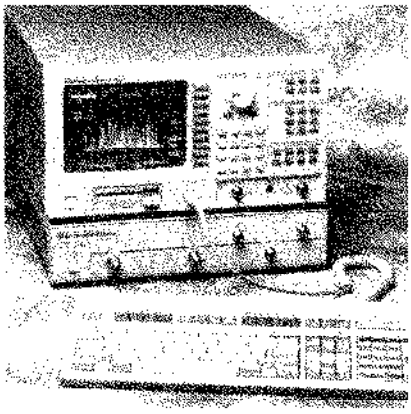
HEWLETT PACKARD

HP 3589A Spectrum/Network Analyzer

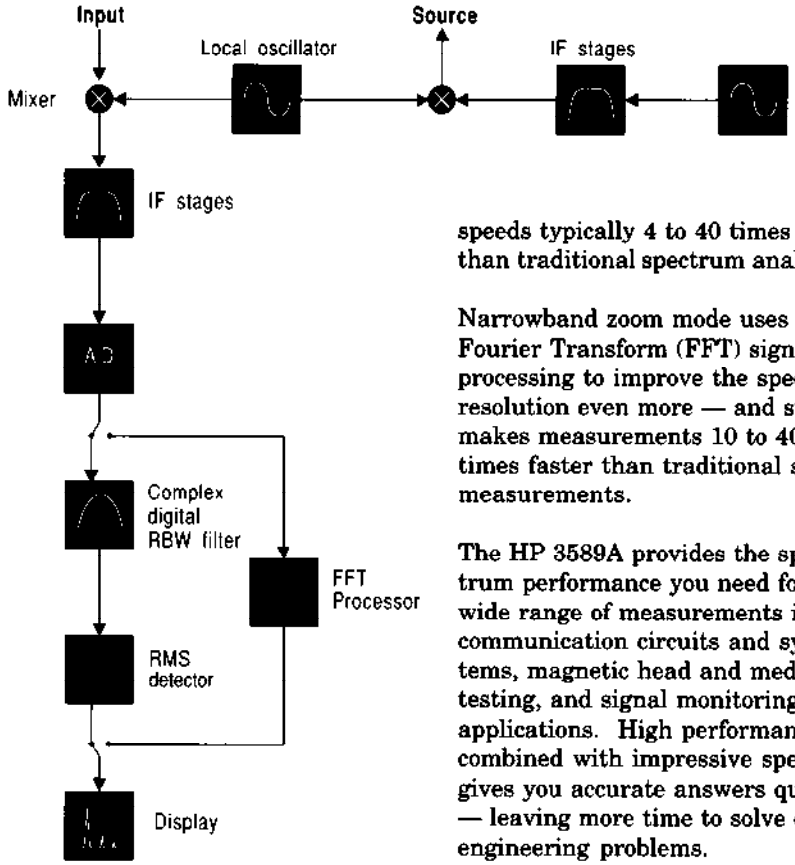
Technical Datasheet

HP 3589A
Spectrum/Network Analyzer
10 Hz to 150 MHz

HP 35689A/B
S-Parameter Test Sets
100 kHz to 150 MHz



Spectrum measurements for uncompromised signal analysis
The HP 3589A spectrum/network analyzer uses new technologies to provide new measurement capabilities. Digital IF filters provide excellent resolution and accuracy without sacrificing measurement speed. These new filters are also extremely stable and predictable. A calibrated oversweep mode takes advantage of these features to make accurate measurements at speeds typically 4 to 40 times faster than traditional spectrum analyzers.



Narrowband zoom mode uses Fast Fourier Transform (FFT) signal processing to improve the spectrum resolution even more — and still makes measurements 10 to 400 times faster than traditional swept measurements.

The HP 3589A provides the spectrum performance you need for a wide range of measurements in communication circuits and systems, magnetic head and media testing, and signal monitoring applications. High performance combined with impressive speed gives you accurate answers quickly — leaving more time to solve other engineering problems.

Vector network measurements for more complete analysis
Complete characterization ensures you'll have fewer problems when you start integrating the pieces of your device, circuit, or system. Avoiding problems early eliminates time-consuming design iterations.

Spectrum measurements help you characterize part of your device. The HP 3589A, however, provides complete insight into its frequency-domain performance by including vector network measurements.

After transmission normalization, a single channel delivers convenient network analysis for amplitude frequency response, phase frequency response, or group delay. And it offers this analysis without sacrificing the performance you need for most network measurements.

To enhance the network measurement capabilities, use the HP 3589A with an HP 35689A or HP 35689B S-parameter test set. The test set lets you make transmission and reflection measurements in both forward and reverse directions without changing device connections. And one-port and two-port calibrations mean high-accuracy results. The HP 35689A/B test sets also have a spectrum input to provide convenient spectrum-mode measurements in the HP 3589A with no cabling changes.

HP 3589A Spectrum/Network Analyzer
HP35689A/B S-Parameter Test Sets

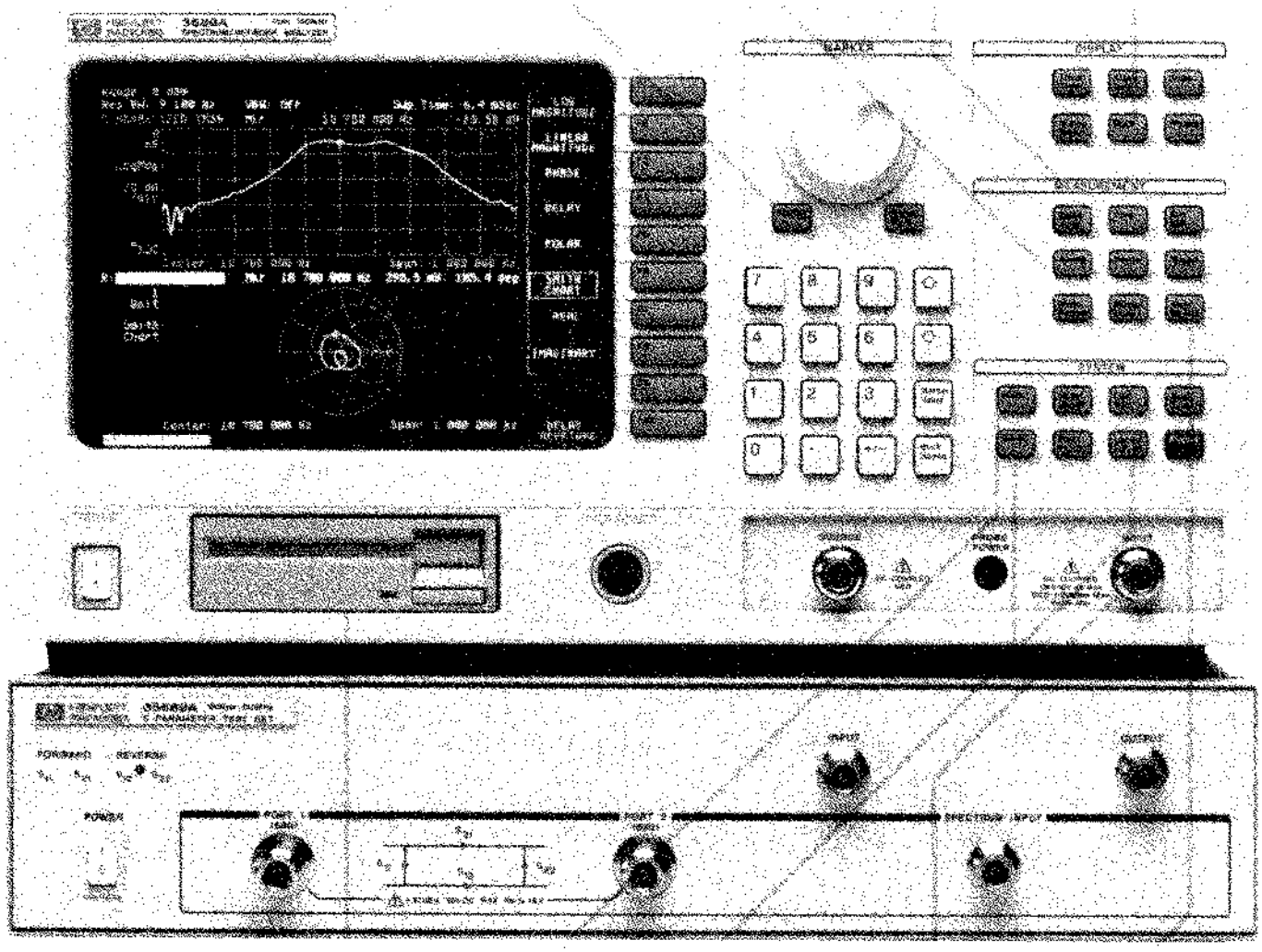
The HP 3589A offers three measurement modes. Swept spectrum mode allows measurements four times faster than traditional analyzers across the 150 MHz bandwidth. Narrowband zoom mode offers spectrum resolution down to 0.0045 Hz, at speeds up to 400 times faster than traditional analysis methods. Vector network mode provides 100 dB (typical) network measurement capability.

