ACTIVE	Activates Channel 1.
CH 2 ACTIVE	Activates Channel 2.

The power spectrum measurement provides the power spectrum, defined as the input spectrum multiplied by its complex conjugate. Several display choices are derived from the power spectrum measurement. When the power spectrum measurement is selected, pressing **MEAS DISP** displays the following menu:

POWER SPEC1	Displays the power spectrum of the time capture data on Channel 1. (This softkey appears only when Channel 1 is active.)
POWER SPEC2	Displays the power spectrum of the time capture data on Channel 2. (This softkey appears only when Channel 2 is active.)
FILTRD INPUT	Displays the filtered input menu, which provides time records and linear spectra. See "The Filtered Input Displays" later in this section.

For an example, please refer to "The Power Spectrum Measurement" in Chapter 1.

The auto correlation measurement shows the similarity between a signal and a progressively time-shifted version of itself. Some uses of auto correlation are detecting periodicity and measuring impulsive signals, such as gear chatter. Several display choices are available from the data acquired with the auto correlation measurement. When the auto correlation measurement is selected, **MEAS DISP** displays the following menu:

AUTO CORR1	Selects the auto correlation display for the time capture data on Channel 1. (This softkey appears only when Channel 1 is active.)
AUTO CORR2	Selects the auto correlation display for the time capture data on Channel 2. (This softkey appears only when Channel 2 is active.)
FILTRD INPUT	Displays the filtered input menu, which offers time records and linear spectra. See "The Filtered Input Displays" later in this section.

For an example, please refer to "The Auto Correlation Measurement" in Chapter 1.

The histogram measurement shows the amplitude distribution of the signal between its minimum and maximum values. It is often used to monitor the performance of electromechanical positioning systems and to measure the statistical properties of noise. Several display choices are derived from the data acquired with the histogram measurement. When the histogram measurement is selected, pressing **MEAS DISP** displays the following menu:

HIST1	Selects the histogram display for the time capture data on Channel 1. (This softkey appears only when Channel 1 is active.)
PDF1	Selects the probability density function display for the time capture data on Channel 1. (This softkey appears only when Channel 1 is active.)
CDF1	Selects the cumulative density function display for the time capture data on Channel 1. (This softkey appears only when Channel 1 is active.)
HIST2	Selects the histogram display for the time capture data on Channel 2. (This softkey appears only when Channel 2 is active.)
PDF2	Selects the probability density function display for the time capture data on Channel 2. (This softkey appears only when Channel 2 is active.)
CDF2	Selects the cumulative density function display for the time capture data on Channel 2. (This softkey appears only when Channel 2 is active.)
FILTRD INPUT	Displays the filtered input menu, which offers time record and linear spectrum displays. See "The Filtered Input Displays" following this menu.

The probability density function (PDF) is a histogram normalized to the number of samples taken and shows the probability that a given level occurred. The cumulative density function (CDF) is the integral of the PDF and indicates the probability that a level equal to or less than a given level occurred. For examples of these displays, refer to "The Histogram Measurement" in Chapter 1.

The filtered input displays provide both time and frequency domain displays that have been digitized and filtered to the current frequency span, but have not been through the measurement process. Pressing FILTRD INPUT on any of the **MEAS DISP** menus in the time capture mode brings up the following menu:

TIME REC 1	Displays the Channel 1 time record. (This softkey appears only when Channel 1 is active.)
TIME REC 2	Displays the Channel 2 time record. (This softkey appears only when Channel 2 is active.)
LINEAR SPEC 1	Displays the linear spectrum on the signal on Channel 1; this is the FFT of the time record. (This softkey appears only when Channel 1 is active.)
LINEAR SPEC 2	Displays the linear spectrum of the signal on Channel 2; this is the FFT of the time record. (This softkey appears only when channel 2 is active.)
INST	Selects only the most recent time record for the filtered input displays. (This softkey does not appear if time averaging is turned off; see "Measurement Step 4: Set Up Averaging."
AVRG	Selects the cumulative average of all time records acquired with the current measurement for the filtered input displays. (This softkey does not appear if time averaging is turned off; see "Measurement Step 4: Set Up Averaging.")
RETURN	Redisplays the first level of the **MEAS DISP** menu.

The time record display shows the time record for the respective input channel. The "time record" is the amount of data required to perform on FFT. The time record length is inversely proportional to frequency span: record length = (800/span). Note that zoomed time displays and all time averaged time displays are uncalibrated.

The linear spectrum display shows the input signal after it has been filtered to the current frequency span and transformed to the frequency domain. The window used to compute the linear spectra is selected with the **WINDOW** menu; see Measurement Step 2. Note that the linear spectrum display is uncalibrated.

Measurement Step 2: Select the Window

The HP 3562A offers six windows in the time capture mode: Hanning, flat top, uniform, force, exponential, and user-defined. Pressing **WINDOW** displays the following menu:

HANN	Selects the Hanning window on both channels.
FLAT TOP	Selects the flat top window on both channels.
UNIFRM (NONE)	Selects the uniform window (no windowing) on both channels.
FORCE EXPON	Displays the FORCE/EXPON menu, which is used to select the force and exponential windows.
USER SAVD 1	Selects the user-defined window stored in the SAVED 1 memory location.

The Hanning, flat top, uniform, and user-defined windows are applied to both channels. The force and exponential windows may be applied individually. The window choice appears at the top of the trace at the end of the measurement.

Pressing FORCE/EXPON displays the following menu:

FORCE CHAN 1	Selects the force window for Channel 1; enter the width using the Entry group.
EXPON CHAN 1	Selects the exponential window for Channel 1; enter the decay using the Entry group.
FORCE CHAN 2	Selects the force window for Channel 2; enter the width using the Entry group.
EXPON CHAN 2	Selects the exponential window for Channel 2; enter the decay using the Entry group.
RETURN	Redisplays the **WINDOW** menu.

The windowing functions offered in the time capture mode are the same as those offered in the linear resolution mode. Please refer to "Selecting Windows" in Chapter 1 if you need more information.

Measurement Step 3: Reset the Frequency Span (Optional)

If you want to measure the data block at a frequency span other the span at which it was captured, it is necessary to reset the span before the measurement is started. If you performed the capture at a baseband span (start frequency = 0 Hz), you can measure the captured data at any span less than or equal to the capture span. For example, you can capture at 100 kHz then measure later at 10 kHz. However, if you zoomed during the capture (non-zero start frequency) you must measure the captured data at the same span as the capture. The analyzer automatically changes the span back to the capture span in these cases, if necessary.

If you measure at a different span than the capture, the HP 3562A's digital filter needs time to resettle to the new span. Because of this, some data distortion can occur in the first record of the measurement (the data in the time buffer are not affected). If this presents a problem, set the capture pointer to some point other than the beginning of the time buffer. Measurement Step 5 gives further instructions.

The amount of zooming you can perform on the time buffer depends on the number of records you want to average. Remember that as you zoom, the span decreases and the record length increases. Here is an example:

> You captured 10 records at a 100 kHz span, giving you 80 ms of time data.
>
> If you then want to zoom at a 50 kHz span, you will need 16 ms of data for each zoom record (800/50 kHz). Therefore, you could zoom at a 50 kHz span with 5 averages (80 ms total data length divided by 16 ms per record).

Measurement Step 4: Set Up Averaging

The averaging features offered in the time capture mode are also offered in the linear resolution mode; these features are described in detail in Chapter 1. However, several averaging features offered in linear resolution are not available in time capture (overload rejection, fast averaging and previewing). To set up averaging, press **AVG** to display the following menu:

NUMBER AVGS	Allows you set the number of averages you want, from 1 to 32 767, using the Entry group. The number of averages can also be entered immediately after **AVG** is pressed.
AVG OFF	Turns off all averaging functions. If this is pressed while an averaged measurement is in progress, the measurement pauses.
STABLE (MEAN)	Selects stable averaging.
EXPON	Selects exponential averaging.
PEAK HOLD	Selects the peak hold function.
CONT PEAK	Selects the continuous peak function.
TIM AV ON **OFF**	When pressed ON, time domain averaging is selected; when pressed OFF, frequency domain averaging is selected.
OVLRP%	Allows you to set the overlap percentage from 0 to 90%, using the Entry group. The default is 0%.

Overlap processing on unaveraged measurements is different in time capture. If AVG OFF is active, there is no overlap processing, regardless of the value of OVRLP%. (In the linear resolution mode, AVG OFF causes maximum overlap.)

Selecting the number of averages can also be used to exclude data in the end of the capture buffer. For example, if you want to measure only the first five records in a ten-record buffer, select five averages before starting the measurement. This can be combined with the capture pointer to exclude records from both the beginning and the end of the buffer.

Measurement Step 5: Set the Starting Point

After viewing the captured data with the TIME BUFFER display, you may decide that some of the data should be excluded from the measurement. Time capture measurements can be started at any point in the captured data block. The starting point is specified by the current capture pointer position. If the pointer is not active, the measurement starts at the beginning of the first record.

If you are measuring at a different span than the capture, the digital filter's settling time requirements can introduce distortion in the first 1/10 record of the measurement. This affects only measurements that are measured at a different span than the capture. If this presents a problem, set the starting point of the measurement past the first 1/10 of the output record. For example, you could press CAPTUR POINTR, then enter a value equal to 0.1 times the zoom factor, then use the Record softkey.

Measurement Step 6: Start the Measurement

When the HP 3562A is in the time capture mode, pressing **START** causes the instrument to measure the data stored in the time capture memory. All the measurement input data come from the capture buffer, not from the input channels. Figure 4-1 at the beginning of this chapter summarizes this action. Because individual records are not triggered, phase displays for time capture measurements are not accurate.

USING CAPTURE BLOCKS AS THROUGHPUT FILES

Captured data blocks can be used as input to a throughput measurement, if they are saved to disc. To do this, first display the capture block using TIME BUFFER in the **VIEW INPUT** menu. Next, save this display to disc using SAVE FILE in the **DISC** menu. "Using Capture Blocks as Throughput Files," the corresponding section in Chapter 6, explains how to identify the saved capture data as the active file for throughput. For more information on using throughput, refer to Chapter 6. For more information on saving and recalling disc files, see Chapter 11.

CAPTURE SETUP CHECKLIST

Here are the steps required to set up a time capture then measure the captured data block:

Capture Data:

1. Select capture channel: use CH 1 ACTIVE or CH 2 ACTIVE in the **SELECT MEAS** menu. (page 4-4)
2. Set capture length: use CAPTUR LENGTH in the CAPTUR SELECT menu. (page 4-4)
3. Set frequency span: use the **FREQ** menu. (page 4-5)
4. Set up the source (if necessary): use the **SOURCE** menu. (page 4-6)
5. View the input signals (if necessary): use the **VIEW INPUT** menu. (page 4-7)
6. Set up the inputs: refer to Chapter 7 for triggering, coupling, calibrating, range and engineering units. See note on page 4-8 regarding triggering.
7. Start the capture: press START CAPTUR in the CAPTUR SELECT menu. (page 4-8)
8. View the captured data: use the capture pointer and TIME BUFFER, TIME RECORD and LINEAR SPEC in the **VIEW INPUT** menu. (page 4-8)
9. View the capture header, if desired: press CAPTUR HEADER in the CAPTUR SELECT menu. (page 4-10)

Measure the Captured Data:

1. Select measurement: use the **SELECT MEAS** menu. (page 4-11)
2. Select window: use the **WINDOW** menu. (page 4-15)
3. Reset frequency span, if necessary: use the **FREQ** menu. (page 4-16)
4. Set up averaging: use the **AVG** menu. (page 4-17)
5. Set starting point: use the capture pointer in the CAPTUR SELECT menu. (page 4-18)
6. Start measurement: press the yellow **START** key. (page 4-18)

Chapter 5

USING DEMODULATION

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you the details of using the HP 3562A's demodulation feature. For an introductory example using demodulation, please refer to the User's Guide at the beginning of this manual.

This chapter describes the demodulation softkey menus and explains the eight steps in setting up demodulation measurements:

1. Activate demodulation
2. Select the channel(s) to be demodulated
3. Select the type(s) of demodulation
4. Select auto or user carrier
5. Set up the delete frequency table (optional)
6. Proceed with measurement setup
7. Use previewing
8. Use the DEMOD POLAR display (optional)

GETTING STARTED WITH DEMODULATION

There are several points to consider when using the HP 3562A's demodulation feature:

1. Demodulation can be used only in conjunction with the linear resolution mode.
2. Demodulation can be performed on zoom measurements only (measurements with non-zero start frequencies). The start frequency can be set to its lowest non-zero value (64 μHz), but not to 0 Hz.
3. Because of the number of calculations required, demodulation measurements are not as fast as normal linear resolution measurements.
4. Demodulation measurements are not in real time.
5. Demodulation collects a 4096-point time record to provide 2048 points in the time domain after demodulation. When these 2048 points are downsampled to the display (to 1024 points), the trace may appear to be shifted slightly.
6. All zoomed time record displays in the HP 3562A are uncalibrated. This is important to note when using demod, since all time displays in demod are zoomed.

The remainder of this chapter is divided into two parts: the first part explains the softkey menus used in demodulation, and the second part guides you through the eight setup steps. To keep track of where you are while setting up demodulation, fold out the demodulation setup checklist at the end of this chapter.

To activate and set up demodulation:

1. Press **MEAS MODE**.
2. Select the linear resolution mode by pressing the LINEAR RES softkey; this displays the DEMOD ON OFF softkey.
3. Press the DEMOD ON OFF softkey to ON; this displays the DEMOD SELECT softkey.
4. Press DEMOD SELECT to display its menu.

THE DEMODULATION MENUS

The softkeys used to set up demodulation are contained in several menus accessed through **MEAS MODE**. There are four menus used to set up demodulation: DEMOD SELECT, the demod types menu, PM/FM CRRIER and DELETE FREQ. These menus are described in order in this section.

The DEMOD SELECT Menu

DEMOD CHAN 1	Selects Channel 1 for demodulation and displays the demod types menu. This softkey is used in Step 1.
DEMOD CHAN 2	Selects Channel 2 for demodulation and displays the demod types menu. This softkey is used in Step 1.
DEMOD BOTH	Selects both channels for demodulation and displays the demod types menu. This softkey is used in Step 1.
PRVIEW **ON** OFF	Controls demodulation previewing, which allows you to view modulated records before they are demodulated and measured. This softkey is used in Step 7.
PM/FM CRRIER	Displays the PM/FM CRRIER menu that allows you to select auto carrier or enter a user carrier. This softkey is used in Step 4.
DELETE FREQ	Displays the delete frequency table and its menu. This softkey is used in Step 5.
DELETE ON **OFF**	Enables or disables the delete frequency table. When this is off, the table is not used, but its contents are preserved. This softkey is used in Step 5.
RETURN	Redisplays the **MEAS MODE** menu.

The Demod Types Menu

The following menu is displayed when DEMOD CHAN 1, DEMOD CHAN 2 or DEMOD BOTH is pressed:

This menu is used in Step 3

AM CHAN 1	Selects AM demodulation on Channel 1.	(do not appear for DEMOD CHAN 2)
FM CHAN 1	Selects FM demodulation on Channel 1.	
PM CHAN 1	Selects PM demodulation on Channel 1.	
AM CHAN 2	Selects AM demodulation on Channel 2.	(do not appear for DEMOD CHAN 1)
FM CHAN 2	Selects FM demodulation on Channel 2.	
PM CHAN 2	Selects PM demodulation on Channel 2.	
RETURN	Redisplays the DEMOD SELECT menu.	

The PM/FM CRRIER Menu

The following menu is displayed when PM/FM CRRIER is pressed:

AUTO CRRIER	Causes the instrument to calculate the carrier frequency based on the input signal; see "Step 4: Select Auto or User Carrier."
USER CRRIER	Allows you to enter the carrier frequency; see "Step 4: Select Auto or User Carrier."
RETURN	Redisplays the DEMOD SELECT menu.

The DELETE FREQ Menu

The delete frequency table and the following menu are displayed when DELETE FREQ is pressed (this menu is used in Step 5):

EDIT LINE#	Used to specify the line to be edited. Press EDIT LINE#, then enter the number of the line or move the line pointer with the arrows or knob. The edit line is highlighted and indicated by an arrow at the side of the table.
DELETE REGION	Deletes the region identified by the edit line.
CHANGE REGION	Allows you to change the region identified by the edit line. Press CHANGE REGION, then enter the new minimum and maximum separated by a comma (,).
ADD REGION	Allows you to add a region after the edit line. Press ADD REGION, then enter the minimum and maximum frequencies separated by a comma (,).
CLEAR TABLE	Clears the delete frequency table. The message "Push Again to Clear" is displayed to allow you to confirm that the table can be cleared.
RETURN	Redisplays the DEMOD SELECT menu.

SETTING UP DEMODULATION

This section shows you how to set up demodulated measurements. Refer to the menu explanations at the beginning of this chapter for descriptions of the softkeys used in demodulation.

Step 1: Activate Demodulation

To activate demodulation, first press **MEAS MODE** then select the LINEAR RES mode. This displays the DEMOD ON OFF softkey. Press DEMOD ON OFF to ON, then press the DEMOD SELECT softkey to display the first demodulation menu.

If triggering is in free run and averaging is off, a demodulation measurement begins as soon as you press DEMOD ON OFF to ON. If necessary, press the yellow **START** key to restart the measurement after you have finished setting up demodulation.

Step 2: Select the Demodulation Channel(s)

Either or both channels can be selected for demodulation. In the DEMOD SELECT menu, press DEMOD CHAN 1, DEMOD CHAN 2 or DEMOD BOTH to make the selection. When one of these three is pressed, the demod types menu is displayed to allow you to select the demodulation type(s).

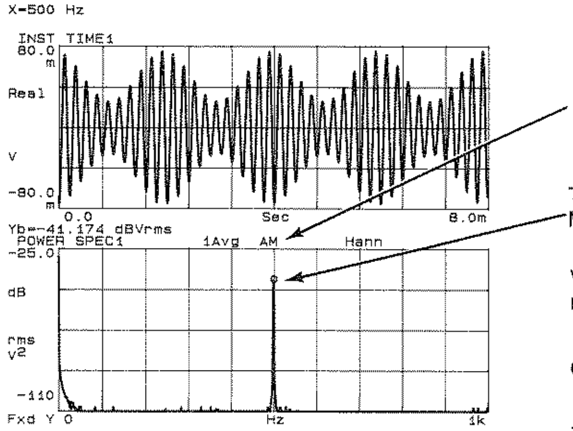
If you plan to use the DEMOD POLAR display, both channels must be set up for demodulation, with AM on Channel 1 and PM on Channel 2.

Step 3: Select Demodulation Type(s)

AM, FM or PM demodulation can be selected independently on either channel. Keep in mind that if demodulation has been selected on a single channel, a baseband measurement is set up on the other channel. When DEMOD CHAN 1, DEMOD CAN 2 or DEMOD BOTH is pressed, the appropriate menu of demodulation types is displayed.

If you plan to use the DEMOD POLAR display, Channel 1 needs to be set up for AM and Channel 2 for PM.

Figures 5-1 through 5-3 show examples of AM, FM and PM demodulation.



Indicates AM Demod

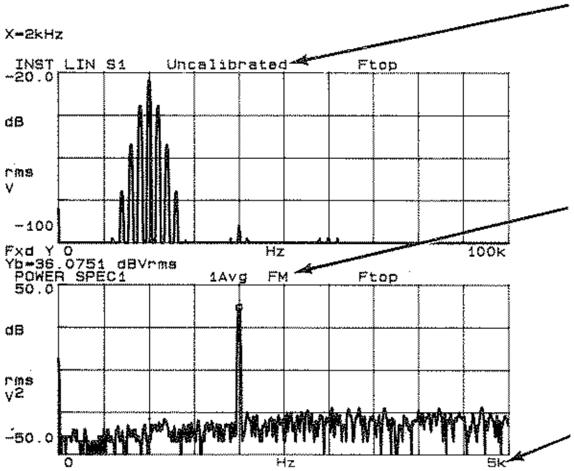
This is the 500 Hz Signal That was Modulating Trace A

Values on display are absolute amplitude, not referenced to carrier.

Original Span was 2 kHz

The carrier value shown is 6 dB higher than its actual value.

Figure 5-1 AM Demodulation



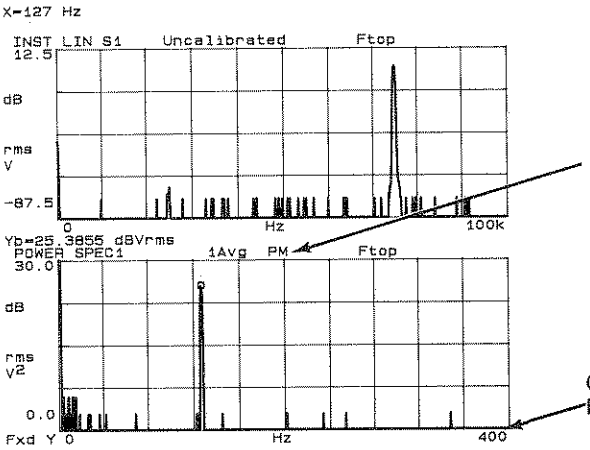
Note That This Display Is Not Calibrated

Indicates FM Demod

The trace and markers are scaled in "volts" but this should be interpreted as "Hertz."

Frequency Span Set to 10 kHz, so Demodulated Span Is 5 kHz.

Figure 5-2 FM Demodulation



Indicates PM Demod

The trace and markers are scaled in "volts" but this should be interpreted as "degrees."

Original Frequency Span Was 800 Hz

Figure 5-3 PM Demodulation

Step 4: Select Auto or User Carrier

When performing FM or PM demodulation, the HP 3562A gives you the choice between entering a known carrier frequency or letting the instrument calculate the carrier based on the input signal. (AM demodulation does not require any carrier frequency entry.)

Because of the time involved in the auto carrier calculation, it is recommended that you set the carrier frequency whenever it is known. The PM/FM CRRIER menu gives you the choice between AUTO CRRIER and USER CRRIER. Press AUTO CRRIER to select the auto carrier feature or press USER CRRIER then enter the known carrier frequency. The carrier must be greater than 0 Hz and less than 100 kHz. This carrier frequency value must be frequency of the actual carrier signal; suppressed carrier demodulation is not allowed. If the user carrier is not within the current frequency span, auto carrier is automatically selected.

For two-channel demodulation, (DEMOD BOTH active), when AUTO CRRIER is active, the carrier frequency is calculated separately for each channel. However, with USER CRRIER, the frequency you enter is applied to both channels.

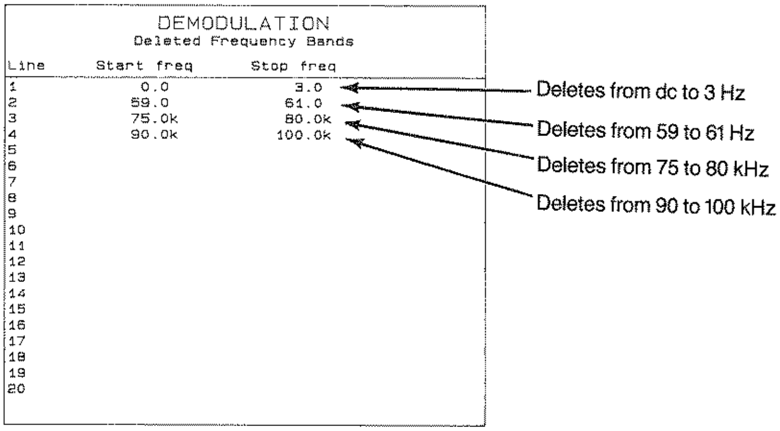
The auto carrier values derived during a measurement can be read via HP-IB; refer to Chapter 6 in the *HP 3562A Programming Manual.*

Step 5: Set Up the Delete Frequency Table (optional)

The delete frequency table allows you to delete portions of the incoming signal before it is demodulated. One use of this is to remove spurious components that might be misinterpreted as modulation sidebands. It also can be used to force the instrument to analyze just selected portions of the signal. The HP 3562A performs linear interpolation across removed areas of the frequency spectrum.

Using the delete frequency table is, of course, optional. If DELETE ON OFF is OFF or the table is empty, no frequency components are removed from the incoming signals.

When DELETE FREQ is pressed, the delete frequency table and its menu are displayed. Values to be added are entered in the table by pressing ADD VALUE, then entering the minimum and maximum frequencies separated by a comma (,). Figure 5-4 shows an example of the table.



```
                 DEMODULATION
            Deleted Frequency Bands
Line     Start freq      Stop freq
1           0.0             3.0
2          59.0            61.0
3          75.0k           80.0k
4          90.0k          100.0k
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
```

Deletes from dc to 3 Hz

Deletes from 59 to 61 Hz

Deletes from 75 to 80 kHz

Deletes from 90 to 100 kHz

Figure 5-4 The Delete Frequency Table

Step 6: Proceed with Measurement Set Up

Once demodulation has been set up using the first five steps, you now finish setting up the measurement as you would any other measurement in the linear resolution mode. Turn to Chapter 1 for the steps unique to this mode, then use Chapter 7 to set up the inputs. Note that demodulation must be zoomed (use a non-zero start frequency). Also, the previewing feature (in the **AVG** menu) normally offered in the linear resolution mode is not applicable to demodulation. The special demodulation preview feature, covered next in Step 7, is used instead. When averaging is off and a demod measurement is started, one measurement is taken.

Step 7: Use Previewing (optional)

Demodulation previewing allows you to view each time record before it is demodulated. When PRVIEW ON OFF is ON, the record is displayed along with the message "Accept Data? (Yes/No)." The analyzer pauses until you press **YES** (in the Entry group) to demodulate the record and measure it. If you press **NO**, the record is discarded then the next one is collected and presented for approval. Note that pressing PRVIEW ON OFF while a measurement is in progress pauses the measurement.

Step 8: Use the DEMOD POLAR Display (optional)

The DEMOD POLAR display is a plot of the locus of the tip of the carrier vector as it is being modulated. The normalized carrier vector can be thought of as extending from −100.0% to 0.0%. The origin of the display, therefore, is at the tip of the at-rest carrier vector. Phase modulation deflects the vector up or down. Amplitude modulation makes the carrier vector shorter or longer. For example, a ±90 degree PM with no AM is displayed as a semicircle centered at −100.0% with radius 100% passing through 0.0% on the right side.

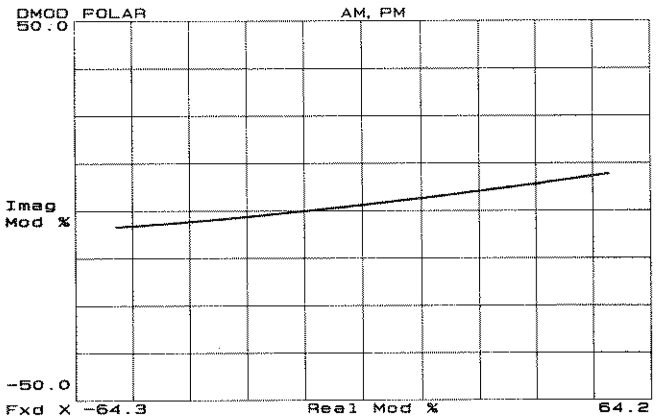


Figure 5-5 The DEMOD POLAR Display

DEMODULATION SETUP CHECKLIST

Here are the steps to set up demodulation measurements:

1. Activate demodulation: press **MEAS MODE** followed by LINEAR RES, press DEMOD ON OFF to ON, then press DEMOD SELECT. (page 5-6)
2. Select the channel(s) to be demodulated: use the DEMOD SELECT menu. (page 5-6)
3. Select AM, FM or PM demodulation: use the demod types menu. (page 5-6)
4. For FM or PM demodulation, select auto carrier or enter a user carrier frequency: use the PM/FM CRRIER menu. (page 5-8)
5. Set up the delete frequency table (optional): press DELETE FREQ in the DEMOD SELECT menu. (page 5-9)
6. Proceed with linear resolution measurement setup: refer to Chapter 1.
7. Use previewing (optional): press PRVIEW ON OFF to ON. (page 5-10)
8. Use the DEMOD POLAR display, if desired: press **MEAS DISP**, then FILTRD INPUT followed by DEMOD POLAR. (page 5-10).

USING TIME THROUGHPUT

PURPOSE OF THIS CHAPTER

This chapter shows you the details of using the time throughput feature. The HP 3562A's HP-IB system controller capability allows you to store input data directly to disc memory, without using an external controller. Time throughput supports the Hewlett-Packard 914X and 91XX series of disc drives. (Some other discs drives may be used, but their service diagnostics are not supported by the 3562A.) No HP-IB programming knowledge is required to use time throughput. For an introductory discussion of throughput, please refer to the User's Guide at the beginning of this manual.

This chapter is divided into four parts:

1. Creating throughput files on disc
   —set file size
   —name and create the file

2. Setting up the throughput session
   —activate throughput
   —select channel(s)
   —set throughput length
   —view input signals
   —set up the inputs
   —identify active file
   —start throughput
   —view the throughput header

3. Measuring and analyzing throughput data
   —identify active file
   —view the active file
   —set the measurement starting point
   —set up and start the measurement

4. Using capture blocks as throughput files

To keep track of where you are while setting up throughput sessions, fold out the throughput setup checklist at the end of this chapter.

OVERVIEW OF TIME THROUGHPUT

Figure 6-1 shows the interaction between the HP 3562A and the disc drive during time throughput.

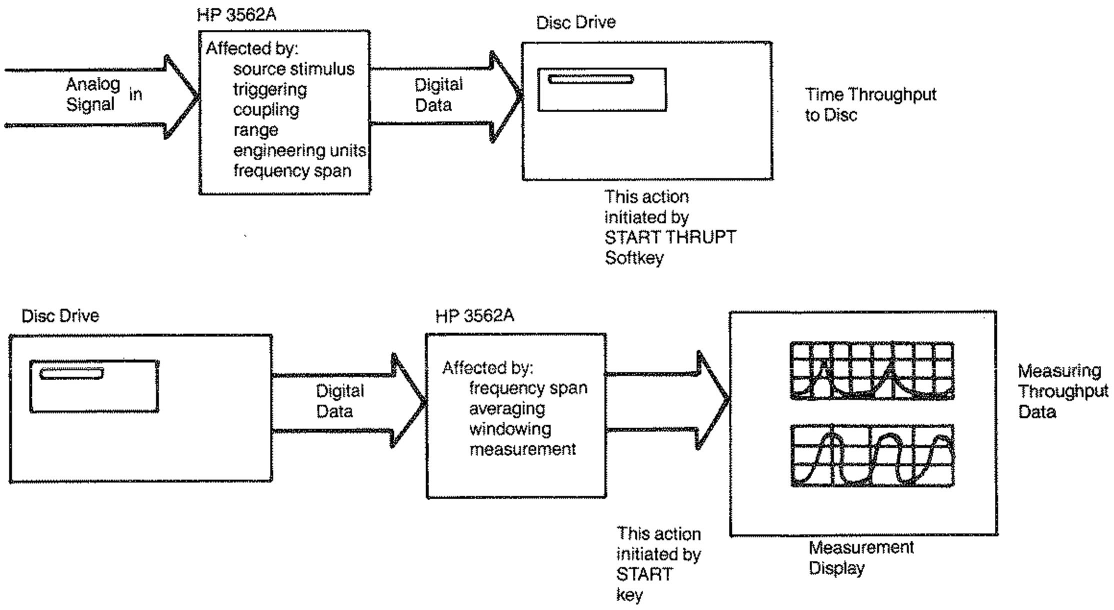


Figure 6-1 Overview of Time Throughput

The remainder of this chapter explains the steps to create files, set up throughput sessions, and measure throughput files.

THROUGHPUT REAL TIME BANDWIDTHS

Real time bandwidth (RTBW) with time throughput is a function of the disc drive being used. Here are nominal RTBWs for several Hewlett-Packard disc drives:

Model	1-channel	2-channel
All Command Set/80 drives:	10 kHz	5 kHz
Subset/80 drives:		
9122D	1.56 kHz	800 Hz
9133D floppy	1.56 kHz	800 Hz
Winchester	2.5 kHz	1.25 kHz
9121S	500 Hz	200 Hz
9121D	500 Hz	200 Hz
9133V	500 Hz	200 Hz
9133XV	500 Hz	200 Hz

Note that these are nominal values and are not guaranteed for a particular setup. The throughput header indicates the number of records that were collected in real time. For example, if "10" is indicated under REAL TIME in the header, the first ten records were real time and gaps appear between records starting with the eleventh record.

A NOTE ABOUT LOG RESOLUTION THROUGHPUT

Because the log resolution mode measures multiple-decade spans in parallel (see Chapter 2 for details), more records are required when creating a file and setting up a session for log resolution throughputs. Here are the required number of real time records for each log resolution span (double these numbers for two-channel throughputs):

Span (in decades)	Number of Records Required
1	1
2	10
3	100
4	1000
5	10000

Because you do not have to measure in the same mode as you throughput, the number of records on disc is the same. For example, if you throughput at a 4-decade span, you need to set a session length of 1000 records.

The number of records required for log resolution throughputs must be taken into consideration twice in this chapter: first when creating the disc file, then again when setting the session length.

CREATING TIME THROUGHPUT FILES ON DISC

Time throughput requires a disc drive connected to the HP 3562A and an initialized disc. To connect the disc drive, select drive addresses and unit numbers, and initialize discs, please refer to Chapter 11.

Once your disc has been initialized, a file must be created for throughput sessions. This requires two steps:

1. Set the file size
2. Name and create the file

To perform these two steps, press **DISC** in the HP-IB group. When its menu appears, press the DISC FCTN softkey, which displays the following menu (the only softkeys of concern here are THRUPT SIZE and CREATE THRUPT):

SERVCE FCTNS	Displays the disc service functions menu; see Chapter 11.
DISC COPY	Displays the disc copy menu; see Chapter 11.
FORMAT	Displays the disc formatting menu; see Chapter 11.
PACK DISC	Packs the disc; see Chapter 11.
THRUPT SIZE	Used to enter the size of the throughput file. The size is limited to 32,767 records or the space available on your disc. You must be specify the size every time you create a file.
CREATE THRUPT	Creates and names the throughput file.
ABORT HP-IB	Aborts HP-IB operations. Press this if the disc drive does not respond properly.
RETURN	Redisplays the **DISC** menu.

File Creation Step 1: Set File Size

The size of throughput files is set in units of time, revolutions, or records. File size is limited to 32, 767 records or the space available on disc. The current value of THRUPT SIZE determines the size of the file created when CREATE THRUPT is pressed. To set the size, press **DISC,** followed by the DISC FCTN softkey. When its menu appears, press THRUPT SIZE and enter the size using the **0** - **9** keys and the units softkeys that appear. If you enter a file size that does not represent an integer number of time records, the size is rounded up to the next whole record. For example, if the record length is currently 1.0 seconds and you enter 9.5 seconds with THRUPT SIZE, a file 10 records (i.e. 10.0 seconds) long will be created.

NOTE 1

The file size must be equal to or greater than the size of any throughput session that will use the file. ***If you plan to save two-channel measurements to disc, make the throughput file twice as long.*** *For example, a 10-record, two-channel record throughput session requires a 20-record throughput file.*

NOTE 2

If you intend to use cross-channel delays (i.e., use different trigger delays on the two channels), you need to make the throughput file at least one record longer than any session that will be using that file.

File Creation Step 2: Name the File

When CREATE THRUPT is pressed, the HP 3562A shifts into the alpha mode to allow you to enter the name for the file about to be created. When a file is created, its size is set to the current value of THRUPT SIZE. The default name for the active file (explained later in this chapter) is "THRUPUT." If the file name is not critical, creating a file called "THRUPUT" saves you some keystrokes because this is the default active file name. In the alpha mode, all front panel keys (except **LINE** and **HELP**) are converted to their blue labels, and the following menu is displayed:

ENTER	Saves the current alpha entry, exits the alpha mode, and creates the file on disc. The TALK and LISTEN indicators in the HP-IB group alternately flash as the file is being created.
SPACE FORWRD	Moves the cursor one space forward for editing. Use the "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use **BACK SPACE.**
INSERT ON **OFF**	When this is pressed ON, characters are inserted at the cursor position. When it is OFF, new characters are written over existing ones.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the entry from the cursor to the end of the line. This does not exit the alpha mode.
CANCEL ALPHA	Clears the current entry and exits the alpha mode. The file cannot be created until a valid name is entered.

SETTING UP THROUGHPUT SESSIONS

A throughput "session" differs from a throughput "file" in that the file is merely space reserved on disc, while a session is the actual throughputting of data to the disc. Files can be used repeatedly for successive sessions, but note that each file can contain only one session. Once a throughput file has been created on disc, you are ready to activate throughput and set up the throughput session. Setting up and starting a session requires eight steps:

1. Activate time throughput
2. Select the channel(s)
3. Set the throughput length
4. View the input signals (optional)
5. Set up the inputs
6. Identify the active file
7. Start the throughput session
8. View the throughput header (optional)

Setup Step 1: Activate Time Throughput

To activate time throughput, press **MEAS MODE.** When its menu appears, select LINEAR RES or LOG RES—time throughput is applicable only to the linear and log resolution modes. When one of these modes is selected, the THRUPT ON OFF softkey is displayed. Pressing this softkey ON activates time throughput and displays the THRUPT SELECT softkey. Pressing THRUPT SELECT displays the following menu:

START THRUPT	Starts the throughput session.
ABORT THRUPT	Aborts the current throughput session. All data up to the last complete record are preserved when a session is aborted. The throughput header shows the actual number of records saved on disc.
ACTIVE FILE	Used to identify the active throughput file; see "Setup Step 6: Identify the Active File."
THRUPT LENGTH	Used to enter the length of the next throughput session. The length is limited only by the length of the active file on the disc. See "Setup Step 3: Set Throughput Length."
THRUPT HEADER	Displays the throughput header; see "Setup Step 8: View the Throughput Header."
RETURN	Redisplays the **MEAS MODE** menu.

When throughputting to CS/80 drives, spared areas on disc are skipped over (without losing real time), but the record count continues to increment as these areas are passed over. Consequently, you should make your file a few records longer than your session to allow room for spared blocks. When throughputting to SS/80 drives, spared areas are not skipped, so real time could be lost. It is recommended that you use only unspared, high-quality media for long throughputs.

Setup Step 2: Select the Throughput Channel(s)

The channels to be used for throughput are selected with the **SELECT MEAS** menu. Press **SELECT MEAS,** then press CH 1&2 ACTIVE, CH 1 ACTIVE or CH 2 ACTIVE.

Setup Step 3: Set the Throughput Length

THRUPT LENGTH sets the length for the next throughput session. This differs from THRUPT SIZE in the DISC menu in that THRUPT LENGTH specifies the length of a particular session, while THRUPT SIZE is the actual reserved size of the file on disc. The length may be set in time, number of revolutions, or records. **Note that two-channel throughputs require twice the session length.** For example, to throughput 5 records on both channels, the throughput size must be 10 records.

Setup Step 4: View the Input Signals (Optional)

It is generally desirable to view the input signals before the throughput session is started so that the optimum input setup can be determined. Pressing **VIEW INPUT** displays the following menu:

INPUT TIME 1	Displays the time data present at the Channel 1 input connector.
INPUT TIME 2	Displays the time data present at the Channel 2 input connector.
INPUT SPEC 1	Displays the FFT of the time data on Channel 1.
INPUT SPEC 2	Displays the FFT of the time data on Channel 2.
THRUPT TIME 1	Displays the first record (referenced to the Channel 1 trigger delay value) of the Channel 1 time data in the active file. The record length is determined by the frequency span used in the throughput session.
THRUPT TIME 2	Displays the first record (referenced to the Channel 2 trigger delay value) of the Channel 2 time data in the active file. The record length is determined by the frequency span used in the throughput session.
NEXT RECORD	Displays the next record of time data in the active file. NEXT RECORD checks the position of the displayed files and recalls the next record of the active trace(s).
VIEW OFF	Disables updating of the view input displays.

THRUPT TIME 1, THRUPT TIME 2 and NEXT RECORD are used after the throughput session has been taken. The use of these three softkeys is explained in "Measuring and Analyzing Throughput Files" later in this chapter.

Setup Step 5: Set Up the Inputs

The next step is to set up the Measurement and Input Setup groups. The mode **(MEAS MODE)** has already been selected, and the measurement, averaging and windowing are not selected until the the throughput file is recalled from disc and measured. However, frequency span and the source (if you plan to use it) need to be set up now. Refer to Chapter 1 (for linear resolution) or Chapter 2 (for log resolution) to perform these steps. Then turn to Chapter 7 (for either mode) for instructions on the Input Setup group. When that is completed, return to this chapter and proceed with Setup Step 6.

Triggering on throughputs determines the start of the entire session, not of each record. You can set differential delay between the two channels up to 50 records. Overload rejection is ignored in throughput. Overloaded data will not be indicated when throughput data is recalled from disc.

Setup Step 6: Identify the Active File

Once a file has been created on disc using THRUPT SIZE and CREATE THRUPT in the **DISC** menu, it may be identified as the active file. The active file receives the data when the throughput session is started. The default active file name is "THRUPUT," so if you have a disc file with this name, the active file is already identified for you. When ACTIVE FILE is pressed, the HP 3562A shifts into the alpha mode and displays the alpha menu. This is the same menu described earlier in this chapter under "File Creation Step 2: Naming and Creating the File." The only difference is that pressing ENTER in this case identifies the active file, rather than creating a file on disc.

Setup Step 7: Start the Throughput Session

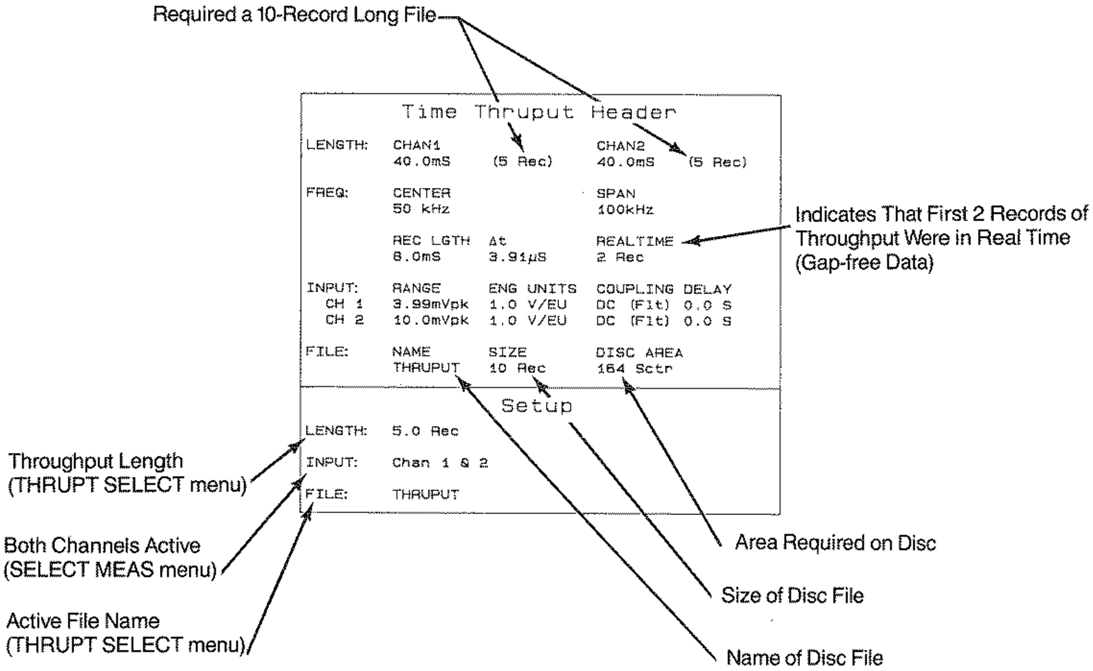
When the first six steps have been completed, the session can be started by pressing START THRUPT. If a problem is encountered, such as the disc not being connected, press ABORT THRUPT to abort the session and return to normal operation. When finished, the throughput session is saved under the active file name and can recalled at any time for measurement and analysis.

NOTE

Pressing ABORT THRUPT does not preserve any data from the current session.

Setup Step 8: View the Throughput Header (Optional)

The throughput header shows the instrument state and session information for the current throughput session. To display the header, press THRUPT HEADER after the session is complete. Figure 6-2 shows an example header.



```
             Time Thruput Header
LENGTH:   CHAN1                     CHAN2
          40.0mS     (5 Rec)        40.0mS    (5 Rec)

FREQ:     CENTER                    SPAN
          50 kHz                    100kHz

          REC LGTH   Δt             REALTIME
          8.0mS      3.91µS         2 Rec

INPUT:    RANGE      ENG UNITS      COUPLING DELAY
  CH 1    3.99mVpk   1.0 V/EU       DC (Flt) 0.0 S
  CH 2    10.0mVpk   1.0 V/EU       DC (Flt) 0.0 S

FILE:     NAME       SIZE           DISC AREA
          THRUPUT    10 Rec         164 Sctr
                    Setup
LENGTH:   5.0 Rec

INPUT:    Chan 1 & 2

FILE:     THRUPUT
```

Figure 6-2 The Time Throughput Header

MEASURING AND ANALYZING THROUGHPUT FILES

Throughput files may be recalled from disc at any time for measurement and analysis. Because throughput must be used in conjunction with the linear or log resolution mode, files are measured and analyzed in one of these two modes. (Data throughput in log resolution then measured in linear resolution will not be calibrated correctly.) To analyze measured data using the display and marker features, please refer to Chapter 8. There are four steps to measure data from a throughput file:

1. Identify the active file
2. View the active file (optional)
3. Set the measurement starting point
4. Set up the measurement

Measurement Step 1: Identify the Active File

When the disc file was being filled with a throughput session, identifying the active file specified which disc file was to receive the data. When the file is to be recalled from disc and measured, identifying the active file specifies which disc file is the source of the data. Identify the file using the procedure outlined in "Setup Step 3: Identify the Active File." Again, the default file name for the active file is "THRUPUT," so if your file has that name, the active file is already identified for you.

Measurement Step 2: View the Active File (Optional)

You can view the time domain data in the throughput file after the session has been stored on disc and before it has been measured. One of the uses of viewing the data before the measurement is made is to determine the appropriate starting point for the measurement. Pressing **VIEW INPUT** displays the following menu:

INPUT TIME 1	Displays the time data present at the Channel 1 input connector.	
INPUT TIME 2	Displays the time data present at the Channel 2 input connector.	
INPUT SPEC 1	Displays the FFT of the time data on Channel 1.	
INPUT SPEC 2	Displays the FFT of the time data on Channel 2.	
THRUPT TIME 1	Displays the first record (relative to the Channel 1 trigger delay) of the Channel 1 time data in the active file. The record length is determined by the frequency span used in the throughput session.	Softkeys of interest here
THRUPT TIME 2	Displays the first record (relative to the Channel 2 trigger delay) of the Channel 2 time data in the active file. The record length is determined by the frequency span used in the throughput session.	
NEXT RECORD	Displays the next record of time data in the active file. NEXT RECORD remembers the position of the displayed files and recalls the next record into the active trace(s).	
VIEW OFF	Turns off the view input displays. These displays must be turned off before measurement displays are selected.	

Measurement Step 3: Set the Starting Point

When a throughput file is recalled from disc to be measured, you can set the starting point of the measurement using delayed triggering. (For example, if you do not want the first record in the throughput file included in the measurement, set a trigger delay of one record. The measurement would then start at the second record in the file.) The measurement starts at the beginning of the file if you do not set a different starting point. This value of trigger delay is relative to the original trigger point in the data acquired during the throughput session.

This use of delayed triggering is completely separate from any triggering done during the throughput session; the only function of delay here is to set the starting point of the measurement. To set the starting point, press **TRIG DELAY,** then use CHAN 1 DELAY or CHAN 2 DELAY. The maximum delay is 50 records, regardless of the units you select. Note that this is the only time triggering is applicable to the log resolution mode. You must select one of the trigger types to use delay; delay is ignored in free run (except in log resolution).

If you measure the file on a different span than it was throughput, the digital filter in the HP 3562A needs to resettle to the new span. This resettling can introduce a transient into the beginning of the measurement. In this case, it is generally recommended that the beginning of the file be excluded from the measurement to allow time for the filter to settle. The maximum that needs to be excluded is 1/10 of an output record. You can either use pre-triggering during the session to collect 1/10 record (times the zoom factor you will be using) more than you need, or set the measurement starting point at 1/10 record when recalling the file from disc.

Measurement Step 4: Set Up the Measurement

When you are ready to measure a stored throughput file, go to Chapter 1 (for the linear resolution mode) or Chapter 2 (for the log resolution mode) and select the measurement you wish to perform on the throughput data. At this point, you also need to select windowing, averaging and a new frequency span, if desired. Note that you cannot zoom (use a non-zero start frequency) during the throughput measurement if you had zoomed during the throughput session. For example, if the span during the throughput session was 0 - 10 kHz, you could zoom at 5 - 6 kHz for the measurement. However, if you had zoomed during the session from 10 - 20 kHz, you must retain that span for the measurement. If you are using delayed triggering to set the measurement starting point and you changed the frequency span, you should set the trigger delay after changing the span because the delay (if entered in records) is converted to seconds upon entry.

Overlap processing with averaging off operates differently when throughput is active. If averaging is off (AVG OFF active), no overlap processing is achieved, regardless of the value of OVRLP%.

NOTE

If you are processing throughput data at a frequency span other than the span at which the data were acquired, the measurement is terminated if it encounters a gap in the data coming from disc (resulting from a loss of real time during the session).

When the setup is ready, press the yellow **START** key. The TALK and LISTEN indicators in the HP-IB group alternately flash to show that the file is being recalled from disc. Because individual records are not triggered, single-channel phase displays for throughput measurements are not accurate.

USING CAPTURE BLOCKS AS THROUGHPUT FILES

Capture blocks that have been stored on disc previously can be used as input to a throughput measurement. Identify the stored capture block as the active file (Measurement Step 1), then proceed as with a normal throughput measurement. Chapter 4 shows how to save captured blocks to disc.

THROUGHPUT SETUP CHECKLIST

Here are the steps to create a throughput file on disc, set up a throughput session, and then measure the throughput file:

Create a file

1. Set file size: use THRUPT SIZE in the DISC FCTN menu (under **DISC**). (page 6-6)
2. Name and create the file: use CREATE THRUPT in the DISC FCTN menu (under **DISC**). (page 6-7)

Set up a throughput session

1. Activate throughput: activate LINEAR RES then THRUPT ON OFF in the **MEAS MODE** menu. (page 6-9)
2. Select throughput channel(s): use CH 1&2 ACTIVE, CH 1 ACTIVE or CH 2 ACTIVE in the **SELECT MEAS** menu.
3. Set session length: use THRUPT LENGTH in the THRUPT SELECT menu. (page 6-9)
4. View the input signals, if desired: use the **VIEW INPUT** menu. (page 6-10)
5. Set up the inputs: refer to Chapter 7 for triggering, range, coupling, calibrating and engineering units. See note regarding triggering on page 6-11.
6. Identify the active file: use ACTIVE FILE in the THRUPT SELECT menu. (page 6-11)
7. Start the session: press START THRUPT in the THRUPT SELECT menu. (page 6-11)
8. View the throughput header, if desired: press THRUPT HEADER in the THRUPT SELECT menu. (page 6-12)

Measure and analyze a throughput file

1. Identify the active file: use ACTIVE FILE. (page 6-13)
2. View the active file, if desired: use THRUPT TIME 1 and/or THRUPT TIME 2 in the **VIEW INPUT** menu. (page 6-14)
3. Set the measurement starting point (if other than the beginning of the file): use the **TRIG DELAY** menu. (page 6-14)
4. Set up and start the measurement: refer to Chapter 1 or Chapter 2.

Chapter 7

INPUT SETUP

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you how to set up the HP 3562A's input section, the group of six keys labeled "Input Setup." This chapter shows you how to:

1. couple the inputs

2. set the input range

3. set up triggering, including delayed triggering

4. calibrate the input channels

5. use engineering units

COUPLING THE INPUTS

WARNING

To assure operator protection, do not exceed ± 42 Vpeak relative to ground or 42 Vpeak between Channels 1 and 2.

CAUTION

Do not ground the input channels when measuring from a low impedance source; this could result in damage to the device under test because grounding the input channels connects them through 200Ω to chassis ground.

Because the HP 3562A's inputs are differential, they normally float with respect to ground. However, you have the option of floating or grounding the inputs independently. Grounding connects the input channels' ground reference (the outside shell of the BNC connectors) through 200Ω to chassis ground.

You can also specify ac or dc coupling for the inputs independently. With ac coupling, a series capacitor is inserted to remove dc signals and drifts associated with dc from the input signals. The 3 dB cutoff frequency for ac coupling is less than 1 Hz. Press **INPUT COUPLE** to display the following menu:

CHAN 1 AC **DC**	Selects ac or dc coupling for Channel 1.
CHAN 2 AC **DC**	Selects ac or dc coupling for Channel 2.
FLOAT **CHAN1**	Floats Channel 1.
GROUND CHAN 1	Grounds Channel 1.
FLOAT **CHAN2**	Floats Channel 2.
GROUND CHAN 2	Grounds Channel 2.

SETTING THE INPUT RANGE

You have a choice between manually setting the input range or letting the HP 3562A automatically set the range. The auto-range feature sets the range in response to the amplitude level detected at the inputs; it adjusts the range so that the input level stays in the upper half of the input range. Press **RANGE** to display the following menu:

CHAN 1 RANGE	Allows you to set the range for Channel 1, from −51 dBV (3.99 mVpeak) to +27 dBV (31.66 Vpeak).
AUTO 1 **UP&DWN**	Activates autoranging on Channel 1 and allows it to adjust the range in either direction.
AUTO 1 RNG UP	Activates autoranging on Channel 1 but allows it to increase the range only.
CHAN 2 RANGE	Allows you to set the range for Channel 2, from −51 dBV (3.99 mVpeak) to +27 dBV (31.66 Vpeak).
AUTO 2 **UP&DWN**	Activates autoranging on Channel 2 and allows it to adjust the range in either direction.
AUTO 2 RNG UP	Activates autoranging on Channel 2 but allows it to increase the range only.

When active, autoranging occurs whenever the input signal level falls below half range or exceeds full range, with several exceptions. It does not interrupt averaged measurements, time captures, or time throughputs. Auto ranging activity is indicated by flashing of the OVER RANGE and HALF RANGE LEDs. Refer to Chapter 3 for an explanation of autoranging in the swept sine mode.

Preventing autoranging from decreasing the range (AUTO 1/2 RNG UP) is helpful for impact, transient, and random noise measurements. When the input signal level drops momentarily (e.g., between hammer impacts), this prevents the analyzer from immediately autoranging down to the ambient noise level. If necessary, you can restart AUTO 1/2 RNG UP by momentarily switching to AUTO 1/2 UP&DWN, then back to AUTO 1/2 RNG UP.

When entering a range in Vrms or dBVrms, the peak-to-rms ratio of a sine wave is always used to convert Vrms to Vpk. This differs source level, where the ratio matches the current source type. You can manually set the range (using CHAN 1 RANGE and/or CHAN 2 RANGE) anywhere from −51 dBV (3.99 mVpeak) to +27dBV (31.66 Vpeak), where dBV is referenced to 1 Vrms. Note that you can set the range for both channels at once by entering the value immediately after pressing **RANGE**.

Setting the input range is critical for making distortion-free measurements. The input range should be set at such a level that the input signal is at least 50% of the input range. You can monitor this by ensuring that the green HALF RANGE indicator is on (flashing or steady), but the red OVER RANGE indicator is not. If HALF RANGE is off, the signal-to-noise ratio is less than optimum; if OVER RANGE is on, the measurement will be distorted. The message "OV1" or "OV2" at the top right corner of the trace indicates an overload occurred in the respective channel. Figure 7-1 gives an example of the distortion introduced by an incorrect range setting.

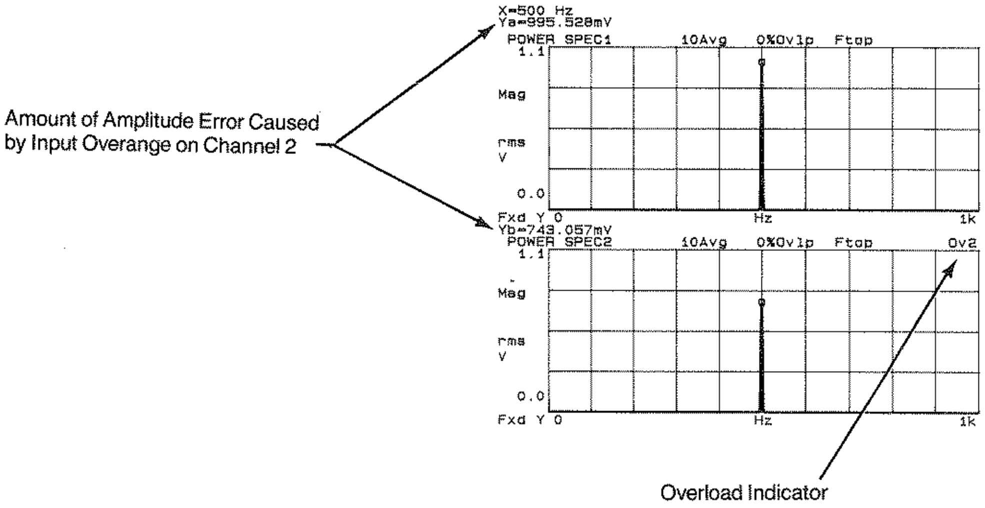


Figure 7-1 The Importance of Correct Input Range

If you are in the linear or log resolution modes, the **AVG** menu offers automatic overload rejection, which can reject any time record whose amplitude exceeded the input range; refer to Chapter 1 (for linear resolution) or Chapter 2 (for log resolution). Also, the **VIEW INPUT** displays can simplify setting the input range by allowing you to view the actual amplitude of the input signals.

When using time throughput, overloads are indicated only during the throughput session—not when data files are being read back from disc during a measurement.

SETTING UP TRIGGERING

The HP 3562A's trigger function defines the conditions for acquiring a new time record. To set up triggering, press **SELECT TRIG** to display the following menu:

TRIG LEVEL	Allows you to set the level at which the trigger will be activated. The resolution of the trigger level is a function of input range. If the trigger level is greater than the input range for input triggering, the range becomes the trigger level. External trigger level has hysteresys of 320 mV.
ARM **AU** MAN	Selects auto or manual arming of the trigger circuit.
FREE RUN	Selects the free run trigger mode.
CHAN 1 INPUT	Designates the signal on Channel 1 as the trigger signal. The maximum trigger level you can set is limited to the input range on Channel 1.
CHAN 2 INPUT	Designates the signal on Channel 2 as the trigger signal. The maximum trigger level you can set is limited to the input range on Channel 2.
SOURCE TRIG	Designates the source gating signal as the trigger signal. Note that level and slope are not selectable with source triggering. Source triggering is designed for use with the source burst outputs because it ensures accurate triggering with these signals. The source gating signal is also available at the rear panel SYNC OUT connector; see "SYNC OUT (connector)" in Chapter 12 for more information.
EXT	Designates the signal at the EXT TRIGGER front panel input as the trigger signal. This signal is limited to ± 10 Vpeak. This input is always DC coupled.
SLOPE ± −	Determines whether the measurement triggers on the positive or negative transition of the trigger signal through the selected trigger level.

The trigger conditions are level and slope, as defined by TRIG LEVEL and SLOPE + −. Whenever the designated trigger signal (except source triggering) passes through the specified level on the specified transition, the trigger conditions are met, and the measurement triggers.

Trigger level is limited to the current range setting for CHAN 1/2 INPUT triggering, to ±10V for EXT, and is irrelevant for FREE RUN and SOURCE TRIG.

NOTE

External triggering does not operate reliably on signals below 500 mVpeak. With the Channel 1 or 2 inputs, triggering is possible at levels down to 32 dB below the current input range. If the desired external trigger signal is less than 500 mVpeak, it can be applied to either input channel, if the range is set approximately and input channel triggering is used.

Manual Arming versus Auto Arming

Auto arming automatically resets the trigger after each time record is acquired. Manual arming collects one time record when **ARM** (in the Status group) is pressed and the trigger conditions are satisfied. The instrument does not look for the trigger signal until **ARM** is pressed. When one record is acquired, the instrument then waits until **ARM** is pressed again. Free run triggering always overrides manual arming.

Delayed Triggering

The HP 3562A can pre-trigger up to 4095 samples (4094 for zoom) before and post-trigger up to 102,400 samples after the trigger signal actually arrives. Pre-triggering is useful for impact analysis to ensure that you have captured the entire impulse. Post-triggering is helpful when analyzing systems with time delays because the measurement can wait until the desired signal arrives. Delayed triggering is also used when recalling and measuring throughput files from disc (see Chapter 6 for more information on time throughput). Note that overload rejection does not reject records used in counting post-trigger delay. Press **TRIG DELAY** to display the following menu:

CHAN 1 DELAY	Allows you to set the pre- or post-trigger delay for Channel 1, using the Entry group.
CHAN 2 DELAY	Allows you to set the pre- or post-trigger delay for Channel 2, using the Entry group.

The delay may be specified in microseconds, milliseconds, seconds, minutes, revolutions or records. Enter negative numbers to specify pre-trigger delay. The resolution is 1/2048 of a record (one sample). To find the current time record length for setting delayed triggering, press **STATE TRACE** until the state is displayed and look under FREQ: REC LGTH. Delay is rounded to the nearest Δt, and the actual delay used can be echoed by pressing CHAN 1/2 DELAY after the measurement. Free run triggering overrides trigger delays.

CALIBRATING THE HP 3562A

The HP 3562A's calibration routine adjusts the gain and phase accuracy and common mode rejection of the input channels to comply with the analyzer's specifications. It starts by applying a known signal (internally) to the input channels. Next, it measures this known signal and compares it to the channels' responses. From these, it then generates calibration constants to use in adjusting the input circuitry.

You can choose auto cal, which calibrates on a regular schedule, or single cal, which calibrates only when you desire. To make the choice, press **CAL** to display the following menu:

AUTO **ON** OFF	Selects auto cal; see table 7-1 for the auto cal schedule. This softkey is reset to ON at power-up.
SINGLE CAL	Performs a single calibration.

Auto cal performs calibration according to the schedule in table 7-1.

Table 7-1 Auto Calibration Schedule

At power-on
8 minutes after power-on
1 hour after power-on
Every 2 hours thereafter

There are several exceptions to the auto cal schedule. Auto cal does not interrupt averaged measurements, time captures, time throughputs, auto math/auto sequence edits, or sweeps. If source protect is on, calibration turns the source off during the cal, then turns it back on when the cal is finished. Before starting lengthy measurements, turn auto cal off and perform a single cal. Note that the gain and phase are still accurate after 2 hours unless a significant change in the operating environment (temperature change, etc.) is experienced. Calibration activates AC coupling and leaves it active.

If a cal failure should occur (the failure message will be displayed on the screen), refer servicing to qualified personnel. A list of HP Sales and Support Offices is included at the end of this manual.

USING ENGINEERING UNITS

The HP 3562A can calibrate and display measurements using your own engineering units (EU). For example, assume you have a accelerometer calibrated at 10 mV/G. You can tell the HP 3562A to calibrate its measurements at 10 mV/EU and label the display in Gs. Now you can read the display directly and accurately in Gs. You can enter EU values and labels for the two channels independently. Press **ENGR UNITS** to display the following menu:

EU VAL CHAN 1	Selects engineering units for Channel 1. Press EU VAL CHAN 1, then enter your calibration constant.
VOLTS CHAN 1	Selects volts for Channel 1 and disables engineering units.
EU LBL CHAN 1	Used to enter the label for Channel 1 engineering units. See "Entering EU Labels." The label can contain up to 5 characters. Pressing this displays the alpha menu.
EU VAL CHAN 2	Selects engineering units for Channel 2. Press EU VAL CHAN 2, then enter your calibration constant.
VOLTS CHAN 2	Selects volts for Channel 2 and disables engineering units.
EU LBL CHAN 2	Used to enter the label for Channel 2 engineering units. "See Entering EU Labels." The label can contain up to 5 characters. Pressing this displays the alpha menu.

Engineering units labels replace "volts" on the vertical scale and in all applicable units menus. The label also replaces the vertical units label on the screen. For example, if "METER" is the EU label and you select VOLTS2 as the vertical unit, the display reads METE2 (truncated to 5 characters). Two-channel measurements display both EU labels.

EU VAL entries are limited to ± 1nV to ± 1000V. The dB terminator choice is dB referenced to 1Vrms. The EV terminator softkey that appears in some menus is always linear, even if the trace is displayed on a log scale.

Entering EU Labels

When either EU LBL CHAN 1 or EU LBL CHAN 2 is pressed, the HP 3562A shifts into the alpha mode to allow you to enter an alphanumeric label. In the alpha mode, all front panel keys (except **LINE** and **HELP**) are converted to their blue labels, and the following menu is displayed:

ENTER	Saves the current alpha entry and exits the alpha mode.
SPACE FORWRD	Moves the cursor one space forward for editing. Use the "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use the **BACK SPACE** key.
INSERT ON **OFF**	When this is ON, characters are inserted at the cursor position. When it is OFF, new characters are written over existing ones.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the alpha entry from the cursor to the end of the line.
CANCEL ALPHA	Clears the current entry and exits the alpha mode.

