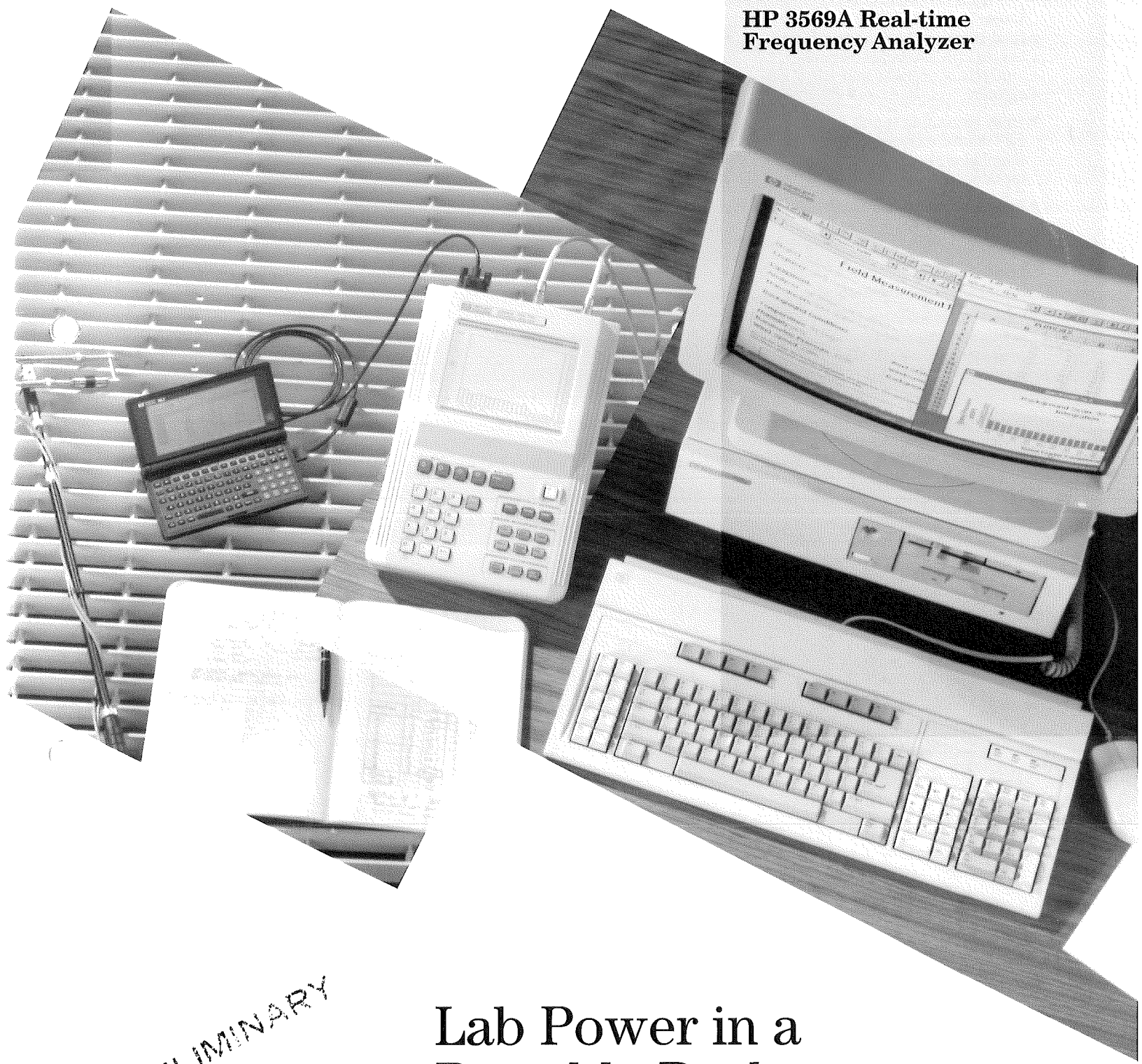
HEWLETT PACKARD

HP 3569A Real-time Frequency Analyzer

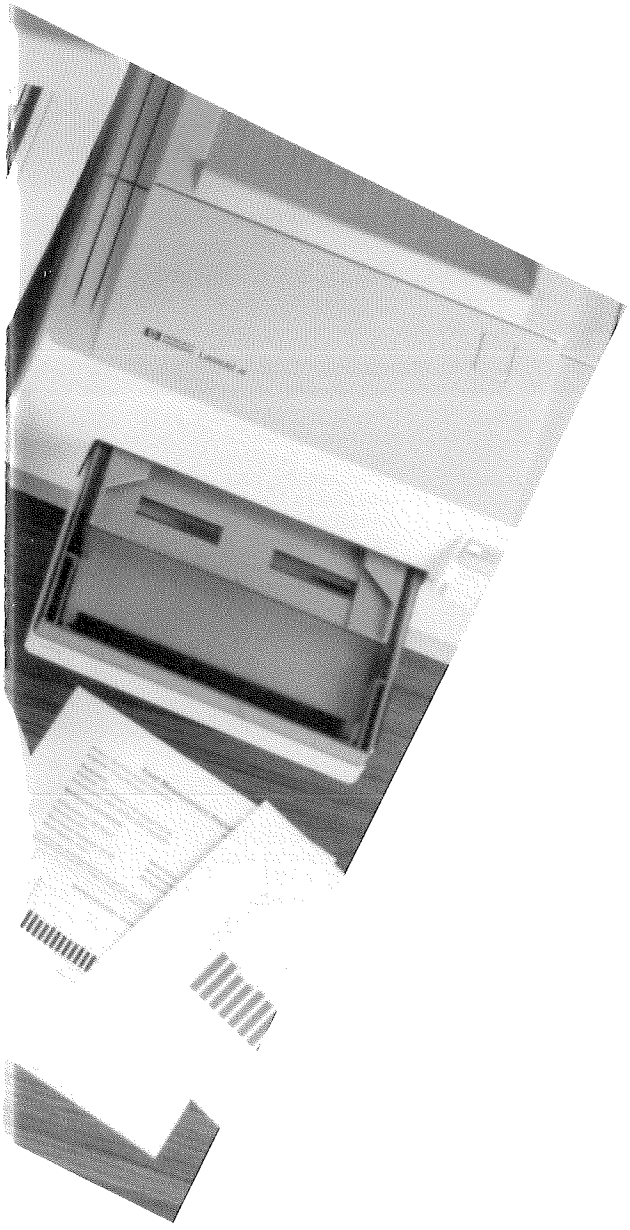


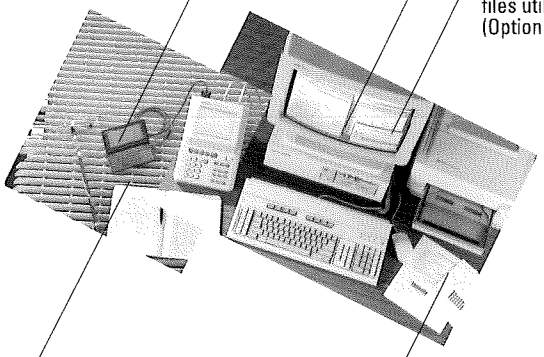
PRELIMINARY

Lab Power in a Portable Package

HP 3569A Real-Time Frequency Analyzer

- **22.4 kHz real-time 1/3-octave analysis**
- **Two microphone/ICP/voltage inputs**
- **Built-in White/Pink Noise Source**
- **Sound Pressure, Sound Intensity, Statistics**
- **1/1 and 1/3 octave resolution**
- **IEC 651 Type 1 accuracy**
- **ANSI S1.11-1986 Type 1-D octave filter shapes**
- **IEC 1043-199X Class 1 processor accuracy**
- **Optional narrowband FFT**
- **Optional reverberation time measurements**
- **Optional data transfer utilities**