Comprehensive marker functions make it easy to do min/max or 3 dB searches, peak tracking, and much more.

Use optional sweep gating for time-gated spectrum analysis.

True rms detection is built-in for accurate signal-to-noise measurements

Trace math lets you generate custom results, including normalization and calibration functions. Use it to automatically normalize noise measurements to a 1 Hz or any other desired bandwidth.



The optional S-parameter test set provides complete one-port or two-port characterization. The test set also includes a spectrum input to reduce cabling changes.

720 Kbyte disk holds measurement results, math functions, limit tables, instrument setup states, and HP Instrument BASIC programs. Standard software provided allows MS-DOS compatibility.

Online Help provides instant operating assistance. "Hypertext" cross-referencing gives you a complete picture of important measurement topics

Complete HP-IB programmability.

Optional HP Instrument BASIC lets you automate testing and even turns the HP 3589A into a system controller

Type-N connectors guarantee good signal connection for repeatable spectrum/network measurements. 50Ω, 75Ω and 1 MΩ inputs are provided.

Video averaging (exponential rms) improves measurement accuracy. Peak hold monitors and displays maximum spectral components.

HP 3589A Spectrum/Network Analyzer
Standard Features

Measurement types
Swept spectrum
Narrowband zoom
Swept network

Sweep types
Linear
Time-gated (linear swept spectrum and network) (optional)
Log (network)
Zero span
Manual (linear sweep and gated sweep only)

Data types
Input spectrum
Normalized transmission
Normalized reflection coefficient
Normalized VSWR
Normalized impedance
S_{11}, S_{21}, S_{12}, S_{22} (with HP 35689A/B only)

Trace coordinates
Log magnitude
Linear magnitude
Phase
Polar
Smith chart
Delay
Imaginary part
Real part

Display formats
Single trace
Upper and lower trace
Front and back overlay traces
Set-up state table
Graticule on/off
Annotation blanking
Display blanking
Frequency mirror (special function)
Frequency and amplitude annotation adjustment (special function)

Display scaling
Autoscale
Selectable /div and reference level
Reference level tracking to range
Phase unwrap and slope
Selectable reference line position

Marker operations
Marker search
To peak
Next peak
Next peak right
Next peak left
To minimum
To target
Offset marker
Marker to center frequency
Marker to reference level
Real/imaginary or magnitude/phase
Peak tracking
Frequency counter
Noise level marker
Limit testing

Averaging
Video average (1 to 1024 averages)
Peak hold
Video filtering

Triggering
Free run
External
HP-IB

Automatic/manual arming
Selectable polarity and delay

Source
Tracking generator standard
Type-N connector

Input
Manual ranging
Autoranging
Electrical length compensation
On-screen overload indicators
Type-N connector

Frequency
150 MHz maximum
401 points of display resolution

Trace math
Operators
*+, -, *, /, square root, conjugate*
Operands
Input spectrum, network functions, data registers, constants, other trace math functions, square root of the current equivalent noise bandwidth, jω

Memory and data-storage functions
Memory and disk devices
3.5-in floppy disk (720 Kbyte)
Internal volatile RAM disk (1 Mbyte partitionable between HP Instrument BASIC program space and RAM)
Internal non-volatile RAM disk (64 Kbyte)
Non-volatile clock with time/date
Format, delete, rename, copy
Save/recall of:
Trace data
Instrument set-up states
Limit lines
User math defintions
HP Instrument BASIC programs

Hard copy output
To HP-IB/HP-GL plotters
To HP-IB printers
Time stamp of data

Interfaces
HP-IB (IEEE-488.1 and 488.2)
Optional keyboard (standard PC-style)
S-parameter test set accessory
Active probe power

HP-IB capabilities
System controller
Addressable only
User-defined SRQs
Conformance to IEEE 488.1/488.2

Calibration
Single or automatic calibration
Built-in diagnostics and service tests

On-line help

Standard data format utilities
Utilities run in MS-DOS ® 2.1 or greater on an IBM PC (AT or higher) or compatible. The utilities include:
LIF-to-DOS format conversions
Conversion to standard data format (SDF)
Display data and instrument state information
Conversion to PC-MATLAB, MATRIXx, data set 58, and ASCII formats

For product overview, see HP 3589A brochure HP P/N 5091-1522E

Burst signal and component analysis with sweep gating (option 1D6)

Add optional time-gated spectrum analysis for additional measurement flexibility. This option allows you to characterize only a portion of the cycle that you select — such as during a pulse or even between pulses. Sweep gating is used in the HP 3589A to examine bursts as short as 150 microseconds.

Burst signals are common in communications, office automation, optoelectronics, and medical and industrial ultrasound applications. Many applications, such as magnetic and optical media and head testing require signal-to-noise ratio measurements. All noise measurement features, as well as trace averaging functions of the HP 3589A, are completely operable with the sweep gating option. This offers an excellent solution for making these demanding measurements.

Sweep gating in the HP 3589A is easy to use. Flexible triggering modes can control the gate, and a gate signal output, when used with a multi-channel oscilloscope, confirms that the gate is where you want it. When using edge triggering, programmable gate delay and gate length fully control the time-gate. Level triggering with a programmable gate delay uses the external trigger signal to control the gate length.