If engineering units are selected but an EU label is not entered, the default labels EU1 and EU2 are used. Note that EU labels are not displayed on the horizontal axis of orbits diagrams.

Chapter 8

DISPLAY CONFIGURATION

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you how to analyze measured data using the HP 3562A's display and marker features. It shows you how to:

1. Select the active trace
2. Format the display
3. Define the trace by selecting coordinates, units and scale
4. Select the display data—measurement display, input signals or instrument state
5. Use the X, Y and special markers
6. Save and recall states and traces using the HP 3562A's internal memory (storage in external disc memory is discussed in Chapter 11)

THE HP 3562A DISPLAY

Figure 8-1 shows a plot of the HP 3562A's display and explains the various fields on the screen. Some fields depend on display format (single, upper/lower, or front/back).

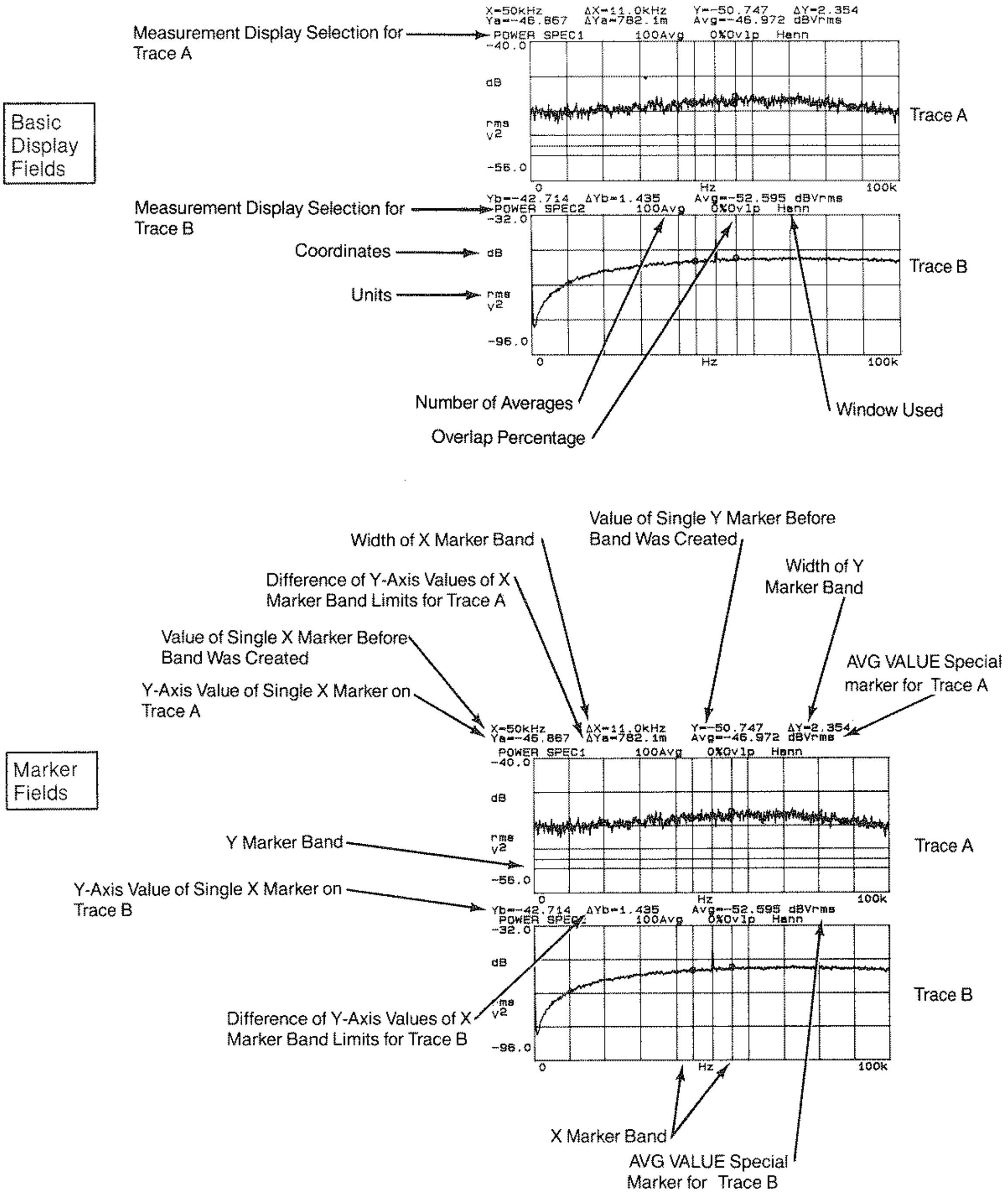


Figure 8-1 The HP 3562A Display

SELECTING THE ACTIVE TRACE

The three keys in the Active Trace group select the active trace. Pressing **A** activates trace A and illuminates the indicator above that key. Pressing **B** activates trace B and illuminates the indicator above that key. Pressing **A&B** activates both traces and illuminates both indicators.

Selection of the active trace is important because most dispay functions, including markers, math, coordinates, scale and Y-axis units, apply only to the active trace(s). In addition to selecting the active trace, these three keys may be used to return a measurement display after a table has been displayed.

FORMATTING THE DISPLAY

The three keys in the Display Format group determine the format of the display.

SINGLE shows the active trace in a full 7 cm display. If both traces are active, trace A is displayed and becomes the active trace.

UPPER LOWER divides the screen into two 3 cm displays. If both traces are active, trace A is displayed on the upper grid, and trace B is displayed on the lower grid. If one trace is active, it is displayed on both grids. The labels for the active trace(s) are highlighted.

FRONT BACK superimposes both traces in a 6.5 cm display. The display height is reduced slightly to allow room for the extra annotation at the top of the screen. The active trace and its annotation are highlighted. If both traces are active, trace A is highlighted.

DEFINING THE TRACE

Three keys and their associated menus define the active trace(s). **COORD** selects the display coordinates, including the choice between linear and logarithmic X-axis, to show different aspects of the measurement data. **SCALE** defines the horizontal and vertical scales. **UNITS** selects the horizontal and vertical units in which the traces are displayed.

COMBINING COORDINATES AND UNITS

The HP 3562A was designed to provide maximum flexibility in arranging the display to best fit your measurement needs. As a result, it can provide many combinations of units and coordinates. Some of these combinations yield unconventional results, so you should verify each combination. Refer to the coordinate and units fields on the display when interpreting each trace. Figure 8-1 at the beginning of this chapter shows where these fields are on the display.

SELECTING DISPLAY COORDINATES

Display coordinates may be selected before or after the measurement is made. Changing coordinates changes only the displayed trace; it does not alter or destroy any measurement data. Coordinates cannot be selected for the ORBITS T1vsT2 and DEMOD POLAR displays. Press **COORD** to display the following menu:

MAG (dB)	Defines the vertical axis as magnitude displayed in dB (deciBels).
MAG (dBm)	Defines the vertical axis as magnitude displayed in dBm (deciBels referenced to 1 milliwatt). After pressing MAG (dBm), you can enter an impedance value that matches the impedance of your input signal. The dBm coordinate must be referenced to a known impedance (traditionally 50Ω), so the analyzer needs to know the impedance of your inputs. The default value is 50Ω. See note 3 at the end of this menu.
MAG (LOG)	Defines the vertical axis as linear magnitude on a log scale.
MAG (LIN)	Defines the vertical axis as linear magnitude on a linear scale.
PHASE	Defines the vertical axis as phase in degrees. The phase center value can be entered after pressing PHASE. See note 1 at the end of this menu.
REAL	Displays the real portion of complex measurement data.
IMAG	Displays the imaginary portion of complex measurement data.
NEXT	Displays the second level of the **COORD** menu.

Pressing NEXT in the COORD menu displays the following menu:

NYQUST	Configures the display as a Nyquist diagram (imaginary vs. real).
NICHOL	Configures the display as a Nichols plot (log magnitude vs. phase). After pressing NICHOL, you can enter the the phase center of the X-axis, from −180 to +180 degrees. The default is 0 degrees.
LOG X	Selects a logarithmic horizontal axis. This softkey is not applicable to time or amplitude domain displays. See note 2 at the end of this menu.
LIN X	Selects a linear horizontal axis. See note 2 at the end of this menu.
RETURN	Redisplays the first level of the **COORD** menu.

NOTE 1

The appearance of the phase display depends on the Y-axis scaling; see "Scaling the Display" later in this section. Single-channel phase is referenced to the middle of the time record for the Hann, user-defined, flat top; and the beginning of the record for force, exponential and uniform windows. Phase is not calibrated for time capture and time throughput measurements.

NOTE 2

If a trace is originally measured or synthesized with linear resolution then converted to a log scale using LOG X, points in the resultant trace will not be distributed proportionately. To achieve true log distribution, the original trace must have log resolution. The converse is true for converting log traces to linear scale using LIN X.

NOTE 3

MAG (dBm) selects dBm for power spectra and dB for frequency response. If a frequency response is displayed when MAG (dBm) is pressed, dBm is still selected for subsequent power spectra.

SELECTING UNITS

The **UNITS** key allows you to select the horizontal and vertical units and enter trace titles. As with coordinates, changing the units does not alter or destroy any measurement data. Press **UNITS** to display the following menu:

P SPEC UNITS	Displays the power spectrum units menu, which sets the units for power and cross spectrum displays. See "The Power Spectrum Units Menu" following this menu.
L SPEC UNITS	Displays the linear spectrum units menu, which set the units for lnear spectrum displays. See "The Linear Spectrum Units Menu" following this menu.
SWEPT UNITS	Displays the swept units menu, which sets the units for power and cross spectrum displays in the swept sine mode. See "The Swept Units Menu" following this menu.
Hz (Sec)	Selects Hertz (or seconds for time domain traces) as the horizontal unit. This softkey does not apply to amplitude domain displays.
RPM (Sec)	Selects RPM (or seconds for time domain traces) as the horizontal unit. The X-axis is scaled in seconds in the time domain. This softkey does not apply to amplitude domain displays.
Orders (Revs)	Selects orders (or revolutions for time domain traces) as the horizontal unit. This is normally used with external sampling; refer to Chapters 1, 2 or 4 (depending on the mode) for more information. This softkey does not apply to amplitude domain displays.
Orders CAL	Used to enter Orders calibration in Hz/Ord. The calibration is stored in nonvolatile memory and is not affected by power-down or reset. This display unit does not affect the sampling frequency.
TRACE TITLE	Displays the alpha mode menu and allows you to enter a trace title. See "Trace Title" following this menu.

The Power Spectrum Units Menu

Power spectrum units apply to power and cross spectrum displays in the linear resolution, log resolution and time capture modes. After a selection is made, all power and cross spectrum displays in these three modes are in those units. Note that power spectrum units apply only to these displays and do not affect any other displays. To select these units, press **UNITS**, followed by P SPEC UNITS to display the following menu:

VOLTS PEAK	Selects volts (peak) as the basic amplitude unit.
VOLTS RMS	Selects volts (rms) as the basic amplitude unit.
VOLTS	Displays the trace in volts.
VOLTS^2	Displays the trace in volts^2.
$V/\sqrt{Hz}$ ($\sqrt{PSD}$)	Displays the trace in volts divided by square root of equivalent filter bandwidth.
V^2/Hz (PSD)	Displays the trace in volts^2 divided by equivalent filter bandwidth (power spectral density).
V^2s/Hz (ESD)	Displays the trace in volts^2 times record length divided by equivalent filter bandwidth (energy spectral density).
RETURN	Redisplays the **UNITS** menu.

The Linear Spectrum Units Menu

Linear spectrum units apply to linear spectrum displays. After a selection is made, all linear spectra are displayed in those units. Note that linear spectrum units apply only to these displays and do not affect any other displays. To select these units, press **UNITS**, followed by L SPEC UNITS to display the following menu:

VOLTS PEAK	Selects volts (peak) as the basic amplitude unit.
VOLTS RMS	Selects volts (rms) as the basic amplitude unit.
VOLTS^2	Displays the trace in volts^2.
$V/\sqrt{Hz}$ ($\sqrt{\ }$ PSD)	Displays the trace in volts divided by square root of equivalent filter bandwidth.
RETURN	Redisplays the **UNITS** menu.

The Swept Units Menu

Swept units apply to power and cross spectrum displays in the swept sine mode. After a selection is made, all power and cross spectrum displays in the swept sine mode are in those units. Note that swept units apply only to these swept sine displays and do not affect any other displays. To select these units, press **UNITS**, followed by SWEPT UNITS to display the following menu:

VOLTS PEAK	Selects volts (peak) as the basic amplitude unit.
VOLTS RMS	Selects volts (rms) as the basic amplitude unit.
VOLTS	Displays the trace in volts.
VOLTS^2	Displays the trace in volts^2.
RETURN	Redisplays the **UNITS** menu.

NOTE

MAG (dB) provides a faster display when used with the VOLTS^2 unit, as opposed to the VOLTS unit.

Trace Title

This softkey is used to enter trace titles. Titles can contain up to 20 alphanumeric characters and are plotted along with the display. When TRACE TITLE is pressed, the instrument shifts into the alpha mode, in which all front panel keys (except **LINE** and **HELP**) are converted to the blue labels under them. The **START** key, for example, becomes "C" in the alpha mode. Titles are erased at power-down and after reset. Here is the alpha mode menu that appears when TRACE TITLE is pressed:

ENTER	Saves the current alpha entry, displays it under the active trace, then exits the alpha mode.
SPACE FORWRD	Moves the cursor one space forward without erasing any characters. Use the "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use **BACK SPACE**.
INSERT ON **OFF**	When this is ON, characters are inserted at the cursor position. When it is OFF, characters are written over existing characters at the cursor position.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the alpha entry from the cursor position to the end of the line.
CANCEL ALPHA	Exits the alpha mode without changing the trace title.

SCALING THE DISPLAY

The horizontal and vertical axes offer several scaling options. You can explicitly enter minimum and maximum values for either axis, or the HP 3562A can auto scale to obtain the optimum display. In addition, the scale can be set to the current X and Y marker bands. Note that several of the **SCALE** softkeys are duplicated in the **X** and **Y** marker menus for convenience. Press **SCALE** to display the following menu:

X FIXD SCALE	Used to enter the X-axis scale values. Press X FIXD SCALE then enter the minimum and maximum values separated by a comma (,). A single entry sets the right side of the scale. You can also press this to fix scales defined by auto scaling.
X MRKR SCALE	Scales the X-axis to the current X marker band. See "The X Marker" later in this chapter for information on setting up the band.
X AUTO SCALE	Automatically scales the X-axis to display all of the measured data. To fix a scale defined by autoscaling, press X FIXD SCALE.
Y FIXD SCALE	Used to enter the Y-axis scale values. Press Y FIXD SCALE then enter the minimum and maximum values separated by a comma (,). A single entry sets the top of the scale. You can also press this to fix scales defined by autoscaling.
Y MRKR SCALE	Scales the Y-axis to the current Y marker band. See "The Y Marker" later in this chapter for information on setting up the band.
Y AUTO SCALE	Automatically scales the Y-axis to obtain the optimum display and activates the autoscaling mode. To fix a scale defined by autoscaling, press Y FIXD SCALE.
Y DFLT SCALE	Selects the Y default scale, which is defined by the current input range, amplitude units and measurement display.

Y-axis Scaling

Y-axis scaling operates in one of two modes: auto or fixed. Vertical autoscaling (selected with Y AUTO SCALE) checks the active trace every time it is changed or updated to ensure that the vertical scale is providing the optimum display. Pressing Y AUTO SCALE scales the trace immediately and leaves the display in the autoscale mode. Y DFLT SCALE, Y MRKR SCALE and Y FIXD SCALE explicitly define the vertical scale. When one of these three softkeys is pressed, the display leaves the auto scale mode and stays fixed at the selected values. To determine whether the display is in auto or fixed scaling, look at the bottom of the Y axis on the display; if "Fxd Y" or "Fxd XY" is displayed, the scale is fixed. If not, Y-axis autoscaling is active. To leave autoscaling in the last scale it defined, press Y FIXD SCALE.

X-axis Scaling

X-axis scaling also operates in the auto or fixed mode, but the X-axis auto scale operates in a different manner than the Y-axis. X AUTO SCALE sets the horizontal scale to match the frequency span (for frequency domain dislays), the time record length (for time domain displays), or amplitude range (for amplitude domain displays). X AUTO SCALE also activates the autoscaling mode and changes the scale whenever the span, record length or amplitude range is changed. X FIXD SCALE and X MRKR SCALE explicitly define the horizontal scale. When either of these is pressed, the display leaves the auto scale mode and stays fixed at the selected values. To determine whether the display in auto or fixed scaling, look at the bottom of the Y-axis on the display; if "Fxd X" or "Fxd XY" is displayed, the scale is fixed. If not, X-axis autoscaling is active. To leave auto scaling in the last scale it defined, press X FIXD SCALE.

The Nichols, Nyquist, ORBITS T1vsT2, and DEMOD POLAR displays have special scaling characteristics since they are three-dimensional displays. The X and Y scaling softkeys operate on the horizontal and vertical axes, not on the third axis. On the Nichols display, for example, X FIXD SCALE sets phase on the X-axis, not frequency. The third axis is adjusted automatically when either the X- or Y-axis is adjusted. Note also that adjusting the X-axis on Nyquist, orbits, and demod polar automatically adjusts the Y-axis, and vice versa. This is done to maintain the display's aspect ratio.

With the Nyquist, orbits, and demod polar displays, Y DFLT SCALE sets the center of the display to 0,0 and puts all measurement data on the screen and sets the minimum and maximum scales depending on input range. Y AUTO SCALE also puts all data on the screen, but sets the center of the display to the center of the data. For the Nichols display, Y DFLT SCALE sets the Y scale to the MAG (dB) scale and fixes the X scale to its current value. X and Y AUTO SCALE adjust their respective scales for an optimum display.

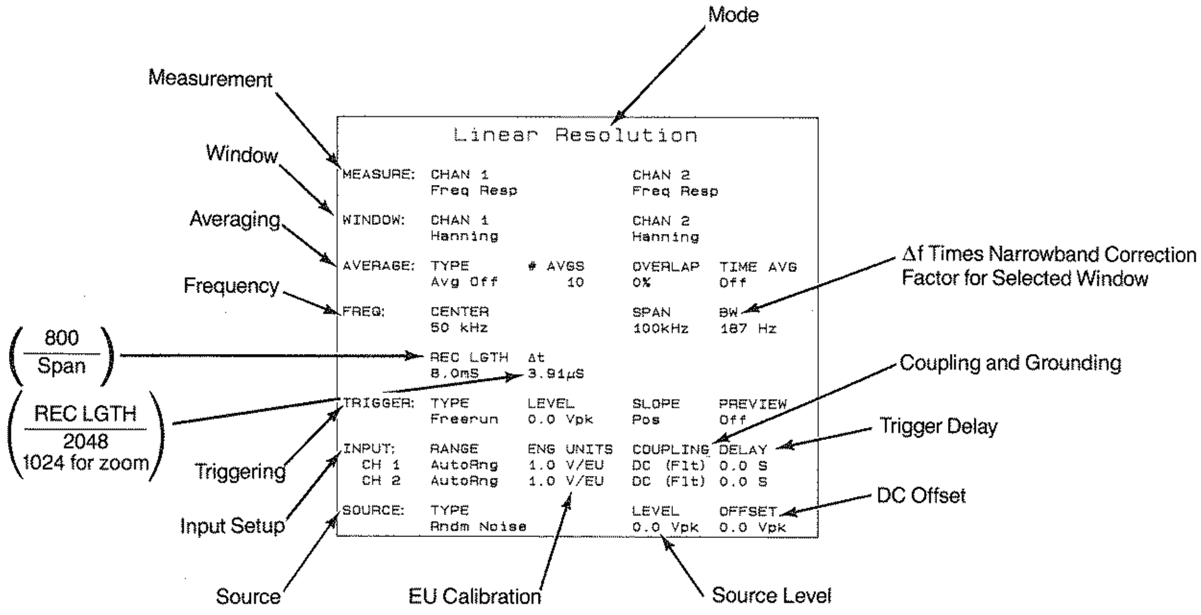
SELECTING DISPLAY DATA

The Select Data keys provide three choices of display data: measurement displays, view inputs and the state display.

MEAS DISP selects measurement displays. The menu displayed with this key depends on the measurement mode selected; refer to Chapters 1-4 (depending on the current mode) for more information. Note that displays shared by two modes are not changed when the mode is changed from one to the other.

VIEW INPUT lets you display the input signals before they are filtered to the current frequency span and before they are measured. Appendix E shows how these displays are derived and how they differ from measurement displays. The view input displays are useful when you need to verify the presence of an input signal or compare the input signal with the measurement display. The menu displayed with this key also depends on the mode selected; refer to Chapters 1-4 (depending on the mode selected) for more information.

STATE/TRACE toggles between the instrument state display and a measurement or view input display. Figure 8-2 shows the state display at power-on (after completion of the self-test).



```
                Linear Resolution

MEASURE:  CHAN 1                    CHAN 2
          Freq Resp                 Freq Resp

WINDOW:   CHAN 1                    CHAN 2
          Hanning                   Hanning

AVERAGE:  TYPE      # AVGS          OVERLAP  TIME AVG
          Avg Off       10          0%       Off

FREQ:     CENTER                    SPAN     BW
          50 kHz                    100kHz   187 Hz

          REC LGTH  Δt
          8.0mS     3.91µS

TRIGGER:  TYPE      LEVEL           SLOPE    PREVIEW
          Freerun   0.0 Vpk         Pos      Off

INPUT:    RANGE     ENG UNITS       COUPLING DELAY
  CH 1    AutoRng   1.0 V/EU        DC (Flt) 0.0 S
  CH 2    AutoRng   1.0 V/EU        DC (Flt) 0.0 S

SOURCE:   TYPE                      LEVEL    OFFSET
          Rndm Noise                0.0 Vpk  0.0 Vpk
```

Figure 8-2 The Instrument State Display at Power-On

USING THE MARKERS

The HP 3562A offers both horizontal (X-axis) and vertical (Y-axis) markers, as well as several special marker functions. The markers can be used to magnify a narrow portion of a trace, identify a band or region, curve fit inside a band, adjust the horizontal and vertical scales, measure relative to fixed reference, or highlight items such as harmonics and sidebands. In addition, the **MARKER VALUE** key in the Entry group works in conjunction with the markers to simplify numeric entries by entering values that are identified on the display.

The knob in the Marker group is assigned to move the marker that is currently active. The active marker is identified by the indicators above the **X** and **Y** keys.

The X marker is tied to the displayed trace data, while the Y marker is tied to screen locations. Because of this, minor rounding discrepancies may occur when the markers are positioned at the same point.

Creating Marker Bands

Bands are created in one of two ways:

1. After pressing **X**, **Y**, X VALUE or Y VALUE, enter the minimum and maximum values separated by a comma. For example, pressing X VALUE 10,20 kHz sets up an X marker band from 10 to 20 kHz.
2. Activate either marker then use the HOLD X or HOLD Y softkeys to expand the band from the single dot (X) or line (Y).

To erase marker bands and return the single dot or line, refer to the descriptions of HOLD X OFF and HOLD Y OFF in the following sections.

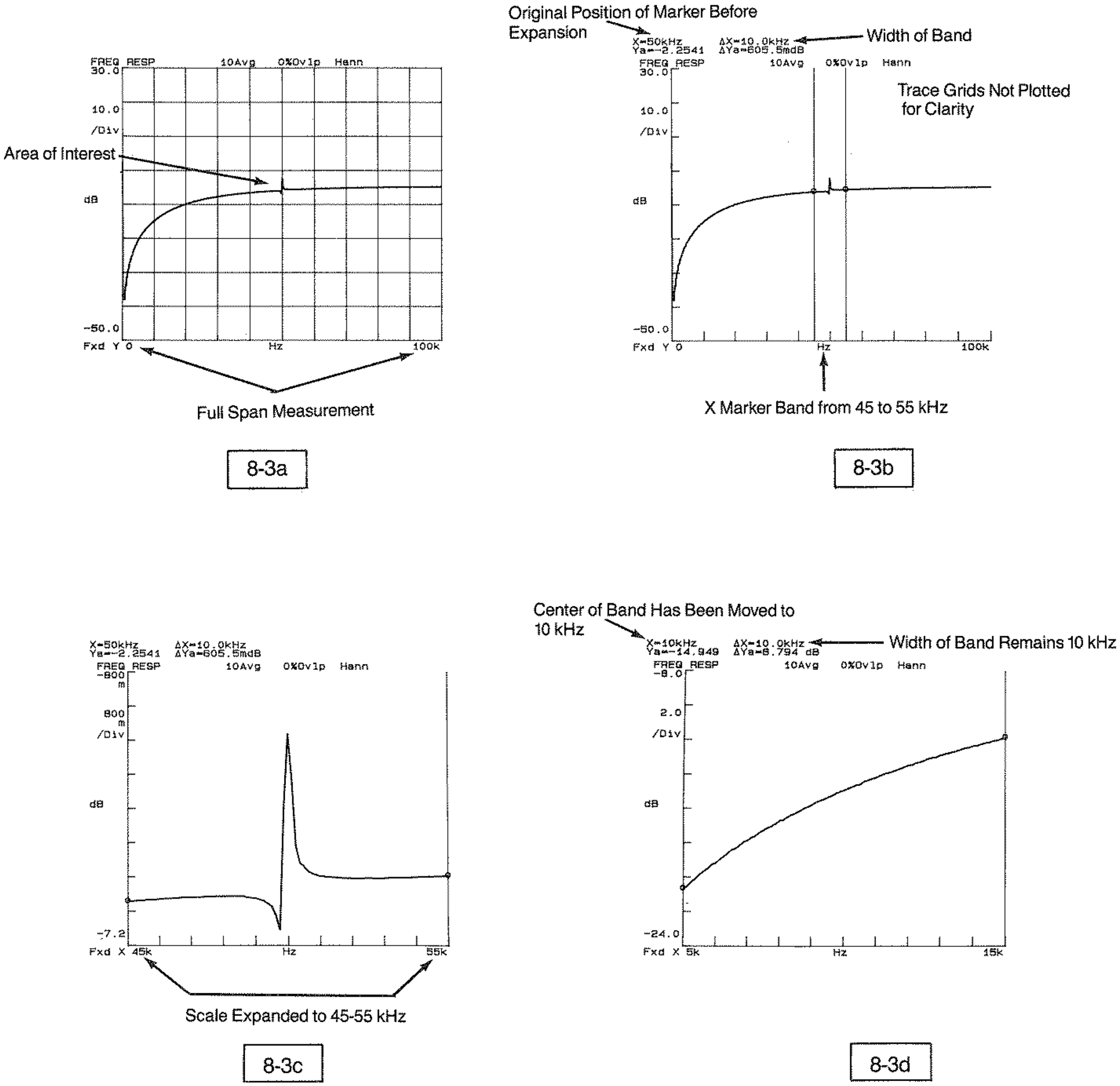
THE X MARKER

Pressing **X** in the Marker group activates the X marker. When it is activated, the X marker appears as an intensified dot which is moved across the trace with the Markers knob. Pressing **X** also displays the following menu:

X VALUE	Used to move the X marker to a explicit point on the horizontal axis. The units softkeys displayed after you enter the value are determined by the current horizontal units. To set up a band, enter the minimum and maximum values separated by a comma. You can also enter X values immediately after pressing the **X** key.
X MRKR SCALE	Scales the horizontal axis to the span currently defined by the X marker band (see the HOLD X softkeys below). No information is lost when the display is scaled; the original scale can be returned by pressing X AUTO SCALE. Pressing this with a single X marker results in a scaled display centered about the marker position.
X AUTO SCALE	Scales the X-axis to display all measured data.
SCROLL ON **OFF**	Allows you to scroll the complete trace through the magnifying "window" of an X marker band. See the HOLD X softkeys and "An Example of Scrolling" following this menu.
HOLD X CENTER	Causes the X marker to split and expand symmetrically around its original position as the knob in the Entry group is rotated. The two vertical lines outline the band. See "Using the X Marker Bands" later in this chapter.
HOLD X RIGHT	Causes the X marker to split and expand to the left as the knob in the Entry group is rotated. The two vertical lines outline the band. See "Using the X Marker Bands" later in this chapter.
HOLD X LEFT	Causes the X marker to split and expand to the right as the knob in the Entry group is rotated. The two vertical lines outline the band. See "Using the X Marker Bands" later in this chapter.
HOLD X OFF	To move a band across the display while maintaining its current width, press HOLD X OFF, then move the band with the Marker knob. To erase a band and restore the single X marker dot, activate one of the HOLD X softkeys, then turn the knob until the band contracts to a single line and press HOLD X OFF.

An Example of Scrolling

Figure 8-3a shows a measurement made at 0—100 kHz. A 10 kHz wide X marker band was created using HOLD X CENTER; the band is shown from 45 to 55 kHz in figure 8-3b. Figure 8-3c shows this 10 kHz band magnified using X MRKR SCALE. Finally, SCROLL ON OFF was toggled ON, then the entire 0—100 kHz trace was viewed, 10 kHz at a time, using the knob in the Marker group. Figure 8-3d shows the trace scrolled through 5 to 15 kHz. Note that scrolling follows the time or frequency axis in displays with more than two axes.



8-3a

8-3b

8-3c

8-3d

Figure 8-3 Using X Marker Scrolling

THE Y MARKER

Pressing **Y** in the Marker group activates the Y marker. When the Y marker is activated, it appears as a single horizontal line which is moved along the vertical axis with the Markers knob. Pressing **Y** also displays the following menu:

Y VALUE	Used to move the Y marker to an explicit point on the vertical axis. The units softkeys displayed after you enter the value are determined by the current amplitude units and coordinates. To set up a band, enter the minimum and maximum values separated by a comma. You can also enter Y values immediately after pressing the **Y** key.
Y MRKR SCALE	Scales the vertical axis to the span currently defined by the Y marker band (see the HOLD Y softkeys below). No information is lost when the display is scaled; the original scale can be returned by pressing Y DFLT SCALE (assuming the trace hasn't changed.) Pressing this with a single Y marker puts the marker level at the top of the display.
Y AUTO SCALE	Automatically scales the vertical axis to obtain the optimum display.
Y DFLT SCALE	Select the Y default scale, which is determined by the input range setting, measurement display and coordinates.
HOLD Y CENTER	Causes the Y marker to split and expand symmetrically around its original position to form a band as the Markers knob is rotated.
HOLD Y UPPER	Causes the Y marker to split and expand downward to form a band as the Markers knob is rotated.
HOLD Y LOWER	Causes the Y marker to split and expand upward to form a band as the Markers knob is rotated.
HOLD Y <u>OFF</u>	To move a HOLD Y band along the vertical axis while maintaining its current width, press HOLD Y OFF, then move the band with the Marker knob. To erase a band and restore the single Y marker, activate one of the HOLD Y softkeys, then turn the knob until the markers contract to a single line, then press HOLD Y OFF.

RELATIVE MARKER MEASUREMENTS

The HOLD X and HOLD Y marker bands are also used to measure points on the display relative to a fixed reference. As an example, here are the steps to measure the amplitude level of a harmonic relative to the fundamental:

1. Activate the Y marker and move it to the peak of the fundamental.
2. Press HOLD Y UPPER to activate the Y marker band.
3. Rotate the Markers knob until the band spreads from the fundamental to the harmonic in question.
4. The absolute amplitude of the fundamental is displayed as "Y = " and the amplitude of the harmonic relative to the fundamental is displayed as "ΔY = ." These readouts appear at the top of the screen.

THE SPECIAL MARKER FUNCTIONS

The special marker functions provided by the HP 3562A are harmonic and sideband markers, a variety of special calculations, and peak search. These functions operate with the X markers in both single and band modes. Press **SPCL MARKER** to display the following menu:

X FCTN OFF	Deactivates all special marker functions.
HMNC ON	Activates the harmonic marker and displays its menu. See "The Harmonic Markers" following this menu.
SBAND ON	Activates the sideband marker and displays its menu. See "The Sideband Markers" following this menu.
SLOPE	Calculates and displays the slope at the current X marker position. If an X marker band is active, the least squares average of the slopes inside the band is calculated. Slope on log Y-axes is read out as Log Y/x-axis unit; slope is not available on Nyquist or Nichols.
FREQ & DAMP	Calculates and displays the resonant frequency and damping values in the active trace using a 1½ degree of freedom curve fitter. The calculation is made inside the X marker band if it is active, or 20 points on both sides of the active single X marker if a band is not active. For accurate values, the marker band (or the 20 points), should cover at least the 3 dB bandwidth. This works only for frequency response displays.
POWER	Calculates and displays the power contained in the current X marker band or in the entire trace if a band is not active. For frequency domain displays that have units, POWER shows energy (if the ESD unit is selected) or power (for all other units). Energy is always expressed as peak, and power is expressed as rms. For all frequency domain displays, the POWER marker compensates for the effect of the window.
MRKR→ PEAK	Moves the marker to the highest amplitude point on the active trace. If more than one point is at the highest amplitude, the marker moves to the leftmost point. If an X marker band is active, the single marker moves to the highest point in the band.
AVG VALUE	Calculates the average value over the portion of the active trace enclosed by the current X marker band or the entire trace if a band is not active.

NOTE

*To pause view input displays for stable marker readouts, press VIEW OFF (***VIEW INPUT*** menu).*

Note that for computationally-intensive functions (such as slope) the marker display jumps across the trace as you rotate the Markers knob, rather than calculating across.

The Harmonic Markers

These markers highlight a fundamental frequency and its first twenty harmonics. To activate the harmonic markers, press HMNC ON to display the following menu:

FNDMTL FREQ	Used to enter the frequency of the fundamental. Press FNDMTL FREQ, then enter the frequency using the Entry group. The range of fundamental frequencies is 0 to 100 kHz.
HMNC POWER	Shows the harmonic power in the area outlined by the X marker band. If a band is not active, the power in all 20 harmonics is calculated. See "The X Marker" for information on the X marker bands. Only harmonics on the screen are included.
THD	Shows the percentage of total harmonic distortion generated by the harmonics identified with the harmonic marker. This reads out in dB for log magnitude traces and % for linear magnitude traces. Only harmonics on the screen are included.
CALC OFF	Deactivates the HMNC POWER and THD calculations. This does not affect the harmonic markers themselves.
RETURN	Redisplays the **SPCL MARKER** menu.

The Sideband Markers

The sideband markers highlight a carrier frequency and the first ten sidebands on each side of the carrier. You can specify the carrier frequency and the sideband increment. Press SBAND ON to activate the sideband markers and display the following menu:

CRRIER FREQ	Used to enter the carrier frequency. The default value at power-on and after reset is 5 kHz.
SBAND INCRMT	Used to enter the sideband increment. This value is used to calculate the sideband frequencies based on the carrier frequency. The default value at power-on and after reset is 2.5 kHz.
SBAND POWER	Calculates and displays the power contained in the area outlined by the X marker band. If the band is not active, the power in all 20 sidebands is calculated. Only sidebands on the screen are included.
CALC OFF	Deactivates the SBAND POWER calculation. This does not affect the sideband markers themselves.
RETURN	Redisplays the **SPCL MARKER** menu.

SAVING AND RECALLING STATES AND TRACES

The HP 3562A can save up to five instrument states and two data trace displays in its internal memory. (Refer to Chapter 11 for saving states and traces in disc memory.) The current state is stored in nonvolatile memory at power-down and may be recalled later. Only the information in the instrument state display is saved. Coordinates, for example, are not saved. A triangle preceding the measurement display name indicates that the trace has been recalled from memory.

The five states and data trace #1 are saved in nonvolatile memory as well. Data trace #2 is erased when power is removed or the instrument is reset. It is recommended that you save the state when saving a trace so that you can later recall the trace into the same instrument state. Time buffer and demod preview displays cannot be saved in local memory. Press **SAVE RECALL** to display the following menu:

RECALL PWR DN	Recalls the state the instrument was in when power was last removed.
RECALL STATE#	Recalls a saved instrument state; press RECALL STATE#, then enter the number (from 1 to 5) under which the state was stored.
SAVE STATE#	Saves the current instrument state; press SAVE STATE#, then enter the number (from 1 to 5) under which you want the state to be saved. Note that any information previously saved under this number will be erased.
RECALL DATA #	Recalls a saved data trace display; press RECALL DATA #, then enter the number (1 or 2) under which the display was saved.
SAVE DATA #	Saves the current data trace display; press SAVE DATA #, then enter the number (1 or 2) under which you want the display to be saved. Note that any information previously saved under this number will be erased.

NOTE

When you save a trace while the display is the upper/lower or front/back formats, only the active trace (or Trace A if both are active) is saved in memory.

Chapter 9

DATA OPERATIONS

PURPOSE OF THIS CHAPTER

This chapter shows you how to use the HP 3562A's math, auto math, frequency response synthesis and curve fit features—the Operators group. It assumes you are familiar with the basic operation of the instrument (at the minimum you should be familiar with Chapters 1 and 8).

WAVEFORM MATH

The HP 3562A offers a number of waveform math capabilities, including:

Algebraic (+ ,−, ÷ , ×)

Square root

Reciprocation

Negation

Integration/differentiation

Complex integration/differentiation

Open-loop from closed-loop response

Real part

Complex conjugation

Logarithm and antilogarithm

FFT and inverse FFT

Waveform math operates on the data block represented by the displayed trace, not on the trace itself. An example of each type of operation is provided after the following description of the **MATH** menu. These operations apply to the active trace(s); if both traces are active, the selected operation applies to both. With the exception of the algebraic operations, the calculation is performed immediately after the operation is selected. To enter complex values, enter the real and imaginary parts separated by a comma. Floating point numbers are represented by 24-bit mantissas and 8-bit exponents; their numeric range is $\pm 10^{\pm 38}$. Integers are represented in 2's complement, 16-bit form, with a numeric range of −32,768 to +32, 767.

The results of waveform math are noted on the display with M: preceding the display label. For example, if you add a constant to a frequency response trace, the label becomes M:FREQ RESP. Also, the V and V^2 units are displayed as (V) and (V^2) to indicate that the original units have been replaced.

The error message "Trace Not Compatible" is displayed if you attempt math on incompatible traces. The operations not allowed are:

1. ADD,SUB,MPY,DIV on 2 traces where the domain, lin/log x-scale, or number of elements do not match
2. jw and jw^{-1} on non-frequency domain traces
3. FFT and FFT^{-1} on log x-axis, histogram/PDF/CDF, orbits, or demod polar
4. Any math on time capture buffer or demod preview displays.

Pressing **MATH** displays the following menu:

ADD	Selects addition; see "Algebraic Operations."
SUB	Selects subtraction; see "Algebraic Operations."
MPY	Selects multiplication; see "Algebraic Operations."
DIV	Selects division; see "Algebraic Operations."
SQUARE ROOT	Calculates and displays the square root of the active trace; see "Square Root."
RECIP	Reciprocates the active trace; see "Reciprocation."
NEGATE	Negates the active trace; see "Negation."
NEXT	Displays the second level of the **MATH** menu.

Pressing NEXT in the previous menu displays the following menu:

DIFF	Differentiates the active trace; see "Differentiation/ Integration."
jw	Multiplies the active frequency domain trace by $j\omega$; see "Artificial Differentiation/Integration."
INTGRT	Integrates the active frequency domain trace; see "Differentiation/ Integration."
INTGRT INIT = 0	Integrates the active trace without including the first bin; see "Differentiation/Integration."
jw^{-1}	Divides the active trace by $j\omega$; see "Artificial Differentiation/Integration."
$\frac{T}{1-T}$	Calculates open-loop response from measured closedloop response, where T is the active trace; see "Calculating Open-Loop Response." T must be positive.
NEXT	Displays the third level of the **MATH** menu.
RETURN	Redisplays the first level of the **MATH** menu.

Pressing NEXT in the previous menu displays the following menu:

REAL PART	Displays the real part of complex measurement data; see "Real Part."
COMPLX CONJ	Calculates the complex conjugate of the active trace; see "Complex Conjugation."
LN OF DATA	Calculates the logarithm of the active trace; see "Logs and Antilogs."
LN^{-1} OF DATA	Calculates the antilogarithm (exponential) of the active trace; see "Logs and Antilogs."
FFT	Calculates the fast Fourier transform (FFT) of the active trace; see "FFT and Inverse FFT."
FFT^{-1}	Calculates the inverse FFT of the active trace; see "FFT and Inverse FFT."
RETURN	Redisplays the second level of the **MATH** menu.

Algebraic Operations

The algebraic operations (ADD,SUB,DIV,MPY) require three steps:

1. Select the active trace as the first operand.
2. Select the math operation.
3. Select a displayed or stored trace or a numeric constant as the second operand.

When the operation is selected, the following menu is displayed to allow you to choose the second operand:

ENTER	Used to enter a numeric constant as the second operand.
EXP	Used to enter a numeric constant in exponential notation. Numbers entered before EXP is pressed are the base, and number entered after are the exponent. For example, 100 000 is entered as 1 EXP 5.
TRACE A	Selects trace A as the second operand.
TRACE B	Selects trace B as the second operand.
SAVED 1	Selects saved data trace #1 as the second operand. See "Saving and Recalling States and Displays" in Chapter 8 for information on the saved traces.
SAVED 2	Selects saved data trace #2 as the second operand. See "Saving and Recalling States and Displays" in Chapter 8 for information on the saved traces.
CANCEL	Cancels the math operation.

NOTE

To divide log magnitude traces, use the DIV softkey, not SUB. A log magnitude trace is strictly a function of the display. The data are stored in linear format, so division is required.

Figure 9-1 shows an example of adding two traces.

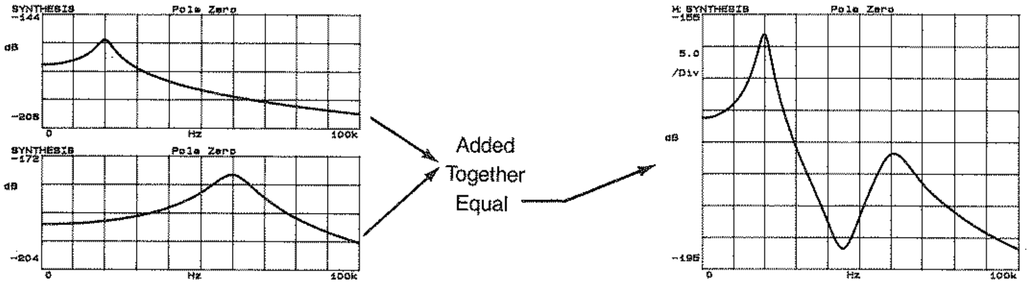
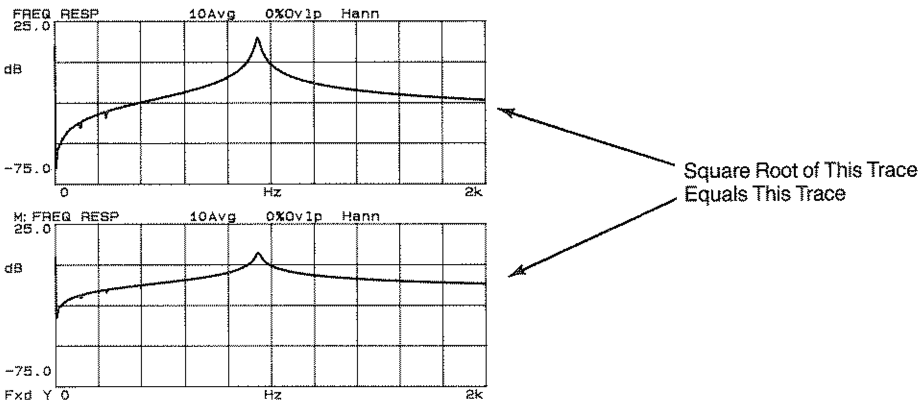


Figure 9-1 Addition

Square Root

SQUARE ROOT calculate the square root of each point in the active trace; figure 9-2 shows an example. Note that computing square root of a negative function dues not yield an imaginary result.

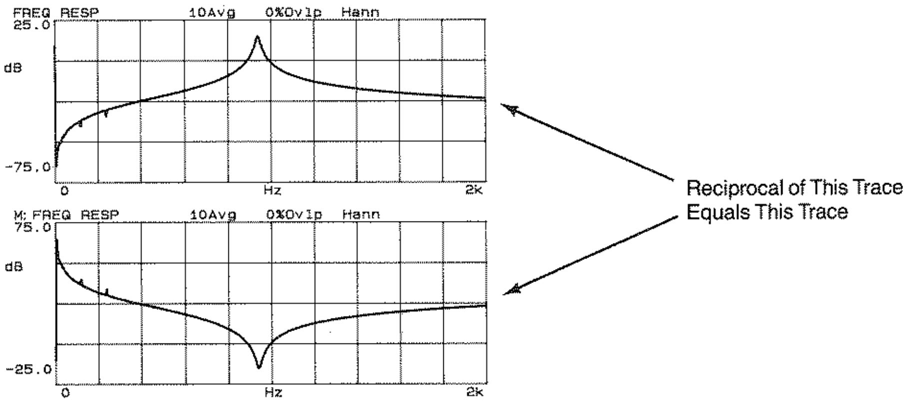


Square Root of This Trace Equals This Trace

Figure 9-2 Square Root

Reciprocation

RECIP divides each point in the active trace into one; figure 9-3 shows an example.

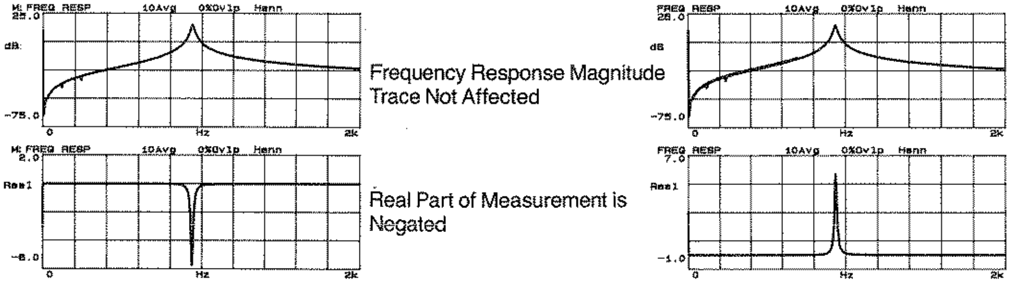


Reciprocal of This Trace Equals This Trace

Figure 9-3 Reciprocation

Negation

NEGATE individually multiplies the real and imaginary parts of the measurement data by minus one; figure 9-4 shows an example.



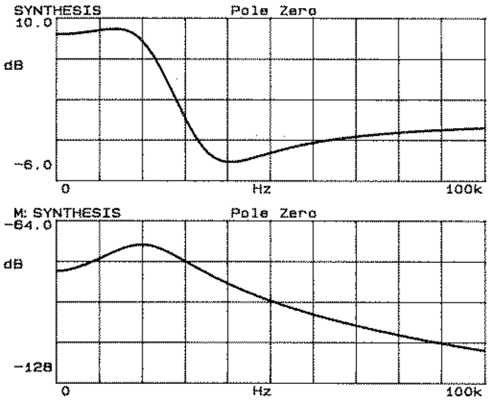
Frequency Response Magnitude Trace Not Affected

Real Part of Measurement is Negated

Figure 9-4 Negation

Differentiation/Integration

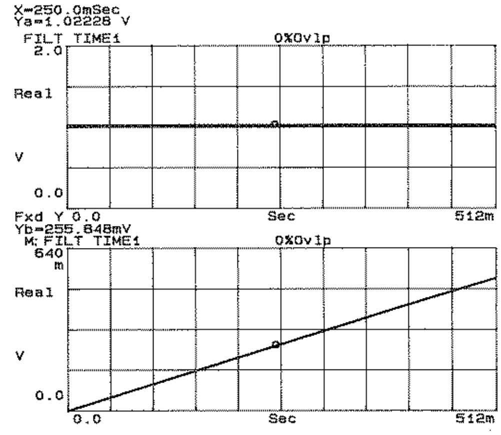
DIFF differentiates the active trace by calculating the difference between adjacent points on the X-axis, then divides each difference by the bin spacing; figure 9-5 shows an example.



Trace B is the Derivative of Trace A

Figure 9-5 Differentiation

INTGRT integrates the active trace by summing the discrete areas contained at each point on the display. Figure 9-6 shows an example of integration. INTGRT sums all points, while INTGRT INIT = 0 initializes the first point to zero. INTGRT and INTGRT INIT = 0 should be used on time domain traces.

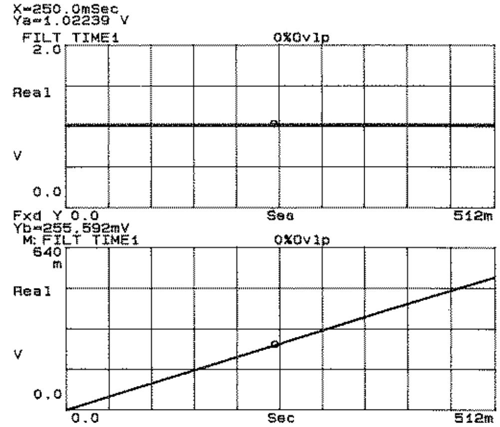


Trace B is the Numeric Integral of Trace A

Note Scaling of Integration: Result is Scaled by Δt. In this Case, Δt = 250μs. The Marker Position at 250ms Covers the First 1000 Bins. Marker Readout on Trace B Shows 255.848mV at 250 ms (1.02228V × 1000 × 250μs)

Figure 9-6 Integration (INTGRT)

INTGRT INIT = 0 initializes the first point in the display to zero (effectively excluding it from the integration), then integrates the active trace in the same manner as INTGRT. Figure 9-7 shows an example. INTGRT INIT = 0 shifts the result down one-half Δf.

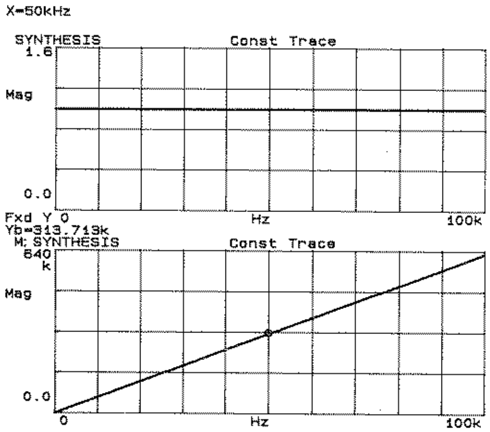


Similar to INTGRT in Figure 9-6 Except: Because First Bin is Not Integrated, Notice Trace B Marker Readout of 255.592 mV, Which is One Bin (1.02239mV × 250μS = 255.6μV) Less: 255.848mV − 255.592 = 256.0μV)

Figure 9-7 Integration (INTGRT INIT = 0)

Artificial Integration/Differentiation

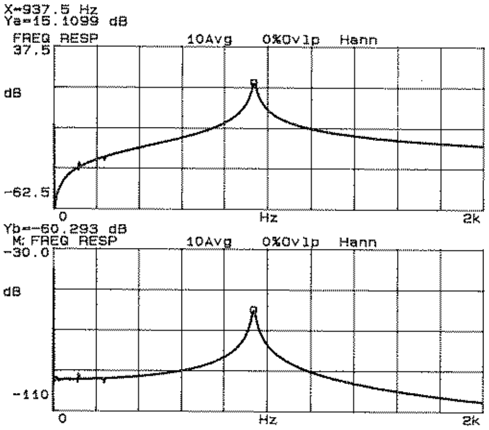
Artificial differentiation is performed by multiplying the trace by j2πΔf. This function provides the frequency spectrum of the time domain derivative.



Value at X Marker Readout on
Trace B Equals:
400 Bins (50kHz divided by Δf of
125 Hz) Times Δf of 125 Times 2π
Times Value of Trace A (about 1.0)
= 313.713K

Figure 9-8 Artificial Differentiation

Artificial integration is performed by dividing the trace by jπΔf. This function provides the frequency spectrum of the time domain integral.



Trace B is the Result of Artificially
Integrating Trace A

Figure 9-9 Artificial Integration

Calculating Open-Loop Response

T/1 – T calculates open-loop response from a measured closed-loop frequency response curve, as the example in figure 9-10 shows. To yield a valid result, the measured response (T) must be the active trace.

$$\text{Trace B} = \frac{T}{1-T}$$

Where T is Trace A

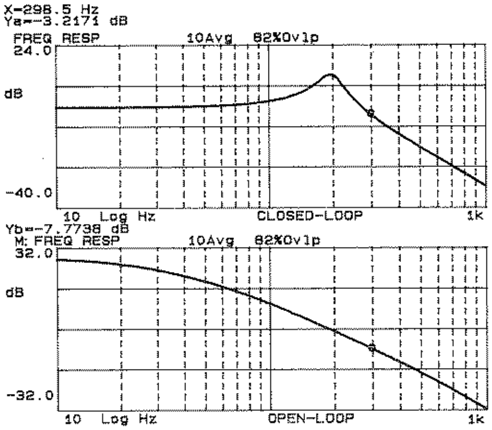


Figure 9-10 Calculating Open-Loop Response

Real Part

REAL PART separates and displays the real part of complex measurement data. This differs from the REAL display coordinate (under **COORD**) in that REAL PART actually converts a complex block into a real block by removing the imaginary points and filling the second half of the real block with zero values.

Trace B is Real Part of Frequency Response in Trace A

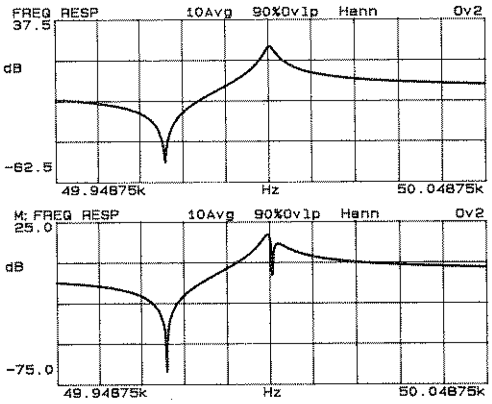
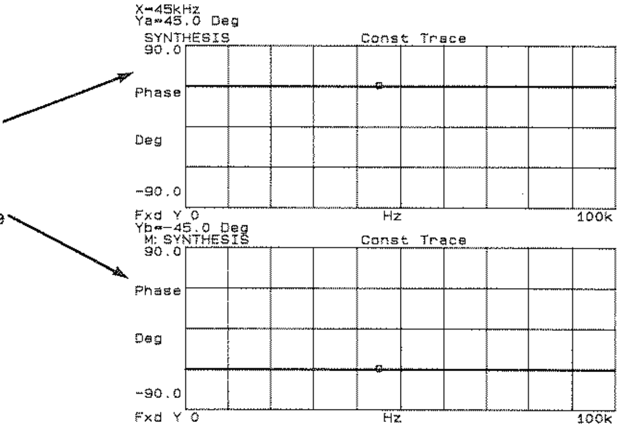


Figure 9-11 Real Part

Complex Conjugation

COMPLX CONJ calculates the complex conjugate of the active trace; figure 9-12 shows an example.



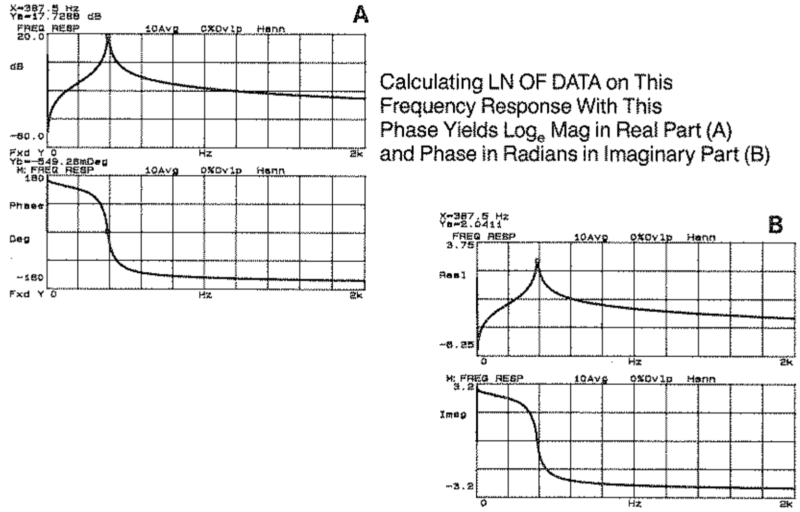
Trace A is a Synthesized Constant of 1 + j1, Which Yields a Phase of 45°

Trace B Shows Complex Conjugate of Trace A (1 + j1)* = (1 − j1), Which Yields a Phase of − 45°

Figure 9-12 Complex Conjugation

Logs and Antilogs

LN OF DATA calculates the $\log_e$ of the active trace, leaving the natural log of the magnitude in the real part and the phase in radians in the imaginary part. Figure 9-13 shows an example.



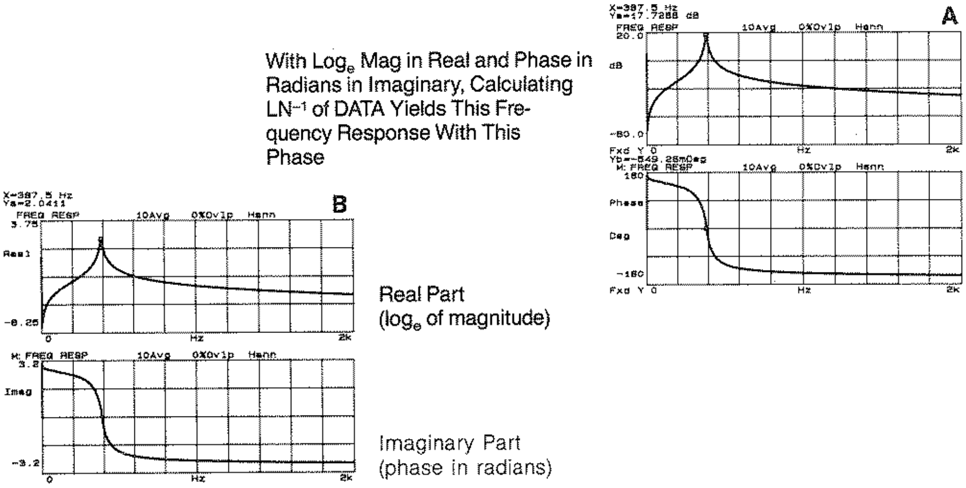
Calculating LN OF DATA on This Frequency Response With This Phase Yields Log_e Mag in Real Part (A) and Phase in Radians in Imaginary Part (B)

Real Part ($\log_e$ of magnitude)

Imaginary Part (phase in radians)

Figure 9-13 LN OF DATA

LN^{-1} OF DATA calculates the antilog$_e$ of the active trace, taking phase in radians from the imaginary part of the data and log$_e$ of the magnitude from the real part.



With Log$_e$ Mag in Real and Phase in Radians in Imaginary, Calculating LN^{-1} of DATA Yields This Frequency Response With This Phase

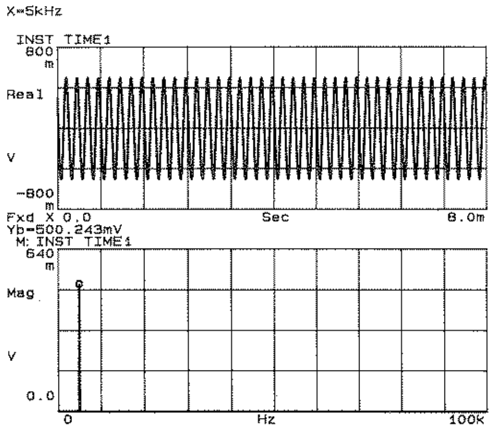
Real Part (log$_e$ of magnitude)

Imaginary Part (phase in radians)

Figure 9-14 LN^{-1} OF DATA

FFT and Inverse FFT

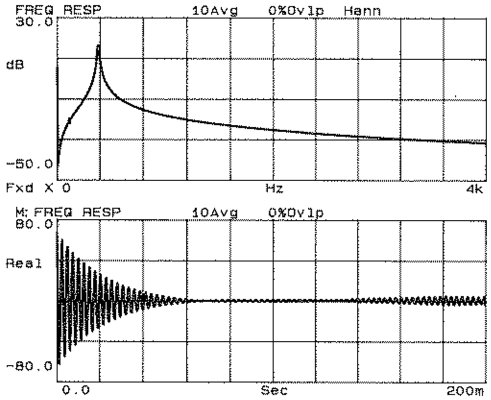
FFT computes a 1024-line FFT from either a 1024-point complex record or a 2048-point real record. For FFTs on time domain traces, 1024 lines are produced; 801 are saved and displayed (the remaining 223 lines fall outside the analyzer's frequency span). Because of dithering in the computation, FFTs on identical data do not always produce identical results. Figure 9-15 shows an example of the FFT command.



Trace B is Linear Spectrum Resulting from Computing FFT of 5 kHz Sine Wave in Trace A

Figure 9-15 FFT

FFT^{-1} performs an inverse fast Fourier transform (FFT) on the active trace. Figure 9-16 shows an example. If you have performed an FFT on a time record, then transformed it back to the time domain using FFT^{-1}, the analyzer adds 223 zeros outside the frequency span to fill the 223 lines discarded by the FFT. The FFT^{-1} is 6 to 10 dB noisier than FFT.



Impulse Response in Trace B resulted from Computing Inverse FFT of Frequency Response in Trace B. Note Wrap-around at End of Impulse Response Due to Truncation of the Response in the Frequency Domain

Figure 9-16 Inverse FFT

AUTO MATH

The HP 3562A's auto math feature allows you to program math operations using the Active Trace keys and the softkeys in the **MATH** and **MEAS DISP** menus. The current auto math table is saved in nonvolatile memory inside the instrument and is not erased when power is removed. Tables can also be stored in disc memory; see Chapter 11 for instructions. The next two sections explain how to program and start the auto math table.

An important feature of auto math is that it can be selected as a measurement display in the linear, log and swept sine modes. This allows you to view the math results while a measurement is in progress.

The table is limited to twenty lines, but it may fill with fewer than twenty lines depending on the commands used. (The limit is 20 lines or 200 characters.) The message in the top right corner of the table "xxx Keys Left" tells you how many key strokes are available. Also, keep in mind the instrument states under which you may run the auto math table. A table created to operate on a given set of traces may not work if you (or the analyzer) provide different traces.

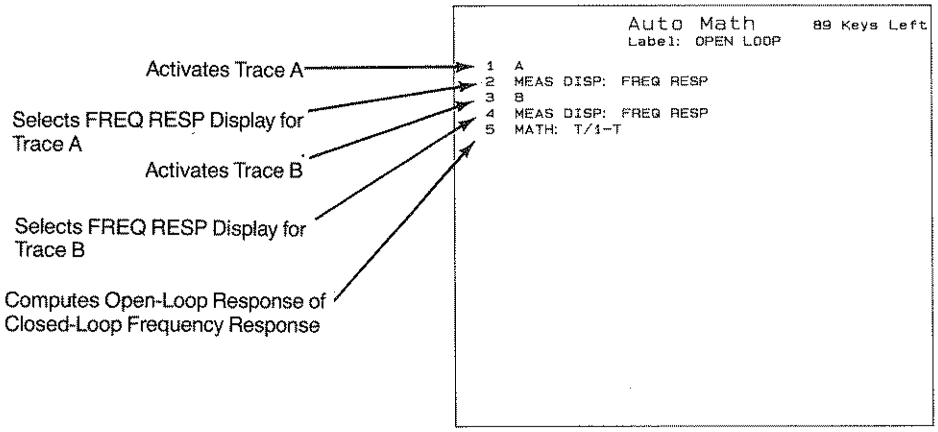
Programming the Auto Math Table

Commands are programmed in the auto math table in the same manner as they are executed directly from the front panel. For example, to add trace B to the active trace, enter **MATH**, ADD, TRACE B as a command. Figure 9-17 shows this example in the auto math table. You can select one measurement display for each trace, and the **MEAS DISP** selections must precede the **MATH** selections. To fill or edit the auto math table, press **AUTO MATH**, which displays the following menu:

EDIT MATH	Displays the auto math table and its editing menu.
VIEW MATH	Displays the auto math table but does not allow any editing. This is useful to display the table for plotting or saving to disc.
START MATH	Starts the auto math table; see the next section, "Starting the Auto Math Table."

When EDIT MATH is pressed, the following menu is displayed:

LABEL MATH	Used to add a label to the auto math table; see "The Auto Math Label" following this menu.
EDIT LINE#	Used to the select a line for editing. This only selects the line; the actual editing is done with DELETE LINE, CHANGE LINE and ADD LINE.
DELETE LINE	Deletes the edit line.
CHANGE LINE	Allows the edit line to be changed. When this is active, the edit line changes as you enter new commands.
ADD LINE	Allows a line to be added after the edit line. To add a line before the current line #1, use EDIT LINE# to move the pointer to line #0, then add the new line.
CLEAR MATH	Press twice to clear the auto math table. The message "Push Again to Clear" is displayed to allow you to confirm that the table is to be cleared.
END EDIT	Exits the editing mode and saves the changes made during the current editing session.



```
                         Auto Math     89 Keys Left
                         Label:  OPEN LOOP
 1   A
 2   MEAS DISP:  FREQ RESP
 3   B
 4   MEAS DISP:  FREQ RESP
 5   MATH:  T/1-T
```

Figure 9-17   The Auto Math Table

The Auto Math Label

The label (entered with LABEL MATH) serves three purposes:

1. It is displayed at the top of the table to identify the function of each table. This is helpful when tables are plotted or stored on disc.
2. It replaces the AUTO MATH softkey label in the **MEAS DISP** menu (linear resolution, log resolution, and swept sine modes only). This allow you to start the auto math table and display the results while a measurement is in progress.
3. It appears on top of the active trace (in the same field as the other **MEAS DISP** selections).