Calculate ANSI S12.12 field indicator functions using the example Lotus 1-2-3 spreadsheet. (Option 550)

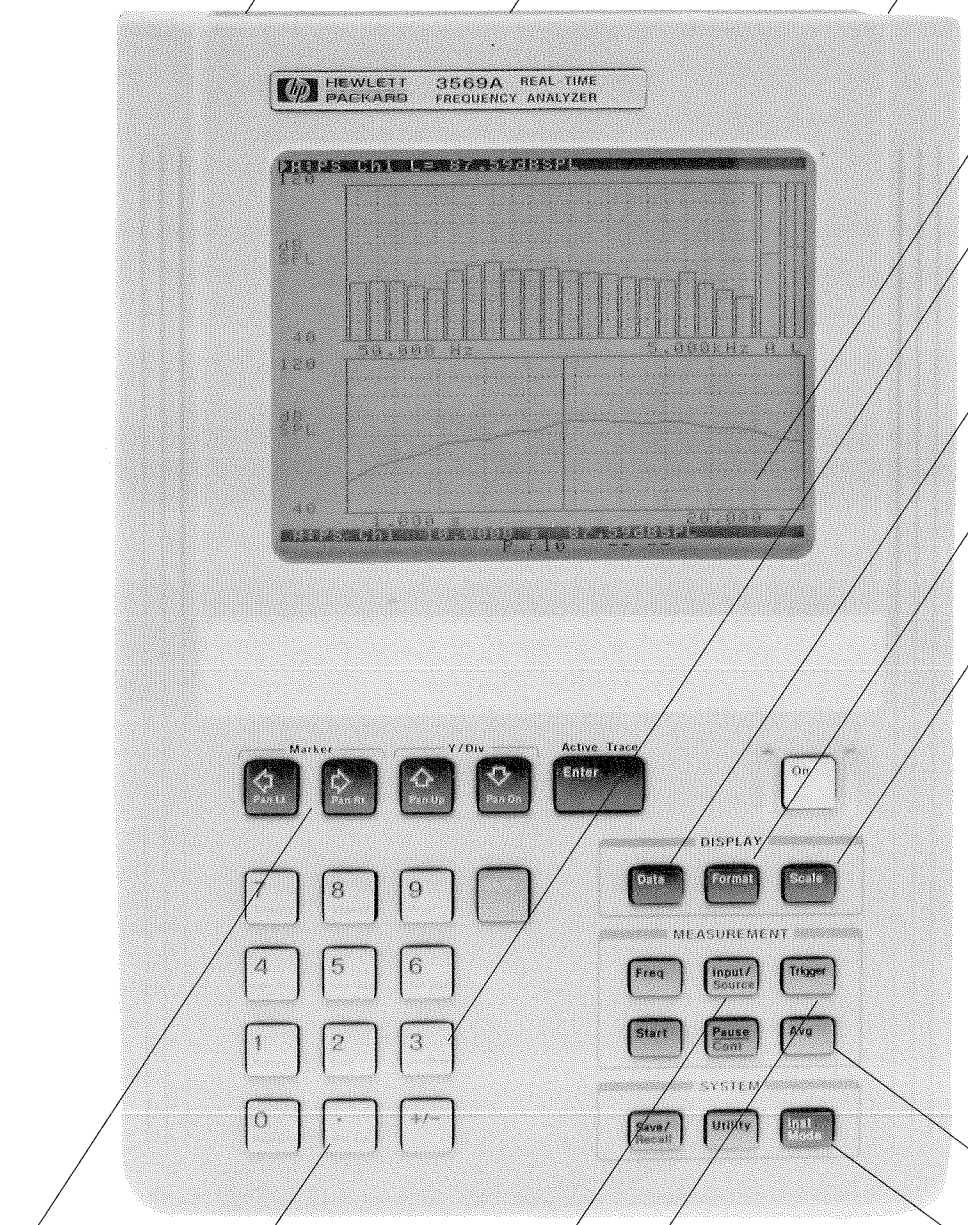
Merge measurements data and plots into your word processor via HP-GL plot files and ASCII text files.

Download data into Lotus 1-2-3 using data files utilities. (Option 550)

Use the HP 95LX as a measurement scheduler allowing custom measurements to be performed at the specified time and date. (Option 550)

Print directly to HP LaserJet and Epson compatible printers and plot directly to HP-GL plotters such as the HP 7550A.

HP 3569A Real Time Frequency Analyzer



RS-232 (EIA-232D) Interface
for PCs, HP 95LX Palmtop PC, External printers and plotters

Two input channels
with seven-pin microphone pre-amplifier inputs and BNC inputs with ac, dc and ICP transducer coupling

Digital I/O
for tape recorder triggering and sound intensity probe

Display
Back-lit LCD display for clear viewing in all lighting conditions

Marker Function
Band-Power, Sound Power and Critical Bandwidth calculations

Data
Flexible measurement data type for sound intensity, sound pressure and vibration analysis

Format
Single, front/back, upper/lower, slice, difference and tabular display configuration

Scale
Automatic display calibration for transducer calibration with user-selectable transducer sensitivity, dB referencing, plus temperature, atmospheric pressure and media density. In FFT mode, single differentiation and single or double integration for transducer units conversion between acceleration, velocity and displacement

Average
3.9 ms to 100 ks user-selectable integration time. Up to 1000 1/3 octave spectra in multispectrum measurements

Instrument Mode
Four powerful measurement modes: 1/1- and 1/3- octave sound pressure measurements, 1/1- and 1/3- octave sound intensity measurements, narrowband FFT analysis (optional) and 1/1 and 1/3 octave reverberation time analysis (optional)

Arrow cursor keys
Marker and display control

Microphone Calibration
One-step microphone pistonphone calibration. Store calibration for your sensors, and track sensors with time for greater measurement confidence

Input
5 mV to 5 V full-scale inputs on each channel, with automatic input range calibration in dBSPL

Trigger
Trigger on 1/1 and 1/3 octave band levels, events (specific band level for minimum duration), External TTL, External Gate and External Start triggering for more quantitative sound-intensity scans

Affordable Product Noise Testing from the Leader in Test and Measurement Products

Uses:

- Real-time, constant-percentage bandwidth filters for frequency analysis of acoustic and vibration signals
- High-resolution (up to 1600 lines) FFT-based measurements for tonal, narrowband or time analysis (optional)
- Noise-source identification and ranking for complex sound fields
- Direct in-situ sound power measurements using standard sound intensity techniques
- Direct reverberation time measurements using either impulse sources or broadband excitation (optional)
- Product noise characterization in automotive, aerospace, transportation applications using sound pressure and sound intensity techniques
- Environmental noise monitoring with built in event capture and exceedance levels per 1/1- and 1/3-octave band

Features

- Direct 7-pin microphone (preamplifier) input as well as BNC voltage and ICP inputs.
- Real-time frequency analysis to 22.4 kHz (single channel), and 11.2 kHz (dual channel)
- 1/1- and 1/3-octave frequency resolution in real-time octave sound pressure and sound intensity measurements
- EIA 232D (RS 232C) direct connection to personal computers, or the HP 95LX Palmtop PC
- Direct data import utilities for LOTUS 1-2-3 for post measurement analysis (option 550)
- Storage rate 256 spectra/second. Up to 1000 1/3-octave spectra in non-volatile slice measurement memory; up to 3000 1/3-octave spectra in non-volatile RAM-disk memory
- Weight: 3.2 kg (7 lb.) with battery
- Size: 300 x 210 x 95 mm (11.75 x 8.25 x 3.75 inches)

Introduction

The HP 3569A is a two-channel real-time frequency analyzer that packs the performance of larger transportable analyzers into a portable package that weighs less than 3.2 kg (7lb.) including the battery. Its ruggedized case is water and shock resistant. The internal battery provides 4 hours (typical) of operation. Included with the analyzer is the HP 82241X ac adapter can charge the internal battery during operation, or can charge external battery packs.

