HEWLETT PACKARD

HP 8720A
Microwave Network Analyzer
130 MHz to 20 GHz

A new member of the HP 8700 series...
bringing economy and simplicity
to microwave component test

Technical Data

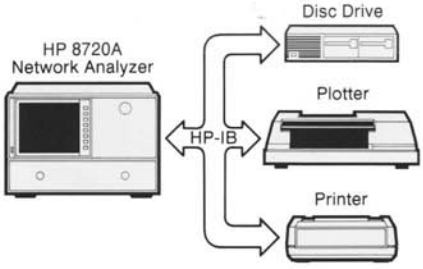
The simple solution for microwave component measurements

The HP 8720A microwave network analyzer brings economy and simplicity to microwave component measurements. Integration of the synthesized source, test set, and receiver into a single and compact instrument results in a high performance 130 MHz to 20 GHz network analyzer with a substantial reduction in cost.

...the instrument of choice for quality measurements in high volume applications...

Simple and complete network analysis

Simply add the calibration kit and test port return cables that fit your requirements to the HP 8720A, and your microwave network analysis system is complete.



Data hardcopy and storage without a computer

With the addition of an HP-IB plotter or printer, obtain hardcopy plots or printouts of your devices' performance easily without an external computer. Store and retrieve test setups quickly and repeatedly at your test stations using the internal memory, or externally with the addition of an HP-IB disc drive.

The HP 8700 series economy network analyzers

The HP 8720A is part of the growing HP 8700 series network analyzer family.

Developed by the industry leader in network analysis, the HP 8700 series offers outstanding value in terms of performance versus price. The HP 8700 series meets your need for accurate yet economical characterization of networks and components in volume production from 300 kHz to 20 GHz.

All of the instruments in the series feature large displays for easy viewing of measurement data, superb built-in synthesized sources, and excellent measurement accuracy and capability, all at a surprisingly low price.

For the ultimate in measurement accuracy, versatility, and capability for design and analysis applications, Hewlett-Packard offers the industry standard HP 8510 series.

Frequency ranges covered:

	Frequency range		
	RF	Microwave	Millimeter wave
HP 8700 series			
HP 8753A	300 kHz — 3 GHz		
HP 8720A	130 MHz — 20 GHz		
HP 8510 series			
HP 8510B	45 MHz — 100 GHz		

The first completely integrated microwave network analyzer

Softkey operation

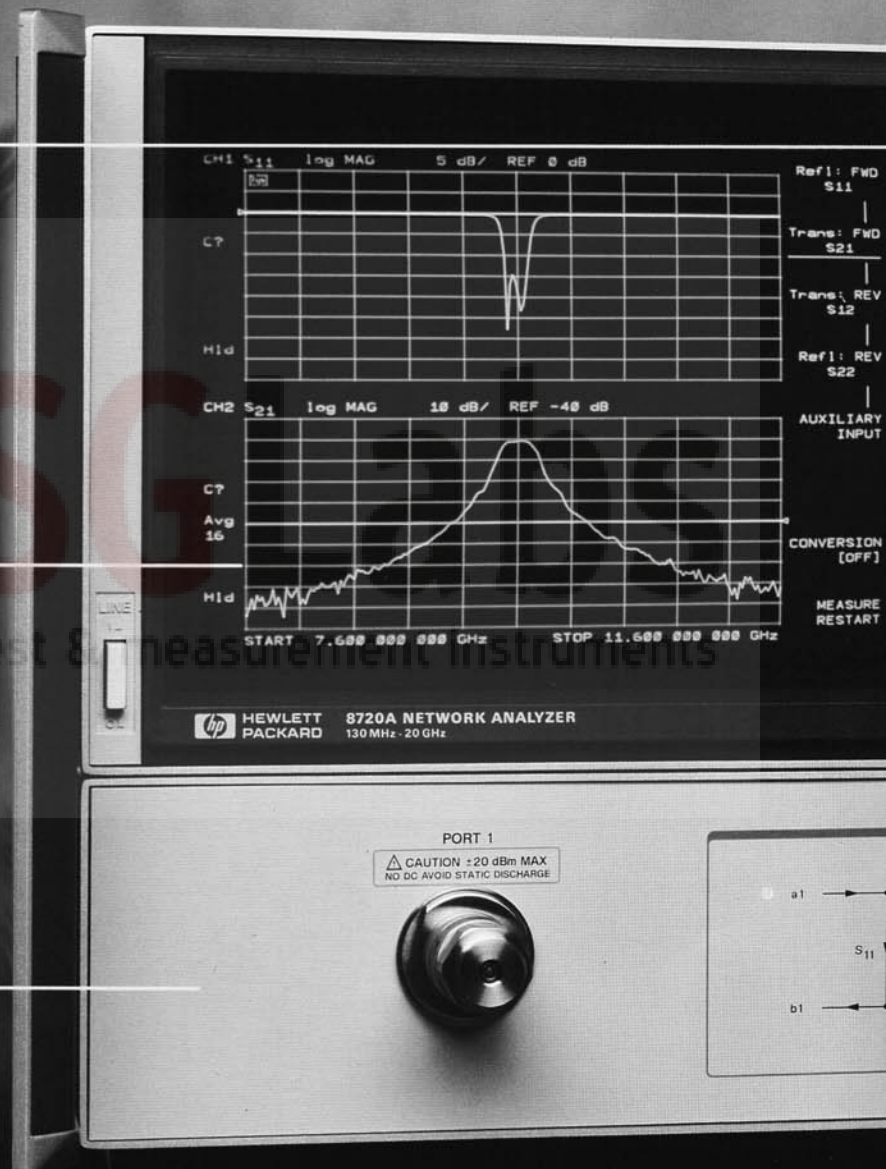
Secondary instrument functions are accessed through softkeys. "Menus" of softkey functions are activated by clearly labeled hardkeys, allowing direct selection of the desired function.

Large digital display

Measurement data is easily viewed during tuning and final test on the large 23 cm (9") high resolution display. Frequency range, display scaling, marker information, instrument status, and softkey functions are displayed.

Built-in synthesized source

An integral, swept synthesized source allows fast operation from 130 MHz to 20 GHz, with 100 kHz resolution. 1 Hz frequency resolution is optional.



Compact size

The total system is only 27 cm (10.5") high, ideal for a small manufacturing benchtop system or one that consumes minimum rack space. System installation is easy: just connect the power cord, and turn on the instrument.

Simple operation

Primary instrument functions
marked hardkeys. The instru
measurement using a simple k
select the measurement type,
frequencies, **[CAL]** to calibrat

Two independent display channels

The two independent channels allow simultaneous display of transmission and reflection measurements, magnitude and phase, or time domain and swept frequency measurements.

Numerical entry

Data entry for all functions is quickly accomplished with the knob, step keys, or keypad.

Save/Recall

Save and recall complete instrument states, including calibration, in the internal memories or an external HP-IB disc drive.

Integrated test set

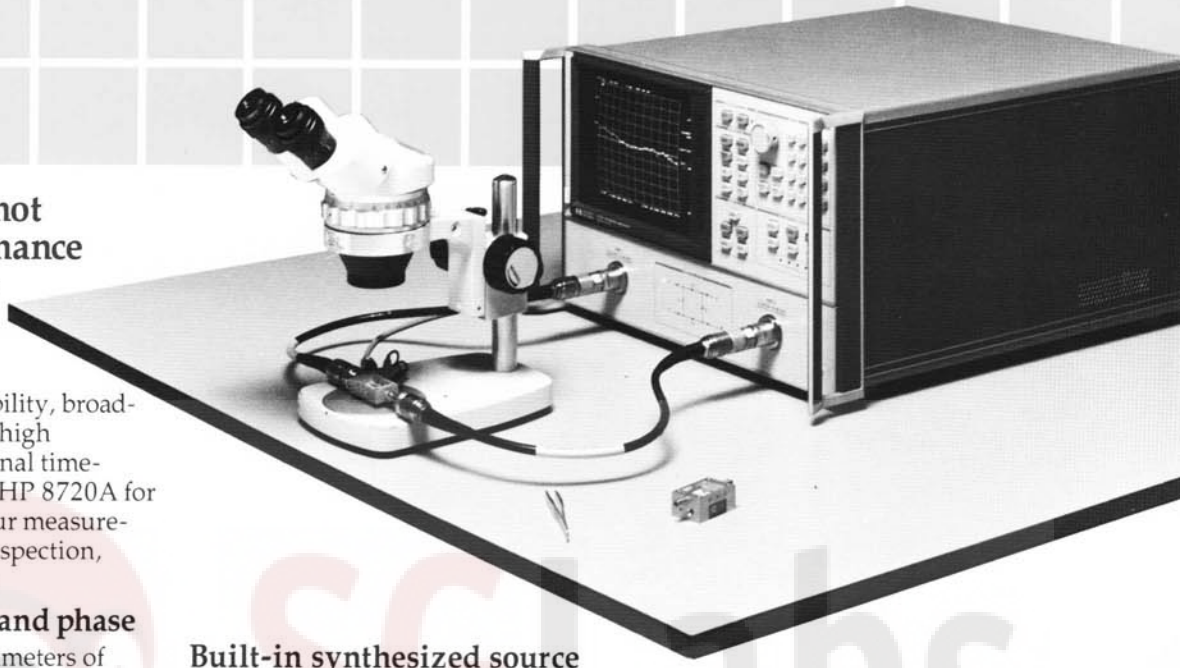
Built-in bias tees and step attenuators allow convenient analysis of active devices. The switching s-parameter test set allows measurement of all four s-parameters without physically reversing the DUT.