To enter the label, press LABEL MATH, and the HP 3562A shifts into the alpha mode. In this mode, the hardkeys (except **LINE** and **HELP**) are converted to their blue labels, and the following menu is displayed:

ENTER	Saves the current alpha entry, displays the label in the table, and exits the alpha mode.
SPACE FORWRD	Moves the cursor one space forward to edit an entry. Use the "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use **BACK SPACE**.
INSERT ON **OFF**	When this is pressed ON, characters are inserted at the cursor position. When pressed OFF, characters are written over existing ones.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the alpha entry from the cursor position to the end of the line.
CANCEL ALPHA	Clears the current entry and exits the alpha mode.

Labels are limited to two lines of six characters each. Enter the first and second lines separated by a comma (,).

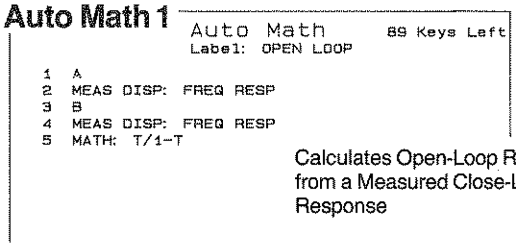
Starting the Auto Math Table

The auto math table can be started in two ways:

1. Press **AUTO MATH**, then the START MATH softkey.
2. Press **MEAS DISP**, then the AUTO MATH softkey. Note that the AUTO MATH softkey label is replaced by the math label, if one was programmed in the table (POWER TEST, for example). The auto math table can be started from the **MEAS DISP** menu in linear resolution, log resolution, and swept sine modes.

Auto Math Examples

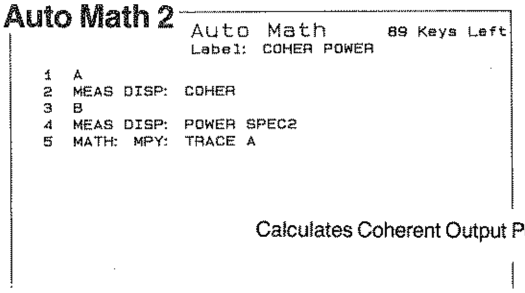
Auto Math 1



```
Auto Math          89 Keys Left
Label:  OPEN LOOP

 1  A
 2  MEAS DISP:  FREQ RESP
 3  B
 4  MEAS DISP:  FREQ RESP
 5  MATH:  T/1-T
```

Calculates Open-Loop Response from a Measured Close-Loop Response

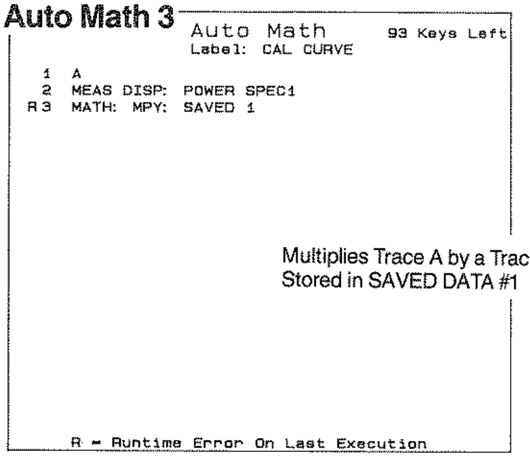
Auto Math 2



```
Auto Math          89 Keys Left
Label:  COHER POWER

 1  A
 2  MEAS DISP:  COHER
 3  B
 4  MEAS DISP:  POWER SPEC2
 5  MATH:  MPY:  TRACE A
```

Calculates Coherent Output Power

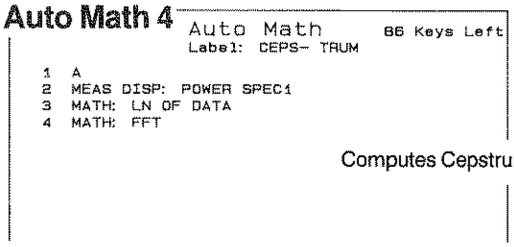
Auto Math 3



```
Auto Math          93 Keys Left
Label:  CAL CURVE

 1  A
 2  MEAS DISP:  POWER SPEC1
R3  MATH:  MPY:  SAVED 1

R - Runtime Error On Last Execution
```

Multiplies Trace A by a Trace Stored in SAVED DATA #1

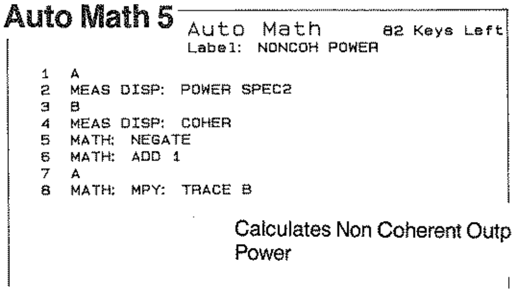
Auto Math 4



```
Auto Math          86 Keys Left
Label:  CEPS- TRUM

 1  A
 2  MEAS DISP:  POWER SPEC1
 3  MATH:  LN OF DATA
 4  MATH:  FFT
```

Computes Cepstrum

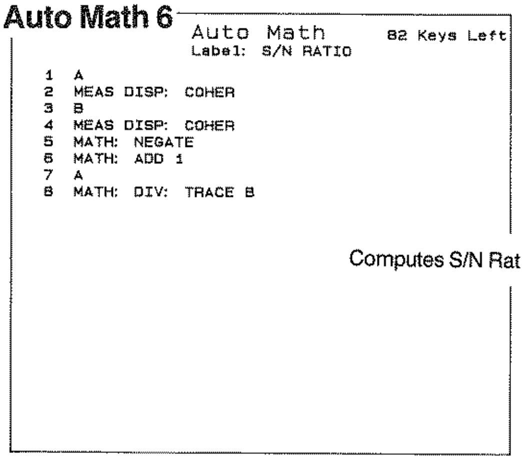
Auto Math 5



```
Auto Math          82 Keys Left
Label:  NONCOH POWER

 1  A
 2  MEAS DISP:  POWER SPEC2
 3  B
 4  MEAS DISP:  COHER
 5  MATH:  NEGATE
 6  MATH:  ADD 1
 7  A
 8  MATH:  MPY:  TRACE B
```

Calculates Non Coherent Output Power

Auto Math 6



```
Auto Math          82 Keys Left
Label:  S/N RATIO

 1  A
 2  MEAS DISP:  COHER
 3  B
 4  MEAS DISP:  COHER
 5  MATH:  NEGATE
 6  MATH:  ADD 1
 7  A
 8  MATH:  DIV:  TRACE B
```

Computes S/N Ratio

FREQUENCY RESPONSE SYNTHESIS

This feature synthesizes frequency response curves from pole/zero, pole/residue or polynomial data. The synthesis table can contain up to 22 lines of poles and zeros. If all entries are complex, up to 44 poles and 44 zeros can be used. (Conjugate pairs are considered two values.) Constants can also be synthesized for use in waveform math. The current synthesis table is saved in nonvolatile memory inside the instrument and is not erased when power is removed. (Tables can also be stored in disc memory; see Chapter 11 for instructions).

Synthesized traces match the mode in which they are created. For example, if the HP 3562A is in the linear resolution mode, the synthesized trace contains 801 lines. The frequency span of synthesized traces is set using the **FREQ** menu. (If demod is active, the pre-demod span is used.) The Laplace operator S is normalized in Hertz.

This section contains the following topics:

1. Using the **SYNTH** menu: selecting the type of synthesis, creating the traces and creating constants.
2. Adding to and editing the synthesis table.
3. Using the SYNTH FCTN menu for gain, delay and frequency scaling.
4. Converting tables to other synthesis types and transferring them to curve fit.

For an example of synthesizing a frequency response trace, please refer to the User's Guide at the beginning of this manual.

Pressing **SYNTH** displays the following menu:

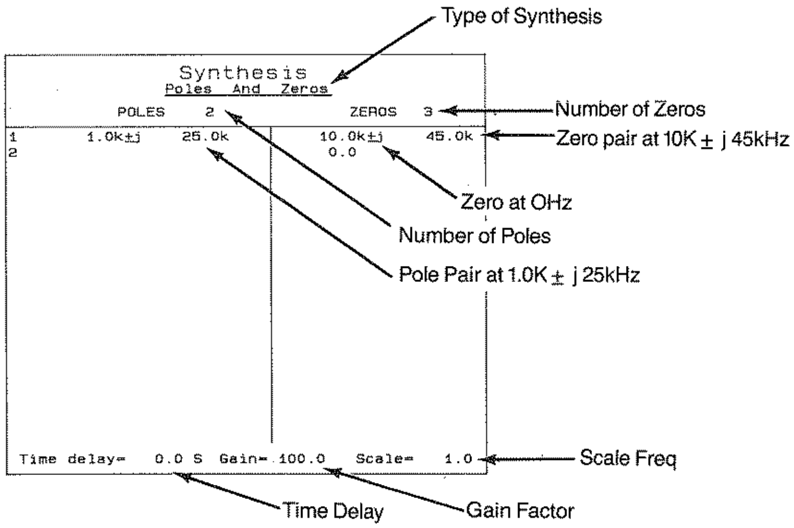
POLE ZERO	Selects pole/zero synthesis and displays the table and its editing menu; see "The Synthesis Table."
POLE RESIDU	Selects pole/residue synthesis and displays the table and its editing menu; see "The Synthesis Table."
POLY-NOMIAL	Selects polynomial synthesis and displays the table and its editing menu; see "The Synthesis Table."
CONVRT TABLE	Displays the convert tables menu; see "Converting Synthesis Tables."
CREATE CONST	Creates real or complex constants for use in waveform math. Real values are entered as a single number; complex values are entered as real, imaginary separated by a comma (,). As an example, 6 ± j3 is entered as 6,3.
CREATE TRACE	Creates a frequency response curve based on the current synthesis table. The message "Synthesis in Progress" is displayed while the trace is being created, and the trace is displayed when synthesis is complete.

NOTE

Changing synthesis types without converting the table erases the original contents. For example, if the table had been filled in pole/zero format then you press POLE RESIDU, the table will be erased when you press any one of the editing softkeys.

The Synthesis Table

The synthesis table contains the data used by the HP 3562A in creating the frequency response curve. Figure 9-18 shows an example of the table in the pole/zero format.

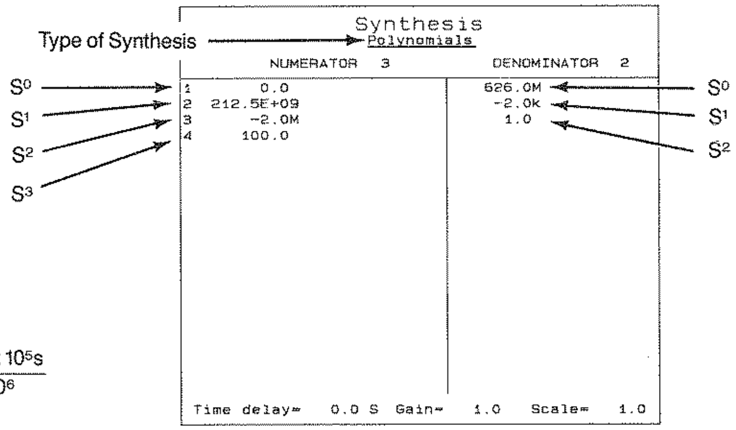


```
            Synthesis
        Poles  And  Zeros
      POLES    2              ZEROS    3
1     1.0k±j   25.0k         10.0k±j   45.0k
2                             0.0

Time delay=   0.0 S  Gain= 100.0   Scale=   1.0
```

Figure 9-18 The Synthesis Table—Pole/Zero Format

In the polynomial and pole-residue formats, values can be entered that produce a trace that is not conjugate symmetric (i.e., non-Hermitian). The message "Not Hermitian" is displayed in those cases. The pole-zero format provides the best assurance of numerical accuracy.

Figure 9-19 shows this information converted to the ratio-of-polynomials format (using the CONVRT TABLES menu).



```
                    Synthesis
                   Polynomials
          NUMERATOR  3              DENOMINATOR  2
1         0.0                         626.0M
2   212.5E+09                          -2.0k
3        -2.0M                          1.0
4       100.0

Time delay=   0.0 S  Gain=   1.0    Scale=   1.0
```

$$\frac{100s^3 - 2 \times 10^6 s^2 + 212.5 \times 10^5 s}{s^2 - 2 \times 10^3 + 626.0 \times 10^6}$$

Figure 9-19 The Synthesis Table—Polynomial Format

The table shows the pole and zero (or pole/residue or polynomial) locations plus any gain, time delay or scaling frequency used. When POLE ZERO in the **SYNTH** menu is pressed, the following menu is displayed with the table (the variations for POLE RESIDU and POLYNOMIAL are included):

EDIT POLE#	Used to select a pole for editing; the actual editing is done with DELETE VALUE, CHANGE VALUE and ADD VALUE. This softkey is replaced by EDIT NUMER# when polynomial synthesis is active.
EDIT ZERO#	Used to select a zero for editing; the actual editing is done with DELETE VALUE, CHANGE VALUE and ADD VALUE. This softkey is replaced by EDIT RESDU# when pole residue synthesis is active and by EDIT DENOM# when polynomial synthesis is active.
DELETE VALUE	Deletes the edit line. Be careful when deleting poles and residues; these must be in pairs in the table.
CHANGE VALUE	Allows the edit line to be changed. When this is active, the edit line changes as you enter new values.
ADD VALUE	Allows a value to be added after the edit line. Enter the new value in mHz, Hz or kHz. Real values are entered as single numbers; complex values are entered as real,imaginary. For example, 6 ± j3 is entered as 6,3 Hz.
SYNTH FCTN	Displays the synthesis functions menu, which is used to enter system gains, time delays and scaling frequencies; see "The Synthesis Functions Menu" following this menu.
CLEAR TABLE	Press twice to clear the table. The message "Push Again to Clear" is displayed after the first press to allow you to confirm that the table is to be cleared.
RETURN	Redisplays the **SYNTH** menu.

The Synthesis Functions Menu

The synthesis functions menu allows you to add system gains, time delays and scaling frequencies to synthesis tables. The values entered are used by the instrument when it creates the trace. Note that the values must be entered before the trace is synthesized. Pressing SYNTH FCTN displays the following menu:

GAIN FACTOR	Used to enter the constant (K) if needed to set the desired gain of a synthesized frequency response function. See the example following this menu.
TIME DELAY	Used to enter time delay values for simulating delays in the synthesized frequency response. The delay is entered in microseconds, milliseconds or seconds; the default is 0.0 seconds.
SCALE FREQ	Used to enter the scaling frequency. This frequency is multiplied by the values in the table to scale the curve up or down in frequency without having to change every value. The frequency can be entered in Hz, RPM, or orders; the range is 10^{-6} to 10^{6}. An example use of scale frequencies is entering normalized values from a filter design handbook then translating the function to the desired range. You can also convert Hz to radians. SCALE FREQ should be used to avoid the occurrence of very large or very small numbers.
RETURN	Redisplays the POLE ZERO, POLE RESIDU, or POLYNOMIAL menu, depending on the type of synthesis selected.

To illustrate the use of GAIN FACTOR, synthesize a 20 kHz low-pass filter (single pole). In pole/zero format, enter a pole at -20kHz. The equation for this filter is:

$$f_{(s)} = \frac{1}{s + 20\text{kHz}}$$

This yields a pass band gain (at 0Hz) of $1/20000$ (-86dB). If you wanted a gain of 1 – (0dB), press GAIN FACTOR then enter 20000. This changes the equation to:

$$f_{(s)} = \frac{20000}{s + 20000}$$

Now the gain is 1 (0db) at 0Hz.

Converting Synthesis Tables

Synthesis tables can be converted from the current type to one of the other two types using the CONVRT TABLE menu. To convert a synthesis table, press the CONVRT TABLE softkey to display the following menu:

TO→POL ZERO	Converts a pole/residue or polynomial table to pole/zero format.
TO→POL RESIDU	Converts a pole/zero or polynomial table to pole/residue format.
TO →POLY	Converts a pole/zero or pole/residue table to polynomial format.
RETURN	Redisplays the **SYNTH** menu.

Also, pole/zero tables can be converted to curve fit tables using the SYNTH- > **FIT softkey in the FIT FCTN menu under CURVE FIT**—see "Using the Curve Fitter" later in this chapter. To convert a pole/residue or polynomial table to curve fit, first convert it to pole/zero format. When converting tables containing large numbers, it is recommended that you scale the numbers down using SCALE FREQ.

Synthesis Formulas

The following formulas are used in synthesis (remember that S is in Hertz in all these):

Pole-zero format:

$$\text{(gain factor)}\nearrow\frac{K(S-S_1)(S-S_1{}^*)(S-S_2)\ldots}{(S-S_3)\underset{\nwarrow\text{(non-zero case)}}{(S-S_3{}^*)}(S-S_4)\ldots}$$

Pole-residue format:

$$\underbrace{C_0S^0 + C_1S^1}_{\text{(residual terms)}} + \ldots + \frac{A_1}{S-S_1} \underset{\nwarrow\text{(non-zero case)}}{+} \frac{A_2}{S-S_2} + \frac{A_2{}^*}{S-S_2{}^*} + \frac{A_3}{\underset{\nwarrow\text{(repeated poles case)}}{(S-S_2)^2}} + \ldots$$

Polynomial format:

$$\frac{K(a_1s^0 + a_2s^1 + a_3s^2 + \ldots)}{(b_1s^0 + b_2s^1 + b_3s^2 + \ldots)}$$

(can be complex if synthesizing; must be real for table conversion)

THE CURVE FITTER

The curve fitter in the HP 3562A extracts pole and zero locations from measured or synthesized frequency response functions. This creates a mathematical model that "fits" the measured response. Conceptually, curve fitting can be thought of as synthesis process that tries pole and zero locations until it can produce a curve that matches the measured response. Up to forty poles and forty zeros can be extracted. You can explicitly specify the system order or let the auto order routine select a good number of poles and zeros. The curve fitter also has a weighting function that emphasizes pole and zero locations and high-coherence areas while de-emphasizing low-coherence areas. This function can be modified then used in place of the auto weight function.

The curve fitter produces both a table of pole/zero values and the curve defined by these values. As part of the development process, you can fit a measured response then transfer those values to synthesis and modify the curve to produce the desired response. Based on the combined curve fit and synthesis values, you can design device modifications (e.g., compensation networks) then curve fit the device with its modifications to see if the design goals have been met.

The HP 3562A allows you to curve fit frequency response functions while in the linear resolution, log resolution and swept sine modes.

The success of any curve fitting technique is highly dependent on a number of factors, including the weighting function, the specified system order, and the quality of the measurement. While the HP 3562A's curve fitter is designed for maximum performance and accuracy, you must exercise judgment when setting up the fit and when interpreting the results.

Here are the general steps to perform a curve fit:

1. Select the input data
2. Specify the system order
3. Specify the weighting function
4. Create the fit
5. View and edit the curve fit table
6. View and edit the weighting function

After the curve has been fitted once, steps can be repeated in any order to change the setup. For example, if a fit with 3 poles and 3 zeros did not seem adequate, you can specify a higher system order then create the fit again.

Because the HP 3562A can automatically help find a good system order and weighting function, curve fitting can be as simple as selecting input data and starting the fit. On the other hand, the curve fitter's flexibility allows you to control various aspects of the fit by bounding the problem with constraints (a specific system order, for example). The remainder of this chapter is divided into two parts: the first explains the softkey menus used for curve fitting, and the second guides you through the six setup steps.

THE CURVE FIT MENUS

There are four softkey menus used for setting up and performing curve fitting: **CURVE FIT**, EDIT TABLE, TABLE FCTN, FIT FCTN, and EDIT WEIGHT. The menus are described in this order in the following section.

The CURVE FIT Menu

CREATE FIT	Starts the curve fit using the current setup.
STOP FIT	Stops the curve fit before it is complete. This should be used if the fit is not converging.
NUMBER POLES	Used to enter the number of poles, from 0 to 40 (a conjugate pair is considered 2 poles).
NUMBER ZEROS	Used to enter the number of zeros, from 0 to 40 (a conjugate pair is considered 2 zeros).
LAST MEAS	Selects the last frequency response measurement made as the input to the curve fitter.
A & B TRACES	Selects the data in the A and B traces as the input to the curve fitter.
EDIT TABLE	Displays the table of values resulting from a fit and its editing menu. See "The EDIT TABLE Menu" following this menu.
FIT FCTN	Displays the curve fit functions menu, which is used to specify user/auto weight and user/auto order, convert synthesis and curve fit tables, and view and edit the weighting function. See "The FIT FCTN Menu" following this menu.

The EDIT TABLE Menu

The following menu is displayed when EDIT TABLE is pressed:

EDIT POLES	Shifts the editing softkeys to the poles in the table. When this is active, FIX LINE#, ADD LINE, and DELETE LINE# affect only the poles.
EDIT ZEROS	Shifts the editing softkeys to the zeros in the Stable. When this is active, FIX LINE#, ADD LINE, and DELETE LINE# affect only the zeros.
FIX LINE#	Fixes an existing line in the table. The curve fitter then assumes the line is correct and will not change it during subsequent fits. Whether a a pole or a zero is fixed depends on whether EDIT POLES or EDIT ZEROS is active. Fixed lines are identified by an arrow in the table.
UNFIX LINE#	Unfixes a previously fixed line. When a line is unfixed, the curve fitter treats it as a normal line.
ADD LINE	Used to add a pole or zero to the table. The curve fitter assumes added lines are correct and includes them. Whether a pole or zero is added depends on whether EDIT POLES or EDIT ZEROS is active. Added lines are identified by an arrow.
DELETE LINE#	Deletes the selected line in the table. Whether a pole or a zero is deleted depends on whether EDIT POLES or EDIT ZEROS is active.
TABLE FCTN	Displays the table functions menu, which allows you to add time delays and system gains to the table. This menu also allows you to clear the table. See "The TABLE FCTN Menu."
RETURN	Saves the changes made in the current editing session and redisplays the **CURVE FIT** menu.

The TABLE FCTN Menu

Pressing TABLE FCTN displays the following menu:

TIME DELAY	Used to enter time delay values. If the system being fit has an extraneous time delay in its response, this value must be included to obtain an accurate fit. The default value is 0.0 seconds.
SCALE FREQ	Used to enter the scaling frequency, which is multiplied by the pole and zero values to shift the curve up or down in frequency without actually changing any values. The frequency can be entered in Hz, RPM or Orders; use the units in which the the curve is displayed. The range is 10^{-6} to 10^{6}, and the default is 1.0.
CLEAR TABLE	Allows you to clear the table. This erases all values found by the curve fitter, as well as values added or fixed by the user. Clearing the table also resets the system gain to 1.0 and the time delay to 0.0 seconds.
RETURN	Redisplays the EDIT TABLE menu.

The FIT FCTN Menu

The following menu is displayed when FIT FCTN is pressed:

USER WEIGHT	Selects user weighting, which causes the HP 3562A to use the weighting function defined with the EDIT WEIGHT menu.
AUTO WEIGHT	Selects auto weighting, which causes the HP 3562A to automatically calculate the weighting function.
USER ORDER	Selects user order, which causes the HP 3562A to fit with the number of poles and zeros specified with NUMBER POLES and NUMBER ZEROS.
AUTO ORDER	Selects auto order, which causes the HP 3562A to select the optimum number of poles and zeros, up to the number specified by the user.
FIT →SYNTH	Transfers the curve fit table to the pole/zero synthesis table. Note that any values already in the synthesis table will be erased when the curve fit table is transferred.
SYNTH →FIT	Transfers the pole/zero synthesis table to the curve fit table.
EDIT WEIGHT	Displays the edit weight menu, which is used to view and modify the weighting function.
RETURN	Redisplays the **CURVE FIT** menu.

The EDIT WEIGHT Menu

The following menu is displayed when EDIT WEIGHT is pressed:

VIEW WEIGHT	Displays the weighting function, if one exists, or a unity function if one does not.
WEIGHT REGION	Used to specify a portion of the weighting function to be modified by WEIGHT VALUE. Enter the minimum and maximum frequencies separated by a comma. (Using an X marker band and **MARKER VALUE** is convenient.) Portions of the function outside the weight region retain their original values. More than one region can be modified.
WEIGHT VALUE	Used to define the value of the weighting function inside the region identified by WEIGHT REGION. Press WEIGHT VALUE, then enter the weighting constant for the region from 0 to 1.0. (Any value can be entered, but it will be normalized to 1.0.) View the level of the weighting function in side the weight region to determine its effect on the curve fit. Any portion of the weighting function outside the weight region retains its original weighting value.
STORE WEIGHT	Stores the weighting function and any changes made to it in the current editing session. **The function must be stored for the changes to be saved.**
RETURN	Redisplays the FIT FCTN menu. Note that changes made to the user weighting function are lost if STORE WEIGHT is not pressed.

CURVE FIT SETUP STEPS

These steps are the general procedure for curve fitting. As stated earlier, the steps do not have to be performed in any particular order. Steps may be repeated as many times as needed to obtain the best fit.

Step 1: Select the Input Data

Input data for the curve fitter must be a frequency response either measured or synthesized. It may be made in the linear resolution, log resolution or swept sine mode. (Refer to Chapters 1, 2 or 3, respectively, for instructions on making frequency response measurements.) There are two ways of providing the input data: A & B TRACES or LAST MEAS (both are in the **CURVE FIT** menu). A & B TRACES requires the frequency response display in trace A and the coherence display in trace B. To do this:

Press **A**, then **MEAS DISP**, then FREQ RESP

Press **B**, then COHER

LAST MEAS uses the last measurement made since power-on as the input to the curve fitter, regardless of the current display. Note that this must be a frequency response measurement; it cannot be the result of synthesis or waveform math.

Step 2: Specify the System Order

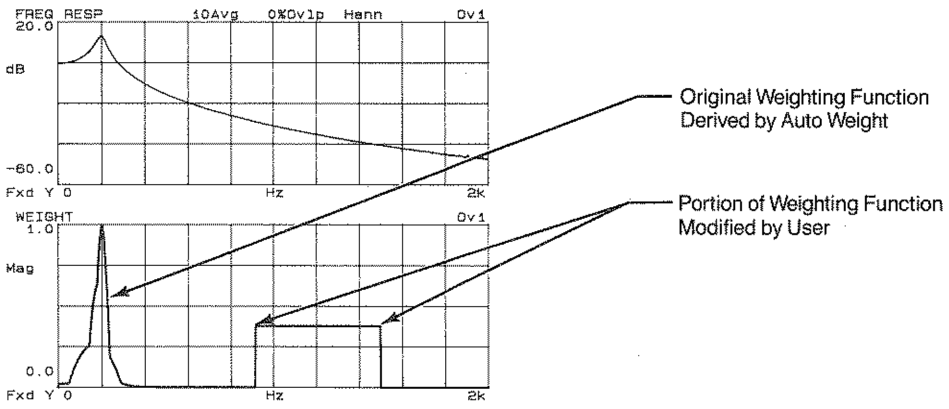
Specifying the system order of the curve to be fitted can be done in two ways: enter the exact number of poles and zeros (user order) or let the HP 3562A calculate the number that yields the best fit (auto order). The selection is made with USER ORDER and AUTO ORDER in the FIT FCTN menu. The number of poles and zeros is entered with NUMBER POLES and NUMBER ZEROS. Note that the number of poles and zeros indicated at the top of the table is the number you entered, not the number found with auto order.

There are several considerations when specifying the system order. If the order is known, selecting USER ORDER and entering the number of poles and zeros results in a faster fit than using AUTO ORDER. Keep in mind that selecting too few poles and zeros reduces the accuracy of the fit. As a general rule, use two poles for each positive peak in the trace, plus several extra to provide for hidden poles. Likewise, use two zeros for each negative peak in the trace, plus several extra to provide for hidden zeros.

Step 3: Specify the Weighting Function

The weighting function emphasizes important areas of the curve, such as poles and zeros. Weighting can be automatically calculated based on the measured data, or it can be specified at a constant value by the user. If AUTO WEIGHT is selected, the HP 3562A automatically derives the weighting function based on the pole and zero locations and the coherence of the measurement. If USER WEIGHT is selected, the curve fitter uses the weighting function stored by the user. Window corrections are not built into the auto weighting function.

The value of any portion of the curve can be specified by first identifying it with WEIGHT REGION (use either the **0-9** keys or an X marker band and the **MARKER VALUE** key), then entering the value with WEIGHT VALUE. You can enter values between −32,767 and +32,767, but the weighting is always normalized to a scale of 0 to +1.



Original Weighting Function Derived by Auto Weight

Portion of Weighting Function Modified by User

Figure 9-20 User-Modified Weighting Function

The user-defined function must be saved using STORE WEIGHT for the changes to take effect. User weighting functions are erased if a new measurement is started; save the function in local memory (use **SAVE RECALL**) if necessary. The curve fitter uses the specified value inside the weight region and uses the previous levels (either user or auto) for the parts of the function outside the weight region. You can specify and modify more than one region. Figure 9-20 shows an example of a user-modified weighting function.

Step 4: Create the Fit

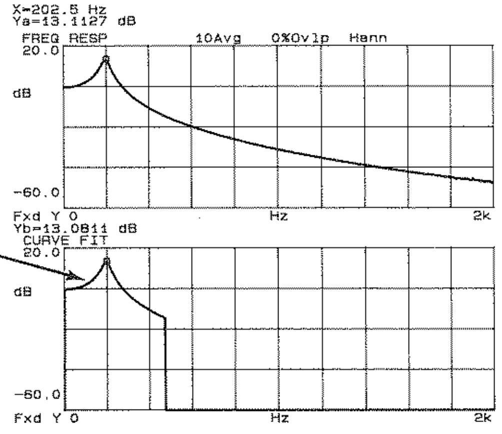
The fit is created when CREATE FIT in the **CURVE FIT** menu is pressed. The message "Curve Fit in Progress" is displayed while the fit is in progress. When the fit is complete, the extracted pole and zero locations can be viewed in the curve fit table; press EDIT TABLE.

You can fit any portion of the displayed frequency response trace. Use the X marker (see Chapter 8 for instructions) to identify the band of interest, then press CREATE FIT. The curve is then fitted inside the marker band only.

If an acceptable fit is achieved before the specified number of poles and zeros have been extracted, the fit can be stopped by pressing STOP FIT. It is helpful to press **FRONT BACK** while the fit is in progress. This superimposes the measured response and the fit results so you can monitor the progress. The fit can also be stopped if it becomes clear that the setup is inappropriate. Because fitting high-order systems can be time consuming, stop the fit if it is obviously incorrect.

To judge the accuracy of a fit, view the **FRONT BACK** display when the fit is complete. Because this superimposes the measured frequency response and the curve fit result, it quickly indicates any differences.

Figure 9-21 shows an example display at the completion of a fit.



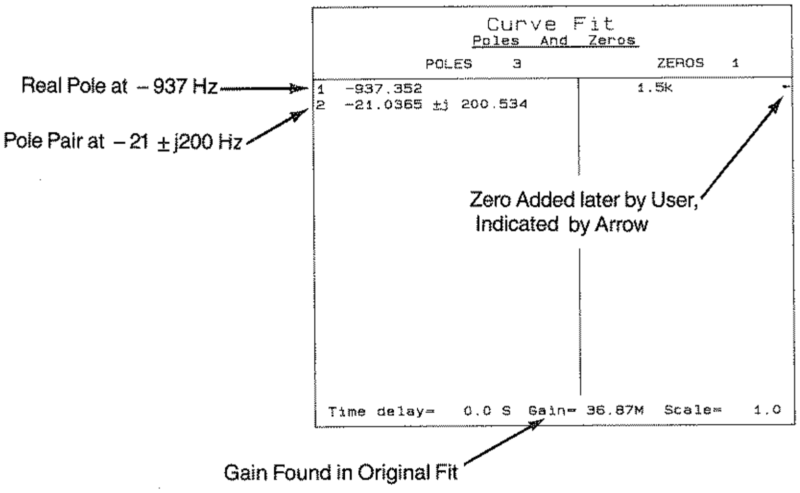
Trace Synthesized at Completion of Fit to Give You Visual Confirmation of Fit

This Portion of First Was Weighted to Zero by Auto Weighting Function

Figure 9-21 Example Curve Fit

Step 5: View and Edit the Curve Fit Table

The curve fit table, displayed by pressing EDIT TABLE, contains the pole and zero locations extracted by the curve fitter. Figure 9-22 shows an example of the table. Lines identified with arrows are either added by the user or first extracted by the fitter then later fixed by the user.



```
                  Curve Fit
               Poles  And  Zeros
        POLES     3                 ZEROS   1
1  -937.352                        1.5k              -
2  -21.0365 ±j 200.534

 Time delay=   0.0 S  Gain= 36.87M  Scale=   1.0
```

Figure 9-22 The Curve Fit Table

Pressing EDIT TABLE also displays the menu used to edit the table. This menu allows you to alter the pole and zero information to obtain the desired fit. The four editing softkeys (FIX LINE#, UNFIX LINE#, ADD LINE# and DELETE LINE#) apply to either the poles or zeros, depending on whether EDIT POLES or EDIT ZEROS is active.

When lines are fixed, the curve fitter assumes they are correct and includes them in the next fit. Lines added to the table are also considered fixed. One use of fixed lines is fitting a narrow region around a resonance, fixing these values, then expanding the fit to encompass the entire frequency span. The pole and zero locations found in the first fit are retained and used in the second fit. Fixed lines that have been subsequently unfixed are treated in the same manner as lines found by the curve fitter.

AUTO SEQUENCE PROGRAMMING

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you how to create, run and edit auto sequence programs. The auto sequence feature allows you to program up to twenty commands in a table that is stored in the HP 3562A's internal nonvolatile memory. Up to five auto sequences, each containing up to twenty commands, can be stored. (Additional tables can be saved in disc memory; see Chapter 11 for instructions.) Several example auto sequences are presented at the end of this chapter to show the convenience and versatility of the auto sequence feature.

Depending on the commands used, a table may fill with fewer than twenty lines. (The limit is 20 lines or 200 characters.) Messages and softkeys several menu levels deep require more space than key or simple softkey commands. The message "xxx keys left" is displayed at the top of the table to let you know how many key strokes you have left.

If an auto sequence initiates an indefinitely-long process, it does not wait for that process to finish, but continues after one time record. For example, if you start a measurement with 10 exponential averages, the auto sequence continues after the first record is measured. Similarly, indefinite processes initiated by an auto sequence are allowed to finish if the auto sequence ends before the process finishes.

There are several keys and softkeys in the HP 3562A that change other softkey menus. For example, if you want to select the histogram measurement, you must first select the linear resolution mode. Although keystrokes are not executed as they are entered in on auto sequence, **MEAS MODE**, **SELECT MEAS**, TM AVG ON OFF, and DEMOD ON OFF do change several softkey menus. If you want to use selections that depend on these keys/softkeys, make sure that you first make the necessary selections with **MEAS MODE**, **SELECT MEAS**, TM AVG ON OFF, or DEMOD ON OFF.

For entries that toggles (AUTO ON OFF, for example), press the softkey, enter a 0 or a 1, then press the Enter softkey.

CREATING AND RUNNING AUTO SEQUENCES

The **AUTO SEQ** menu provides access to the five auto sequence tables and allows you to start, pause, and continue individual auto sequences:

START ASEQ1	Starts the auto sequence stored in table #1. Note that "START ASEQ1" is replaced by a label if one was programmed in the auto sequence.
START ASEQ2	Starts the auto sequence stored in table #2. Note that "START ASEQ2" is replaced by a label if one was programmed in the auto sequence.
START ASEQ3	Starts the auto sequence stored in table #3. Note that "START ASEQ3" is replaced by a label if one was programmed in the auto sequence.
START ASEQ4	Starts the auto sequence stored in table #4. Note that "START ASEQ4" is replaced by a label if one was programmed in the auto sequence.
START ASEQ5	Starts the auto sequence stored in table #5. Note that "START ASEQ5" is replaced by a label if one was programmed in the auto sequence.
PAUSE ASEQ	Pauses a running auto sequence. This softkey applies only when "AUTO SEQUENCE RUNNING" is displayed. A paused auto sequence can be continued by pressing CONT ASEQ. PRESET also pauses auto sequences.
CONT ASEQ	Continues a paused auto sequence. "Aseq Finished" is displayed if the auto sequence is already finished when CONT ASEQ is pressed.
SELECT ASEQ#	Used to select the auto sequence to be viewed or edited. Press SELECT ASEQ#, then enter the number from 1 to 5. If you terminate this entry with the VIEW softkey, the table is displayed, but it cannot be edited. If you terminate the entry with the EDIT softkey, the table is displayed, and it can be edited. Note that if a label has replaced the START ASEQ1—5 softkey, the auto sequence is still selected by its number from one to five.

Auto Sequences with More Than 20 Lines

There are three techniques available if you need more than twenty lines to solve a measurement problem. First, if some steps are repetitive, you can create loops in individual auto sequences to effectively yield more than twenty lines. Second, you can command an auto sequence to start others, giving you up to one hundred lines in five auto sequences. Third, you can recall auto sequences from disc memory and run them under auto sequence control, giving you a nearly unlimited number of command lines.

The LOOP TO command is explained in "The Auto Sequence Functions Menu," and using auto sequences with discs is explained in "Saving Auto Sequences in Disc Memory."

Running Auto Sequences

Auto sequences are started by pressing the desired softkey in the **AUTO SEQ** menu. Commands are executed simultaneously. In most cases, the auto sequence waits until each command has been completely executed before continuing. However, with infinite processes, such as exponential averaging, execution continues after one measurement is made. On the other hand, if you have **START** in the auto sequence, and the analyzer is set up for a 100-average measurement, the auto sequence will idle after executing **START** until all 100 averages are taken.

In the swept sine mode, auto sequences idle after starting sweeps.

The EDIT Menu

This menu is used to fill and edit auto sequence tables. Commands, or lines, are entered in the table in the same manner as they are executed directly: key, softkey(s), then units softkeys, if necessary. For example, to program an input range of 5 volts for Channel 1, the command is entered as **RANGE:** CHAN 1 RANGE: 5:V. To program the B trace to activate, the command is entered as just **B**. The HP 3562A enters each line in the table as soon as you enter a complete command. Press SELECT ASEQ# followed by a number 1—5, then press the EDIT softkey to display the following menu:

LABEL ASEQ	Used to add labels; see "Labeling Auto Sequences" following this menu.
EDIT LINE #	Used to select the line to be edited. The edit line can be changed if CHANGE LINE is active, or a new line can be added after the edit line if ADD LINE is active. The current line is highlighted and indicated by an arrow.
DELETE LINE	Deletes the edit line, as selected with EDIT LINE#.
CHANGE LINE	Allows the edit line (as selected with EDIT LINE#) to be changed. Once CHANGE LINE is pressed, it remains active until ADD LINE is pressed or the instrument is turned off, or the edit is ended.
ADD LINE	Allows a line to be added after the edit line (as selected by EDIT LINE#). Once ADD LINE is pressed, it remains active until CHANGE LINE is pressed. To add a line before the current line #1, move the line pointer to line #0 (above line #1), then enter the new line.
CLEAR ASEQ	Clears the auto sequence table. The message "Push Again to Clear" is displayed to allow you to confirm that the auto sequence is to be cleared.
ASEQ FCTN	Displays the auto sequence functions menu; see "The Auto Sequence Functions Menu."
END EDIT	Saves the changes made in the current editing session, exits the editing mode and redisplays the **AUTO SEQ** menu.

Labeling Auto Sequences

An auto sequence label serves two functions: it is displayed at the top of the table so that the auto sequence can be easily identified, and it replaces the appropriate START ASEQ# softkey label so that the function of the table is shown in the **AUTO SEQ** menu. Note that clearing the auto sequence also erases the label. Labels are limited to six characters per line; separate the first and second lines with a comma.

When LABEL ASEQ is pressed, the HP 3562A shifts into the alpha mode, in which the keys (except LINE and HELP) are converted to their blue labels. LABEL ASEQ also displays the following menu to allow you to enter the label:

ENTER	Saves the current alpha entry and exits the alpha mode.
SPACE FORWRD	Moves the cursor one space forward to edit an entry. Use the "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use **BACK SPACE**.
INSERT ON **OFF**	When this is pressed ON, characters are inserted at the cursor position. When it is pressed OFF, characters are written over existing ones.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the alpha entry from the cursor position to the end of the line.
CANCEL ALPHA	Clears the current entry and exits the alpha mode.

Auto sequence labels are not stored in calling auto sequences. For example, if ASEQ1 has the command "START ASEQ2" and you change the label of ASEQ2 to "TEST A," the next time you edit ASEQ1, the "START ASEQ2" will be changed to "TEST A."

The Autostart Auto Sequence

You can program one of the five auto sequences to start when power is turned on. In the editing menu, use the LABEL ASEQ softkey and enter "AUTOST" as the first six characters of auto sequence label. Normally, the HP 3562A starts the measurement when power is applied. AUTOST, however, inhibits this, so you need to program the **START** key into AUTOST if you want it to start a measurement at power-on. If more than one auto start sequence exists, only the first one is executed. To interrupt an autostart sequence at power-on, continually press softkey #6 (even though it has no label) immediately after power-on.

The Auto Sequence Functions Menu

The auto sequence functions menu allows you to add time pauses and timed starts, messages and display control to the auto sequence. Pressing ASEQ FCTN (in the SELECT ASEQ# menu) displays the following menu:

LOOP TO	Used to program loops into auto sequences. Two numbers are required: the number of the first line in the loop and the number of times you want the loop to repeat. Press LOOP TO then enter the line number and loop count separated by a comma. Loops are limited to three levels deep.
GO TO	Causes the program to jump to the indicated line and continue from there. Press GO TO then enter the number of the destination line.
ASEQ MESSGE	Used to enter auto sequence messages. These are limited to 24 characters and are displayed in the lower right corner of the display. When ASEQ MESSGE is pressed, the instrument shifts to the alpha mode; see "Labeling Auto Sequences" for instructions on using the alpha menu.
TIMED PAUSE	Used to enter timed pauses. When the program encounters a timed pause, it pauses for the specified time, then continues. Press TIMED PAUSE and enter the desired time, from 0 to 32,767 seconds (546.12 minutes).
TIMED START	Used to enter delayed starting times. The start time is tied to the non-real time clock. See TIME H,M,S in the **SPCL FCTN** menu to view or set the clock. If a starting time is entered, the auto sequence begins when the clock reaches that time. Start times must be between 00,00,00 and 23,59,59. To turn off timed start, set the hour to 24.
DSPLAY **ON** OFF	When this is pressed ON, all displays generated by the auto sequence are displayed. When it is pressed OFF, only the final display is shown; any intermediate results are not displayed.
RETURN	Redisplays the SELECT ASEQ# menu.

To program audible beeps into an auto sequence, press **SPCL FCTN,** followed by BEEPER ON OFF, then type in 1 and press ENTER.

SAVING AUTO SEQUENCES IN DISC MEMORY

Auto sequences can be stored in disc memory both for archival purposes and to provide more command lines. Chapter 11 gives instructions for connecting a disc drive and using one in general, but several aspects of auto sequences require noting here.

First, recalled auto sequences do not have to be stored in the auto sequence table in which they were created. For example, if you created an ASEQ1 and saved it on disc as file "TEST," you can recall it into ASEQ5 by using **DISC:** RECALL FILE: TEST,5. (This would erase the original contents of ASEQ5, of course.) The number (1—5) after the file name and the comma indicates the table you want the recalled auto sequence to be stored in.

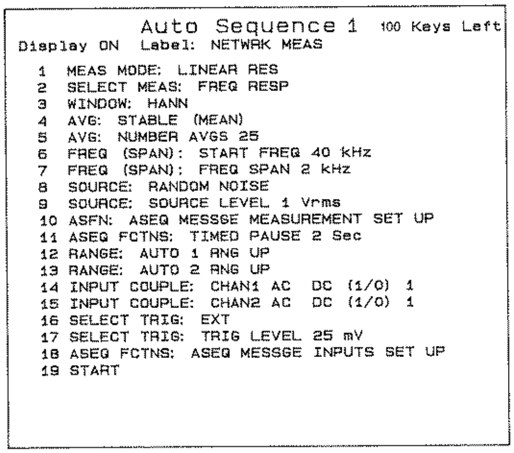
Second, an auto sequence can be recalled from disc by another auto sequence and stored into one of the five tables. Recalled tables are then started with the appropriate START ASEQ command. For example, you could use **DISC:** RECALL FILE: TEST and AUTO SEQ: TEST as commands to recall and start an auto sequence saved on disc.

Third, labels are not tracked, only auto sequence numbers. For example, if ASEQ1 has the command "START ASEQ2" and you save ASEQ2 on disc and later recall it into ASEQ3, the command in ASEQ1 will no longer be valid. (It will go ahead and start ASEQ2, but the auto sequence you want is now in ASEQ3.)

EXAMPLE AUTO SEQUENCES

This section provides examples that demonstrate the power and flexibility of the HP 3562A's auto sequence feature. All were plotted directly from the display.

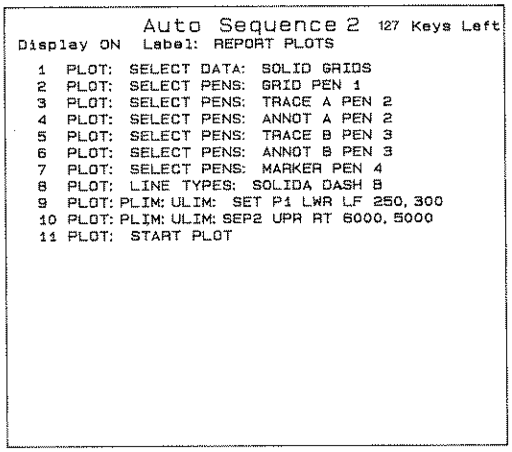
Sets Up a Frequency Response Measurement for Network Analysis



```
             Auto  Sequence 1  100 Keys Left
Display ON  Label:  NETWRK MEAS

  1  MEAS MODE:  LINEAR RES
  2  SELECT MEAS:  FREQ RESP
  3  WINDOW:  HANN
  4  AVG:  STABLE  (MEAN)
  5  AVG:  NUMBER AVGS 25
  6  FREQ  (SPAN):  START FREQ 40 kHz
  7  FREQ  (SPAN):  FREQ SPAN 2 kHz
  8  SOURCE:  RANDOM NOISE
  9  SOURCE:  SOURCE LEVEL 1 Vrms
  10 ASFN:  ASEQ MESSGE MEASUREMENT SET UP
  11 ASEQ FCTNS:  TIMED PAUSE 2 Sec
  12 RANGE:  AUTO 1 RNG UP
  13 RANGE:  AUTO 2 RNG UP
  14 INPUT COUPLE:  CHAN1 AC  DC  (1/0)  1
  15 INPUT COUPLE:  CHAN2 AC  DC  (1/0)  1
  16 SELECT TRIG:  EXT
  17 SELECT TRIG:  TRIG LEVEL 25 mV
  18 ASEQ FCTNS:  ASEQ MESSGE INPUTS SET UP
  19 START
```

Figure 10-1

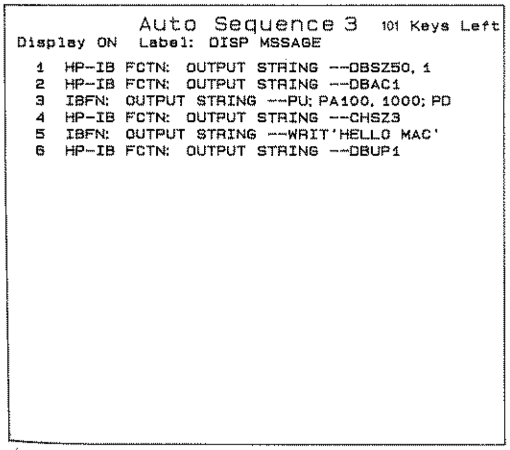
Sets Up Several Plotting Parameters to Generate Consistent Plots



```
             Auto  Sequence 2  127 Keys Left
Display ON  Label:  REPORT PLOTS

  1  PLOT:  SELECT DATA:  SOLID GRIDS
  2  PLOT:  SELECT PENS:  GRID PEN 1
  3  PLOT:  SELECT PENS:  TRACE A PEN 2
  4  PLOT:  SELECT PENS:  ANNOT A PEN 2
  5  PLOT:  SELECT PENS:  TRACE B PEN 3
  6  PLOT:  SELECT PENS:  ANNOT B PEN 3
  7  PLOT:  SELECT PENS:  MARKER PEN 4
  8  PLOT:  LINE TYPES:  SOLIDA DASH B
  9  PLOT: PLIM: ULIM:  SET P1 LWR LF 250, 300
  10 PLOT: PLIM: ULIM: SEP2 UPR RT 6000, 5000
  11 PLOT:  START PLOT
```

Figure 10-2

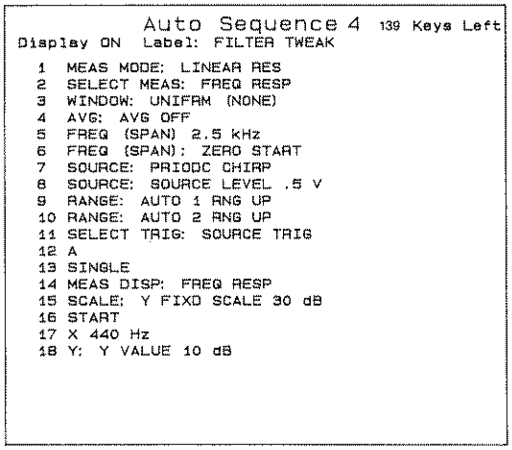
Displays "HELLO MAC" on the Computer's Screen. Refer to Chapter 5 in the *HP 3562A Programming Manual* for Information on the Commands Used Here.



```
             Auto  Sequence 3  101 Keys Left
Display ON  Label:  DISP MSSAGE

  1  HP-IB FCTN:  OUTPUT STRING --OBSZ50, 1
  2  HP-IB FCTN:  OUTPUT STRING --DBAC1
  3  IBFN:  OUTPUT STRING --PU; PA100, 1000; PD
  4  HP-IB FCTN:  OUTPUT STRING --CHSZ3
  5  IBFN:  OUTPUT STRING --WRIT'HELLO MAC'
  6  HP-IB FCTN:  OUTPUT STRING --DBUP1
```

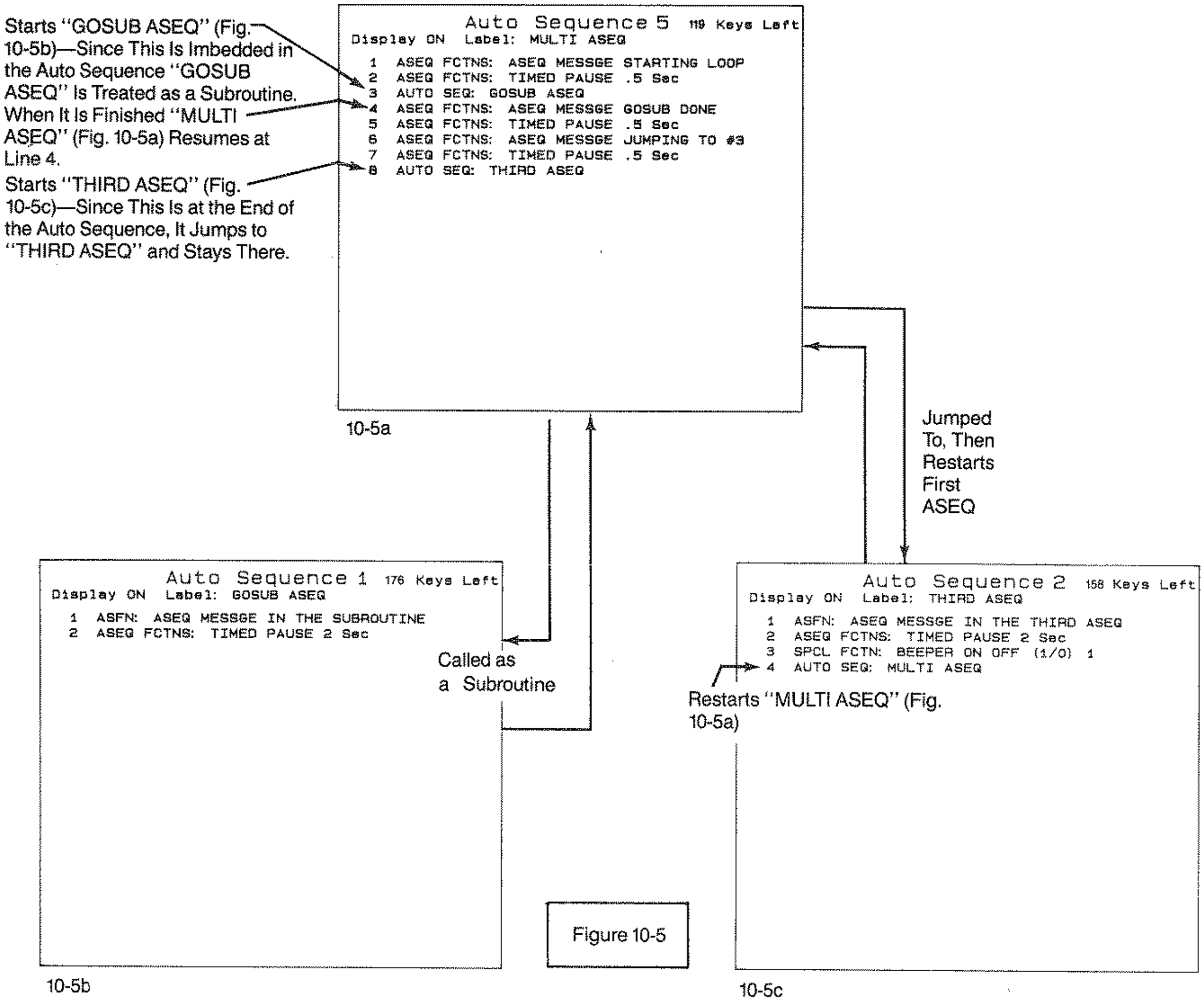
Figure 10-3

Sets Up a Continuous, Exponentially Averaged Measurement for Adjusting Filters.



```
             Auto  Sequence 4  139 Keys Left
Display ON  Label:  FILTER TWEAK

  1  MEAS MODE:  LINEAR RES
  2  SELECT MEAS:  FREQ RESP
  3  WINDOW:  UNIFRM  (NONE)
  4  AVG:  AVG OFF
  5  FREQ  (SPAN)  2.5 kHz
  6  FREQ  (SPAN):  ZERO START
  7  SOURCE:  PRIODC CHIRP
  8  SOURCE:  SOURCE LEVEL  .5 V
  9  RANGE:  AUTO 1 RNG UP
  10 RANGE:  AUTO 2 RNG UP
  11 SELECT TRIG:  SOURCE TRIG
  12 A
  13 SINGLE
  14 MEAS DISP:  FREQ RESP
  15 SCALE:  Y FIXD SCALE 30 dB
  16 START
  17 X 440 Hz
  18 Y:  Y VALUE 10 dB
```

Figure 10-4



Starts "GOSUB ASEQ" (Fig. 10-5b)—Since This Is Imbedded in the Auto Sequence "GOSUB ASEQ" Is Treated as a Subroutine. When It Is Finished "MULTI ASEQ" (Fig. 10-5a) Resumes at Line 4.

Starts "THIRD ASEQ" (Fig. 10-5c)—Since This Is at the End of the Auto Sequence, It Jumps to "THIRD ASEQ" and Stays There.

```
                 Auto  Sequence 5  119 Keys Left
Display ON  Label: MULTI ASEQ
  1  ASEQ FCTNS:  ASEQ MESSGE STARTING LOOP
  2  ASEQ FCTNS:  TIMED PAUSE .5 Sec
  3  AUTO SEQ:  GOSUB ASEQ
  4  ASEQ FCTNS:  ASEQ MESSGE GOSUB DONE
  5  ASEQ FCTNS:  TIMED PAUSE .5 Sec
  6  ASEQ FCTNS:  ASEQ MESSGE JUMPING TO #3
  7  ASEQ FCTNS:  TIMED PAUSE .5 Sec
  8  AUTO SEQ:  THIRD ASEQ
```

10-5a

Jumped To, Then Restarts First ASEQ

```
               Auto  Sequence 1  176 Keys Left
Display ON  Label: GOSUB ASEQ
  1  ASFN:  ASEQ MESSGE IN THE SUBROUTINE
  2  ASEQ FCTNS:  TIMED PAUSE 2 Sec
```

Called as a Subroutine

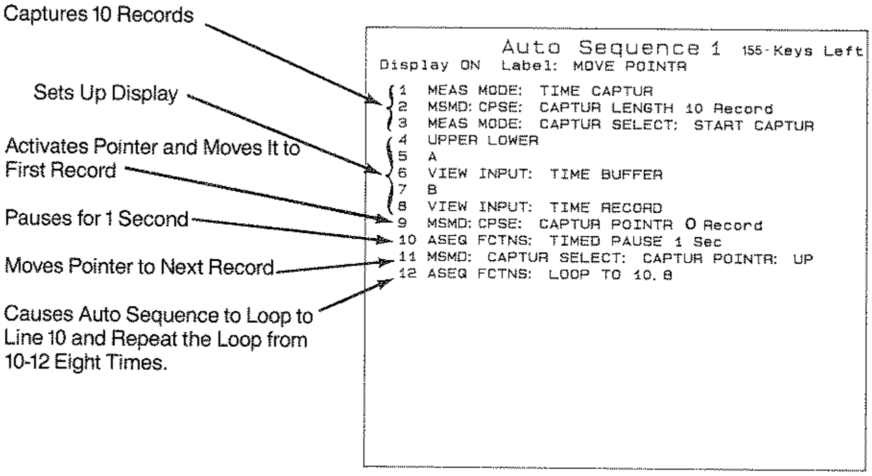
10-5b

```
               Auto  Sequence 2  158 Keys Left
Display ON  Label: THIRD ASEQ
  1  ASFN:  ASEQ MESSGE IN THE THIRD ASEQ
  2  ASEQ FCTNS:  TIMED PAUSE 2 Sec
  3  SPCL FCTN:  BEEPER ON OFF (1/0)  1
  4  AUTO SEQ:  MULTI ASEQ
```

Restarts "MULTI ASEQ" (Fig. 10-5a)

10-5c

Figure 10-5



Captures 10 Records

Sets Up Display

Activates Pointer and Moves It to First Record

Pauses for 1 Second

Moves Pointer to Next Record

Causes Auto Sequence to Loop to Line 10 and Repeat the Loop from 10-12 Eight Times.

```
                 Auto  Sequence 1  155-Keys Left
Display ON  Label: MOVE POINTR
 {1  MEAS MODE:  TIME CAPTUR
 {2  MSMD: CPSE:  CAPTUR LENGTH 10 Record
 {3  MEAS MODE:  CAPTUR SELECT:  START CAPTUR
 {4  UPPER LOWER
 {5  A
 {6  VIEW INPUT:  TIME BUFFER
 {7  B
 {8  VIEW INPUT:  TIME RECORD
  9  MSMD: CPSE:  CAPTUR POINTR 0 Record
  10 ASEQ FCTNS:  TIMED PAUSE 1 Sec
  11 MSMD:  CAPTUR SELECT:  CAPTUR POINTR:  UP
  12 ASEQ FCTNS:  LOOP TO 10, 8
```

Figure 10-6

Chapter 11

HP-IB FUNCTIONS

PURPOSE OF THIS CHAPTER

The purpose of this chapter is to show you how to use the HP 3562A as an HP-IB controller to plot the display, access disc memories, and output HP-IB command strings. The topics covered are:

1. Using the **HP-IB FCTN** menu

   Selecting system controller or addressable-only
   Viewing and setting HP-IB addresses
   Sending user service requests

2. Plotting the display

   Connecting and addressing the plotter
   Setting the plot parameters

3. Using disc memories

   Connecting and addressing the disc drive
   Saving and recalling displays
   Using the disc functions menu
   Formatting discs
   Copying disc files
   Using the disc service functions

4. Outputting HP-IB command strings

THE HP-IB FCTN MENU

The **HP-IB FCTN** menu allows you to identify the HP 3562A as the HP-IB system controller, view and set addresses, send user service requests and output HP-IB command strings. For programming the HP 3562A as an addressable-only device on the bus, please refer to the *HP 3562A Programming Manual.*

SYSTEM CNTRLR	Identifies the HP 3562A as the system controller. This is necessary for plotting, accessing discs and outputting command strings.
ADDRES ONLY	Identifies the HP 3562A as an addressable-only bus device. This is necessary for programming the instrument over the HP-IB with an external controller.
SELECT ADDRES	Displays the select address menu, which is used to set the HP 3562A's address and enter the addresses of plotters and disc drives. See "The Select Address Menu" following this menu.
USER SRQ	Displays the user service request menu, which allows you to send eight unique service requests to an external controller. See "User Service Requests" following this menu.
OUTPUT STRING	Allows you to output command strings to the HP-IB. See "Outputting Command Strings" following this menu.
ABORT HP-IB	Aborts HP-IB operations.

The Select Address Menu

Press SELECT ADDRES to display the following menu:

HP-IB ADDRES	Used to view and set the HP-IB address of the HP 3562A, from 0 to 31.
PLOT ADDRES	Used to enter the plotter's address, from 0 to 31. The HP 3562A needs to know the plotter's address to communicate with it.
DISC ADDRES	Used to enter the disc drive's address, from 0 to 7. The HP 3562A needs to know the drive's address to communicate with it.
DISC UNIT	Used to enter the unit number on multiple-unit disc drives, from 0 to 15. This does not actually set it on the drive, but the HP 3562A needs to know the drive unit number to access the desired disc.

User Service Requests

The HP 3562A allows you to send up to eight unique service requests to an external controller on the HP-IB. The USER SRQ1 through SRQ8 softkeys are in the USER SRQ menu. For information on customizing the softkeys labels and handling the SRQs, please refer to the *HP 3562A Programming Manual.* The analyzer can also be set to send an SRQ at power-on. See "PwrSRQ ON OFF" under the **SPCL FCTN** menu in Chapter 12 for more information.

PLOTTING THE DISPLAY

The HP 3562A offers direct digital control of HP-IB compatible plotters equipped with Hewlett-Packard Graphics Language (HP-GL). Traces, tables and instrument states may be plotted. HP-IB or HP-GL programming knowledge is not required to use the plotter.

NOTE

The HP 3562A must be identified as the system controller (if an external controller is not on the bus) in order to plot. Press ***HP-IB FCTN,*** *followed by SYSTEM CNTRLR. If you are using a controller and a plotter on the bus simultaneously, refer to the* HP 3562A Programming Manual *to pass control between the controller and the HP 3562A.*

Connecting and Addressing the Plotter

To connect a plotter to the HP 3562A, refer to figure 11-1. A standard HP-IB cable is required; the following cables are available from Hewlett-Packard:

Part Number	Length
10833A	1 m (3.3 ft)
10833B	2 m (6.6 ft)
10833C	4 m (13.2 ft)
10833D	0.5 m (1.6 ft)

CAUTION

The HP 3562A has metric threaded HP-IB cable mounting studs, as opposed to English threads. Metric threaded HP 10833A/B/C/D cables must be used. Metric fasteners are colored black, while English fasteners are colored silver. DO NOT attempt to connect black and silver fasteners, or damage to cable and instrument will result.

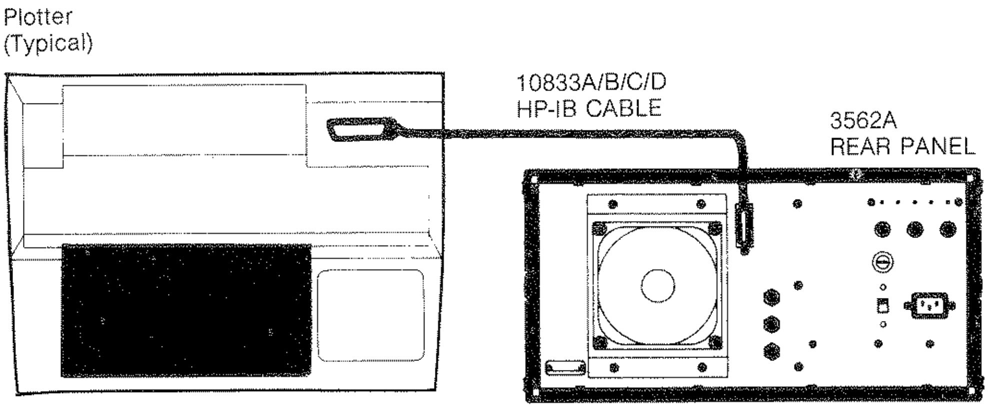


Figure 11-1 Connecting a Plotter to the HP 3562A

To address the plotter, the HP 3562A needs to know the plotter's HP-IB address. Refer to your plotter's manual to set and read its address. To enter the corresponding address into the HP 3562A, press **HP-IB FCTN** in the HP-IB group. When its menu is displayed, press SELECT ADDRES followed by PLOT ADDRES, then enter the plotter's current address. The address is stored in nonvolatile memory (it need not be reentered if the instrument is turned off). Note that some plotters do not recognize an address change until their power is turned off then on again.

