HEWLETT PACKARD

HP 35665A Acoustic Measurement Performance

Technical Datasheet

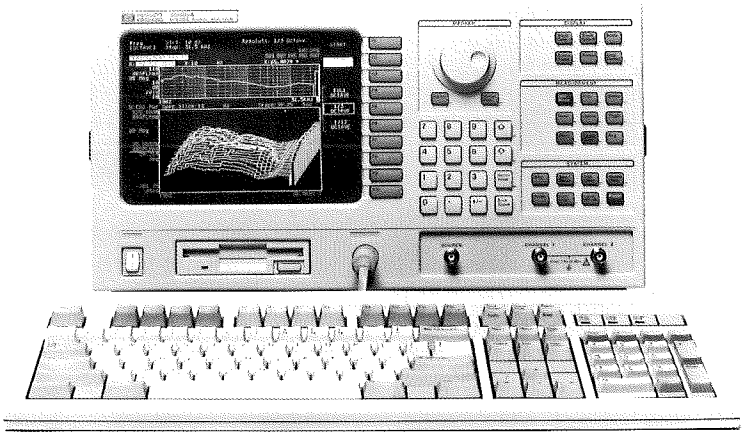
HP 35665A 2-Channel, 32 kHz Real-Time Analyzer

Meets ANSI S1.11-1986 and ANSI S1.4-1984 Measurement Standards

The HP 35665A Real-Time Frequency Analyzer is a bench-top frequency analyzer for acoustics, electro-acoustics, and vibration measurements in the laboratory. The analyzer features real-time digital filtering up to 32 kHz. Real-time operation is important for the analysis of non-stationary signals such as decays and impulsive events.

Up to six megabytes of optional internal memory can be added to the HP 35665A. This can be dynamically allocated for time-capture files, HP Instrument BASIC programs, or octave, 1/3-octave, or 1/12-octave waterfalls.

With optional HP Instrument BASIC, the HP 35665A can control any external IEEE-488 device.



Uses:

- Constant-percentage bandwidth frequency analysis of sound and vibration signals in real-time to 32 kHz
- Narrowband (FFT) frequency analysis of sound and vibration signals
- Measurement of sound power
- Electro-acoustic testing
- Building acoustics testing: sound transmission, absorption, reverberation time
- Automobile acoustic testing
- Aircraft flyover noise measurements and analysis

Features:

- Single-channel operation, 32 kHz real-time bandwidth
- Dual-channel operation, 16 kHz real-time bandwidth-per-channel
- Direct inputs and ICP transducer power supply
- 80 dB dynamic range in 1/3-octave mode as per ANSI S1.11-1986 for ranges above 50 mV
- 1/1-,1/3-, and 1/12-octave digital filters
- 64 spectra-per-second storage rate
- Internal memory capacity expandable to measure 49,000 1/3-octave spectra
- PC/MS-DOS ® compatible, 1.44 Mbyte 3-1/2 in. flexible disk drive for back-up storage of spectra and ASCII data exchange
- Optional HP Instrument BASIC provides extensive programmability including learn mode for push-key autosequencing
- High-visibility CRT screen with 100 dB (or specifiable) display range
- Spectra annotated in decibels or absolute units
- IEEE-488 and RS-232C interface
- Weight 22 kg (47 lb)
- Power requirements:
  280 VA maximum
  90 Vrms to 132 Vrms, 47 Hz to 440 Hz
  198 Vrms to 264 Vrms, 47 Hz to 66 Hz
- Standard configuration has two channels

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Introduction

The HP 35665A Real Time Frequency Analyzer is neatly packed into a 22x43x53 cm frame and weighs less than 22 kg. The display is a green CRT with a resolution of 560 by 400 pixels.

With the exception of the analog front end (which includes input amplifiers, attenuators and anti-aliasing filters, and the tachometer board), the HP 35665A is a wholly digital instrument. Thus, the calibration of the analyzer is extremely stable, exhibiting no drifting effects. Standard internal memory capacity of the HP 35665A is equivalent to 4,300 1/3-octave spectra. Optional memory extends this to 49,000 spectra.

Long term data storage is provided by a built-in PC/MS-DOS compatible 3-1/2-in. flexible disk drive with a formatted capacity of 1.44 Mbytes.

The HP 35665A real-time frequency analyzer can be controlled over the IEEE-488 bus and is compatible with SCPI, the Hewlett-Packard standard for HP-IB programmability. The HP 35665A analyzer can also control the IEEE-488 bus, enabling use of external instrumentation such as switches, power supplies, sources, and voltmeters to configure custom instrument systems.

The HP 35665A operates in real time when analyzing in 1/1-, 1/3-, or 1/12-octaves. In time-capture mode, signals from each channel can be acquired at a high rate and post-processed in real time through all measurement modes. This requires optional memory but increases the available frequency range in 1/12-octave mode to 49.4 kHz. This approach to analysis is valid for all signals, including those with a transient or impulsive nature. Table 1 shows the frequency ranges for real-time and time-capture analysis.

Figure 2
The HP 35665A measures aircraft noise as required by FAR36.
HP Instrument BASIC programs can compute test-day EPNL in 30 seconds.

Input/Output

The HP 35665A's two front panel BNC inputs accept either ICP-type accelerometers or direct electrical signals. The source output includes pink and white noise, arbitrary sources and fixed sine. The back panel has an IEEE-488 input/output interface, a tachometer input BNC, an external trigger port, and a RS-232 port.

Each of the signal inputs has a dynamic range of more than 80 dB as per ANSI S1.11-1986 for ranges above 50 mV. Input coupling is ac or dc, where the -3 dB corner frequency of the ac high-pass filter is 1 Hz. In addition, an analog A-weighting filter meeting IEC651-1979 Type 0 standards can be applied to all input signals.