Selecting the right instrument

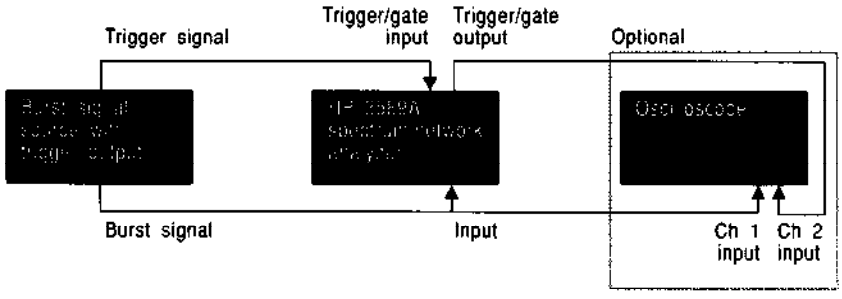
Hewlett-Packard offers a variety of analyzers to provide frequency-domain analysis. The HP 3588A spectrum analyzer and the HP 3589A spectrum/network analyzer are high-performance baseband and IF analyzers for signal and component characterization applications. For complete HP 3588A specifications, refer to HP publication number 5952-0605.

HP 3588A and HP 3589A key feature differences

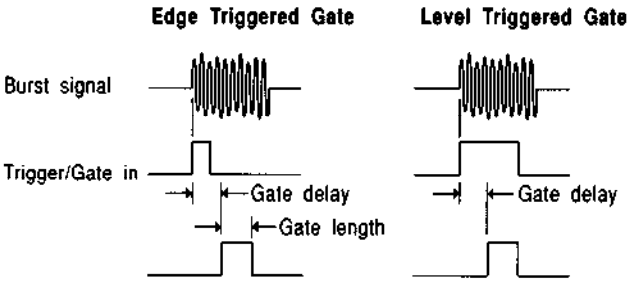
Feature	HP 3588A	HP 3589A
Spectrum measurements	Standard	Standard
Network measurements	No	Standard
S-parameter test set	No	Accessory
Source/input connector	BNC	Type-N
Time gated analysis	No	Option 1D6
External keyboard	No	Option
Source amplitude	-59.9 to +10dBm	-54.9 to +15dBm

For high performance dedicated baseband and IF analyzers, also see the HP 3585B spectrum analyzer (HP publication number 5954-7995) and the HP 3577B network analyzer (publication number 5952-2139)

Gating setup with the HP 3589A



HP 3589A Gating modes



HP 3589A General Specifications

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warmup from ambient conditions unless otherwise noted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

The general specifications apply independent of the measurement type selected. Refer to the spectrum measurements and network measurements for specifications that are measurement-type dependent.

Frequency Specifications

Frequency range
Tuning range: 0 Hz to 150 MHz
Specifications for 50 and 75 Ω apply over the frequency range of 10 Hz to 150 MHz. The 1 MΩ input operates over the full span and is specified from 10 Hz to 40 MHz.

Frequency accuracy
Frequency accuracy is specified using the frequency counter marker function and is the sum of initial accuracy, aging, and frequency counter resolution.

Initial accuracy:

	Without opt. 1D5	With opt. 1D5**
20° to 30° C	±0.5 ppm	±0.01 ppm
0° to 55° C	±3.0 ppm	±0.07 ppm
Aging*	±0.25 ppm/mo.	±0.125 ppm/mo.

*Referenced to the most recent reference calibration at 23° C.

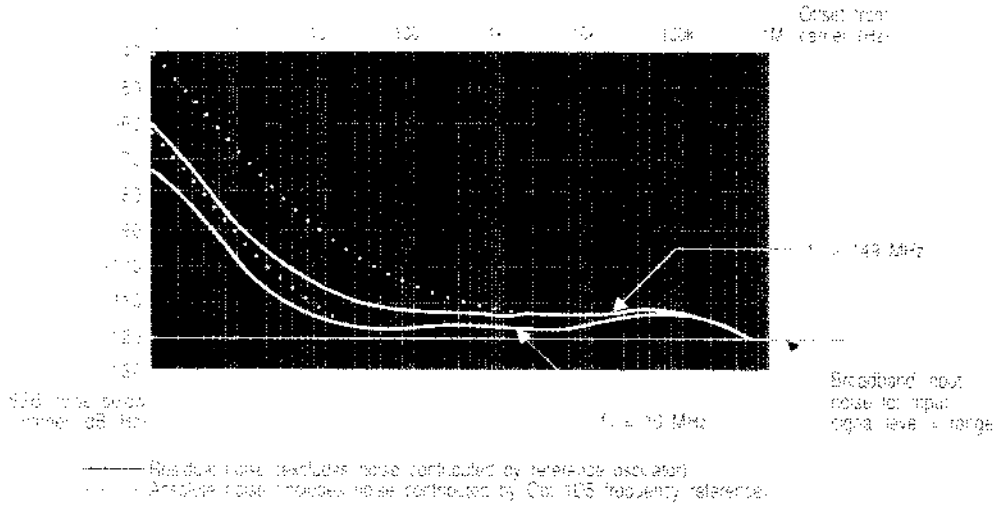
**Add ±0.1ppm if the instrument has been continually powered <48 hours.

Frequency counter resolution: 0.1 Hz

Stability
Spectral purity: See chart below.
Noise sidebands: less than -105 dBc when measured at a 1 kHz offset from CW signal and normalized to a 1 Hz noise-power bandwidth.

Drift/residual FM
The HP 3589A uses a fully synthesized local oscillator and is phase-locked to the frequency reference throughout the sweep. Refer to the frequency accuracy specifications stated earlier for the resulting accuracy.

Spectral Purity (typical)



Note: Equivalent noise bandwidth is narrower than 1 Hz for spans below 150 Hz with the narrowband zoom measurement type, providing additional reduction in phase noise from that shown. This maintains good dynamic range, even for extremely small offset frequencies in narrow spans. Noise is reduced by 10*Log [1/noise bandwidth] dBc relative to the graph.

Amplitude Specifications

Amplitude measurement range:

Maximum Safe Input Level

	50 Ω	75 Ω	1M Ω
Avg. Continuous Power: (10 Hz to 150 MHz)	26 dBm	28 dBm	13dBV
dc Voltage:	±4 V	±4 V	±25 V
Combined ac/dc:	±4 Vpk	±4 Vpk	±25 Vpk

Maximum Without Degrading Performance

	50 Ω	75 Ω	1M Ω
Input dc:	±3 Vdc	±3 Vdc	±25 Vdc
Measured input:	20 dBm	22 dBm* 26 dBm**	±7 dBV

*With included BNC adapter
**With minimum loss pad (optional)

Input range settings
(characteristics only)
50 Ω input (in 10 dB steps):
+20 dBm to -20 dBm
75 Ω input (in 10 dB steps):
+21.76 dBm to -18.24 dBm, with included BNC adapter and automatic corrections.
+25.72 dBm to -14.28 dBm, with minimum loss pad (option) and automatic corrections
1 MΩ input (in 10 dB steps):
+7 dBV to -33 dBV

Amplitude display range
Reference level:
-1000 to +1000 dBm, dB
Display resolution:
0.001 to 100 dB/div
Marker resolution: 0.01 dB
Display units: dBm, dBV, Vrms

Normalization
Normalization routines allow the single receiver channel to accurately measure scalar network parameters when swept spectrum measurement type is selected, or vector network parameters when swept network measurement type is selected. Measurement normalizations require the reference measurement to be taken first, using either quick normalization, which uses an internal source to receiver path, or transmission normalization, which can correct for additional cable, adapter, and fixture effects. Measurements are then referenced to that measurement as a ratio.