Data hardcopy

Create high quality plots of measurement data, and generate tabular printouts of measurement values.

re easily accessed via the clearly
ent can be configured for a
ystroke sequence: **[MEAS]** to
START]/[STOP] to set the
the instrument.

...with excellent measurement performance and capability

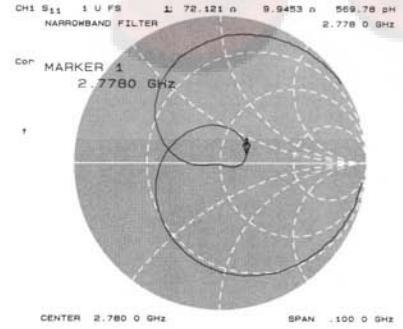


Lower price need not imply less performance

The HP 8720A has the capability and performance you need: error-corrected magnitude and phase measurement capability, broadband synthesized source, high dynamic range, and optional time-domain analysis. Use the HP 8720A for absolute confidence in your measurements during incoming inspection, production, and final test.

Measure magnitude and phase

Measure all four s-parameters of your device with one connection, with the data displayed in the format you need. Choose from logarithmic, linear or Smith chart display modes. Phase distortion can be displayed as group delay or deviation from linear phase.



Optional time domain analysis

Find the location and nature of troublesome mismatches in components, packages, and transmission lines with the optional time domain capability (available as Option 010). With time domain "gating", you can even remove the effects of unwanted reflections from your measurement data in the frequency domain.

Built-in synthesized source

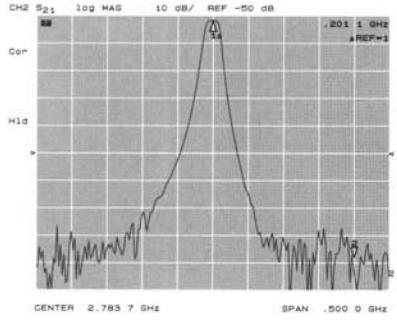
Excellent frequency accuracy and stability are provided by the internal swept synthesized source. Operating from 130 MHz to 20 GHz, this built-in source has a frequency resolution of 100 kHz which is suitable for most broadband applications. For narrow-band device testing, or in cases where better frequency settability is required, 1 Hz frequency resolution is available as Option 001.

Accuracy enhancement

Improve the accuracy of your measurements by calibrating the HP 8720A with one of the several calibration kits available in the common connector types. After a full 2-port measurement calibration, the instrument uses 12-term error correction to remove predictable system errors caused by mismatches, crosstalk, directivity and frequency response. Measurement calibrations are even easier with the high return loss fixed broadband loads in the HP 3.5 mm and 7 mm economy calibration kits.

High dynamic range

Measurements with over 85 dB of dynamic range are possible with the highly sensitive tuned receiver of the HP 8720A. Source harmonics are not a concern in filter rejection measurements because of the receiver's variable narrow detection bandwidth.



Measure >85 dB filter rejection

Ideal for use on the production floor

Economy and ease of use for production test

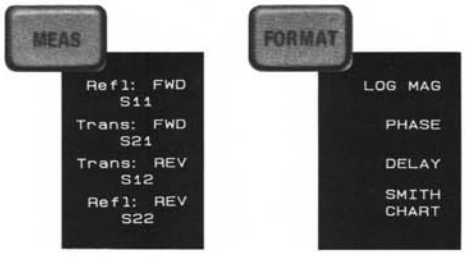
Simple, straightforward operation

Primary functions are clearly marked on the hardkeys which in turn activate menus of functions for the softkeys. The less-used or more advanced functions are available on second level softkey menus.

A basic measurement can be set up swiftly using a quick, four step sequence:

1 Select the measurement

Use the **[MEAS]** key to select the s-parameter to be measured. Then press the **[FORMAT]** key to choose the display format (log magnitude, phase, or Smith chart for example).



2 Choose the desired frequencies

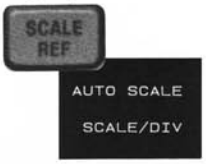
Using the keys under the STIMULUS section, such as **[START]** and **[STOP]**, set the frequency range for the measurement.

3 Perform a calibration

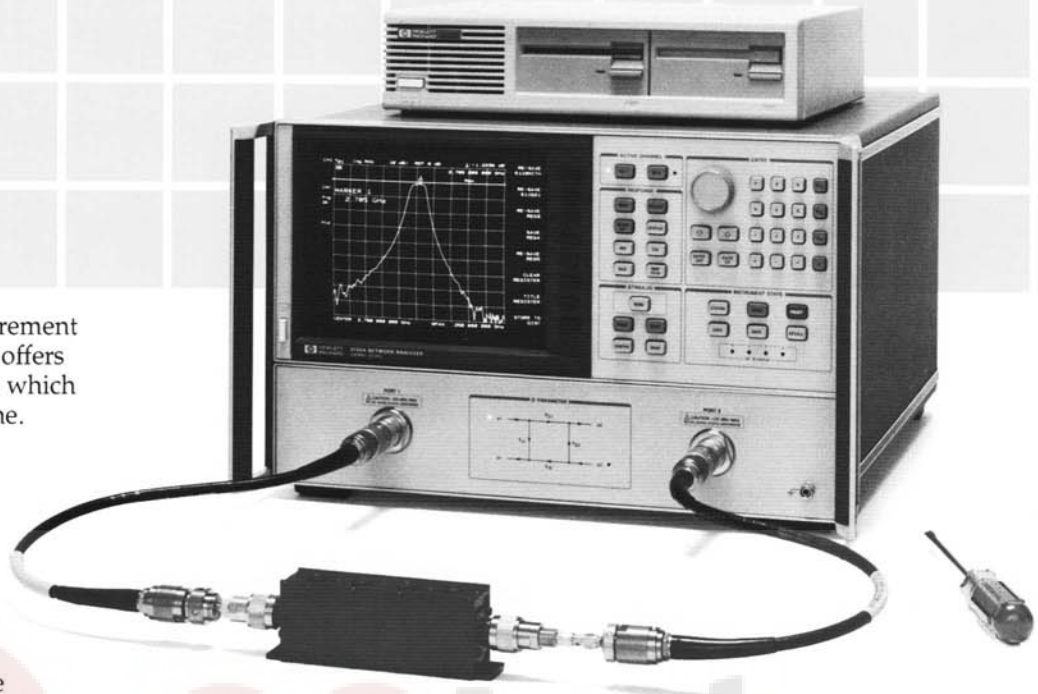
Press **[CAL]** to see the list of possible calibrations types. Select the desired calibration, and follow the on-screen prompts through the calibration sequence. When the calibration process is complete, error correction is automatically enabled.

4 Connect and measure the device

Now, connect the device under test, and center the measurement data on the display for easy viewing using the autoscale function available with the **[SCALE REF]** key.



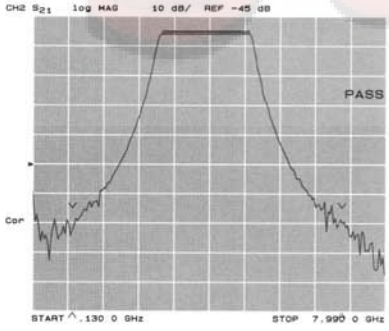
...with features that simplify and speed testing



In addition to basic measurement capability, the HP 8720A offers several advanced features which can save you tuning and test time.

Pass/Fail testing for tuning and final test

Make go/no go decisions easily and systematically using the HP 8720A's limit testing capability. Define up to 22 limit lines on each channel, based on the specifications of the device under test so you can align or verify the device's response. Limits can be a combination of flat or sloped lines, or single points, and automatically reposition themselves when the display scale or frequency range is changed. Pass/Fail information is available on the HP 8720A's display, over the HP-IB, or as a TTL signal on a rear panel output.