Accelerometer Power

ICP-type accelerometers can be directly connected to the input BNC, where a built-in constant-current power supply can be selected via the Input Setup softkeys. The power supply maintains a constant current of 4 mA and can drive cables longer than 100 m.

Direct Input

Voltage signals are connected via the input BNC. The input signal range is from 1.8 μV to 31.7 V (RMS sine wave).

Interface

For integration of the HP 35665A into a larger measurement set-up under computer control, the IEEE-488 interface provides convenient access to all raw and processed data in the analyzer. It also provides complete control of the front panel and "soft" functions. In addition, the HP 35665A can control external IEEE-488 devices with HP Instrument BASIC option 1C2.

Hardcopy

A variety of print and plot formats are available for direct printing of screen pictures on Hewlett-Packard HP-IB plotters and HP-IB printers. You can also plot or print to a file on the MS-DOS compatible flexible disk. These files may be imported directly into Microsoft Excel, Word for Windows or Lotus® 1-2-3 ®. Programmable control of the RS-232 port is also supported with HP Instrument BASIC.

Table 1
Frequency ranges for real-time and time-capture analysis.

Upper frequency	Bandwidth (octaves) 1/1	1/3	1/12
49.4 kHz			Real-time with time capture
32 kHz		Real-time	Real-time with time capture
16 kHz	Real-time	Real-time	Real-time with time capture
12.34 kHz			Real-time

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Anti-Alias Filtering and Sampling

For maximum dynamic range, the sample rate of the HP 35665A is 262,144 Hz with a precision of 14 bits. Analog alias protection is provided by a 12-pole elliptical low-pass filter with a -3 dB corner frequency of 112 kHz. Further alias protection for the 32 kHz 1/3-octave band comes from a digital anti-alias filter with a corner frequency of 58 kHz and decimation of the sample rate to 131,072 Hz as shown in Figure 3. This gives at least 88 dB of attenuation of high-frequency signals that could cause aliasing and also provides sufficient filter performance to meet ANSI S1.11-1986 for Order 3, Type 1-D Butterworth filters.

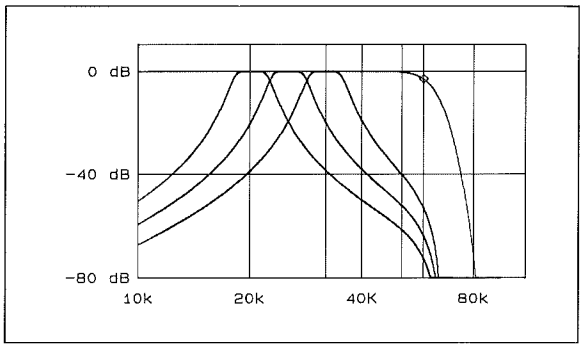

Figure 3
The HP 35665A anti-alias filter ensures 88 dB of stop-band attenuation.

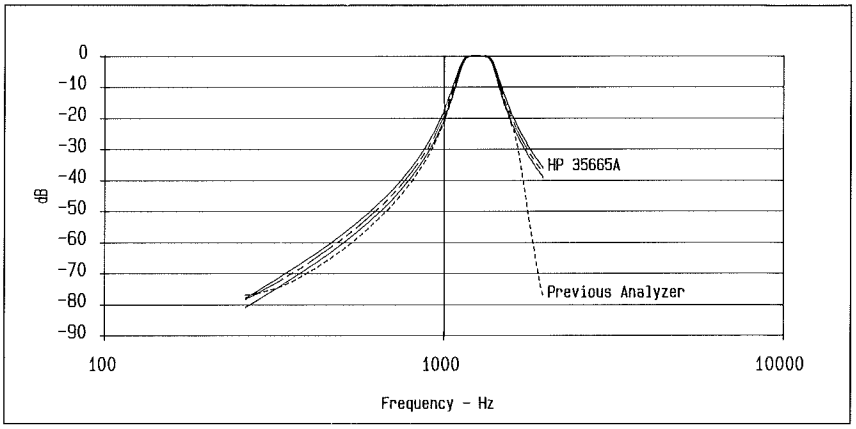

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Figure 4
The limits of ANSI S1.11 Order 3 Type-0 Butterworth filter shapes are compared to the HP 35665A and a previous real-time analyzer.