With the exception of analog input circuitry (amplifiers, attenuators and anti-alias filters), the HP 3569A is implemented completely with digital technology. Thus the instrument calibration is inherently stable and does not exhibit the drifting normally associated with analog analyzers.

Internal multispectrum display memory holds up to 1000 traces. Internal RAM-disk memory holds up to 3000 1/3-octave spectra, or up to 500 instrument set-up states.

Download measurements via the RS-232 port into PC/MS-DOS compatible machines via the Standard Data Format (SDF) utilities provided with every analyzer. These include data translation utilities from SDF to ASCII and to other third party packages such as Matrix$_x$ from Integrated Systems and Matlab from The MathWorks. Structural Measurement System's StarAcoustics sound intensity analysis package directly supports the HP 3569A's SDF file format.

The HP 3569A operates in real-time when analyzing with 1/1- and 1/3-octave resolution. For tonal measurements of single frequency or narrowband signals, the FFT mode (option AY2) provides 100 to 1600 lines of linear frequency resolution for high accuracy.

Input/Output

The HP 3569A's input and output connectors are conveniently located on the top panel. Also, they are directly accessible through the soft-sided carrying case provided with every instrument.

Microphone Preamplifier Input
The 7-pin microphone preamplifier input provides a compact, high-performance connection. The HP 3569A provides a selectable 0V and 200V polarization power supply that supports direct connection the full range of HP microphones, and a wide variety of modern microphones from most manufacturers.

With the input units set to Pascals, the HP 3569A automatically scales the inputs in dBSPL using the microphone calibration factor and user-defined dB reference (20 µPascals).

Probe/Tape Input/Output
The 15-pin Digital I/O connector provides control lines to illuminate sound intensity probe "measurement" and "overload" indicator LEDs. These lines are also useful for synchronizing external equipment to the HP 3569A measurement process. When using event triggering, a control line can be used to trigger an external tape recorder when an event is detected.

ICP Accelerometer Input
The ICP accelerometer input provides a center-pin dc current source that provide-power to ICP accelerometers. Approximately 4 mA of current is supplied, with a maximum compliance voltage of 22 volts. The ICP current source is available on the standard BNC input. This allows one channel to have a voltage or ICP input while the other channel simultaneously measures acoustic signals from a microphone.

Direct Voltage Input
The direct voltage input provides ten input ranges from 5 mV peak to 5 V peak.

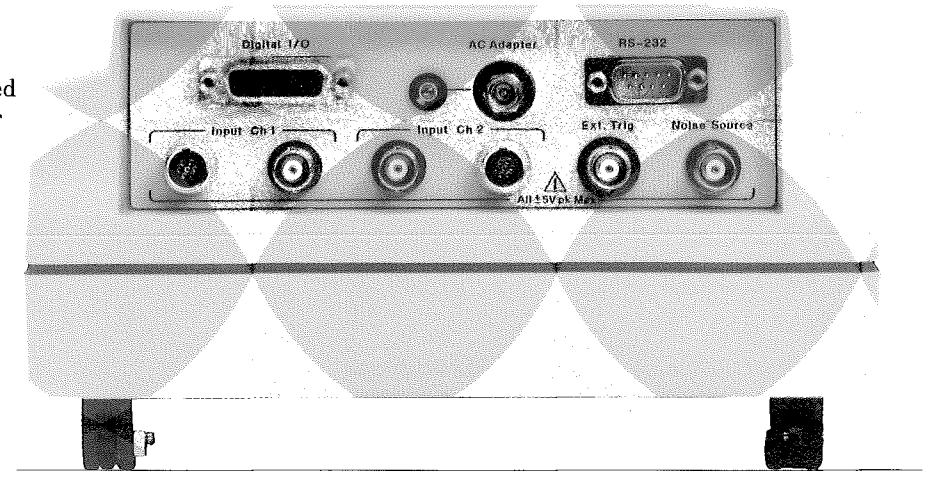
Noise Source
User-selectable white or pink noise with variable attenuation from 0 to 30 dB in 5 dB steps. Pseudo-random sequence length is $2^{31} - 1$.

Analog-to-Digital Conversion
The HP 3569A uses an anti-alias filter to provide at least 75 dB of high-frequency signal attenuation to avoid alias products. The 12-bit analog-to-digital converter and the 24-bit signal processing hardware easily provide the 72 dB dynamic range as specified by ANSI S1.11-1986.

Triggering/Gating
The external input (open collector) accepts a TTL signal to control the external triggering and gating functions.

EIA-232D (RS-232) Interface
The EIA 232D serial input provides direct HP 3569A control of hard-copy devices such as the HP LaserJet and HP 7550 plotter for measurement documentation. It also provides the serial link for personal computer communication.

Hardcopy Output
The HP 3569A directly supports the HP 7550A plotter via HP-GL commands and HP LaserJet printers for bit-mapped raster graphics output. For HP LaserJet III printers with internal HP-GL, high-resolution measurement results are possible without the delays of plotters.



The HP 3569A top panel contains all input/output connectors. These connectors are accessable when the instrument is in its soft-sided carrying case.

Display

The analyzer's LCD display-scaling functions are controlled automatically to provide 80 dB of display range. The Y/Div setting is modified with the arrow keys. Automatic display scaling is possible. In narrowband analysis, the X-axis display can be expanded and compressed using the shifted function keys.

Backlight

The display includes a backlight for situations where ambient lighting is low. The backlight can be switched off to conserve battery power.

A/L and Weighting

The A and L bands are shown on the extreme right of the display. The L band represents the overall level with a broadband linear weighting. The A band represents the overall level with a standard IEC 651 A-weight filter. Analog A, C, Linear and Flat weightings can also be applied to Channel 1 measurements. A digitally-applied A-weight overall band is applied to Channel 2 measurements.

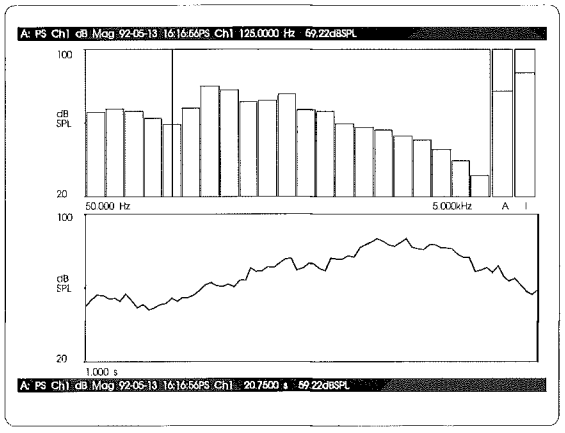
When selected, the L overall bands can be replaced with impulse averaged measurements (L_{pAI}) per IEC 651.

Slice Mode

When the multispectrum count is set between 2 and 1000, the analyzer collects and stores all the measurements in memory, and allows you to examine the instantaneous frequency spectrum at any point in time or the time history of the selected band (including the A and L bands) in the frequency domain.

Slice Marker

With the slice marker, measurements for a multispectrum data array can be collected, or retaken, in an arbitrary sequence.