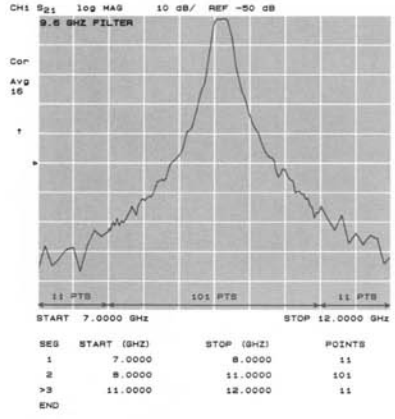


Hardcopy plots and printouts for documentation

Obtain graphic or tabular hardcopies of measurement data at the press of a button, just by adding an HP-IB plotter or printer. The HP 8720A allows you to title each output, to document device serial number or test conditions.

Rapid testing at arbitrary frequencies

Measure at the specific frequencies required by your customers using the HP 8720A's frequency list mode. You can specify up to 30 distinct CW frequencies or swept frequency segments at which you want to test your device. By measuring only at the needed frequencies, testing is more efficient, and test time is minimized. Calibrate over the whole frequency list, and then zoom-in on specific segments with the HP 8720A's segmented calibration capability.



Test at the specific frequencies you need

Marker tracking functions simplify tuning

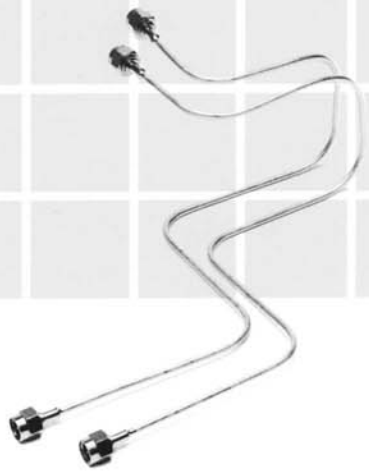
Track the specific point of interest automatically while tuning your device. Updated on each sweep, the marker tracks the maximum, minimum, or a user-selectable value on the trace of measured data (−3 dB for example), and displays that point's frequency.

Internal and external storage of test setups

You can save measurement setup time by storing up to five complete test setups, including calibration data, internally in the HP 8720A's memory. Create the measurement configuration only once, calibrate, and store it. Then, recall that test setup whenever it is called for.

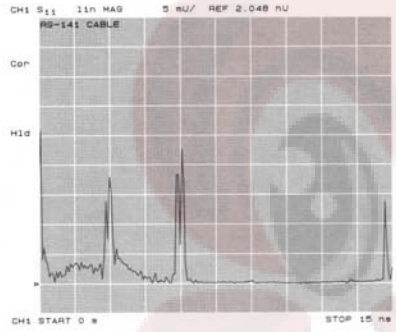
Unlimited storage capacity is afforded by the HP 8720A's disc drive interface. Store the measurement data of your device's performance during final test on disc with the addition of an HP-IB disc drive. No external computer is necessary.

Component measurements made simple



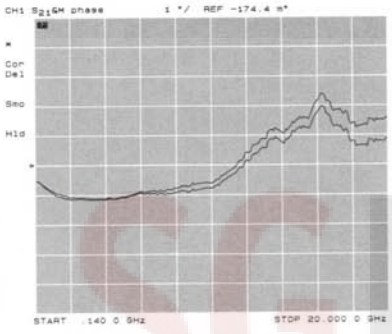
Cables

Verify the insertion loss of your coaxial transmission lines much more accurately than with a scalar network analysis system, for only a small increase in cost. With the HP 8720A's 2-port measurement calibration, errors due to source and load match are almost negligible, and total measurement uncertainties less than ±0.2 dB and ±2 degrees are obtainable.



Troubleshoot cables with optional time domain analysis

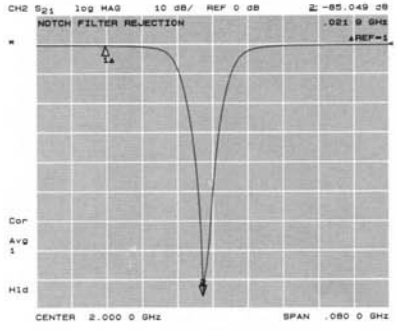
Perform precise phase matching of transmission lines with the 0.01 degree phase resolution of the HP 8720A. The built-in synthesized source allows stable, repeatable measurements of cable group delay with 1 picosecond resolution. Determine the location and nature of faults in your cable with the HP 8720A's optional time domain analysis capability.



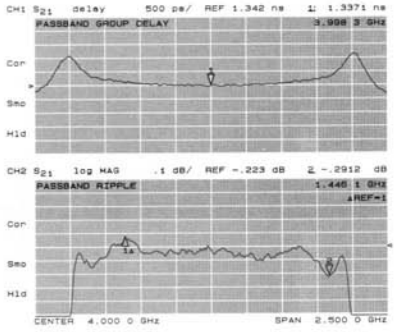
Phase match transmission lines with precision

Filters

Characterize filter rejection performance to better than −85 dB with the HP 8720A's high dynamic range. The analyzer's immunity to source harmonics results in accurate measurements of the filter's actual performance in the reject band. Make precise measurements of magnitude and phase performance with the HP 8720A's 0.001 dB and 0.01 degree resolution. Mismatch-induced ripple is almost completely eliminated from passband measurements when using a full 2-port measurement calibration.



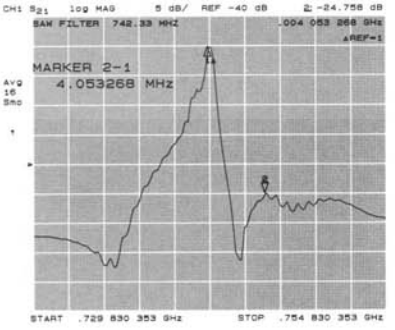
Immunity to source harmonics allows accurate notch filter testing



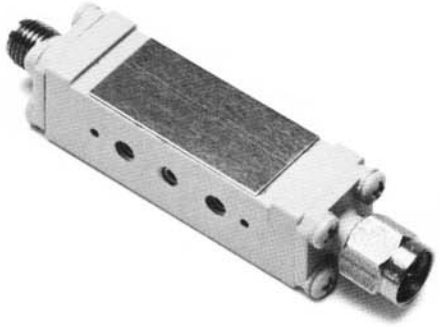
Verify passband performance accurately

Narrowband device testing

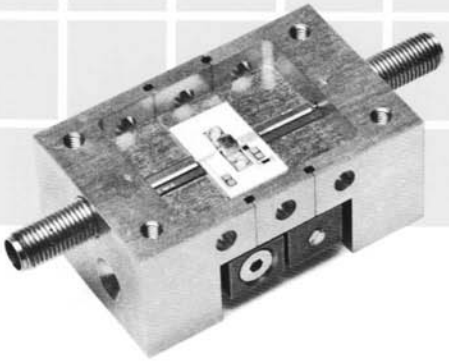
Devices which have narrow frequency spans (such as crystal or notch filters) require better frequency resolution than 100 kHz. The HP 8720A Option 001 provides 1 Hz frequency resolution for finer control of the start, stop and marker frequencies of the measurement.



Optional 1 Hz resolution for narrowband devices

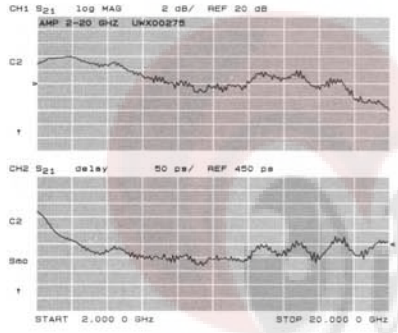


Active device testing



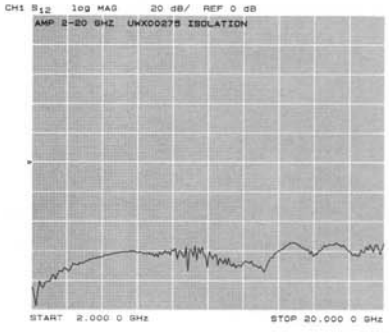
Amplifiers

Save time and increase throughput by measuring the forward and reverse performance of your amplifiers without having to reverse the amplifier under test. The HP 8720A's high dynamic range and switching s-parameter test set allow you to observe gain, isolation, and input/output return loss, all with



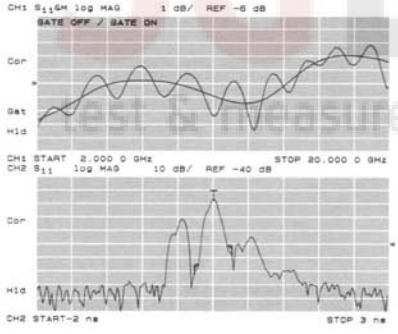
Measure amplifier group delay and gain

one connection. And, with a 2-port measurement calibration, you can be confident of your measurements of amplifier magnitude and phase response.



