

# Agilent 35670A Dynamic Signal Analyzer

Versatile two- or four-channel high-performance  
FFT-based spectrum/network analyzer  
122  $\mu$ Hz to 102.4 kHz 16-bit ADC

Data Sheet



## Key Specifications

Frequency range	102.4 kHz 1 channel 51.2 kHz 2 channel 25.6 kHz 4 channel
Dynamic range	90 dB typical
Accuracy	$\pm 0.15$ dB
Channel match	$\pm 0.04$ dB and $\pm 0.5$ degrees
Real-time bandwidth	25.6 kHz/1 channel
Resolution	100, 200, 400, 800 & 1600 lines
Time capture	> 6 Msamples
Source types	Random, burst random, periodic chirp, burst chirp, pink noise, sine, swept-sine ( Option1D2), arbitrary ( Option 1D4)



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# Summary of Features on Standard Instrument

The following features are standard with the Agilent 35670A:

## Instrument modes

FFT analysis	Histogram/time
Correlation analysis	Time capture

## Measurement

Frequency domain	
Frequency response	Power spectrum
Linear spectrum	Coherence
Cross spectrum	Power spectral density

Time domain (oscilloscope mode)

Time waveform	Autocorrelation
Cross-correlation	Orbit diagram
Amplitude domain	
Histogram, PDF, CDF	

## Trace coordinates

Linear magnitude	Unwrapped phase
Log magnitude	Real part
dB magnitude	Imaginary part
Group delay	Nyquist diagram
Phase	Polar

## Trace units

**Y-axis amplitude:** combinations of units, unit value, calculated value, and unit format describe y-axis amplitude

**Units:** volts, g, meters/sec<sup>2</sup>, inches/sec<sup>2</sup>, meters/sec, inches/sec, meters, mils, inches, pascals, Kg, N, dyn, lb, user-defined EUs

**Unit value:** rms, peak, peak-to-peak

**Calculated value:** V, V<sup>2</sup>, V<sup>2</sup>/Hz, √Hz, V<sup>2</sup>s/Hz (ESD)

**Unit format:** linear, dB's with user selectable dB reference, dBm with user selectable impedance.

**Y-axis phase:** degrees, radians

**X-axis:** Hz, cpm, order, seconds, user-defined

## Display formats

- Single
- Quad
- Dual upper/lower traces
- Small upper and largelower
- Front/back overlay traces
- Measurement state
- Bode diagram
- Waterfall display with skew, -45 to 45 degrees
- Trace grids on/off
- Display blanking
- Screen saver

## Display scaling

Autoscale	Selectable reference
Manual Scale	Linear or log X-axis
Input range tracking	Y-axis log
X & Y scale markers with expand and scroll	

## Marker functions

- Individual trace markers
- Coupled multi-trace markers
- Absolute or relative marker
- Peak search
- Harmonic markers
- Band marker
- Sideband power markers
- Waterfall markers
- Time parameter markers
- Frequency response markers

## Signal averaging (FFT mode)

Average types (1 to 9,999,999 averages)	
RMS	Time exponential
RMS exponential	Peak hold
Time	

## Averaging controls

- Overload reject
- Fast averaging on/off
- Update rate select
- Select overlap process percentage
- Preview time record

## Measurement control

- Start measurement
- Pause/continue measurement

## Triggering

- Continuous (Freerun)
- External (analog or TTL level)
- Internal trigger from any channel
- Source synchronized trigger
- GPIB trigger
- Armed triggers
- Automatic/manual
- RPM step
- Time step
- Pre- and post-trigger measurement Delay

## Tachometer input:

- ±4 V or ±20 V range
- 40 mv or 200 mV resolution
- Up to 2048 pulses/rev
- Tach hold-off control

## Source outputs

Random	Burst random
Periodic chirp	Burst chirp
Pink noise	Fixed sine

Note: Some source types are not available for use in optional modes. See option description for details.

## Input channels

Manual range	Anti-alias filters On/Off
Up-only auto range	AC or DC coupling
Up/down auto range	LED half range and overload indicators
Floating or grounded	A-weight filters On/Off
Transducer power supplies (4 ma constant current)	

## Frequency

20 spans from 195 mHz to 102.4 kHz (1 channel mode)  
20 spans from 98 mHz to 51.2 kHz (2 channel mode)  
Digital zoom with 244  $\mu$ Hz resolution throughout the 102.4 kHz frequency bands.