Figure 5
The 1/3-octave filter algorithms in the MC56001 receive alias-protected digital samples at the correct rate from a custom gate array.
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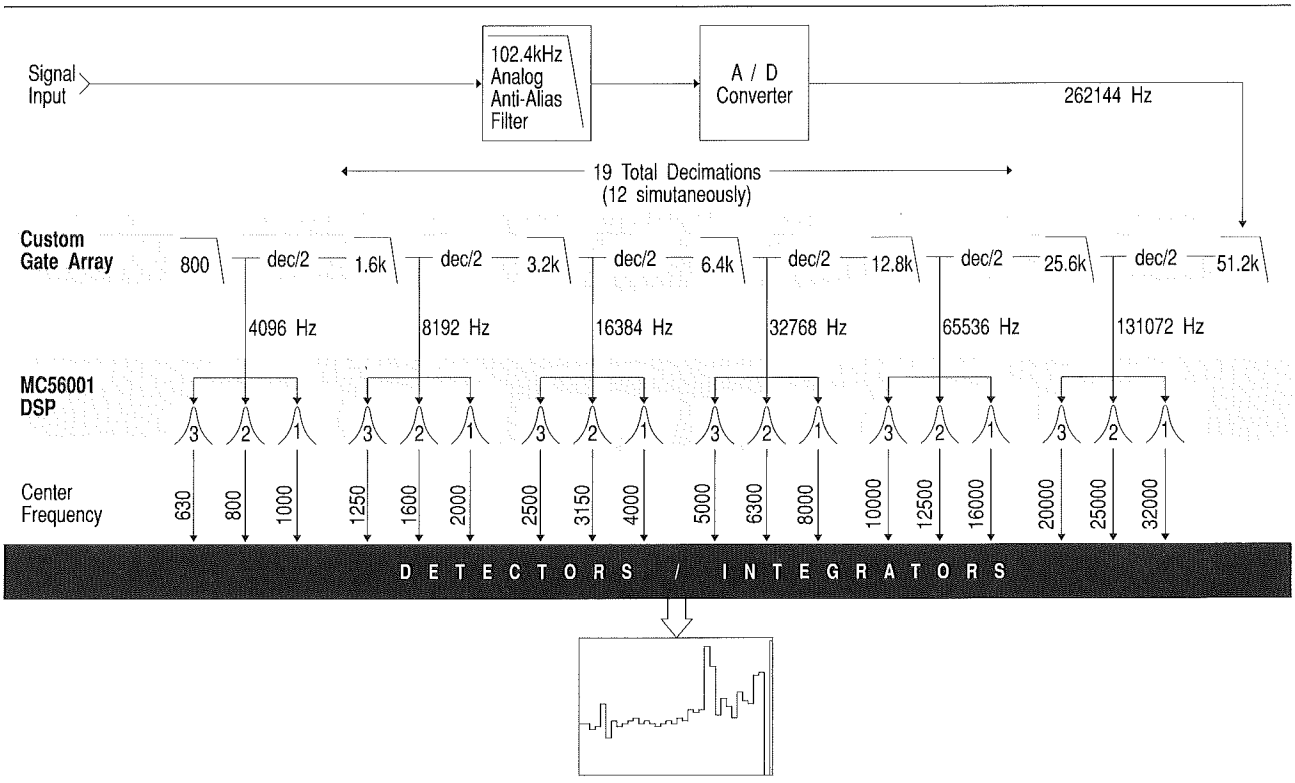

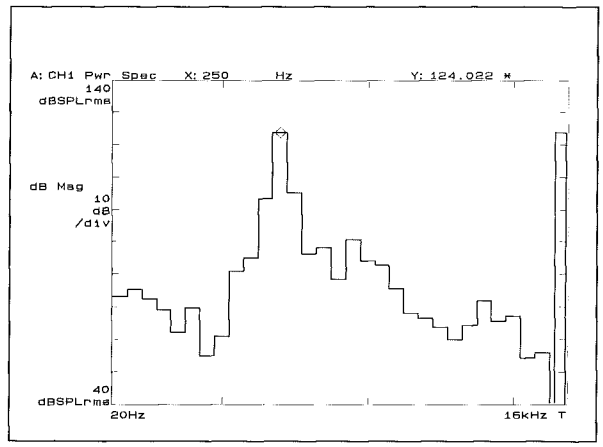

Figure 6
Use EU at MKR to automatically calibrate the input sensitivity using a pistonphone.

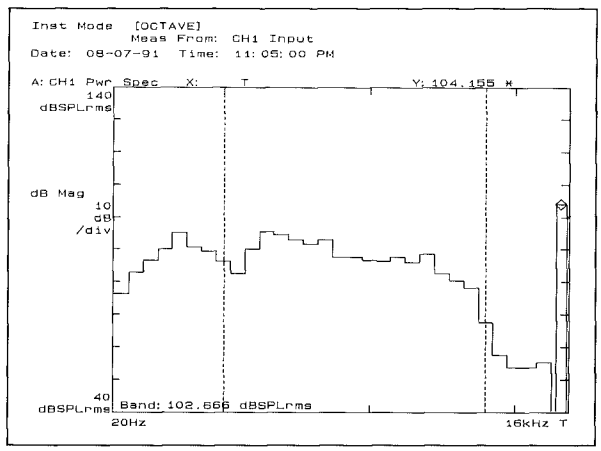

Figure 7
Overall power can be compared to bandpower using marker functions.

Operation

The HP 35665A features a combination of user-interactive hard keys and soft keys. These keys configure the required frequency range, filter bandwidth and linear or exponential averaging. The hard keys provide quick access to logical groups of softkeys. Keystrokes can be captured with ENABLE RECORDING, which is a part of the HP Instrument BASIC option 1C2. This provides an easy way to automate repetitive keystroke sequences without additional programming.

Overview of Settings

The settings in all the menus are displayed in two screens under Display Format: MEASUREMENT STATE and INPUT STATE. A copy of the current state can be saved along with measurement results so that results are fully documented. Up to eight states may be saved in non-volatile RAM. When the analyzer is switched on, the special state labelled AUTOSTATE is used to set up the analyzer.

Help Pages

Once a menu has been called to the screen it can be alternated with an associated help page. The system of help pages, one for each keystroke, provides sufficient information for field operation of the analyzer without reference to an instruction manual.

Calibration

When a system consisting of an analyzer and transducer is to be calibrated, a reference source can be used to apply a calibrated level to the transducer. The auto-calibration feature in the HP 35665A automatically adjusts the input sensitivity of the analyzer so the displayed results correspond to the calibration level of the reference source.

If no reference source is available and the sensitivity of the transducer is known from its calibration chart, you can enter the sensitivity directly into the Input Setup menu as an engineering unit multiplier.

Averaging

Exponential and linear averaging are available, with selectable averaging times as shown in Table 3 specifications on page 9. Averaging is controlled by manual operation of the Start or Pause/Cont push keys. Averaging times from 15.625 ms to 1024 s for linear averaging can be selected depending on bandwidth. For exponential averaging, time constants from 1/16 s to 4096 s in a binary sequence are possible.