Setting the Plot Parameters

The HP 3562A offers control of every aspect of plotting. However, plotting can be a very simple operation by using the preset parameters. To set the parameters and start plotting, press **PLOT** to display the following menu:

START PLOT	Initiates plotting using the current plot parameters and displays the ABORT HP-IB command to abort plotting, if necessary.
SELECT DATA	Displays the select data menu; this determines the combination of data, annotation and grid for plotting.
SELECT PENS	Displays the select pens menu; this determines the pen numbers for plotting the various parts of the display.
SPEED F S	Selects fast or slow plotting; fast is the default speed of the plotter (usually 36 cm/s), while slow is 5 cm/s.
LINE TYPES	Displays the line types menu; this is used to select the line type for each trace.
PAGING CONTRL	Displays the paging control menu; this is used for plotters with paging control.
PLOT LIMITS	Displays the plot limits menu; this is used to select default or user-defined limits.
PLOT PRESET	Presets all plot parameters; see table 11-1 for details.

NOTE

The HP logo in the upper left corner of table and state displays is not normally plotted. If you do wish to plot it with the display, refer to Chapter 6 of the HP 3562A Programming Manual *for instructions.*

Plot Preset Table 11-1 shows the plot preset parameters. These are the conditions immediately after PLOT PRESET is pressed. These conditions also apply immediately after power-up and after RESET in the preset menu is pressed. However, pressing only the green **PRESET** key or one of the special presets does not affect the plot setup.

Table 11-1 The Plot Preset Parameters

Parameter	Preset Condition
SELECT DATA	DATA & ANNOT active DFAULT GRIDS active
SELECT PENS	Pen #1 for grid, Trace A and its annotation Pen #2 for marker, Trace B and its annotation
SPEED F S	Fast
LINE TYPES	SOLID LINES is active
PAGING CONTRL	NO PAGING is active CUT PAGE ON OFF is OFF
PLOT LIMITS	PLOT AREA is active DFAULT LIMITS is active ROT 90 ON OFF is OFF

The Select Data Menu To select the combination of data, annotation and grid to be plotted, press SELECT DATA to display the following menu:

DATA ONLY	Selects only the data trace(s) for plotting.
DATA & ANNOT	Selects the data traces and all the alphanumeric annotation for plotting; also displays the three grid control softkeys shown below.
DFAULT GRIDS	Plots the grids exactly as they appear on the screen.
SOLID GRIDS	Plots the grids with solid lines, regardless of how they appear on the screen.
TICK MARKS	Plots ticks marks on the grid axes in place of the horizontal and vertical grid lines.
RETURN	Redisplays the **PLOT** menu.

The Select Pens Menu To select the pen number for plotting the various parts of the display, press SELECT PENS to display the following menu:

GRID PEN	Used to enter the pen number for plotting the grid and the capture pointer.
TRACE A PEN	Used to enter the pen number for plotting trace A.
TRACE B PEN	Used to enter the pen number for plotting trace B.
ANNOT A PEN	Used to enter the pen number for plotting the annotation for trace A.
ANNOT B PEN	Used to enter the pen number for plotting the annotation for trace B.
MARKER PEN	Used to enter the pen number for plotting the markers.
RETURN	Redisplays the **PLOT** menu.

The pen numbers can range from 0 to the maximum number of pens in the plotter. Refer to your plotter's manual for its response to invalid pen numbers. If you enter 0 for a pen number, the HP 3562A instructs the plotter to put the pen away. This is useful to selectively avoid plotting parts of the display.

The Line Types Menu To select one of the preset line types or to define one of your own, press LINE TYPES to display the following menu:

SOLID LINES	Selects solid lines for both traces.
DASHED LINES	Selects dashed lines for both traces.
DOTS	Selects dotted lines for both traces.
SOLIDA DASH B	Selects a solid line for Trace A and a dashed line for Trace B.
USER LINES	Displays the line type number softkeys below, which allow you to define custom line types, and activates user lines.
LINE A TYPE #	Used to enter a line type number and length for Trace A; see "User Lines." This softkey appears only after USER LINES is pressed.
LINE B TYPE #	Used to enter a line type number and length for Trace B; see "User Lines." This softkey appears only after USER LINES is pressed.
RETURN	Redisplays the **PLOT** menu.

User Lines The user lines are defined by two variables: the pattern number and pattern type. Refer to your plotter's programming manual for more information. (This feature uses the HP-GL command "LT" to enter the user line numbers.) You can use just the standard line numbers 1 through 8, if desired, without using the second parameter. The second parameter is always optional. In the HP 3562A, solid lines are assigned the line type number −32,768.

The Paging Control Menu To control paging features on plotters so equipped, press PAGING CONTRL to display the following menu:

PAGE FORWRD	Enables the page forward feature. Pages are forwarded after the plots are finished.
PAGE BACK	Enables the page back feature. Pages are backed up after the plots are finished.
NO PAGING	Disables the paging features.
CUT PG ON **OFF**	Controls the page cutting feature. Pages are cut after the plot is finished.
RETURN	Redisplays the **PLOT** menu.

These commands are not sent to plotters without paging capabilities. Refer to your plotter's manual for information on its paging features.

The Plot Limits Menu You can set the plotter's limits directly from the HP 3562A. Press PLOT LIMITS to display the following menu:

PLOT AREA	Causes the entire screen, including annotation, to be plotted within the plot limits.
GRID AREA	Causes the plot grid to line up with the plot limits. Useful for printed graph paper.
DFAULT LIMITS	Selects the P1 and P2 values defined by the plotter.
USER LIMITS	Selects the P1 and P2 values defined by the HP 3562A, and displays the user limits menu and allows you to set the plotter's P1 and P2 coordinates directly from the HP 3562A. See "The User Limits Menu" following this menu.
ROT 90 ON **OFF**	Rotates the plot 90 degrees. This puts P1 in the upper left corner and P2 in the lower right corner. Note that if your plotter also has a rotate feature, it does not have to be active if ROT 90 is ON. This reverses the aspect ratio to 3.7:4.9 (X:Y).
RETURN	Redisplays the **PLOT** menu.

Once you select USER LIMITS and redefine the P1 and P2 positions, these new locations become the plotter's default values. This sets the DFAULT LIMITS equal to USER LIMITS.

The User Limits Menu The HP 3562A allows to you define the P1 and P2 locations from the instrument. When USER LIMITS is active, the plotter uses the analyzer's definitions of P1 and P2, not its own. You can also read the current P1 and P2 locations as defined on the plotter. Press USER LIMITS to display the following menu:

SET P1 LWR LF	Used to specify the location of P1.
SET P2 UPR RT	Used to specify the location of P2.
READ PEN→P1	Reads the current location of the plotter's pen into the HP 3562A's P1.
READ PEN→P2	Reads the current location of the plotter's pen into the HP 3562A's P2.
ABORT HP-IB	Aborts HP-IB operations. Use this if the plotter fails to respond to one of the READ PEN softkeys.
RETURN	Redisplays the USER LIMITS menu.

P1 is the lower left corner of the plot, and P2 is the upper right corner. The screen's aspect ratio is 4.9:3.7 (X:Y). HP-GL assigns the origin to the lower left corner of the plotter's usable area. The values entered for P1 and P2 are an X-Y coordinate pair separated by a comma. For example, entering a P1 location of 250,100 sets the lower left corner 250 units to the right and 100 units above the corner. Refer to your plotter's programming manual for more information.

USING DISC MEMORIES

The HP 3562A allows you to store an unlimited number of displays (tables, traces, and states) to disc memory without using an external controller. The instrument supports the Hewlett-Packard 794X and 91XX series disc drives. (Other drives can be used as well but the HP 3562A does not support their service diagnostics.) This ability to directly control a disc is also used with time throughput; refer to Chapter 6 for using throughput.

This section shows you how to:

1. Connect and address the disc drive
2. Save and recall displays
3. Use the disc functions menu
4. Format discs
5. Copy disc files
6. Use the disc service functions

Any Hewlett-Packard ¼-inch tape drives using the Command Set/80 disc control language can be used for any applicable operations. Because of their slower speed, tapes are used primarily for disc backup. The HP 3562A accesses only volume 0 of multi-volume discs.

Connecting and Addressing the Disc Drive

NOTE

*The HP 3562A must be identified as the system controller (if an external controller is not on the bus) in order to use a disc memory. Press **HP-IB FCTN**, followed by SYSTEM CNTRLR. If you are using a controller and a disc drive on the bus simultaneously, refer to the* HP 3562A Programming Manual *information on passing control.*

To connect a disc drive to the HP 3562A, refer to figure 11-2. A standard HP-IB cable is required; the following cables are available from Hewlett-Packard:

Part Number	Length
10833A	1 m (3.3 ft)
10833B	2 m (6.6 ft)
10833C	4 m (13.2 ft)
10833D	0.5 m (1.6 ft)

CAUTION

The HP 3562A has metric threaded HP-IB cable mounting studs, as opposed to English threads. Metric threaded HP 10833A/B/C/D cables must be used. Metric fasteners are colored black, while English fasteners are colored silver. DO NOT attempt to connect black and silver fasteners, or damage to cable and instrument will result.

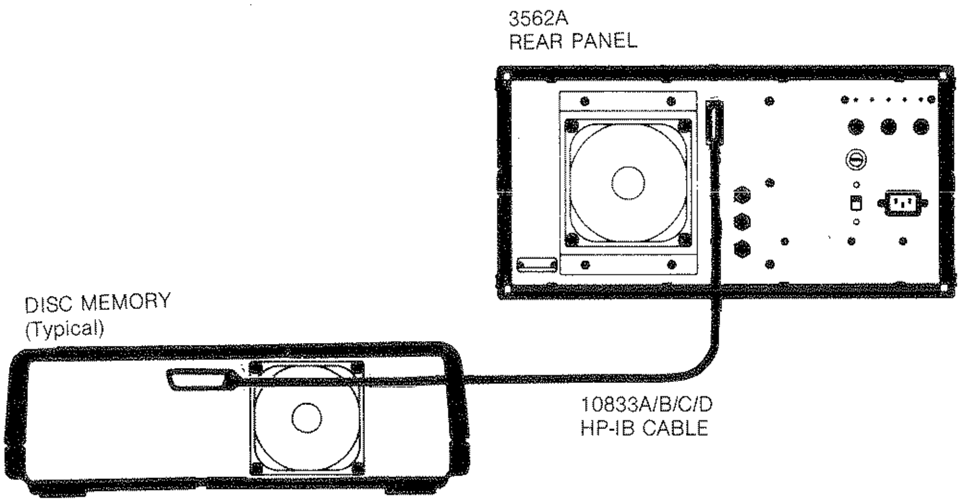


Figure 11-2 Connecting a Disc Memory to the HP 3562A

To address the disc, the HP 3562A needs to know the disc's HP-IB address (and the current disc unit number for multiple-drive memories). Refer to your disc's manual to set and read its address. To enter the address into the HP 3562A, press **HP-IB FCTN** in the HP-IB group. When its menu is displayed, press SELECT ADDRES, then DISC ADDRES and enter the disc's current address. The address is stored in nonvolatile memory and is not affected by power-down or reset.

If the disc has more than one drive unit, you need to specify which unit is to be addressed. Press DISC UNIT in the SELECT ADDRES menu, then enter the unit number. The unit selected is addressed for all disc operations. As with the address, the unit number is saved in nonvolatile memory.

NOTE

Discs must be initialized before data can be stored on them. Refer to "Formatting Discs" later in this chapter.

SAVING AND RECALLING DISPLAYS

Data traces, instrument state displays, fault logs, curve fit tables, delete frequency tables and synthesis tables can be saved on disc memory. In addition, auto sequence, auto math, synthesis, curve fit and delete frequency tables are fully operational when recalled. Press **DISC** to display the following menu:

SAVE FILE	Used to save the current display on disc. There are three ways to save files; see "Saving Files on Disc" following this menu.
RECALL FILE	Used to recall an existing file from the disc to the display. There are three ways to recall files; see "Recalling Files from Disc" following this menu.
DELETE FILE	Used to delete a file from the disc. Enter the name of the file to be deleted, then press ENTER. You can also use AT POINTR; refer to the alpha menu description following this menu. Note that deleted files cannot be recovered.
VIEW CATALOG	Displays the disc catalog; see "Using the Disc Catalog" following this menu. The last page of multi-page catalogs is displayed.
NEXT PAGE	Displays the next page of disc catalogs that contain more than one page (20 files).
PREV PAGE	Displays the previous page of disc catalogs that contain more than one page (20 files).
CATLOG POINTR	Enables the Entry group to move the catalog pointer. See "Using the Disc Catalog" following this menu.
DISC FCTN	Displays the disc functions menu; see "Using the Disc Functions Menu" later in this chapter.

Saving Files on Disc

There are three ways to specify the name for a file you are saving to disc:

1. Enter a file name (up to 8 characters) using the alpha menu that is displayed then press ENTER.

2. Enter a file name then press OVER WRITE in the alpha menu. If a file under this name already exists on the disc, OVER WRITE deletes the original file and replaces it with the new file. This differs from pressing ENTER as in #1 above, which will not let you write over an existing file.

3. Press ENTER immediately after pressing SAVE FILE. This uses the last file name you stored on disc since power-up, increments any number at the end of its name by one, then stores the current display under the incremented file name. If the last file name does not contain a number, a 1 is appended to the new file name. If no files have been saved since power-up, the new file is simply named "1."

To give you an idea of the space required to save files on disc, here are some example file sizes:

File Type	Size (in 256-byte sectors)
Time record trace	33
Frequency response trace	28
Power spectrum trace	15
Setup state	3
Auto sequence table	4
Auto math table	4
Synthesis table	4
Curve fit table	4
Throughput file (1 record)	20
Throughput file (10 records)	164
Throughput file (50 records)	804

A double-sided 3.5″ microfloppy disc can hold about 80 frequency response traces.

To save files not currently on the display, use "NAME, XXX" where XXX is the proper code from Table 11-1.

Table 11-1 Codes for Saving Files Not on Display

To save:	Use this code:
Active Trace	DA
Data in trace A	DAA
Data in trace B	DAB
Instrument state	SE
Synthesis table (active type)	ST
Auto sequences	A1,A2,A3,A4 or A5
Auto Math	AM
Fault Log	FL
Captive buffer	CS
Test Log	TL
Demod delete frequency	DM
Curve Fit	CF

Recalling Files from Disc

There are three ways to recall files from disc:

1. After pressing RECALL FILE, enter a file name using the alpha menu that is displayed.

2. Display the disc catalog, move the pointer to the file you want to recall, press RECALL FILE, then press AT POINTR in the alpha menu.

3. After pressing RECALL FILE, press ENTER in the alpha menu. This recalls the next file from disc of the same file type as the last file you recalled since power-up. For example, if the catalog showed:

(name)	(type)
TEST1	State
TEST2	State
FRESP	Synth
TEST3	State

and the last file you recalled since power-up was TEST1, pressing RECALL FILE followed by ENTER would recall TEST3.

Note that auto sequences can be recalled into tables other than the one in which they were created by appending a comma and the desired table number to the file name when recalling.

Using the Disc Catalog

When VIEW CATALOG is pressed, the disc's file catalog is displayed. The catalog shows the number of files on the disc, along with name, type, and size. The amount of disc space deleted and the number of entries available are shown at the top of the table. The upper left corner indicates the name of the disc, as entered when the disc is initialized (see "Using the Disc Functions Menu").

The catalog pointer makes entering file names much faster. The pointer highlights a file in the catalog and can be moved through the display with the Entry group. Press CATLOG POINTR to enable the Entry group, move the pointer to a file you wish to recall or delete, then press RECALL FILE or DELETE FILE. When the catalog is displayed, AT POINTR is displayed in the alpha menu. Press AT POINTR, and the file highlighted with the pointer will be recalled or deleted. This saves you the trouble of manually entering each file name with the alpha mode.

The Alpha Mode

When SAVE FILE, RECALL FILE or DELETE FILE is pressed, the HP 3562A shifts into the alpha mode to allow you to enter the file name. In the alpha mode, all front panel hard keys (except **LINE** and **HELP**) are converted to the blue labels under them, and the following menu is displayed:

ENTER	Saves, recalls or deletes the file, then exits the alpha mode. A status message is displayed for saving, recalling and deleting.
SPACE FORWRD	Moves the cursor one space forward for editing. Use the blue "BL" key to add blanks.
SPACE BACKWD	Moves the cursor one space backward without erasing any characters. To erase, use BACK SPACE or DELETE CHAR.
INSERT ON **OFF**	When this is pressed ON, characters are inserted at the current cursor position. When pressed OFF, characters are writen over existing ones.
DELETE CHAR	Deletes the character at the cursor position.
CLEAR LINE	Clears the alpha characters from the cursor position to the end of the line.
AT POINTR	Appears when DELETE FILE or RECALL FILE is pressed.
CANCEL ALPHA	Aborts the current entry and exits the alpha mode.

The number of files stored is limited only by space on the disc. Note that when ENTER is pressed and the file is saved, recalled or deleted, the instrument exits the alpha mode, and the keys return to normal operation.

USING THE DISC FUNCTIONS MENU

The disc functions menu allows you to pack discs, abort HP-IB operations, and create throughput files. It also gives you access to the service functions, copying and formatting menus. Press DISC FCTN in the **DISC** menu to display the following menu:

SERVCE FCTNS	Displays the disc service functions menu, which allows you to perform media and hardware tests and spare blocks in media. See "Sparing Blocks" later in this chapter.
DISC COPY	Displays the disc copying menu, which allows you to copy files and perform backups. See "Copying Disc Files" later in this chapter.
FORMAT	Displays the formatting menu, which allows you to initialize catalogs, format media and select format options for HP Subset/80 discs. See "Formatting Discs" later in this chapter.
PACK DISC	Packs the disc by removing any space remaining when files have been deleted. Before packing, look at the top of the catalog to see how much space has been deleted. This is the amount of space that packing will recover.
THRUPT SIZE	Used to specify the size of throughput files; refer to Chapter 6 for instructions.
CREATE THRUPT	Creates time throughput files; refer to Chapter 6 for instructions.
ABORT HP-IB	Aborts disc operations. Use this when the bus fails to respond or when you wish to gracefully terminate a bus operation before it is finished.
RETURN	Redisplays the **DISC** menu.

Packing discs requires several minutes because the entire contents of the disc must be read then rewritten. "PACK DISC IN PROGRESS" and "% Done" are displayed while the pack is in progress. Disc packing can be gracefully aborted by pressing ABORT HP-IB.

FORMATTING DISCS

CAUTION

The first step the analyzer takes when formatting discs is to erase any existing data. When formatting discs with multiple software volumes, the HP 3562A re-initializes the entire disc into a single volume.

The HP 3562A allows you to format discs to two levels: INIT CATLOG writes a catalog on the media, and INIT DISC writes the formats and catalogs the media. In addition, FORMAT OPTION allows you to enter a format option number for Hewlett-Packard Subset/80 discs. Press **DISC** then DISC FCTN, followed by FORMAT to display the following menu:

FORMAT OPTION	allows you to enter a formatting option, from 0 to 239, for Subset/80 discs. This is ignored by all other disc command sets.
INIT DISC	Initializes media by writing a catalog and formatting the media. On tapes, INIT DISC performs an automatic certification test and stores the results in the ERT log.
INIT CATLOG	Initializes media by writing a catalog. This does not format the media and is primarily used to initialize pre-formatted tapes. This is also a fast, easy way to erase discs.
RETURN	Redisplays the DISC FCTN menu.

Please refer to your Subset/80 disc drive's manual for more information on the formatting options. The HP 3562A can use only the 256-byte sector size. For example, the HP 9122D disc drive must use format options 0 (its default), 1 or 4 to work with the HP 3562A. Not all drives default to 256 bytes/sector, so refer to your drive's manual if there is any question about its default format.

After you press INIT DISC or INIT CATLOG, the instrument shifts into the alpha mode to allow you to enter the name for the disc. If you choose not to specify the number of files, 6% of the disc is automatically reserved for the catalog and the rest is reserved for files. After typing in the name, you can type a comma followed by a number from 1 to 32 767 to specify the maximum number of files you will be storing on this disc. The number you enter is rounded up to the nearest 8n (8, 16, 24, etc). For example, on a disc to be used solely for time throughput, you could initialize it as "THRU,5." This initializes the disc and allows you to store up to 8 large files. The reason for specifying the number of files is that it reserves only the minimum necessary space for the catalog and allows you maximum space for files.

Both INIT DISC and INIT CATLOG erase any files existing on media. If you are not sure whether a tape or disc has been initialized, press VIEW CATLOG in the **DISC** menu. If "Unformatted Disc" is displayed, you need to initialize the media with INIT DISC. If "Not a Valid Catalog" is displayed, you need to initialize the catalog with INIT CATLOG.

COPYING DISC FILES

The DISC COPY menu allows you to copy any number of files, from one to the entire disc contents. It also provides image backup to quickly copy data images from discs and tapes, sector-by-sector. Press **DISC**, then DISC FCTN followed by DISC COPY to display the following menu:

DESTN ADDRES	Used to enter the HP-IB address of the destination disc drive, from 0 to 7. See "Identifying the Copy Destination" following this menu.
DESTN UNIT	Used to enter the unit number of the destination disc, from 0 to 15. See "Identifying the Copy Destination" following this menu.
COPY FILES	Used to enter name(s) of the file(s) to be copied. See "Selecting Files To Be Copied" following this menu.
OVERWR AU **MAN**	Selects auto or manual overwrite. Auto overwrites any duplicate files without stopping; manual pauses each time it encounters duplicates. See "Selecting Files To Be Copied" following this menu.
RESUME OVERWR	Instructs the file copier to write over the duplicate file, erasing the destination file. See "Selecting Files To Be Copied." This can also be used to resume over writing on a second disc if the first one fills before copying is finished and to resume after HP-IB aborts.
RESUME COPY	Instructs the file copier not to write over the destination file and skip the file in question when duplicates are encountered. See "Selecting Files To Be Copied." This can also be used to resume copying on a second disc if the first one fills before copying is finished and to resume after HP-IB aborts.
IMAGE BACKUP	Performs a backup of the source to the destination. Refer to "Image Backup" following this menu. **DO NOT PRESS THIS UNTIL YOU HAVE READ "IMAGE BACKUP" FOLLOWING THIS MENU.**
RETURN	Redisplays the DISC FCTN menu.

Identifying the Copy Destination

The destination disc is identified with DESTN ADDRES and DESTN UNIT. An error message is displayed if the destination address and unit match those of the source when a copy or backup is attempted. The source address and unit are identified with the SELECT ADDRES menu under the **HP-IB FCTN** key.

Selecting Files To Be Copied

You have four choices for selecting the files you wish to copy: enter a single name, use the catalog pointer and AT POINTR, enter the starting and ending of a group of file names, or copy all the files from the source disc.

1. To copy a single file, press COPY FILES then enter the file name using the alpha menu and the blue labels on the front panel. Copying starts when you press the ENTER softkey.

2. Move the catalog pointer to the desired file, press COPY FILES, then press AT POINTR in the alpha menu.

3. To copy a contiguous group of files, first display the disc catalog by pressing VIEW CATLOG in the **DISC** menu. Then press DISC FCTN followed by DISC COPY and COPY FILES. Enter the starting and ending file names separated by a comma. When you press the ENTER softkey, all the files from the starting to the ending in the catalog are copied. Files are stored on the destination disc in the same order they appear on the source disc. If the ending file is not found, all files after the starting file are copied. To copy from the beginning of the catalog to a specific file, enter:

   <,filename

   To copy from a specific file to the end of the catalog, enter:

   filename,>

4. To copy all the files from the source to the destination, press COPY FILES followed immediately by the ENTER softkey.

If the file copier encounters a file on the destination with the same name as the a file in the source, it takes one of two actions depending on the state of OVERWR AU MAN. If this set to AU (auto overwrite), the destination file is written over by the source file and erased. **NO COPY OF THE ORIGINAL DESTINATION FILE IS PRESERVED.**

However, if OVERWR AU MAN is set to MAN, the file copier stops and informs you each time it encounters a duplicate file name. You then have the options of ignoring the warning and writing over the destination file or skipping the file in question and proceeding to the next source file. Press RESUME OVERWR to write over the destination file or RESUME COPY to skip the file.

RESUME COPY or RESUME OVERWR can also be used to resume copying on a second disc if the first destination disc fills before all files are copied. If "Disc Full" or Catalog Full" is displayed, replace the disc in the destination drive then press RESUME COPY or RESUME OVERWR to finish copying.

If a copy is aborted before finished, the destination disc retains all files copied up to but not including the one being transferred. ABORT HP-IB during copying does not affect the source disc.

Image Backup

NOTE

The first action IMAGE BACKUP takes is to completely erase the destination disc or tape. Do not perform an image backup to a tape or disc that contains valuable data.

Image backups are used to save entire discs for security and archival purposes. This feature allows you to quickly copy the entire contents of a disc; it is much faster than using the COPY FILES command. Backup creates an exact data image of the source disc on the destination disc. You cannot perform a partial backup on one disc then resume on a second disc. IMAGE BACKUP does not allow you to start a backup if the destination is too small.

USING THE DISC SERVICE FUNCTIONS

The disc service functions are intended for disc service technicians as well as advanced HP 3562A operators who need to spare blocks on disc or tape. The run time error log and the hardware fault logs are offered, as well as the read-only error rate test. Press **DISC** then DISC FCTN followed by SERVCE FCTNS to display the following menu:

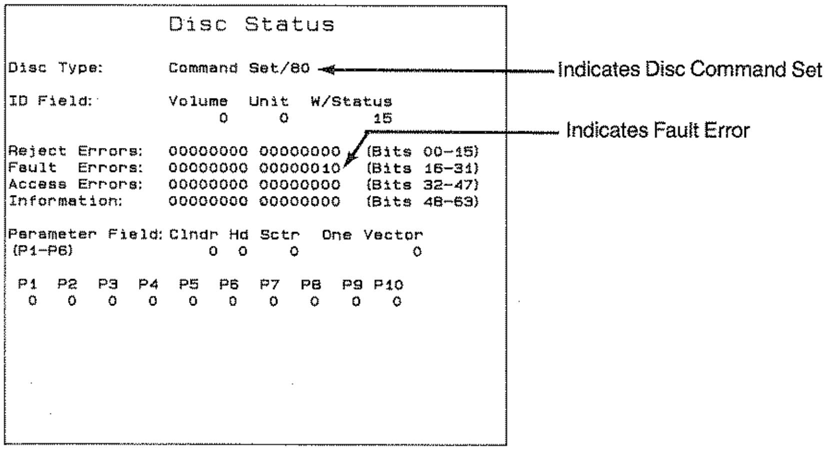
RESTOR CATLOG	Restores the catalog if power was lost during a data transfer or the catalog was somehow erased. See "Restoring Catalogs" following this menu.
RO ERT TEST	Clears the ERT log and starts the read-only error rate test (ERT). See "The Error Rate Test" following this menu.
OUTPUT LOG	Displays the output log menu, which gives you access to the run time, ERT or fault logs.
NEXT PAGE	Displays the next page of the log displayed last. Page numbering in logs is separate for each head in multi-head discs, so keep pressing NEXT PAGE until "LAST PAGE" is displayed in the log.
CLEAR LOGS	Clears the run time, ERT and fault logs. You should read and appropriately act on any information in the logs before clearing them.
DISC STATUS	Retrieves the disc status display, which shows the last disc access error that occurred since power-up. See "Disc Status" following this menu.
SPARE BLOCK	Allows you to spare blocks that have been confirmed bad. Blocks are identified either with a 1-vector address or a 3-vector cylinder,head,sector address. Refer to "Sparing Blocks" later in this chapter before attempting to spare blocks.
RETURN	Redisplays the DISC FCTN menu.

When OUTPUT LOG in the SERVCE FCTNS menu is pressed, the following menu is displayed:

FAULT LOG	Displays the hardware fault log. Refer to "The Fault Log" later in this chapter.
ERT LOG	Displays the ERT Log. Refer to "The Error Rate Test" following this menu.
RUN TM LOG	Displays the run time log. Refer to "The Run Time Log" later in this chapter.
RETURN	Redisplays the SERVCE FCTNS menu.

Disc Status

The disc status display shows the last disc data access error since power-up. An example is shown in figure 11-3.



```
                   Disc  Status

Disc Type:         Command Set/80

ID Field:          Volume  Unit  W/Status
                         0     0         15

Reject Errors:     00000000 00000000  (Bits 00-15)
Fault  Errors:     00000000 00000010  (Bits 16-31)
Access Errors:     00000000 00000000  (Bits 32-47)
Information:       00000000 00000000  (Bits 48-63)

Parameter Field: Clndr Hd Sctr   One Vector
 (P1-P6)             0  0    0            0

 P1   P2   P3   P4   P5   P6   P7   P8   P9  P10
  0    0    0    0    0    0    0    0    0    0
```

Figure 11-3 The Disc Status Display

Restoring Catalogs

Catalogs can be restored if power was lost during a data transfer or if the catalog appears corrupted. If RESTOR CATLOG finds a catalog sector that it determines to be bad, it clears that catalog sector. For this reason, be certain that a catalog definitely needs restoring before you press RESTOR CATLOG.

The next step after pressing RESTOR CATLOG is to use the alpha mode to enter a name for the restored catalog. As with INIT DISC and INIT CATLOG, you may add a comma and the number of files for the disc (for restoration you **must** use the original number of files). The name and number of files entered after RESTOR CATLOG is pressed are used only if the volume sector (the first sector) is bad. If the volume sector is good, these entries are ignored.

If you terminate this entry with the ENTER softkey, the analyzer only checks for bad sectors. If you terminate it with the OVER WRITE softkey, it actually performs the restoration. You are given this choice because restoration starts by validating the catalog, then it searches for files that may exist in data sectors addressed by bad catalog sectors. It attempts to validate all files in ascending order, and if it finds a file out of order it assumes that sector is bad. If no valid files are found in a sector, the message "BAD Cat Sector nnn" is displayed, and that sector is cleared. The "Restore Catalog" display at the end of restoration shows the the number of bad sectors found.

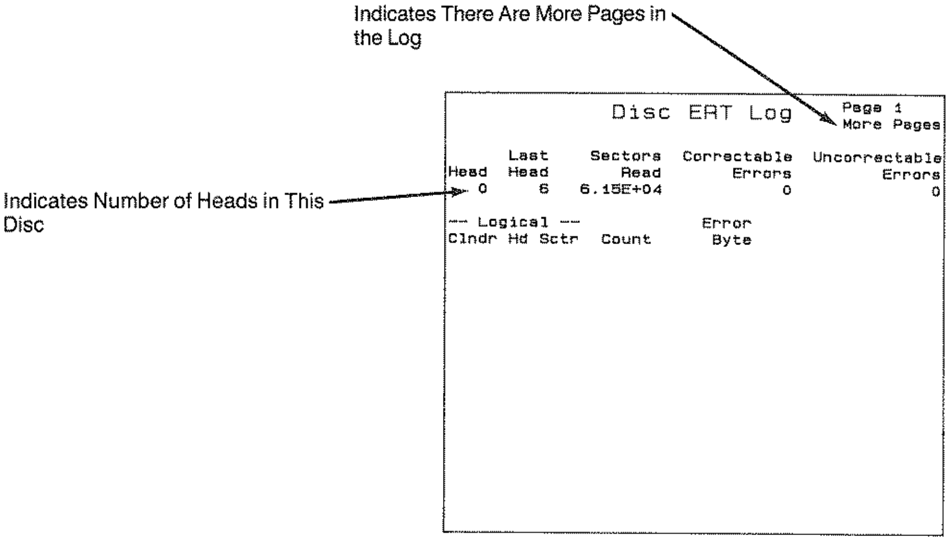
Restoration is fast if all files can be located in the order indicated in the catalog. If some sectors are determined bad and need to be spared, restoration can take a long time. It can, however, be gracefully aborted by pressing ABORT HP-IB and started again.

The Error Rate Test—Discs

This test checks for data reading errors. The error rate test (ERT) is read-only, so it does not destroy data on the disc. Because the disc drive's error correction circuitry is disabled while the ERT is running, the ERT records all errors—both correctable and uncorrectable. This differs from the run time log, which shows only uncorrectable errors.

The ERT starts by performing a full-volume error test, noting bad sectors in the ERT log. Next, it reads the ERT log to check each bad sector individually. Each bad sector is checked twenty times to see if errors occur consistently. The ERT then reads the run time log to individually check sectors that historically produced errors. These are checked twenty times also. The final ERT log can be retrieved from disc when the ERT is finished; it shows the number of times each error occurred.

Figure 11-4 shows an example of the disc ERT log. Note that pressing RO ERT TEST to start the ERT erases the ERT log.



Indicates There Are More Pages in the Log

Indicates Number of Heads in This Disc

```
                        Disc  ERT  Log        Page 1
                                              More Pages

      Last      Sectors  Correctable  Uncorrectable
Head  Head         Read       Errors         Errors
   0     6     6.15E+04            0              0

-- Logical --               Error
Clndr Hd Sctr   Count        Byte
```

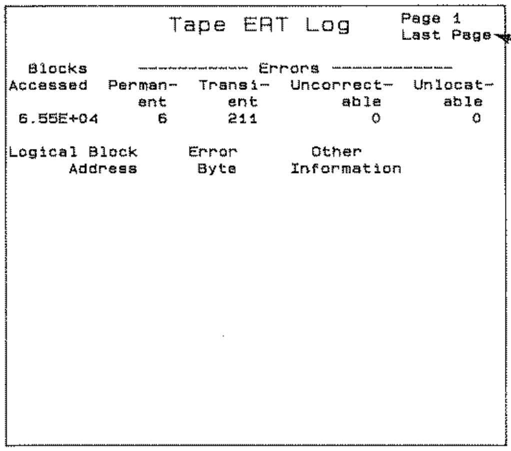
Figure 11-4   The Disc ERT Log

The ERT is used in conjunction with the run time log to help you locate and spare bad blocks on media. Refer to "Sparing Blocks" later in this chapter for instructions.

The Error Rate Test—Tapes

The ERT is run differently for tapes. First, it does not disable error correction circuitry, so only uncorrectable error are shown. Second, it does all the interpreting for you, so any sector that shows up in the ERT log on a tape needs to be spared. Any errors it encounters are tested three times to see if they are transient or permanent. The ERT then ignores transient errors and tries to correct permanent errors. Any permanent errors it cannot correct or locate are shown in the ERT log and need to be spared. Note that the ERT takes 8—10 minutes for 150 ft tapes and 35—40 minutes for 600 ft tapes.

Figure 11-5 shows an example of the tape ERT log.



```
                 Tape ERT Log        Page 1
                                     Last Page
  Blocks      ------------ Errors ------------
Accessed  Perman-  Transi-  Uncorrect-  Unlocat-
              ent      ent        able      able
 6.55E+04       6      211           0         0

Logical Block     Error       Other
      Address      Byte    Information
```

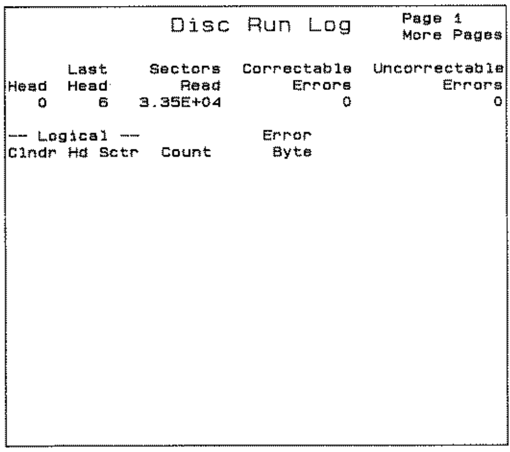
Indicates This Is the Only Page in the Log

Figure 11-5 The Tape ERT Log

Any errors displayed in the uncorrectable or unlocatable columns need to be spared. If 150 ft tapes have more than 128 errors, they need to be backed up and replaced. If 600 ft tapes have more than 250 errors, they need to be backed up and replaced.

The Run Time Log

This log records data errors that occur during normal operation. Because the error correction circuitry is enabled during normal operation, the run time log does not show correctable errors. Other than that, it records and shows the same information as the ERT log. Figure 11-6 shows an example.



```
                Disc Run Log            Page 1
                                        More Pages

      Last    Sectors   Correctable  Uncorrectable
Head  Head       Read        Errors         Errors
   0     6 3.35E+04             0              0

-- Logical --             Error
Cindr Hd Sctr  Count       Byte
```

Indicates More Pages

Figure 11-6 The Run Time Log

You should first read the run time log to see if the ERT needs to be run. It also can be used in conjunction with the ERT and its log to help you locate and spare bad blocks on media. Refer to the next section, "Sparing Blocks," for instructions.

Sparing Blocks

You can use the run time and ERT logs to locate bad blocks on media. Once located, these blocks can be spared using SPARE BLOCK. This allows you to continue using the media while avoiding bad areas. There are four steps to sparing blocks:

1. View the run time log (press **DISC**, DISC FCTN, SERVCE FCTNS, OUTPUT LOG then RUN TM LOG). If there are no errors in this log, there are probably no data access problems. If there are errors recorded in this log, proceed with step 2.

2. Run the error rate test (press **DISC**, DISC FCTN, SERVCE FCTNS then RO ERT TEST). NOTE: pressing RO ERT TEST erases the ERT log—view the ERT log first to avoid erasing valuable test data. The ERT first checks all sectors by reading their data and checking for errors. Any bad sectors are noted in the log. For discs, the ERT then reads the log to check each bad sector individually. Each bad sector is checked twenty times to see if errors occur consistently. The ERT then reads the run time log to check those bad sectors twenty times also. When the ERT is finished, proceed to step 3.

3. Any disc sector that produced a repeatable error is probably bad. View the run time and ERT logs to see if any address appears more than once. Those that do should be spared; proceed to step 4. Errors that occur only once are probably random and could not be remedied by block sparing. A large number of bad sectors could indicate other trouble.

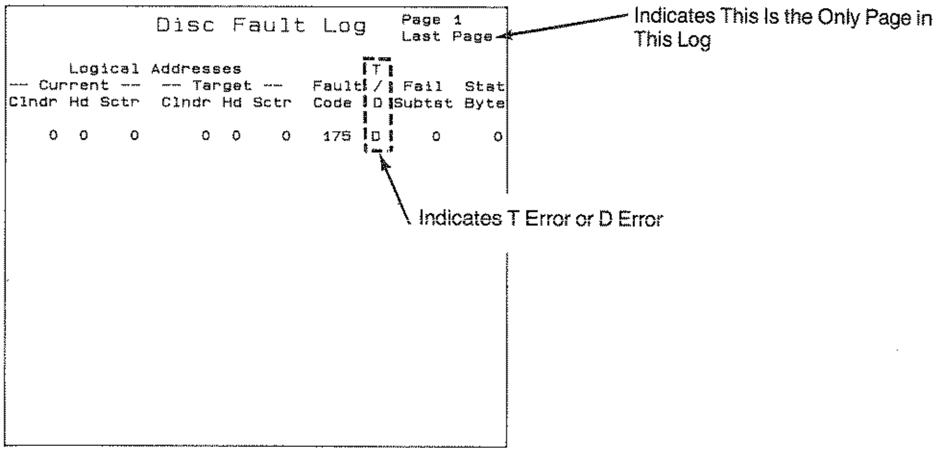
For tapes, every block in the uncorrectable and unlocatable columns in the ERT log is confirmed bad and needs to be spared.

4. To spare a block, press SPARE BLOCK then enter the block's address. This will either be the 1-vector address or the 3-vector cylinder,head,sector address; use the address shown in log. In 3-vector addresses, enter all three vectors at once, separated by commas.

5. To verify sparing, you can run the ERT again. In any case, you should clear all three logs after sparing all bad blocks and see if any errors accumulate when you put the disc or tape back into operation.

The Fault Log

The fault log shows disc hardware errors that have accumulated since the log was last cleared. Figure 11-7 shows an example.



```
                   Disc Fault Log     Page 1
                                      Last Page

      Logical Addresses                T
-- Current --   -- Target --     Fault / Fail   Stat
Clndr Hd Sctr   Clndr Hd Sctr    Code  D Subtst Byte

     0  0    0       0  0    0    175  D    0      0
```

Indicates This Is the Only Page in This Log

Indicates T Error or D Error

Figure 11-7 The Disc Fault Log

NOTE

This fault log is designed for the disc service technician who is familiar with its contents. It is not intended for use by HP 3562A operators.

Request Status Summary

	ERROR REPORTING FIELDS[1]	
IDENTIFICATION FIELD	**REJECT ERRORS FIELD**	**FAULT ERRORS FIELD**[2]
<VVVVUUUU> <SS SS SS SS>	0 7 8 15 <0 0 2 0 0 5 6 7> <8 9 10 0 12 0 0 0>	16 23 24 31 <0 17 0 19 0 0 22 0> <24 0 26 27 28 0 30 31>
VVVV = Volume number **UUUU** = Unit number **SSSSSSSS** = Value of the lowest numbered unit with status pending (all ones if no units have status pending).	**2** = **CHANNEL PARITY ERROR** A channel command was received without odd parity. **5** = **ILLEGAL OPCODE** An unrecognizable opcode was received. **6** = **MODULE ADDRESSING** An illegal volume or unit number was specified for this device. **7** = **ADDRESS BOUNDS** The target address has exceeded the bounds for this device. **8** = **PARAMETER BOUNDS** A parameter (other than unit, volume, or target address) is not allowed for this device. **9** = **ILLEGAL PARAMETER** A parameter field was the wrong length for the opcode preceding it. **10** = **MESSAGE SEQUENCE** The message sequence has been violated. (Error suppressed if any reject or fault errors have occurred prior to sequence error.) **12** = **MESSAGE LENGTH** The total length of the execution message differs from the current default value.	**17** = **CROSS-UNIT**[3] An error has occurred during a Copy Data operation. **19** = **CONTROLLER FAULT** A hardware fault occurred in the controller. **22** = **UNIT FAULT** A hardware fault has occurred in the unit addressed. **24** = **DIAGNOSTIC RESULT**[3] The hardware failed the diagnostic indicated in the parameter field. **26 - 28** = **RELEASE REQUIRED** This command cannot be executed until after release is granted to the device. Device requires release for indicated reason: **26** = **OPERATOR REQUEST** Release required for operator request (e.g., load/unload, restore). **27** = **DIAGNOSTIC REQUEST** Release required for diagnostics initiated from control panel (e.g., HIO, self test). **28** = **INTERNAL MAINTENANCE** Release required for internal maintenance (e.g., head alignment, error log). **30** = **POWER FAIL** The power to the unit failed, a diagnostic destroyed configuration, or a pack was loaded. Device should be reconfigured. **31** = **RETRANSMIT** The preceding transaction should be retried.

Notes:

1. Error bit positions correspond to bit positions in Set Status Mask command. A "1" indicates presence of an error. Unused bit positions must be zeroes.
2. All Fault Errors are unmaskable.
3. Error uses parameter field.
4. - Parameter field configuration is dependent on reported errors.
   - Highest priority is given to lowest numbered errors.
   - Masked errors relinquish their priority.

Request Status Summary (continued)

ERROR REPORTING FIELDS[1]

ACCESS ERRORS FIELD	INFORMATION ERRORS FIELD	PARAMETER FIELD[4]
32 39 40 47 <32 33 34 35 36 37 0 0><40 41 0 43 44 0 0 0>	48 55 56 63 <48 49 50 51 52 0 0 55><0 57 58 59 0 61 0 0>	< P1 > - - - - - - - - - - < P10 >
32 = ILLEGAL PARALLEL OPERATION The requested operation cannot be executed in parallel with some other operation(s) currently in progress. **33 = UNINITIALIZED MEDIA** The host attempted to access unformatted media, or unusable media has been loaded. **34 = NO SPARES AVAILABLE** Spare Block cannot be executed due to lack of spare media. **35 = NOT READY** The selected unit is not ready for access at this time (e.g., heads or media not yet fully loaded). **36 = WRITE PROTECT** The selected volume is write protected. **37 = NO DATA FOUND** A block accessed during a read has not been written. **40 = UNRECOVERABLE DATA OVERFLOW** The previous transaction generated more than 1 unrecoverable data error. The entire transfer should be considered in error. **41 = UNRECOVERABLE DATA[3]** Unrecoverable data at indicated block(s). **43 = END OF FILE** End of file encountered on file structured device. **44 = END OF VOLUME** The host attempted to access across a volume boundary.	**48 - 50 = REQUEST RELEASE[3]** Device requests release for indicated reason: **48 = OPERATOR REQUEST[3]** Release requested for operator request (e.g., load/unload, restore). **49 = DIAGNOSTIC REQUEST[3]** Release request initiated from diagnostic control panel (e.g., HIO, self test). **50 = INTERNAL MAINTENANCE[3]** Release requested for internal maintenance (e.g., head alignment, error log). **51 = MEDIA WEAR** Only one spare track (disc) or one spare block (tape) remaining. **52 = LATENCY INDUCED** A latency was induced during the transfer due to slow transfer rate or seek retry. **55 = AUTO SPARING INVOKED** A defective block has been automatically spared by the device. **57 = RECOVERABLE DATA OVERFLOW** The previous transaction generaged more than 1 recoverable data error. **58 = MARGINAL DATA[3]** Data was recovered, but with difficulty. **59 = RECOVERABLE DATA[3]** A latency was introduced in order to correct a data error. **61 = MAINTENANCE TRACK OVERFLOW** Error and fault log area is full.	No Errors: P1 through P6 indicate new Target Address. The address format, which is used any time P1 through P6 contain address information, is defined by the Set Return Addressing command (refer to paragraph 2-24). No Errors: P7 through P10 contain run-time drive error codes (DERRORS), except after a Spare Block command. The errors are arranged chronologically: P7 contains the most recent of the four errors recorded; P10 contains the oldest of the four recorded. Note: Error codes 40H and CBH will always be followed by a single byte containing fault latch information. After a **Spare Block** command, P1 through P6 contain the beginning address of the reformatted area. (Disc operation only.) After **Spare Block** command, P7 through P10 indicate the length - in blocks - of the reformatted area. The length is a four-byte, unsigned binary number. (Disc operation only.) Error Bit No. 17 **Cross-unit:** P1 through P6 contain the encoded values of each unit which has experienced an error. A byte of all ones indicates no additional units. Error Bit No. 24 **Diagnostic Results:** P1 through P6 contain the following information: P1 = most suspect component P2 = next most suspect component P3 = test error (TERROR) associated with P1 P4 = test error (TERROR) associated with P2 P5 - P6 = not used P7 - P10 contain DERROR information (format described above). Error Bit No. 41 **Unrecoverable Data:** P1 through P6 indicate address of bad block. Error Bit No. 48 - No. 50 **Request Release:** P1 through P6 contain the encoded values of each unit requesting release. A byte of all ones indicates no additional units. Error Bit No. 58 **Marginal Data:** P1 through P6 indicate address of the marginal block. Error Bit No. 59 **Recoverable Data:** P1 through P6 indicate address of recoverable block.

OUTPUTTING COMMAND STRINGS

The HP 3562A can output HP-IB command strings up to twenty-five characters long (excluding the address). Press OUTPUT STRING, enter the address of the destination device followed by a comma, then enter the command string. For example, the command

OUTPUT STRING 5,PA1000,1000

sends the HP-GL command "PA1000,1000" (Plot Absolute to location 1000,1000) to a plotter at address 5. For secondary addresses, use 3- or 4-digit addresses. The last two digits in 3- and 4-digit addresses are treated as the secondary address.

The HP 3562A can send HP-IB commands to itself. Use – – as the address, instead of a standard HP-IB address from 0 to 31. This sends each commands back through the analyzer's HP-IB command translator. You can use all the commands except those involving data transfer. All parameter entry commands can be used, however. For example, the command

OUTPUT STRING – – DBAC1

clears and activates display buffer #1.

OUTPUT STRING is especially useful when programmed in auto sequences. Refer to Chapter 10 for information on creating and using auto sequences. Refer to the *HP 3562A Programming Manual* for information on the analyzer's HP-IB commands.

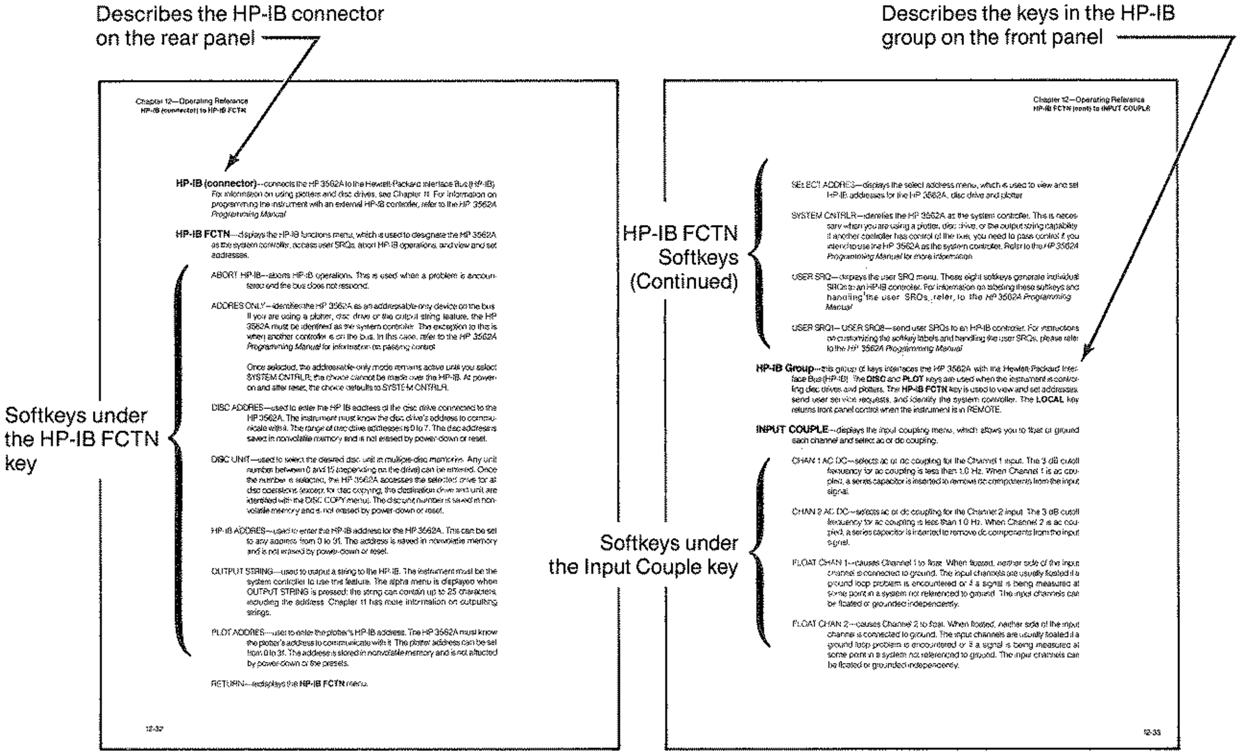
Chapter 12

OPERATING REFERENCE

INTRODUCTION

This chapter contains descriptions of the HP 3562A's keys, softkeys, indicators and connectors. It provides individual definitions and refers you to Chapters 1 through 11 when broader explanations are required. For example, the **CURVE FIT** key is described in this chapter, and for instructions on using the curve fitter you are referred to Chapter 9.

The chapter is alphabetized by key, connector and indicator. Softkeys are alphabetized under each key. Here are several sample pages:



The page numbers in the margin beside each entry refer you to the places in Chapters 1 through 11 where the use of each item is discussed. Appendix D shows fold-out menu diagrams of the keys and softkeys. These can be used with the individual descriptions to learn more about specific menus or to help you find particular softkeys.

THE ALPHA MENU

When the HP 3562A requires an alphabetic entry (e.g., when saving and recalling displays) it converts the keys on the front panel to their blue alpha labels and displays the alpha menu. The keys in the Entry group (except the arrows) can be used to enter numbers and punctuation. When you complete the alpha entry by pressing the ENTER softkey, the alpha menu is erased and the front panel returns to normal operation.

AT POINTR—enters the file name identified by the catalog pointer. This softkey appears in the alpha menu only after DELETE FILE, RECALL FILE or COPY FILES has been pressed. See the **DISC** menu for more information.

CANCEL ALPHA—cancels the current alpha entry and exits the alpha mode.

CLEAR LINE—clears the alpha entry from the cursor position to the end of the line. This does not exit the alpha mode.

DELETE CHAR—deletes the character at the cursor position.

ENTER—saves the current alpha entry and exits the alpha mode. Pressing ENTER in the alpha menu results in one of several different actions, depending on the softkey that activated the alpha menu. For example, when SAVE FILE activates the alpha menu, pressing ENTER causes the display to be saved to disc.

INSERT ON OFF—when INSERT is ON, characters are inserted at the current cursor position, and existing characters are shifted to the right. When it is OFF, new characters are written over existing characters.

OVER WRITE—if you terminate a file name alpha entry with OVER WRITE when saving a file to disc and a file with that name already exists, OVER WRITE erases the original file and replaces it with the current display. To avoid overwriting, press ENTER instead of OVER WRITE.

SPACE BACKWD—moves the cursor one space backward, without deleting any characters. To delete while moving backwards, use the **BACK SPACE** key in the Entry group.

SPACE FORWRD—moves the cursor one space forward, without deleting any existing characters. This softkey is used to move the cursor for editing; to enter blanks, use the "BL" key (the alpha mode version of **ENGR UNITS**).

A—activates trace A. See the **SINGLE**, **UPPER LOWER** and **FRONT BACK** keys to determine where trace A is displayed for each of these formats. The active trace and its annotation are highlighted. Selection of the active trace is important because the markers, units, coordinates, math operations, displays and scale affect only the active trace. This key can also be used to return to a data trace display after a table has been displayed. If both traces are active and a display feature is activated which can apply to only one trace, trace A is always selected. For example, if you try to save both traces simultaneously in local memory, only trace A is saved.

A (indicator)—this LED indicates when trace A is active.

A&B—activates both traces. Selection of the active trace is important because the markers, units, math operations, coordinates, displays and scale affect only the active trace(s). This key can also be used to return to a data trace display after a table has been displayed. Note that if the display is currently in the single format, pressing **A&B** selects the upper/lower format.

ARM—enables triggering while in the manual arm mode. In this mode, the **ARM** key must be pressed before the instrument looks for the trigger signal. After **ARM** is pressed, the TRIG ARMED indicator lights to show that manual arming has been enabled. Manual arming is selected with ARM AU MAN in the **SELECT TRIG** menu.

ARROWS—see **UP** or **DOWN**

AUTO MATH—displays the auto math menu, which is used to start and edit the auto math table. The auto math feature allows you to program the **A**, **B** and **A&B** keys and the softkeys under **MEAS DISP** and **MATH** into a program that is run when START MATH is pressed. One auto math table of up to twenty lines can be programmed. The routine is saved in nonvolatile memory and can be recalled after power-down. (Additional routines can be saved in disc memory; see **DISC** for more information.)

To edit an existing table or create a new one, press EDIT MATH. To view the table without enabling its menu, press VIEW MATH. If a measurement is in progress when **AUTO MATH** is pressed, the menu appears, but the softkeys are disabled until the measurement finishes or is paused.

An important feature of auto math is that the math function can be selected as a measurement display. (See **MEAS DISP** while in the linear, log or swept sine mode.) You can then view the math results as measurements are being made.

ADD LINE—used to insert lines after the edit line (selected with EDIT LINE#) in the table. Once ADD LINE is pressed, any number of lines up to the maximum of twenty may be entered without pressing it again. Lines are programmed into the auto math table in the same manner as they are executed directly from the front panel: key, softkey(s), then units softkey (if needed).

If a mistake is made in selecting the key, just press the desired key to correct the error. However, if a mistake is made when pressing the softkeys, the entire line must be reentered. If you attempt to enter more than twenty lines, the last line in the table (#20) changes as each additional line is entered. To add a line before the current line #1, use EDIT LINE# and the Entry group to move the line pointer to line #0, then press ADD LINE and enter the new line.

CHANGE LINE—used to change the edit line (selected with EDIT LINE#) in the table. Press CHANGE LINE, then enter the line. If a mistake is made in selecting the key, just press the desired key to correct the error. However, if a mistake is made when pressing the softkeys, the entire line must be reentered. Once CHANGE LINE is pressed, it remains active until ADD LINE is selected, and the edit line continues to change with each new entry.

CLEAR MATH—clears all commands and the label in the auto math table. When CLEAR MATH is pressed once, the message "Push Again to Clear" is displayed so you can confirm that the table is to be cleared. Once cleared, tables cannot be recovered. However, they can be saved in disc memory; see **DISC**.

DELETE LINE—deletes the edit line (selected with EDIT LINE#) in the table. The line is deleted immediately after DELETE LINE is pressed, then the remaining lines are renumbered.

EDIT LINE#—used to identify a line in the table for editing. The edit line is affected by ADD LINE, CHANGE LINE and DELETE LINE. Press EDIT LINE#, then enter the line number with the Entry group. Note that the arrows and the knob can scroll the line pointer through the table. The edit line is highlighted and indicated with the pointer at the left side of the display.

EDIT MATH—displays the auto math table and enables its menu. EDIT MATH is ignored if pressed while a measurement is in progress. If no routine exists when EDIT MATH is pressed, an empty table labeled "Edit Math" is displayed.

END EDIT—exits the table and saves the changes made during the current editing session.

LABEL MATH—used to add a label to the auto math table. Pressing this displays the alpha menu to allow you to enter the label. The label you enter appears at the top of the auto math table and replaces the AUTO MATH softkey in the **MEAS DISP** menu. When LABEL MATH is pressed, the alpha menu is displayed, and the keys are converted to their blue labels. To enter a two-line label for the softkey, separate the first and second lines with a comma. Each line is limited to six characters.

START MATH—starts the auto math table. When this is pressed, the auto math table runs once and displays the result of the programmed commands. If an error is encountered during execution, the display shows which line produced the error. When EDIT MATH is pressed again, an "R" is displayed to the left of the line that causes the runtime error. Errors result from attempting to use invalid commands or operating on incompatible traces. For example, a time domain trace cannot be added to a frequency domain trace.

VIEW MATH—allows you to view the auto math table without enabling its editing menu.

AUTO SEQ—displays the auto sequence menu, which is used to create, edit and start auto sequence programs. All keys and softkeys may be programmed, except for **LINE,** the EDIT ASEQ# softkey and the softkeys in its menu, and DSPLAY ON OFF and TIMED START in the ASEQ FCTN menu. To create an auto sequence, press EDIT ASEQ#, enter a number from 1 to 5, press ADD LINE, then start entering commands.

Five auto sequences of up to twenty lines each may be programmed and saved in the HP 3562A's internal memory. These programs are stored in nonvolatile memory and are not erased when the instrument is turned off. An unlimited number of auto sequences may be saved in disc memory; see **DISC.** Depending on the commands used, a table may fill with less than twenty lines. Messages and softkeys several menu levels deep require more space than key or simple softkey commands. The limit is 20 lines or 200 characters.

ADD LINE—used to insert lines after the edit line (selected with EDIT LINE#) in the table. Once ADD LINE is pressed, any number of lines up to the maximum of twenty may be entered without pressing it again. Lines are programmed into the auto math table in the same manner as they are executed directly from the front panel: key, softkey(s), then units softkey (if needed).

If a mistake is made in selecting the key, just press the desired key to correct the error. However, if a mistake is made when pressing the softkeys, the entire line must be reentered. If you attempt to enter more than twenty lines, the last line in the table (#20) changes as each additional line is entered. To add a line before the current line #1, use EDIT LINE# and the Entry group to move the line pointer to line #0, then press ADD LINE and enter the new line.

ASEQ FCTN—displays the auto sequence functions menu, which is used to program auto sequence messages, timed pauses, timed starts, and display control.

ASEQ MESSGE—used to program a message into an auto sequence. When ASEQ MESSGE is pressed, the alpha mode menu is displayed and the keys are converted to their blue labels. (Refer to the alpha menu at the beginning of this chapter for instructions on its use.) Messages are limited to 24 characters and appear in the message field in the lower right corner of the display.

CHANGE LINE—used to change the edit line (selected with EDIT LINE#) in the table. Press CHANGE LINE, then enter the new line. If a mistake is made in selecting the key, just press the desired key to correct the error. However, if a mistake is made when pressing the softkeys, the entire line must be reentered. Once CHANGE LINE is pressed, it remains active until ADD LINE is selected or the instrument is turned off or reset.

CLEAR ASEQ—clears all commands and the label in the current auto sequence. When CLEAR ASEQ is pressed once, the message "Push Again to Clear" is displayed so you can confirm that the auto sequence is to be cleared. Once cleared, auto sequences cannot be recovered. However, they can be saved in disc memory; see **DISC.**

CONT ASEQ—continues an auto sequence that has been paused with PAUSE ASEQ. The auto sequence resumes with the command immediately following the last one executed prior to pausing. The message "Autosequence Finished" is displayed if CONT ASEQ is pressed and the auto sequence is already finished.

DELETE LINE—deletes the edit line (selected with EDIT LINE#) in the table. The line is deleted immediately after DELETE LINE is pressed, then the remaining lines are renumbered.

DSPLAY ON OFF—controls the display during auto sequences. The selection is made when the auto sequence is created or edited. If the display is turned off, any intermediate traces generated by the auto sequence are not displayed; only the final result is shown. If the display is turned on, all traces generated are displayed.

EDIT—displays the selected auto sequence and enables its editing menu. Press EDIT when you want to create an auto sequence or editing an existing one. Press VIEW when you merely want to view an auto sequence.

EDIT LINE#—used to identify a line in the table for editing. The edit line is affected by ADD LINE, CHANGE LINE and DELETE LINE. Press EDIT LINE#, then enter the line number with the Entry group. Note that the arrows and the knob can scroll the line pointer through the table. The edit line is highlighted and indicated with the pointer at the left side of the display.

END EDIT—exits the table and saves the changes made during the current editing session.

GO TO—when this is programmed in an auto sequence, it instructs the program to jump to the indicated line and continue from there. Press GO TO, then enter the destination line using the Entry group.

LABEL ASEQ—used to add labels to auto sequence programs. This label replaces the appropriate "START ASEQ" label on the **AUTO SEQ** menu. When LABEL ASEQ is pressed, the alpha mode menu is displayed and the key are converted to their blue labels. (See the alpha menu at the beginning of this chapter for instructions on its use.) To enter a two-line label for the soft-key, separate the first and second lines with a comma. Each line is limited to six characters. Note that even though a label replaces one of the START ASEQ1—5 labels, the auto sequence is still identified by its number 1—5.

You can program one of the auto sequences to start automatically at power-on. Enter "AUTOST" as the first 6 characters in label, and this auto sequence will start when power is applied. Note that a measurement is not started with AUTOST unless you enter **START** in the program. This differs from the normal power-on routine, which starts a free run measurement.

LOOP TO—allows you to program loops into auto sequences. This requires two numbers: the number of the last line in the loop and the number of times you want the loop to run. Press LOOP TO, enter the line number and the loop count separated by a comma, then press ENTER. The auto sequence loops from the first line containing LOOP TO to the first line in the loop as many times as you specify, then continues with the program. Nested loops are limited to three levels deep.

PAUSE ASEQ—pauses a running auto sequence. The pause takes effect at the completion of the current command (except timed pauses, which are terminated immediately). If the auto sequence is continued with CONT ASEQ, it resumes with the next command. If the auto sequence is restarted rather than continued, it starts with the first command in the table.

RETURN—redisplays the EDIT ASEQ# menu.

SELECT ASEQ#—used to select an auto sequence program for viewing or editing. Press SELECT ASEQ#, enter the number from 1 to 5, then press EDIT or VIEW. Both display the table, but only EDIT activates the table's editing menu. Note that if a label has replaced one of the START ASEQ1—5 softkeys, the auto sequence is still identified by its number from 1—5. If SELECT ASEQ# is pressed and a number is entered while a measurement is in progress, the command is ignored until the measurement finishes.

START ASEQ1—starts the auto sequence stored under number 1. Note that if a label was added to the auto sequence, it replaces the START ASEQ1 softkey label.

START ASEQ2—starts the auto sequence stored under number 2. Note that if a label was added to the auto sequence, it replaces the START ASEQ2 softkey label.

START ASEQ3—starts the auto sequence stored under number 3. Note that if a label was added to the auto sequence, it replaces the START ASEQ3 softkey label.

START ASEQ4—starts the auto sequence stored under number 4. Note that if a label was added to the auto sequence, it replaces the START ASEQ4 softkey label.

START ASEQ5—starts the auto sequence stored under number 5. Note that if a label was added to the auto sequence, it replaces the START ASEQ5 softkey label.

TIMED PAUSE—used to program a timed pause in an auto sequence. Press TIMED PAUSE, then enter a pause time from 0 to 32 767 seconds. If PAUSE ASEQ is pressed during a timed pause, the auto sequence pauses immediately, without waiting the duration of the timed pause. Note that timed pauses are required in many cases if the operator needs to view intermediate displays generated by the auto sequence.

TIMED START—used to specify the starting time of an auto sequence. The starting time is tied to the non-real time clock and is entered in hours, minutes, and seconds. The start time must be between 00,00,00 and 23,59,59. To set or view the clock, see TIME H,M,S in the **SPCL FCTN** menu.

VIEW—allows you to view the specified auto sequence without activating its editing menu. Pressing EDIT rather than VIEW activates the editing menu and begins storing any keys you press into the auto sequence.