## Resolution

100, 200, 400, 800 and 1600 lines

## Windows

Hann	Uniform
Flat top	Force/exponential

## Math

+ , - , * , /	Conjugate
Magnitude	Real and imaginary
Square Root	FFT, FFT <sup>-1</sup>
LN	EXP
*j $\omega$ or /j $\omega$	PSD
Differentiation	A, B, and C weighting
Integration	Constants K1 thru K5 Functions F1 thru F5

## Analysis

Limit test with pass/fail  
Data table with tabular readout  
Data editing

## Time capture functions

Capture transient events for repeated analysis in FFT, octave, order, histogram, or correlation modes (except swept-sine). Time-captured data may be saved to internal or external disk, or transferred over GPIB. Zoom on captured data for detailed narrowband analysis.

## Data storage functions

Built-in 3.5 in., 1.44-Mbyte flexible disk also supports 720-KByte disks, and 2 Mbyte NVRAM disk. Both MS-DOS<sup>®</sup> and HP-LIF formats are available. Data can be formatted as either ASCII or binary (SDF). The 35670A provides storage and recall from the internal disk, internal RAM disk, internal NVRAM disk, or external GPIB disk for any of the following information:

Instrument setup states	Trace data
User-math	Limit data
Time capture buffers	Agilent Instrument BASIC Programs
Waterfall display data	Curve fit/synthesis tables
Data tables	

## GPIB capabilities

Conforms to IEEE 488.1/488.2  
Conforms to SCPI 1992  
Controller with Agilent Instrument Basic Option

## Calibration & memory

Single or automatic calibration  
Built-in diagnostics & service tests  
Nonvolatile clock with time/date  
Time/date stamp on plots and saved data files

## Online help

Access to topics via keyboard or index

## Fan

On/Off

# Agilent 35670A Specifications

Instrument specifications apply after 15 minutes warm-up and within 2 hours of the last self-calibration. When the internal cooling fan has been turned OFF, specifications apply within 5 minutes of the last self-calibration. All specifications are with 400 line frequency resolution and with anti-alias filters enabled unless stated otherwise.

## Frequency

### Maximum range\*\*

1 channel mode	102.4 kHz, 51.2 kHz (opt AY6*)
2 channel mode	51.2 kHz
4 channel mode (Option AY6 only)	25.6 kHz

### Spans

1 channel mode	195.3 mHz to 102.4 kHz
2 channel mode	97.7 mHz to 51.2 kHz
4 channel mode (Option AY6 only)	97.7 mHz to 25.6 kHz

### Minimum resolution

1 channel mode	122 $\mu$ Hz (1600 line display)
2 channel mode	61 $\mu$ Hz (1600 line display)
4 channel mode (Option AY6 only)	122 $\mu$ Hz (800 line display)

### Maximum real-time bandwidth

FFT span for continuous data acquisition)  
(Preset, fast averaging)

1 channel mode	25.6 kHz
2 channel mode	12.8 kHz
4 channel mode (Option AY6 only)	6.4 kHz

### Measurement rate

(Typical) (Preset, fast averaging)

1 channel mode	$\geq 70$ averages/sec
2 channel mode	$\geq 33$ averages/sec
4 channel mode (Option AY6 only)	$\geq 15$ averages/sec

### Display update rate

Typical (Preset, fast average off)	$\geq 5$ updates/Sec
Maximum	$\geq 9$ updates/Sec

(Preset, fast average off, single channel, single display, undisplayed trace displays set to data registers)

## Accuracy

$\pm 30$  ppm (.003%)

### Single channel amplitude

#### Absolute amplitude accuracy (FFT)

(A combination of full scale accuracy, full scale flatness, and amplitude linearity.)

$\pm 2.92\%$  (0.25 dB) of reading

$\pm 0.025\%$  of full scale

FFT full scale accuracy at 1 kHz (0 dBfs)

$\pm 0.15$  dB (1.74%)

FFT full scale flatness (0 dBfs) relative to 1 kHz

$\pm 0.2$  dB (2.33%)

FFT amplitude linearity at 1 kHz measured on +27 dBVrms range with time avg, 0 to -80 dBfs

$\pm 0.58\%$  (0.05 dB) of reading

$\pm 0.025\%$  of full scale

### Amplitude resolution

(16 bits less 2 dB over-range) with averaging 0.0019% of full scale (typical)

### Residual DC response (FFT mode)

#### Frequency display (excludes A-weight filter)

<-30 dBfs or 0.5 mVdc

### FFT dynamic range

Spurious free dynamic range

(Includes spurs, harmonic distortion, intermodulation distortion, alias products). Excludes alias responses at extremes of span.