Display

Over 20 traces per second can be updated on the HP 35665A display. Four display formats are available: single, upper/lower, front/back and waterfall. A specified trace might be recalled data, input spectra from channel 1 or channel 2, a waterfall slice, or a function defined in the analysis menu.

In the waterfall display mode, the upper trace can be a specified trace or slice. The waterfall trace may be viewed with a specifiable skew angle.

"T" Band

The overall "T" band displays the broadband unweighted (total) level of the input signal. If the analog A-filter has been selected in the Input Setup menu, the analyzer displays the broadband A-weighted level (tolerance meets IEC 651-1979 Type 0). Another technique to obtain the overall sound pressure is with the marker function BAND POWER, which enables independent specification of the limits of overall power calculation.

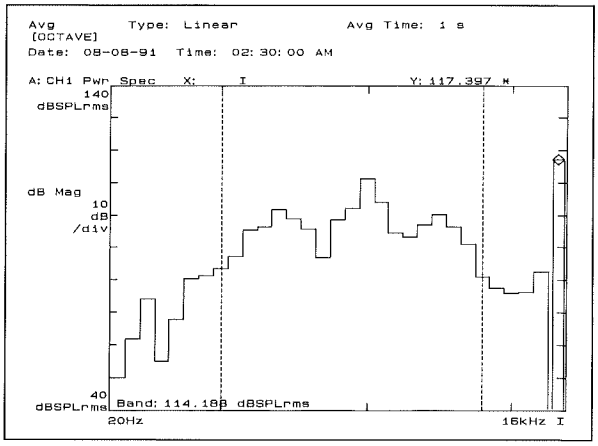

Figure 8
The HP 35665A measures impulsive noise as per IEC 651-1979 Type 0 and ANSI S1.4-1983 Type 0.

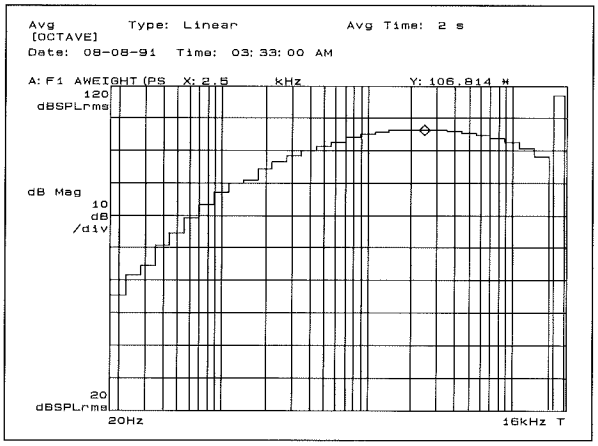

Figure 9
Digital A-weighting is available as a supplied analysis function.

Impulse Detection

The HP 35665A can measure impulsive sounds in conformance with IEC 651-1979 Type 0. This measurement is necessary for many noise-compliance specifications (for example, the measurement of sound power, from office equipment as required in ISO 7779). The overall impulse sound level is indicated in the overall "I" band when the IMPULSE ON mode is activated in the Average menu. For sound-power measurements that require a comparison of impulsive sound with overall Leq (linear average) measurements, the HP 35665A can determine both levels simultaneously. To accomplish this, measure Leq with the IMPULSE detector turned on. Since only the overall "I" band indicates the overall impulsive level and the other 1/3-octave bands are measuring true Leq, the overall Leq can be determined using the BAND POWER marker function over the frequency range of interest as shown in Figure 8. Typically the analog A-weighting filter would be applied to both measurements. The resulting difference between A-weighted Leq (impulsive) indicated in the overall "I" band and A-weighted Leq indicated by the BAND POWER function is a direct measure of the impulsive nature of an product's noise signature as required in ISO 7779. The HP 35665A calculates this value in one measurement in real time.

Peak Hold Detection

Many sound level meters have the ability to measure the absolute peak signal detected by the meter. These detectors typically operate over a range of 25 kHz. With the PEAK HOLD averaging mode in the HP 35665A, it is possible to measure the instantaneous, absolute peak signal received by the analyzer over a span of 25 kHz. It is also possible to measure the absolute, instantaneous peak level detected by each 1/3-octave bin. This new measurement extends the functionality of peak detection into the 1/3-octave frequency domain.

Digital Spectrum Weighting

The Analysis menu can be used to add user-defined digital weightings or standard A-, B-, or C-weightings to measured spectra. The digital weighting functions are permanently stored in the user-defined function menus and can be applied to power spectrum measurement data. This operation, shown in Figure 9, can be done in real-time or during post-processing of captured data.

Maximum and Minimum Hold

To simulate the function of a sound-level meter, the HP 35665A has a Maximum or Minimum Hold function in the HOLD SETUP menu under the Averaging key. In this mode, the display maintains the maximum or minimum level detected during each measurement. The HOLD function is applied to all frequency bands and the overall band.

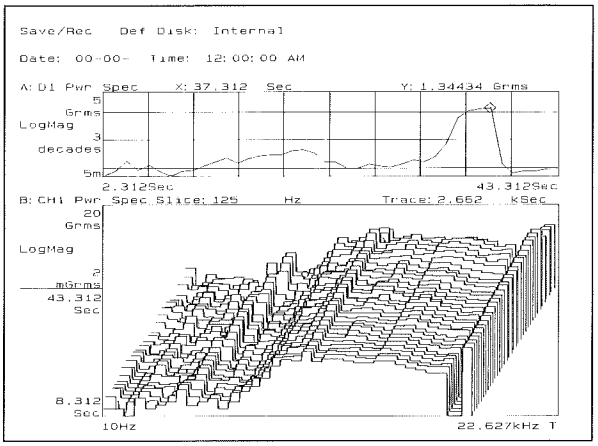

Figure 10 Exponential averages can be captured at specified time intervals using TIME STEP ARM.