AVG—displays the averaging menu. Depending on the mode selected, the HP 3562A offers stable and exponential averaging, peak hold and continuous peak functions, overlap processing, overload rejection, fast averaging, previewing, and time or power spectrum averaging. Pressing **AVG** merely displays the averaging menus; it does not select any of the averaging functions. However, the desired number of averages can be entered with the Entry group immediately after pressing **AVG,** before any softkeys in the averaging menu are pressed.

In the swept sine mode, the AVG menu offers you the choice between auto and fixed integration. Select the swept sine mode (under the **MEAS MODE** key), then refer to the softkeys in the AVG menu.

AUTO INTGRT—Selects auto integration. In this mode, the amount of integration is determined by the user-defined variance threshold and maximum integration time. The variance threshold is entered in dB or as a percentage after pressing this softkey. The maximum integration time is set with INTGRT TIME.

When auto integration is active, each point is integrated for a minimum of approximately 1 second. Integration continues until the transfer function variance falls below the threshold you set or the maximum integration time is exceeded. Chapter 3 explains the operation of auto integration.

AVG OFF—turns all averaging functions off. If an averaged measurement is in progress when averaging is turned off, the measurement pauses at the completion of the current average. When AVG OFF is active, the analyzer continually makes one-average measurements, and erases the results of each measurement. For linear and log resolution measurements, the maximum possible overlap processing (regardless of the value of OVRLP%) is used when averaging is off. For unaveraged time capture and throughput measurements, however, the OVRLP% always sets the maximum overlap percentage.

CONT PEAK—selects the continuous peak function, which yields a composite spectrum containing the maximum values for each of the display lines that occurred during the measurement period. Continuous peak accumulates data until the measurement is paused. Note that continuous peak applies only to frequency response and power spectrum measurements. Compare with PEAK HOLD.

EXPON—selects exponential averaging, which weights new data more than old to maintain a moving average, rather than the cumulative result obtained with stable averaging. Regardless of the number of averages selected, exponential averaging continues until the measurement is paused.

The number of averages you enter determines the weighting of old versus new data. As the number entered with NUMBER AVGS increases, new time records are weighted less. Exponential averaging accepts only 2^n for the number of averages and is limited to 16 384. (It rounds up all other entries to the next higher 2^n.) Up to the power of 2, used for weighting exponential averaging computes a stable average, then shifts into exponential after n records. The weighting is calculated with this formula:

$$A_n = (1 - 2^{-n})A_n + 2^{-n}D_n$$

where: A_n = cumulative average
D_n = current quantity*
n = number of averages

*quantity is time record when time averaging is on; power spectrum, frequency response or correlation when time averaging is off.

FIXED INTGRT—Selects fixed integration. In this mode, each point is integrated for the amount of time you enter with INTGRT TIME.

Long integration times may not be required for all parts of your sweep. Refer to the description of AUTO INTGRT; this feature can significantly reduce sweep times while giving you control of the variance level in the measurement.

FST AV ON OFF—selects fast averaging, which performs the measurement as fast as possible without stopping to display the results of each average. The display does not update until all averages have been taken. Fast averaging defaults to off at power-on and after reset. Fast averaging can be temporarily deactivated during a measurement to check its progress. Note that fast averaging must be active to achieve the maximum real time bandwidths. Fast averaging can be used only with stable and peak hold averaging.

INTGRT TIME—selects the length of time that each point is integrated in the swept sine mode. Longer integration times increase the signal-to-noise ratio of the measurement because the measurement is concentrated in a narrower span. Harmonic rejection is also increased by increasing the integration time. For auto integration, INTGRT TIME selects the maximum integration time.

MANUAL PRVIEW—displays time records for approval before they are included in the measurement. When each time record is displayed, the measurement pauses indefinitely until you approve or reject the record by pressing **YES** or **NO.** Manual previewing is deactivated by pressing PRVIEW OFF. When using this feature over the HP-IB, "ACPT" must be used in place of YES, and "REJT" must be used in place of NO. Previewing cannot be used with time throughput.

NEXT—displays the second level of the **AVG** menu.

NUMBER AVGS—in the linear, log and time capture modes, this softkey selects the number of averaged measurements, from 1 to 32 767. The default is 10. Note that the number of averages may also be entered immediately after pressing **AVG,** before any softkeys in its menu are pressed. For exponential averaging, the number is the weighting factor, which is limited to 16 384.

In the swept sine mode, this softkey selects the number of averages per point. More averages improve variance but result in a slower measurement. The maximum number of averages per point is 32 767; the default is 1. Note that if auto averaging is selected, the number of averages actually computed may vary.

OV REJ ON OFF—selects overload rejection, which excludes any data records which exceed the input range (see **RANGE** for instructions on setting the input range). If overload rejection is not selected, all records are included in the average. Overload rejection defaults to off at power-on and after reset. To maintain the optimum range setting, keep the green HALF RANGE indicator on and the red OVER RANGE indicator off. Overload rejection cannot be used with time throughput.

OVRLP%—determines the percentage of the time record that is used for overlap processing, from 0 to 90%. The percentage selected determines the portion of each time record overlapped with the next time record in the averaging. There may be some difference between the requested overlap percentage and the percentage actually achieved. The achieved percentage is displayed on the screen and is always equal to or less than the requested percentage. The default percentage is 0%. When averaging is off, the analyzer overlaps as much as possible, regardless of the setting of OVRLP% (except for capture and throughput measurements, which use the value of OVRLP%). The overlap percentage readout at the top of measurement displays shows the overlap between the last two averages only.

PEAK HOLD—selects the peak hold function, which yields a composite spectrum containing the maximum values that occurred during the measurement in each of the display lines. Peak hold continues until the selected number of averages have been computed (this is the difference between peak hold and continuous peak). Note that peak hold can be applied only to frequency response and power spectrum measurements.

PRVIEW OFF—deactivates manual or timed previewing. When previewing is off, the measurement includes all time records, without waiting for your approval. The possible exception to this is overload rejection; see OV REJ ON OFF.

RETURN—redisplays the first level of the **AVG** menu.

STABLE (MEAN)—selects stable averaging, which weights old and new data equally to yield the arithmetic mean at each display line for the number of averages calculated. If **PAUSE CONT** is pressed before the specified number of averages have been calculated, the measurement pauses at the completion of the current average. Pressing **PAUSE CONT** again resumes the measurement at the next average. The formula used to calculate stable averaging is:

$$A_n = \frac{\Sigma D_n}{n}$$

where A_n = cumulative average
D_n = current quantity*
n = number of averages

*quantity is time record when time averaging is on; power spectrum, frequency response or correlation when time averaging is off.

TM AVG ON OFF—switches between linear and power spectrum quantity averaging. For linear averaging (TM AVG ON), the averaged quantity is the time record. For power spectrum quantity averaging (TM AVG OFF), the averaged quantity is the power spectrum, frequency response or correlation, depending on the measurement. Table 12-1 summarizes the advantages and disadvantages of the two types.

Table 12-1 Linear versus Power Spectrum Function Averaging

Power Spectrum Quantity	**Linear**
Applicable to both pure random and mixed random/periodic signals	Signal must have periodic component
Does not improve S/N ratio	Improves S/N ratio (random components average to their mean values
Does not require a synchronized trigger	Requires a synchronized trigger in fixed relation to the signal

TIMED PRVIEW—displays the time records for approval before they are included in the measurement. When each time record is displayed, the measurement pauses for a specified amount of time for you to approve or reject the record by pressing **YES** or **NO.** Any records you do not reject are automatically accepted at the end of the preview interval.

Press TIMED PRVIEW, then enter the pause in seconds. Timed previewing is deactivated by pressing PRVIEW OFF. When using this feature over the HP-IB, "ACPT" must be used in place of YES, and "REJT" must be used in place of NO. Previewing cannot be used with time throughput.

B—activates trace B. See the **SINGLE**, **UPPER LOWER** and **FRONT BACK** keys to determine where trace B is displayed for each of these formats. The active trace and its annotation are highlighted. Selection of the active trace is important because the markers, units, coordinates, math operations, displays and scale affect only the active trace. This key can also be used to return to a data trace display after a table has been displayed.

B (indicator)—this LED indicates when trace B is active.

BACK SPACE—moves the cursor one space back and deletes the last character or units selection entered. **BACK SPACE** applies only during alphabetical and numeric entries requested by the instrument.

CAL—displays the calibration menu. The HP 3562A's calibration routine checks and adjusts the gain and phase accuracy of the input channels to conform to specifications. Either auto calibration or a single calibration can be selected with the **CAL** menu; the routine performed is the same. "CALIBRATION IN PROGRESS" is displayed while the calibration routine is being performed.

AUTO ON OFF—controls auto calibration. When this softkey is ON, calibration occurs on the following schedule:

At power-on
8 minutes after power-on
1 hour after power-on
every 2 hours thereafter

The HP 3562A's calibration routine does not disrupt averaged measurements, swept sine measurements, time captures or time throughputs in progress.

SINGLE CAL—performs a single calibration routine. A single calibration pauses measurements. Perform a single calibration before starting a measurement if auto cal is off and the measurement must provide calibrated results.

CHANNEL 1 (connector)—the maximum input signal level is ±42 Vpeak. The input impedance is 1 MΩ ±0.5%, shunted by <100 pF. The input may be ac or dc coupled as well as grounded or floated; see **INPUT COUPLE**.

CHANNEL 2 (connector)—the maximum input signal level is ±42 Vpeak. The input impedance is 1 MΩ ±0.5%, shunted by <100 pF. The input may be ac or dc coupled as well as grounded or floated; see **INPUT COUPLE**.

CHASSIS (Connector)—used to connect to the instrument's chassis ground.

CONTROL Group—this group controls the instrument's operation. Measurements are started, paused and continued using **START** and **PAUSE CONT**. Auto sequence programs are controlled with the **AUTO SEQ** key. The preset instrument states are activated with the **PRESET** key. The **SPCL FCTN** key provides the self-test, service diagnostics and several additional functions.

COORD—displays the coordinates menu, which allows you to display different aspects of the measurement data, as well as select a log or linear X-axis. Coordinates may be selected before, during or after the measurement. The analyzer's display flexibility allows many combinations of coordinates and units for data traces; verify your selections under **COORD** and **UNITS** when viewing traces.

IMAG—displays the imaginary portion of complex measurement data.

LIN X—converts the horizontal axis of the displayed trace to a linear scale. If the trace was originally measured or synthesized with logarithmic resolution, the points in the converted linear trace will not be distributed proportionately. To achieve a true linear distribution, select the linear resolution mode before acquiring the trace (See **MEAS MODE**).

LOG X—converts the horizontal axis of the displayed trace to a logarithmic scale. If the trace was originally measured or synthesized with linear resolution, the points in the converted log trace will not be distributed proportionately. To achieve a true log distribution, select the log resolution mode before acquiring the trace (See **MEAS MODE**). This softkey is not applicable to time domain displays.

When both axes have log scales, the Y-axis reverts to a linear scale if a large number of decades are displayed on both axes.

MAG (dB)—defines the Y-axis as magnitude displayed in dB.

MAG (dBm)—defines the Y-axis as magnitude displayed in dBm (dB referenced to 1 milliwatt). After MAG (dBm) is pressed, an impedance value equal to the impedance of the input signal can be entered. The default value is 50Ω. If MAG (dBm) is pressed for a frequency response display, dB is selected; dBm will be applied to subsequent power spectra.

MAG (LIN)—defines the Y-axis as magnitude displayed linearly.

MAG (LOG)—defines the Y-axis as magnitude displayed logarithmically. When both axes have log scales, the Y-axis reverts to a linear scale if a large number of decades are displayed on both axes.

NEXT—displays the second level of the **COORD** menu.

NICHOL—configures the display as a Nichols plot. This display shows phase on the X-axis versus log magnitude on the Y-axis. At power-on and after reset, the center of the X-axis defaults to zero degrees. You can enter a new phase center, from −360 to +360 degrees, after pressing NICHOL. The Nichols display has special scaling characteristics; refer to Chapter 8 for more information. This display is available only with complex data.

NYQUST—Configures the display as a Nyquist diagram, often referred to as a polar plot. Nyquist shows real values on the X-axis versus imaginary values on the Y-axis. The Nyquist display has special scaling characteristics; refer to Chapter 8 for more information. This display is available only with complex data.

PHASE—selects phase coordinates for the display. The vertical axis units are degrees. At power-on and after presetting, the center of the vertical axis is set at zero degrees. Other center values may be selected by pressing PHASE, entering the new phase for the center of the display, then pressing Degree. Phase is not calibrated for time capture or single-channel time throughput displays.

The phase display depends on the type of scaling (see **SCALE**). If Y DFLT SCALE is active, the phase display is wrapped. If Y FIXD SCALE or Y AUTO SCALE is active, the phase display is unwrapped. Wrapped displays are wrapped back into the display area if they exceed the scale, while unwrapped traces are truncated if they exceed the scale. Figure 12-1 shows examples of wrapped and unwrapped phase traces.

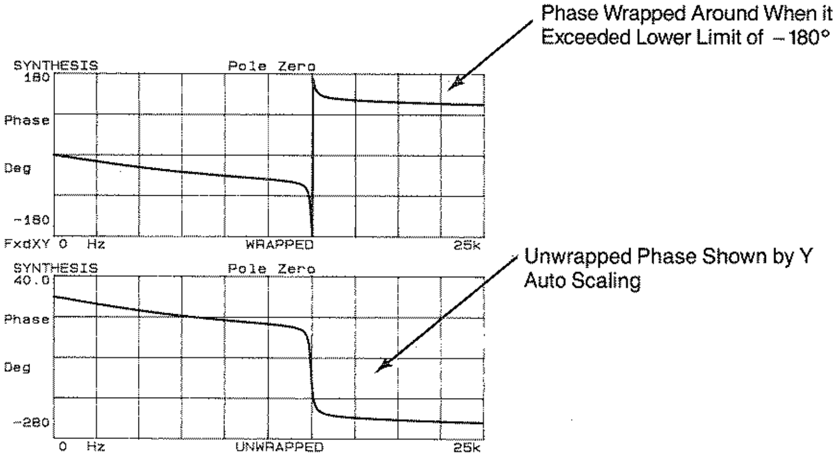


Figure 12-1 Wrapped and Unwrapped Phase Display

REAL—displays the real portion of complex measurement data. REAL differs from the REAL PART math function (under the **MATH** key) in that REAL does not erase the imaginary data.

RETURN—redisplays the first level of the **COORD** menu.

CURVE FIT—displays the curve fit menu. The HP 3562A's curve fitter can extract poles and zeros from frequency response functions, measured or synthesized. You can enter the order of the system to be fit or let the curve fitter estimate the number of poles and zeros. A weighting function is generated as the curve is fitted to emphasize important areas of the curve. Chapter 9 explains the operation of the curve fitter and its features.

A & B TRACES—selects the current A and B traces as the input to the curve fitter. If A & B TRACES is active, and you want the fitter to use the coherence function in calculating variance, put the frequency response in trace A and the coherence in trace B.

ADD LINE—enters a fixed value in the curve fit table. The curve fitter assumes the fixed value is correct and includes it the next time a fit is performed. To enter a line, first select EDIT POLES or EDIT ZEROS then press ADD LINE. Now enter the value of the pole or zero in mHz, Hz, or kHz. Complex values are entered with the real and imaginary parts separated by a comma. The total number of poles or zeros is increased if it is not already large enough to allow the addition of a line. Added lines are arranged according to magnitude after the next fit, so it does not matter where in the table they are entered.

AUTO ORDER—causes the HP 3562A to estimate the optimum number of poles and zeros for the transfer function to be fitted. The minimum is 1 pole and 1 zero, and the maximum is the number entered with NUMBER POLES and NUMBER ZEROS. Select AUTO ORDER if the order of the system is unknown. USER ORDER is faster and should be used if you know the system order. If AUTO ORDER is active and the number of poles and zeros is 0 for both (the default conditions), the order constraint is removed and the fitter uses the numbers it determines best. Note that the number of poles and zeros shown in the table is the number you entered, not the number found with AUTO ORDER.

AUTO WEIGHT—causes the curve fitter to generate a weighting function that emphasizes the high-coherence portions of the curve and de-emphasizes the low-coherence portions. It also emphasizes important regions of the curve, such as poles and zeros.

CLEAR TABLE—clears the curve fit table. After this is pressed once, the message "Push Again to Clear" is displayed to allow you to confirm that the table is to be cleared. Once cleared, tables cannot be recovered. However, they can be saved in disc memory; see **DISC.**

CREATE FIT—Starts the curve fitting process using the current setup. The status message "CURVE FIT IN PROGRESS" is displayed during the fit. "Fit Complete" is displayed when the fit is finished.

DELETE LINE#—used to delete a line in the curve fit table. Press DELETE LINE#, use the **0** - **9** keys to enter the number of the line to be deleted, then press ENTER. The line is deleted immediately, then the remaining lines are renumbered. Note that the state of EDIT POLES and EDIT ZEROS determines whether the line deleted is a pole or a zero.

EDIT POLES—shifts the curve fit editing functions to the poles in the table. The editing softkeys apply either to the poles or the zeros, depending on whether EDIT POLES or EDIT ZEROS is active.

EDIT TABLE—displays the curve fit table and its editing menu. If a curve has not been fitted since power-on or reset, the table is empty. Note that removing power or resetting erases the table.

EDIT WEIGHT—displays the edit weight menu, which is used to view and modify the weighting function used by the curve fitter. The weighting function emphasizes important areas of the curve, such as poles and zeros. In general, high-coherence areas are emphasized, and low-coherence areas are de-emphasized.

EDIT ZEROS—shifts the curve fit editing functions to the zeros in the table. The editing softkeys apply either to the poles or the zeros, depending on whether EDIT POLES or EDIT ZEROS is active.

FIT FCTN—displays the fit functions menu, which is used to view and edit the weight function, select user or auto order, and transfer synthesis and curve fit tables.

FIT → SYNTH—transfers the curve fit table to the pole/zero synthesis table. Synthesis is forced to the pole/zero method, and any information existing in the synthesis table is erased. FIT → SYNTH is used to modify and recreate fitted response curves using synthesis.

FIX LINE#—used to fix a pole or zero, depending on whether EDIT POLES or EDIT ZEROS is active. When a line is fixed, the curve fitter assumes it is accurate and includes it in the fit process without changing it. Fixed lines are identified in the table by an arrow on the right side of the column.

LAST MEAS—selects the last frequency response measurement made as the input to the curve fitter, regardless of the current display. If a valid frequency response has been measured and LAST MEAS is active, the curve fitter selects the necessary displays during the fitting process.

NUMBER POLES—used to specify the number of poles for a curve fit operation. Conjugate pairs are considered two poles. If USER ORDER (in the FIT FCTN menu) is active, the curve fitter finds the specified number of poles. If AUTO ORDER is active, the curve fitter finds the optimum number of poles, without exceeding the specified number. Any number of poles from 0 to 40 can be selected.

If the system order is unknown, it is best to specify a large number of poles, then use the auto order feature (see FIT FCTN) to determine the actual order. Otherwise, a general rule is to use two poles for each peak in the curve, plus one pole at the origin, plus several extra to allow for any hidden poles.

NUMBER ZEROS—used to specify the number of zeros for a curve fit operation. Conjugate pairs are considered two zeros. If USER ORDER (in the FIT FCTN menu) is active, the curve fitter finds the specified number of zeros. If AUTO ORDER is active, the curve fitter finds the optimum number of zeros, without exceeding the specified number. Any number of zeros from 0 to 40 can be selected.

If the system order is unknown, it is best to specify a large number of zeros, then use the auto order feature (see FIT FCTN) to determine the actual order. Otherwise, a general rule is to use two zeros for each negative peak in the curve, plus one zero at the origin, plus several extra to allow for any hidden zeros.

RETURN—redisplays the previous menu.

SCALE FREQ—use to enter the scaling frequency, which is multiplied by the pole and zero values to shift the curve up or down in frequency without actually changing any values. Enter the frequency, from 1 μHz to 1 MHz, using the Entry group. The default is 1 Hz.

STOP FIT—stops the curve fit process. The message "Stopped" is displayed as soon as the curve fitter stops to remind you that the fit was not completed.

STORE WEIGHT—stores the user-defined weighting function. The function is stored in nonvolatile memory and is not erased when power is removed, but it is removed if a new measurement is run. If any changes are made to the weighting function, it must be stored for the changes to be implemented.

SYNTH → FIT—transfers the contents of the pole/zero synthesis table to the curve fit table. To transfer a pole/residue or polynomial table to the curve fitter, first convert it to a pole/zero table using the CONVRT TABLE menu (under **SYNTH**), then transfer it using SYNTH → FIT.

TABLE FCTN—displays the curve fit table functions menu, which allows you to enter time delays and scaling frequencies and clear the table.

TIME DELAY—if the system to be fit has a time delay, this value must be entered before the fit is started to obtain an accurate fit. The value can be entered in microseconds, milliseconds, or seconds; the value used in the fit is displayed in the curve fit table. Note that the time delay can be measured directly using the cross correlation measurement (see **SELECT MEAS** while in the linear resolution mode).

UNFIX LINE#—unfixes a previously fixed line. When lines are unfixed, the curve fitter treats them as normal lines (i.e., they can be changed in the next fit).

USER ORDER—causes the curve fitter to find the number of poles and zeros specified with NUMBER POLES and NUMBER ZEROS. Select USER ORDER if the system order is known and the curve fitter to extract a specific number of poles. AUTO ORDER should be used for the first fit on a system with unknown order.

USER WEIGHT—causes the curve fitter to use the user-defined weighting function during the fit process. The user weight can be viewed and edited with the EDIT WEIGHT menu.

VIEW WEIGHT—displays the weighting function in the bottom trace. If AUTO WEIGHT is active, the weight calculated from the coherence function is displayed. If USER WEIGHT is active, the previous weighting function, as modified by the user, is displayed. The weight must be displayed before it can be modified. If no weighting function exists in memory from an earlier fit, VIEW WEIGHT displays a unity function.

WEIGHT REGION—used to specify a portion of the weighting function to be modified by WEIGHT VALUE. Enter the minimum and maximum frequencies separated by a comma. (Using an X marker band and **MARKER VALUE** is very convenient.) Any portion of the weighting function outside the weight region retains its original weighting value. More than one region can be specified and modified.

WEIGHT VALUE—used to define the value of the weighting function inside the region identified by WEIGHT REGION. Press WEIGHT VALUE, then enter the weighting constant for the region. You can enter any value from −32,767 to 32, 767, but the value is always normalized from 0 to 1.0. View the level of the weighting function inside the weight region to determine its effect on the curve fit. Any portion of the weighting function outside the weight region retains its original weighting value.

DISC—displays the disc menu, which you can use to save and recall files, view the catalog, initialize discs, create time throughput files, and perform disc servicing diagnostics. Disc addresses are entered in the HP-IB FCTNS menu.

ABORT HP-IB—aborts HP-IB operations. This can be used if you encounter trouble with disc operations and the bus or the disc drive does not respond. Aborting does not affect files existing on the disc.

CATLOG POINTR—enables the Entry group to move the catalog pointer, which is used to select disc files for recalling or deletion. If the catalog has been read previously then replaced with another display, it is redisplayed when CATLOG POINTR is pressed. AT POINTR in the alpha menu is used to recall or delete files identified by the catalog pointer.

CLEAR LOGS—clears the disc fault log, error rate test (ERT) log and run time log. The ERT log is cleared each time the read-only error rate test is performed (see RO ERT TEST), but CLEAR LOGS is the only way to clear the fault and run time logs. Make certain that you have read and appropriately responded to any information in the logs before clearing them.

COPY FILES—used to copy one or more files from the source disc to the destination disc. To copy a single file, press COPY FILES, enter the name with the alpha menu then press ENTER. To copy several contiguous files, type in the starting file name followed by a comma. Next, type in the ending file name and press ENTER. This copies the files in the disc catalog from the starting file to the ending file, inclusive. The source disc is identified by DISC ADDRES and DISC UNIT in the HP-IB FCTN menu. The destination disc is identified by DESTN DISC and DESTN UNIT in the DISC COPY menu. See "OVERWR AU MAN" to handle duplicate file names.

To copy all the files from the source disc to the destination disc, press COPY FILES followed immediately by ENTER. To restart copying if "Disc Full" is displayed, insert a second disc into the destination drive and press RESUME COPY. You have two options for copying all files on a disc: COPY FILES or IMAGE BACKUP. IMAGE BACKUP is faster, but it starts by erasing the destination and is used primarily for media backups.

CREATE THRUPT—used to enter a file name and create a throughput file on disc. When CREATE THRUPT is pressed, the alpha menu is displayed to allow entry of the file name. (For instructions on using the alpha menu, please refer to the beginning of this chapter.) The size of the file created is determined by THRUPT SIZE and must be specified every time you create a throughput file. To use the size previously specified, you still must press THRUPT SIZE to verify this. Note that throughput sessions (see the THRUPT SELECT menu under **MEAS MODE**) require throughput files that are equal to or greater than the length of the session.

DELETE FILE—used to delete files from disc memory. The file can be selected with an alphanumeric entry or the catalog pointer. To select it with an alphanumeric entry, press DELETE FILE, enter the file name using the alpha menu, then press ENTER. To select it with the catalog pointer, press CATLOG POINTR and scroll through the catalog with the Entry group until the pointer is at the desired file. Then press DELETE FILE and AT POINTR, and the file will be deleted. Pressing CATLOG POINTR assumes that the catalog has already been read from the disc.

DESTN ADDRES—used to enter the address of the destination disc drive for file copying. Press DESTN ADDRES, enter the address from 0 to 7, then press ENTER.

DESTN UNIT—used to enter the unit number of the destination disc drive for file copying. Press DESTN UNIT, enter the unit number from 0 to 15, then press ENTER.

DISC COPY—displays the disc copying menu, which allows you to identify the destination disc unit, copy files, and perform image backups.

DISC FCTN—displays the disc functions menu, which you can use to initialize and pack discs, restore catalogs, create throughput files, abort disc operations, and access the disc servicing softkeys.

DISC STATUS—retrieves the disc status display, which shows the last disc access error. Chapter 11 explains how to interpret this display and provides an example.

ERT LOG—displays the ERT log, which shows the results of the read-only error rate test (ERT). (Pressing RO ERT TEST starts the ERT.) Chapter 11 explains how to interpret the ERT log and provides an example.

FAULT LOG—displays the disc fault log, which shows accumulated disc hardware faults. Chapter 11 explains how to interpret the fault log and provides an example.

FORMAT—displays the disc formatting menu, which allows you to initialize discs, tapes and catalogs and specify format options for Hewlett-Packard Subset/80 discs.

FORMAT OPTION—allows you to specify the format option for Hewlett-Packard Subset/80 disc media. This command is ignored by other command sets. You can enter a format option number from 0 to 239. This number is used when INIT CATLOG or INIT DISC is pressed. Refer to your disc drive's manual for more information on the format numbers. Note that 256 bytes is the only sector size compatible with the HP 3562A.

IMAGE BACKUP—erases the destination disc or tape, then transfers the data image of the source to the destination. This transfers the exact image of the source; all files existing on the destination are erased, and the destination is given the source's name. If you do not need to retain any existing data on the destination disc or tape, use IMAGE BACKUP because it is much faster than copying an entire disc with COPY FILES.

INIT CATLOG—initializes a media catalog. Note: this effectively erases any existing files. After you press this, the alpha menu is displayed to allow you to enter the disc name. The disc name is limited to six alphanumeric characters and must start with a letter. If you do not enter a name, "HP3562" is used. If you do not specify the number of files, 6% of the disc space is reserved for the catalog, and the rest is reserved for files. This softkey differs from INIT DISC in that this does not format the media. INIT CATLOG is used primarily for initializing catalogs on pre-formatted tapes. INIT CATLOG also erases any files existing on the media, so it is a fast, easy way to erase discs.

When you initialize the catalog, you can specify the number of files allowed on the disc or tape, from 1 to 32 767. After typing in the name, enter a comma followed by the desired maximum number of files. For example, the command

```
INIT CATLOG: DISC1,2500
```

initializes the catalog on the medium, calls it "DISC1" and reserves space for 2500 files. The remaining space is then reserved for the catalog. Note that the number of files is rounded up to the nearest 8n (8, 16, 24, etc.).

INIT DISC—initializes the disc in the currently selected drive unit. After pressing INIT DISC, enter the desired name for the disc, then press ENTER. The alpha menu appears as soon as INIT DISC is pressed; the disc name is limited to six alphanumeric characters and must begin with a letter. If you do not enter a name, "HP3562" is used. If you do not specify the number of files, 6% of the disc space is reserved for the catalog. INIT DISC differs from INIT CATLOG in that it writes the disc catalog and formats the media, whereas INIT CATLOG only writes the catalog.

Note that initialization erases any files already on the disc. To see if a disc has been initialized previously, insert it in the drive and press VIEW CATLOG. If "Unformatted Disc" is displayed, you need to initialize using INIT DISC. If "Not a Valid Catalog" is displayed, initializing with INIT CAT will suffice.

When you initialize the disc, you can specify the number of files allowed on that disc, from 1 to 32 767. After typing in the disc name, enter a comma followed by the desired maximum number of files. For example, the command

```
INIT DISC: DISC1,2500
```

formats the disc, calls it "DISC1" and reserves space for 2500 files. The remaining space is then reserved for the catalog. Note that the number of files is rounded up to the nearest 8n (8, 16, 24, etc.).

When using a tape unit for mass storage, INIT DISC performs an automatic certification test and stores the results in the ERT log. Because of this, you should view the ERT log (press ERT LOG in the OUTPUT LOG menu) before running the ERT for the first time.

NEXT PAGE (**DISC** menu)—displays the next page of disc catalogs containing more than one page (20 files).

NEXT PAGE (SERVCE FCTNS menu)—displays the next page of the fault log, ERT log or run time log, depending on which one was last displayed. The page number count at the top right corner of these logs applies to individual heads in multi-head discs. To view the entire log, keep pressing NEXT PAGE until "LAST PAGE" is displayed under the page number.

OUTPUT LOG—displays the output log menu, which allows you to view the disc fault, ERT and run time logs. Note that these logs are supported only on Hewlett-Packard Command Set/80 discs and tapes.

OVERWR AU MAN—selects automatic or manual overwriting for file copying. If you select automatic overwrite, copying will not stop if it encounters duplicate file names on the destination disc, but will write the source file into the destination file. If you select manual overwrite, copying stops and informs you if it encounters duplicates. You then have two choices: Press RESUME OVERWR to copy the source file into the destination file (erasing the contents of the destination file) or press RESUME COPY to skip the source file in question and proceed to the next file (not copying the source file).

PACK DISC—packs the disc in the selected drive unit. Packing rewrites disc files to remove the space created when files are deleted.

PREV PAGE—displays the previous page of disc catalogs containing more than one page (20 files).

RECALL FILE—used to recall a saved display from disc memory. The desired file can be selected with an alphanumeric entry, the catalog pointer, or RECALL FILE followed by ENTER. (1) To select it with an alphanumeric entry, press RECALL FILE, enter the file name, then press ENTER. (2) To select it with the catalog pointer, press CATLOG POINTR and scroll through the catalog using the arrows or the knob in the Entry group until the pointer is at the desired file. Then press RECALL FILE and AT POINTR, and the selected file will be recalled. (3) If you press ENTER after RECALL FILE, the previous file of the same type as the last file recalled is recalled from disc. Chapter 11 has an example.

RESTOR CATLOG—reads the disc directory and restores the file catalog. This is used when a data transfer has been interrupted, such as a power loss on the disc drive or the HP 3562A during a disc operation. When you press RESTOR CATLOG, the alpha menu is displayed to let you enter the name for the restored catalog. Refer to Chapter 11 before attempting to restore a catalog.

RESUME COPY—this softkey has two uses: 1. when copying disc files and a duplicate file name is encountered, press RESUME COPY to ignore the source file in question. This preserves both files in their original states.

2. when copy files and the destination disc becomes full, insert a new disc in the destination drive and press RESUME COPY to finish copying the desired source files.

RESUME OVERWR—this softkey is used when copying disc files if duplicate files names are encountered. Press RESUME OVERWR to write over the destination file with the source file. This destroys the destination file and preserves the source file on both discs. See OVERWR AU MAN for more information.

RETURN—redisplays the previous menu.

RO ERT TEST—starts the read-only error rate test (ERT). This tests for disc and tape problems, including media wear. For discs, it reads the entire disc and identifies bad sectors and tells you whether the drive's error correction circuitry (ECC) can correct the bad sectors. The ECC is disabled while the ERT is in progress, so any correctable problems remain uncorrected after the test. The results of the ERT can be viewed in the ERT log by pressing OUTPUT LOG followed by ERT LOG. Chapter 11 explains how to interpret the results of the ERT, how the tape ERT differs, and how to use it to spare blocks.

Note that the ERT log is cleared as soon as you press RO ERT TEST. If you have formatted a tape with INIT DISC since the last time the ERT was run, view the ERT log before starting the test. INIT DISC stores tape certification information in the ERT log, which is erased when the ERT is started. Refer to Chapter 11 before running the ERT.

RUN TM LOG—this shows the cumulative run time errors of the disc. Unlike the ERT log, this does not show correctable errors because during normal operation the error correction circuitry (ECC) is enabled and any correctable errors are corrected then ignored. Chapter 11 explains how to interpret the run time log and provides an example.

SAVE FILE—used to save the current display on disc. Data traces, state displays, curve fit tables, delete frequency tables, auto sequences, auto math tables and synthesis tables can be saved. The alpha mode menu appears when SAVE FILE is pressed to allow entry of the new file name. You have three file name options:

1. Enter a file name (up to 8 characters) using the alpha menu that is displayed then press ENTER.
2. Enter a file name then press OVER WRITE in the alpha menu. If a file under this name already exists on the disc, OVER WRITES writes over the original file and replaces it with the new file. This differs from pressing ENTER as in #1 above, which will not let you write over an existing file.
3. Press ENTER immediately after pressing SAVE FILE. This finds the last file you stored on disc since power-up, increments any number in its name by one, then stores the current display under the incremented file name. If the last file name does not contain a number, a 1 is appended to the new file name. If no files have been saved since power-up, the new file is simply named "1."

SERVCE FCTNS—displays the disc service functions menu, which allows you to:

Restore catalogs
Run the read-only error rate test
View the fault, run time and ERT logs
Determine the status of the last disc access error
Spare blocks on media

The functions accessed by this menu are intended for the use of disc servicing technicians as well as advanced HP 3562A operators who wish to spare blocks and restore catalogs on disc media.

SPARE BLOCK—allows you to spare blocks that you have determined to be defective. Use the test procedure described in Chapter 11 before attempting to spare blocks. This softkey requires either a one-vector or a three-vector address.

THRUPT SIZE—used to specify the throughput file size to be used by CREATE THRUPT. File size is limited to 32 767 records or the amount of space available on the disc. The file size must be at least as large as the intended throughput session. To set the size, press THRUPT SIZE, enter the length in time or number of records using the Entry group. (It is always rounded up to an integer number of records.) The default size is 20 time records. Time record size is a function of frequency span; to find the current record length, look in the state display under FREQ: REC LGTH. The size must be specified every time you create a file. If you want to use the previously defined size, you still need to press THRUPT SIZE to verify this.

VIEW CATLOG—displays the catalog of the disc currently selected. If a disc is not in the drive, or some other problem occurs after VIEW CATLOG is pressed, press DISC FCTN followed by ABORT DISC to terminate the operation.

DISPLAY Group—this group of keys control the display format. The display can be configured before, during and after measurements.

DISPLAY OUTPUTS X,Y,Z (connectors)—connects to large-screen displays, such as the HP 1310B.

DOWN—when the ENABLED indicator in the Entry group is on, the down arrow decrements the active numeric entry. The amount of the decrement depends on the variable being entered.

ENABLED (indicator)—when this LED is on, the Entry group can be used to make numeric entries.

ENGR UNITS—displays the engineering units menu, which allows measurements to be calibrated in user-defined units. For example, if a transducer is calibrated at 10 mV/G, the HP 3562A can be calibrated at 10 mV/EU. "G" can be entered as the EU label, and the measurement and the display are then calibrated in Gs. "EU" appears in all appropriate units softkey menu (**RANGE**, for example).

EU LBL CHAN 1—used to label the engineering units defined for Channel 1. Press EU LABEL CHAN 1, enter the desired label (limited to five alphanumeric characters) using the alpha menu that appears, then press ENTER. The label is displayed on the vertical axis after the measurement is started. EU labels are not saved in the instrument state. If you select EU VAL CHAN 1 and do not enter an EU label, "EU1" is used for the label.

EU LBL CHAN 2—used to label the engineering units defined for Channel 2. Press EU LABEL CHAN 2, enter the desired label (limited to five alphanumeric characters) using the alpha menu that appears, then press ENTER. The label is displayed on the vertical axis after the measurement is started. EU labels are not saved in the instrument state. If you select EU VAL CHAN 2 and do not enter an EU label, "EU2" is used for the label.

EU VAL CHAN 1—selects engineering units for Channel 1. Press this softkey, then enter the calibration in V/EU, mV/EU or dB. The EXP (exponential) softkey is displayed to allow entry in exponential notation. The dB softkey serves as a multiplier referenced to 1 volt rms. The entry is limited to ± 1nV to ± 1000V.

EU VAL CHAN 2—selects engineering units for Channel 2. Press this softkey, then enter the calibration in V/EU, mV/EU or dB. The EXP (exponential) softkey is displayed to allow entry in exponential notation. The dB softkey serves as a multiplier referenced to 1 volt rms. The entry is limited to ± 1nV to ± 1000V.

VOLTS CHAN 1—selects volts on the Y-axis for Channel 1 and disables the engineering units. Any EU label and calibration previously entered are erased when VOLTS CHAN 1 is selected. This is the default selection at power-on and after reset.

VOLTS CHAN 2—selects volts on the Y-axis for Channel 2 and disables the engineering units. Any EU label and calibration previously entered are erased when VOLTS CHAN 2 is selected. This is the default selection at power-on and after reset.

ENTRY Group—this group is used to make numeric entries requested by the instrument. When the ENABLED indicator is on, the up/down arrows and the knob can be used to modify the active entry. The keys in this group are not converted in the alpha mode, and are used to add numbers and punctuation to alpha entries. The **YES** and **NO** keys are used during previewing; refer to their descriptions for more information. **MARKER VALUE** and **BACK SPACE** are also described individually in this chapter.

EXT SAMPLE IN (connector)—used to input sampling signals when the instrument is in external sampling mode. This signal must be TTL-compatible and not greater than 256 kHz. Refer to the descriptions of the E SMPL ON OFF and SAMPLE FREQ softkeys in the FREQ menu for more information.

EXT TRIGGER (connector)—used to connect an external trigger signal. This input is enabled when EXT (in the AVG menu) is pressed and the EXT TRIGGER indicator is illuminated. The maximum voltage allowed at this input is ±10 volts. Note that the external trigger signal level must be at least 200 mVpk. The external trigger signal is subject to the slope and level conditions; see **SELECT TRIG** for more information.

EXT TRIGGER (indicator)—this LED indicates that an external trigger signal is expected at the EXT TRIGGER input. When external triggering is active, any signal present at this input is treated as the trigger signal.

FREQ—displays the frequency selection menus for all modes. These menus depend on the mode selected. All frequency selections must be made prior to starting the measurement. The linear, log and time capture modes have predefined frequency spans (these spans are a function of the FFT process). The swept sine spans are not predefined.

CENTER FREQ—used to select the center of the frequency span, using the Entry group. In the linear resolution and time capture mode, CENTER FREQ, START FREQ, and FREQ SPAN are interrelated; changing one may affect the other two. In the swept sine mode, CENTER FREQ, START FREQ, FREQ SPAN and STOP FREQ are interrelated; changing one affects one or more of the others. It is easiest to use CENTER FREQ and FREQ SPAN as a pair or START FREQ and STOP FREQ as a separate pair.

E SMPL ON OFF—selects external sampling and displays the SAMPLE FREQ softkey. External sampling allows you to synchronize the HP 3562A's data acquisition rate to an external signal, such as a tachometer pulse. See SAMPLE FREQ for more information.

If external sampling is active, you must provide a sampling signal to the rear panel EXT SAMPLE IN connector and enter that frequency with SAMPLE FREQ.

FREQ SPAN—used to enter the measurement frequency span. The span must be entered before the measurement is started. A frequency span can also be identified with an X marker band, then entered with the **MARKER VALUE** key. In the linear, log and time capture modes, the available frequency spans are predefined by the instrument.

MAX SPAN—sets the frequency span at the maximum of 0 to 100 kHz. This is the default span for the linear resolution and time capture modes at power-up and after resetting.

RESLTN—allows you to enter the resolution of the sine sweep. Resolution defines the distance between measurement points in the frequency spectrum. Sweep rate and resolution are inversely proportional; changing one automatically changes the other. Press RESLTN then enter the resolution using the Entry group and one of the units softkeys that are displayed. See also RESLTN AU FIX.

RESLTN AU FIX—selects auto or fixed resolution. Auto resolution adjusts the resolution of the sweep when it encounters rapid changes in the response curve. Fixed resolution maintains the resolution specified with RESLTN, regardless of the signal's rate of change. Refer to Chapter 3 for more information on auto resolution.

SAMPLE FREQ—used to enter the external sampling frequency ($\leq$ 256 kHz), using the Entry group. This softkey appears only when E SMPL ON OFF is ON. To ensure measurement accuracy, the exact frequency of the external sampling signal applied to the EXT SAMPLE IN connector must be entered using this softkey. If the sampling frequency is entered in Hertz, it must remain constant. If it is entered in pulses/revolution, it can vary without affecting the accuracy of the measurement. In the log resolution mode, the sampling frequency must be fixed (i.e., it must be entered in Hertz).

START FREQ—used to specify the measurement start frequency. In the linear resolution and time capture modes, enter the start frequency then the frequency span. In the log resolution mode, enter the start frequency then the span or start frequency. In the swept sine mode, it is easiest to use CENTER FREQ and FREQ SPAN as a pair or START FREQ and STOP FREQ as a separate pair.

STOP FREQ—used to enter the measurement stop frequency in the swept sine mode.

SWEEP RATE—used to enter the sweep rate for swept sine measurements. Sweep rate and resolution are inversely proportional; changing one automatically changes the other. Press SWEEP RATE, then enter the rate using one of the units softkeys that appear. Note that this softkey appears in both the **FREQ** and **SOURCE** menus.

TIME LENGTH—used to enter the length of the time record. The "time record" is the amount of data required to perform one FFT. The "time record length" is the amount of time required to fill the time record. The record length is limited to the range of 8 ms (100 kHz span) to 78 100s (10.2 mHz span). Changing the time record length automatically changes the frequency span, according to the formula:

$$\begin{array}{c}\text{record length}\\\text{(in seconds)}\end{array} = \frac{801}{\text{frequency span (in Hertz)}}$$

ZERO START—selects 0 Hz (dc) as the start frequency in the linear resolution and time capture modes.

FRONT BACK—superimposes trace A and trace B in a full-size display, regardless of which trace is active. The active trace and its annotation are highlighted. If both traces are active, trace A is highlighted.

FUSE (fuse holder)—contains the line fuse, which must correspond with the selected line voltage. The proper fuses are:

115V operation—6A/250V HP part number 2110-0003
230V operation—3A/250V HP part number 2110-0304

Appendix A explains how to replace the fuse.

HALF RANGE (indicators)—these LEDs indicates that the input signal levels on the respective channels are at least half the current input range. To ensure maximum measurement sensitivity and avoid distortion, maintain the input range such that HALF RANGE remains on and OVER RANGE stays off. For more information see **RANGE**.

HELP—The help mode explains each of the HP 3562A's keys and softkeys. To display a description, press **HELP** followed by the desired key or softkey. Once the help display is on the screen, the front panel returns to normal operation. To erase the help display, press **A** or **B.** This returns the previous display. These displays also show:

HP-IB Command
Key Type (Hard or Soft)
Number of Entry Parameters (when applicable)
Entry Type (alpha, numeric or Boolean—when applicable)

All keys and softkeys (except **LINE** and the service diagnostics softkeys) offer help displays. If you need more information than these displays provide, refer to the index at the end of this manual.

HP-IB (connector)—connects the HP 3562A to the Hewlett-Packard Interface Bus (HP-IB). For information on using plotters and disc drives, see Chapter 11. For information on programming the instrument with an external HP-IB controller, refer to the *HP 3562A Programming Manual.*

HP-IB FCTN—displays the HP-IB functions menu, which is used to designate the HP 3562A as the system controller, access user SRQs, abort HP-IB operations, and view and set addresses.

ABORT HP-IB—aborts HP-IB operations. This is used when a problem is encountered and the bus does not respond.

ADDRES ONLY—identifies the HP 3562A as an addressable-only device on the bus. If you are using a plotter, disc drive or the output string feature, the HP 3562A must be identified as the system controller. The exception to this is when another controller is on the bus. In this case, refer to the *HP 3562A Programming Manual* for information on passing control. Once selected, the addressable-only mode remains active until you select SYSTEM CNTRLR; the choice cannot be made over the HP-IB.

DISC ADDRES—used to enter the HP-IB address of the disc drive connected to the HP 3562A. The instrument must know the disc drive's address to communicate with it. The range of disc drive addresses is 0 to 7. The disc address is saved in nonvolatile memory and is not erased by power-down or reset.

DISC UNIT—used to select the desired disc unit in multiple-disc memories. Any unit number between 0 and 15 (depending on the drive) can be entered. Once the number is selected, the HP 3562A accesses the selected drive for all disc operations (except for disc copying; the destination drive and unit are identified with the DISC COPY menu). The disc unit number is saved in nonvolatile memory and is not erased by power-down or reset.

HP-IB ADDRES—used to enter the HP-IB address for the HP 3562A. This can be set to any address from 0 to 31. The address is saved in nonvolatile memory and is not erased by power-down or reset.

OUTPUT STRING—used to output a string to the HP-IB. The instrument must be the system controller to use this feature. The alpha menu is displayed when OUTPUT STRING is pressed; the string can contain up to 25 characters, including the address. Chapter 11 has more information on outputting strings.

PLOT ADDRES—user to enter the plotter's HP-IB address. The HP 3562A must know the plotter's address to communicate with it. The plotter address can be set from 0 to 31. The address is stored in nonvolatile memory and is not affected by power-down or the presets.

RETURN—redisplays the **HP-IB FCTN** menu.

SELECT ADDRES—displays the select address menu, which is used to view and set HP-IB addresses for the HP 3562A, disc drive and plotter.

SYSTEM CNTRLR—identifies the HP 3562A as the system controller. This is necessary when you are using a plotter, disc drive, or the output string capability. If another controller has control of the bus, you need to pass control if you intend to use the HP 3562A as the system controller. Refer to the *HP 3562A Programming Manual* for more information.

USER SRQ—displays the user SRQ menu. These eight softkeys generate individual SRQs to an HP-IB controller. For information on labeling these softkeys and handling the user SRQs, refer to the *HP 3562A Programming Manual*.

USER SRQ1—USER SRQ8—send user SRQs to an HP-IB controller. For instructions on customizing the softkey labels and handling the user SRQs, please refer to the *HP 3562A Programming Manual*.

HP-IB Group—this group of keys interfaces the HP 3562A with the Hewlett-Packard Interface Bus (HP-IB). The **DISC** and **PLOT** keys are used when the instrument is controlling disc drives and plotters. The **HP-IB FCTN** key is used to view and set addresses, send user service requests, and identify the system controller. The **LOCAL** key returns front panel control when the instrument is in REMOTE.

INPUT COUPLE—displays the input coupling menu, which allows you to float or ground each channel and select ac or dc coupling.

CHAN 1 AC DC—selects ac or dc coupling for the Channel 1 input. The 3 dB cutoff frequency for ac coupling is less than 1.0 Hz. When Channel 1 is ac coupled, a series capacitor is inserted to remove dc components from the input signal.

CHAN 2 AC DC—selects ac or dc coupling for the Channel 2 input. The 3 dB cutoff frequency for ac coupling is less than 1.0 Hz. When Channel 2 is ac coupled, a series capacitor is inserted to remove dc components from the input signal.

FLOAT CHAN 1—causes Channel 1 to float. When floated, neither side of the input channel is connected to ground. The input channels are usually floated if a ground loop problem is encountered or if a signal is being measured at some point in a system not referenced to ground. The input channels can be floated or grounded independently.

FLOAT CHAN 2—causes Channel 2 to float. When floated, neither side of the input channel is connected to ground. The input channels are usually floated if a ground loop problem is encountered or if a signal is being measured at some point in a system not referenced to ground. The input channels can be floated or grounded independently.

GROUND CHAN 1—grounds the Channel 1 input. When grounded, the outside shell of the BNC connector is connected through 200Ω to chassis ground. The input channels can be floated or grounded independently.

GROUND CHAN 2—grounds the Channel 2 input. When grounded, the outside shell of the BNC connector is connected through 200Ω to chassis ground. The input channels can be floated or grounded independently.

INPUT SETUP Group—this group of keys sets up the two input channels. These selections must be made prior to starting measurements, throughput or captures.

LINE—controls ac power to the HP 3562A. All circuits are deactivated when **LINE** is OFF; nothing is put in a standby mode.

LINE (connector)—connects the HP 3562A to ac line power. Refer to Appendix A for instructions on setting line voltages and installing fuses.

LISTEN (indicator)—this LED indicates when the HP 3562A is operating as a listener on the HP-IB.

LOCAL—returns front panel control the HP 3562A. **LOCAL** overrides any attempt by the controller to retain control of the instrument, except when the controller has previously issued a local lockout command. In this case, **LOCAL** is disabled until the GO TO LOCAL command is issued by the controller.

MARKER VALUE—enters the value currently displayed by the X or Y marker. This key can be used in place of the **0** - **9** keys when the HP 3562A is expecting a numeric input and the marker is displaying a value in the units expected. For example, if a frequency domain trace is displayed with the X marker active at some point on the trace, this marker value can be entered for the new center frequency by pressing CENTER FREQ followed by **MARKER VALUE**. Note also that marker bands can be used to quickly enter such variables as frequency span and weight region.

MARKERS Group—this group of keys controls the X and Y markers and the special marker functions.

MATH—displays the math menu, which is used to perform waveform math operations on the active trace(s). Most of these operations are performed as soon as they are selected. The four algebraic operations (+, −, ×, ÷), however, require a second trace or numeric constant before the math is performed. If both traces are active when a math operation is selected, the operation is be performed on both traces. Chapter 9 explains waveform math and its companion auto math feature.

ADD—selects the addition operation, which requires three steps:

1. Activate trace A or trace B as the first addend.
2. Press **MATH**, followed by ADD, to select addition.
3. Select TRACE A, TRACE B, SAVED 1, SAVED 2, or a numeric constant as the second addend. The sum appears as soon as the addition is completed.

The addend choices displayed after ADD is pressed are the only ones applicable to addition. The addends must also be compatible. For example, a time domain trace cannot be added to a frequency domain trace.

COMPLX CONJ—calculates the complex conjugate of the active trace. The resultant trace is displayed as soon as the calculation is complete.

DIFF—differentiates the active trace. The resultant trace is displayed as soon as the calculation is completed. This should be used to differentiate time domain traces.

DIV—selects the division operation, which requires three steps:

1. Activate trace A or trace B as the dividend.
2. Press **MATH**, followed by DIV, to select division.
3. Select TRACE A, TRACE B, SAVED 1, SAVED 2, or a numeric constant as the divisor. The quotient appears as soon as the division is completed.

The divisor choices displayed after DIV is pressed are the only ones applicable to division. The traces must also be compatible. For example, a time domain trace cannot be divided by a frequency domain trace.

FFT—performs a fast Fourier transform (FFT) on the active trace. The transformed trace is displayed as soon as the calculation is completed. This computes a 1024-line FFT from either a 1024-point complex record or a 2048-point real record. Of the 1024 FFT lines, 801 are saved and displayed (the remaining 223 lines fall outside the analyzer's frequency span).

FFT^{-1}—performs an inverse fast Fourier transform (FFT) on the active trace. The resultant trace is displayed as soon as the calculation is completed. If you have performed an FFT on a time record, then transformed it back to the time domain using FFT^{-1}, the analyzer adds 223 zeros outside the frequency span to fill the 223 lines discarded by the FFT. This may have some effect on the displayed trace if the original signal had a frequency component greater than 100 kHz. FFT^{-1} is 6 – 10 dB noisier than FFT.

INTGRT—integrates the active trace. The integrated waveform is displayed as soon as the calculation is completed. INTGRT starts the integration at the first point on the X-axis. Compare this with INTGRT INIT = 0, which sets the first point in the integrated trace to zero then starts integrating at the second point. INTGRT should be used to integrate time domain traces.

INTGRT INIT = 0—integrates the active trace. The integrated waveform is displayed as soon as the calculation is completed. INTGRT INIT = 0 sets the first point to zero then starts integrating at the second point. INTGRT INIT = 0 should be used to integrate time domain traces.

$j\omega$—performs artificial differentiation by multiplying the data by $j\pi\Delta f$. This provides the frequency spectrum of the time domain derivative.

$j\omega^{-1}$—performs artificial integration by dividing the data by $j2\pi\Delta f$. This provides the frequency spectrum of the time domain integral.

LN OF DATA—calculates the natural logarithm ($\log_e$) of the active trace. The resultant trace is displayed as soon as the calculation is completed. This computes $\log_e$ of the magnitude and converts the phase to radians from degrees. The magnitude is put in the real part, and the phase is put in the imaginary part.

LN^{-1} OF DATA—calculates the antilog (e^x) of the active trace. The resultant trace is displayed as soon as the calculation is completed. This computes e^x of the magnitude and converts the phase to degrees from radians. The magnitude is assumed to be in the real part, and the phase is assumed to be in the imaginary part.

MPY—selects the multiplication operation, which requires three steps:

1. Activate trace A or trace B as the multiplicand.
2. Press **MATH**, followed by MPY, to select multiplication.
3. Select TRACE A, TRACE B, SAVED 1, SAVED 2, or a numeric constant as the multiplier. The product appears as soon as the multiplication is completed.

The multiplier choices displayed after MPY is pressed are the only ones applicable to multiplication. The factors must also be compatible; for example, a time domain trace cannot be multiplied by a frequency domain trace.

NEGATE—negates the active trace. The resultant trace is displayed as soon as the calculation is completed. This multiplies the real and imaginary parts of the data separately by –1. If you have a power spectrum displayed, for example, NEGATE has no visible effect because the two negations are cancelled when the real and imaginary parts are squared then added to produce the power spectrum display.

NEXT—displays the next level of the **MATH** menu.

REAL PART—displays the real part of complex measurement data. REAL PART differs from the REAL coordinate in that this math operation actually deletes the imaginary part of the data. If REAL PART is pressed when the active trace is real-only, there is no change to the trace.

RECIP—calculates the reciprocal of the active trace. The resultant trace is displayed as soon as the calculation is completed. Each point in the trace is divided into 1.

RETURN—redisplays the previous level of the **MATH** menu.

SAVED 1—enters the trace stored in the SAVE DATA#1 memory location for math operations. See **SAVE RECALL** for storing trace in this location.

SAVED 2—enters the trace stored in the SAVE DATA#2 memory location for math operations. See **SAVE RECALL** for storing trace in this location.

SQUARE ROOT—calculates the square root of the active trace. The resultant trace is displayed as soon as the calculation is completed. The square root of each point in the trace is calculated.

SUB—selects the subtraction operation, which requires three steps:

1. Activate trace A or trace B as the minuend.
2. Press **MATH**, followed by SUB, to select subtraction.
3. Select TRACE A, TRACE B, SAVED 1, SAVED 2, or a numeric constant as the subtrahend. The difference appears as soon as the subtraction is completed.

The subtrahend choices displayed after SUB is pressed are the only ones applicable to subtraction. The traces must also be compatible. For example, a time domain trace cannot be added to a frequency domain trace.

T/1 – T—calculates the open-loop response from a measured closed-loop frequency response. The measured closed-loop response (T) must be displayed in the active trace. T must also be positive.

TRACE A—enters the trace currently displayed in trace A for math operations.

TRACE B—enters the trace currently displayed in trace B for math operations.

MEAS DISP—displays the measurement display menus. Each measurement provides a specific group of displays, and the **MEAS DISP** menus are automatically changed to present only those displays applicable to the selected measurement. Displays can be selected before, during and after the measurement.

AUTO CORR1—selects the auto correlation display for the auto and cross correlation measurements. This display detects periodicity by multiplying the input signal by a progressively time-shifted version of itself. AUTO CORR1 is displayed when Channel 1 is active.

AUTO CORR2—selects the auto correlation display for the auto and cross correlation measurements. This display detects periodicity by multiplying the input signal by a progressively time-shifted version of itself. AUTO CORR2 is displayed when Channel 2 is active.

AUTO MATH—selects the display calculated in the auto math table. Note that if a math label has been programmed into the math table, that label replaces this softkey label.

AVRG—selects the cumulative average of all time records acquired with the current measurement for the filtered input displays. This softkey appears only when time averaging is on.

CDF1—selects the cumulative density function for the histogram measured on Channel 1. This is calculated by integrating the PDF display, and it shows the probability that a level equal to or less than a given level has occurred. This softkey appears when Channel 2 is active.

CDF2—selects the cumulative density function for the histogram measured on Channel 2. This is calculated by integrating the PDF display, and it shows the probability that a level equal to or less than the given level has occurred. This softkey appears when Channel 2 is active.

COHER—selects the coherence display. Coherence is derived from the frequency response measurement and indicates the portion of the output related to the input. Coherence is scaled from 0.0 (complete incoherence) to 1.0 (perfect, or unity, coherence). Coherence less than unity indicates the presence of extraneous noise, system nonlinearities, or unexpected input signals. At least two averages must be taken to yield a valid coherence.

CROSS CORR—selects the cross correlation display. This shows the similarity between two signals as a function of the time shift between them. This display is available with the cross correlation measurement.

CROSS SPEC—selects the cross spectrum display. This is computed by multiplying the Channel 2 linear spectrum by the complex conjugate of the Channel 2 linear spectrum.

DEMOD POLAR—This display is a plot of the tip of the carrier vector as it is being modulated. The normalized carrier vector can be thought of as extending from −100,0% to 0,0%. The origin of the display, therefore, is at the tip of the at-rest carrier vector. Phase modulation deflects the vector at angles up or down. Amplitude modulation makes the carrier vector longer or shorter. For example, a ±90 degree PM with no AM is displayed as a semicircle centered at −100,0% with radius 100% passing through 0,0% on the right side.

FILTRD INPUT—displays the filtered input menu. These displays show the input time records and linear spectra after they have been filtered to the current frequency span. This menu also provides several other displays, depending on the active mode and whether throughput and demodulation are active.

FREQ RESP—selects the frequency response display. This display shows a system's frequency response function, with frequency on the horizontal axis and gain on the vertical axis (these are the default units and coordinates; others can be selected). This display is available only with the frequency response measurement.

HIST1—selects the histogram display of the measurement on Channel 1. This shows how the amplitude of the input signal is distributed between its minimum and maximum values. This display is available with the histogram measurement when Channel 1 is active.

HIST2—selects the histogram display of the measurement on Channel 2. This shows how the amplitude of the input signal is distributed between its minimum and maximum values. This display is available with the histogram measurement when Channel 2 is active.

IMPLSE RESP—selects the impulse response display, which shows the time domain response of the system under test. Mathematically, impulse response is equal to the inverse FFT of the frequency response function.

INST—selects the most recent time record for the filtered input displays.

INST WNDOWD—displays the filtered input time record as it appears after exponential windowing. The appearance of this softkey depends on the status of time averaging and previewing; refer to the menu diagrams in Appendix D for explanations.

LINEAR SPEC 1—selects the filtered input linear spectrum on Channel 1. This display has been filtered to the current frequency span, but has not been through the measurement process. A linear spectrum is the direct result of the FFT process. A power spectrum is computed by multiplying a linear spectrum by its complex conjugate. Linear spectrum displays are not calibrated.

LINEAR SPEC 2—selects the filtered input linear spectrum on Channel 2. This display has been filtered to the current frequency span, but has not been through the measurement process. A linear spectrum is the direct result of the FFT process. A power spectrum is computed by multiplying a linear spectrum by its complex conjugate. Linear spectrum displays are not calibrated.

ORBITS T1vsT2—selects the orbits diagram, which shows the Channel 1 time domain signal on the vertical axis versus the Channel 2 time domain signal on the horizontal axis. Orbits diagrams are available only with baseband data.

PDF1—selects the probability density function display for the histogram measurement on Channel 1. Equivalent to a normalized histogram, the PDF yields the probability that a given level has occurred. This display is available only with the histogram measurement.

PDF2—selects the probability density function display for the histogram measurement on Channel 2. Equivalent to a normalized histogram, the PDF yields the probability that a given level has occurred. This display is available only with the histogram measurement.

POWER SPEC1—selects the power spectrum display for the measurement on Channel 1. This display can be derived from both the frequency response and power spectrum measurements. This softkey is displayed when Channel 1 is active.

POWER SPEC2—selects the power spectrum display for the measurement on Channel 2. This display can be derived from both the frequency response and power spectrum measurements. This softkey is displayed when Channel 2 is active.

RETURN—redisplays the **MEAS DISP** menu.

TIME REC1—displays the current time record (or the last record measured if the measurement is finished) on Channel 1. The "time record" is the amount of time required to collect enough data to perform one FFT. TIME REC 1 can be used to verify the presence of an input signal. It is also helpful when manually setting the input range. Zoomed time record displays are not calibrated, nor are time averaged time displays.

TIME REC2—displays the current time record (or the last record measured if the measurement is finished) on Channel 2. The "time record" is the amount of time required to collect enough data to perform one FFT. TIME REC 2 can be used to verify the presence of an input signal. It is also helpful when manually setting the input range. Zoomed time record displays are not calibrated, nor are time averaged time displays.

MEAS MODE—used to select the analyzer's fundamental operating mode. When a mode is selected, many of the softkey menus in the instrument are redefined to provide the best selections for that particular mode. Refer to Chapters 1 through 6 fro instructions on using each mode and the time throughput and demodulation features.

A GAIN ON OFF—activates the auto gain function in the swept sine mode and displays the A GAIN SELECT softkey. The auto gain feature adjusts the source amplitude level to maintain a constant amplitude level on the reference channel.

A GAIN SELECT—displays the auto gain select menu, which allows you to select the reference channel and set the reference level and source limit. Chapter 3 explains the operation of the auto gain feature.

ABORT CAPTUR—aborts time captures. Any complete time records in memory before the capture is aborted are still available for measurement.

ABORT THRUPT—aborts time throughput sessions. ABORT THRUPT does not preserve any data from the session.

ACTIVE FILE—used to identify the active file for throughput operations. The active file is identified once when the session is stored on disc and then again when the throughput file is recalled from the disc for measurement. Press ACTIVE FILE, then enter the file name using the alpha menu that is displayed. The active file must already exist on the disc; see CREATE THRUPT in the DISC FCTN menu to create throughput files. See the alpha menu description at the beginning of this chapter for more information on its use.

Note that "THRUPUT" is the default name for the active file. Creating a file on disc under this name saves time when identifying the active file.

ADD REGION—used to add a region to the remove frequency table. Press ADD REGION, enter the lower and upper limits separated by a comma (,) then press one of the units softkeys. Up to twenty regions can be entered in the table. They may overlap and extend outside the current frequency span.

AM CHAN 1—selects AM demodulation for Channel 1.

AM CHAN 2—selects AM demodulation for Channel 2.

AUTO CRRIER—causes the HP 3562A to automatically calculate the carrier frequency for FM and PM demodulation. If you have not entered the carrier frequency with USER CRRIER, AUTO CRRIER must be active.

CAPTUR HEADER—displays the time capture header. This shows the capture setup and relevant instrument state variables for the last capture.

CAPTUR LENGTH—used to set the length (up to 10 time records) of the time capture. The length can be set in units of time, revolutions, points or records. To determine the current time record length, look under FREQ: REC LGTH in the state display or the capture header. If the length you enter is longer than 10 records, the capture header shows the length actually achieved.

CAPTUR POINTR—enables the Entry group to move the capture pointer. The rate at which the pointer scrolls is set with POINTR INCRMT. The pointer can also be used to start the measurement at some point other than 0 seconds; move the pointer to the desired starting point before starting the measurement. Refer to Chapter 4 for additional information on the pointer and setting the starting point.

CAPTUR SELECT—displays the capture select menu, which is used to set up and start time captures. This softkey appears only when the time capture mode is active.

CHANGE REGION—used to change the edit line in the delete frequency table. Press CHANGE REGION, enter the lower and upper limits separated by a comma (,) then press one of the units softkeys.

CLEAR TABLE—clears the remove frequency table. The message "Push Again to Clear" appears so you can confirm that the table is to be cleared. Once cleared, tables cannot be recovered. However, they can be stored on disc for future use; refer to DISC.

DELETE FREQ—displays the delete frequency table and its editing menu. This table allows up to twenty regions to be deleted from the inputs before they are demodulated. The delete frequency table may be saved in disc memory for future use. To add values to the table, see ADD REGION.

DELETE ON OFF—enables or disables the delete frequency table. When this is OFF, the table is not used, but its contents are preserved.

DELETE REGION—deletes the edit line (selected with EDIT LINE#) in the delete frequency table.

DEMOD BOTH—selects a demodulation measurement on both channels and displays the demod types softkey menu. The frequency span and carrier frequency are set the same for both channels.