High dynamic range allows isolation testing

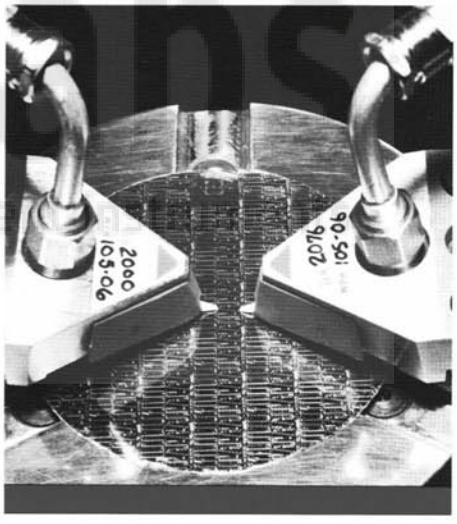
Gain additional insight into the performance of your packaged amplifier with the optional time domain analysis capability. Determine the reflections caused by the coax to microstrip transition, as well as those caused by the amplifier circuit itself. With time domain gating, you can separate and remove package responses in the time domain, prior to converting back to the frequency domain, allowing you to observe the performance of the amplifier circuit directly.



Remove unwanted responses with optional time domain gating

Wafer probing

When combined with a wafer probing station, the HP 8720A can make measurements of devices while they are still on the wafer. Use an external bias supply to provide the appropriate bias voltage through the HP 8720A's built-in bias tees. With "on-wafer" calibration standards, a full 2-port measurement calibration can be performed at the probe tips, allowing direct, error-corrected measurements of devices before they are separated and individually packaged.



Test devices still on the wafer

By discovering defective devices early in the production process, substantial savings can be realized because no effort is wasted on mounting and packaging faulty devices. And with the low cost of the HP 8720A, your budget will support more wafer probing stations in high-volume applications.

SgLabs
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tel. +39 0755149360

Designed for low cost of ownership

On-site repair means high uptime

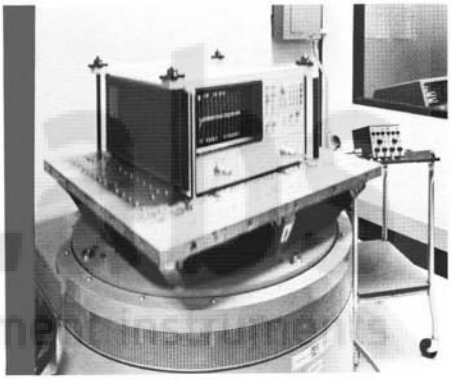
The reliability of an instrument can be measured by its uptime. High reliability means low down time and fewer production line shutdowns. Because the HP 8720A is aimed at high-volume manufacturing environments, reliability was a key design priority.

Reliability designed-in

Reliability is designed into the HP 8720A. The instrument's integrated nature reduces the number of internal components. Prototypes of the HP 8720A were subjected to severe vibrational and thermal stresses to discover and eliminate design weaknesses. The result is a rugged, more reliable instrument with a low cost of ownership through maximum uptime.

One year on-site warranty

Because uptime is critical in production environments, Hewlett-Packard offers a standard one-year on-site repair warranty with the HP 8720A, where available. Should a failure occur within one year, a qualified HP Customer Engineer will repair and verify the instrument at your site, at no cost to you.



The instrument's self diagnostics and module level repair result in fast turn around times. Built-in self tests check over 80% of the instrument in just minutes. If a failure is detected, the self-diagnose feature indicates the assembly at fault. Replacement is simple using Hewlett-Packard's exchange parts.

Automatic testing

Full automation with HP software

Reduce operator training time and device test time, especially in high volume testing environments, by automating your measurements. With the addition of an HP 9000 series 300 computer and HP-IB software, the HP 8720A can be controlled automatically.

HP 85162A Measurement Automation Software

The HP 85162A Measurement Automation Software improves the repeatability of device measurements by providing a consistent, simple user interface that leads the operator through the measurement sequence one step at a time. From system calibration to device measurement and high-quality hardcopy output, the software provides clear instruction and guidance.

Guided measurements

With the HP 85162A, the measurement sequence can be as simple as answering a series of questions about the test parameters for the device, following a step-by-step calibration sequence, connecting and measuring the device, and printing, plotting, or storing the resulting measurement data.

Advanced features

The HP 85162A's more advanced features allow you to set up a more sophisticated measurement configuration. For example, use the frequency list mode of the HP 8720A to customize the test frequencies to your specific measurement needs, choose a different type of calibration, or set up a customized print format.

When the configuration is complete, save it on disc for later use, When you need to run the measurement again, simply recall the configuration. The test is immediately set up on the measurement system, including frequency range, power levels, calibration data, display format and output parameters.

Data can be displayed in a variety of formats, such as log or linear magnitude, SWR, phase, group delay, polar, and Smith chart. Conversion to H, Y, or Z parameters is also available.

When data is stored on disc, it operates through the measurement sequence one step at a time. From system calibration to device measurement and high-quality hardcopy output, the software provides clear instruction and guidance.

Create your own software

For situations where specialized software is required, you can create your own software programs to run the HP 8720A. With clear programming documentation provided in the operating manual, and some familiarity with HP-IB programming, you can easily create custom software to suit your needs. Many of the HP-IB commands used by the HP 8720A are identical to those used by the HP 8510, so programs already written for the HP 8510 can be used on the HP 8720A with little modification.

System performance

*Specifications describe the instrument's warranted performance over the temperature range 0° to 55°C (except where noted). **Supplemental characteristics** are intended to provide information useful in applying the instrument, by giving typical but non-warranted performance parameters. These are denoted as "typical," "nominal," or "approximate."*

Dynamic Range (for transmission measurements)[1]

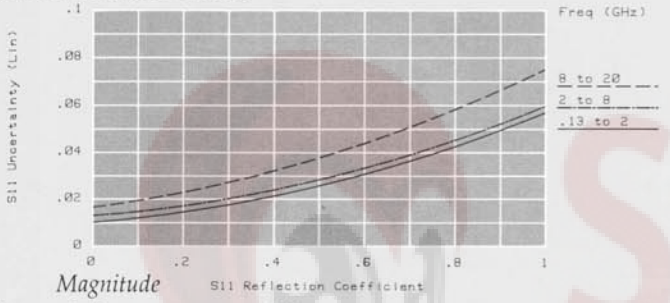
	Frequency range			
	0.13 to 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 20 GHz
Dynamic range	70 dB	80 dB	85 dB	85 dB

For devices with 3.5 mm connectors

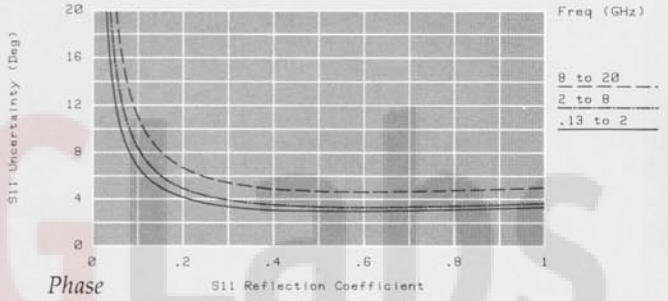
Measurement uncertainty

The following graphs show total worst case uncertainty for the HP 8720A network analyzer after accuracy enhancement using a full 2-port measurement calibration (including isolation) with the HP 85052D 3.5 mm calibration kit, HP 85131D cable set, and an IF bandwidth of 10 Hz. This includes the residual systematic errors, as well as the system dynamic accuracy, 3.5 mm connector repeatability, noise, and switch repeatability[2]. Specific points on the graphs are verified by measuring the devices in the HP 85053B verification kit.

Reflection measurements[3]

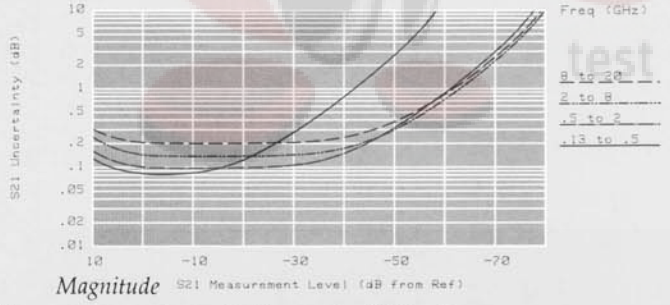


Magnitude

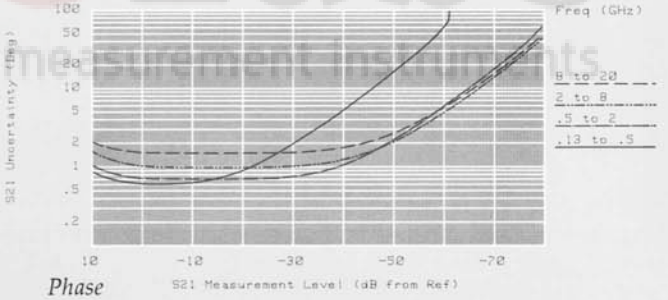


Phase

Transmission measurements[4]



Magnitude



Phase

Measurement port characteristics[5]

The following specifications show the residual system uncertainties (including switch repeatability) after accuracy enhancement using a full 2-port measurement calibration (including isolation) with an IF bandwidth of 10 Hz, and the specified calibration kit. Environmental temperature is 23 ± 3°C.