Overall, A-weight, and A-weight impulse measurements are available.

Operation

Status

You can examine the set-up state at any time with the status screen. Measurements are still active and running when examining the status screen.

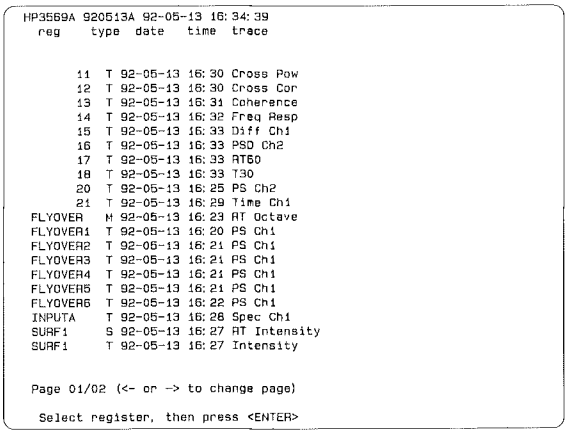
Saved Measurement States

Up to 500 instrument setup states can be stored on the analyzer's internal non-volatile RAM disk. These states are named using standard DOS naming conventions and can be viewed and selected by examining the RAM catalog.

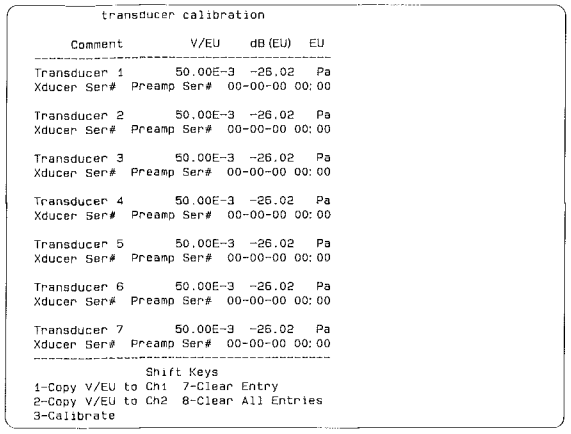
Transducer Calibration

The transducer/analyzer system is calibrated by applying a reference signal to the transducer and using the analyzer's autocalibration capability. The analyzer sensitivity factors are automatically adjusted to the calibrated value.

After the reference source has stabilized, the microphone calibration function is invoked by the user. The analyzer marker locates the peak signal on the display and queries you for the calibration level of the source. Then analyzer automatically adjusts the input sensitivity (Volts/EU) to



Store instrument set-up states, traces and measurement data in the internal RAM disk. Standard MS-DOS file names are used with numeric, alphanumeric and auto-incrementing alphanumeric file names.



The microphone calibration table makes entering and tracking transducer calibration factors easy. Weighting functions can also be applied via saved file names on the internal RAM catalog.

display the reference source value at the marker position.

If no reference source is available, the transducer sensitivity you can enter into the transducer reference chart as the volts/EU factor.

The calibration table stores time, date, transducer serial number and sensitivity for up to 28 different transducers. You can also use this table to track the calibration history of one or more transducers, giving direct readings of pre/post test calibrations and transducer history.

Display Configuration

There are two traces, A and B, each of which can be assigned to any measurement data. The display can be configured to show A only, B only, A above B, A front B, Slice, A–B (dB), A–B (lin) or a data table.

Slice displays access the multispectrum time history data as defined in the Average menu. The top trace shows the instantaneous frequency spectrum at the time noted by the marker in the bottom trace. The bottom trace shows a time history or "strip chart" recording of the amplitude of the band selected by the marker in the top display. In this way, both axes of the three-dimension multispectrum display can be examined in detail with the full marker capability of the HP 3569A. Figure above shows an example of a multispectrum display in the slice display format.

The difference display calculates the difference of spectrums in trace A and B using either dB or linear units. With linear units, the difference is A-B (in volts). In dB units, the difference is A/B (in volts).

Measurement Types

There are four distinct measurement modes in the HP 3569A.

Real-time Octave Analysis

In this mode, the HP 3569A is a single or dual-channel real-time frequency analyzer spanning 1 to 12 octaves simultaneously over the frequency bands shown below. In all cases, the power-spectrum and power-spectral density measurements are real-time. All measurements are implemented with real-time digital filters—there are no non-real-time multipass or synthesized measurements.

By measuring 1/1- and 1/3-octave spectra over time, amplitude histograms and Ln measurements are possible for each frequency band.

HP 3569A Real-time frequency ranges (band center frequencies)

Resolution	1 Channel	2 Channel
1/3 Octave	1.6 Hz	1.6 Hz
	20 kHz	10 kHz
1/1 Octave	2 Hz	2 Hz
	16 kHz	8 kHz

Sound Intensity Analysis

In this mode, the HP 3569A is a dual-channel acoustic intensity analyzer that (at this writing) meets IEC 1043-199X draft standard class 1 processor requirements.

When used with the sound power measurement table, the HP 3569A calculates the resultant sound power based on a series of sound intensity measurements. For each surface, individual areas are entered into the table and sound power is automatically calculated at the end of measurement. For gated trigger, the analyzer also measures the trigger time and enters this into the table as well, allowing you to concentrate on the sweep rate during sound intensity measurements. The anayzer provides a quan-titative measure of the sweep rate.

There are two different measurement modes for sound intensity measurement. Either active intensity or particle velocity measurements are offered.

The P-I index (Pressure/Intensity index) field indicator provides an effective measure of the signal-to-noise of each intensity measurement, and is used as a figure-of-merit for a specific measurement.

Narrowband FFT Analysis
(Option AY2)
In this mode, the HP 3569A is a two-channel FFT-based spectrum and network analyzer with a broad range of both single-channel and dual-channel measurements. To learn more, see the detailed option description on page 11.

Reverberation Time Analysis
(Option AY3)
In this mode, the HP 3569A becomes a single-channel reverberation time analyzer. The analyzer uses the multispectrum measurements and slice capability to measure the decay times in a room, perform reverse-Schroeder integration on the decays, and calculate the reverberation time for each frequency band. Select from T20, T30 or user-defined slope estimates to compute RT60 using either the internal broad-band source or external impulsive sources, such as balloon bursts or pistols. To learn more, see the detailed option description on page 11.

HP 3569A Measurement Results Summary

Real-time Octave	Real-time Intensity	Narrowband FFT (Option AY2)	Reverberation Time (Option AY3)
CH1 Pwr	Mean Pressure	CH 1 Pwr	Power Spectrum
CH2 Pwr	Intensity	CH 2 Pwr	PSD
CH1 PSD	P-I Index	CH 1 PSD	T20
CH 2 PSD	Particle Velocity	CH 2 PSD	T30
CDF	P-V Index	CH 1 Time	RT60
PDF	Sound Power	CH 2 Time	
L(1)	Field Indicator	Diff Time	
L(10)		FRF	
L(50)		Cross Corr.	
L(90)		Coherence	
L(99)		Cross Spectrum	
L(user)			

Averaging

Maximum/Minimum Hold
For applications where signal extremes are of interest, the average can be programmed to hold the maximum or minimum value as defined in the Average menu.

Linear Averaging
All 1/1- and 1/3-octave bands have user-selectable linear integration times from 3.9 ms to 100 ks.

Minimum integration time limited to 7.8 ms for 20 kHz single-channel measurements, 7.8 ms for 10 kHz dual-channel measurements and 31.25 ms for acoustic intensity measurements.

Exponential Averaging
All 1/1- and 1/3-octave bands have exponential weighting with user-selectable time constants from 15.625 ms to 16 s.