DEMOD CHAN 1—selects a demodulation measurement on Channel 1 and displays the demod types menu.

DEMOD CHAN 2—selects a demodulation measurement on Channel 2 and displays the demod types menu.

DEMOD ON OFF—activates demodulation and displays the DEMOD SELECT softkey. Chapter 5 has instructions for using demodulation. This softkey appears only when LINEAR RES is active.

DEMOD SELECT—displays the demodulation softkey menu, which is used to select the type of modulation, the channels, the carrier frequency and the remove frequencies. This softkey appears only when DEMOD ON OFF is ON.

EDIT LINE#—used to specify the edit line in the delete frequency table. Press EDIT LINE#, then enter the line number using the Entry group. The edit line is highlighted in the table.

FM CHAN 1—selects FM demodulation for Channel 1.

FM CHAN 2—selects FM demodulation for Channel 2.

LINEAR RES—configures the instrument to the linear resolution mode. Linear resolution provides fast Fourier transform (FFT) measurements from 0 to 100 kHz. The time throughput and demodulation features can also be used with the linear mode. This mode offers the greatest number of measurements, displays and averaging features in the instrument.

LINEAR SWEEP—selects linear frequency sweeps in the swept sine mode. This selection must be made prior to starting the sweep.

LOG RES—configures the instrument to the log resolution mode. This mode offers fast Fourier transform (FFT) measurements with a logarithmic frequency axis. The frequency response and power spectrum measurements are available in log resolution.

LOG SWEEP—selects logarithmic frequency sweeps in the swept sine mode. This selection must be made prior to starting the sweep.

PM CHAN 1—selects PM demodulation for Channel 1.

PM CHAN 2—selects PM demodulation for Channel 2.

PM/FM CRRIER—displays the PM/FM CRRIER menu, which allows you to select AUTO or USER CRRIER for FM and PM demodulation.

POINTR INCRMT—used to enter the pointer increment. This determines the resolution of the pointer and the speed at which it scrolls through the captured data. The increment can be entered in units of time, revolutions, points or records.

PRVIEW ON OFF—enables or disables demodulation previewing. Note that normal linear resolution previewing (under **AVG**) is replaced in demodulation with this previewing.

REF CHAN 1—designates Channel 1 as the reference channel for the auto gain function. The source then adjusts its amplitude to maintain the reference level (set with REF LEVEL) on Channel 1.

REF CHAN 2—designates Channel 2 as the reference channel for the auto gain function. The source then adjusts its amplitude to maintain the reference level (set with REF LEVEL) on Channel 2.

REF LEVEL—used to enter the reference level for the auto gain function. This is the level the source maintains on the reference channel. The level may be set from 5 millivolts to 31.5 volts, using the Entry group.

RETURN—redisplays the previous menu.

SOURCE LIMIT—used to set a limit on the source level for auto gain. This limits the level to which auto gain may raise the source level in attempting to maintain the reference level. SOURCE LIMIT can be set from 5mV to 5V. Note that the source limit does not guarantee any limit on the output of a device under test. Auto gain predicts the future response of the system and attempts to maintain the reference level, but a narrow resonant peak may escape predetection. Take this into consideration when measuring devices with potentially high amplitude responses at resonant frequencies.

START CAPTUR—starts the time capture using the current capture setup. The ABORT CAPTUR softkey may be used to abort the capture before it is completed. When the capture is finished, the screen shows the entire capture block compressed to one display. The HP 3562A compresses the block by selecting the points containing the most information.

START THRUPT—starts a time throughput session using the current throughput setup. The TALK and LISTEN indicators in the HP-IB group alternately flash during the throughput to disc.

SWEPT SINE—selects the swept sine mode and displays the LINEAR SWEEP, LOG SWEEP and A GAIN ON OFF softkeys. This mode steps a sine wave over a given frequency span while measuring the frequency response at each point. The swept sine mode offers auto gain, auto averaging and auto resolution; refer to Chapter 3 for details.

THRUPT HEADER—displays the throughput header, which shows the throughput setup and relevant instrument state variables for the last session.

THRUPT LENGTH—used to set the length of the next throughput session. The only limit on length is that it cannot exceed the size of the throughput file identified as the active file. The length may be set in time, revolutions, points, orders or records. Note that two-channel throughputs require twice the file size of single-channel throughputs with the same number of records.

THRUPT ON OFF—activates time throughput and displays the THRUPT SELECT softkey. Throughput allows you to digitize the input signals and store the digital data directly to disc memory. Disc files can later be measured and analyzed using the linear and log resolution modes.

THRUPT SELECT—displays the throughput selection menu, which is used to set the session length, identify the active file, view the header and start the session. This softkey appears only when THRUPT ON OFF is ON.

TIME CAPTUR—configures the instrument to the time capture mode and displays the CAPTUR SELECT softkey. Time capture allows up to 10 time records (20, 480 samples) of input data to be sampled, digitized and stored in the instrument's internal memory for future measurement and analysis. The time capture menu is used to set the capture length, start the capture, view the header and use the pointer.

USER CRRIER—allows you to set the carrier frequency to be used in PM and FM demodulation. Entering a carrier frequency with USER CRRIER deactivates AUTO CRRIER. The carrier frequency must be inside the current frequency span; the default is 50 kHz.

MEASUREMENT Group—this group of keys is used to set up measurements. The lower subgroup of six keys labeled "Input Setup" is used to configure the two input channels. All the keys in this group control pre-processing and/or measurement; consequently, they must be used before measurements are started. They have no effect on data already measured.

MEASURING (indicator)—this LED indicates when the HP 3562A is measuring data, either input signals or digital data from disc or capture memory.

NO—represents either "NO" or "0." When the instrument needs a yes or no answer during previewing, this key is automatically converted to NO. Otherwise, it represents 0. Previewing is available in the **AVG** menu while in the linear resolution mode; Chapter 1 has instructions on its use.

OPERATORS Group—this group of keys operate on measured data (math, auto math, and curve fitting) or created data (synthesis).

OVER RANGE (indicators)—these LEDs indicate when the input signal level on the respective channel is exceeding the input range. When this occurs, distortion results and measurement quality is degraded. The ideal input range is achieved when HALF RANGE is on and OVER RANGE is off. See Chapter 7 for information on setting the input range or using autoranging.

PAUSE CONT—when pressed once, this pauses the measurement in progress. The measurement is then continued when **PAUSE CONT** is pressed again. If averaging is active, the measurement pauses at the completion of the current average. If the measurement is continued, it resumes with the next average.

This key can also be used to change the number of averages after a measurement is started. Press **PAUSE CONT**, enter the new number of averages with the **AVG** menu, then press **PAUSE CONT** again. Changing modes does not affect the status of **PAUSE CONT**.

PLOT—displays the plot menu, which allows you to select the following:

Combination of data, annotation and grid

Pen numbers

Line types

Paging control

Plot limits

The HP 3562A offers direct control of HP-IB compatible digital plotters equipped with Hewlett-Packard Graphics Language (HP-GL). The plot softkeys provide control of many plotting variables; however, plotting can be as simple as pressing PLOT PRESET and START PLOT.

ABORT HP-IB—aborts HP-IB operations.

ANNOT A PEN—used to define the pen number for use in plotting the annotation associated with trace A. The pen number can range from 0 to the maximum number of pens allowed by the plotter.

ANNOT B PEN—used to define the pen number for use in plotting the annotation associated with trace B. The pen number can range from 0 to the maximum number of pens allowed by the plotter.

CUT PG ON OFF—enables the page cutting features on plotters so equipped. Defaults to off at power-on and after reset and plot preset. Note that if page cutting is active, pages are cut after the plot is finished.

DASHED LINES—selects dashed lines for use in plotting the display. The default selection at power-on and after reset and plot preset is SOLID LINES.

DATA & ANNOT—causes both the data traces and the alphanumeric annotation to be plotted when START PLOT is pressed. Pressing this also displays the three grid selection softkeys. This is the default selection at power-on and after reset and plot preset.

DATA ONLY—causes just the data trace(s), without the alphanumeric annotation or the grid, to be plotted when START PLOT is pressed.

DFAULT GRIDS—causes the grids to be plotted exactly as they appear on the display.

DFAULT LIMITS—uses the plotter's P1 and P2 locations to define the boundary of the plot. P1 is the lower left corner, and P2 is the upper right corner.

DOTS—selects dotted lines for use in plotting the display. The default selection at power-on and after reset and plot preset is SOLID LINES.

GRID AREA—expands the grid area so that it will be plotted in the same area as the entire screen is plotted with PLOT AREA. This is helpful when plotting data traces on preprinted graph paper.

GRID PEN—used to select the pen number for plotting the grid. This number can range from 0 to the maximum number of pens allowed by the plotter being used. Refer to the plotter's manual for its response to invalid pen numbers.

LINE A TYPE#—used to enter a line type for plotting trace A. The line type is composed of the pattern number and an optional pattern type, which must be separated by a comma. Refer to your plotter's programming manual for more information.

LINE B TYPE#—used to enter a line type for plotting trace B. The line type is composed of the pattern number and an optional pattern type, which must be separated by a comma. Refer to your plotter's programming manual for more information.

LINE TYPES—displays the line types menu; you can choose one of the four predefined lines or customize plots with user-defined lines.

MARKER PEN—used to select the pen number for plotting the markers. This number can range from 0 to the maximum number of pens allowed by the plotter being used. Refer to the plotter's manual for its response to invalid pen numbers.

NO PAGING—disables the paging feature on plotters so equipped. Plotters without paging ignore this command.

PAGE BACK—enables the plotter page back feature. This softkey is applicable only to plotters that offer the page back feature, and is ignored by all others.

PAGE FORWRD—enables the plotter page forward feature. This softkey is applicable only to roll and sheet-feed plotters that offer automatic page feeding; it is ignored by all others.

PAGING CONTRL—displays the paging control menu, which is used to select paging and page cutting.

PLOT AREA—causes the entire screen, including all annotation, to be plotted. This is the normal mode for plotting.

PLOT LIMITS—displays the plot limits menu, which is used to select plot or grid area and user-defined or default limits. The aspect ratio of the HP 3562A's display is 4.9:3.7 (X:Y).

PLOT PRESET—presets all plot variables to the following default conditions:

SELECT DATA—DATA & ANNOT, DEFAULT GRIDS

SELECT PENS—Pen #1 for grid, trace A & its annotation
—Pen #2 for markers, trace B & its annotation

SPEED—Fast

LINE TYPES—SOLID LINES

PAGING CONTRL—NO PAGING, CUT PG OFF

PLOT LIMITS—PLOT AREA, DFAULT LIMITS, ROT 90 OFF

PLOT PRESET does not affect the rest of the instrument setup state.

READ PEN → P1—reads the plotter's current pen location into the HP 3562A's P1.

READ PEN → P2—reads the plotter's current pen location into the HP 3562A's P2.

RETURN—redisplays the **PLOT** menu.

ROT 90 ON OFF—causes the plot to be rotated 90 degrees. This redefines P1 as the upper left corner and P2 as the lower right corner. The aspect ratio is reversed to 3.7:4.9 (X:Y).

SELECT DATA—displays the select data menu, which is used to select the combination of data trace, annotation and grid to be plotted.

SELECT PENS—displays the select pens menu, which is used to select the pens for plotting the traces, annotation and grids. A pen number of zero forces the plotter to replace the pen, which can be used to selectively not plot parts of the display.

SET P1 LWR LF—used to specify the location of P1, normally the lower left corner of the plot. When USER LIMITS is active, the plotter uses the HP 3562A's definition of the P1 location, not its own. The P1 location is entered as an X,Y coordinate pair separated by a comma. Refer to the plotter's HP-GL instructions for more information. Note that defining P1 as the upper left corner and P2 as the lower right corner produces a mirror image of the display. This can be useful for making overhead transparencies.

SET P2 UPR RT—used to specify the location of P2, normally the upper right corner of the plot. When USER LIMITS is active, the plotter uses the HP 3562A's definition of the P2 location, not its own. The P2 location is entered as an X,Y coordinate pair separated by a comma. Refer to the plotter's HP-GL instructions for more information. Note that defining P1 as the upper left corner and P2 as the lower right corner produces a mirror image of the display. This can be useful for making overhead transparencies.

SOLID GRIDS—causes the grid to be plotted with solid lines, regardless of the displayed grids. For example, this plots the dashed vertical lines in log resolution displays as solid lines.

SOLID LINES—selects solid lines for plotting the display. This is the line type at power-on and after reset and plot preset.

SOLIDA DASHB—selects a solid line for trace A and a dashed line for trace B. The default selection is SOLID LINES.

SPEED F S—selects fast or slow plotting. The fast rate is the default speed for the plotter (usually 36 cm/s), while the slow rate is 5 cm/s. Fast is the default selection at power-on and after reset and plot preset. The slow speed is generally used when plotting on transparencies or when the fast speed causes the pens to skip.

START PLOT—plots the information on the display. Once a plot has been started, it may be stopped by pressing ABORT PLOT, which is displayed while the plot is in progress.

TICK MARKS—plots short tick marks on the grid axes in place of the horizontal and vertical grid lines.

TRACE A PEN—used to select the pen number for plotting Trace A. The pen number is limited only by the number of pens in the attached plotter. Refer to your plotter's manual for its response to invalid pen numbers.

TRACE B PEN—used to select the pen number for plotting Trace B. The pen number is limited only by the number of pens in the attached plotter. Refer to your plotter's manual for its response to invalid pen numbers.

USER LIMITS—displays the user limits menu and disables the default limits. User limits allow you to set the P1 and P2 locations using the HP 3562A. Once you redefine the pen locations using this menu, these locations become the plotter's locations. This effectively sets DFAULT LIMITS equal to USER LIMITS.

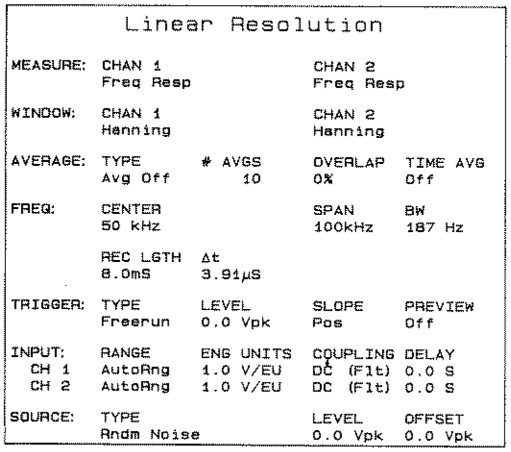
USER LINES—displays the LINE A TYPE# and LINE B TYPE# softkeys, which are used to define custom line types.

PRESET—presets the instrument to the current mode and displays the special preset menu. A complete reset to power-on conditions is performed by pressing the RESET softkey in this menu. Pressing the green **PRESET** key is similar, but it does not change the measurement mode. The **PRESET** offers the following special presets:

Frequency Response—linear resolution
Frequency Response—log resolution
Frequency Response—swept sine
Power Spectrum—linear resolution
Time Throughput—linear resolution
Time Capture
Reset

Refer to each softkey's description for a plot of its setup state.

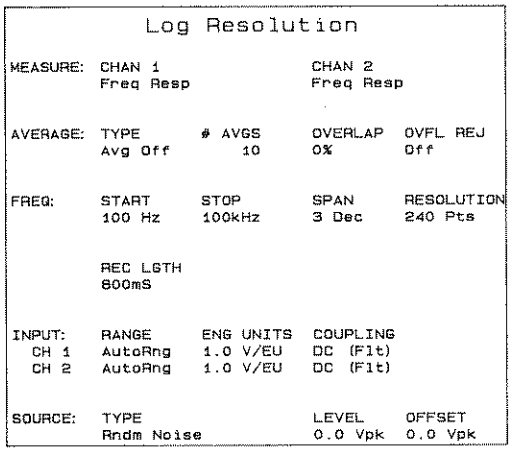
F RESP LINRES—Presets the instrument to the frequency response measurement in the linear resolution mode. Figure 12-2 shows the instrument state display.



```
                Linear Resolution

MEASURE:  CHAN 1                     CHAN 2
          Freq Resp                  Freq Resp

WINDOW:   CHAN 1                     CHAN 2
          Hanning                    Hanning

AVERAGE:  TYPE        # AVGS         OVERLAP   TIME AVG
          Avg Off         10         0%        Off

FREQ:     CENTER                     SPAN      BW
          50 kHz                     100kHz    187 Hz

          REC LGTH    Δt
          8.0mS       3.91µS

TRIGGER:  TYPE        LEVEL          SLOPE     PREVIEW
          Freerun     0.0 Vpk        Pos       Off

INPUT:    RANGE       ENG UNITS      COUPLING  DELAY
  CH 1    AutoRng     1.0 V/EU       DC  (Flt) 0.0 S
  CH 2    AutoRng     1.0 V/EU       DC  (Flt) 0.0 S

SOURCE:   TYPE                       LEVEL     OFFSET
          Rndm Noise                 0.0 Vpk   0.0 Vpk
```

Figure 12-2 Frequency Response (linear resolution) Preset

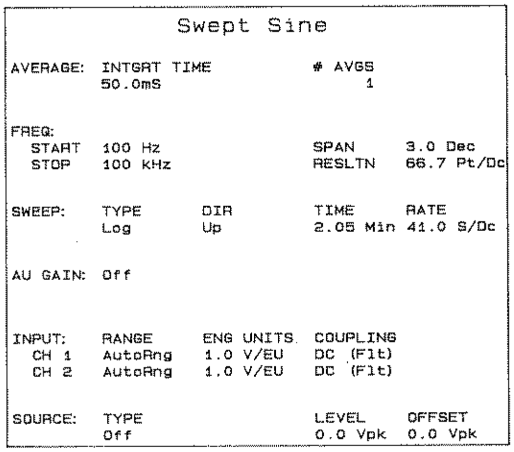
F RESP LOGRES—Presets the instrument to the frequency response measurement in the log resolution mode. Figure 12-3 shows the instrument state display.



```
                 Log  Resolution

MEASURE:  CHAN 1                    CHAN 2
          Freq Resp                 Freq Resp


AVERAGE:  TYPE        # AVGS        OVERLAP   OVFL REJ
          Avg Off         10        0%        Off


FREQ:     START       STOP          SPAN      RESOLUTION
          100 Hz      100kHz        3 Dec     240 Pts


          REC LGTH
          800mS


INPUT:    RANGE       ENG UNITS     COUPLING
  CH 1    AutoRng     1.0 V/EU      DC  (Flt)
  CH 2    AutoRng     1.0 V/EU      DC  (Flt)


SOURCE:   TYPE                      LEVEL     OFFSET
          Rndm Noise                0.0 Vpk   0.0 Vpk
```

Figure 12-3 Frequency Response (log resolution) Preset

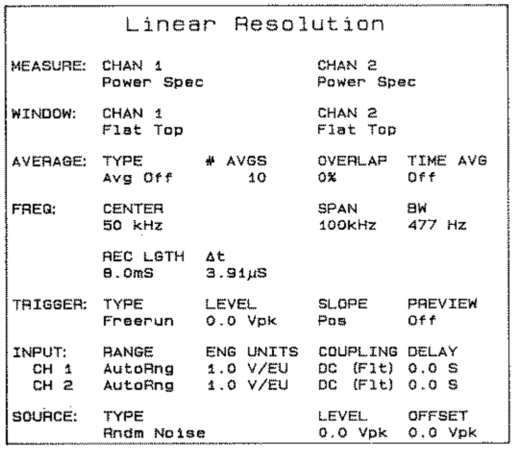
F RESP SWEPT—Presets the instrument to the frequency response measurement in the swept sine mode. Figure 12-4 shows the instrument state display.



```
                    Swept  Sine

AVERAGE:  INTGRT TIME               # AVGS
          50.0mS                         1


FREQ:
  START   100 Hz                    SPAN      3.0 Dec
  STOP    100 KHz                   RESLTN    66.7 Pt/Dc


SWEEP:    TYPE        DIR           TIME      RATE
          Log         Up            2.05 Min  41.0 S/Dc


AU GAIN:  Off



INPUT:    RANGE       ENG UNITS     COUPLING
  CH 1    AutoRng     1.0 V/EU      DC  (Flt)
  CH 2    AutoRng     1.0 V/EU      DC  (Flt)


SOURCE:   TYPE                      LEVEL     OFFSET
          Off                       0.0 Vpk   0.0 Vpk
```

Figure 12-4 Frequency Response (swept sine) Preset

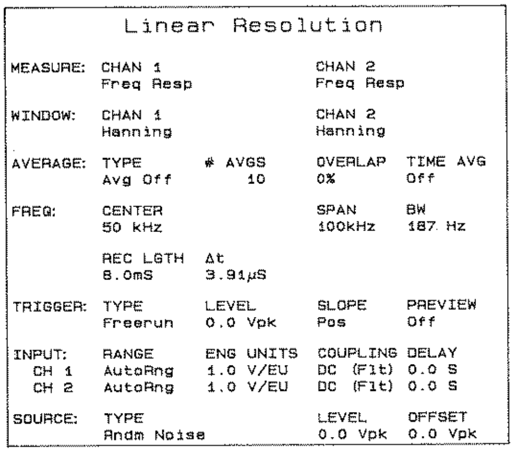
P SPEC LINRES—Presets the instrument to the power spectrum measurement in the linear resolution mode. Both channels are active and the flat top window is selected. Figure 12-5 shows the instrument state display.



```
                Linear Resolution

MEASURE:  CHAN 1                      CHAN 2
          Power Spec                  Power Spec

WINDOW:   CHAN 1                      CHAN 2
          Flat Top                    Flat Top

AVERAGE:  TYPE        # AVGS          OVERLAP   TIME AVG
          Avg Off        10           0%        Off

FREQ:     CENTER                      SPAN      BW
          50 kHz                      100kHz    477 Hz

          REC LGTH    Δt
          8.0mS       3.91μS

TRIGGER:  TYPE        LEVEL           SLOPE     PREVIEW
          Freerun     0.0 Vpk         Pos       Off

INPUT:    RANGE       ENG UNITS       COUPLING  DELAY
  CH 1    AutoRng     1.0 V/EU        DC (Flt)  0.0 S
  CH 2    AutoRng     1.0 V/EU        DC (Flt)  0.0 S

SOURCE:   TYPE                        LEVEL     OFFSET
          Rndm Noise                  0.0 Vpk   0.0 Vpk
```

Figure 12-5 Power Spectrum (linear resolution) Preset

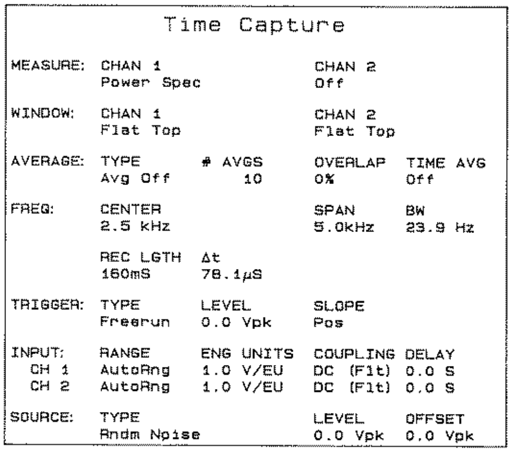
RESET—Resets the instrument to its power-on default conditions. Figure 12-6 shows the reset instrument state display and additional default conditions. RESET also clears the analyzer's HP-IB command buffer and stops any running auto sequence.



```
                Linear Resolution

MEASURE:  CHAN 1                      CHAN 2
          Freq Resp                   Freq Resp

WINDOW:   CHAN 1                      CHAN 2
          Hanning                     Hanning

AVERAGE:  TYPE        # AVGS          OVERLAP   TIME AVG
          Avg Off        10           0%        Off

FREQ:     CENTER                      SPAN      BW
          50 kHz                      100kHz    187 Hz

          REC LGTH    Δt
          8.0mS       3.91μS

TRIGGER:  TYPE        LEVEL           SLOPE     PREVIEW
          Freerun     0.0 Vpk         Pos       Off

INPUT:    RANGE       ENG UNITS       COUPLING  DELAY
  CH 1    AutoRng     1.0 V/EU        DC (Flt)  0.0 S
  CH 2    AutoRng     1.0 V/EU        DC (Flt)  0.0 S

SOURCE:   TYPE                        LEVEL     OFFSET
          Rndm Noise                  0.0 Vpk   0.0 Vpk
```

Figure 12-6 RESET Default Conditions

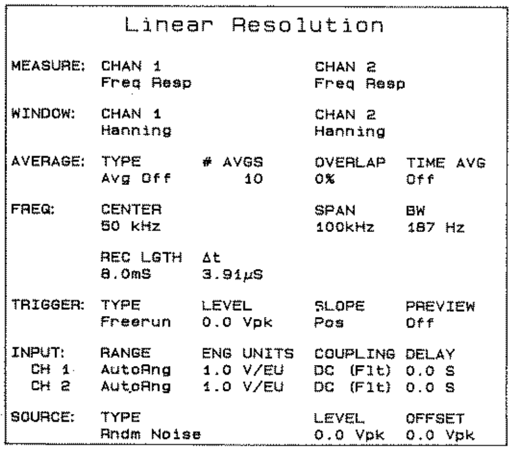
TIME CAPTUR—Presets the instrument to the time capture mode and sets up a 10-record capture on Channel 1, from 0 to 5 kHz. Figure 12-7 shows the instrument state display.



```
                 Time Capture

MEASURE:  CHAN 1                     CHAN 2
          Power Spec                 Off

WINDOW:   CHAN 1                     CHAN 2
          Flat Top                   Flat Top

AVERAGE:  TYPE        # AVGS         OVERLAP   TIME AVG
          Avg Off        10          0%        Off

FREQ:     CENTER                     SPAN      BW
          2.5 kHz                    5.0kHz    23.9 Hz

          REC LGTH    Δt
          160mS       78.1µS

TRIGGER:  TYPE        LEVEL          SLOPE
          Freerun     0.0 Vpk        Pos

INPUT:    RANGE       ENG UNITS      COUPLING  DELAY
  CH 1    AutoRng     1.0 V/EU       DC (Flt)  0.0 S
  CH 2    AutoRng     1.0 V/EU       DC (Flt)  0.0 S

SOURCE:   TYPE                       LEVEL     OFFSET
          Rndm Noise                 0.0 Vpk   0.0 Vpk
```

Figure 12-7 Time Capture Preset

TIME THRUPT—Presets the instrument to the linear resolution mode and activates time throughput. The power spectrum measurement is selected and both channels are active. Fiqure 12-8 shows the instrument state.



```
              Linear Resolution

MEASURE:  CHAN 1                     CHAN 2
          Freq Resp                  Freq Resp

WINDOW:   CHAN 1                     CHAN 2
          Hanning                    Hanning

AVERAGE:  TYPE        # AVGS         OVERLAP   TIME AVG
          Avg Off        10          0%        Off

FREQ:     CENTER                     SPAN      BW
          50 kHz                     100kHz    187 Hz

          REC LGTH    Δt
          8.0mS       3.91µS

TRIGGER:  TYPE        LEVEL          SLOPE     PREVIEW
          Freerun     0.0 Vpk        Pos       Off

INPUT:    RANGE       ENG UNITS      COUPLING  DELAY
  CH 1    AutoRng     1.0 V/EU       DC (Flt)  0.0 S
  CH 2    AutoRng     1.0 V/EU       DC (Flt)  0.0 S

SOURCE:   TYPE                       LEVEL     OFFSET
          Rndm Noise                 0.0 Vpk   0.0 Vpk
```

Figure 12-8 Time Throughput Preset

RANGE—displays the range menu, which is used to select autoranging or manual ranging for each input channel. Setting the input range is critical for making distortion-free measurements with optimum sensitivity and amplitude resolution. The range should be set at such a level that the input signal stays in the top half of the range. Autoranging automatically ensures the proper range setting. When using manual ranging, set the range so that the HALF RANGE indicator is on, but OVER RANGE is not.

AUTO 1 RNG UP—selects autoranging for Channel 1. This continually monitors and adjusts the input range to ensure that the signal level is at least half-scale but not greater than full-scale. Autoranging does not interrupt averaged measurements, time captures or time throughputs. AUTO 1 RNG UP allows autoranging to increase the range only. This is useful for measuring transients, performing impact testing, and when using random noise.

AUTO 1 UP&DWN—selects autoranging for Channel 1 (refer to AUTO 1 RNG UP for a description). This differs from AUTO 1 RNG UP in that this allows autoranging to adjust the range in either direction. Autoranging up/down is incompatible with sources and signals that are intentionally off for some part of the time record (e.g., bursts and impacts).

AUTO 2 RNG UP—selects autoranging for Channel 2. This continually monitors and adjusts the input range to ensure that the signal level is at least half-scale but not greater than full-scale. Autoranging does not interrupt averaged measurements, time captures or time throughputs. AUTO 2 RNG UP allows autoranging to increase the range only. This is useful for measuring transients, performing impact testing, and when using random noise.

AUTO 2 UP&DWN—selects autoranging for Channel 2 (refer to AUTO 2 RNG UP for a description). This differs from AUTO 2 RNG UP in that this allows autoranging to adjust the range in either direction. Autoranging up/down is incompatible with sources and signals that are intentionally off for some part of the time record (e.g., bursts and impacts).

CHAN 1 RANGE—used to manually set the input range for Channel 1. The range can be set anywhere from – 51 dBV (3.972 mVpk) to + 27 dBV (31.547 Vpk).

CHAN 2 RANGE—used to manually set the input range for Channel 2. The range can be set anywhere from – 51 dBV (3.972 mVpk) to + 27 dBV (31.547 Vpk).

REF IN (connector)—used to phase-lock the HP 3562A to an external clock signal. This reference input replaces the internal 20.48 MHz clock. The signal frequency must be at 1, 2, 5, or 10 Mhz ±0.01%. The signal level must be between 0 and 20 dBm. This is a 50Ω input.

REMOTE (indicator)—indicates when the HP 3562A is in the HP-IB remote mode. In this mode, the instrument is under the control of an external controller on the HP-IB. When REMOTE is on, all keys and softkeys (except the **LOCAL** key) are disabled. Pressing **LOCAL** returns front panel control. However, if a controller has issued the HP 3562A the LOCAL LOCKOUT command, **LOCAL** is disabled, and remains so until the controller issues the GO TO LOCAL command.

SAVE RECALL—displays the menu for saving and recalling states and traces in the HP 3562A's internal memory. Five instrument states and two data traces may be saved. In addition, the power-down state is automatically saved. All five states, the power-down state, and saved data #1 are stored in nonvolatile memory and are not erased when power is removed.

RECALL DATA#—used to recall a saved data trace from the HP 3562A's internal memory. Press RECALL DATA#, enter the number (1 or 2) under which the trace was saved, and press ENTER. The display is recalled into the active trace.

RECALL PWR DN—restores the state the instrument was in when power was removed. Because reapplying power resets the instrument to its default values, this feature allows you to restore a state lost when power is removed.

RECALL STATE#—used to recall a saved instrument state from the HP 3562A's internal memory. Press RECALL STATE, enter the number (from 1 to 5) under which the state was saved, then press ENTER. The instrument is immediately configured to that instrument state.

SAVE DATA#—used to save a data trace in the HP 3562A's internal memory. Press SAVE DATA#, enter the number (1 or 2) under which the trace is to be saved, and press ENTER. Note that only saved data #1 is stored in nonvolatile memory; #2 is erased when power is removed. When the display is in the upper/lower or front/back formats, only trace A is saved. Time capture buffers and demod preview displays cannot be saved in local memory.

SAVE STATE#—used to save an instrument state in the HP 3562A's internal memory. Press SAVE STATE#, enter the number (from 1 to 5) under which the state is to be saved, then press ENTER. All 5 of these states are stored in nonvolatile memory. Table 12-2 shows the parameters saved when an instrument state is saved.

SCALE—displays the scale menu, which is used to specify the horizontal and vertical display scales or to select autoscaling. Chapter 8 offers more information on the display scaling features.

X AUTO SCALE—selects X autoscaling, which sets the horizontal axis to one of three scales:

1. To the frequency span (for frequency domain displays)
2. To the time record length (for time domain displays)
3. To the input range (for amplitude domain displays)

Pressing this softkey also activates the autoscaling mode, which automatically adjusts the scale when the span, record length, or range is changed. Autoscaling remains active until one of the other X scaling softkeys is pressed. The Nichols, Nyquist, orbits and phase displays have special scaling; refer to Chapter 8 for more information on these. This softkey appears in both the **X** and **SCALE** menus for convenience. To fix a scale defined by auto scaling, press X FIXD SCALE.

X FIXD SCALE—used to specify the horizontal scale. Enter the lower and upper frequencies separated by a comma (,) then press one of the units softkeys. A single entry sets the right side of the scale and uses the previous width to determine the left side. You can also press this to fix a scale defined by autoscaling.

X MRKR SCALE—changes the horizontal scale to the scale currently outlined by the X marker band. The X marker must be active and in one of the hold modes. This softkey appears in both the **X** and **SCALE** menus for convenience.

Y AUTO SCALE—activates the Y autoscaling mode, which checks the active trace every time it is changed or updated to ensure that the vertical scale is providing the optimum display. Autoscaling remains active until one of the other Y scaling keys is pressed. The Nichols, Nyquist, orbits and phase displays have special scaling; refer to Chapter 8 for more information. To fix a scale defined by autoscaling, press Y FIXD SCALE.

Y DFLT SCALE—selects the Y default scale, which is defined by the current input range, amplitude units, and measurement display.

Y FIXD SCALE—used to specify the vertical scale. Enter the minimum and maximum values separated by a comma (,) then press one of the units softkeys. A single entry sets the top of the scale and uses the previous height to determine the bottom. You can also press this to fix a scale defined by autoscaling.

Y MRKR SCALE—changes the vertical scale to the range currently defined by the Y marker. The Y marker must be active and in one of the hold modes. This softkey is duplicated in the **Y** menu for convenience.

SELECT MEAS—displays the measurement selection menus, which offer these measurements:

Linear Resolution Mode: Frequency Response, Power Spectrum, Auto Correlation, Cross Correlation and Histogram

Log Resolution Mode: Frequency Response and Power Spectrum

Swept Sine Mode: Frequency Response

Time Capture Mode: Power Spectrum, Auto Correlation and Histogram

These menus depend on the mode previously selected. Each menu displays only the allowed measurement choices for the current mode. Note that the measurement and active channel must be selected before averaged measurements are started. The measurement are further described where they appear in Chapters 1 through 4.

AUTO CORR—selects the auto correlation measurement. This indicates the periodicity in a signal by multiplying it by a continuously time-shifted version of itself. It is a single-channel measurement, and can be performed independently on both channels in the linear resolution mode.

CH 1&2 ACTIVE—activates both channels. The selected measurement is made on both channels if this softkey is active. If a dual-channel measurement is selected, both channels are automatically activated.

CH 1 ACTIVE—activates Channel 1, which causes the selected measurement to be performed on Channel 1 only.

CH 2 ACTIVE—activates Channel 2, which causes the selected measurement to be performed on Channel 2 only.

CROSS CORR—selects the cross correlation measurement. This shows the similarity between two signals as a function of the time shift between them. Because it is a dual-channel measurement, both channels are activated when it is selected.

FREQ RESP—selects the frequency response measurement. This indicates the gain and phase shift of the system under test. In the HP 3562A, Channel 1 measures the system's input, and Channel 2 measures its output. Because this is a dual-channel measurement, both channels are activated when it is selected.

HIST—selects the histogram measurement. This shows how the input signal's amplitude is distributed between its minimum and maximum values. It is a single-channel measurement, and can be performed independently on both channels in the linear resolution mode. The accuracy and resolution of the histogram is dependent on frequency span, record length and number of averages.

POWER SPEC—selects the power spectrum measurement. This shows how the input signal's power is distributed in the frequency spectrum. It is a single-channel measurement, and can be performed independently on both channels in the linear resolution mode.

SELECT TRIG—displays the trigger selection menu. This specifies the type of triggering and the trigger conditions. See the descriptions for each of the triggering types in this menu for more information. Delayed triggering is selected with the **TRIG DELAY** menu.

ARM AU MAN—selects auto or manual arming. In auto arm, the instrument automatically triggers when the level and slope conditions on the trigger signal have been met. Manual arming requires that **ARM** in the Status group be pressed before the instrument looks for the trigger signal. Once **ARM** has been enabled and the conditions are met, one time record is collected. The instrument then waits for **ARM** to be pressed again. The trigger signal conditions are level (defined by TRIG LEVEL) and slope (specified by SLOPE + −). Free run always overrides manual arm.

CHAN 1 INPUT—designates the signal on the Channel 1 input as the trigger signal. The instrument triggers when this signal meets the level and slope requirements, as defined by TRIG LEVEL and SLOPE + −.

CHAN 2 INPUT—designates the signal on the Channel 2 input as the trigger signal. The instrument triggers when this signal meets the level and slope requirements, as defined by TRIG LEVEL and SLOPE + −.

EXT—designates the signal present at the EXT TRIGGER input as the trigger signal. The instrument triggers when this signal meets the level and slope requirements, as defined by TRIG LEVEL and SLOPE + −. The signal at this input is limited to ±10V; the input impedance is typically 50 kΩ ±5%.

FREE RUN—selects the free run triggering mode. In free run, the instrument collects the next time record as soon as the current one is full, without waiting for a trigger signal.

SLOPE + −—determines whether the instrument triggers on the positive or negative transition of the trigger signal through the specified level.

SOURCE TRIG—selects source triggering, which causes the measurement to trigger on an internal signal synchronized to the source. This source synchronization signal is available at the rear panel SYNC OUT connector.

TRIG LEVEL—used to specify the amplitude level at which the HP 3562A triggers off the trigger signal. Press TRIG LEVEL and enter the level using the Entry group. The allowable range of trigger level entries is determined by the current input range for input channel triggering. If a value greater than the range for the trigger channel is entered, the level is set to the input range value. For external triggering, the level is limited to ± 10V. For source triggering and free run, the trigger level is irrelevant.

SINGLE—puts the active trace into the single display format. If both traces are active, trace A is displayed.

SOURCE—displays the source menu, which is used to set the source amplitude and select the type of source signal. The measurement modes offer these source outputs:

Linear Resolution Mode:	Random Noise, Burst Random, Burst Chirp, Periodic Chirp and Fixed Random
Log Resolution Mode:	Random Noise and Fixed Sine
Swept Sine Mode:	Sine Sweeps (up, down, hold and manual)
Time Capture Mode:	Random Noise, Burst Random, Burst Chirp, Periodic Chirp and Fixed Random

The source is band-limited at spans $\geq$ 160 mHz. At power-on and after reset, the source selection is random noise at 0V. See the **SPCL FCTN** menu for the source protection feature. In external sampling, the source tracks the sampling frequency.

BURST CHIRP—outputs a frequency chirp for the specified portion of the time record. The burst chirp is a fast sine sweep over the current frequency span that repeats with the same period as the time record. The burst percentage —from 1 to 99% of the time record—is specified with the Entry Group. If the response of the device under test decays to zero before the end of the time record, no windowing is required with the burst chirp.

BURST RANDOM—outputs a true random noise burst for the specified portion of the time record. The burst percentage—from 1 to 99% of the time record—is specified with the Entry Group. If the response of the device under test decays to zero before the end of the time record, no windowing is required with burst random.

DC OFFSET—used to add positive or negative dc offsets to the source output. The offset is limited to 10V minus the source level. Precede negative entries with the – key in the Entry group.

FIXED SINE—provides a constant-frequency sine wave. The frequency is entered with the Entry group after FIXED SINE is pressed. The limits are 64 µHz and 100 kHz, and the default frequency is 125 Hz.

MANUAL SWEEP—selects manual sweep and activates the Entry group to move the sweep marker. This allows you to move the sweep to any point on the display. The manual sweep measures using the number of averages selected, then averages successive measurements. This differs from sweep hold, which calculates the selected number of averages, then erases this result and restarts the average.

PRIODC CHIRP—selects the periodic chirp output. The periodic chirp is a fast sine sweep across the current frequency span that repeats with the same period as the time record. Note that the effect of the periodic chirp is similar to a pseudo random noise source, except that the chirp has a much higher peak-to-rms ratio. The periodic chirps set the center frequency to the nearest Δf.

RANDOM NOISE—selects the true random noise source output. Random noise yields a fast, linear estimate of the system under test. Because it is not periodic in the time record, random noise requires windowing (usually the Hanning; see **WINDOW**).

SOURCE LEVEL—used to set the amplitude level of the source. The maximum source level is ±5.0V; the maximum combined source level and dc offset is ±10V. The maximum current is 50 mA. For the noise outputs, setting the source level in volts^{peak} sets the highest likely noise level.

SOURCE OFF—deactivates the source output. Note that at power-on and after reset, the source is turned on but its level is set at 0 volts. This softkey actually turns off all source selections, regardless of the current level.

SOURCE ON OFF—controls the source in the swept sine mode. The source is always off when you enter the swept sine mode.

SWEEP DOWN—causes the measurement to sweep downward from the current measurement point to the specified start frequency. If the sweep is already at the start frequency, the instrument takes one measurement at that point and then stops.

SWEEP HOLD—halts the sweep without stopping the measurement. When this is pressed, the HP 3562A continues to measure at the point where the sweep stopped. The display is updated as each average is calculated, but the accumulated average is erased at the end of each measurement.

SWEEP UP—causes the measurement to start sweeping upward, from the current measurement point to the specified stop frequency. If the sweep is already at the stop frequency, the instrument starts measuring at that point without sweeping.

SWEEP RATE—used to enter the sweep rate for swept sine measurements. Sweep rate and resolution are inversely proportional; changing one automatically changes the other. Press SWEEP RATE, then enter the rate using one of the units softkeys that appear. Note that this softkey appears in both the **FREQ** and **SOURCE** menus.

SOURCE (connector)—provides the source output signal. The source's output impedance is 50 Ω (nominal). The maximum current is 50 mA.

SOURCE (indicator)—this LED indicates when the source output is active. For the burst output types, the LED can be active when no signal is actually present at the output.

SPCL FCTN—displays the special functions menu, which provides the following:

Self Test

Service Tests

Non-real Time Clock

Beeper Control

Source Protection

Power-on SRQ

BEEPER ON OFF—controls the beeper. This selection defaults to ON at power-up and after reset.

DATE D,M,Y—used to enter the date of the non-real time clock, which is used when cataloging files on disc. Enter the date as dd,mm,yy. Leap years and month length are automatically accounted for. The date is stored in nonvolatile memory and is not affected by power-down or reset.

PROTCT ON OFF—controls source protection. When protection is on, the source is affected in several ways. If the measurement mode is changed, the source level returns to 0V. The source also turns off if the source output type is changed (e.g., random noise to fixed sine). Finally, with source protection you can specify the rate at which the level changes, whether it is between the present level and zero or between the present level and a new level. This time is entered with the RAMP TIME softkey. Changing the source level with the entry knob overrides source protect.

PwrSRQ ON OFF—when this is on, the instrument outputs an SRQ to the HP-IB when power is switched on. For instructions on handling the SRQ, refer to the *HP 3562A Programming Manual.* The state of this softkey is saved in non-volatile memory and is not affected by power-down or reset.

RAMP TIME—allows you to enter the ramp time for source protection. This is the time the source takes to change levels, either from the present level to zero or from the present level to another level, when source protection is on. Press RAMP TIME and enter the time using the Entry group and the units menu that is displayed. In the swept sine mode, ramp time is a volts/second slope, not an absolute time.

RETURN—redisplays the previous menu.

SELF TEST—you can perform this test to ensure that the HP 3562A is operating properly. The self test must be run from a reset instrument state. This test takes about two minutes and finishes by calibrating the input channels. The self test does not erase any data stored in nonvolatile memory (e.g., the synthesis table), but it does erase all measurement data. If the message "SELF TEST PASSES" is displayed, your anaylzer is operating properly. If any other message is displayed indicating a failure, refer servicing to qualified personnel. HP Sales and Support Offices are listed at the end of this manual.

SERVCE TEST—this softkey accesses the servicing diagnostics softkeys; please refer to the HP 3562A Service Manual for instructions on their use. **These softkeys are intended for the use of service technicians only; none of the softkeys accessed through SERVCE TEST are intended for use by HP 3562A operators.**

SOURCE PROTCT—displays the source protection menu, which allows you to activate protection and set the ramp time. Source protection helps avoid damage to devices under test by shutting the source off when the mode, frequency span or source type is changed. It also ramps the source to new levels, rather than changing the level abruptly. For example, you can set a ramp time of 10 seconds to allow you to monitor the device under test as you turn the source on.

TIME H,M,S—used to enter the time for the non-real time clock. Enter the time as hh,mm,ss. The hours reset after 23, and the minutes and seconds reset after 59. The time and date of the clock are used in the disc catalog and to provide timed starts for auto sequences. The time is saved in nonvolatile memory and is not erased at power-down or after reset.

SPCL MARKER—displays the special markers menu, which offers the following markers and marker calculations:

Harmonics
Sidebands
Resonant Frequency and Damping
Band Power
Slope
Average Value

These features are used in conjunction with the X marker.

AVG VALUE—shows the average value of the trace area contained in the X marker band. If just the single marker is active, the trace value at the marker position is displayed. If the marker is not active, the average value of the entire trace is displayed.

CALC OFF (HMNC ON menu)—deactivates the harmonic power and THD calculations of the harmonic markers. This has no effect on the markers themselves.

CALC OFF (SBAND ON menu)—deactivates the sideband power calculation of the sideband markers. This has no effect on the markers themselves.

CRRIER FREQ—used to enter the carrier frequency for the sideband marker. The first marker is placed at the frequency entered with this softkey. After the sideband increment has been entered with SBAND INCRMT, additional markers are placed at the first ten sidebands. The carrier may be set at any frequency and need not be within the current frequency span. The default value at power-on and after reset is 5 kHz.

FNDMTL FREQ—used to enter the fundamental frequency for the harmonic markers. After the fundamental has been entered, markers are displayed at that frequency and its first 20 harmonics. The fundamental can be set below the current frequency span. At power-on and after reset, it defaults to 5 kHz.

FREQ & DAMP—shows resonant frequency and damping. If the X marker band is active, the calculation is made across the area inside the band. If the single X marker is active, the calculation is made for 20 points on either side of the marker.

HMNC ON—activates the harmonic marker and displays its menu. This marker indicates the fundamental frequency and its first 20 harmonics. It also offers the harmonic power and THD calculations. Harmonics that fall outside the display scale are not marked. The harmonic markers are not available on log X-axis displays.

HMNC POWER—shows harmonic power contained in the X marker band. If the a band is not active, the power in all 20 harmonics is calculated. Harmonics that fall outside the display scale are not included in the calculation. This calculation is deactivated by pressing CALC OFF. The harmonic power readout is in volts squared (or volts squared seconds for ESD units). Refer to the power softkey for other power calculations.

The label on the HMNC POWER readout depends on the trace units. HEG indicates harmonic energy, HSM indicates harmonic sum, and HPR indicates harmonic power.

MRKR → PEAK—moves the marker to the highest amplitude point on the active trace. If two or more points are at the highest amplitude, the marker moves to the leftmost point.

POWER—shows the power in the area contained by the X marker band. If the marker is not active, the power in the entire trace is displayed. If just the single X marker is active, the power at that marker position is displayed. An X-band causes POWER to show the power contained in that band.

For non-frequency domain displays and unitless frequency displays, POWER calculates the linear sum of magnitudes and displays the result in the active units. For frequency domain displays with the ESD unit selected, POWER computes energy and displays the result in volts (peak) squared seconds.

For frequency domain displays with all units other than ESD, POWER computes power and displays the result in volts (rms) squared. For all frequency domain displays with band markers, POWER compensates for the effects of Hann and Flat top windows.

RETURN—redisplays the previous menu.

SBAND INCRMT—used to enter the sideband increment for the sideband markers. The increment calculates and marks the first 10 sidebands on both sides of the fundamental. The default value is 2.5 kHz.

SBAND ON—activates the sideband marker and displays its menu. This marker shows a fundamental frequency and its first 10 sidebands. The fundamental is entered with FNDMTL FREQ, and the sideband increment is entered with SBAND INCRMT.

SBAND POWER—shows power in the sidebands identified by the sideband markers. If an X marker is active, the sideband power inside the band is shown. The calculation is deactivated by pressing CALC OFF. This marker function reads out in volts squared (or volts squared seconds for ESD units). See the POWER softkey for other power calculations.

The label on the sideband power readout depends on the trace units. SEG indicates sideband energy; SSM indicates sideband summation; SPR indicates sideband power.

SLOPE—shows the slope of the active trace at the current X marker position. If the X marker band is active, the HP 3562A calculates the least squares average of the area in the band and shows its slope.

THD—shows the total harmonic distortion (THD) generated by the harmonics identified with the harmonic markers. THD is displayed in dB for log magnitude traces and in % for linear magnitude traces. The X marker has no affect on this calculation. Only those harmonics inside the display scale are included in the calculation.

X FCTN OFF—turns off the special marker functions.

SRQ (indicator)—this LED indicates when the HP 3562A has issued a service request (SRQ) to the HP-IB. Chapter 6 in the *HP 3562A Programming Manual* provides information on handling SRQs.

START—clears the time record or sweep and accumulated number of averages and initiates a measurement based on the current setup state.

STATE TRACE—switches the display between the instrument state and data trace displays. If a table (e.g., synthesis) is currently displayed, pressing **STATE TRACE** once displays the instrument state.

STATUS Group—the four LEDs in this group indicate the instrument's status. Refer to individual descriptions in this chapter for more information. The **ARM** key enables triggering when in the manual trigger mode; see **SELECT TRIG** for more information.

SYNC OUT (connector)—this output provides a TTL-level signal synchronized to the source. When the burst chirp or burst random is active, the duty cycle of the SYNC OUT square wave equals the burst percentage. (This is the signal that controls the bursts.) When random noise, periodic chirp or fixed sine is active or the source is off, the duty cycle of SYNC OUT is indeterminate. Figure 12-9 shows the SYNC OUT signal (upper trace) with the burst random source output (lower trace).

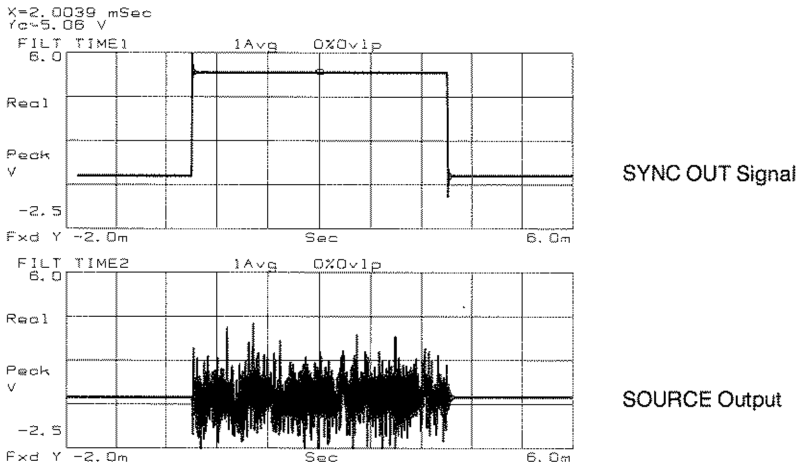


Figure 12-9 The SYNC OUT Signal

SYNTH—displays the synthesis menu. The HP 3562A can synthesize frequency response curves containing up to 40 poles and 40 zeros. Data can be entered in pole/zero, pole/residue or polynomial formats. You can also synthesize constants for use in math operations. To synthesize linear traces, put the instrument in the linear resolution mode. For log traces, select the log resolution mode.

Press POLE ZERO, POLE RESIDU or POLY NOMIAL to select the type of synthesis and display its table. To convert from one type to another, use the CONVRT TABLE menu. To erase one type and enter another, press the desired type. This displays a blank table, and as soon as you press one of the editing softkeys the old table is erased.

ADD VALUE—adds a value after the edit value in the synthesis table. The edit value is selected with EDIT DENOM#, EDIT NUMER#, EDIT POLE#, EDIT RESIDU#, or EDIT ZERO# (depending on the type of synthesis). To add a value before the first one in the table, move the pointer to line #0 (above line #1), then enter the new value. To enter a real-only value, enter the value then press one of the units softkeys. To enter a complex value, enter the real and imaginary values separated by a comma (,) then press one of the units softkeys.

CHANGE VALUE—used to change the edit value in the synthesis table. The edit value is selected with EDIT DENOM#, EDIT NUMER#, EDIT POLE#, EDIT RESIDU#, or EDIT ZERO# (depending on the type of synthesis). To enter a real-only value, enter the value then press one of the units softkeys. To enter a complex value, enter the real and imaginary values separated by a comma (,) then press one of the softkeys.

CLEAR TABLE—clears the synthesis table. The message "Push Again to Clear" is displayed to allow you to confirm that the table is to be cleared. Once cleared, tables cannot be recovered. Hoewever, they can be saved in disc memory; see **DISC.**

CONVRT TABLE—displays the convert table menu, which converts synthesis tables to one of the other two types. For example, you can convert a pole/zero table to ratio-of-polynomials format by pressing CONVRT TABLE followed by TO → POLY.

CREATE CONST—used to create a constant value for use in waveform math. To create a real-only constant, press CREATE CONST, enter the value with the **0—9** keys in the Entry group, then press ENTER. To create a complex constant, press CREATE CONST, enter the real and imaginary values separated by a comma (,) then press ENTER.

CREATE TRACE—synthesizes a trace using the selected synthesis table. "SYNTHESIS IN PROGRESS" is displayed while the trace is being created, and the synthesized trace is labeled "SYNTHESIS."

DELETE VALUE—deletes the edit value in the synthesis table. The edit value is selected with EDIT DENOM#, EDIT NUMER#, EDIT POLE#, EDIT RESDU# OR EDIT ZERO# (depending on the type of synthesis). Be careful when deleting poles and residues; these must be in pairs in the table.

EDIT DENOM#—used to specify the denominator to be edited. Press EDIT DENOM#, then select the denominator using the Entry group. Specifying the edit value does not immediately change it; the actual editing is done with ADD VALUE, CHANGE VALUE, or DELETE VALUE.

EDIT NUMER#—used to specify the numerator to be edited. Press EDIT NUMER#, then select the numerator using the Entry group. Specifying the edit value does not immediately change it; the actual editing is done with ADD VALUE, CHANGE VALUE, and DELETE VALUE.

EDIT POLE#—used to specify the pole to be edited. Press EDIT POLE#, then select the pole using the Entry group. Specifying the edit value does not immediately change it; the actual editing is done with ADD VALUE, CHANGE VALUE, and DELETE VALUE.

EDIT RESIDU#—used to specify the residue to be edited. Press EDIT RESDU#, then select the residue using the Entry group. Specifying the edit value does not immediately change it; the actual editing is done with ADD VALUE, CHANGE VALUE, and DELETE VALUE.

EDIT ZERO#—used to specify the zero to be edited. Press EDIT ZERO#, then select the zero using the Entry group. Specifying the edit value does not immediately change it; the actual editing is done with ADD VALUE, CHANGE VALUE, and DELETE VALUE.

GAIN FACTOR—used to enter the constant (K) needed to set the desired gain of a synthesized frequency response function. Chapter 9 has an example of selecting gain for a low pass filter.

POLE RESIDU—specifies pole/residue synthesis and displays the pole/residue table and its editing menu.

POLE ZERO—specifies pole/zero synthesis and displays the pole/zero table and its editing menu.

POLY NOMIAL—specifies ratio-of-polynomials synthesis and displays the polynomial table and its editing menu.

RETURN—redisplays the previous menu.

SCALE FREQ—used to add a scaling frequency to the synthesis table. This frequency is multiplied by the values in the table to scale the curve up or down in frequency, without actually changing the values in the tables. Enter the frequency, from 1 μHz to 1 MHz, using the Entry group.

SYNTH FCTN—displays the synthesis functions menu, which is used to add system gains, time delays and scaling frequencies to the synthesis table.

TIME DELAY—used to add time delays to synthesized functions. The default value for new tables is 0.0 seconds. Enter the time delay, between 10^{-38} to 10^{38}, using the Entry group and the units softkeys. The delay you enter is displayed in the lower left corner of the synthesis table.

TO → POL RESIDU—converts a pole/zero or polynomial table to the pole/residue format.

TO → POL ZERO—converts a pole/residue or polynomial table to the pole/zero format.

TO → POLY—converts a pole/residue or pole/zero table to the ratio-of-polynomials format.

TALK (indicator)—this LED indicates that the HP 3562A is in the HP-IB talk mode.

TRIG ARMED (indicator)—this LED indicates that the trigger has been armed. If ARM AU MAN is set to AU (auto arm), the trigger is armed automatically. If it is set to MAN (manual arm), the **ARM** key in the Status group must be pressed to arm the trigger. Once it is armed, the trigger will start looking for the trigger signal.

TRIG DELAY—displays the trigger delay menu, which is used to specify pre- or post-trigger delay. The HP 3562A allows up to 4095 samples (4094 for zoom) of pre-trigger delay and up to 102,400 samples of post-trigger delay. Pre-trigger delay allows the measurement to include data before the trigger signal arrives. This is useful when measuring transients to ensure that the entire signal is measured. Post-trigger delays allows the measurement to ignore data for some period after the trigger signal arrives. This is useful when measuring systems with long response times because you can ignore input data until the desired response occurs. Trigger delay is also used to set the measurement starting point when recalling throughput files from disc memory.

CHAN 1 DELAY—used to enter pre- or post-trigger delay on Channel 1. The delay may be set in time or number of revolutions (if external sample is active) or records; the maximum values are 2 records of pre-trigger delay and 32 records of post-trigger delay. The resution is 1/2048 record. Press **STATE/ TRACE** and look under FREQ: REC LGTH to find the current time record length in seconds. A negative value specifies pre-trigger delay, while a positive value specifies post-trigger delay.

CHAN 2 DELAY—used to enter pre- or post-trigger delay on Channel 2. The delay may be set in time or number of revolutions (if external sample is active) or records; the maximum values are 2 records of pre-trigger delay and 32 records of post-trigger delay. The resolution is 1/2048 record. Press **STATE/ TRACE** and look under FREQ: REC LGTH to find the current time record length in seconds. A negative value specifies pre-trigger delay, while a positive value specifies post-trigger delay.

TRIGGERING (indicator)—Indicates triggering and trigger signal status. For free run, the LED is on while the time record is being filled. (For real time measurements, it remains on without flashing.) For input channel and external triggering, the LED flashes when the signal is received, if a record is not already in progress. For source triggering, the LED flashes at the beginning of the time record, when the trigger from the source is generated.

Exceptions: For free run and source triggering, the LED does not flash if the measurement is paused. For all triggering modes, the LED does not flash after averaged measurement have been completed.

UNITS—displays the units menu, which is used to select the horizontal and vertical units and to add trace titles. There are three secondary menus for vertical units: spectrum, sine and correlation. Spectrum units apply to linear power and cross spectrum displays. Sine units apply to swept sine power and cross spectrum displays. Correlation units apply to auto and cross correlation displays. Selections made in each of these four secondary menus affect only the applicable traces for each type of unit, and the selections stay in effect until power-down or reset. In addition to their individual choices, the three vertical units menus offer the choice between volts$_{peak}$ and volts$_{rms}$ as the basic amplitude unit. Refer to Chapter 8 for a description of the interaction between units and coordinates.

Hz (Sec)—specifies Hz as the basic horizontal unit for frequency domain displays and seconds for time domain displays. This softkey does not apply to amplitude domain displays.

L SPEC UNITS—Displays the linear spectrum units menu, which applies only to linear spectrum displays (VIEW INPUT and FLTRD INPUT menus).

Remember that these units apply only to these traces. If the active trace is not appropriate, you will not see any change after making a selection in this menu.

Orders CAL—used to enter orders calibration in Hz/Ord. For example, if 100 Hz/Ord is the orders calibration, 100 Hz becomes the first order of revolution, 200 Hz the second order, and so forth.

Orders (Revs)—selects orders as the basic horizontal unit for frequency domain displays and revolutions for time domain displays. This softkey does not apply to amplitude domain displays. Orders are used to normalize the display to a given rate of revolution. Use Orders CAL to enter the orders calibration in Hz/Ord.

P SPEC UNITS—displays the power spectrum units menu, which applies to power and cross spectrum displays in the linear, log and time capture modes. In addition to the volts peak/RMS selction, this menu offers the choice of volts, volts^2, V/$\sqrt{\text{Hz}}$ ($\sqrt{\text{PSD}}$), volts^2 /Hz (PSD) and volts^{2}s/Hz (ESD).

RETURN—redisplays the **UNITS** menu.

RPM (Sec)—selects rotations per minute (RPM) as the basic horizontal unit for frequency domain displays and seconds for time domain displays. This unit is derived by multiplying the Hz units by 60 seconds/minute.

SWEPT UNITS—displays the swept units menu, which applies to power and cross spectrum displays in the swept sine mode. In addition to the volts peak/rms selection, this menu offers the choice between volts and volts^2.

TRACE TITLE—used to add titles to the active trace. Titles can contain up to 20 alphanumeric characters and are plotted along with the display. When TRACE TITLE is pressed, the HP 3562A shifts into the alpha mode. In this mode, the keys are converted to their blue labels and the alpha menu is displayed. For instructions on using this menu, please refer to the beginning of this chapter.

V/√Hz (√PSD)—displays the trace in volts divided by the square root of the frequency (equivalent filter noise bandwidth), which is the square root of the power spectral density.

V^2/Hz (PSD)—displays the trace in volts squared divided by frequency (equivalent filter noise bandwidth), which normalizes the power to 1 Hz. This is commonly referred to as power spectral density.

V^2s/Hz (ESD)—displays the trace in volts squared times seconds (record length) divided by frequency (equivalent filter noise bandwidth), which normalizes the energy to 1 Hz. This is commonly referred to as energy spectral density.

VOLTS—displays the trace in volts.

$VOLTS^2$—displays the trace in $volts^2$.

VOLTS PEAK—defines $volts_{peak}$ as the basic voltage unit.

VOLTS RMS—defines $volts_{rms}$ as the basic voltage unit.

UP—when the ENABLED indicator in the Entry group is on, the up arrow increments the active numeric entry. The amount of the increment depends on the variable being entered.

UPPER LOWER—converts the display to the upper/lower format. Trace A is displayed in the upper half, and trace B is displayed in the lower half. The upper/lower format is also selected automatically when the **A & B** key is pressed.

VIEW INPUT—displays the view input menu, which are used to view the signals present at the inputs. These displays show the signals before they are filtered to the current frequency span or measured. Stored time capture and time throughput data can also be viewed with this menu when these features are active. The menu displayed when this is pressed depends on the mode and whether or not throughput is active.

INPUT SPEC 1—displays the frequency spectrum of the signal on Channel 1. This display shows the full-bandwidth (0-100 kHz) FFT of the input signal, regardless of the current frequency span.

INPUT SPEC 2—displays the frequency spectrum of the signal on Channel 2. This display shows the full-bandwidth (0-100 kHz) FFT of the input signal, regardless of the current frequency span.

INPUT TIME 1—displays the time domain signal on Channel 1. Because the view input displays are always at full-span, the input time displays show an 8 millisecond time length (800 ÷ 100 kHz), regardless of the current time record length. This display can be used to verify the presence of an input and is also useful when manually setting the input range.

INPUT TIME 2—displays the time domain signal on Channel 2. Because the view input displays are always at full-span, the input time displays show an 8 millisecond time length (800 ÷ 100 kHz), regardless of the current time record length. This display can be used to verify the presence of an input and is also useful when manually setting the input range.

LINEAR SPEC—displays the linear spectrum of the time record outlined in the time buffer by the capture pointer. The frequency span of the spectrum is equal to the span at which the capture was made.

NEXT RECORD—displays the next record of time data in the active throughput file. NEXT RECORD remembers the positions of the displayed files and displays the next record in the active trace(s).

THRUPT TIME 1—recalls the first Channel 1 time record in the active throughput file into the active trace. The record length is determined by the frequency span used in the throughput session. The starting point of the record is determined by the Channel 1 trigger delay value.

THRUPT TIME 2—recalls the first Channel 2 time record in the active throughput file into the active trace. The record length is determined by the frequency span used in the throughput session. The starting point of the record is determined by the Channel 2 trigger delay value.

TIME BUFFER—displays the time capture buffer. The length of the buffer display is equal to the number of records captured times one record length. For example, if 10 records were captured, and the record length is 80 ms, the TIME BUFFER display is 800 ms long. This is the display shown at the completion of a time capture.

TIME RECORD—displays the time record outlined in the time buffer by the capture pointer. The length of this record is always one time record (at the capture span). To view this information transformed to the frequency domain, use LINEAR SPEC.

VIEW OFF—pauses the view input displays. This does not interrupt the flow of the input signals to instrument, but merely disables display updating. VIEW OFF affects only the view input displays.

VOLTAGE SELECTOR—selects 115 or 230 volt operation. Refer to Appendix A for instructions on setting this switch and selecting the proper fuse for each setting.

WINDOW—displays the window menu. A window is a time domain weighting function applied to the input signal to reduce leakage (the smearing of energy across the frequency spectrum caused by transforming signals that are not periodic in the time record). The HP 3562A offers Hanning, flat top, uniform, force, exponential and user-defined windows. Note that windowing is applicable only to the linear resolution and time capture modes. (The log resolution mode uses a special, non-selectable window, and swept sine does not use a window.) Please see "Selecting Windows" in Chapter 1 for illustrations and details of each window type.