Calibration kit: HP 85052B
(male and female lowband and sliding loads)

	Frequency range			
	0.13 to 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 20 GHz
Directivity	40 dB	40 dB	40 dB	40 dB
Source match	30 dB	30 dB	30 dB	30 dB
Load match	35 dB	35 dB	30 dB	30 dB
Reflection tracking	±0.10 dB	±0.10 dB	±0.10 dB	±0.20 dB
Transmission tracking	±0.10 dB	±0.10 dB	±0.12 dB	±0.15 dB

Calibration kit: HP 85052D
(male and female broadband precision fixed load)

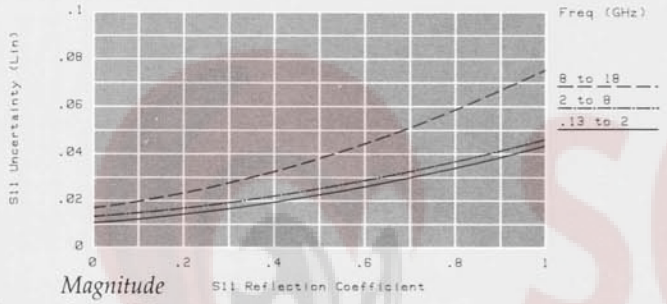
	Frequency range			
	0.13 to 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 20 GHz
Directivity	40 dB	40 dB	38 dB	36 dB
Source match	30 dB	30 dB	30 dB	30 dB
Load match	35 dB	35 dB	30 dB	30 dB
Reflection tracking	±0.10 dB	±0.10 dB	±0.10 dB	±0.20 dB
Transmission tracking	±0.10 dB	±0.10 dB	±0.12 dB	±0.15 dB

For devices with 7 mm connectors

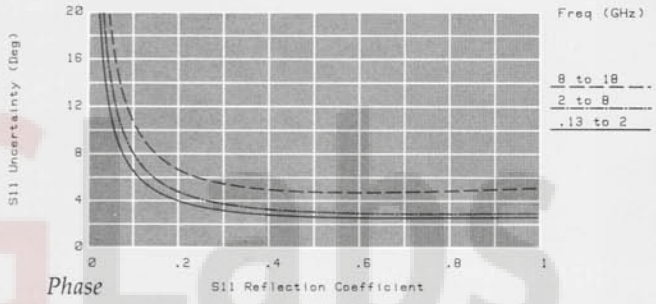
Measurement uncertainty

The following graphs show total worst case measurement uncertainty for the HP 8720A network analyzer after accuracy enhancement using a full 2-port measurement calibration (including isolation) with the HP 85050D 7 mm calibration kit, HP 85132D cable set, and an IF bandwidth of 10 Hz. This includes the residual systematic errors, as well as the system dynamic accuracy, 7 mm connector repeatability, noise, and switch repeatability[2]. The HP 85130B special 3.5 mm to 7 mm adapter set is used to adapt the 3.5 mm test ports to 7 mm. Specific points on the graphs are verified by measuring the devices in the HP 85051B verification kit.

Reflection measurements[3]

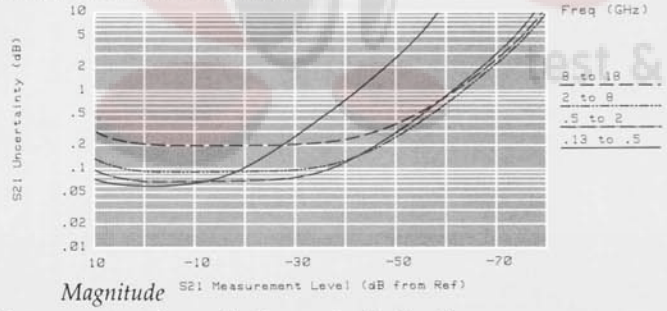


Magnitude

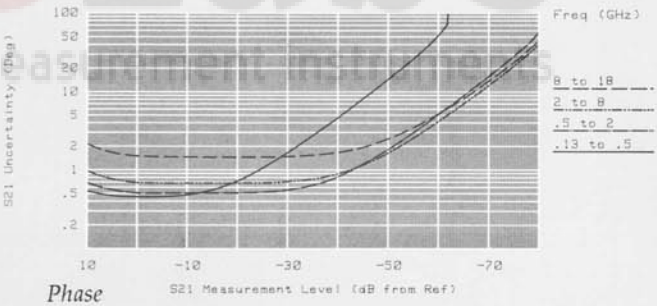


Phase

Transmission Measurements[4]



Magnitude



Phase

Measurement port characteristics[5]

The following specifications show the residual system uncertainties (including switch repeatability) after accuracy enhancement using a full 2-port measurement calibration (including isolation) with an IF bandwidth of 10 Hz, and the specified calibration kit. Environmental temperature is 23 ± 3°C.

Calibration Kit: HP 85050B
(Lowband and sliding loads)

	Frequency range			
	0.13 to 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 18 GHz
Directivity	45 dB	45 dB	45 dB	45 dB
Source match	35 dB	35 dB	35 dB	30 dB
Load match	40 dB	40 dB	35 dB	30 dB
Reflection tracking	±0.10 dB	±0.10 dB	±0.10 dB	±0.20 dB
Transmission tracking	±0.05 dB	±0.05 dB	±0.10 dB	±0.15 dB

Calibration Kit: HP 85050D
(Broadband precision fixed load)

	Frequency range			
	0.13 to 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 18 GHz
Directivity	40 dB	40 dB	38 dB	36 dB
Source match	35 dB	35 dB	35 dB	30 dB
Load match	40 dB	40 dB	35 dB	30 dB
Reflection tracking	±0.10 dB	±0.10 dB	±0.10 dB	±0.20 dB
Transmission tracking	±0.05 dB	±0.05 dB	±0.10 dB	±0.15 dB

[1] Limited by maximum output power and system noise floor. Specified for an IF bandwidth of 10 Hz, using a full 2-port measurement calibration (including an isolation calibration performed with an averaging factor of 16).
[2] Cable stability and system drift are not included.
[3] The graphs shown for reflection measurement uncertainty apply to a one-port device.
[4] The graphs for transmission measurements assume a well-matched device ($S_{11}=S_{22}=0$).
[5] Crosstalk, after an isolation calibration, is below the system noise floor and can be ignored.

General characteristics

Source frequency characteristics

Range: 130 MHz to 20.0 GHz
Resolution: 100 kHz (1 Hz with Option 001)
Stability: typically ±7.5 ppm @ 0° to 55°C
typically ±3 ppm/year
Accuracy: 10 ppm @ 23° ± 3°C

Output characteristics (at test ports, 23° ± 3°C)

Power range: −10 to −65 dBm in 5 dB steps
Power level: −10 dBm ±3 dB
Harmonics: < −15 dBc @ −10 dBm (typical)

Test ports

Connector type: 3.5 mm (male)
Impedance: 50 ohms nominal
Switch type: Mechanical
Switch lifetime: >3 million cycles (typical)
Nominal operating power level:
Test port 1: −10 dBm
Test port 2: −10 dBm
Maximum input level: +20 dBm
DC bias: 500 mA, 40 VDC maximum

Effect of frequency resolution

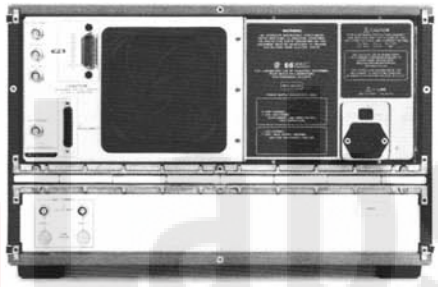
The following table shows the differences in operation between the standard HP 8720A (100 kHz frequency resolution) and the HP 8720A Option 001 (1 Hz frequency resolution).

	Standard	Option 001
Source control:		
Start/Stop/Center/CW	100 kHz	1 Hz
Min. span @ 101 points[1]	10 MHz	100 Hz
Min. span @ 201 points	20 MHz	200 Hz
Time domain:		
Max. time domain range[2]	10 µs	1 s
Group delay:		
Max. group delay range	5 µs	500 ms
Minimum aperture	100 kHz	1 Hz

[1] Minimum span = (number of data points − 1) × frequency resolution
[2] Using time domain bandpass mode.