Input port
Input channels: 1
Return loss: >20 dB
Impedance: 50 Ω, 1 MΩ (<60 pF shunt capacitance)
(75 Ω with included BNC adapter or optional minimum loss pad)
Connector: Type-N

Source Specifications

Frequency specifications (characteristic only)
Frequency range: 10 Hz to 150 MHz

Amplitude specifications
Amplitude range 50 Ω output:
+15 dBm to -54.9 dBm and off
Amplitude range 75 Ω output:
+13.2 dBm to -56.7 dBm and off, with included BNC adaptor.
+9.3 dBm to -60.6 dBm and off, with minimum loss pad (option).

Amplitude resolution: 0.1 dB

Accuracy: Output amplitude accuracy is determined by the sum of absolute accuracy, dynamic accuracy, and frequency response.

Absolute amplitude accuracy: ±1 dB (at 300 kHz, +15 dBm output level)
Dynamic accuracy: Add 0.02 dB/dB below 15 dBm (add to absolute accuracy)
Frequency response: ±1 dB (Variation relative to level at 300 kHz)

Spurious products:
Harmonic products: <-30 dBc
Non-harmonic products: <-40 dBc

Noise: <-80 dBc/Hz
(for offsets greater than 500 Hz from the carrier)

Source port:
Return loss: >20 dB
Impedance: 50 Ω
(75 Ω with included BNC adapter or optional minimum loss pad)
Connector: Type-N

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warmup from ambient conditions unless otherwise noted. Typical performance is applicable over ±5° C from the temperature during the most recent autocalibration and is not warranted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

All spectrum measurement specifications apply when swept spectrum or narrowband zoom measurement type is selected and with the source turned off and low-distortion mode off unless otherwise noted.

Frequency Specifications

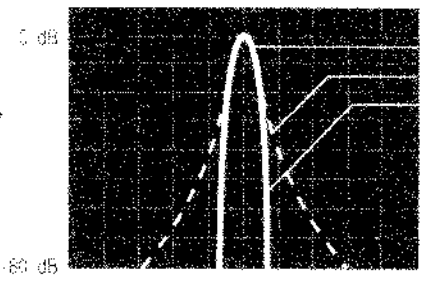
Frequency span (characteristic only)
Swept spans:
Range:10 Hz to 150 MHz, and zero span
Resolution: 0.1 Hz
Accuracy: Greater of 0.1 Hz or 0.125% of span
Start/stop frequency:
0 Hz to 150 MHz

Narrowband zoom spans:
Range: 1.23 Hz to 40 kHz in x2 steps
Accuracy: ±0.001% of span

Resolution bandwidth
Swept spectrum: 1.1 Hz to 17 kHz ±10%

Narrowband zoom:
High-accuracy mode: 0.90% of span (11 mHz-360 Hz)
High-resolution mode: 0.37% of span (4.5 mHz-148 Hz)

HP 3589A digital RBW filter shape (solid line) compared with a standard (Gaussian) analog RBW filter of equivalent 3 dB bandwidth. Shape factor of the analog filter is approximately 11:1.



3 dB resolution bandwidth Gaussian (analog) filter HP 3589A digital RBW filter

Bandwidth selectivity
(shape factor or ratio of -60 dB to -3 dB bandwidths)

Swept spectrum mode:
(see also filter comparison graph)
Manual sweep: <4.0:1
Auto-coupled sweep: 4.3:1 (typical)
Auto-coupled oversweep:
5.1:1 (typical)

Narrowband zoom:
High-accuracy mode: 2.6:1
High-resolution mode: 9.1:1

Equivalent noise bandwidth
The equivalent noise bandwidth and 1 Hz normalization factor are available for the current RBW filter in the state setup table.

Narrowband zoom:
High-accuracy mode:
0.955% of span
High-resolution mode:
0.375% of span

Video bandwidth
Entered in frequency values which are coupled to the current RBW and are from (1.54 * RBW) to (0.012 * RBW) in seven steps, and off.

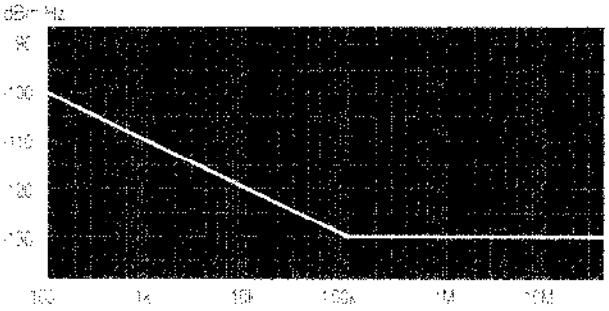
Noise level: (dBm/Hz using the noise marker function)

50 Ω Input Noise

For start frequency <30 kHz with autocoupled sweep degrade specification and typical above 30 kHz by 3 dB.

Specified for swept spectrum mode, with 50 Ω input, range set to -20 dBm and low-distortion mode off. Degrade 10 dB if in low-distortion mode. For 75 Ω input with included BNC adapter barrel degrade 2 dB, or with minimum loss pad degrade 6 dB.

1MΩ Input Noise



For start frequency <30 kHz with autocoupled sweep degrade specification above 30 kHz by 3 dB.

Specified for swept spectrum mode with 1MΩ input, range set to -33dBV (100 kΩ termination) and low-distortion mode off. Degrade 10 dB if in low-distortion mode.

For narrowband zoom spans >10 kHz, input noise is degraded by 4 dB.

Note: Equivalent noise bandwidth is narrower than 1 Hz for spans below 150 Hz with the narrowband zoom measurement type, providing additional reduction in noise from that shown. Noise is reduced by 10 *Log [1/noise bandwidth] dBc relative to the graph.

Amplitude Specifications

Dynamic range
Note: Spectrum dynamic range specifications apply with the source off.

A/D overload level: >2 dB (relative to selected range)

Spurious responses
General spurious
Unless specifically mentioned in other spurious specifications, spurious responses are <-70 dBc (<-80 dBc typical) for signal levels equal to input range.

Harmonic distortion*
Harmonic distortion products are for a spectrally pure input signal with total input power level equal to the range and low distortion mode on.

50 Ω and 75 Ω inputs:
<-80 dBc (<-90 dBc typical)
1 MΩ input:
<-75 dBc (<-80 dBc typical)

Intermodulation distortion*
Intermodulation distortion products are with respect to two tones 6 dB below range and low-distortion mode on.
50 and 75 Ω inputs:
<-80 dBc (<-90 dBc typical)
1 MΩ input:
<-75 dBc (<-80 dBc typical)

*Degrade distortion specifications by 10 dB (5 dB for 1 MΩ input) when input frequency is less than 30 kHz. Degrade specification by 10 dB when low-distortion mode is off.

Residual responses
Residual responses are less than -110 dBm on the -20 dBm range. Degrade specification by 10 dB when low-distortion mode is on. Degrade 10 dB for 40 kHz spans in narrowband zoom mode.