Source impedance = 50  $\Omega$ .

800 line display.

90 dB typical (<-80 dBfs)

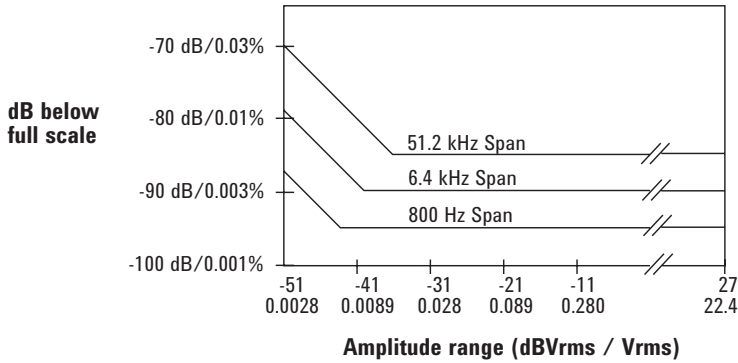
\* Option AY6 single channel maximum range extends to 102.4 kHz without anti-alias filter protection.

\*\* Show all lines mode allows display of up to 131.1, 65.5 and 32.7 kHz respectively. Amplitudes accuracy is unspecified and not alias protected.

**Full span FFT noise floor (typical)**

Flat top window, 64 RMS averages, 800 line display.

**Typical noise floor vs. range for different frequency spans**



<b>Harmonic distortion</b>	< -80 dBfs
Single Tone (in band), $\leq 0$ dBfs	
<b>Intermodulation distortion</b>	< -80 dBfs
Two tones (in-band), each $\leq -6.02$ dBfs	
<b>Spurious and residual responses</b>	< -80 dBfs
Source impedance = 50 $\Omega$ .	
<b>Frequency alias responses</b>	
Single tone (out of displayed range), $\leq 0$ dBfs, $\leq 1$ MHz	
( $\leq 200$ kHz with IEPE transducer power supply On)	
2.5% to 97.5% of the frequency span	< -80 dBfs
Lower and upper 2.5% of frequency span	< -65 dBfs

**Input noise**

**Input noise level**

Flat top window, -51 dBVrms range

Source impedance = 50  $\Omega$

Above 1280 Hz < -140 dBVrms/ $\sqrt{2}$ Hz

160 Hz to 1280 Hz < -130 dBVrms/ $\sqrt{2}$ Hz

Note: To calculate noise as dB below full scale:

Noise [dBfs] = Noise [dB/ $\sqrt{2}$ Hz] + 10LOG(NBW) - Range [dBVrms]; where NBW is the noise equivalent BW of the window (see below).

Window parameters	Uniform	Hann	Flat top
-3 dB bandwidth*	0.125% of span	0.185% of span	0.450% of span
Noise equivalent bandwidth*	0.125% of span	0.1875% of span	0.4775% of span
Attenuation at $\pm 1/2$ bin	4.0 dB	1.5 dB	0.01 dB
Shape factor	716	9.1	2.6
(-60 dB BW/-3 dB BW)			

\* For 800 line displays. With 1600, 400, 200, or 100 line displays, multiply bandwidths by 0.5, 2, 4, and 8, respectively.

### Single channel phase

**Phase accuracy relative to external trigger**  $\pm 4.0$  deg

16 time averages center of bin,  
DC coupled 0 dBfs to -50 dBfs only  
0 Hz < freq  $\leq$  10.24 kHz only

For Hann and flat top windows, phase is relative to a cosine wave at the center of the time record. For the uniform, force, and exponential windows, phase is relative to a cosine wave at the beginning of the time record.