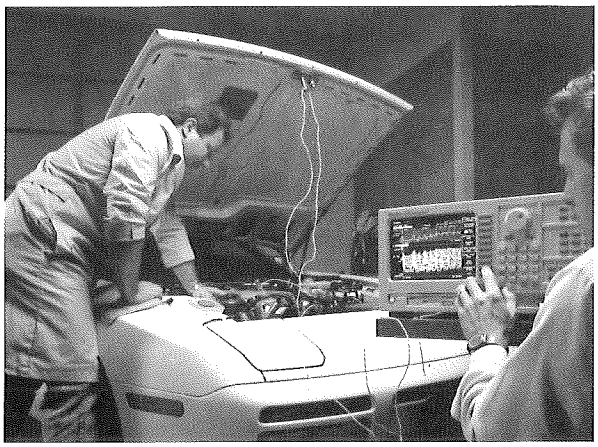

Figure 11 Use RPM STEP ARM to acquire real time 1/3-octave SPL at desired rpm intervals.

Arming

To start 1/3-octave data acquisition, the HP 35665A must first be triggered. Data is then acquired every time the arm condition is satisfied. Three choices are available for arming a measurement: AUTOMATIC ARM, TIME STEP ARM, or RPM STEP ARM. In the AUTOMATIC ARM mode, a trace is acquired immediately after the triggering conditions are met. In TIME STEP ARM mode, arms occur at equal time intervals referenced to the start time. The time interval is specified by TIME STEP SIZE. In RPM STEP ARM mode, arms occur at equal rpm intervals referenced to the start rpm. RPM intervals are specified by RPM STEP SIZE.

Triggering

Three triggers are available in the octave measurement mode: FREE RUN trigger, EXTERNAL trigger, and HP-IB trigger. In FREE RUN triggering, the analyzer processes data as quickly as possible. In EXTERNAL triggering, the analyzer processes data less than 500 msec after a TTL signal is received at the external trigger connector. In HP-IB trigger mode, the analyzer processes data immediately after receiving a trigger command over the IEEE-488 bus.

Repeat Measurement On/Off

Linear averages will be repeated in real time when REPEAT mode is ON. Each spectra will continue to fill the waterfall buffer. When HP-IB or EXTERNAL triggers are active and REPEAT mode is ON, a trigger event starts a succession of real-time linear averages that continue to fill the waterfall buffer. If REPEAT mode is OFF, then one linear average is measured. With HP-IB or EXTERNAL triggering and REPEAT mode OFF, each trigger event initiates filter settling and measurement of one spectrum. Subsequent triggers repeat this process and continue to fill the waterfall buffer.

Waterfall Measurements

Waterfall memory is automatically updated with the latest spectrum. In AUTOMATIC ARM mode, the waterfall is filled in real time with the number of spectra specified by WATERFALL STEPS. When the waterfall buffer is full, the newest spectrum is inserted while the oldest spectrum is discarded. In RPM STEP ARM mode, spectra are armed at specific rpm intervals as measured at the tachometer input BNC. Measurement parameters include RPM INCREASING OR DECREASING, START RPM, RPM STEP SIZE, and WATERFALL STEPS. When the analyzer has finished measuring the number of spectra defined in WATERFALL STEPS, the measurement stops. For TIME STEP ARMING, the analyzer arms each spectra at equal intervals of time, specified by TIME STEP SIZE to the nearest 1/64 s. Arming continues until the waterfall buffer is full, after which the measurement stops. For all ARM modes, when the PAUSE key is pushed, the current contents of the waterfall are held in memory. Pushing START refreshes the waterfall memory.

Spectrum Recording Rate
The HP 35665A can record spectra into waterfall memory at intervals down to 15.625 ms with no loss of data, depending on the chosen filter bandwidth, frequency range and, if linear averaging has been selected, the linear-averaging time.

Trigger Delay
The user-defined post-trigger delay can be used to delay the start of averaging by a fixed period after the trigger conditions have been met. The duration of the delay is specifiable from 1 to 99,999 s.

Source
The HP 35665A has a source that includes the following excitation types: white noise, pink noise, fixed sine, and arbitrary data block. Amplitude is set manually or programmatically. Source limit is ± 5 V.

Memory
The HP 35665A has non-volatile internal memory which stores up to eight setup states, and sufficient on-board RAM to capture a significant waterfall. Extra on-board RAM can be added for HP Instrument BASIC programs, deep waterfalls, or time capture memory. Total waterfall capacity (channel 1 plus channel 2) for each RAM option is shown in Table 2.

Disk-Drive
The built-in 3-1/2 inch disk drive can be used for permanent storage of spectra. Results saved in the spectrum memory of the analyzer can be transferred directly onto disk, and a list of the files already on disk can be viewed at any time. Formatted disks are compatible with PC/MS-DOS or LIF.

Files up to 1.44 Mbytes can be stored on a single flexible disk. Each stored trace can be labelled with up to 22 characters of text.

Autosequence
HP Instrument BASIC, Option 1C2, provides full autosequencing capability through programming or the ENABLE RECORDING function. You can record extensive keystroke sequences in the analyzer, name, store and edit the keystroke file, and play it back. The number of keystrokes captured can exceed several thousand operations, if required. An autosequence can include any procedure that can be performed manually by using push keys on the front panel of the analyzer.