Image, multiple, and out-of-band responses:
<-70 dBc (<-80 dBc typical) where applied signal level = range.

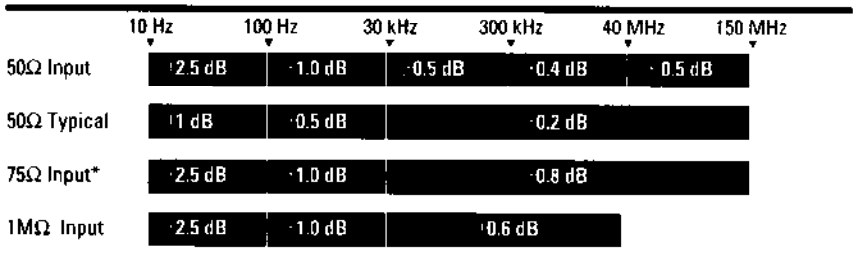
Local oscillator feedthrough
Local oscillator feedthrough (appears as signal at dc) is >20 dB below range. Degrade specification by 10 dB when low-distortion mode is on.

Amplitude accuracy
Measurement accuracy is determined by the sum of full-scale absolute accuracy and scale fidelity (linearity). For measurements made at full-scale (signal level = range), only full-scale accuracy need be considered. Recalibration due to change in center or manual frequency is not required for the accuracy shown.

Example: To compute the typical cumulative accuracy for a signal of -45 dBm at 100 MHz with 50 Ω full-scale range of -20 dBm and manual sweep, sum the typical full-scale absolute accuracy and scale fidelity, i.e.
(0.2 dB + 0.02 dB) = 0.22 dB.

Full-scale absolute accuracy
(applies over entire 0° to 55° C temperature range)

Full-scale absolute accuracy



Full-scale absolute accuracy at 300 kHz is ±0.3 dB (0.1 dB typical) when input level is equal to the range.

*Using either included BNC adaptor or optional minimum loss pad.

Accuracy is specified for manual frequency or for sweeps where sweep time is increased by a factor of four. Add ±0.1 dB for autocoupled sweep times.

Narrowband zoom: Add the following errors to the full-scale absolute accuracy specifications when in narrowband zoom mode. (This compensates for "window flatness" errors that result from windowing during the FFT operation):

High-accuracy mode (flat-top window): ±0.005 dB
High-resolution mode (Hanning window): +0, -1.5 dB

Scale fidelity (linearity) maximum cumulative error of log scale:

Level*	Incremental**	Typical
0 to -30 dB	<0.05 dB	0.02 dB
-30 to -40 dB	<0.1 dB	0.03 dB
-40 to -50 dB	<0.3 dB	0.05 dB
-50 to -60 dB	<0.5 dB	0.10 dB
-60 to -70 dB	<0.7 dB	0.10 dB
-70 to -80 dB	———	0.25 dB
-80 to -90 dB	———	0.25 dB
-90 to -100 dB	———	0.40 dB
-100 to -110 dB	———	0.70 dB
-110 to -120 dB	———	4.00 dB

Specified for frequencies >200 kHz.
*relative to the specified range.
**Incremental deviation must be added to other reference level accuracy specifications to obtain the total cumulative error.

Automatic calibration
Calibrations, which may be turned off, are periodically performed to compensate for time and temperature drift effects. No recalibration is necessary for changes in frequency parameters.

Sweep Characteristics

Trigger (characteristic only)
HP-IB, internal free run, or external triggering is available for linear sweep and narrowband zoom. Trigger arming is manual or automatic.

Trigger latency (uncertainty between the trigger input and internal trigger identification):
Linear sweep: 160 µsec (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)
Zero span: 4 µsec (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)
Narrowband zoom: $8 * 2^{40000/span}$ µsec

Trigger delay (HP-IB or external trigger only): 0 msec to the maximum gate length indicated for gated sweep. (See the gate length and trigger delay table in the gated sweep characteristics.)

Linear sweep
Measurement speed:
(characteristic only)
Sweep rate, oversweep off:
$RBW^2/2$ Hz/s
Sweep rate, oversweep on:
4 * ($RBW^2/2$) Hz/s

Note: Analog Gaussian RBW filters are usually swept at $RBW^2/2$ Hz/s (or slower) to limit amplitude errors due to sweeping to <0.1 dB. The oversweep mode of the HP 3589A provides four times faster sweep time without increased error. To calculate sweep time, compute span/sweep rate.

Narrowband zoom
Measurement Speed:
>7 measurements/s
(for spans ≥10 kHz)

Time record length:
400/span (Hz) sec

Gated sweep (with option 1D6)
(characteristic only)
Gated sweep is not available in narrowband zoom mode.

Gate length and trigger delay:

RBW [Hz]	Gate length minimum [msec]	Gate length maximum [msec]	Edge trigger default delay* [msec]
17000	0.02	131	0.13
9100	0.04	131	0.2
4600	0.08	131	0.38
2300	0.16	131	0.76
1200	0.32	131	1.5
580	0.64	131	3.1
290	1.28	665	6.25
150	2.56	1,311	12.5
73	5.12	2,621	25
36	10.24	5,243	50
18	20.48	10,486	100
9.1	40.96	20,972	200
4.5	81.92	41,861	400
2.3	163.84	83,886	800
1.1	327.68	167,772	1600

*Filter settling time required to achieve accurate noise and amplitude measurements. Delay range is from 0 msec to the maximum gate length indicated (10 µsec steps for 17 kHZ RBW). Level trigger default delay is equal to the sum of edge trigger default delay and the minimum gate length.

Edge trigger latency (uncertainty between the gate trigger input and internal trigger identification) is equal to the greater of 10 µsec and 1/64 of the minimum gate length indicated. Level trigger latency is equal to the minimum gate length indicated.

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warmup from ambient conditions unless otherwise noted. Typical performance is applicable over ±5° C from the temperature during the most recent reference measurement and is not warranted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

All network measurement specifications apply when swept network measurement type is selected. Specifications apply to 50 Ω to 75 Ω only, unless otherwise noted.

Frequency Specifications

Frequency span (characteristic only)

Linear sweep:
Range: 10 Hz to 150 MHz, and zero span
Resolution: 0.1 Hz
Accuracy: Greater of 0.1 Hz or 0.125% of span
Start/stop frequency:
0 Hz to 150 MHz

Log sweep:
Range: 10 Hz to 149.99999 MHz
Resolution: 0.1 Hz
Accuracy: 3%
Start/stop frequency:
10 Hz to 150 MHz

Resolution bandwidth
Range: 1.1 Hz to 17 kHz ±10%

Bandwidth selectivity (shape factor or ratio of -60 dB to -3 dB bandwidths)
Manual sweep: <4.0:1

Amplitude Specifications

Dynamic range

A/D overload level: >2 dB (relative to selected range)

Sensitivity
Sensitivity is the dynamic range limitation due to noise level (measured in a 1 Hz bandwidth) and internal crosstalk between the source and receiver: (75 Ω with included BNC adaptor or optional minimum loss pad)

Impedance	10 Hz - 30 kHz	30 kHz - 40 MHz	40 MHz- 150 MHz
50/75 Ω	80 dB	100 dB	100 dB
50/75 Ω typical	85 dB	110 dB	110 dB
1 MΩ	75 dB	100 dB	—

General spurious
Unless specifically mentioned in other spurious specifications, spurious responses are <-80 dBc for signal levels equal to range.