Rear panel connectors

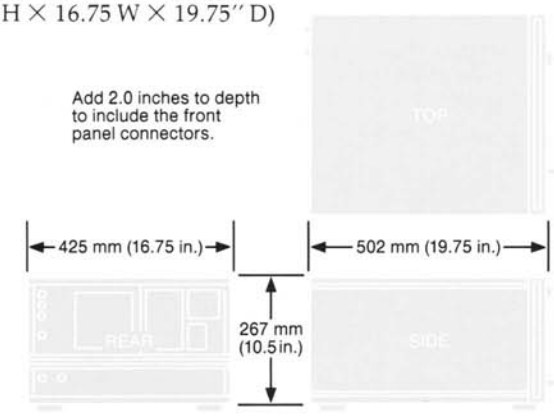
External reference frequency input:
Frequency: 1, 2, 5, and 10 MHz; < ±200 Hz at10 MHz
Level: −10 dBm to +20 dBm, typical
Impedance: 50 ohms
External trigger:
Triggers start of sweep on a negative TTL transition or contact closure to ground.
External AM auxiliary input:
0 to 10 volts (1 dB/volt) into a 10 kohm resistor, 5 kHz max.
Auxiliary voltage input:
−10 to +10 V
IO interconnect:
Type: DB-25
Output: Standard LS TTL output (active high logic) on pin 17 indicative of PASS/FAIL status during limit testing. Output voltage remains at +5 Vdc (nominal) until a FAIL condition occurs. Remains at 0 Vdc until a PASS condition occurs.



HP 8720A rear panel

Environmental characteristics

Operating conditions:
Temperature: 0° to 55°C
Non-operating storage conditions:
Temperature: −40° to +75°C
Power:
47.5 to 66 Hz: 115V +10% −25%, 230V +10% −15%, 220 VA max
Weight:
Net, 31 kg (67 lb); shipping, 38 kg (80 lb)
Dimensions:
267 H × 425 W × 502 mm D
(10.5 H × 16.75 W × 19.75″ D)



System capabilities

Measurement

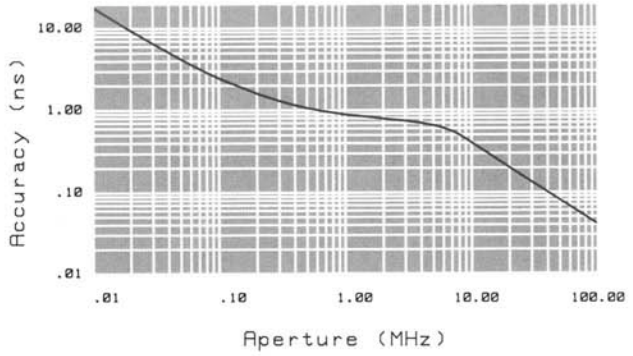
Number of display channels: 2
Measurement parameters: S_{11}, S_{21}, S_{12}, S_{22}. May be converted to impedance, admittance, or 1/S.
Domains available: Frequency, time[1], and auxiliary voltage
Formats:

Cartesian: Log magnitude, linear magnitude, phase, group delay, SWR, real part of complex parameters.
Smith chart: Marker format can be selected as log magnitude, linear amplitude, R+jX, or G+jB.
Polar: Marker format can be selected as log amplitude, linear amplitude, phase, or real and imaginary.

Data markers: Each display channel has four independent markers. Markers can indicate data at actual data points or they can interpolate between data points to allow the setting of a marker at an exact frequency. Functions allow delta marker operation, marker search (max, min, target), marker bandwidth, and trace statistics (average value, standard deviation, and peak-to-peak deviation of the data trace).

Group delay characteristics

Group delay is computed by measuring the phase change within a specified frequency step (determined by the frequency span and the number of points per sweep). The phase change, in degrees, is then divided by the frequency step, in Hz (times −360).
Aperture: Determined by the frequency span, the number of steps per sweep, and the amount of smoothing applied.
Minimum aperture = (frequency span)/(#points-1)
Maximum aperture = 20% of the frequency span.
Range: The maximum delay is limited to measuring no more than ±180 degrees of phase change within the minimum aperture. For example, with a minimum aperture of 100 kHz, the maximum delay that can be measured is 5 microseconds.
Accuracy: Accuracy is a function of the uncertainty in determining the phase change. The graph shows typical group delay accuracy at 20 GHz. Insertion loss is assumed to be zero.



Typical group delay accuracy

In general, the following formula can be used to determine the accuracy, in seconds, of a specific group delay measurement.

$$\pm \frac{0.003 \times \text{Phase Uncertainty (deg)}}{\text{Aperture (Hz)}}$$

[1] Time Domain (the inverse Fourier Transformation of Frequency Domain data) is available only with Option 010.

Source control

Sweep limits: Set start/stop or center/span
Frequency resolution: 100 kHz. Frequency resolution of 1 Hz is available with Option 001.
Frequency span: Frequency span is a function of the number of points and frequency resolution. With a frequency resolution of 100 kHz using 201 points, the minimum span is 20 MHz. With a frequency resolution of 1 Hz (Option 001), using 201 points, the minimum useful span is 200 Hz.
Sweep type: Set a linear or log sweep, an arbitrarily defined frequency list, or a CW (single frequency) type of sweep.
Linear frequency selectable as 3, 11, 21, 51, 101, 201, 401, or 801 points.
Frequency List Sweep defines up to 30 different subsweep frequency ranges in any combination of CW, CW/delta F, or start/stop sweep modes.
Alternate sweep: The two channels, including markers, may be coupled (same sweep parameters) or uncoupled (different sweep parameters).
Sweep time: Can be set manually, or to automatic (fastest sweep time is selected automatically).
Sweep trigger: Set to either continuous, hold, single, group sweep, or external trigger.

Data accuracy enhancement

Calibration types available:

Frequency response: Simultaneous magnitude and phase correction of frequency response errors for either reflection or transmission measurements. Requires a short or open circuit termination (reflection) or a through connection (transmission).
Response/isolation cal: Compensates for frequency response and directivity (reflection) or frequency response and crosstalk (transmission) of test set. Requires a short or open circuit and load termination (reflection) or through connection and load termination (transmission).
1-port cal: Correction of test set port 1 or port 2 directivity, frequency response and source match errors. Requires open, short, and load (fixed or sliding) terminations.
2-port cal: Compensates for directivity, source match, reflection frequency response, load match, transmission frequency response and crosstalk. Crosstalk (isolation) calibration can be eliminated. Requires open, short, and load (fixed or sliding) terminations plus a through connection.

Reference plane extension: Redefine the plane of measurement reference (zero phase) to other than port 1 or port 2 of the test set, defined in seconds of delay from the test set port and ranges between ±10 μs.
Calibration kits: Select either standard (7 mm, 3.5 mm, Type N 50 ohm) calibration kits or define the standards (e.g., open circuit capacitance coefficients, offset short length, or fixed loads) and store them as the "User" cal kit.
Data averaging:

IF bandwidth: Selectable from 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, and 3 kHz bandwidths.
Sweep-to-sweep averaging: Averages vector data on each successive sweep. Averaging factors range from 1 to 999.
Trace smoothing: Similar to video filtering, this function computes the moving average of adjacent data points. Smoothing aperture defines the trace width (number of points) to be averaged, and ranges from 0.10% to 20% of the trace width. Not available in polar or Smith chart display mode.

Display control

CRT formats: Single channel, dual channel overlay (both traces on one graticule), dual channel split (both traces onseparate graticules).

Trace functions: Display current measurement data, memory data, or current measurement and memory data simultaneously. Trace Math allows vector division or subtraction of current linear measurement values and memory data.

Display annotations: Frequency, source level, scale/div, reference level, marker data, title (49 characters maximum), and limit test pass/fail indication.

Scale resolution:

Magnitude:
Log format (dB/div): 0.01 to 50
Linear format (units/div): 10×10^{-12} to 10×10^{3}

Phase:
Cartesian (degrees/div): 0.1 to 180
Polar (degrees/display graticule): 45

Reference position: Ranges from bottom to top graticule position.

Autoscale: Automatically selects scale resolution and reference value to center the trace on the display.

Electrical delay: (electronic line stretcher) Offset measured phase or group delay by a defined amount of electrical delay, in seconds. Amount of electrical delay can range between ± 10 µs. ($\pm 3 \times 10^{3}$ m).

Frequency blanking: (Security Feature) Blanks all frequency information on the display. Requires an instrument preset to re-enable frequency information on the display.

Limit lines: Define 22 test limit lines per channel that appear on the CRT display for Pass/Fail (go/no go) testing. Lines may be any combination of horizontal or sloping lines, or discrete points.