The HP Instrument BASIC programming language within the HP 35665A includes most HP BASIC input and output commands for IEEE-488 controllers. Use Option 1CL external keyboard for convenient program development and editing.

Analysis
The DEFINE FUNCTION menu can be used to perform arithmetic operations on spectra. The arithmetic basis for spectrum additions and subtractions is "absolute power" for which dB units are first converted to absolute power units for the arithmetic operation and then converted back to dB for the final answer (example: 2 dB plus 2 dB gives 5 dB).

Auxiliary Equipment
The HP 35665A can control any IEEE-488 instrument, including the HP 3488A or Bruel & Kjaer Type 2811 8-Channel Microphone Multiplexer. This enables sequential measurements to be automatically made at many microphone positions.

Table 2
Traces stored in the waterfall memory

Memory Option	Dual Channel			Single Channel		
	octave	1/3 octave	1/12 octave	octave	1/3 octave	1/12 octave
Standard	6,000	2,100	550	11,700	4,300	1,100
ICI	50,000	9,500	2,500	50,000	18,000	4,900
ANA	50,000	24,900	6,300	50,000	49,000	12,500

Specifications

HP 35665A Input Characteristics

All inputs are single-ended and you have a choice of ground floating or connecting to the chassis.

Number of Channels: 2

ICP Accelerometer Input:
4.25 mA constant current supply via front panel input BNC; software selectable

Open Circuit Voltage: +26 to +32 Vdc

Direct Input: Via front panel input BNC

Input Impedance:1 MW, <100pF

Input Ranges: 40 ranges from 4 mV peak to 31.7 V peak selectable in steps of 2 dB

DC Coupling: Direct connection

AC Coupling: -3 dB at 1 Hz, 6 dB/ octave rolloff

A-Weighted Filter: According to IEC publication 651-1979 and ANSI S1.4-1983 Type 0

Maximum Input Voltage: 31.7 V peak (max. safe input: 42V peak)
HP 35665A complies with UL 1244, Fourth Edition, IEC 348, Second Edition 1978.

Common Mode Range:
± 4 V peak (floating mode)

Common Mode Rejection:
DC to 1 kHz > 80 dB (for -51 dB to -11 dB ranges)

Overload Detection: Both analog and A/D-converter overloads indicated. Overloaded condition occurs approximately 3 dB higher than specified range

Crosstalk: -130 dB below signal or -72 dB dBfs of receiving channel, whichever has greater amplitude

Alias Protection

Anti-Aliasing Filter:
Single-Channel Cut-Off Frequency, 32 kHz @RTBW: < 58 kHz.
Dual-Channel Cut-Off Frequency, 16 kHz RTBW: < 29 kHz.
Provides at least 88 dB attenuation of those input frequencies which can cause aliasing

Sampling

Input Sampling, Internal Sample Clock:
Single Channel Operation, 32 kHz RTBW: 131,072 Hz
Dual channel operation, 16 kHz RTBW: 65,536 Hz
A/D conversion: 14 bit
Resulting dynamic range is 80 dB as per ANSI S1.11-1986 for ranges above 50mV

Acquisition Modes

Real-Time Measurements
The default HP 35665A measurement mode is real-time analysis. Signals are acquired, filtered, stored in waterfall memory and displayed in real time. Trace storage in waterfall memory is automatic and has priority over all other functions, including marker functions and display update.

Time Capture
On-board RAM can be configured as TIME CAPTURE memory. Signals can be acquired and post-processed using CAPTURE ON any number of times using the following measurement modes in the HP 35665A: ORDER TRACKING (if an rpm signal was present), FFT ANALYSIS with post-process zoom, HISTOGRAM/ TIME, CORRELATION and OCTAVE ANALYSIS. In OCTAVE ANALYSIS, signals can be replayed through octave, 1/3-octave, and 1/12-octave modes with any averaging, detection, or display parameters available. Exact start time and duration of analysis can be specified with the CAPTURE BUFFER display. Capture buffers can be stored on flexible disk drives or any externally connected IEEE-488 disk drives.

Digital Filters

1/1-Octave Filters
One to 12 third-order Butterworth filters can be measured simultaneously in real time. Start frequencies range from 63 mHz to 16 kHz. Stop frequencies range from 125 Hz to 16 kHz. Default span is 16 Hz to 16 kHz. Center frequencies are given by

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

where $-14 \le N \le 4$

Fulfill IEC 225-1966, DIN 45651 and ANSI S1.11-1986, Order 3 , Type 1-D.

1/3-Octave Filters
Three to 36 third-order Butterworth filters can be measured simultaneously in real time. Start frequencies range from 80 mHz to 20 kHz. Stop frequencies range from 250 Hz to 32 kHz. Default span is 10 Hz to 16 kHz. Dual channel post-processing to 32 kHz is possible if data is TIME CAPTURED in FFT mode with a span of 51.2 kHz. Center frequencies are given by

$$CF = 1000 * 2^{\frac{(30 - N)}{3}}$$

where $-11 \le N \le 45\ N$

Fulfills IEC 225-1966, DIN 45651 and ANSI S1.11-1986, Order 3, Type 1-D.

1/12-Octave Filters
Twelve to 144 third-order Butterworth filters can be measured simultaneously in real time. Start frequencies range from 99.7 mHz to 6.536 Hz. Stop frequencies range from 385 Hz to 12.34 kHz. Default span in single-channel mode is 6.3825 Hz to 12.34 kHz. Default span in dual-channel mode is 3.19 Hz to 6.17 kHz. Center frequencies are given by

$$CF = 1000 * 2^{\frac{1}{24}} * 2^{\frac{N}{12}}$$

where $-160 \le N \le 43$.