Residual responses
Residual responses are less than -110 dBm on the -20 dBm range.

Local oscillator feedthrough
Local oscillator feedthrough (appears as signal at dc) is >20 dB below range.

Ratio amplitude and phase specifications

Display range
Amplitude reference level:
-1000 to +1000 dB
Amplitude display resolution:
0.001 to 100 dB/div
Amplitude marker resolution:
0.01 dB
Amplitude display units: dB
Phase reference level: -72000° to +72000°
Phase display resolution: 0.001° to 7200°/div
Phase marker resolution: 0.01 deg
Phase display units: deg

Accuracy
Dynamic accuracy:

Level * [dB]	Accuracy** [dB]	[deg]	Typical*** [dB]	[deg]
0 to -5	<0.05	<1.0	0.05	0.2
-5 to -30	<0.10	<1.5	0.10	0.5
-30 to -40	<0.15	<2.0	0.10	1.0
-40 to -50	<0.35	<3.0	0.10	1.0
-50 to -60	<0.55	<4.0	0.15	1.5
-60 to -70	<0.75	<6.0	0.15	2.5
-70 to -80	——	——	0.30	——
-80 to -90	——	——	0.30	——
-90 to -100	——	——	0.45	——
-100 to -110	——	——	0.75	——
-110 to -120	——	——	4.00	——

Specified for frequencies >200 kHz.
*relative to the specified range.
**At stable temperature following a 2 hour warmup, and within 5 minutes of normalization.
***Typical within one minute of normalization.

Note: Drift due to changes in ambient temperature is less than ±0.2 dB/°C and ±2°/°C. Time and temperature errors are periodically compensated for, with calibration intervals between 5 and 20 minutes. Calibration will not interrupt the current measurement.

Group Delay Specifications

(Group delay is not available with log sweep)

Group delay reference level: 0 sec to ±10 sec
Group delay display resolution:
1 psec/div to 1 sec/div
Group delay marker resolution:
0.01 nsec
Group delay display units: sec

Aperture frequency: 0.5% to 16% of span in 2x steps

Group delay accuracy:
Group delay accuracy = dynamic phase accuracy/(360*aperture frequency) ± 1 nsec

Sweep Characteristics

Trigger (characteristic only)
HP-IB, internal free run, or external triggering is available for linear sweep. Trigger arming is manual or automatic.

Trigger latency (uncertainty between the trigger input and internal trigger identification):
160 µsec (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)

Trigger delay (HP-IB or external trigger only): 0 msec to the maximum gate length indicated for gated sweep. (See the gate length and trigger delay table in the gated sweep characteristics.)

Linear sweep
Sweep time is uncoupled from the span and resolution bandwidth.

Log sweep
Log sweep uses a linear approximation to perform a log frequency sweep. Resolution bandwidths are selected automatically or manually.

Gated sweep (with option 1D6)
(characteristic only)
Gating is available only with linear frequency sweep or manual frequency selected.

Gate length and trigger delay:

RBW [Hz]	Gate length minimum [msec]	Gate length maximum [msec]	Edge trigger default delay* [msec]
17000	0.16	131	0.13
9100	0.32	131	0.2
4600	0.64	131	0.38
2300	1.28	131	0.76
1200	2.56	131	1.5
580	5.12	131	3.1
290	10.24	665	6.25
150	20.48	1,311	12.5
73	40.96	2,621	25
36	81.92	5,243	50
18	163.84	10,486	100
9.1	327.68	20,972	200
4.5	655.36	41,861	400
2.3	1310.72	83,886	800
1.1	2621.44	167,772	1600

*Filter settling time required to achieve accurate noise and amplitude measurements. Delay range is from 0 msec to the maximum gate length indicated. Level trigger default delay is equal to the sum of edge trigger default delay and one-eighth of the minimum gate length.

Edge and level trigger latency (uncertainty between the gate trigger input and internal trigger identification) is equal to the minimum gate length indicated.

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warmup from ambient conditions unless otherwise noted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

Safety and environmental
Safety standards: CSA Certified for Electronic Test and Measurement Equipment per CSA 22.2, no. 231

This product is designed for compliance to: UL1244, 2nd Edition and IEC348, 2nd Edition, 1978

EMI/RFI standards:
FTZ 527 - Germany

Acoustics: LpA <70 dB

Temperature:
Operating: 5° to 50° C
Storage (no disk in drive):
-20° to 60° C

Humidity, non-condensing:
Operating: 8% to 80% at 30° C
Storage (no disk in drive): 5% to 95%

Altitude:
Operating: 2150 m (7000 ft)
Storage: 4570 m (15,000 ft)

Calibration interval: 1 year

Warmup time: 30 minutes

Power requirements:
115 VAC operation:
90-132 Vrms, 47-440 Hz
230 VAC operation:
198-264 Vrms, 47-66 Hz
Max power dissipation: 450 VA

Weight:
Net: 28 kg (62 lbs)
Shipping: 38 kg (81 lbs)

Dimensions:
Height: 222 mm (8.75 in)
Width: 425.5 mm (16.75 in)
Depth: 630 mm (24.8 in)

Trigger/gate (characteristic only)
Trigger/gate input:
Triggers on positive or negative TTL transition or contact closure or release from ground. For gated sweep (option 1D6) polarity is selectable for TTL edge or level.

Trigger/gate output:
Produces a negative TTL transition at the internal trigger identification. For gated sweep (option 1D6) produces a high TTL level during the active gate window. Fanout is 3 TTL LS loads

Reference (characteristic only)
Reference output: 10 MHz at +3dBm (nominal) 50 Ω

External reference input: 1 MHz, 2 MHz, 5 MHz, or 10 MHz between -5 dBm and +10 dBm into 50 Ω (nominal)

High stability reference oven output (option 1D5): 10MHz at +10dBm into 50 Ω

Display (characteristic only)
Number of horizontal axis points: 401
Formats: single, upper/lower, front/back, setup state
Display blanking: annotation, full

Frequency axis mirror and frequency and amplitude annotation correction for use with external down-converters and receivers.

Trace math (characteristic only)
Operators: +,-,*, /, SQRT, CONJ
Operands: input, network function, data registers, constants, other functions, SQRT(NBW), $j\omega$

Trace math can be used to correct the data on each measurement. Uses include user units correction and normalizations. Noise data is automatically referred to a 1 Hz bandwidth by displaying a function defined as SPECT/SQRT(NBW) or to any desired bandwidth by displaying a function defined as (SPECT/SQRT(NBW))*SQRT(K1), where K1 is set to the desired bandwidth. SQRT(NBW) is a trace math argument that automatically uses the equivalent noise bandwidth of the current resolution bandwidth filter.

Corrected data for use with divider probes can be displayed by displaying a function defined as SPECT * K1, where K1 is set to the probe division ratio.

External keyboard (characteristic only): Compatible with PC-style 101 key keyboard model number HP C1405A and HP Keyboard cable part number 5081-2249 (DIN connector).