Multispectrum and Slice in Averaging
The multispectrum data array and slice display can be combined to provide a time history of averaged measure-ments. The slice marker can be used to build a multi-spectrum array of intensity or pressure spectra in either sequential or random order.

Triggering

Freerun
In freerun trigger mode, the HP 3569A captures data at the fastest possible rate with the selected integration time.

Ch1/Ch2 Level
With level triggering, the trigger point is selected by specifying a trigger amplitude for a specific frequency band or the A, and L bands. Either channel 1 or channel 2 input data can be used as the trigger source.

Ch1/Ch2 Event
Event triggering is similar to level triggering specified above, except that the level in the specific frequency band must exceed the trigger level for at least the time duration specified in the trigger menu. This is useful for signals that have short transient data you wish to ignore, but still trigger on a band level. Trigger duration time is user selectable from 3.9 ms to 60 s.

The Tape Out signal is set after event detection allowing external tape recorders to record the event. After the measurement is complete, the results are then saved to RAM disk using the auto-increment, file-naming convention.

External
When an external TTL pulse is applied to the external trigger connector, the analyzer increments another measurement to the average.

External Start
In external start, the analyzer switches to freerun after an external trigger is sensed.

External Gate
External gating controls when the real-time digital filter bank is sampled and included in the selected integration or average time.

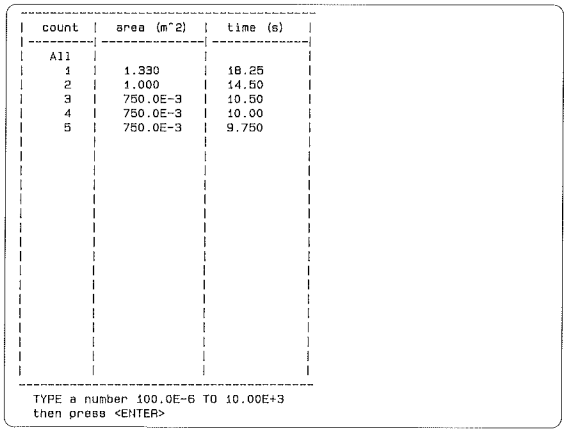
This is very useful in preliminary sound intensity scans where each surface is swept with a probe. No initial setup of the sweep time is required.

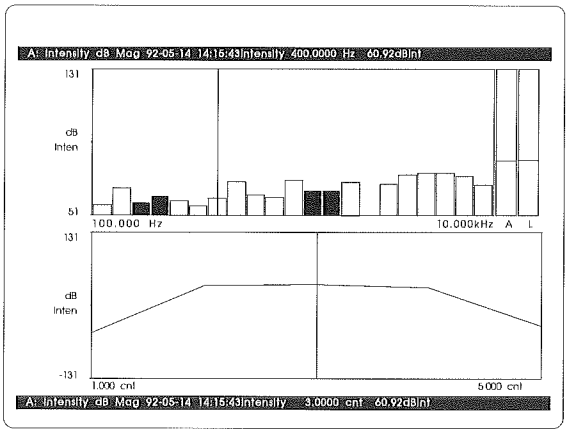
In sound intensity mode, the analyzer measures the time that the gating signal is active and enters this time automatically in the sound power measurement table. This lets you concentrate on maintaining a constant sweep rate when performing sound power measurements, and provides a quantitative figure-of-merit for sound power scans when using the sweeping technique.

Pre/Post Trigger Delay
With level triggering the user-defined pre/post trigger delay can be entered to control the start of averaging with respect to the trigger time. Up to ± 256 integration times (± 256 time steps for exponential average) can be offset for the beginning of a multispectrum display.

Repeat On/Off
At the completion of a multispectrum, the analyzer can be programmed to either pause the measurement (Repeat off) or to re-trigger and continue with another measurement (Repeat on).

User-Accept
With User Accept on, the analyzer prompts you to either accept the measurement, or reject it at the completion of an average. When the measurement is accepted, it is entered into the multispectrum display, and the next multispectrum measurement is initiated. When the measurement is rejected, the data is discarded, and the measurement repeated for the same multispectrum display location.





When using the timed gate mode, the analyzer measures the gated sweep time. This allows you to concentrate on maintaining a constant sweep rate and probe positioning.

Data Storage

There are two separate memory locations in the HP 3569A: multispectrum memory and the internal RAM disk. The multispectrum display contains the current measurement, while the RAM-disk can contain instrument state files, measurement data files, and display trace files.

Multispectrum Memory
Up to 1000 1/3-octave spectra, 3000 1/1-octave spectra or 400 real-time measurements can be stored in a multispectrum measurement.

Multispectrum Recording Rate
Multispectrum measurements can be recorded at the full bandwidth of the HP 3569A real-time measurement range. These are 16 kHz for 1/1-octave, 20 kHz for 1/3-octave, and 5 kHz on both input channels for the optional Narrowband FFT mode. Spectra can be recorded to multispectrum memory at a maximum rate of 256 spectra/second.

Trace Storage on RAM-disk
There are 512 kbytes of user memory on the RAM disk. Up to 3000 1/3-octave and 9000 1/1-octave measurement traces can be stored on the RAM disk.
Instrument State

```
HP3569A 920513A 92-05-13 16:34:39
  reg    type  date   time  trace


       11  T 92-05-13 16:30 Cross Pow
       12  T 92-05-13 16:30 Cross Cor
       13  T 92-05-13 16:31 Coherence
       14  T 92-05-13 16:32 Freq Resp
       15  T 92-05-13 16:33 Diff Ch1
       16  T 92-05-13 16:33 PSD Ch2
       17  T 92-05-13 16:33 RT60
       18  T 92-05-13 16:33 T30
       20  T 92-05-13 16:25 PS Ch2
       21  T 92-05-13 16:29 Time Ch1
 FLYOVER   M 92-05-13 16:23 RT Octave
 FLYOVER1  T 92-05-13 16:20 PS Ch1
 FLYOVER2  T 92-05-13 16:21 PS Ch1
 FLYOVER3  T 92-05-13 16:21 PS Ch1
 FLYOVER4  T 92-05-13 16:21 PS Ch1
 FLYOVER5  T 92-05-13 16:21 PS Ch1
 FLYOVER6  T 92-05-13 16:22 PS Ch1
 INPUTA    T 92-05-13 16:28 Spec Ch1
 SURF1     S 92-05-13 16:27 RT Intensity
 SURF1     T 92-05-13 16:27 Intensity


 Page 01/02 (<- or -> to change page)

  Select register, then press <ENTER>
```

The internal non-volatile RAM disk provides measurement and state storage.

Standard Data Format (SDF) Utilities
All HP acoustics analyzers now use a common data format—Standard Data Format (SDF). SDF allows different analyzers to share data. In this way, your data never becomes obsolete as you move to newer test platforms. The HP 3560A, HP 3562A, HP 3563A, HP 3566A/67A, HP 3569A and HP 35665A are all supported under SDF.