In TIME CAPTURE mode, where single-channel data is collected at 102.4 kHz, it is possible to post-process 1/12-octave in real time to 49.351 kHz.

Filter settling
The HP 35665A filters settle before valid data is acquired into memory. The filter settling time is consistent and deterministic. Settle time is computed from the following equation:

$$BW = CF * \left(2^{\frac{1}{2n}} - 2^{-\frac{1}{2n}}\right)$$

where:

BW = filter bandwidth,
CF = lowest filter center frequency,
n = 1 for octave, 3 for 1/3-octave and 12 for 1/12-octave

$$Settling\ time = \frac{5.0}{BW}\ in\ seconds$$

Detectors

Digital true RMS detection of filter bank and two broadband channels. No crest factor limitation.

Control
Start: Clears the average accumulator and waterfall buffer and starts an average
Pause/Continue: Stops the average process and retains the waterfall buffer

Linear
Averaging without truncation. Averaging times as per Table 2.

Exponential
Time constants can be specified as per Table 3. Time constants of 1/8 s and 1 s correspond to "Fast" and "Slow" sound level meter responses, respectively.

Impulse
Detects and displays the overall impulsive noise level as per IEC 651-1979 Type 0, as found in many precision sound level meters. Combined with the BAND POWER marker function, it is possible to measure A-weighted Leq and A-weighted Leq (Impulse) simultaneously as required for ISO 7779 and other product noise emission specifications.

Peak Hold
Holds the absolute peak power in each displayed band. In single-channel mode, the overall band indicates the overall peak power over a span of 25.6 kHz. In dual-channel mode the overall peak is detected over a span of 12.8 kHz.

Waterfall Spectra
Standard on-board RAM will hold 4,300 1/3-octave spectra. Optional memory can extend this capacity to 49,000 spectra.

Measurement Trigger

Measurement Trigger Conditions: Free run, external trigger with specified slope and delay, HP-IB trigger.

Measurement Arming Modes: Automatic arm, time step arm and rpm step arm

Trigger Delay: Delay between trigger condition and filter settling, set in seconds. Specifiable between 0 s and 99,999 s.

Maximum Latency: 1 ms

Table 3 Averaging times for 1/3-octave measurements.

	Linear		Exponential	
Real-time Span	**Minimum**	**Maximum**	**Minimum**	**Maximum**
31.5 kHz	15.625 msec	1024 sec	62.5 msec	4096 sec
16 kHz	31.25 msec	2048 sec	125 msec	8 ksec
8 kHz	62.5 msec	4096 sec	0.25 sec	16 ksec
4 kHz	125 msec	8192 sec	0.5 sec	32 ksec
2 kHz	0.25 sec	16 ksec	1 sec	64 ksec
1 kHz	0.5 sec	32 ksec	2 sec	128 ksec
500 Hz	1 sec	64 ksec	4 sec	256 ksec
250 Hz	2 sec	128 ksec	8 ecs	512 ksec
125 Hz	4 sec	256 ksec	16 sec	1 Msec

Hold Maximum and Hold Minimum

Maximum (or Min.) hold, all bands, for all detection modes, similar to hold function on sound level meters.

AutoSequence
(optional HP Instrument BASIC)

HP Instrument BASIC provides programmatic control of the instrument or external IEEE-488 devices, such as a switch, voltmeter, or source. Programming constructs include variables and arrays, conditional branching, looping, functions and subroutines. HP Instrument BASIC can assert control of the display and I/O ports. Editing utilities and an optional keyboard support program development and debugging.

Simple keystroke capture and playback is possible with HP Instrument BASIC through ENABLE RECORDING. Programs can be named and executed through user-defined softkeys. Keystroke capture files can be edited, stored and recalled.

Display

Green CRT display has resolution of 560 x 400 pixels. Maximum display update rate is over 20 traces per second in 1/3-octave mode.

Display Formats
Single: A single trace showing measured or recalled traces, slices through waterfalls, time capture buffer, or a math function

Upper/Lower: Two traces displayed in upper and lower parts of the display

Front/Back: Two superimposed traces with independent markers and scaling

Waterfall/Trace: Upper 1/3 of display shows trace, lower 2/3 shows waterfall

Waterfall/Slice: A time slice through a waterfall is displayed in the upper 1/3 of display

Trace Coordinates
Linear magnitude, log magnitude, dB magnitude

Y-Axis
Y-Units: Linear, rms power, PSD, square root of PSD, ESD

Calibration: Direct entry of transducer sensitivity or autocalibration with an appropriate transducer calibrator

Scaling: Manual or automatic scaling. Control of dB division and display limits.

X-Axis
Spectrum display: Logarithmic axis with annotation in Hz. Octave bands labelled by the preferred center frequency as per ANSI S1.6-1984. Two-12 octaves are measured at a time and shown on the display.

X-Axis Scaling: Flexible control of x-axis scaling.

Slice Display: Linear axis annotated with index numbers, time, or rpm depending on arming method used in acquisition. Display all or part of a waterfall with scrolling and depth control.

Marker

On x-axis reads frequency in Hz (spectrum display) or index number, time or rpm (slice display), and at the same time reads amplitude level in dB or absolute units on the y-axis. Reference marker can be set and relative levels can be read directly. Peak search or tracking is provided. Coupled markers are used for dual-trace mode.

Marker Functions:
BAND POWER can be calculated with selectable bounds of integration.

Operation
Menus: User-interactive menus set up the analyzer for measurements. Eight user-defined measurement set ups can be saved and recalled from non-volatile internal memory

Instrument Mode: For specifying measurement mode: OCTAVE ANALYSIS, ORDER ANALYSIS, SWEPT-SINE, FFT ANALYSIS, CORRELATION, HISTOGRAM/TIME.