Interfaces
Active probe power: +15 Vdc, -12.6 Vdc; 150 mA maximum, suitable for HP active probes

HP-IB:
Implementation of IEEE Std 488.1 and 488.2
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C12, E2

Benchmarks (characteristics only):
Binary trace output:
120 ms/trace typical

Peripherals
HP-IB graphics printers (raster output only)
HP-IB plotters using HP-GL

Memory and data storage (characteristic only)
Standard internal memory:
Non-volatile RAM: 64 Kbyte
Volatile RAM: 1 Mbyte (partitionable between HP Instrument BASIC program space and RAM disk)

Optional Memory:
Volatile RAM Option 1C1: additional 2 Mbyte RAM

Disk drive: (Only internal disk drive supported).
The HP 3589A's internal disk drive can format only double-sided, double-density disks (720 Kbyte). It can also read and write single-sided disks that were formatted in a double-sided drive. It does not read, write or format high density (1.44 Mbyte) disks.

Benchmarks (characteristic only):
Trace memory size: 2850 bytes
State memory size: 3100 bytes

Standard data format utilities (characteristic only)
Included on two 3 1/2-inch high-density (1.44 Mbyte) and two 5 1/4-inch high-density (1.2 Mbyte) floppy disks. The utilities run in MS-DOS 2.1 or greater on an IBM PC (AT or higher) or compatible. The utilities include LIF to DOS format conversions, conversion to standard data format (SDF), displaying data and instrument state information, and utilities for conversion to PC-MATLAB, MATRIXx, data set 58, and ASCII format.

HP 35689A/B
S-parameter Test Set Specifications

Note: All specifications apply from 100 kHz to 150 MHz and include 30 minute warmup from ambient conditions unless otherwise noted. Typical performance is applicable over ±5°C from the temperature during the most recent reference measurement and is not warranted.

Frequency range:
100 kHz to 150 MHz

Test port impedance:
HP 35689A: 50 Ω
HP 35689B: 75 Ω

Directivity: >40 dB

Frequency response:
Transmission (S_{21}, S_{12}):
±1 dB, ±5°
Reflection (S_{11}, S_{22}): ±1 dB, ±5°

Port match:
Return loss input/output port:
>20 dB
Source match: >26 dB

Reference path match:
Magnitude: ±0.25 dB
Phase: ±5°

Test port isolation: >80 dB

Insertion loss:
RF input to test port 1 or 2:
HP 35689A: typically 13 dB
HP 35689B: typically 19 dB
RF input to output:
HP 35689A: typically 19 dB
HP 35689B: typically 31 dB

Test port reciprocity:
Transmission (S_{21}, S_{12}):
±0.5 dB, ±5°
Reflection (S_{11}, S_{22}): ±0.5 dB, ±5°

RF input maximum operating level:
+25 dBm or 30 Vdc

RF input damage level:
+27 dBm or ±30 Vdc

Port 1 or 2 damage level:
+27 dBm or ±30 Vdc

Spectrum port:
The spectrum port is provided as a convenient input when the HP 3589A is connected to the HP 35689A/B. For specified HP 3589A measurement performance, direct connection to the HP 3589A input connector is required.

Spectrum port damage level:
HP 35689A: See HP 3589A specifications
HP 35689B: Add 6 dB to HP 3589A specifications

Spectrum port insertion loss:
HP 35689A: <0.5 dB typical
HP 35689B: 5.7 dB typical (due to included minimum loss pad)

Programming: The HP 35689A/B are completely controlled through the HP 3589A using the HP 3589A interconnecting cable.

Power:
115 VAC operation:
90-132 Vrms, 47-66 Hz
230 VAC operation:
198-264 Vrms, 47-66 Hz
Maximum power dissipation: 70 VA

Weight:
Net: 7.8 kg (17 lb.)
Shipping: 11.5 kg (25 lb.)

Dimensions
Height: 90 mm (3.5 in)
Width: 426 mm (16.75 in)
Depth: 584 mm (22.75 in)

Accessories included:
2 ea 190 mm (7.5 in) 50 Ω cables with Type-N male connectors for connection to the HP 3589A (HP P/N 8120-4387)

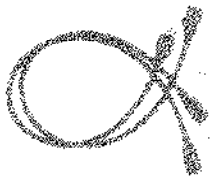
1 ea Test set interconnect cable to HP 3589A (HP P/N 35689-61612)

1 ea power cord

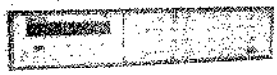
Other Accessories

Minimum loss pads
The HP 11852B provides a 50 Ω matched impedance to the HP 3589A and a 75 Ω matched impedance to the device under test. Use 50 Ω cables between the minimum loss pad and the instrument front panel connection.
Insertion loss: 5.7 dB
Return loss: ≥26 dB (50 Ω); ≥30 dB (75 Ω)
Maximum input power: +24 dBm
Connectors: 50 Ω Type-N female to 75 Ω Type-N male

The HP 11852B opt C04 provides a 50 Ω matched impedance to the HP 3589A and a 75 Ω matched impedance to the device under test. Use 75 Ω cables between the device under test and the minimum loss pad at the instrument front panel.
Insertion loss: 5.7 dB
Return loss: ≥26 dB (50 Ω); ≥30 dB (75 Ω)
Maximum input power: +24 dBm
Connectors: 75 Ω Type-N female to 50 Ω Type-N male



Test port extension cables
The HP 35679A and HP 35679B are used to extend ports for measurements of devices having any two port geometry. The HP 35679A is used with the HP 35689A. The HP 35679B is used with the HP 35689B.
Kit includes:
HP 35679A: 2 ea 610 mm (24 in) 50 Ω cables with 50 Ω Type-N male connectors, 1 ea Type-N female-to-female adapter (HP 1250-1472)
HP 35679B: 2 ea 610 mm (24 in) 75 Ω cables with 75 Ω Type-N male connectors, 1 ea Type-N female-to-female adapter (HP 1250-1529)



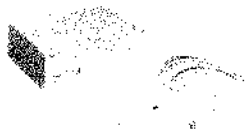
Programmable switch
The HP 3488A switch/control unit and the HP 3235A high-performance switch/control unit can be used to provide manual and HP-IB controlled signal switching to the HP 3589A. A wide selection of products are available in both switch/control units for RF and low-frequency signals. The HP 3589A with HP Instrument BASIC can directly control these instruments without the need for an external controller.

Calibration kits
The HP 35678A and HP 35678B are used with the HP 35689A/B to make vector error corrections for high-accuracy reflection measurements in 50 Ω and 75 Ω type-N connector systems, respectively. These standards and adapters are supplied with a convenient storage case.

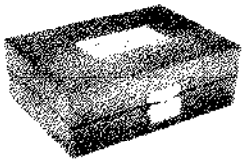
Kit includes:

Qty	Description	35678A (50 Ω) (HP Part No.)	35678B (75 Ω) (HP Part No.)
1 ea	Type-N male short	11512A	1250-1530
1 ea	Type-N female short	11511A	1250-1531
1 ea	Type-N male-to-male adapter	1250-1475	1250-1528
1 ea	Type-N female-to-female adapter	1250-1472	1250-1529
1 ea	Type-N male termination	909C Opt.200, Opt.012	1250-1540
1 ea	Type-N female termination	909C Opt.200, Opt.013	1250-1541

Probes
The HP 41800A active probe is used for 10 Hz to 150 MHz spectrum and network measurements with the HP 3589A. Probe tip impedance is 100 kΩ shunted by approximately 3 pF. A 10:1 divider tip is included. Power is supplied directly from the HP 3589A front panel probe power jack. Output connector is a type-N male.