### Cross-channel amplitude

**FFT cross-channel gain accuracy**  $\pm 0.04$  dB (0.46%)

Frequency response mode  
Same amplitude range  
At full scale: Tested with 10 RMS averages on the -11 to +27 dBVrms ranges, and 100 RMS averages on the -51 dBVrms range

### Cross-channel phase

**Cross-channel phase accuracy**  $\pm 0.5$  deg

(Same conditions as cross-channel amplitude)

### Input

**Input ranges** (full scale)

(Auto-range capability)

+27 dBVrms (31.7 Vpk) to -51 dBVrms  
(3.99 mVpk) in 2 dB steps

**Maximum input levels** 42 Vpk

**Input impedance** 1 M $\Omega$   $\pm$ 10%

90  $\mu$ F nominal

**Low side to chassis impedance** 1 M $\Omega$   $\pm$ 30% (typical)

Floating mode <0.010  $\mu$ F

Grounded mode  $\leq$ 100  $\Omega$

**AC coupling rolloff** <3 dB rolloff at 1 Hz

Source impedance = 50  $\Omega$

### Common mode rejection ratio

Single tone at or below 1 kHz

-51 dBVrms to -11 dBVrms ranges >75 dB typical

-9 dBVrms to +9 dBVrms ranges >60 dB typical

+11 dBVrms to +27 dBVrms ranges >50 dB typical

### Common mode range

(floating mode)  $\pm 4$  V pk

### IEPE transducer power supply

Current source 4.25  $\pm$  1.5 mA

Open circuit voltage +26 to +32 Vdc

### A-weight filter

Type 0 tolerance

Conforms to ANSI Standard S1.4-1983;

and to IEC 651-1979; 10 Hz to 25.6 kHz

### Crosstalk

Between input channels, and source-to-input (Receiving channel source impedance = 50  $\Omega$ ) < -135 dB below signal or < -80 dBfs of receiving channel, whichever response is greater in amplitude

### Time domain

Specifications apply in histogram/time mode, and unfiltered time display

**DC amplitude accuracy**  $\pm 5.0$  %fs

**Rise time of -1 V to 0 V test pulse** <11.4  $\mu$ Sec

**Settling time of -1 V to 0 V test pulse** <16  $\mu$ Sec to 1%

**Peak overshoot of -1 V to 0 V test pulse** <3%

### Sampling period

1 channel mode 3.815  $\mu$ Sec to 2 Sec in 2x steps

2 channel mode 7.629  $\mu$ Sec to 4 Sec in 2x steps

4 channel mode 15.26  $\mu$ Sec to 8 Sec in 2x steps

(Option AY6 only)

## Trigger

<b>Trigger modes</b>	Internal, source, external (analog setting) GPIB
<b>Maximum trigger delay</b>	
Post trigger	8191 seconds
Pre trigger	8191 sample periods
No two channels can be further than $\pm 7168$ samples from each other.	
<b>External trigger max. input</b>	$\pm 42$ Vpk
<b>External trigger range</b>	
Low range	-2 V to +2 V
High range	-10 V to +10 V
<b>External trigger resolution</b>	
Low range	15.7 mV
High range	78 mV

## Tachometer

<b>Pulses per Revolution</b>	0.5 to 2048
<b>RPM</b>	$5 \leq \text{RPM} \leq 491,519$
<b>RPM Accuracy</b>	$\pm 100$ ppm (0.01%) (typical)
<b>Tach level range</b>	
Low range	-4 V to +4 V
High range	-20 V to +20 V
<b>Tach level resolution</b>	
Low range	39 mV
High range	197 mV
<b>Maximum tach input level</b>	$\pm 42$ Vpk
<b>Minimum tach pulse width</b>	600 nSec
<b>Maximum tach pulse rate</b>	400 kHz (typical)

## Source output

<b>Source types</b>	Sine, random noise, chirp, pink noise, burst random, burst chirp
<b>Amplitude range</b>	AC: $\pm 5$ V peak* DC: $\pm 10$ V* <small>* <math>V_{ac_{pk}} +  V_{dc}  \leq 10</math> V</small>
<b>AC amplitude resolution</b>	
Voltage > 0.2 Vrms	2.5 mVpeak
Voltage < 0.2 Vrms	0.25 mVpeak
<b>DC offset accuracy</b>	$\pm 15$ mV $\pm 3\%$ of $( DC  + V_{ac_{pk}})$ settings
<b>Pink noise adder</b>	Add 600 mV typical when using pink noise
<b>Output impedance</b>	< 5 $\Omega$
<b>Maximum loading</b>	
Current	$\pm 20$ mA peak
Capacitance	0.01 $\mu$ F
<b>Sine amplitude accuracy at 1 kHz</b>	$\pm 4\%$ (0.34 dB) of setting
Rload > 250 $\Omega$	0.1 Vpk to 5 Vpk
<b>Sine Flatness</b> (relative to 1 kHz)	$\pm 1$ dB 0.1 V to 5 V peak
<b>Harmonic and sub-harmonic distortion and spurious signals (In band)</b>	0.1 Vpk to 5 Vpk sine wave
Fundamental < 30 kHz	< -60 dBc
Fundamental > 30 kHz	< -40 dBc