EXPON CHAN 1—selects the exponential window for Channel 1. This window attenuates the input signal at a decaying exponential rate determined by the specified time constant. Enter the time constant, from 3.9 μs to 10^{38}s, using the Entry group. One example of using the exponential window is measuring lightly-damped systems that do not decay in one time record. The exponential window is displayed on the filtered input time record display (see **MEAS DISP**).

EXPON CHAN 2—selects an exponential window for Channel 2. This window attenuates the input signal at a decaying exponential rate determined by the specified time constant. Enter the time constant, from 3.9 μs to 10^{38}s, using the Entry Group. One example of using the exponential window is measuring lightly-damped systems that do not decay in one time record. The exponential window is displayed on the filtered input time record display (see **MEAS DISP**).

FLAT TOP—selects the flat top window for both input channels. The flat top window offers greater amplitude accuracy but lower frequency resolution than the Hanning. It is generally used when a component's amplitude must be measured accurately, such as when usinq a fixed sine stimulus.

FORCE CHAN 1—selects the force window for Channel 1. This window passes the input signal for the specified amount of time then attenuates it to the average value of the remaining data for the remainder of the time record. Enter the time width using the Entry group. To find the current record length, press **STATE TRACE** and look under FREQ: REC LGTH. The force window is generally used in impact testing to cancel unwanted signals occurring before and after the actual impact.

FORCE CHAN 2—selects the force window for Channel 2. This window passes the input signal for the specified amount of time then attenuates it to the average value of the remaining data for the remainder of the time record. Enter the time width using the Entry group. To find the current record length, press **STATE TRACE** and look under FREQ: REC LGTH. The force window is generally used in impact testing to cancel unwanted signals occurring before and after the actual impact.

FORCE/EXPON—displays the menu for selecting force and exponential windows. Because the force and exponential windows are single-channel, they can be mixed in two-channel measurements. If you select the frequency response measurement with the force window on one channel and exponential on the other, the channel for which you select the force window gets both the force and exponential windows. Chapter 1 offers more details.

HANN—selects the Hanning window for both input channels. The Hanning offers higher frequency resolution but lower amplitude accuracy than the flat top window. It is the most commonly used window and is usually applied in random noise measurements.

RETURN—redisplays the **WINDOW** menu.

UNIFRM (NONE)—selects the uniform window for both channels. This window's rectangular shape does not attenuate any portion of the time record. The uniform window is generally used with self-windowing functions such as burst and random chirps.

USER SAVD 1—selects the time waveform stored in the SAVED 1 location (see **SAVE RECALL**) as the window to be applied to both channels. This must be a time domain waveform to be used as a window. Chapter 1 explains how to create and store user windows.

X—activates the X (horizontal) marker and displays its menu. When active, the X marker appears as an intensified dot which is moved across the active trace(s) with the Markers knob. Marker bands can also be activated to identify portions of the trace and to make relative measurements. You can enter X marker values immediately after pressing the **X** key. See the description of the X VALUE key for details.

HOLD X CENTER—used to mark off a band on the horizontal axis of the display. When HOLD X CENTER is active, the marker splits and expands symmetrically around its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD X CENTER is active. When HOLD X OFF is pressed after a band has been marked, the band remains the same size but moves across the display when you turn the knob. To erase a band, press HOLD X CENTER, turn the knob counterclockwise until the band retracts to a single line, then press HOLD X OFF.

HOLD X LEFT—used to mark off a band on the horizontal axis of the display. When HOLD X LEFT is active, the marker splits and expands to the right of its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD X LEFT is active. When HOLD X OFF is pressed after a band has been marked, the band remains the same size but moves across the display when you turn the knob. To erase a band, press HOLD X LEFT, turn the knob counterclockwise until the band retracts to a single line, then press HOLD X OFF.

HOLD X OFF—performs one of two functions: 1) If one of the three HOLD X modes is active and a band has been expanded, pressing HOLD X OFF disables any further expansion or contraction of the band. Once this happens, turning the knob moves the band across the display in the same manner as the single X marker. 2) If one of the three HOLD X modes is active and the band has been contracted to a single line, pressing HOLD X OFF erases the band and deactivates the HOLD X mode.

HOLD X RIGHT—used to mark off a band on the horizontal axis of the display. When HOLD X RIGHT is active, the marker splits and expands to the left of its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD X RIGHT is active. When HOLD X OFF is pressed after a band has been marked, the band remains the same size but moves across the display when you turn the knob. To erase a band, press HOLD X RIGHT, turn the knob clockwise until the band retracts to a single line, then press HOLD X OFF.

SCROLL ON OFF—allows the entire trace to be scrolled through a magnifying "window" defined by a HOLD X band. To use scrolling, press SCROLL ON, then outline a band using HOLD X CENTER, RIGHT or LEFT. Press HOLD X OFF then X MRKR SCALE to expand the trace inside the band. Rotating the Markers knob now scrolls the trace through the "window" outlined with the marker band. Please refer to "Using the Markers" in Chapter 8 for an illustrated example of scrolling.

X AUTO SCALE—automatically adjusts the horizontal scale to display all measured data. The Nichols, Nyquist and phase coordinates and the ORBITS T1vsT2 measurement display have special autoscaling features; refer to "Scaling the Display" in Chapter 8 for more information. This softkey is duplicated in the **SCALE** menu for convenience.

X MRKR SCALE—changes the horizontal scale to the range currently defined by the X marker. The marker must be active and in one of the HOLD X modes. Trace information erased when the scale changes is not lost when scaling to the marker band. The entire trace can be redisplayed by pressing X AUTO SCALE (assuming the trace has not changed). Note that this softkey is duplicated in the **SCALE** menu for convenience.

X VALUE—used to move the X marker to a specific point on the trace. Press X VALUE, then enter the desired location; the units softkeys that appear are determined by the type of display. To display an X marker band, enter the lower and upper limits separated by a comma. You can also enter X values immediately after pressing the **X** key.

X (indicator)—when this LED is on, the knob in the Markers group moves the X marker and operates with the softkeys in the **X** menu.

X OFF—deactivates the X marker. Any markers readouts gathered with the marker are erased when the marker is deactivated.

Y—activates the Y marker and displays its menu. When active, the Y marker appears as a single horizontal line on the display that is moved along the vertical axis with the Markers knob. Marker bands can also be activated to identify portions of the trace and to make relative measurements. You can enter Y values immediately after pressing the **Y** key. See the description of the Y VALUE softkey for details.

HOLD Y CENTER—used to mark off a band on the vertical axis of the display. When HOLD Y CENTER is active, the marker splits and expands symmetrically around its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD Y CENTER is active. When HOLD Y OFF is pressed after a band has been marked, the band remains the same size but moves vertically on the display when you turn the knob. To erase a band, press HOLD Y CENTER, turn the knob counterclockwise until the band retracts to a single line, then press HOLD Y OFF.

HOLD Y LOWER—used to mark off a band on the vertical axis of the display. When HOLD Y LOWER is active, the marker splits and expands upward from its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD Y LOWER is active. When HOLD Y OFF is pressed after a band has been marked, the band remains the same size but moves vertically on the display when you turn the knob. To erase a band, press HOLD Y LOWER, turn the knob counterclockwise until the band retracts to a single line, then press HOLD Y OFF.

HOLD Y OFF—performs one of two functions: 1) If one of the three HOLD Y modes is active and a band has been expanded, pressing HOLD Y OFF disables any further expansion or contraction of the band. Once this happens, the band moves vertically on the display in the same manner as the single Y marker. 2) If one of the three HOLD Y modes is active and the band has been contracted to a single line, pressing HOLD Y OFF erases the band and deactivates the HOLD Y mode.

HOLD Y UPPER—used to mark off a band on the vertical axis of the display. When HOLD Y UPPER is active, the marker splits and expands downward from its original position as you rotate the Markers knob. The band can be expanded or contracted as long as HOLD Y UPPER is active. When HOLD Y OFF is pressed after a band has been marked, the band remains the same size but moves vertically on the display when you turn the knob. To erase a band, press HOLD Y UPPER, turn the knob counterclockwise until the band retracts to a single line, then press HOLD Y OFF.

Y AUTO SCALE—automatically adjusts the vertical axis to obtain the optimum display. The Nichols, Nyquist and phase coordinates and the ORBITS T1vsT2 measurement display have special default scales; refer to "Scaling the Display" in Chapter 8 for more information. This softkey is duplicated in the **SCALE** menu for convenience.

Y DFLT SCALE—adjusts the vertical scale to default value, which is determined by the input range setting and the type of measurement display. The Nichols, Nyquist and phase coordinates and the ORBITS T1vsT2 measurement display have special default scales; refer to "Scaling the Display" in Chapter 8 for more information. This softkey is duplicated in the **SCALE** menu for convenience.

Y MRKR SCALE—changes the vertical scale to the scale currently defined by the Y markers. The markers must be active and in one of the hold modes. Trace information erased when the scale changes is not lost and can be redisplayed by pressing Y DFAULT SCALE (assuming the trace has not changed). Note that this softkey is duplicated in the **SCALE** menu for convenience.

Y VALUE—used to move the Y marker to a specific point on the trace. Press X VALUE, then enter the desired location; the units softkeys that appear are determined by the display coordinates. To display a Y marker band, enter the minimum and maximum values separated by a comma. You can also enter Y values immediately after pressing the **Y** key.

Y (indicator)—when this LED is on, the knob in the Markers group moves the Y marker and operates with the softkeys in the **Y** menu.

Y OFF—deactivates the Y marker. Any marker readouts gathered with the marker are erased when the marker is deactivated.

YES—used to accept time records in manual or timed previewing. When the instrument needs a yes or no answer, the **1** and **0** keys are automatically converted to **YES** and **NO**, respectively. Otherwise, these keys represent 1 and 0. See the **AVG** key for information on the preview modes.

Appendix A

GENERAL INFORMATION

INTRODUCTION

This appendix contains several topics to help you operate the HP 3562A correctly and safely, from initial inspection through storage and shipment:

1. Initial inspection
2. Operating environment
3. Accessories and options
4. Installation
5. Performance verification
6. HP-IB connections
7. Operator maintenance
8. Storage and shipment

INITIAL INSPECTION

This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, inspect the instrument for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for accessories supplied plus any additional accessories, options or systems components ordered with the instrument. After installing the HP 3562A, verify its operation using the "Performance Verification" section in this appendix. If there is damage or deficiency, see the warranty information in this manual.

WARNING

The integrity of the protective earth ground may be interrupted if the HP 3562A is mechanically damaged. Under no circumstances should the HP 3562A be connected to power if it is damaged.

POWER REQUIREMENTS

CAUTION

Before applying ac line voltage to the HP 3562A, make certain the voltage selection switch on the rear panel is set for the proper line voltage and the correct line fuse is installed in the rear panel fuse holder. Refer to "Line Voltage and Fuse Selection."

The HP 3562A can be operated from any single phase ac power source supplying:

87V to 126V, 48 to 440 Hz (115V Voltage Selector setting)

196V to 253V, 48 to 66 Hz (230V Voltage Selector setting)

Power consumption is less than 250 VA.

Line Voltage and Fuse Selection

The line voltage is selected at the factory for the country of destination. The voltage is set with the red switch labeled " ~VOLTAGE SELECTOR" on the rear panel. Before changing the setting, press the LINE switch OFF (lower left corner of the front panel) and remove the power cable from its connector.

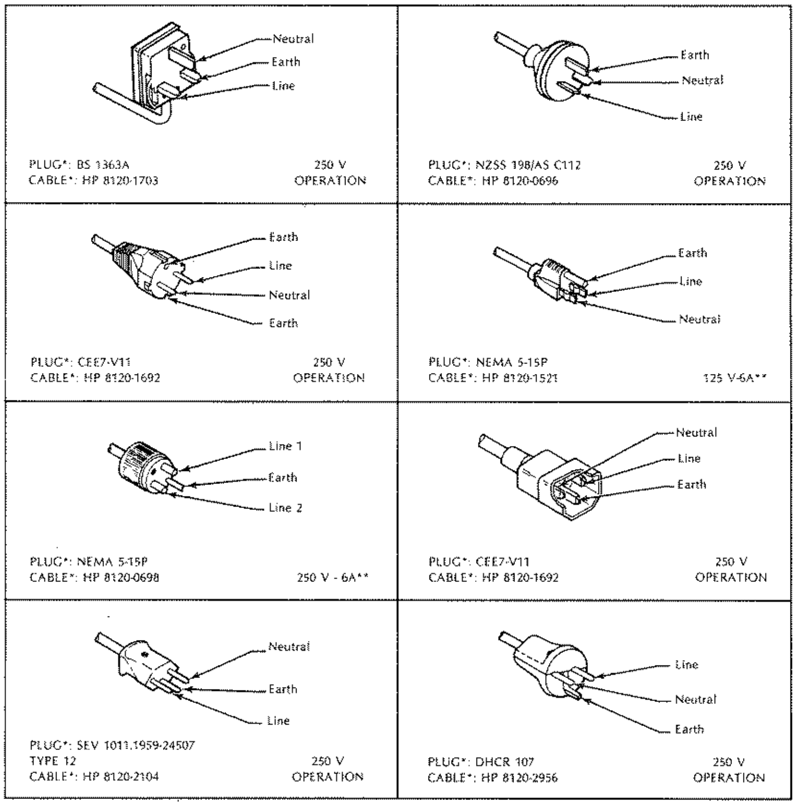
In addition, the fuse must correspond with the selected line voltage. The fuses for each setting are:

115V	6A/250V	HP Part Number 2110-0003
230V	3A/250V	HP Part Number 2110-0304

The fuse holder is located on the rear panel. To replace the fuse, press the **LINE** switch OFF and remove the power cable from its socket. Remove the fuse holder cap by turning it counterclockwise with a screwdriver. After inserting the correct fuse, replace the fuse holder cap, reconnect the power cable, then press **LINE** ON.

Power Cable and Grounding Requirements

The HP 3562A is equipped with a three-conductor power cord that grounds the instrument cabinet when plugged into an appropriate receptacle. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to figure A-1 for the part number of the power cable and plug configurations available.



*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.
**UL listed for use in the United States of America.

Figure A-1 Power Cables

WARNING

The power cable plug must be inserted into a socket outlet provided with a protective earth terminal. Defeating the protection of the grounded instrument cabinet can subject the operator to lethal voltages.

OPERATING ENVIRONMENT

WARNING

The HP 3562A is not intended for outdoor use. To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.

Environmental Considerations

Temperature The HP 3562A can be operated in temperatures from 0 degrees C to 55 degrees C.

Humidity The HP 3526A can be operated in environments with humidity up to 95%. However, the instrument should be protected from temperature extremes which cause condensation.

Altitude The HP 3562A can be operated at altitudes up to 4572 meters (15,000 feet).

Cooling Fan

The HP 3562A is equipped with a cooling fan mounted on the rear panel. The instrument should be mounted so that air can freely circulate through it. Choose a location that provides at least 75 mm (3 inches) clearance at the rear and 25 mm (1 inch) at each side. Failure to provide adequate air clearance will result in excessive internal temperatures, reducing the instrument's reliability. The filter for the cooling fan should be removed and cleaned by flushing with soapy water every thirty days. Refer to "Operator Maintenance" later in this appendix for instructions.

Thermal Cutout

The HP 3562A is equipped with a thermal cutout switch that automatically removes line voltage whenever the internal ambient temperature exceeds 80 degrees C. The temperature at which this occurs is dependent upon line voltage and airflow. With proper airflow and operating line voltage, thermal cutout will not occur at less than 55 degrees C ambient temperature. The switch is reset by switching power off, then on again, after the instrument has cooled down sufficiently. If a thermal cutout occurs, verify that the fan is operating and the fan filter is not blocked. If the filter is blocked, clean it as discussed in "Operator Maintenance" then wait 30 minutes and reapply power. If this does not solve the problem, check the environmental considerations listed earlier and the airflow requirements discussed under "Cooling Fan." If these steps do not return power, the instrument is in need of service. Refer to the list of HP Sales and Support Offices at the end of this manual.

ACCESSORIES SUPPLIED

Table A-1 lists the accessories supplied with the HP 3562A.

Table A-1 Accessories Supplied

HP 3562A Operating Manual	Part Number 03586-90000
HP 3562A Programming Manual	Part Number 03586-90020
HP 3562A Service Manual	Part Number 03586-90010

ACCESSORIES AVAILABLE

Table A-2 lists the accessories available for the HP 3562A. These accessories may be obtained through the HP Sales and Support Offices listed at the back of this manual.

Table A-2 Accessories Available

Transit case	Part Number 9211-2663
BNC cables and adapters	Contact Sales Representative or refer to current HP catalog

OPTIONS

Table A-3 lists the options available for the HP 3562A. These options may be ordered with the instrument by ordering the option number. They may also be ordered after the instrument has been purchased by ordering the option part number.

Table A-3 Options

Description	Option Number	Part Number
Front Handle Kit	907	5061-0091
Rack Mount Kit	908	5061-0079
Rack Mount & Front Handle Kit	909	5061-0085
Extra Operating, Programming, and Service Manuals	910	03562-90000 03562-90030 03562-90010
Delete Service Manual	914	

INSTALLATION

WARNING

There are no operator serviceable parts inside the HP 3562A. Servicing should be performed only by trained service personnel aware of the hazards involved. A list of HP Sales and Support Offices is included at the end of this manual.

The HP 3562A is shipped with plastic feet attached, ready for use as a bench instrument. The feet allow full-width instruments to be stacked securely. Because of its weight, the instrument is not equipped with a tilt stand. The front handle kit (Option 907, Part Number 5061-0091) can be installed for use on the bench.

The HP 3562A also can be rack mounted, with or without slides. To rack mount with slides:

a. Remove the front handles, if so equipped.

b. Remove the plastic feet from the bottom of the instrument.

c. Install the flange kit (with or without handles) according to the instructions supplied with the kit:

Rack Flange & Front Handle Kit, Option 909, HP Part Number 5061-0085

OR

Rack Flange Kit (without handles), Option 908, HP Part Number 5061-0079

d. Install an instrument support rail on each side of the instrument rack. (These rails are supplied with HP rack-mount cabinets.)

WARNING

1. The HP 3562A must be supported by instrument support rails inside the rack. Do not, under any circumstances, attempt to mount the instrument using only the front flanges.

2. The HP 3562A is heavy—approximately 25 kg (56 lbs). Use extreme care when lifting it to avoid personal injury or damage to the instrument.

e. Using two people, lift the HP 3562A to its position in the rack on top of the instrument support rails.

f. Using the appropriate screws, fasten the rack-mount flanges to the front of the instrument rack.

To rack mount with slides, the following items are required:

1 Rack Flange & Front Handle Kit, Option 909, HP Part Number 5061-0085

OR

Rack Flange Kit (without handles), Option 908, HP Part Number 5061-0079

1 Heavy-Duty Slide Kit, HP Part Number 1494-0016

NOTE

Instrument support rails are not absolutely necessary when rack mounting with slides. However, they do relieve a considerable amount of strain from the slides and provide an extra measure of safety.

a. Perform steps a through d of the previous procedure.

b. Attach a slide inner-member bracket to each side of the HP 3562A.

c. Attach the slide's outer members to the instrument rack according to the instructions included with the slides.

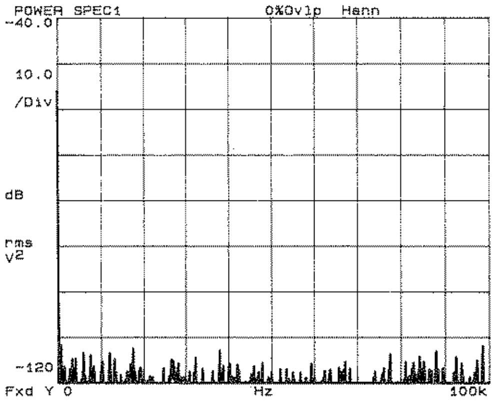
d. If your instrument rack has extension legs on the front, be sure they are extended when installing the instrument.

e. Using two people, lift the HP 3562A to its position in the rack and mate the two sections of the slides. Do not rest the full weight of the instruments on the extended slides until you are sure the rack will not overturn.

f. Slide the instrument into the rack. Using the appropriate screws, fasten the rack mount flanges to the front of the rack.

PERFORMANCE VERIFICATION

After the HP 3562A has been installed, you can verify is operation in two steps. First, attach the power cord to the connector on the rear panel and press the **LINE** switch ON. The display should appear as in figure A-2. The power-on self test takes several minutes. During this test "Start Pending" and "DIAGNOSTIC IN PROGRESS" are displayed. The self test must be run from a power-on (default) state.



(Trace data depends on input connections)

Figure A-2 The HP 3562A Display at Power-On

If the display does not appear as in figure A-2, check to see that the instrument has been installed properly. If necessary, refer servicing to qualified personnel. The list of HP Sales and Support Offices is shown at the end of this manual.

Second, activate the self test by pressing the **SPCL FCTN** key followed by the SELF TEST softkey. After about two minutes, the message "Self Test Passes" should be displayed in the lower right corner of the screen. If it does, the analyzer is performing properly. If, however, a failure message is displayed, the analyzer is in need of service.

HP-IB CONNECTIONS

The HP 3562A is compatible with the Hewlett-Packard Interface Bus (HP-IB). The HP-IB is Hewlett-Packard's implementation of IEEE std. 488-1978, ANSI Standard MC 1.1, and IEC Recommendation 625-1. For complete information on the HP 3562A's HP-IB capabilities, refer to the *HP 3562A Programming Manual.*

The instrument is linked to the bus by connecting an interface cable to the connector located on the rear panel. Figure A-3 illustrates a typical HP-IB system connection.

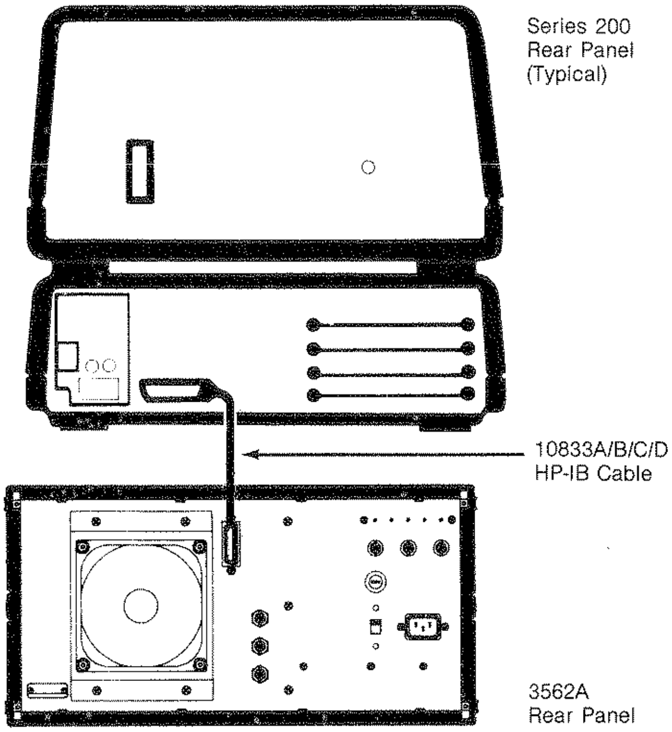


Figure A-3 Typical HP-IB System Connection

Up to 15 instruments can be connected on an HP-IB system. The HP 10833 HP-IB cables have identical piggy-back connectors on each end so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices can be connected in virtually any configuration. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too long, any force on the stack produces great leverage which can damage the connector mounting. Be sure that each connector is firmly screwed in place to keep it from working loose during operation. The HP 3562A uses all the available HP-IB lines; therefore, any damaged connector pins will hinder HP-IB operation.

HP-IB CONNECTIONS

To achieve optimum performance with the HP-IB, proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly, and the system will fail to perform. Total cable length for the system must be less than or equal to 20 meters (65 feet) or 2 meters (6 feet) times the number of devices connected to the bus, whichever is greater.

The following HP-IB cables are available from Hewlett-Packard:

1 m (3.3 ft)	Part Number 10833A
2 m (6.6 ft)	Part Number 10833B
4 m (13.2 ft)	Part Number 10833C
0.5 m (1.6 ft)	Part Number 10833D

CAUTION

The HP 3562A has metric threaded HP-IB cable mounting studs, as opposed to English threads. Metric threaded HP 10833A/B/C/D cables must be used. Metric fasteners are colored black, while English fasteners are colored silver. DO NOT attempt to connect black and silver fasteners, or damage to cable and instrument will result.

For complete instructions on using the HP 3562A with the HP-IB, refer to the *HP 3562A Programming Manual.*

OPERATOR MAINTENANCE

This section explains several maintenance tasks that can be performed safely by all HP 3562A operators.

Cleaning the Front Panel

CAUTION

Harsh chemical cleaners such as acetone and lacquer thinner will destroy the front panel of the HP 3562A, including the display screen and the keycaps. Do not use any cleaners other than a mild detergent.

To clean the front panel, including the display, use a soft, damp cloth with a small amount of mild detergent. For small stains, such as ink, it is safe to use alcohol-based cleaners, but do not dampen the entire front panel. If alcohol is required, start with a very small amount and use as little as possible.

Cleaning the Fan Filter

The fan filter should be cleaned every 30 days, more frequently if the analyzer is operated in dusty environments. To remove the filter, press the **LINE** switch OFF (lower left corner of the front panel) and remove the power cable from its connector. Remove the four knurled nuts holding the fan filter (do not remove the four screws holding the fan assembly). After rinsing the filter and allowing it to dry thoroughly, replace it by reversing the procedure.

Installing Fuses and Selecting Line Voltage

Refer to ''Line Voltage and Fuse Selection'' earlier in this appendix for instructons.

STORAGE AND SHIPMENT

Environment

The HP 3562A should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature	−40° C to +75° C
Humidity	Up to 90%
Altitude	Up to 15,300 meters (50,000 feet)

The instrument should be protected from temperature extremes which cause condensation.

Original Packaging

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

Other Packaging

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

- Wrap the instrument in heavy paper or anti-static plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag to the instrument indicating type of service required, return address, model number, and full serial number.)
- Use a strong shipping container. A double-wall carton made of 350- pound test material is adequate.
- Use a layer of shock absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the front panel with cardboard.

CAUTION

Styrene pellets in any shape should never be used as packing material for electronic instruments. The pellets do not adequately cushion the instrument and do not prevent the instrument from shifting in the carton. The pellets also create static electricity that can damage electronic components.

- Seal shipping container securely.
- Mark shipping container FRAGILE to ensure careful handling.
- In any correspondence, refer to the instrument by model number and full serial number.

ERROR AND STATUS MESSAGES

INTRODUCTION

This appendix provides explanations of the error and status messages displayed by the HP 3562A. Error messages are displayed when the analyzer detects an operator error. Status messages are displayed during various operations to inform you of the analyzer's status.

ERROR MESSAGES

This appendix explains error messages generated by the HP 3562A. Error messages are displayed in the lower left corner of the display, just above the command echo line. Errors are accompanied by an audible beep (if BEEPER ON OFF is ON). The first part of this appendix lists the error messages alphabetically.

If the corrective action is not obvious from the displayed message, refer to this table for more information. The number following each message is the error code returned on the HP-IB with the ERR? command. The error message fall into six categories, according to number:

100—199: Execution errors
200—299: Command errors
300—399: Parameter errors
400—499: HP-IB errors
500—599: Plotter errors
600—699: Disc errors

The error explanations give you one of two types of corrective action. If the operation you attempted is fundamentally valid, but the details were not correct, you are told how to correct the command. An example of this is the "Out Of Range" error. The entry you are attempting is probably valid, you have just exceeded its limits.

If the operation you are attempting is not valid at all, you are given suggestions for avoiding the error. An example of this is the "Function Inactive" error. You are trying to activate a function that is incompatible with the current instrument state—selecting triggering while in the swept sine mode, for example.

STATUS MESSAGES

The HP 3562A displays status messages at various times to inform you of its current state. These messages are displayed in the lower right corner of the screen in bold capital letters. The second part of this appendix lists the status messages alphabetically with explanations. The primary purpose of including status messages in this appendix is to refer you to the proper sections in the operating and programming manuals for more information.

Alpha Too Long (303)

Occurs when an alpha entry greater than 45 characters is attempted.

To avoid this error, keep alpha entries shorter than 45 characters. Refer to the function in entry in question in Chapter 12 for an explanation if its entry limits.

Already Running (137)

Occurs when a curve fit is in progress and START FIT is pressed.

To avoid this error, do not press START FIT while a curve fit is in progress. Press STOP FIT if you want to stop the current fit.

Auto Carrier Selected (308)

Occurs when a demodulated measurement is started and a user carrier is selected that is outside the current measurement span. The analyzer has selected AUTO CRRIER for you.

To avoid this error, activate AUTO CRRIER or enter a user carrier that is inside the current span.

Bad Auto Sequence Table (120)

Occurs if an error is detected when an auto sequence table is being validated. This can happen at power-on and when recalling an auto sequence from disc. The table cannot be recovered.

To avoid future errors, several things should be checked. If the error message was displayed at power-on, either power was lost while the auto sequence was being created or transferred, or the nonvolatile battery needs replacement (servicing required).

If the error message was displayed during recall, power may have been lost while the auto sequence was created or transferred, there may be a problem with your HP-IB cabling, or the storage medium may need replacing.

Bad Capture (131)

This occurs when recalling a capture from disc and the header is not valid. The capture data cannot be recovered.

To avoid future errors, change your storage medium.

Bad Curve Fit Table (130)

Occurs when recalling a curve fit table from disc and the table is not valid. The table cannot be recovered.

To avoid future errors, change your storage medium.

Bad Data Block (123)

Occurs when a data block is loaded into the analyzer that is not valid.

To correct this error, verify that the data block you are trying to load meets the requirements of the load command you are using. Chapter 3 in the *HP 3562A Programming Manual* explains the use of the data transfer commands. If the block was dumped from the analyzer, verify that it was not corrupted while in storage; there may be a problem with your HP-IB cabling or medium.

This error also occurs if you try to curve fit a trace that is not a measured or synthesized frequency response function.

Bad Data Header (124)

Occurs when a data block is loaded into the analyzer and the header for that block is not valid.

To correct this error, verify that the header associated with the data block you are trying to load meets the requirements of the load command you are using. Chapter 3 in the *HP 3562A Programming Manual* explains the use of the data transfer commands. If the block was dumped from the analyzer, verify that it was not corrupted while in storage; there may be a problem with your HP-IB cabling or medium.

Bad Delete Frequency Table (140)

Occurs when a delete frequency table is loaded into the analyzer that is not valid. The table cannot be recovered.

To avoid future errors, several things should be checked. Power may have been lost while the table was created or transferred, there may be a problem with your HP-IB cabling, or the storage medium may need replacing.

Bad Non-volatile State (122)

Occurs at power-on if the nonvolatile state is not valid. The "non-volatile state" comprises those parameters stored in nonvolatile memory and not affected by power-down or presetting (HP-IB addresses, for example). The bad variables cannot be recovered.

To avoid future errors, two things need to be checked. The nonvolatile battery needs replacing (servicing required), or power was lost while one of the nonvolatile parameters was being updated.

Bad # of Parameters (307)

Occurs when you attempt to enter an incorrect number of parameters for the current entry (e.g., entering three variables when only two are requested).

To correct this error, review and correct the entry requirements for the current entry. The command echo field in the lower left corner of the screen shows the number of parameters expected for each entry.

Bad Plotter Data Read (500)

Occurs when START PLOT, READ PEN → P1 or READ PEN → P2 is pressed and the analyzer receives bad data from the plotter.

To correct the error, reset the plotter first by cycling power. If this does correct the error, check the HP-IB cabling. If this does not work, the plotter is in need of servicing.

Bad Primitive Block (134)

Occurs when a primitive block is loaded into the analyzer and its header is not valid, the amount of data is too long for the block, or the block number is out of range.

To correct the error, verify that the block meets the requirements for primitive blocks. Chapter 4 in the *HP 3562A Programming Manual* explains these requirements.

Bad Setup State (119)

Occurs if an error is detected when the instrument state is being validated. This can happen at power-on and when recalling a state. The state cannot be recovered.

To avoid future errors, several things should be checked. If the error message was displayed at power-on or when recalling from internal memory, either power was lost while the state was being changed or transferred, or the nonvolatile battery needs replacement (servicing required).

If the error message was displayed during recall from disc, power may have been lost while the state was being changed or transferred, there may be a problem with your HP-IB cabling, or the storage medium may need replacing.

Bad Synth Table (121)

Occurs if an error is detected when the synthesis table is being validated. This can happen at power-on and when recalling the table from disc. The table cannot be recovered.

To avoid future errors, several things should be checked. If the error message was displayed at power-on, either power was lost while the table was being changed or transferred, or the nonvolatile battery needs replacement (servicing required).

If the error message was displayed during recall from disc, power may have been lost while the table was being changed or transferred, there may be a problem with your HP-IB cabling, or the storage medium may need replacing.

Bad Thrupt (132)

This occurs when a throughput file is measured from disc and its header is bad or the file is empty. The file may be recoverable.

To correct the error, fill the file with data (use START THRUPT), then try to measure it again. If this does not correct the problem, the header is bad and the file cannot be recovered. In this case, to avoid future errors, several things should be checked. Power may have been lost during the throughput session, there may be a problem with your HP-IB cabling, or the storage medium may need replacing.

Buffer Overflow (106)

Occurs when more characters are entered into a display buffer than it was specified to hold.

To correct the error,compare the DBSZ statement for the buffer in question with all subsequent display commands in that buffer. Then either increase the buffer size or eliminate some the buffer's commands.

Calibration in Progress (148)

Occurs when attempting any operation while calibration is in progress.

To avoid this error, wait until calibration is finished.

Cannot Be Complex (139)

Occurs when you attempt to convert a polynomial synthesis table containing complex coefficients to another type.

To avoid the error, do not attempt to convert complex polynomial tables. To be converted, coefficients must be real-only.

Cannot Recall Thruput (600)

Occurs if you attempt to recall a throughput file. These can be measured from disc when throughput is active only—they cannot be recalled as other disc files can.

To avoid the error, do not specify a throughput file when recalling a file from disc. If you want to measure the file, specify it as the active file. Chapter 6 shows the steps required for throughput measurements.

Catalog Full (603)

Occurs when attempting to save, create or copy a file on disc and there is no room for another catalog entry. This differs from the "Disc Full" error in which their is no more space for data.

To avoid the error, switch to another disc. Once a catalog has been initialized, there is no way to request more catalog space without erasing the entire disc. If you need to store or create the file on this particular disc, you can delete another file then pack the disc to recover another entry. Depending on the number of sectors already deleted, you may be able to pack without deleting any more.

Catalog Not In Memory (617)

Occurs when you attempt to activate the disc catalog pointer and no catalog file has been read from disc (or it has been erased).

To avoid this error, read the disc catalog (press VIEW CATLOG in the DISC menu) before attempting to activate the pointer.

Cannot Use Zoom Data (136)

Occurs when attempting to use a zoomed throughput file as the source for a log resolution measurement.

To avoid this error, use only baseband throughput files for log resolution measurements.

Command Too Long (203)

Occurs when an HP-IB mnemonic is received that contains more than four alpha characters.

To correct this error, review and correct the syntax for the command in question. The Quick Reference Guide shows the characters that the HP 3562A expects for each mnemonic.

Cross Corr, No 1 Ch Demod (103)

Occurs when the cross correlation measurement is selected and you are demodulating on only one channel.

To avoid the error, turn demod off, activate DEMOD BOTH (in the DEMOD SELECT menu), or choose a single-channel measurement.

Data Blocks Incompatible (113)

Occurs when an operation is requested that is incompatible with the specified blocks (complex division on real blocks, for example).

To avoid the error, review the requirements for the signal processing command in question and specify data blocks accordingly. Chapter 4 in the *HP 3562A Programming Manual* explains the requirements of each command.

Data Type Incompatible (112)

Occurs when an operation is requested and the data blocks involved are incompatible (different number of points or different data types, for example).

To avoid the error, review and modify the attempted operation or the blocks involved.

Alpha Delimiter Expected (204)

Occurs when an alpha entry is attempted via HP-IB and the command was not terminated by an acceptable delimiter (pair of double quote marks ("."') or a single quote (')—it must match the opening delimiter.

To correct this error, review and correct the delimiter used. The Quick Reference Guide describes the syntax required for each command.

Demod in Zoom Only (142)

Occurs when a demodulation measurement is attempted and the start frequency is 0 Hz (i.e., baseband).

To avoid the error, set the start frequency to any non-zero value.

Destination Too Small (624)

Occurs when attempting an image backup where the destination disc or tape is too small to receive the entire data image of the source.

To avoid the error, replace the destination with one having at least the same storage capacity as the source. You can also selectively copy files to the destination until it is full.

Disc Fault (613)

Occurs when a disc access is requested and a disc drive failure is detected.

To correct the error, view the disc status display to determine the cause of the failure. Refer servicing to qualified personnel.

Disc Full (607)

Occurs when attempting to save, create or copy a file on disc and there is not enough data space available.

To avoid the error, you have several options. First, switch to another disc. Second, delete files from the disc then pack it to reclaim data space. (Depending on the number sectors already deleted, you may be able to just pack without deleting any more.) Third, when creating throughput files, you may be able to reduce the file size and fit a smaller file on the disc.

Disc Reject (608)

Occurs when a disc access is requested and the disc rejected the access.

To correct the error, view the disc status display to determine the source of the error. If necessary, refer servicing to qualified personnel. You should also check the HP-IB cabling and other devices on the bus.

Disc Transfer Error (614)

Occurs when a disc access is requested and the data did not get transferred to disc correctly (such as an aborted throughput).

To correct the error, view the disc status display to determine the source of the error. If necessary, refer servicing to qualified personnel. Ignore this if you have just aborted a throughput session.

Disc Write Protected (612)

Occurs when saving or creating a file on a disc that is write protected.

To avoid this error, determine why the disc was write protected in the first place. If you then decide you want to write to the disc anyway, remove the write protection according to the instructions in the disc drive's operating manual.

ENTRY Not Enabled (309)

Occurs when attempting to use the Entry group (lower knob, up/down arrows, **0-9** keys or **MARKER VALUE**) and the analyzer has not requested an input.

To avoid this error, verify that you have enabled an entry before using the Entry group.

Extra Chars in Command (206)

Occurs when a command line sent over HP-IB has extra characters following a valid command. (For example, SRLV 5V ABC.)

To correct the error, review the command syntax as shown in the Quick Reference Guide.

File Not Found (606)

Occurs when recalling or deleting a file from disc and the file cannot be found (or recalling locally and no data was saved).

To avoid the error, verify spelling of the desired file name and verify that it is an HP 3562A file. Chapter 11 has information on file handling.

File Size Not Specified (618)

Occurs when attempting to create a throughput file without first specifying the file size (using THRUPT SIZE).

To avoid this error, specify file size before attempting to create throughput files. If you want to use the previously specified size, press THRUPT SIZE to confirm this, then create the file.

Freq Resp, No 1 Ch Demod (102)

Occurs when the frequency response measurement is selected and you are demodulating on only one channel.

To avoid the error, turn demod off, activate DEMOD BOTH (in the DEMOD SELECT menu), or choose a single-channel measurement.

Function Inactive (207)

Occurs when attempting to activate a function that is incompatible with the current instrument state.

To avoid this error, review the function you are trying to activate and the current instrument state to determine the conflict. The key and softkey descriptions in Chapter 12 may help identify the problem.

Invalid: Log Data (145)

Occurs when special markers are activated with log x-axis data.

To avoid this error, do not attempt special marker functions with log x-axis data.

Invalid: Nichols/Nyquist (144)

Occurs if special markers are activated with Nichols or Nyquist display.

To avoid the error, do not attempt special marker functions on these displays.

Line Too Long (202)

Occurs if an HP-IB command line with greater than 80 characters is sent to the analyzer.

To correct the error, limit your command lines to 80 characters. For example, in BASIC do not send more than 80 characters with the OUTPUT statement.

Loops Nested Too Deep (141)

Occurs when an auto sequence is started than has loops nested greater than three levels deep.

To avoid the errors, limit loop nesting to three levels.

Marker Not On (125)

Occurs when the **MARKER VALUE** key is pressed and a marker is not on.

To correct the error, activate a marker or make the entry manually.

May Be Inaccurate (138)

Occurs when the pole/zero finder part of the curve fitter or synth table is slow to converge. This implies that the resulting pole and zero locations may be less accurate than normal.

Measurement in Progress (110)

Occurs when a measurement is in progress and you attempt to activate functions such as auto math, auto sequence and synthesis.

To correct, wait until the measurement is finished, or press **PAUSE CONT** to pause the measurement.

Missing Input (300)

Occurs when the analyzer is expecting a numeric input and you terminate the entry without entering a number. For example, the key sequence MATH: ADD: ENT generates this error.

To correct the error, enter a number before terminating the entry.

No Active Display Buffer (116)

Occurs when attempting to use the graphics commands without first activating a user display buffer.

To correct the error, activate a buffer first using DBAC (display buffer active clear) or DBAA (display buffer active append). Chapter 6 in the *HP 3562A Programming Manual* explains the steps for using display buffers.

No Avg For Demod Hist (149)

Occurs when attempting to average histogram measurements while in demod.

To avoid this error, select AVG OFF.

No Capture Data (127)

Occurs when **START** is pressed in capture mode or you try to enable the capture pointer or change the capture increment and the capture buffer does not contain any captured data.

To avoid this error, avoid these operations until the capture buffer contains valid data as a result of a time capture.

No Carrier (146)

Occurs when attempting the MOD INDEX calculation and the carrier is outside the measurement span.

To correct the error, enter a carrier that is inside the current frequency span.

No Coord Change Allowed (107)

Occurs when attempting to select display coordinates for the ORBITS T1vsT2 or DEMOD POLAR displays.

To avoid this error, do not attempt to change the coordinates on these displays: they are not user-definable.

No Data (109)

Occurs when there are no valid data for the display.

To correct, put a data trace on the display using the Display group of keys.

No Disc In Drive (611)

Occurs when a disc access is attempted and there is no disc in the specified drive unit.

To correct this error, insert a disc if the drive is empty or verify the disc address and unit number to make certain the analyzer is accessing the drive you want it to access.

No Fundamental (104)

Occurs when attempting the THD calculation and the fundamental frequency is outside the measurement span.

To correct the error, enter a fundamental that is inside the current frequency span.

No Peak Avg in CORR Meas (101)

Occurs when a correlation measurement is selected and peak hold or continuous peak averaging is active.

To avoid this error, do not use these combinations of measurement and averaging type. Peak averaging applies only to frequency domain measurements.

No Peak Avg in HIST Meas (100)

Occurs when the correlation measurement is selected and peak hold or continuous peak averaging is active.

To avoid this error, do not use these combinations of measurement and averaging type. Peak averaging applies only to frequency domain measurements.

No Peak Hold In Time Avg (147)

Occurs when attempting peak hold averaging when time averaging is ON.

To avoid this error, turn time averaging OFF.

No Spares or Fault Area (615)

Occurs when attempting to spare block on a medium that has no remaining spares, or a fault has occurred and the disc has no room to record it.

To avoid this error, do not attempt to spare blocks on such media. NOTE: any medium that does not have any spares or fault area available should be backed up and replaced.

No Thrupt Data (128)

Occurs when THRUPT TIME 1, THRUPT TIME 2 or NEXT RECORD is pressed and there are no throughput data in the throughput file for that channel.

To avoid the error, throughput on the desired channel or don't try to display it.

No Thrupt File (616)

Occurs when attempting a throughput session or measurement, when reading the throughput header, or when using the THRUPT TIME 1 and 2 softkeys and the specified active file cannot be found.

To correct this error, either specify a valid active file or create a throughput file under the desired name.

No Valid Marker Units (126)

Occurs when MARKER VALUE is used to make an entry an the marker units do not match those requested by the analyzer.

To correct the error, change the units to match the units requested (may not be possible) or make the entry manually.

Not a Valid Auto Math (118)

Occurs when AUTO MATH is selected as a measurement display and the auto math table contains keys or softkeys other than **A, B, A&B, MATH** and its softkeys, or **MEAS DISP** and its softkeys (or a **MATH** softkey after **MEAS DISP**).

To correct the error, edit the auto math table to remove all commands that are not valid. An "R" is displayed by each line in the listing that generated an error.

Not A Valid Block Length (400)

Occurs when the length of a block is ≤ 0 or $>32,767$ bytes. Length is specified by the 16-bit word following the mode indicator (#A or #I).

To correct the error, review the transfer you are attempting and change either the length word of the length of the block.

Not a Valid Block Mode (401)

Occurs when an invalid data format is used for data transfers to or from an external controller. Only #A (ANSI and internal binary) and #I (ASCII) block modes are allowed.

To avoid the error, do not attempt transfers using invalid data formats.

Not A Valid Catalog (601)

Occurs when attempting to read a catalog that is not valid. This could be a result of data corruption on the medium, power loss during a data access, or using a medium that has been formatted but has not had a catalog initialized on it.

To correct this error, first verify that it is the proper disc, then restore or initialize the catalog as necessary.

Not a Valid Display (605)

Occurs when attempting to save a display to disc that cannot be saved (a disc catalog, for example).

To avoid the error, change the display before attempting to save it.

Not a Valid Number (302)

Occurs when entering a numeric parameter that is not a valid number. For example, the entry 5..0 generates this error.

To correct the error, match the entry format required for the current parameter. The requirements of each entry are displayed in the command echo line in the lower left corner of the display.

Not a Valid Name (604)

Occurs when specifying a disc file or volume name that is not compatible with Hewlett-Packard's Logical Interchange Format (LIF) or the requirements of the HP 35 62A.

To avoid the error, make sure your file names start with an alphanumeric character (0-9, A-Z) and include only alphanumerics and underscores. Disc file names are limited to 8 characters. Volume names (INIT CATLOG & INIT DISC), must start with a letter (A-Z), cannot contain underscores, and are limited to 6 characters.

Not a Valid Terminator (205)

Occurs when a command with a number was entered and it was not properly terminated.

To correct the error, review the syntax of the command in question. Entries that are terminated by the ENTER or ENT softkeys do not require termination over the bus; all others entries need a terminator. For example, NAVG10 (number of averages) is valid, but CF10 (center frequency) is not.

Not a Valid User Window (133)

Occurs when the user-defined window is selected and the SAVED DATA#1 area does not contain a real-only time domain function.

To correct this error, replace the function in SAVE DATA#1 with a valid windowing function or switch to another window type.

Not Active Softkey (200)

Occurs when making a selection via HP-IB and the function in question is not active. For example, you cannot clear an auto sequence without first selecting and displaying it.

To correct this error, review the requirements for the command in question in the Quick Reference Guide. This explains the menu that needs to be active before using each command.

Not HP-IB Controller (402)

Occurs when attempting to copy files or output command strings while the analyzer is in addressable-only mode.

To correct this error, select SYSTEM CNTRLR before starting these operations.

Not in Frequency Domain (108)

Occurs when the sideband or harmonic markers are activated and the active trace is not in the frequency domain. The markers remain active, but will not be displayed until you change the trace to the frequency domain.

To avoid the error, turn the markers off or switch to a frequency domain display.

Not Valid For This Disc (623)

Occurs when attempting disc service diagnostics on disc drive command sets not supported by the HP 3562A.

To avoid this error, use the disc servicing diagnostics only with Hewlett-Packard Command Set/80 and Subset/80 disc drives. Note that some of the SS/80 diagnostics are not implemented.

Not Valid Format Option (622)

Occurs when selecting a Subset/80 format option that is not valid for this disc.

To correct the error, refer to your disc drive's manual for acceptable values.

Not Valid Units (301)

Occurs when a frequency or time entry is made with a terminator that is incompatible with the sampling units. For example, entering frequency in orders while in internal sampling.

To correct the error, use compatible units or change the sampling mode.

Number Too Long (304)

Occurs when a number greater than 24 characters is entered.

To correct the error, limits numeric entries to 24 characters.

Numeric Overflow (143)

Occurs when the floating point representation of a two's complement 16-bit integer is too large in a transferred block.

To correct the error, review the data format being used and constrain all data to that format.

Out Of Range (305)

Occurs when the attempted entry is outside the allowable range of the current entry function.

To correct this error, constrain the entry to the limits allowed for the current function. Refer to Chapter 12 for descriptions of individual entry limits.

Recall Active Auto Seq (609)

Occurs when an auto sequence is recalled from disc into an auto sequence that is currently running. Either the auto sequence recalled itself or recalled another auto sequence into its own table.

To avoid the error, remove or modify the recall command that caused the error.

Recursive Call (117)

Occurs when an auto sequence calls itself, either directly or indirectly.

To avoid the error, remove or modify the command that caused the error. If you need to loop an auto sequence, use the LOOP TO or GO TO softkey.

Sector Size < > 256 Bytes (621)

Occurs when attempting to access a disc with sector size other than 256 bytes.

To avoid this error, use only discs that are formatted at 256/bytes sector. This is the only sector size compatible with the HP 3562A. (See the "Formatting Discs" in Chapter 11.)

Select Capture to Recall (619)

Occurs when trying to recall a capture file from disc and the analyzer is not in the time capture mode.

To correct the error, first verify that this is the file you want to recall. If so, select the time capture mode (press **MEAS DISP** followed by TIME CAPTUR) before attempting to recall it.

Source Block Empty (114)

Occurs when attempting a signal processing operation and the source data block is empty.

To correct the error, fill the source block first or avoid the operation.

Source = Destination (620)

Occurs when attempting a file copy or image backup and the source address and unit match the destination address and unit (you cannot copy or backup a disc to itself).

To correct this error, review the source and destination addresses and unit numbers and change them so they are no longer equal.

Thrupt Data Too Long (129)

The active throughput file is not large enough to accept the session length you have set up.

To correct, set the session length equal to or smaller than the file size. Remember that two-channel sessions require twice the number of records. Also, if you have changed the frequency span, session length entries in units of time may no longer be valid because the corresponding record length has changed.

Trace Not Compatible (111)

Occurs when attempting math operations on traces that are not compatible.

To correct, review the desired operation and the traces involved to see if they are compatible. For example, you cannot add a frequency domain trace to a time domain trace. Chapter 9 has more information.

Unable to Curve Fit (306)

Occurs when a frequency response measurement is so poor in quality that the curve fitter is unable to fit it. Can also occur if the curve fit is set up incorrectly.

To correct the error, use a better-quality frequency response and review your curve fit setup.

Unformatted Disc (602)

Occurs when attempting to access a disc that has not been formatted.

To correct this error, format the disc (using INIT DISC) before attempting data accesses to it.

Unknown Disc Command Set (610)

Occurs when attempting to access a disc drive whose command set is not supported by the HP 3562A. Hewlett-Packard Command Set/80, Subset/80, and Amigo command sets are supported.

To avoid the error, use only supported disc drives.

Unknown Mnemonic (201)

Occurs when sending an HP-IB command that the analyzer does not recognize.

To correct this error, review the command string that generated the error message and change the incorrect mnemonic. The Quick Reference Guide provides mnemonics for all hardkeys, softkeys and bus-only commands.

User Display Not Enabled (115)

Occurs when attempting to send display graphics commands without first creating and activating a display buffer.

To correct the error, first create a buffer with DBSZ then activate it with DBAC. Chapter 5 of the *HP 3562A Programming Manual* explains the steps needed to generate custom displays.

View Input Disabled (135)

Occurs if you try to view the input signals during a capture or throughput measurement. The input channels are disabled while you are measuring captured data from the time buffer or throughputted data from a disc file.

To avoid the error, don't try to view the input signals during capture or throughput measurements.

X Marker Must be Active (105)

Occurs when one of the read X marker commands is sent to the analyzer and the X marker is not on.

To correct this error, activate the X marker before using RDMK.

ACCEPT DATA? (YES/NO)

Displayed when manual previewing is active and the analyzer is waiting for you to accept or reject the displayed record. To accept, press the **YES (1)** key. To reject, press the **NO (0)** key (ACPT, REJT from HP-IB). For information on previewing, see Chapter 1.

ALPHA MODE

Displayed while the analyzer is in the alpha input mode. This mode is entered automatically whenever an alphanumeric entry is required (after pressing TRACE TITLE, for example). In this mode, the keys (except **LINE, HELP** and **0-9**) are converted to their blue labels. For information on the alpha mode menu, see "The Alpha Menu" in Chapter 12.

AUTO MATH EDIT

Displayed while the auto math table is being edited. In this mode, any key press is entered in the table. To exit, press END EDIT. Chapter 9 has information on auto math.

AUTO MATH LOAD

Displayed while the auto math table is being loaded from the analyzer's internal memory. The contents of the table are listed on the display. Chapter 9 has information on auto math.

AUTO MATH RUNNING

Displayed while the auto math table is running. Chapter 9 has information on auto math.

AUTO SEQUENCE EDIT

Displayed while an auto sequence table is being edited. In this mode, any key press is entered into the auto sequence. To exit, press END EDIT. Chapter 10 has information on auto sequences.

AUTO SEQUENCE LOAD

Displayed while an auto sequence is being loaded from internal memory. The contents of the auto sequence are listed on the display. Chapter 10 has information on auto sequences.

AUTO SEQUENCE RUNNING

Displayed while an auto sequence is running. Chapter 10 has information on auto sequences.

CALCULATION IN PROGRESS

Displayed while lengthy math calculations are in progress. Chapter 9 has information on waveform math.

CALIBRATION IN PROGRESS

Displayed while the analyzer is calibrating the inputs. Chapter 7 has information on the calibration feature.

CAPTURE IN PROGRESS

Displayed while a time capture is in progress. The captured time buffer is displayed when the capture is finished. To abort the capture, press ABORT CAPTUR. Chapter 4 has information on the time capture mode.

CREATE WEIGHT

Displayed while the curve fitter is creating a weighting function from the curve fit data. Chapter 9 has information on curve fitting.

CURVE FIT IN PROGRESS

Displayed while a curve fit is in progress. To abort the fit, press STOP FIT. Chapter 9 has information on the curve fitter.

DATA REJECTED

Displayed when a time record has been rejected by the overload rejection feature, indicating that some part of the record exceeded the input range. Chapter 1 has information on overload rejection.

DEMODULATION IN PROGRESS

Displayed while a demodulation measurement is in progress. Because of the number of calculations involved, demodulation measurements require more time than normal linear resolution measurements. Chapter 5 has information on demodulation.

DIAGNOSTIC IN PROGRESS

Displayed while a service diagnostic test is in progress. This occurs in two situations of interest to operators. At power-on, the self test is run and this status message and "Start Pending" are displayed together. As long as the messages disappear and the analyzer starts normal operation, there is no need for concern. The other time it is displayed for operators is after the SELF TEST softkey is pressed. As with power-on, if the message disappears after several seconds, the analyzer is operating properly. However, if a test failure indication is displayed in either case, the analyzer needs servicing. Refer to the *HP 3562A Service Manual* for more information.

EXT REFERENCE NOT LOCKED

Displayed when an external reference signal is applied and the analyzer is not phase-locked to it. Refer to "Ref In (connector)" in Chapter 12 for the signal requirements.

FAST AVERAGING

Displayed while fast averaging is in effect (the display does not update). Chapter 1 has information on fast averaging.

FILE COPY IN PROGRESS

Displayed while a disc file is being copied. Chapter 11 has more information on file copying.

FILLING TIME RECORD

Displayed when the analyzer is measuring the first record on lower-frequency spans. Partial block FFTs can be displayed while the time record is filling.

FILTERS SETTLING

Displayed when the analyzer's digital filter is settling. Averaged measurements do not start until the filters settle. The nominal settling time is 102 points.

FORMAT DISC IN PROGRESS

Displayed while a disc format is in progress. Chapter 11 has information on disc formatting.

HELP MODE, PRESS ANY KEY

Displayed after you press the **HELP** key. The next key or softkey you press will display a description of that feature. The Help mode is exited after each press. Press any key in the Display group to return the previous display.

IMAGE BACKUP IN PROGRESS

Displayed while an image backup is in progress. Chapter 11 has more information on image backups.

MARKER CALC IN PROGRESS

Displayed when lengthy special marker calculations are in progress.

MISSED SAMPLE

Displayed if a sample of the input signal is missed because the external sampling frequency is too high (>256 kHz). Chapters 1, 2 and 4 have information on external sampling.

PACK DISC IN PROGRESS

Displayed while disc is being packed. Chapter 11 has information on disc packing.

PLOT IN PROGRESS

Displayed while a plot is in progress. The plot can be aborted by pressing the ABORT HP-IB softkey. Chapter 11 has information on using a plotter.

RAMPING SOURCE

Displayed while the source is being ramped up or down. Refer to "Source Protection" in Chapters 1-4 depending on the current mode.

READ ERT IN PROGRESS

Displayed while the read-only ERT is in progress. Chapter 11 has information on the ERT and the other disc servicing features.

RESTORE DISC IN PROGRESS

Displayed while a disc restoration is in progress. Chapter 11 has information on restoring discs.

SWEEP POINT READY

Displayed when the sweep point ready bit in the instrument status register is set and the analyzer is in the addressable-only mode. Chapter 6 in the *HP 3562A Programming Manual* shows how to read sweep points via HP-IB.

SYNTH TABLE CONVERSION

Displayed while the synthesis table is being converted from one type to another. Chapter 9 has information on synthesis.

SYNTHESIS IN PROGRESS

Displayed after CREATE TRACE is pressed and a frequency response synthesis is in progress. The resultant trace is displayed when the synthesis is finished. Chapter 9 has information on synthesis.

SYSTEM FAILURE

Displayed when a system failure is detected and an error is logged in the fault log. Refer servicing to qualified personnel.

THROUGHPUT IN PROGRESS

Displayed while a throughput session is in progress. Chapter 6 has information on the time throughput feature.

TIMED PREVIEW (YES/NO)

Displayed when timed previewing is active and the analyzer is pausing for you to accept or reject the displayed record. Press **YES (1)** to approve or **NO (0)** to reject. Chapter 1 has information on timed previewing.

WAITING FOR ARM

Displayed when the trigger is waiting to be armed. This occurs when ARM AU MAN is set the MAN (manual arming). To arm the trigger, press the **ARM** key. Chapter 7 has information on manual triggering.

WAITING FOR DISC

Displayed when a disc access is requested and the specified action is not occurring. Press ABORT HP-IB to halt access. Chapter 11 has more information on using disc drives. You should also verify your HP-IB addressing and cabling.

WAITING FOR HP-IB

Displayed when the analyzer is waiting for a response from a device on the bus. If necessary, verify your addressing and cabling, then try the operation again.

WAITING FOR TRIG

Displayed when the trigger has been armed (either auto or manually), and it is now waiting for the specified trigger signal conditions (slope and level) to be met. Chapter 7 has information on triggering.

HP 3562A SPECIFICATIONS

Specifications describe the instrument's warranted performance. Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance specifications. Supplemental characteristics are denoted as 'typical,' 'nominal,' or 'approximately.'

Frequency

Measurement Range: 64 μHz to 100 kHz, both channels, single- or dual-channel operation

Accuracy: ±0.004% of frequency reading

Resolution: Span/800, both channels, single- or dual-channel operation, Linear Resolution mode

Spans:	Baseband	Zoom
# of spans	66	65
min span	10.24 mHz	20.48 mHz
max span	100 kHz	100 kHz
time record (Sec)	800/span	800/span

Window Functions: Flat Top, Hann, Uniform, Force, Exponential and User-Defined

Window Parameters:	Flat Top	Hann	Uniform
Noise Equiv BW (% of span)	0.478	0.188	0.125
3 dB BW (% of span)	0.45	0.185	0.125
Shape factor (60 dB BW/3 dB BW)	2.6	9.1	716

Typical Real Time Bandwidths:

Single-channel, single display	2.5 kHz
Single-channel, Fast Averaging	10 kHz
Dual-channel, single display	2 kHz
Dual-channel, Fast Averaging	5 kHz
Throughput to CS/80 disc	
Single-channel	10 kHz
Dual-channel	5 kHz

Amplitude

Accuracy: Defined as Full Scale Accuracy at any of the 801 calculated frequency points. Overall accuracy is the sum of absolute accuracy, window flatness and noise level.

Absolute Accuracy:
Single Channel (Channel 1 or Channel 2)
±0.15 dB ±0.015% of input range (+27 dBV to −40 dBV, input connections as specified in Cases 1 and 2 below)
±0.25 dB ±0.025% of input range (−41 dBV to −51 dBV, input connections as specified in Cases 1 and 2 below)

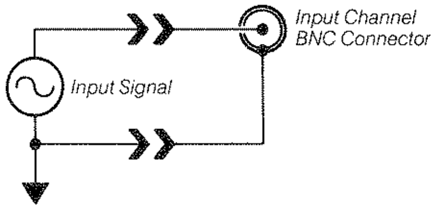
DC Response: Auto-Cal and Auto-Zero on

Input Range (dBV rms)	dc Level
+27 to −35	>30 dB below full scale
−36 to −51	>20 dB below ful scale

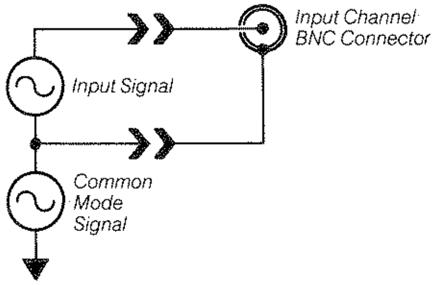
Frequency Response Channel Match:
±0.1 dB, ±0.5 degree (input connections as specified in Cases 1 and 2 below)

Input Connections:
Cases 1 and 2 are the recommended input connections. For these cases, the amplitude accuracy specified above is applicable.

Case 1

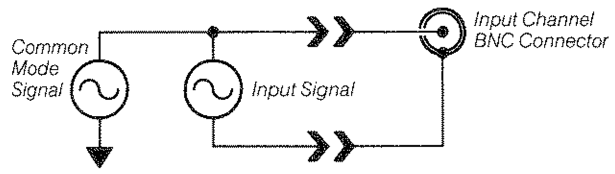


Case 2

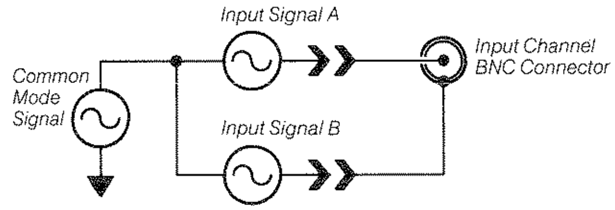


Cases 3 and 4 are input connections which degrade amplitude accuracy. For these cases, the amplitude accuracy specified above must be modified with the accuracy adders stated below.

Case 3



Case 4



Accuracy Adder: Single-channel, inputs connected as shown in Cases 3 and 4 above.
Add ±0.35 dB and ±4.0 degrees to the absolute accuracy.

Accuracy Adder: Dual-channel measurements
Add ±0.35 dB and ±4.0 degrees once for each input connected as shown in Cases 3 and 4 above.

Window Flatness:

Flat Top:	+0, −0.01 dB
Hann:	+0, −1.5 dB
Uniform:	+0, −4.0

Noise Floor: Flat top window, 50 Ω source impedance, −51 dBV range
20 Hz to 1 kHz (1 kHz span) < −126 dBV (−134 dBV/√Hz)
1 kHz to 100 kHz (100 kHz span) < −116 dBV (−144 dBV/√Hz)

Dynamic Range: All distortion (intermodulation and harmonic), spurious and alias products ≥80 dB below full scale input range (16 averages) <10KΩ termination

Phase

Accuracy: Single channel, input connections as specified above in Cases 1 and 2, referenced to trigger point.

<10 kHz	±2.5 degrees
10 kHz to 100 kHz	±12.0 degrees

Inputs

Input Impedance: 1 MΩ ±5% shunted by <100 pF

Input Coupling: The inputs may be ac or dc coupled; ac rolloff is <3 dB at 1 Hz

Crosstalk: −140 dB (50 Ω source, 50 Ω input termination, input connectors shielded)

Common Mode Rejection:

0 Hz to 66 Hz	80 dB
66 Hz to 500 Hz	65 dB

Common Mode Voltage: dc to 500 Hz

Input Range (dBV rms)	Maximum (ac + dc)
+27 to −12	±42.0 Vpeak
−13 to −51	±18.0 Vpeak*

*For the −43 to −51 dBV input ranges, common mode signal levels cannot exceed ±18 Vpeak or (Input Range) + (Common Mode Rejection), whichever is the lesser level.

Common Mode Voltage: 500 Hz to 100 kHz. The ac part of the signal is limited to 42 Vpeak or (Input Range) + (10 dB), whichever is the lesser level.

Common Mode Distortion: For the levels specified, distortion of common mode signals will be less than the level of the rejected common mode signal.

External Trigger Input Impedance: Typically 50 kΩ ±5%

External Sampling Input: TTL compatible input for signals ≤256 kHz (nominal maximum sample rate).

External Reference Input:
Input Frequencies: 1, 2, 5 or 10 MHz ±0.01%
Amplitude Range: 0 dBm to +20 dBm (50 Ω)

Trigger

Trigger Modes: Free Run, Input Channel 1, Input Channel 2, Source and External Trigger. Free Run applies to all Measurement Modes; Input Channel 1, Input Channel 2, Source and External Trigger apply to the Linear Resolution, Time Capture and Time Throughput measurement modes.

Trigger Conditions:
Free Run: A new measurement is initiated by the completion of the previous measurement.

Input: A new measurement is initiated when the input signal to either Channel 1 or Channel 2 meets the specified trigger conditions. Trigger Level range is ± 100%of Full Scale Input Range; Trigger Level is user-selected in steps of (Input Range in volts)/128.