Measurement Data: For specifying data used in a display trace.

Help Pages: Each user-interactive menu is provided with a corresponding page of help text.

Analysis

Spectra and constants are added or subtracted on the basis of power. A broad range of mathematical functions can be applied to trace data. Once defined, functions of measured data can be displayed and kept in waterfall memory.

Digital A-Weighting: Digital A-, B-, or C-weighting is available as a standard math operator. This is especially useful for post-processing TIME CAPTURE data in many measurement modes.

Mass Storage

Built-in flexible disk-drive for storage of measured data, HP Instrument BASIC programs, time capture files, or waterfalls.

Data Media: Removable 3-1/2 inch micro-flexible disk.
Data format: Compatible with PC/MS-DOS from version 3.2 or Hewlett-Packard's LIF. Formatted capacity: 1.44 Mbytes

File List: Contains disk identification, filename, data, user-definable volume label and file list sorting key. Each file is identified by user-definable file name, type of formatting, file size and time of trace acquisition.

Hard Copy

Measurement results can be plotted or printed directly to HP-IB and RS-232 devices, such as the HP Laser Jet III printer family and HP-GL plotters like the HP 7550A. Direct plotting and printing to a MS-DOS file on the internal flexible disk also allow easy documentation using PC-based word processing programs such as Microsoft Word for Windows.

System Accuracy

Dynamic Range:
80 dB as per ANSI S1.11-1986 for full-scale ranges from 50 mV peak to 31.7 V peak.

Overall Frequency Response:
± 0.25 dB at filter centers. Meets or exceeds the measurement accuracy requirements of ANSI S1.11-1986 Butterworth Order 3 Type 1-D, ANSI S1.4-1984, IEC 651-1979 Type 0.

Noise:
Voltage Input: Measured in 1/3-octave bands in input range 2.8 mV with input short-circuited:
0.3 Hz to 20 kHz <2 μV
A-weighted <2 μV
Lin-weighted <2 μV

Frequency Accuracy and Stability:
± 30 ppm

Power Supply

280 VA Maximum
90 Vrms 132 Vrms (47<Hz<440)
198 Vrms 264 Vrms (47<Hz<66)

Standards and Specifications

The HP 35665A meets or exceeds the measurement requirements of the following specifications:

ANSI S1.11-1986 Butterworth Order 3 Type 1-D
ANSI S1.4-1984 Type 0 Measurements
IEC 651-1979 Type 0 Measurements
IEC 804 Type 0 Measurements
IEC 225-1966
FAR 36 Appendix A Measurements
ISO 7779 Section 6
MIL-STD-740-1
MIL-STD-740-2

Environmental

Operating Restrictions:
Ambient Temperature 4 to 45° C
Min Humidity 20% RH
Max Humidity 80% RH at 20° C
Storage Restrictions:
Ambient Temperature -20 to 65°C
Min Humidity 10% RH
Max Humidity 90% RH at 40° C non-condensing
Max Altitude 4600 meters (15,000ft)

Cabinet:
Height 8.75" (222 mm)
Width 16.75" (425.5 mm)
Depth 21" (533 mm)
Weight 22 kg (47 lb)

HP 35665A Ordering Information

HP 35665A Dynamic Signal Analyzer
Standard Configuration:

- 1.4 Mbyte, 3 1/2 inch flexible disk
- 400 kbytes user RAM
- Power cord
- Operating manual set

Options for the HP 35665A

1C2	HP Instrument BASIC
1D0	Computed Order Tracking
1D1	Real-time Octave Measurements
1D2	Swept-sine Measurements
1D3	Curve Fit and Synthesis
1D4	Arbitrary Waveform Source
1BH	General License Version
1C1	Add 2 Mbytes Memory
ANA	Add 6 Mbytes Memory Note: only one of option 1C1 or ANA may be installed.
1CL	PC style 101 Key Keyboard
1CM	EIA 19-in. Rack Flange Kit (HP PN 35660-86010)
0B1	Additional manual set
0B3	Add service manual
W30	Add two years to warranty
Case	Transit Case (HP PN 9211-2663)

HEWLETT PACKARD

For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

United States:
Hewlett-Packard Company
4 Choke Cherry Road
Rockville MD 20850
(301) 670 4300

Hewlett-Packard Company
5201 Tollview Drive
Rolling Meadows IL 60008
(708) 255 9800

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Los Angeles, CA 90045
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Canada:
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6877 Goreway Drive
Mississauga, Ontario L4V 1M8
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Japan:
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Latin American Region Headquarters
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Lomas de Chapultepec
11000 Mexico, D.F.
(525) 202 0155

Australia/New Zealand:
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Blackburn, Victoria 3130
Australia (A.C.N. 004 394 763)
(03) 895 2895

Far East:
Hewlett-Packard Asia Ltd.
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West Tower
89 Queensway
Central, Hong Kong
(852) 848 7777

In Europe, please call your local HP sales office or representative:

Austria:
(0222) 2500 0

Central Europe, USSR, and and Yugoslavia:
Virnna - Austria
(0222) 2500-0

Belgium and Luxembourg:
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Denmark:
(45) 99 31 11

Finland:
(90) 88 721

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(06172) 16 0

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(91) 67 10 00

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(01) 88 33 99

Israel:
Computation and Measurement
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(03) 5380 333

Italy:
(02) 95 300 134

Netherlands:
(020) 547 6669

Norway:
(02) 87 97 00

Portugal:
(11) 301 73 30

South Africa:
HiPerformance Systems
(110) 806 1000

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900 123 123

Sweden:
(08) 750 20 00

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