The HP 1141A differential probe and the HP 1142A probe control and power module are used for 10 Hz to 150 MHz differential measurements with the HP 3589A. The probe offers 3000:1 CMRR at 1 MHz and input impedance of 1 MΩ shunted by 7 pF. Two attenuators (10:1 and 100:1) are included. The HP 1141A probe and HP 1142A control module must be ordered together. Output connector is a BNC male.



Accessory kits
The HP 11853A and HP 11855A provide the high-quality components for general use and for use with the HP 35689A/B. These kits are supplied with a convenient storage case.

Kits include:

Qty	Description	11853A(50 Ω) (HP Part No.)	11855A(75 Ω) (HP Part No.)
2 ea	Type-N male short	11512A	1250-1530
1 ea	Type-N female short	11511A	1250-1531
2 ea	Type-N male-to-male adapter	1250-1475	1250-1528
2 ea	Type-N female-to-female adapter	1250-1472	1250-1529
1 ea	Type-N male termination	(not included)	1250-1532

The HP 11854A and HP 11856A provide the high-quality components for general use and for use with the HP 35689A/B. These kits are supplied with a convenient storage case.

Kits include:

Qty	Description	11854A(50 Ω) (HP Part No.)	11856A(75 Ω) (HP Part No.)
2 ea	Type-N male to BNC female adapter	1250-1476	1250-1535
2 ea	Type-N male to BNC male adapter	1250-1473	1250-1533
2 ea	Type-N female to BNC male adapter	1250-1477	1250-1534
2 ea	Type-N female to BNC female adapter	1250-1474	1250-1536
1 ea	BNC male short	1250-0929	1250-0929
1 ea	BNC male termination	(not included)	11652-60010

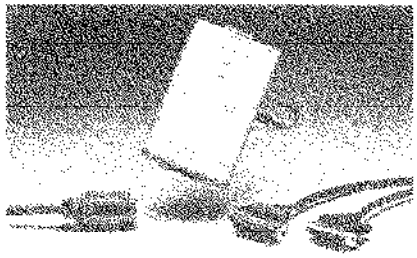
Cables and adapters
1250-0780 50Ω Type-N to BNC adapter
HP 10833A HP-IB cable (1m)
HP 10833B HP-IB cable (2m)
HP 10833C HP-IB cable (4m)
HP 10833D HP-IB cable (0.5m)

Graphics printers and plotters
These plotters and printers provide hard copy graphics and interface directly to the HP 3589A via the HP-IB connector.

HP 2225A HP ThinkJet printer
HP 2227B HP QuietJet Plus printer
HP 92261N HP Jet paper (2500 sheets, fanfold)
HP 7440A HP ColorPro 8-pen plotter, option 002
HP 7475A 6-pen graphic plotter, option 002
HP 7550B 8-pen graphic plotter, option 005
Note: see the HP-IB/Centronix interface converter listed under other accessories for use with Centronix interface printers.

Keyboards
The HP C1405A PC-style 101-key keyboard provides extended instrument operation and text editing capabilities when connected to the HP 3589A front panel. The HP C1405A keyboard language options are listed below. An HP 5081-2249 keyboard cable must be ordered separately.
HP C1405A options:
Option ABA U.S. version
Option ABD German version
Option ABE Spanish version
Option ABF French version
Option ABS Swedish version
Option ABU U.K. version
Option ABZ Italian version

Other
HP 92192A ten 3.5-inch double-sided, double-density disks



HP 92203J/K Microprint 45CH HP-IB/Centronix Interface Converter. The HP 99203J and HP 99203K offer an inexpensive solution for connecting Centronix printers, such as the HP LaserJet, HP DeskJet and HP PaintJet printers, to the HP 3589A. An HP-IB cable (HP 10833A) and a Centronix (parallel) peripherals interface cable (HP 92284A) are required to connect the HP 99203J/K to the HP 3589A.
HP 99203J HP-IB/Centronix Interface Converter; U.S. and Canada (includes ac adapter).
HP 99203K HP-IB/Centronix Interface Converter; International (requires HP 82241A ac adapter with option ABG for Australasia, ABU for the U.K., ABB for Europe, or ABJ for Japan.)

HP 3589A Ordering Guide

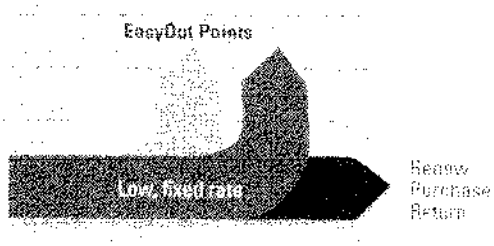
HP 3589A Spectrum/network analyzer
Option 1D5: High-stability frequency reference
Option 1D6: Time-gated spectrum analysis
Option 1D7: 50 Ω to 75 Ω minimum loss pads (2 ea 11852B opt C04)
Option 1C1: Additional 2 Mbyte RAM
Option 1C2: HP Instrument BASIC
Option 1F0: PC-style 101-key keyboard and cable; U.S. Version
Option 1F1: PC-style 101-key keyboard and cable; German Version
Option 1F2: PC-style 101-key keyboard and cable; Spanish Version
Option 1F3: PC-style 101-key keyboard and cable; French Version
Option 1F4: PC-style 101-key keyboard and cable; U.K. Version
Option 1F5: PC-style 101-key keyboard and cable; Italian Version
Option 1F6: PC-style 101-key keyboard and cable; Swedish Version
Option 1CM: Rack mount kit
Option 0B3: Service manual
Option 0BU: Additional HP Instrument BASIC manuals
Option 0B1: Additional manual set

Standard instrument includes:
3.5-inch flexible disk drive
Standard 1-year warranty
Spare fuse
Power cord
Installation Guide
Getting Started Guide
Operation Reference
HP-IB Programming Reference
Automated test program
2 ea 50 Ω Type-N to BNC adapters (HP P/N 1250-0780)
2 ea 25 Ω BNC adapter barrels (HP P/N 1250-2275)
Standard Data Format Utilities and manual
(service manual is not included)

Upgrade options:
Used to add options after the original purchase.
HP 3589U Spectrum/network analyzer upgrade kits
Option 1D5: High stability frequency reference
Option 1D6: Time-gated spectrum analysis
Option 1C1: Additional 2 Mbyte RAM
Option 1C2: HP Instrument BASIC

HP 35689A S-parameter test set for the HP 3589A (50 Ω)
HP 35689B S-parameter test set for the HP 3589A (75 Ω)
Option 1CN: Handle kit
Option 1CM: Rack mount kit
Option 1CP: Rack mount and handle kit

HP EasyRent



HP EasyRent provides a "pay as you go" path for acquiring HP instruments. This popular rental plan combines the low rate of a longer-term plan with early exit options, called EasyOut Points, that offer the convenience of a shorter term plan. A low monthly payment and extra flexibility make using HP instruments easy.

Ask your HP representative for details.

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