Storage[1]

Internal memory:

Instrument state: Five instrument states can be stored via the Save menu. Instrument states can then be recalled via the Recall menu. Instrument states include all control settings, active limit lines, active list frequency tables, memory trace data, active calibration coefficients, and custom display titles. Storage is in volatile and non-volatile memory.

Data traces: Both channels 1 and 2 can each store one data trace in memory.

Calibration sets: One calibration set can be stored together with the instrument state in each of the five Save/Recall registers.

External disc drive: Data may be stored to and retrieved from an external disc drive that is compatible with command subset CS/80. Data files are stored in Hewlett-Packard's standard LIF format, which can be read by a wide variety of computers, including the HP 9000 series 200 or 300. Files can be stored in Binary format or Ascii format (compatible with the HP 85150A Microwave Design System). Discs to be used for data storage can be initialized directly by the HP 8720A.

Recommended disc drives:
HP 9122 Dual 3.5" Disc Drive
HP 9153B 20 Megabyte Winchester Disc Drive with 3.5" Disc Drive
HP 9154B 20 Megabyte Winchester Disc Drive

Data hardcopy

Data plotting: Hardcopy plots are automatically produced when used with an HP-GL compatible digital plotter such as the HP 7440A ColorPro plotter or a compatible graphics printer such as the HP 2225A ThinkJet printer. Plot traces, graticules, markers, or text including operating and system parameters.

Data listings: Printouts of instrument data are produced directly when used with a compatible HP-IB printer such as the HP 2225A ThinkJet printer.

Time domain (Option 010)

Description

With the time domain option, data from transmission or reflection measurements is converted from the frequency domain to the time domain using the inverse Fourier transform and presented on the CRT display. The time domain response shows the measured parameter value versus time. Markers may also be displayed in electrical length (or physical length if the relative propagation velocity is entered).

Time stimulus modes

Two types of time domain stimulus waveforms can be simulated during the transformation – a step or an impulse. Although these waveforms are generated mathematically with the inverse FFT, the results for linear circuits are the same as would be obtained if the actual time waveforms had been applied and measured.

The low pass step stimulus, similar to a traditional time domain reflectometer (TDR) waveform, is used to measure low pass devices. The frequency domain data should extend from DC (extrapolated value) to a higher value, the upper limit being defined by the source. The step response is typically used for reflection measurements only, and is limited to 101 or 201 points. The low pass step waveform displays a different response for each type of impedance (R,L,C), giving useful information about the discontinuities being measured.

The low pass impulse stimulus is also used to measure low pass devices. The frequency domain data should extend from DC (extrapolated value) to a higher value, the maximum frequency determined by the source. The impulse response can be used for reflection (fault location) or transmission measurements and is limited to 101 or 201 points.

The bandpass impulse stimulus simulates a pulsed RF signal (with an impulse envelope) and is used to measure band-limited devices. The start and stop frequencies are selectable by the user to any values within the limits of the source. Bandpass time domain responses are useful for both reflection and transmission measurements.

---

[1] Volatile memory is limited to 128 kbytes total. This will limit operation and storage of calibration and transform data (Time Domain Option 010) for large measurement arrays (e.g., 401, 801 point measurements).

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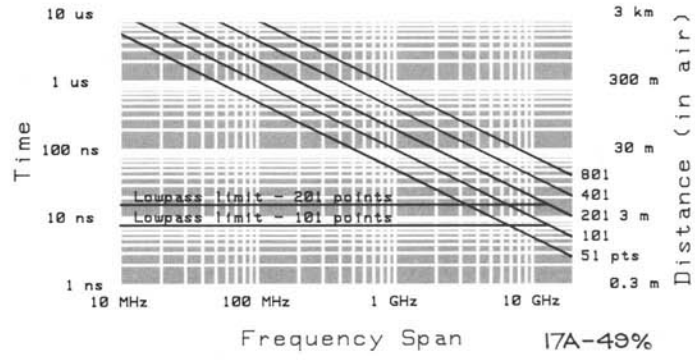
tel. +39 0755149360

Time domain range

The range over which the display is free of response repetition depends on the frequency span and the number of points as shown in the following graph[1].



Time domain range

Range resolution

Range resolution is how closely in time can a response be located.

Range Resolution = Time Span/(number of points − 1)

Windows

The windowing function can be used to modify (filter) the frequency domain data and thereby reduce overshoot and ringing in the time domain response. Three types of windows are available — minimum, normal, and maximum.

Gating

The gating function can be used to selectively remove reflection or transmission time domain responses in time. In converting back to the frequency domain the effects of the responses outside the gate are removed. The location and span of the gate can be controlled by setting either the center position and time span of the gate or by setting the start and stop time of the gate.

Measurement throughput summary

The following table shows typical measurement times for the HP 8720A.

Typical time for completion (msec)

	Number of points				
	51	**101**	**201**	**401**	**801**
Measurement					
1-port cal[2]	120	140	190	330	580
2-port cal[3]	490	610	950	1700	3200
Time domain conversion[4]	140	290	610	1460	3030
HP-IB data transfer[5]					
Internal	20	20	20	20	20
ASCII	500	960	1890	3760	7480
IEEE 754 floating point format					
32 bit	60	70	120	230	420
64 bit	100	190	350	680	1340

Remote programming

Interface: HP-IB interface operates according to IEEE 488.1 and IEC 625 standards.

Addressing: The HP-IB address can be set from the front panel from 0 to 30 decimal (factory set at 16).

Pass control/system controller: Allows the HP 8720A to request control of the HP-IB (when an active controller is present) whenever it needs to output to a plotter or printer. System control allows direct control of of plotter or a printer.

Transfer formats:

Binary (internal 48 bit floating point complex format)
ASCII
32/64 bit IEEE-754 Floating Point Format

User-accessible graphics: Using a subset of HP Graphics Language (HP-GL), vector or text graphics may be written on the HP 8720A CRT via HP-IB. Up to 64 kbytes[6] of data can be stored at one time (4 bytes per vector, 2 bytes per character).

Interface Function Codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, C1, C10, E2

Compatibility

The HP 8720A HP-IB programming is similar to the HP 8510B network analyzer. In many cases, software written for the HP 8510B will require only minor modifications to function properly on the HP 8720A.

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1 In Low Pass mode (step or impulse), range is limited by the minimum spacing between frequency domain data points (130 MHz with 101 points, 65 MHz with 201 points). This limit is labeled on the graph as "Low Pass Limit."

2 S_{11} measurement using 1-port measurement calibration over a frequency span of 2 GHz using an IF Bandwidth of 3 kHz. Includes system retrace time, but does not include source band switch time. Time domain gating is assumed off. If averaging is used, multiply the measurement times by the averaging factor to get the total time.

3 Same as footnote 2, but for an S_{21} measurement using full 2-port measurement calibration. Includes RF switching time (typically 30 ms).

4 Option 010 only, gating off.

5 Measured with an HP 9000 series 300 computer.

6 Graphics memory is part of the instrument's volatile memory. Extensive use of memory for graphics reduces the available memory for normal instrument operation.

HP 85162A
Measurement Automation Software

Description

The HP 85162A Measurement Automation Software is designed specifically to operate on an HP 9000 series 200 or 300 computer with BASIC 3.0 or higher. The software complements the HP 8720A microwave network analyzer, providing all calibration, measurement, and data output capabilities with a minimum of operator interaction.

Performance summary

Measurements (vs. frequency): Insertion loss, gain, return loss, impedance, reflection coefficient, SWR, phase, and group delay.
Source control: Start, stop, center, span, number of points (801 maximum), arbitrary frequency list (30 frequency segments max., 801 points max.)
Power level, sweep time, averaging factor, electrical delay, smoothing, and receiver IF bandwidth are supported. All measurement settings can be stored in a configuration file.
Calibration kits: 7 mm, 3.5 mm, 50 ohm Type N.
Calibration types: S_{11} 1-port, full 2-port, response/isolation, and response calibration methods.
Limit lines: Up to 22 limit segments can be specified for each of the four parameters. Flat, sloping, or CW limit lines can be entered in linear, log, group delay, SWR, phase, polar, and Smith chart formats. Polar and Smith chart limit lines are not displayed on the analyzer. Limit line information can be stored in a configuration file.
Data storage: S-parameter data can be stored to and retrieved from disc in formats suitable for computer-aided engineering (CAE) applications, such as when using the HP 85150A Microwave Design System. Measurement configurations can also be stored.
Typical file sizes:

Configuration files:	15 kbytes
Calibration files:	768 bytes + 200 bytes per point
Test data files:	
Binary	300 bytes + 80 bytes per point
Touchstone	300 bytes + 90 bytes per point
Super compact	400 bytes + 100 bytes per point
Unifile	90 bytes + 88 bytes per point

Typical measurement time (in seconds):
(using 201 points, averaging factor of 16)

Recall Measurement Configuration	5
Recall Calibration	29
Device Measurement	25

HP 85165A
Resonator Measurement Software[1]

Description

The HP 85165A Resonator Measurement Software performs complete characterization of crystals, SAWs, and other resonant devices using the HP 8720A Option 001 network analyzer and an HP 9000 Series 200 or 300 computer with BASIC 3.0 or higher. The software guides the user through the measurement process and calculates key parameters of the device under test according to the EIA-512 resonator measurement standard.