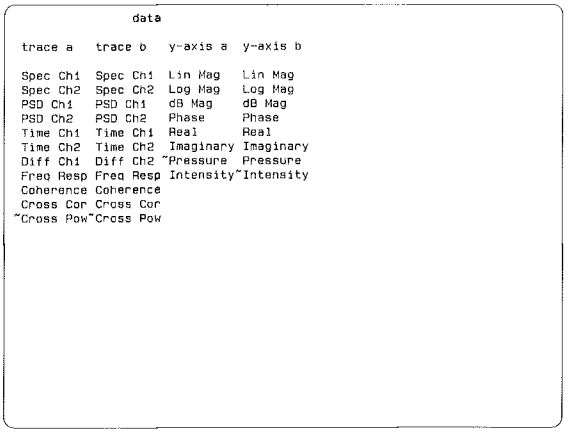
This compatibility allows a set of useful MS-DOS® utilities to be used which are included with every HP 3569A. These include:

- Data download from the HP 3569A to a PC
- Viewing and annotating stored data on a PC
- Making annotated prints/plots from a PC
- File conversions between the different supported analyzers
- File conversions to ASCII and Data Set 58
- File conversions to MATRIX$_x$ and MATLAB PC analysis packages
- C libraries for customers who wish to access SDF files from their own programs
- SMS StarAcoustics Link: Provides additional information to SDF file for easiest integration of intensity spectra into SMS StarAcoustics for noise source identification and ranking.

Options

Narrowband FFT analysis
(Option AY2)
This option adds two-channel FFT analysis measurements for acoustics and vibration measurements to the HP 3569A's basic 1/1- and 1/3-octave measurements.

Measurement Data Type
With the narrowband FFT option a full set of constant-frequency-bandwidth measurements are added to the HP 3569A. See Figure below for a full list of measurement data and display coordinate types.



A full range of FFT measurement are possible with Option AY2, including pressure and intensity for FFT based sound intensity.

Frequency
Either baseband (0 Hz start frequency) or zoom (non-0 Hz start frequency) displays are possible with 100, 200, 400, 800 and 1600 lines of FFT resolution. Frequency spans range from 50 Hz to 25.6 kHz in baseband mode and 20 Hz to 10 kHz in zoom mode.

Windows
The most common window functions are included in the HP 3569A. Hann, Uniform and FlatTop windows are available to maximize either amplitude accuracy or frequency resolution.

Inputs
Basic single-channel spectrum amplitude measurement accuracy of the FFT mode is ±0.5 dB. Basic accuracy for cross-channel measurements is ±0.1 dB and ±1.0 degrees with enhanced accuracy on the 12.8 kHz range where ±0.1 dB and up to ±0.017 deg phase match is maintained. The maximum input noise floor is –100 dBV/ Hz for clean, low-noise measurements.

Dynamic Range
Guaranteed dynamic range in the FFT mode is 70 dB for alias and residual responses, and 65 dB when including harmonic distortion.

Reverberation Time measurements (Option AY3)
The optional reverberation time measurement mode has its measurement basis using the real-time octave measurements, but adds the automatic source and input control to acquire data, and automatic analysis to provide the direct display of RT-60.

Measurement Routine
Before beginning a reverberation measurement, you enter the maximum expected reverberation time (meas duration) under the average menu. The room excitation source is selected as either broad-band (which uses the internal noise source and external amplifier and speakers), or impulsive (which assumes either a pistol shot, balloon burst or other impulse noise source will be used). The frequency bands of interest and inputs are set up appropriately, and the Start key is pressed.

For broadband noise, the noise source is then ramped up. The room is allowed to settle by waiting for the user-specified settling time. The source is then turned off and the resultant decays are measured for each 1/1- or 1/3-octave band and stored in the analyzer's measure-ment memory. Impulse decays are similarly measured upon automatic trigger by the analyzer.

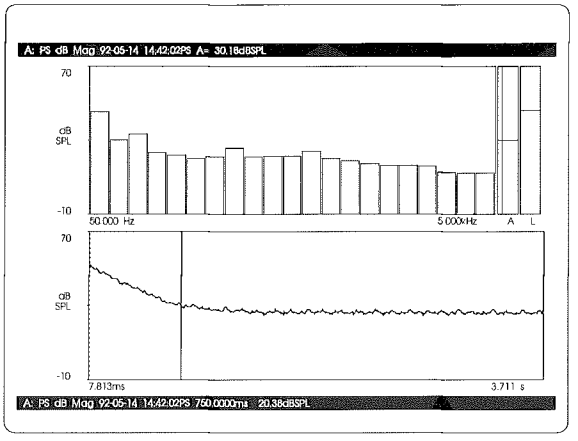
After a measurement is complete, each band is analyzed by first applying a reverse-Schroeder integration to the decay, and then placing markers at the –5 dB, –25 dB and –35 dB points relative to the steady state value established when the source was turned off (t_0). The resultant RT60 times are calculated using the slopes of the curves from –5 dB to –25 dB (T20) and –5 dB to –35 dB (T30). For complex reverberation analysis, the user may then place the markers over any portion of the decay curve, and the analyzer will calculate RT60 based on the selected slope.

When the expected maximum reverberation time is less than 1.75 seconds, the analyzer captures and stores the impulse response in memory, and time-reverses the signal before octave filtering. This minimizes the effects of the octave filter's ringing on very fast decays. This allows accurate reverberation times to be measured in "quiet" rooms.

Measurement Results
Measurements include the input spectrum, RT60 as defined by the slope of T20, RT60 as defined by the slope of T30, and RT60 as defined by the user-selectable markers at the completion of all averages.

Data Transfer Utilities for Palmtop PC (Option 550)
The optional data import utilities are a combination of data management programs and an example spreadsheet. These programs provide the following functions:

- Disk Transfer: Reads data from HP 3569A RAM disk and places it on an internal PC disk drive or HP 95LX memory card.
- Measurement Scheduler: At specified time, wakes analyzer, recalls measurement state, takes a measurement and stores results to RAM disk. Total number of scheduled results limited by HP 3569A RAM disk space, and HP 3569A/HP 95LX sleep mode battery life.
- Easy import of measurement data into Lotus 1-2-3 in the Palmtop PC.
- Example Spreadsheet: Calculates ANSI S12.12 sound intensity indication functions from HP 3569A multispectrum measurement data.



Optional reverberation time measurements in the HP 3569A, automatically calculate individual band RT60 measure-ments from the decay measurements.

HP 95LX Palmtop PC

For truly portable applications, the HP 95LX Palmtop PC and optional data transfer utilities (Option 550) team up to give you the most in portable measurement and analysis solutions with no size/weight penalties.

The HP 95LX Palmtop PC (HP F1010A), removable 1-Mbyte memory card (HP F1004A) and connectivity pack (HP F1001A) allow you to download one or all measurements in the analyzer to perform post-processing functions in the internal Lotus 1-2-3 spreadsheet.

HP 3569A Real Time Frequency Analyzer Specifications:

Input Characteristics

All inputs are single ended.

Preamplifier Input:

Standard seven-pin female connector on instrument top panel to mate with LEMO FGG1B307 connectors.

Input Impedance:
1 MW (typical)

Input Ranges: 5 mV to 5 V peak Analyzer automatically displays ranges and range selections in dBSPL as defined by the microphone sensitivity factor and dB reference (20 µPascals).

Range Control: Either fixed input range or autoranging is user selectable. Autoranging occurs once at the start of a measurement. Input ranges can be incremented/ decremented via front panel control during a measurement to clear overloads or maximize dynamic range.

Microphone Polarization:
0 V and 200 V

Power Supply: + 28 Vdc at 2 mA

Heater Voltage: None

A-Weight Filter: Conforms to IEC 651 Type 1. A-Weight and overall bands are calculated for both channels. Includes analog A, C, Linear (8 Hz to 22.4 kHz at –3 dB), and Flat (0.5 Hz to 25.6 kHz at –3 dB) weighting functions on Channel 1 and digitally applied A-weight filter on Channel 2.

Direct Input

Two BNC inputs on instrument top panel.