Source: Measurements are synchronized with the periodic signal types (burst random, sine chirp and burst chirp).

External: A new measurement is initiated by a signal applied to the front panel External Trigger input. Trigger Level range is ±10 Vpeak; Trigger Level is user selected in 80 mV steps.

Trigger Delay:
Pre-Trigger: The measurement can be based on data from 1 to 4096 samples (1/2048 to 2 time records) prior to trigger conditions being met. Resolution is 1 sample (1/2048 of a time record).

Post-Trigger: The measurement is initiated from 1 to 65,536 samples (1/2048 to 32 time records) after the trigger conditions are met. Resolution is 1 sample (1/2048 of a time record).

Source

Band limited, band translated random noise, burst random, sine chirp, burst chirp, as well as fixed sine and swept sine signals are available from the front panel Source output. DC Offset is also user-selectable.

Output Impedance: 50 Ω (nominal)

Output Level: ≤ ±10 Vpeak (ac + dc) into a ≥10 kΩ, <1000 pF load. Maximum current = 50 mA.

AC Level: ±5 Vpeak (≥10kΩ, <1000 pF load)

DC Offset: ±10 Vpeak in 100 mV steps. Residual offset at 0 V offset ≤10 mV.

% In-Band Energy: (1 kHz span, 5 kHz center frequency)
Random Noise: 70%
Sine Chirp: 85%

Accuracy and Purity: Fixed or Swept Sine
Flatness: ±1 dB (0 to 65 kHz),
+1, −1.5 dB (65 kHz to 100 kHz)

Distortion: (including subharmonics)

dc to 10 kHz	−60 dB
10 kHz to 100 kHz	−40 dB

General

Specifications apply when AUTO CAL is enabled, or within 5°C and 2 hrs of last internal calibration (except for transient environmental changes).

Ambient temperature: 0° to 55° C.
Relative Humidity: ≤95% at 40°C.
Altitude: 4,572 m (15,000 ft)

Storage:
Temperature: −40° to +75°C.
Altitude: ≤ 15,240m (50,000 ft)

Power:
115 VAC +10% — 25%, 48 to 440 Hz
230 VAC + 10% — 25%, 48 to 66 Hz
450 VA maximum

Weight:
26 kg (56 lbs) net
35 kg (77 lbs) shipping

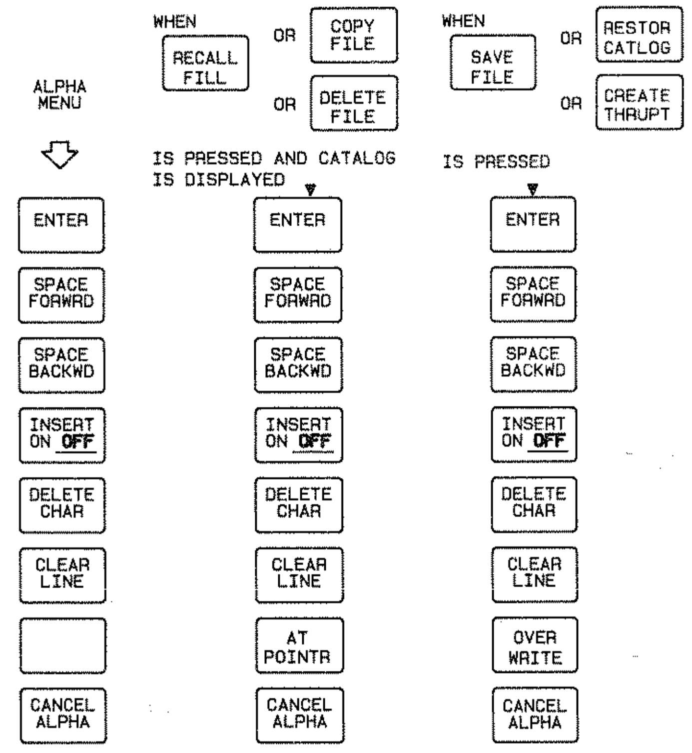
Dimensions:
222 mm (8.75 in) high
426 mm (16.75 in) wide
578 mm (22.75 in) deep

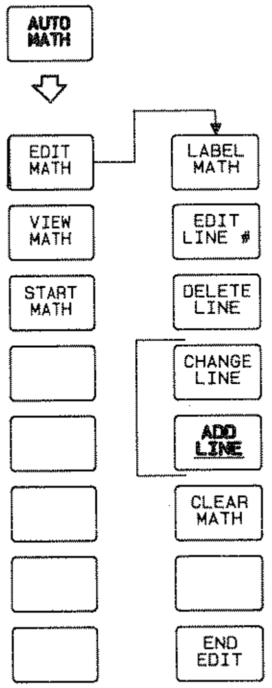
HP-IB:
Implementation of IEEE Std 488-1978
SH1 AH1 T5 TE0 L4 LE0 SR1 RL1 PP0 DC1 DT1 C0
Supports the 91XX and 794X families of HP disc drives as well as Hewlett-Packard Graphics Language (HP-GL) digital plotters.

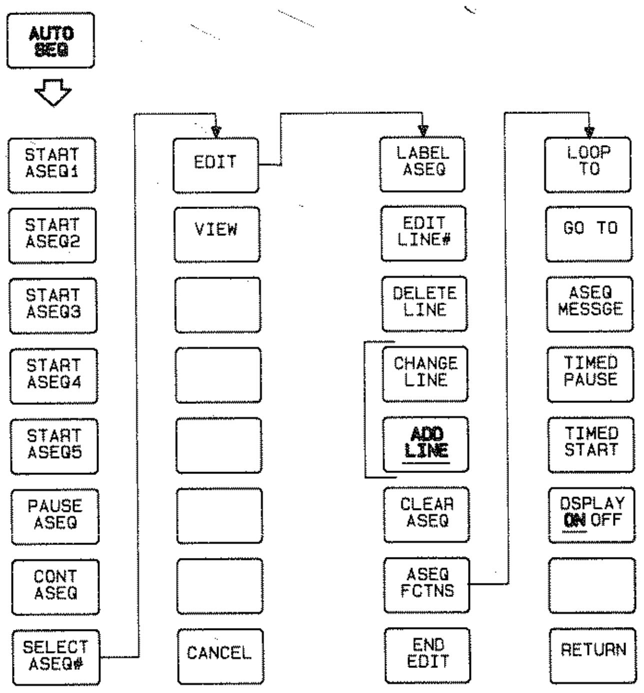
PURPOSE OF THIS APPENDIX

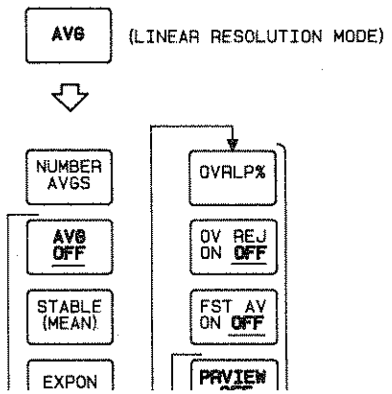
This appendix provides diagrams of the HP 3562A's softkey menus. Each diagram is a "map" that allows you to view all the softkeys under a particular key. Several menus are variable (they depend on other softkey selections); in these cases, notes are provided to explain the cause of each variance.

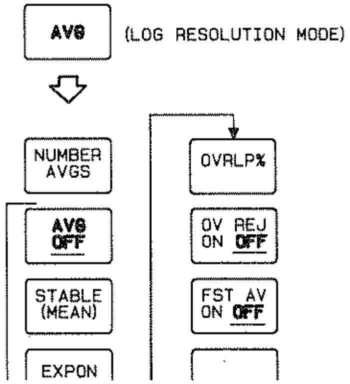
These menu diagrams are arranged in alphabetical order by key. ("Key" refers to a key on the front panel with a permanently etched label. "Softkey" refers to one of the eight unlabeled provided graphically by the display.) Refer to Chapter 12, "Operating Reference," if you need to learn more about a particular key or softkey.

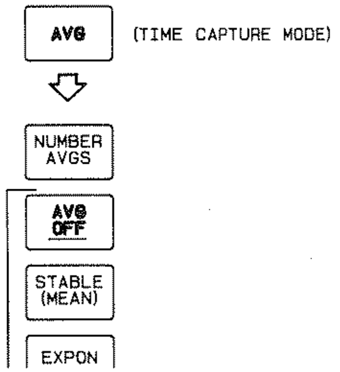

ALPHA MENU
ENTER
SPACE FORWRD
SPACE BACKWD
INSERT ON OFF
DELETE CHAR
CLEAR LINE
CANCEL ALPHA
WHEN
RECALL FILL
OR
COPY FILE
OR
DELETE FILE
IS PRESSED AND CATALOG IS DISPLAYED
ENTER
SPACE FORWRD
SPACE BACKWD
INSERT ON OFF
DELETE CHAR
CLEAR LINE
AT POINTR
CANCEL ALPHA
WHEN
SAVE FILE
OR
RESTOR CATLOG
OR
CREATE THRUPT
IS PRESSED
ENTER
SPACE FORWRD
SPACE BACKWD
INSERT ON OFF
DELETE CHAR
CLEAR LINE
OVER WRITE
CANCEL ALPHA

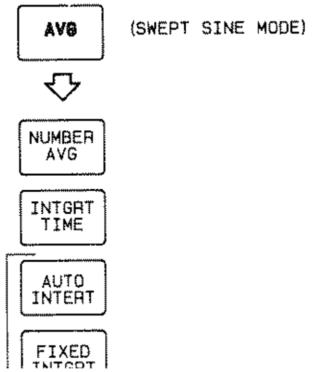

AUTO MATH
EDIT MATH
VIEW MATH
START MATH
LABEL MATH
EDIT LINE #
DELETE LINE
CHANGE LINE
ADD LINE
CLEAR MATH
END EDIT

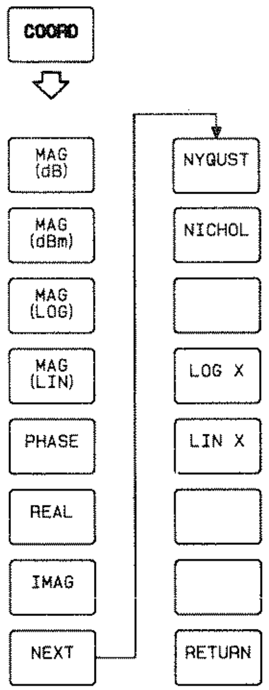

AUTO SEQ
START ASEQ1
START ASEQ2
START ASEQ3
START ASEQ4
START ASEQ5
PAUSE ASEQ
CONT ASEQ
SELECT ASEQ#
EDIT
VIEW
CANCEL
LABEL ASEQ
EDIT LINE#
DELETE LINE
CHANGE LINE
ADD LINE
CLEAR ASEQ
ASEQ FCTNS
END EDIT
LOOP TO
GO TO
ASEQ MESSGE
TIMED PAUSE
TIMED START
DSPLAY ON OFF
RETURN

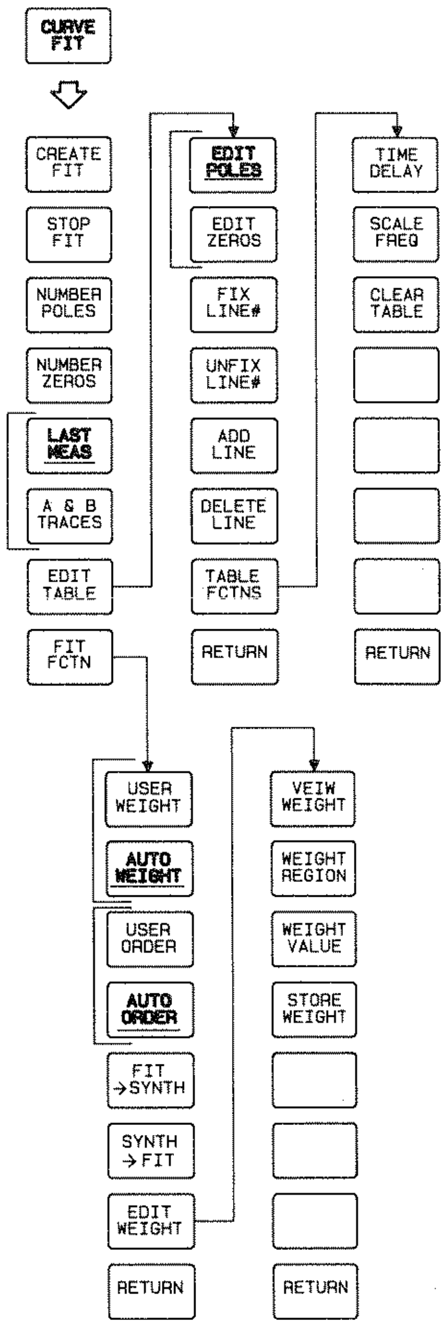

AVG
(LINEAR RESOLUTION MODE)
NUMBER AVGS
AVG OFF
STABLE (MEAN)
EXPON
OVRLP%
OV REJ ON OFF
FST AV ON OFF
PRVIEW


AVG
(LOG RESOLUTION MODE)
NUMBER AVGS
AVG OFF
STABLE (MEAN)
EXPON
OVRLP%
OV REJ ON OFF
FST AV ON OFF

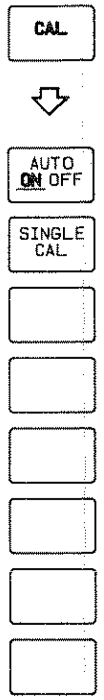

AVG
(TIME CAPTURE MODE)
NUMBER AVGS
AVG OFF
STABLE (MEAN)
EXPON

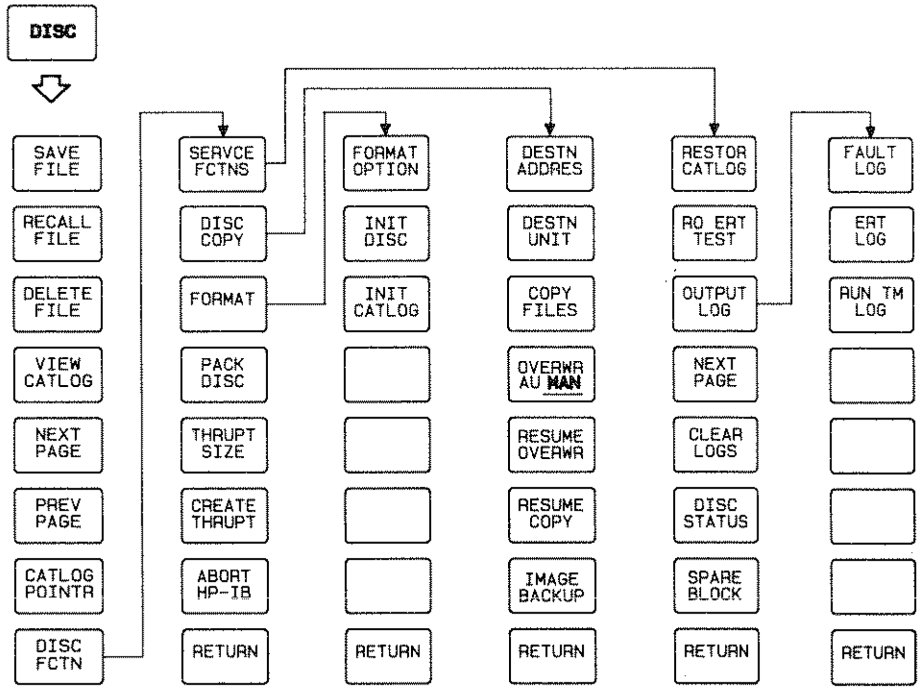

AVG
(SWEPT SINE MODE)
NUMBER AVG
INTGRT TIME
AUTO INTERT
FIXED

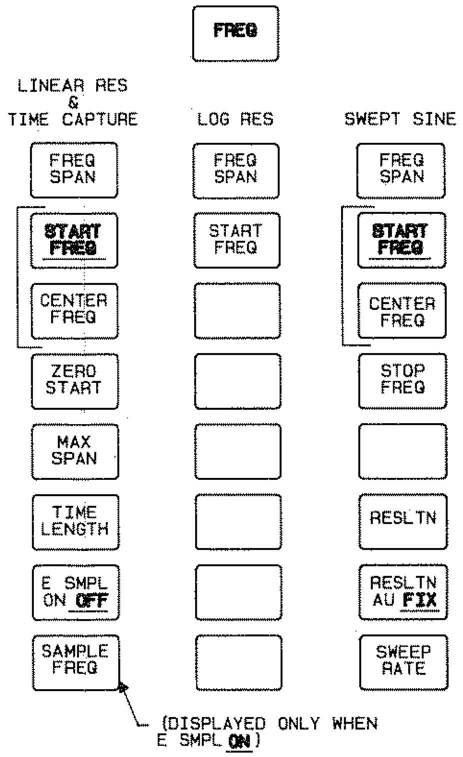

COORD
MAG (dB)
MAG (dBm)
MAG (LOG)
MAG (LIN)
PHASE
REAL
IMAG
NEXT
NYQUST
NICHOL
LOG X
LIN X
RETURN

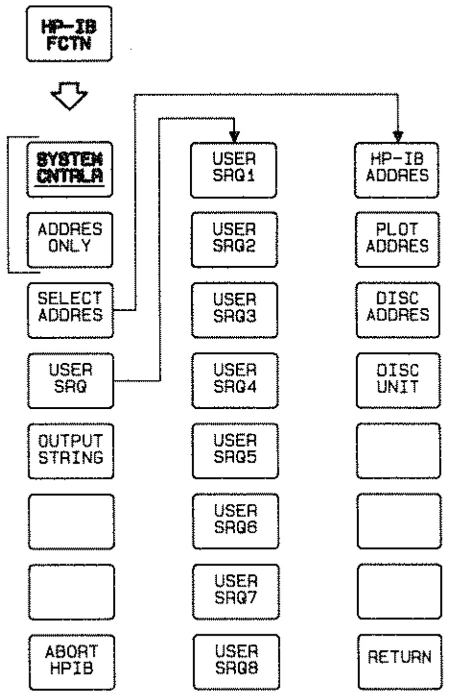

CURVE FIT
CREATE FIT
STOP FIT
NUMBER POLES
NUMBER ZEROS
LAST MEAS
A & B TRACES
EDIT TABLE
FIT FCTN
EDIT POLES
EDIT ZEROS
FIX LINE#
UNFIX LINE#
ADD LINE
DELETE LINE
TABLE FCTNS
RETURN
TIME DELAY
SCALE FREQ
CLEAR TABLE
RETURN
USER WEIGHT
AUTO WEIGHT
USER ORDER
AUTO ORDER
FIT →SYNTH
SYNTH →FIT
EDIT WEIGHT
RETURN
VEIW WEIGHT
WEIGHT REGION
WEIGHT VALUE
STORE WEIGHT
RETURN

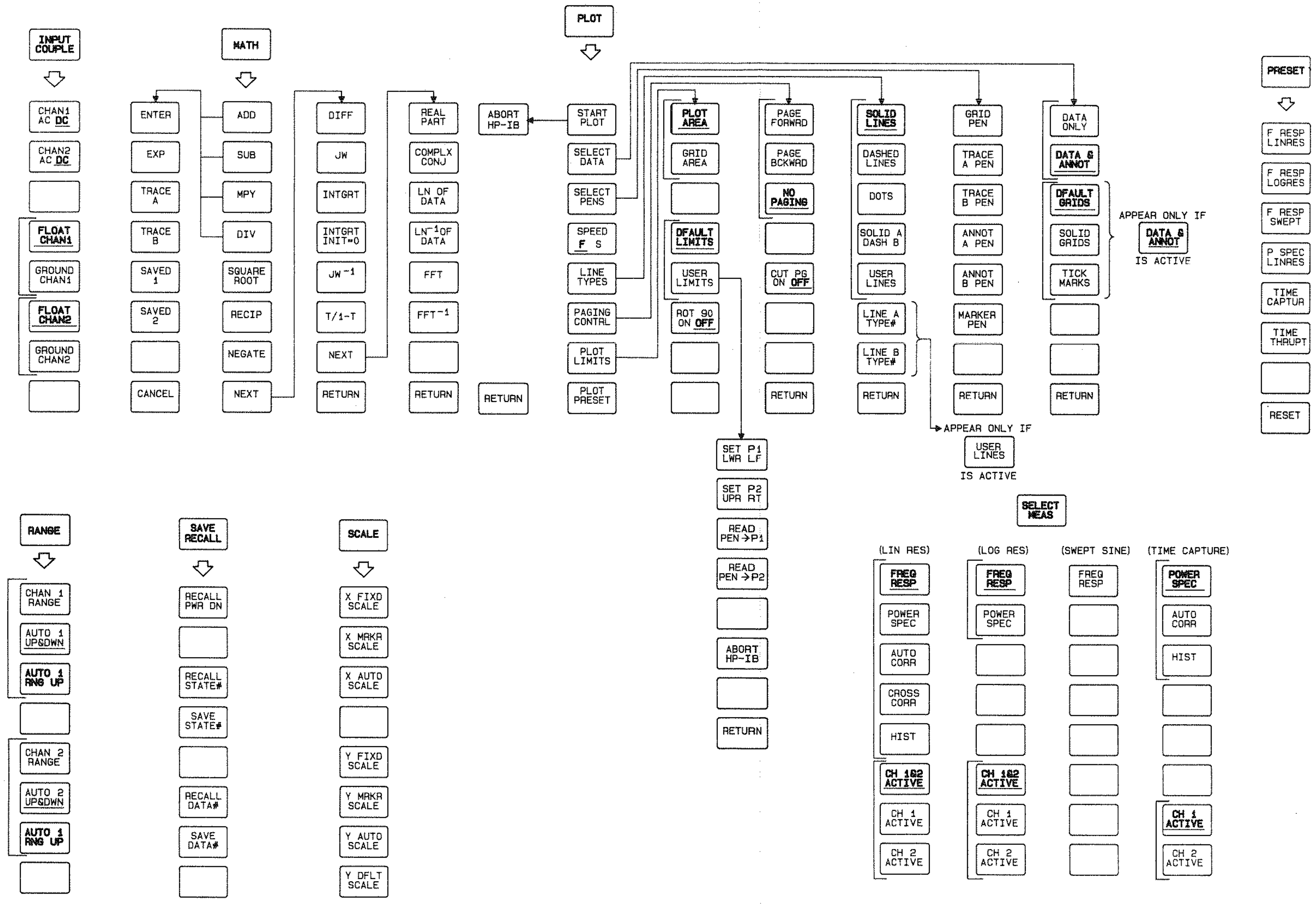

ENGR UNITS
EU VAL CHAN1
VOLTS CHAN1
EU LBL CHAN1
EU VAL CHAN2
VOLTS CHAN2
EU LBL CHAN2

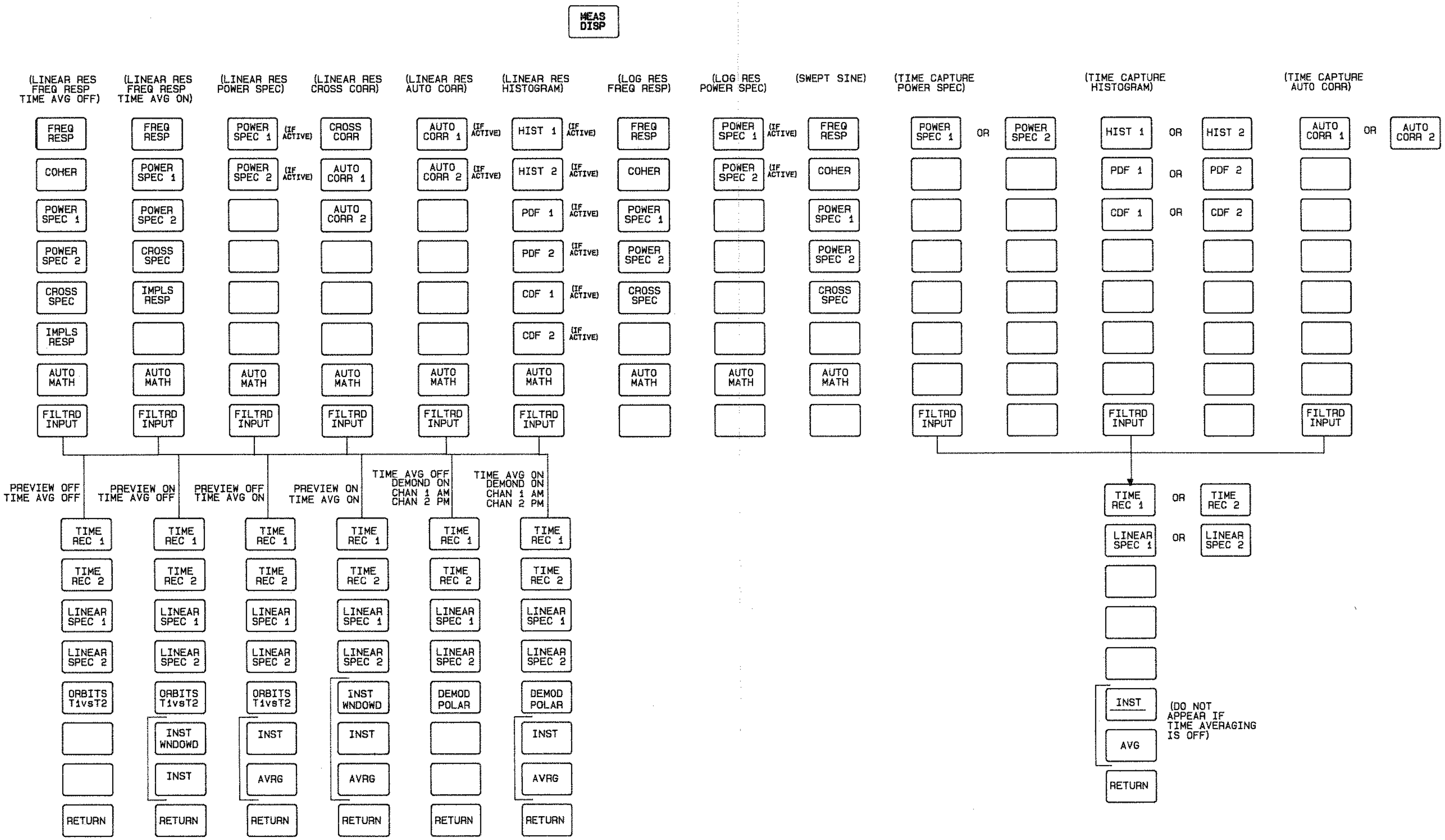

CAL
AUTO ON OFF
SINGLE CAL

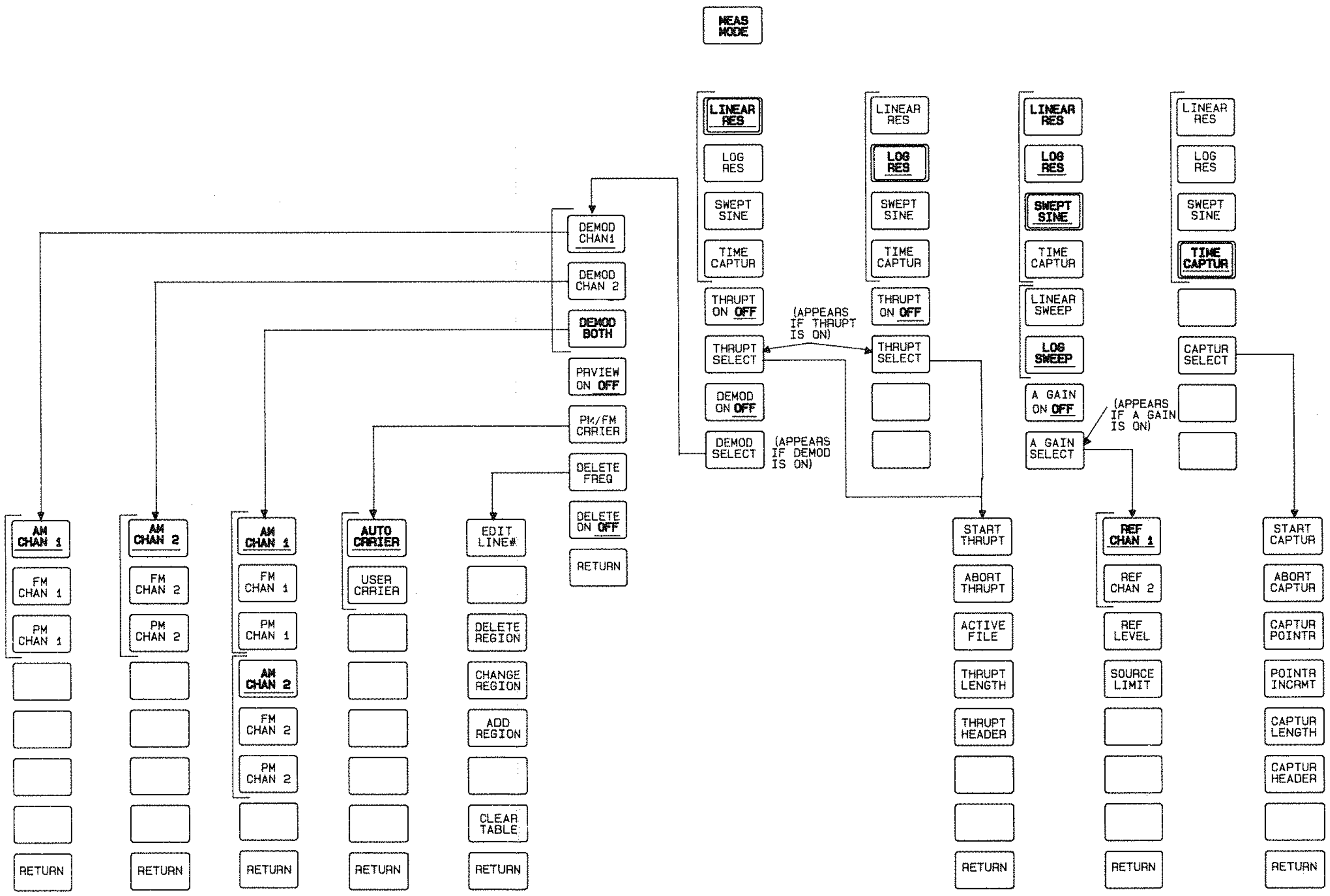

DISC
SAVE FILE
RECALL FILE
DELETE FILE
VIEW CATLOG
NEXT PAGE
PREV PAGE
CATLOG POINTR
DISC FCTN
SERVCE FCTNS
DISC COPY
FORMAT
PACK DISC
THRUPT SIZE
CREATE THRUPT
ABORT HP-IB
RETURN
FORMAT OPTION
INIT DISC
INIT CATLOG
RETURN
DESTN ADDRES
DESTN UNIT
COPY FILES
OVERWR AU MAN
RESUME OVERWR
RESUME COPY
IMAGE BACKUP
RETURN
RESTOR CATLOG
RO ERT TEST
OUTPUT LOG
NEXT PAGE
CLEAR LOGS
DISC STATUS
SPARE BLOCK
RETURN
FAULT LOG
ERT LOG
RUN TM LOG
RETURN


FREQ
LINEAR RES & TIME CAPTURE
FREQ SPAN
START FREQ
CENTER FREQ
ZERO START
MAX SPAN
TIME LENGTH
E SMPL ON OFF
SAMPLE FREQ
LOG RES
FREQ SPAN
START FREQ
SWEPT SINE
FREQ SPAN
START FREQ
CENTER FREQ
STOP FREQ
RESLTN
RESLTN AU FIX
SWEEP RATE
(DISPLAYED ONLY WHEN E SMPL ON)

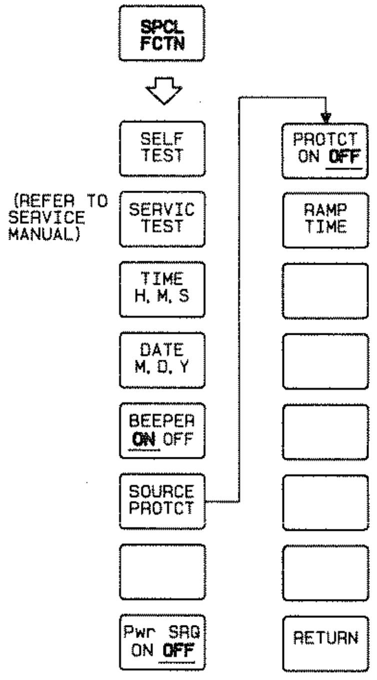

HP-IB FCTN
SYSTEM CNTRLR
ADDRES ONLY
SELECT ADDRES
USER SRQ
OUTPUT STRING
ABORT HPIB
USER SRQ1
USER SRQ2
USER SRQ3
USER SRQ4
USER SRQ5
USER SRQ6
USER SRQ7
USER SRQ8
HP-IB ADDRES
PLOT ADDRES
DISC ADDRES
DISC UNIT
RETURN

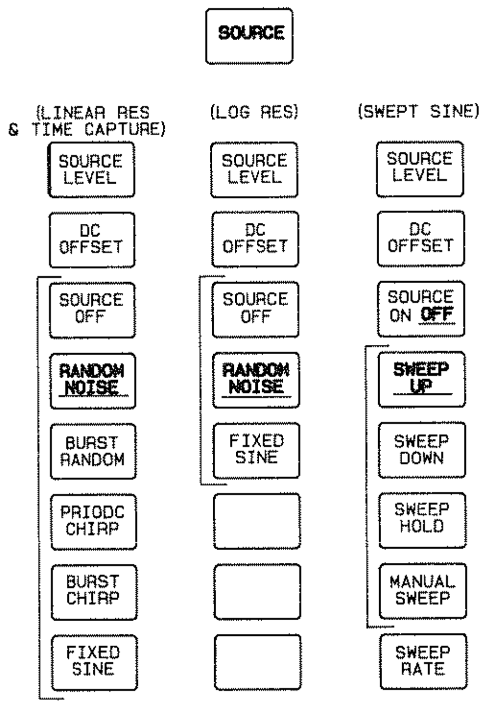

INPUT COUPLE
CHAN1 AC DC
CHAN2 AC DC
FLOAT CHAN1
GROUND CHAN1
FLOAT CHAN2
GROUND CHAN2
MATH
ENTER
EXP
TRACE A
TRACE B
SAVED 1
SAVED 2
CANCEL
ADD
SUB
MPY
DIV
SQUARE ROOT
RECIP
NEGATE
NEXT
DIFF
JW
INTGRT
INTGRT INIT=0
JW⁻¹
T/1-T
NEXT
RETURN
REAL PART
COMPLX CONJ
LN OF DATA
LN⁻¹OF DATA
FFT
FFT⁻¹
RETURN
ABORT HP-IB
RETURN
PLOT
START PLOT
SELECT DATA
SELECT PENS
SPEED F S
LINE TYPES
PAGING CONTRL
PLOT LIMITS
PLOT PRESET
PLOT AREA
GRID AREA
DFAULT LIMITS
USER LIMITS
ROT 90 ON OFF
SET P1 LWR LF
SET P2 UPR RT
READ PEN→P1
READ PEN→P2
ABORT HP-IB
RETURN
PAGE FORWRD
PAGE BCKWRD
NO PAGING
CUT PG ON OFF
RETURN
SOLID LINES
DASHED LINES
DOTS
SOLID A DASH B
USER LINES
LINE A TYPE#
LINE B TYPE#
RETURN
APPEAR ONLY IF
USER LINES
IS ACTIVE
GRID PEN
TRACE A PEN
TRACE B PEN
ANNOT A PEN
ANNOT B PEN
MARKER PEN
RETURN
DATA ONLY
DATA & ANNOT
DFAULT GRIDS
SOLID GRIDS
TICK MARKS
RETURN
APPEAR ONLY IF
DATA & ANNOT
IS ACTIVE
PRESET
F RESP LINRES
F RESP LOGRES
F RESP SWEPT
P SPEC LINRES
TIME CAPTUR
TIME THRUPT
RESET
RANGE
CHAN 1 RANGE
AUTO 1 UP&DWN
AUTO 1 RNG UP
CHAN 2 RANGE
AUTO 2 UP&DWN
AUTO 1 RNG UP
SAVE RECALL
RECALL PWR ON
RECALL STATE#
SAVE STATE#
RECALL DATA#
SAVE DATA#
SCALE
X FIXD SCALE
X MRKR SCALE
X AUTO SCALE
Y FIXD SCALE
Y MRKR SCALE
Y AUTO SCALE
Y DFLT SCALE
SELECT MEAS
(LIN RES)
FREQ RESP
POWER SPEC
AUTO CORR
CROSS CORR
HIST
CH 1&2 ACTIVE
CH 1 ACTIVE
CH 2 ACTIVE
(LOG RES)
FREQ RESP
POWER SPEC
CH 1&2 ACTIVE
CH 1 ACTIVE
CH 2 ACTIVE
(SWEPT SINE)
FREQ RESP
(TIME CAPTURE)
POWER SPEC
AUTO CORR
HIST
CH 1 ACTIVE
CH 2 ACTIVE

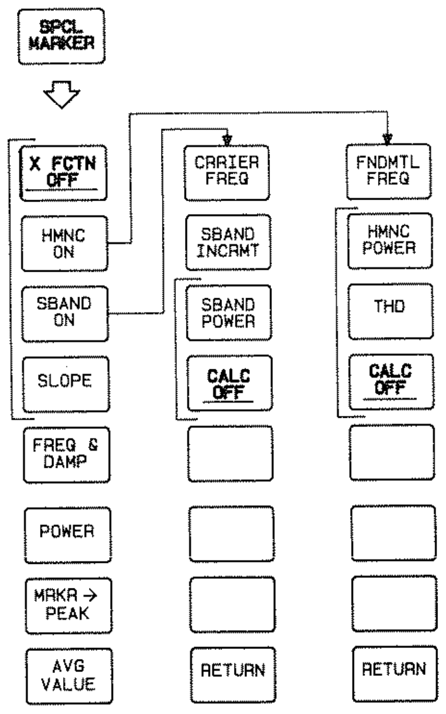

MEAS DISP
(LINEAR RES FREQ RESP TIME AVG OFF)
FREQ RESP
COHER
POWER SPEC 1
POWER SPEC 2
CROSS SPEC
IMPLS RESP
AUTO MATH
FILTRD INPUT
(LINEAR RES FREQ RESP TIME AVG ON)
FREQ RESP
POWER SPEC 1
POWER SPEC 2
CROSS SPEC
IMPLS RESP
AUTO MATH
FILTRD INPUT
(LINEAR RES POWER SPEC)
POWER SPEC 1
(IF ACTIVE)
POWER SPEC 2
(IF ACTIVE)
AUTO MATH
FILTRD INPUT
(LINEAR RES CROSS CORR)
CROSS CORR
AUTO CORR 1
AUTO CORR 2
AUTO MATH
FILTRD INPUT
(LINEAR RES AUTO CORR)
AUTO CORR 1
(IF ACTIVE)
AUTO CORR 2
(IF ACTIVE)
AUTO MATH
FILTRD INPUT
(LINEAR RES HISTOGRAM)
HIST 1
(IF ACTIVE)
HIST 2
(IF ACTIVE)
PDF 1
(IF ACTIVE)
PDF 2
(IF ACTIVE)
CDF 1
(IF ACTIVE)
CDF 2
(IF ACTIVE)
AUTO MATH
FILTRD INPUT
(LOG RES FREQ RESP)
FREQ RESP
COHER
POWER SPEC 1
POWER SPEC 2
CROSS SPEC
AUTO MATH
(LOG RES POWER SPEC)
POWER SPEC 1
(IF ACTIVE)
POWER SPEC 2
(IF ACTIVE)
AUTO MATH
(SWEPT SINE)
FREQ RESP
COHER
POWER SPEC 1
POWER SPEC 2
CROSS SPEC
AUTO MATH
(TIME CAPTURE POWER SPEC)
POWER SPEC 1
OR
POWER SPEC 2
FILTRD INPUT
(TIME CAPTURE HISTOGRAM)
HIST 1
OR
HIST 2
PDF 1
OR
PDF 2
CDF 1
OR
CDF 2
FILTRD INPUT
(TIME CAPTURE AUTO CORR)
AUTO CORR 1
OR
AUTO CORR 2
FILTRD INPUT
PREVIEW OFF TIME AVG OFF
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
ORBITS T1vsT2
RETURN
PREVIEW ON TIME AVG OFF
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
ORBITS T1vsT2
INST WNDOWD
INST
RETURN
PREVIEW OFF TIME AVG ON
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
ORBITS T1vsT2
INST
AVRG
RETURN
PREVIEW ON TIME AVG ON
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
INST WNDOWD
INST
AVRG
RETURN
TIME AVG OFF DEMOND ON CHAN 1 AM CHAN 2 PM
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
DEMOD POLAR
RETURN
TIME AVG ON DEMOND ON CHAN 1 AM CHAN 2 PM
TIME REC 1
TIME REC 2
LINEAR SPEC 1
LINEAR SPEC 2
DEMOD POLAR
INST
AVRG
RETURN
TIME REC 1
OR
TIME REC 2
LINEAR SPEC 1
OR
LINEAR SPEC 2
INST
AVG
(DO NOT APPEAR IF TIME AVERAGING IS OFF)
RETURN

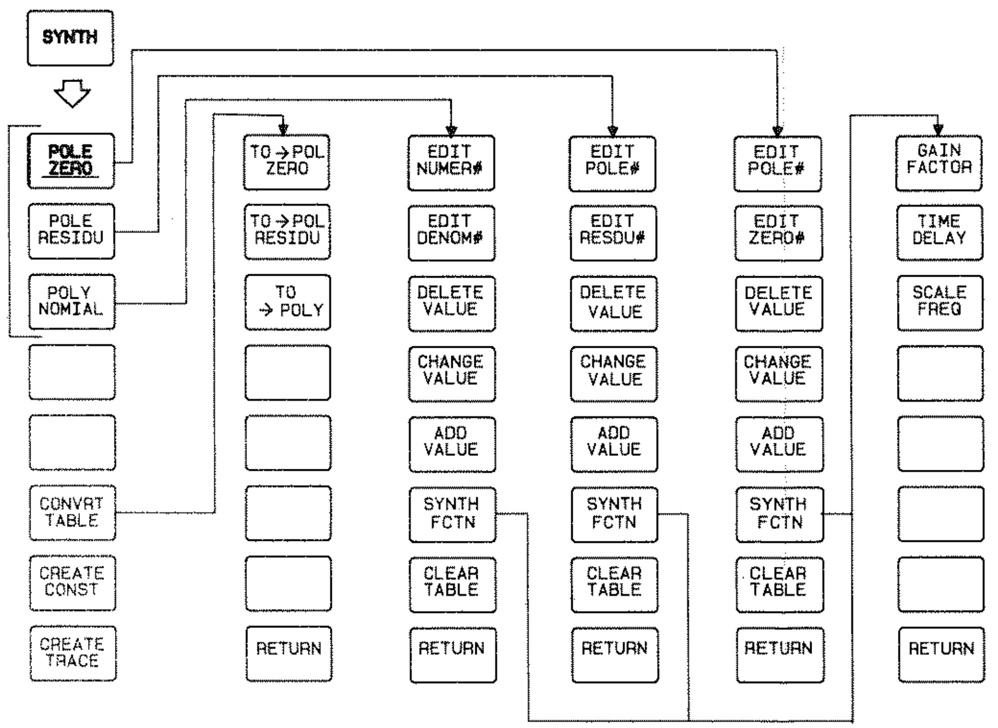

MEAS MODE
LINEAR RES
LOG RES
SWEPT SINE
TIME CAPTUR
THRUPT ON OFF
THRUPT SELECT
DEMOD ON OFF
DEMOD SELECT
(APPEARS IF THRUPT IS ON)
(APPEARS IF DEMOD IS ON)
LINEAR RES
LOG RES
SWEPT SINE
TIME CAPTUR
THRUPT ON OFF
THRUPT SELECT
LINEAR RES
LOG RES
SWEPT SINE
TIME CAPTUR
LINEAR SWEEP
LOG SWEEP
A GAIN ON OFF
A GAIN SELECT
(APPEARS IF A GAIN IS ON)
LINEAR RES
LOG RES
SWEPT SINE
TIME CAPTUR
CAPTUR SELECT
DEMOD CHAN1
DEMOD CHAN 2
DEMOD BOTH
PRVIEW ON OFF
PM/FM CRRIER
DELETE FREQ
DELETE ON OFF
RETURN
AM CHAN 1
FM CHAN 1
PM CHAN 1
RETURN
AM CHAN 2
FM CHAN 2
PM CHAN 2
RETURN
AM CHAN 1
FM CHAN 1
PM CHAN 1
AM CHAN 2
FM CHAN 2
PM CHAN 2
RETURN
AUTO CRRIER
USER CRRIER
RETURN
EDIT LINE#
DELETE REGION
CHANGE REGION
ADD REGION
CLEAR TABLE
RETURN
START THRUPT
ABORT THRUPT
ACTIVE FILE
THRUPT LENGTH
THRUPT HEADER
RETURN
REF CHAN 1
REF CHAN 2
REF LEVEL
SOURCE LIMIT
RETURN
START CAPTUR
ABORT CAPTUR
CAPTUR POINTR
POINTR INCRMT
CAPTUR LENGTH
CAPTUR HEADER
RETURN

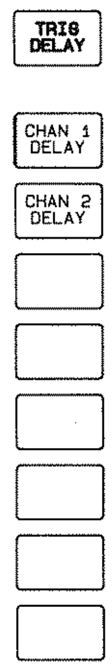

SELECT TRIG
TRIG LEVEL
ARM AU MAN
FREE RUN
CHAN 1 INPUT
CHAN 2 INPUT
SOURCE TRIG
EXT
SLOPE + –

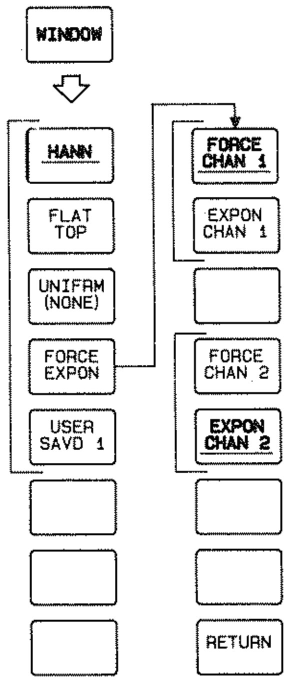

SPCL FCTN
SELF TEST
(REFER TO SERVICE MANUAL)
SERVIC TEST
TIME H, M, S
DATE M, D, Y
BEEPER ON OFF
SOURCE PROTCT
Pwr SRQ ON OFF
PROTCT ON OFF
RAMP TIME
RETURN

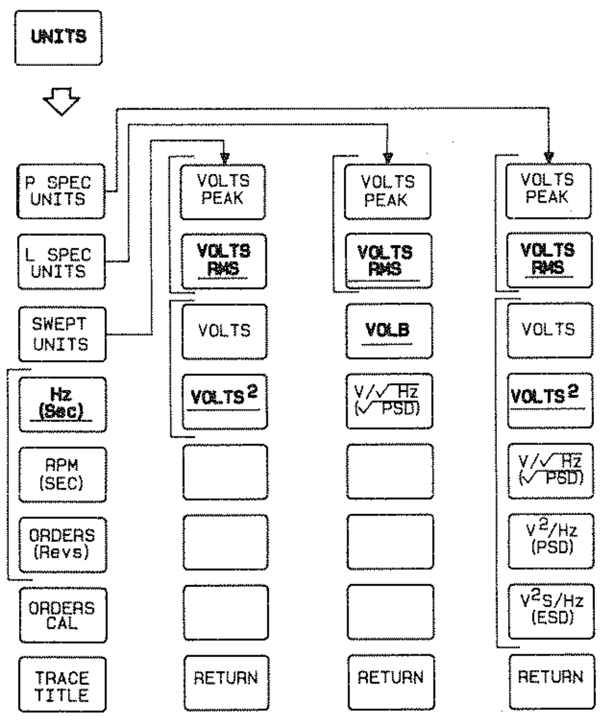

SOURCE
(LINEAR RES & TIME CAPTURE)
SOURCE LEVEL
DC OFFSET
SOURCE OFF
RANDOM NOISE
BURST RANDOM
PRIODC CHIRP
BURST CHIRP
FIXED SINE
(LOG RES)
SOURCE LEVEL
DC OFFSET
SOURCE OFF
RANDOM NOISE
FIXED SINE
(SWEPT SINE)
SOURCE LEVEL
DC OFFSET
SOURCE ON OFF
SWEEP UP
SWEEP DOWN
SWEEP HOLD
MANUAL SWEEP
SWEEP RATE

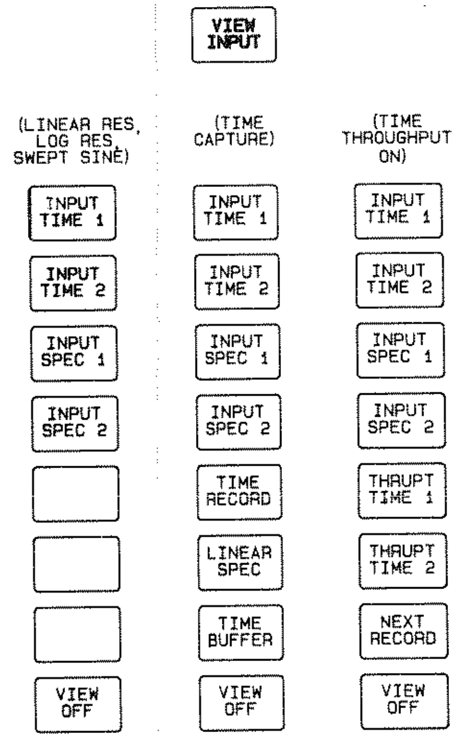

SPCL MARKER
X FCTN OFF
HMNC ON
SBAND ON
SLOPE
FREQ & DAMP
POWER
MRKR → PEAK
AVG VALUE
CRRIER FREQ
SBAND INCRMT
SBAND POWER
CALC OFF
RETURN
FNDMTL FREQ
HMNC POWER
THD
CALC OFF
RETURN

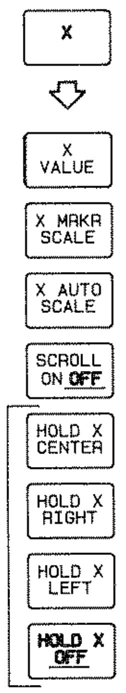

SYNTH
POLE ZERO
POLE RESIDU
POLY NOMIAL
CONVRT TABLE
CREATE CONST
CREATE TRACE
TO → POL ZERO
TO → POL RESIDU
TO → POLY
RETURN
EDIT NUMER#
EDIT DENOM#
DELETE VALUE
CHANGE VALUE
ADD VALUE
SYNTH FCTN
CLEAR TABLE
RETURN
EDIT POLE#
EDIT RESDU#
DELETE VALUE
CHANGE VALUE
ADD VALUE
SYNTH FCTN
CLEAR TABLE
RETURN
EDIT POLE#
EDIT ZERO#
DELETE VALUE
CHANGE VALUE
ADD VALUE
SYNTH FCTN
CLEAR TABLE
RETURN
GAIN FACTOR
TIME DELAY
SCALE FREQ
RETURN

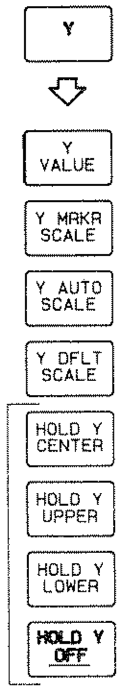

TRIG DELAY
CHAN 1 DELAY
CHAN 2 DELAY


WINDOW
HANN
FLAT TOP
UNIFRM (NONE)
FORCE EXPON
USER SAVD 1
FORCE CHAN 1
EXPON CHAN 1
FORCE CHAN 2
EXPON CHAN 2
RETURN


UNITS
P SPEC UNITS
L SPEC UNITS
SWEPT UNITS
Hz (Sec)
RPM (SEC)
ORDERS (Revs)
ORDERS CAL
TRACE TITLE
VOLTS PEAK
VOLTS RMS
VOLTS
VOLTS²
RETURN
VOLTS PEAK
VOLTS RMS
VOLB
V/√Hz (√PSD)
RETURN
VOLTS PEAK
VOLTS RMS
VOLTS
VOLTS²
V/√Hz (√PSD)
V²/Hz (PSD)
V²S/Hz (ESD)
RETURN


VIEW INPUT
(LINEAR RES, LOG RES, SWEPT SINE)
INPUT TIME 1
INPUT TIME 2
INPUT SPEC 1
INPUT SPEC 2
VIEW OFF
(TIME CAPTURE)
INPUT TIME 1
INPUT TIME 2
INPUT SPEC 1
INPUT SPEC 2
TIME RECORD
LINEAR SPEC
TIME BUFFER
VIEW OFF
(TIME THROUGHPUT ON)
INPUT TIME 1
INPUT TIME 2
INPUT SPEC 1
INPUT SPEC 2
THRUPT TIME 1
THRUPT TIME 2
NEXT RECORD
VIEW OFF


X
X VALUE
X MRKR SCALE
X AUTO SCALE
SCROLL ON OFF
HOLD X CENTER
HOLD X RIGHT
HOLD X LEFT
HOLD X OFF


Y
Y VALUE
Y MRKR SCALE
Y AUTO SCALE
Y DFLT SCALE
HOLD Y CENTER
HOLD Y UPPER
HOLD Y LOWER
HOLD Y OFF

HP 3562A MEASUREMENT PROCESS

INTRODUCTION

This appendix explains how the HP 3562A makes its measurements. It is intended as a conceptual explanation to help you understand how selections you make from the front panel affect the internal operation on the analyzer. It is not intended to provide detailed information about the analyzer's operation. The first section describes the signal flow from input to display, and the second compares the three major types of data traces: view input, filtered input, and measurement display.

NOTE

If you want to learn more dynamic signal analysis in general, ask your HP Sales Representative for a free copy of HP Application Note 243. This publications covers the basics of digital signal processing techniques used in analyzers such as the HP 3562A.

FROM INPUT SIGNAL TO DISPLAY TRACE

This section explains how the HP 3562A takes your input signal and gives you back a trace on the display. This process is divided into three stages: analog to digital conversion, measurement, and display. Figure E-1 shows a conceptual block diagram of the general linear resolution measurement process.

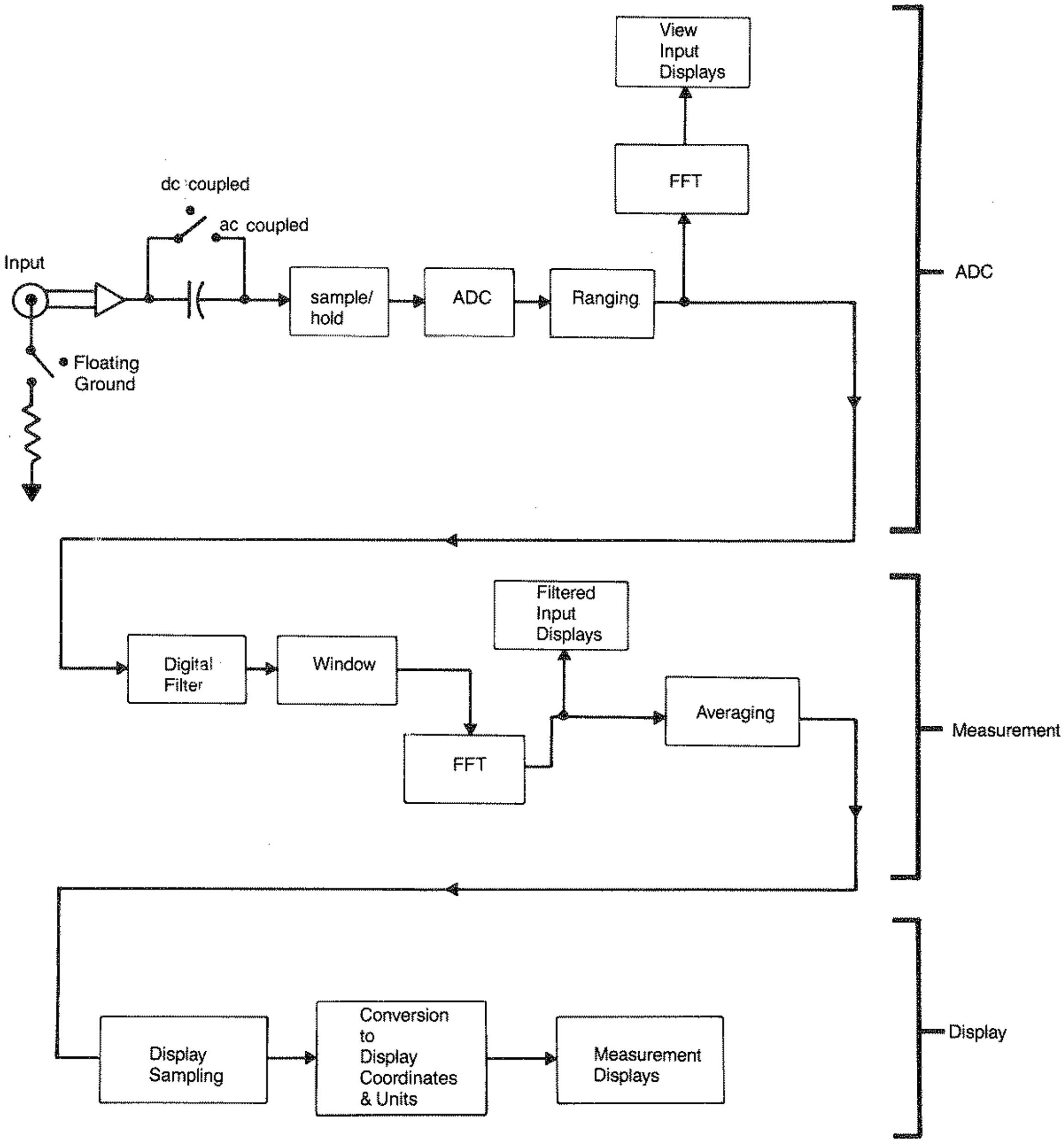


Figure E-1 Overview of Measurement Process

Analog to Digital Conversion

The first effect a user selection has on the input signals is at the BNC connectors. If a channel is floated, it is differential and the high and low sides are measured relative to each other. If a channel is grounded, it is single-ended and the high side is measured relative to ground.

The next step is input coupling. If a channel is ac coupled, a series capacitor is inserted to remove signals below about 3 Hz. If it is dc coupled, all signals down to dc are passed. The analog signals are now ready for conversion to digital data.

The analog to digital converter (ADC) works in two steps. First, the sample/hold circuit "takes a picture" of the signal at one point in time. Second, this analog sample is converted to a 14-bit digital word. The value of the word corresponds to the magnitude of the sample. This sampling is performed 256 000 times per second, so the analyzer takes a sample every 3.91 μs. This 256 kHz sampling frequency determines the highest measurable frequency. Time records are 2048 points (samples) long, and the record length at 100 kHz is 8 ms, so a point is needed every 3.91 μs (8 ms/2048). Note that it is the 13 bits plus a dithering technique that provide the analyzer's 80 dB dynamic range—the difference between the largest and smallest signals that can be measured simultaneously.

The ADC also happens to be the next point at which a user selection affects the measurement process. The range you set with the RANGE menu determines the sensitivity of the ADC. As you adjust the range, you shift the ADC's 80 dB dynamic range up or down to best cover the amplitudes you are trying to measure. If you set the range too low, the ADC may not be able to represent higher amplitude signals; this results in a distorted measurement. On the other hand, if you set the range too far above the highest amplitude in the signal, the ADC may miss lower amplitude signals. These requirements emphasize the importance of correct input range and the advantage of the HP 3562A's auto ranging features. When the analog signal has been converted to digital data and properly scaled, the measurement stage begins.

Measurement

In the measurement stage, the HP 3562A performs the measurement you selected on the data received from the ADC. The first step here is filtering the data to the current frequency span. Because the sampling rate is fixed at 256 kHz (except for external sampling), the ADC always provides enough data for a 0-to-100 kHz measurement. (This is why the VIEW INPUT displays are always 100 kHz or 8 ms; they haven't been filtered to the current span.) The digital filter achieves the selected span by filtering the data from the ADC. By sampling at a fixed rate and using the digital filter to collect the data needed for each span, the HP 3562A needs only one fixed anti-aliasing filter to protect all frequency spans.

In addition to resampling to the desired frequency span, the digital filter also provides for triggering. The ADC supplies the filter with a continual stream of data bits; it is up to the filter to determine when a record starts and stops. By defining the trigger signal and its conditions (slope and level), you specify when each record is to start. For example, say you have external triggering with no trigger delay. The ADC is supplying the data stream, but the filter ignores the data until a trigger is received. When the trigger arrives, the filter marks the current sample as the beginning of the record, then it collects 2047 more samples. This collection of 2048 samples constitutes the time record.

Depending on the record length you have specified (either directly or indirectly by setting the span), the filter selectively collects 2048 samples spaced appropriately to fill the record. For example, at a 50 kHz span the record is 16 ms (800/50 kHz). To fill a 2048-point time record, the points need to be spaced 7.81 µs apart (16 ms/2048). But since the ADC is supplying a sample every 3.91 µs, twice as many as this record needs. So the filter resamples by collecting only every other sample. This resampling is adjusted to match whatever span you select; at the lowest span (10.24 mHz), the record length is 78 125s—the filter collects only every 2^{10} sample.

After the time record is created, the next step is windowing. The window you select is multiplied by the time record to achieve the desired weighting. Chapter 1 describes the available windows.

The windowed record is now ready to be measured. "Measurement" in this context is a mathematical process performed by software with the aid of two specialized processors. The fast Fourier transform (FFT) processor performs the time domain to frequency domain transformations, and the floating point processor (FPP) provides the computational power necessary for averaging and calculating measurement displays.

The measurement process depends on the measurement you selected with the SELECT MEAS menu. The power spectrum measurement, for example, is computed by first transforming the time record to the frequency domain, yielding the linear spectrum. The FPP then multiplies the linear spectrum by its complex conjugate to yield the power spectrum. (Chapter 1 provides the formula used in each measurement.)

The next point at which a user selection affects the process is averaging. Activity at this point depends on the type of averaging; Chapter 1 explains the various selections.

Display

The HP 3562A's digital display creates images by identifying pairs of points, then drawing vectors between them. To produce a data trace, the display draws 1600 vectors (using 1601 display points), so even small variations can be displayed with high accuracy. Engineering Unit (EU) calibrations are also applied at this point.

The number of horizontal data points available for each type of display varies. A time record, for example, has 2048 points, while a power spectrum has 801. The vector display used in the HP 3562A is fixed at 1601 display points, so the analyzer must compress or expand each data trace to fit it on the display.

To compress a set of data that is longer than 1601 points, an algorithm is used to extract the 1601 points that most accurately represent the original data. For example, to compress a 2048-point time record, approximately four out of every five points are used. The extreme case of data compression is displaying a 10-record time record buffer; this uses only about four out of every fifty original data points. The rate at which the points are extracted is adjusted across the trace in order to provide the desired compression.

The case of expanding a set of data up to 1601 points is much simpler. Rather than deciding which points are to be extracted, the analyzer simply adjusts the spacing of the original data points across the display. To display the 801-point time record, for example, a data point is put into every other display point.

DISPLAYS: INPUT, FILTERED, AND MEASUREMENT

There are three major types of data traces displayed by the HP 3562A: view input, filtered input, and measurement. The displays are produced at different points along the measurement process and provide different information. Refer to figure E-1 to see where each display is produced.

View Input Displays

The view input displays (selected with the VIEW INPUT menu) show you what the input signals look like at any given moment. These displays are extracted at the output of the analog to digital converter. Consequently, they have not been through the digital filter or the measurement process. Their primary purpose is to show you the characteristics of the inputs signals to help you set up measurements.

There are two basic view input displays: time domain and frequency domain. The time displays show an 8 ms-long picture of the input signals. This is not the "time record," nor is there any guarantee that a signal you see in a view input display will be included in the measurement. It is simply an instantaneous view of the input signals that is helpful when you need to verify a signal's presence or set input range.

The frequency domain displays show the time domain information transformed to the frequency domain with the FFT. This is still an instantaneous display. Also, note that this is a linear spectrum, not a power spectrum (which is the result of the FFT plus a measurement process.) Note that Chapter 1 has examples of each of these displays.

Filtered Input Displays

The filtered input displays (selected with the FILTRD INPUT menu under the MEAS DISP key) are an intermediate step between view input and measurement displays. Filtered input displays are available in the linear resolution and time capture modes. As their name implies, these displays show the input signals after they have been digitally filtered to the current frequency span. The TIME REC 1 and 2 displays do show the time record. The LINEAR SPEC 1 and 2 displays show the time record transformed to the frequency domain with the FFT. Note once again that this is still not a power spectrum.

The importance of the filtered input displays is the additional information they can provide: the time record and its frequency domain transformation, the orbits diagram, and the demod polar display.

Measurement Displays

The measurement displays (selected with the first level of the MEAS DISP menu) show the results of the measurement process—after the signals have been filtered and measured according to current selections. These displays are derived from measured data; consequently, they depend on three selections:

1. mode
2. measurement
3. active channel(s)

For example, a linear resolution frequency response measurement can provide the power spectrum displays from both channels. If the MEAS DISP menu is not giving you the display selection you want, turn to the softkey menu map for MEAS DISP in Appendix D and find out what you need to select first to get the display you want.

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