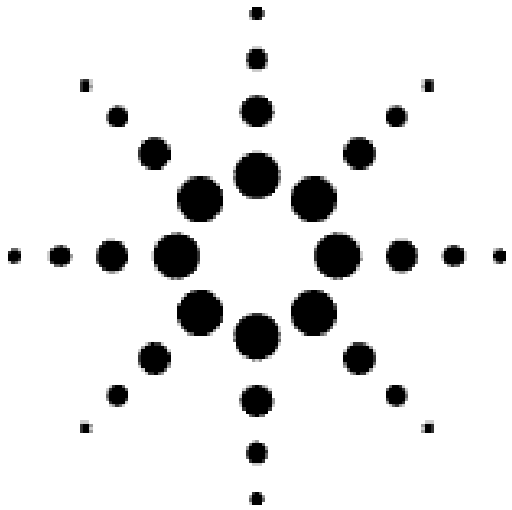

Agilent Technologies 3589A

Data Sheet

Product 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 Ohms apply over the frequency range of 10 Hz to 150 MHz. The 1 MegOhm 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**
20deg. to 30deg. C	+/-0.5 ppm	+/-0.01 ppm

0deg. to 55deg. C +/-3.0 ppm +/-0.07 ppm

Aging* +/-0.25 ppm/mo. +/-0.125 ppm/mo.

*Referenced to the most recent reference calibration at 23deg. C.
**Add +/-0.1ppm if the instrument has been continually powered <48 hours.

Frequency counter resolution: 0.1 Hz

STABILITY

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 Agilent 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.

Amplitude Specifications

AMPLITUDE MEASUREMENT RANGE:

Maximum Safe Input Level

50 Ohms 75 Ohms 1 MOhm

Avg. Continuous Power: 26 dBm 28 dBm 13 dBV (10 Hz to 150MHz)

dc Voltage: +/-4 V +/-4 V +/-25 V

Combined ac/dc: +/-4 Vpk +/-4 Vpk +/-25 Vpk

MAXIMUM WITHOUT DEGRADING PERFORMANCE

50 Ohms 75 Ohms 1 MOhm

Input dc: +/-3 Vdc +/-3 Vdc +/-25 Vdc

Measured input: 20 dBm 22 dBm* +/-7 dBV

26 dBm**

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

INPUT RANGE SETTINGS

(characteristics only)

50 Ohm input (in 10 dB steps): +20 dBm to -20 dBm

75 Ohm 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 MegOhm 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 Ohms, 1 MegOhm (<60 pF shunt capacitance)

(75 Ohms 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 Ohm output: +15 dBm to -54.9 dBm and off

Amplitude range 75 Ohm 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 Ohms

(75 Ohms with included BNC adapter or optional minimum loss pad)

Connector: Type-N

Spectrum Measurements

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 +/-5deg. 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 (characteristiconly)

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)

BANDWIDTH SELECTIVITY (shape factor or ratio of -60 dB to -3 dB bandwidths)

Swept spectrum mode:

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.

Amplitude Specifications

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 Ohm and 75 Ohm inputs: <-80 dBc (<-90 dBc typical)

1 MegOhm input: <-75 dBc (<-80 dBc typical)

INTERMODULATON DISTORTION*

Intermodulation distortion products are with respect to two tones 6 dB below range and low-distortion mode on.

50 and 75 Ohm inputs: <-80 dBc (<-90dBc typical)

1 MegOhm input: <-75 dBc (<-80 dBc typical)

*Degrade distortion specifications by 10 dB (5 dB for 1 MegOhm 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 dueto 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 Ohms 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.

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 usec (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)

Zero span: 4 usec (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)

Narrowband zoom: 8 * 2E(40000/span) usec

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*RBW/2) Hz/s

Sweep rate, oversweep on: 4 * (RBW*RBW/2) Hz/s

Note: Analog Gaussian RBW filters are usually swept at RBW*RBW/2Hz/s (or slower) to limit amplitude errors due to sweeping to <0.1 dB. The oversweep mode of the Agilent 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 ³10 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

*Filter settling time required to achieve accurate noise and amplitude measurements. Delay range is from 0 msec to the maximum gate length indicated (10 usec 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 usec and 1/64 of the minimum gate length indicated. Level trigger latency is equal to the minimum gate length indicated.

Network Measurements

Note: All specifications apply from10 Hz to 150 MHzand include 30 minute warmup from ambient conditions unless otherwise noted. Typical performance is applicable over +/-5deg. 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 Ohms to 75 Ohms 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 Ohm with included BNC adaptor or optional minimum loss pad)

IMPEDANCE 10 Hz-30 kHz 40 MHz-30 kHz 40 MHz-150 MHz

50/75 Ohms 80 dB 100 dB 100 dB

50/75 Ohms typical 85 dB 110 dB 110 dB

1 MegOhm 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: -72000deg. to +72000deg.

Phase display resolution: 0.001deg. to 7200deg./div

Phase marker resolution: 0.01 deg

Phase display units: deg

ACCURACY

Dynamic accuracy:

Level * [dB]	Accuracy** [dB]	Typical*** [deg]	[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/deg.C and +/-2deg./deg.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 usec (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 approximationto 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 achieveaccurate 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.

General Characteristics

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: 5deg. to 50deg. C

Storage (no disk in drive): -20deg. to 60deg. C

Humidity, non-condensing:

Operating: 8% to 80% at 30deg. 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/gateinput:

Triggers on positive or negative TTLtransition 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 Ohms

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

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

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), jw

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 Agilent C1405A and Agilent Keyboard cablepart number 5081-2249 (DIN connector).

INTERFACES

Active probe power: +15 Vdc,

-12.6 Vdc; 150 mA maximum, suitable for Agilent 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 Agilent 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.