Input Impedance:
1 MΩ (typical)

Coupling: dc or ac coupling with –3 dB at 0.5 Hz (Typical)

Frequency Range: dc to 25.6 kHz

Noise Floor:
<–100 dBV/$\sqrt{\text{Hz}}$

A-Weight Filter: Analog input A-weighting filter that meets IEC 651 Type 1 requirements.

ICP Accelerometer Input

Input Impedance:
1 MΩ (Typical)

Frequency Range: dc to 25.6 kHz

Noise Floor: <–100 dBV/Root Hz

Drive Current: 4 mA (typical)

Compliance Voltage:
22 V (typical)

Channel-to-Channel Match:

12.8 kHz Span
Gain Match:

0% to 60% of span	±0.1 dB
60% to 80% of span	±0.2 dB

Phase Match:

40 to 250 Hz	±0.017 deg
250 Hz to 6.3 kHz	±f/14750 deg
6.3 to 8 kHz	±1.1 deg

Other Spans
Gain Match:

0% to 60% of span	±0.1 dB
60% to 80% of span	±0.2 dB

Phase Match:

0% to 60% of span	±1.0 deg
60% to 80% of span	±2.5 deg

Maximum Input Voltage:
100 Volts (damage level)

Overload Detection

Overloads are detected in both the analog input circuits and in the digital processing circuits and reported via a front-panel indication. When the overloaded measure is saved, the overload indication is saved with the data.

Crosstalk

Receiving channel Rs = 50 ohms:
<–90 dB (typical)

Attenuator Linearity

0	to	–40 dBfs	± 0.2 dB
–40	to	–45 dBfs	± 0.7 dB
–45	to	–50 dBfs	± 1.0 dB
–50	to	–60 dBfs	± 2.5 dB
–60	to	–65 dBfs	± 6.0 dB

Anti-Alias Filter

Both inputs are protected with analog anti-alias filters. These filters provide at least 75 dB of stop band attenuation for all possible alias products and exceed the requirements of IEC 225 and ANSI S1.11.

Sampling Rate

65,536 kHz, 32,768 kHz, 16,384 kHz

A/D Conversion

Resolution:
A/D resolution is 12 bits

Quantization Error: ±1/4 LSB

Digital Signal Processing:
MC56002 24-bit processor running at 40 MHz clock rate.

Digital Filters

1/1 Octave Filters
One to 12 seventh-order Butterworth filters can be measured simultaneously in realtime. Center frequencies range from 2 Hz to 16 kHz. Center frequencies are given by

$$CF = 1000*2^{N}$$

Where $9 <= N <= 14$

These filters meet IEC 225-199X, DIN 45651 and ANSI S1.11-1986, Order 7, Type 1-D requirements.

1/3 Octave Filters

Three to 36 third-order Butterworth filters can be measured simultaneously in realtime. Center frequencies range from 1.6 Hz to 20 kHz. Center frequencies are given by

$$CF = 2^{\frac{(30-n)}{3}}$$

Where $-13 <= n <= 28$

These filters meet IEC 225-199X, DIN 45651 and ANSI S1.11-1986, Order 3, Type 1-D requirements.

FFT Constant Frequency Bandwidth Filters
(Option AY2)

Resolution: 100, 200, 400, 800 and 1600 lines of fixed-frequency bandwidth filters.

Windows: User-selectable window function to maximize amplitude accuracy, frequency accuracy or optimize for random noise. Window features include:

	Uniform	Hann	Flat Top
- 3 dB Bandwidth	0.25% of span	0.37% of span	0.90% of span
Noise Equivalent Bandwidth	0.25% of span	0.375% of span	0.955% of span
Window Flatness	+0, -4 dB	+0, -1.5 dB	+0, -0.01 dB
Shape Factor (-60 dB BW/-3 dB BW)	716	9.1	2.6

For 400 line resolution. Scale appropriately for other resolutions.

System Accuracy

Dynamic Range
72 dB per ANSI S1.11-1986

Overall Frequency Response
±0.3 dB at filter centers. Meets or exceeds the measurement accuracy requirements of ANSI S1.11-1986 Order 3, Type 1-D; IEC 225-199X; ANSI S1.4-1984; and IEC 651-1979 Type 1.

Noise
Measured in 1/3-octave bands with 50 mV/Pascal microphone sensitivity and 20 µPascal dB reference per IEC 651.

Amplitude Linearity
Meets or exceeds the requirements of IEC 225 and IEC 1043.

0	to	–40 dBfs	±0.2 dB
–40	to	–45 dBfs	±0.7 dB
–45	to	–50 dBfs	±1.0 dB
–50	to	–60 dBfs	±2.5 dB
–60	to	–65 dBfs	±6.0 dB

Frequency Accuracy and Stability
±0.02% without warm-up. No adjustments are necessary.

Pressure-Residual Intensity Index
For 25 mm microphone separation, pink noise, 6000s average, over intensity operating range.

Detectors

Control

Start: Clears the average accumulator and starts an average.

Pause/Continue: Temporarily suspends the averaging process. Averaging resumes when pressed again.

Averaging Gate: (Real-Time Octave and Real-time Intensity modes only) External TTL trigger signal gates the averaging process. Minimum external gate lengths are 15.625 ms for 20 kHz span, and 3.91 ms for 10 kHz and lower spans. Maximum gate length is 100,000 seconds.

Mode	Real-Time Octave	Real-Time Intensity	FFT	Reverberation Time
Free run	Yes	Yes	Yes	Yes
Channel 1 Level Trigger	Yes	No	No	No
Channel 2 Level Trigger	Yes	No	No	No
Channel 1 Event Trigger, Channel 2 Event Trigger	Yes	No	No	No
External trigger (TTL)	Yes	Yes	Yes	No
External start (TTL)	Yes	Yes	Yes	No
External Gate (TTL)	Yes	Yes	No	No

Trigger Conditions:
Linear:
Linear integration times are user-selectable from 3.91 ms to 1 s in a binary sequence, and from 1 s to 100,000 s in 1 s steps.

Exponential:
Exponential time constants for exponential averaging from 15.625 ms to 16 s in a binary sequence.

Impulse:
Replaces overall band (L) with impulse measurements per IEC 651. Measurements of time-averaged overall A-level, L_{pA}, and overall I-level, L_{pAI}, are available simultaneously on Channel 1.

Spectrum Memory

Non-volatile memory for up to 3000 single spectrum or multispectrum trace files. Standard MS-DOS file names with automatic increment feature for names ending in a numeric value.

Control

Delay: For linear averaging, ± 256 integration time periods for Level or Event triggering. For exponential averaging, ± 256 time step periods for Level or Event triggering.

Multispectrum Update Rate:
4 traces/second to the screen (typical)

Maximum Number of Spectrum:
1000 1/3 Octave, 3000 1/1 Octave spectra in measurement memory.

Maximum (Minimum) Hold:
Composite spectrum of maximum (or minimum) RMS level occurring in each band for each channel.

File Catalog:
3000 1/3 Octave, 9000 1/1 Octave spectra in non-volatile RAM results storage.

Hardcopy Output

Direct support of HP LaserJet raster graphics output and HP-GL plotter control via RS-232. Plots/prints to file are possible using the Standard Data Format utilities included in each shipment.

Measurement Scheduler

When used in conjunction with the HP 95LX Palmtop PC, the HP 3569A can be programmed to wake up and take measurements with a preconfigured instrument state using the Data Transfer Utilities (option 550).

Display

Display Formats

A Only: A single display of trace A.

B Only: A single display of trace B.

A above B: In this mode, the display is split with trace A appearing above trace B.

A Front B: In this mode, the two traces, A&B are overlaid for direct comparison.