Performance summary

Measurements: f_s — nominal resonance frequency, Q, zero phase crossing of impedance minima and maxima, series and parallel resonance points, spurious responses.
Model elements: Equivalent circuits are produced with the following elements: R_1, L_1, C_1, C_0, C_{13}, C_{23}.
Characterization: Cubic temperature coefficients for f_s with curve fit residuals and inflection points, dissipated power, delta R_1 from nominal vs. temperature or input power, delta f_s from nominal vs. temperature or input power, T_s sensitivity of f_s to capacitive loading.

Required equipment for HP 85162A and HP 85165A

Network Analyzer:
HP 8720A microwave network analyzer
Computer:
HP 9000 Series 200 or 300 computer with:
BASIC 3.0 or higher
2.0 Mbytes user memory (including BASIC)
HP 9122 Dual 3.5" Disc Drive (not required for HP 9836A/C)

Optional equipment

Plotter:
HP 7470A Opt. 002, 7475A Opt. 002, 7440A Opt. 002, 7090A Opt. 002, or 7550A.
Printer:
HP 2225A, 82906A, 2932A Opt. 046, 2673A.
Winchester Hard Disc Drive:
HP 9153B, 9154B

Ordering information

HP 85162A Measurement Automation Software
Option 630 3.5" discs
Option 655 5.25" discs

HP 85165A Resonator Measurement Software
(3.5" discs only)

[1] HP 8720A Option 001 required

Accessories

The following accessories allow calibration and verification of the HP 8720A network analyzer. The 3.5 mm calibration and verification kits use the PSC-3.5 (precision slotless) connector, and Type N calibration and verification kits use the PSC-N connector. These 3.5 mm, 7 mm, and Type N accessories provide outstanding reliability and repeatability when calibrating and verifying the HP 8720A.

For devices with 3.5 mm connectors

HP 85052B 3.5 mm Calibration Kit

The HP 85052B kit contains a set of precision calibration standards used to calibrate an HP 8720A network analyzer for making error corrected measurements of devices with a 3.5 mm connector interface. The standards included are open circuits (male and female), short circuits (male and female), lowband fixed loads (male and female), and sliding loads (male and female).

Also contained in the kit are precision adapters for converting the test port to a 3.5 mm interface of either sex, as well as tools for maintaining and verifying the integrity of the test port 3.5 mm connector interface.

HP 85052D 3.5 mm Economy Calibration Kit

The HP 85052D calibration kit enables calibration using a short, an open, and a precision broadband fixed load to provide the most convenient and economical calibration. (No connector gages are included in this kit).

HP 85053B 3.5 mm Verification Kit

The HP 85053B kit includes a set of 3.5 mm measured standards used to verify the performance of an HP 8720A network analyzer operating with error correction. The standards included are a 10 cm airline, a stepped impedance airline, and 20 and 40 dB attenuators. The devices contained in the kit are supplied with data (either electrical or mechanical).

Test port return cables

The HP 85131 series test port return cables are designed to connect the HP 8720A's test ports (3.5 mm) to the device under test (3.5 mm). All 3.5 mm cables are specified from DC to 26.5 GHz.

Cables are available as single long cables for measurements where the device is connected directly to the test port, or as cable sets, which contain two cables, one for each port. Cables are available as semi-flexible cables, offering the best performance and suitable for applications where the connectors of the device are in-line, and as super-flexible cables which are more rugged and have a tighter bending radius, ideal for manufacturing environments. The semi-flexible cables carry a 90-day warranty, whereas the super-flexible cables are warranted for 1 full year.

HP Model	Description	Length	Connectors
HP 85131C	Semi-flexible Single cable	81 cm (32 in.)	Special 3.5 mm to 3.5 mm (F)
HP 85131D	Semi-flexible Cable set	53 cm (21 in.)	Special 3.5 mm to 3.5 mm (M and F)
HP 85131E	Super-flexible Single cable	94 cm (38 in.)	Special 3.5 mm to 3.5 mm (F)
HP 85131F	Super-flexible Cable set	58 cm (23 in.)	Special 3.5 mm to 3.5 mm (M and F)

HP 85130D 3.5 mm Special Adapter Set

The HP 85130D adapter set converts the HP 8720A's test ports to 3.5 mm (male and female), and is recommended for applications which require many direct connections to the test set. The adapters protect the HP 8720A's test ports from damage and wear due to heavy use.

HP 85043B Racked System Kit

HP 85043B racked system kit is a rack standing 123.7 cm (48.7") high, a width of 60.0 cm (23.6"), and a depth of 80.0 cm (31.5") suitable for the HP 8720A microwave network analyzer. Complete with an extendable work surface, support rails and AC power distribution (suitable for 50 to 60 Hz, 100-240 V AC), the kit includes rack mounting hardware for the HP 8720A. Thermal design is such that no rack fan is needed.

For devices with 7 mm connectors

HP 85050B 7 mm Calibration Kit

The HP 85050B calibration kit offers excellent performance with calibration using short and open circuits, a fixed load for lowband (<2 GHz) and a sliding load from 2 to 18 GHz. Also included in this kit are tools for maintaining and verifying the integrity of the test port 7 mm connector interface.

HP 85050D 7 mm Economy Calibration Kit

The HP 85050D calibration kit enables calibration using a short, an open, and a precision broadband fixed load (>40 dB return loss to 18 GHz) to provide the most convenient and economical calibration. (No connector gages are included in this kit).

HP 85051B 7 mm Verification Kit

The HP 85051B kit includes a set of 7 mm measured standards used to verify the performance of an HP 8720A network analyzer operating with error correction. The standards included in the kit are a 10 cm Beadless Airline, a stepped impedance airline, and 20 and 50 dB attenuators. The devices contained in the kit are supplied with data (either electrical or mechanical).

Test port return cables

The HP 85132 series test port return cables are designed to connect the HP 8720A's test ports (3.5 mm) to the device under test (7 mm). All 7 mm cables are specified from DC to 18 GHz.

Cables are available as single long cables for measurements where the device is connected directly to the test port, or as cable sets, which contain two cables, one for each port. Cables are available as semi-flexible cables, offering the best performance and suitable for applications where the connectors of the device are in-line, and as super-flexible cables which are more rugged and have a tighter bending radius, ideal for manufacturing environments. The semi-flexible cables carry a 90-day warranty, whereas the super-flexible cables are warranted for 1 full year.

HP Model	Description	Length	Connectors
HP 85132C[1]	Semi-flexible Single cable	81 cm (32 in.)	Special 3.5 mm to 7 mm
HP 85132D	Semi-flexible Cable set	53 cm (21 in.)	Special 3.5 mm to 7 mm
HP 85132E[1]	Super-flexible Single cable	94 cm (38 in.)	Special 3.5 mm to 7 mm
HP 85132F	Super-flexible Cable set	58 cm (23 in.)	Special 3.5 mm to 7 mm

[1] HP 85130B also required (HP 85130C for Type N devices).

HP 85130B 7 mm Special Adapter Set

The HP 85130B adapter set converts the HP 8720A's test ports to 7 mm, and is recommended for applications where the device under test is connected directly to the test ports.

For devices with Type N connectors

HP 85054B Type N Calibration Kit

The HP 85054B calibration kit contains a set of precision calibration standards used to calibrate an HP 8720A network analyzer system when making error corrected measurements of devices with a Type N connector interface. The standards included are open circuits (male and female), short circuits (male and female), fixed loads (male and female), and sliding loads (male and female).

Also contained in the kit are precision 7 mm to Type N (male and female) adapters for converting the test port interface and tools for maintaining and verifying the integrity of the Type N interface.

HP 85055A Type N Verification Kit

The HP 85055A kit includes a set of Type N measured standards used to verify the performance of the HP 8720A network analyzer operating with error correction. The standards included are a 10 cm airline, a stepped impedance airline, and 20 and 50 dB attenuators. The devices contained in the kit are supplied with data (either electrical or mechanical).

Test Port Return Cables

For Type N measurements, the HP 85132 series 7 mm cables are recommended. Adapters from 7 mm to Type N (male and female) are included in the Type N calibration kit. If the Type N device is to be connected directly to the HP 8720A's test ports, use the HP 85130C Special Adapter Set and the HP 85132C/E cables.

HP 85130C Type N Special Adapter Set

The HP 85130C adapter set converts the HP 8720A's test ports to Type N (male and female), and is recommended for applications where the device under test is connected directly to the HP 8720A's test ports.