Slice: A time slice through the multispectrum measurement. The top trace is the instantaneous trace A measurement as defined in the DATA menu. The bottom display shows the time history (strip chart recorder) of the trace A data at the marker frequency.

Display Update: Four per second for linear average, once per time step for exponential average.

A-B (lin): This single display shows the results of subtracting the linear voltage/pascal values of trace B from trace A. This is equivalent to subtraction.

A-B (dB): This single display shows the results of subtracting the dBSPL/Power values of trace B from trace A. This is equivalent to division.

Table: Tabular output of the data values for both trace A and trace B.

Y-Axis

Annotation: Absolute or relative units (dB) with user-selectable dB reference.

Calibration:
Units: User selectable units of Pascals (dBSPL), g, m/s, in/s, m, in, lbf, kgf, psi, EU and Volts.

Y- Units: Power, PSD.

Scale Expansion: The display scaling can be expanded using the arrow keys.

X-Axis

Linear/Log: Linear and Log scaled X-axes are selectable.

Frequency Zoom/Scroll: Display expansion, compression and scrolling is possible with the shifted function keys.

Slice Display: Linear axis annotated with time for free run or time-stepped triggering. Annotation is in count for triggered measurements.

RS-232 Interface

9-pin male D-subminiature connector. EIA/TIA 562, EIA/TIA 574 38400, 19200, 9600, 4800, 2400 and 1200 baud.

Other Input/Output Connectors

Trigger Input: TTL input (open collector) for use in triggering control. Switch contact to ground is sufficient for triggering.

Tape Recorder Output Signal: When using the microphone connectors as inputs, the signal is amplified and output to the BNC connector for monitoring. Voltage gain is 25 for input ranges of 200 mV and below, and 1.0 for ranges above 200 mV. Output impedance is 4 kW.

Source Output: Pseudo-random white and pink noise. Pseudo-random bit sequence length = 2^{31}-1. Nominal output level = 4 Vpeak with 0 to 30 dB of attenuation in 5 dB steps. Crest factor = 1.6:1 (typical) for white noise (typical) and 6.5:1 (typical) for pink noise.

Digital Input/Output: 15-pin Female D-Subminiature connector:

Digital I/O Pinout:

Pin	Use
1,7	Ground
2	"overload" LED
5	Tape recorder control (open collector, 30 mA)
6	"Measure" LED

Environmental

Operating Temperature:
0 to –40 deg C

Storage Temperature:
–20 to 50 deg C

Humidity: 5% to 95% to 32 deg C, non-condensing

Electromagnetic Compatibility: Complies with IEC 801-2 (ESD), IEC 801-3 (Radiated Immunity), and EN 55022 (Radiated and conducted emissions).

Cabinet

Dimensions:
Length: 300 mm (11.5 in)
Width: 210 mm (8.25 in)
Height: 95 mm (3.75 in)

Weight: 3.2 kg (7 lb) including battery.

Accessories Included:

Standard Data Format Utilities

Instrument soft-sided carrying case

HP 82241A ac adapter (US)
HP 82241AB ac adapter (Europe)
HP 82241AU ac adapter (UK)
HP 82241AJ ac adapter (Japan)
HP 82241AG ac adapter (Australia)
HP 82241AA ac adapter (South Africa)

Other Accessories

HP 35210A 4 meter HP to HP extension cable (one male - one female)

HP 35210B 10 meter HP to HP extension cable (one male - one female)

HP 35211A 2 meter Bruel and Kjaer 7 pin to HP 7 pin preamplifier adapter cable (adapts Bruel and Kjaer microphone preamplifier cable output to HP 3569A microphone preamplifier input).

HP 35212A 2 meter ACO Pacific to HP adapter cable. Adapts exisiting ACO preamlifier output (Also HP 35224A preamlifiers) to HP 3569A microphone preamplifier input).

HP 35239A Bruel and Kjaer Type 3545 Sound Intensity Probe Adapter kit (Adapts Bruel and Kjaer Type 3545 sound intensity probe to HP 3569A use. Includes trigger handle, HP 3569A microphone preamplifier input adapter cables and HP 3569A digital I/O probe trigger cable).

Configuration Guide

HP Product	In-Situ Sound Pressure	In-Situ Sound Power	Noise Source Identi-fication	Com-munity Noise	Reverb-eration Time	MIL-STD-740-1, 740-2	ECMA 160 Sound Power	Availability
HP 3569A Real-time Frequency Analyzer	■	■	■	■	■	■	■	Aug'92
Option AY2 Narrowband FFT	◆	◆	◆			◆		Aug'92
Option AY3 Reverberation Time		◆			■		◆	Aug'92
Option 550 Data Transfer Utilities	◆	◆	◆	◆	◆	◆	◆	Aug'92
HP 95LX Palmtop PC[1]	◆	◆	◆	◆	◆	◆	◆	Aug'92
1420-0504 Extra battery pack (with circuitry to recharge externally)	●	●	●	●	●	●	●	Aug'92
Microphones and Cables								
HP 35220A Free Field, Standard Sensitivity	●			●	●	●		NOW
HP 35221A: Free Field, High Sensitivity	●			●	●	●		NOW
HP 35222A: Pressure, Standard Sensitivity	●			●	●	●		NOW
HP 35223A: Pressure, High Sensitivity	●			●	●	●		NOW
HP 35224B Pre-amplifier[2]	■			■	■	■		Aug'92
HP35210A 4 meter extension cable	●			●	●	●		Aug'92
HP 35210B 10 meter extension cable	●			●	●	●		Aug'92
HP 35211A 2 meter B&K to HP adapter	●			●	●	●		Aug'92
HP 35212A 2 meter ACO to HP adapter	●			●	●	●		Aug'92
Sound Intensity Probes								
HP 35230A Class 2 Sound Intensity Probe with 1/2 inch microphones. Includes matched microphones and preamplifiers, 12mm and 50mm spacers, windscreen, 2 meters of cable length, plus a carrying case. Mates directly to HP 3569A.		●	●				●	Fall'92
HP 35230A Option 001 adds matched pair of 1/4 inch microphones and spacers		●			●	●	●	Fall'92
HP35237A matched pair of 1/2 inch microphones.		●			●	●	●	Fall'92
HP35237B matched pair of 1/4 inch microphones.		●			●	●	●	Fall'92
Vibration Transducers								
HP 35200A General vibration accelerometer								NOW
HP 35201A Machinery Vibration Accelerometer		●			●			NOW
HP 35203A Ruggedized Machinery Vibration Accelerometer		●			●			NOW
HP 35205A Hand Held Velocity Probe		●			●			NOW
Calibration Accessories								
HP35234A Calibrator Kit includes Electronic Sound Calibrator (HP35229A), Cavity Calibrator (HP35236A), Barometer (HP35235A), 1/2" to 1/4" adapters, and carrying case.	●	●	●	●	●	●	●	Fall'92
HP35229A Electronic Sound Calibrator for microphones amplitude calibration.	■			■	■	■		Fall'92
HP35236A Cavity Calibrator for microphone phase calibration.		■	■				■	Fall'92
HP35235A Barometer.								Fall'92

■ = Required
◆ = Recommended
● = Choose one based on application

[1] HP F1010A HP95LX Palmtop PC with 1 Mbyte RAM and HP F1001A Connectivity Pack required. HP F1004A 1 Mbyte memory card recommended for data storage.

[2] To use existing HP 35224A preamplifiers, order one each HP 35212A preamplifier adapter cable.

For more complete specifications see the HP Physical Sensors Catalog (5952-2996).

HEWLETT PACKARD

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(022) 780 41 11 (Suisse Romande)
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