## Digital interfaces

<b>External keyboard</b>	Compatible with PC-style 101-key keyboard
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## GPIB

Conforms to the following standards:  
IEEE 488.1 (SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C12, E2)  
EEE 488.2-1987

Complies with SCPI 1992

<b>Data transfer rate</b> (REAL 64 Format)	< 45 mSec for a 401 point trace
<b>Serial port</b>	
<b>Parallel port</b>	
<b>External VGA port</b>	

### Computed order tracking – Option 1D0

$$\left( \frac{\text{Maximum order} \times \text{Maximum RPM}}{60} \right) \leq$$

<b>Online (real time)</b>	1 channel mode	25,600 Hz
	2 channel mode	12,800 Hz
	4 channel mode	6,400 Hz
<b>Capture playback</b>	1 channel mode	102,400 Hz
	2 channel mode	51,200 Hz
	4 channel mode	25,600 Hz
<b>Number of orders ≤ 200</b>	5 ≤ RPM ≤ 491,519 (Maximum useable RPM is limited by resolution, tach pulse rate, pulses/revolution and average mode settings.)	
<b>Delta order</b>	1/128 to 1/1	
<b>Resolution</b>	≤ 400 (Maximum order)/(Delta order)	
<b>Maximum RPM ramp rate</b>	1000 RPM/second real-time (typical)	
<b>1000 - 10,000 RPM run up</b>		
Maximum order	10	
Delta order	0.1	
RPM step	30 (1 channel) 60 (2 channel) 120 (4 channel)	
<b>Order track amplitude accuracy</b>	±1 dB (typical)	

### Real time octave analysis – Option 1D1

#### Standards

Conforms to ANSI Standard S1.11 - 1986, Order 3, Type 1-D, extended and optional frequency ranges

Conforms to IEC 651-1979 Type 0 Impulse, and ANSI S1.4

1 second stable average

Single tone at band center: ≤ ± 0.20 dB

Readings are taken from the linear total power spectrum bin. It is derived from sum of each filter.

**1/3-octave dynamic range** > 80 dB (typical) per ANSI S1.11-1986

2 second stable average

Total power limited by input noise level

#### Frequency ranges (at centers)

Online (real time):

	Single channel	2 channel	4 channel
1/1 octave	0.063 - 16 kHz	0.063 - 8 kHz	0.063 - 4 kHz
1/3 octave	0.08 - 40 kHz	0.08 - 20 kHz	0.08 - 10 kHz
1/12 octave	0.0997 - 12.338 kHz	0.0997 - 6.169 kHz	0.0997 - 3.084 kHz

#### Capture playback

1/1 octave	0.063 - 16 kHz	0.063 - 16 kHz	0.063 - 16 kHz
1/3 octave	0.08 - 31.5 kHz	0.08 - 31.5 kHz	0.08 - 31.5 kHz
1/12 octave	0.0997 - 49.35 kHz	0.0997 - 49.35 kHz	0.0997 - 49.35 kHz

One to 12 octaves can be measured and displayed.

1/1-, 1/3-, and 1/12-octave true center frequencies related by the formula:  $f(i+1)/f(i) = 2^{(1/n)}$ ;  $n=1, 3, \text{ or } 12$ ; where 1000 Hz is the reference for 1/1, 1/3 octave, and  $1000 \times 2^{(1/24)}$  Hz is the reference for 1/12 octave. The marker returns the ANSI standard preferred frequencies.

### Swept sine measurements – Option 1D2

**Dynamic range** 130 dB

Tested with 11 dBVrms source level at: 100 mSec integration

### Curve fit/synthesis – Option 1D3

20 Poles/20 zeroes curve filter frequency response

synthesis pole/zero, pole residue & polynomial format

### Arbitrary waveform source – Option 1D4

**Amplitude range** AC: ±5 V peak\*

DC: ±10 V\*

\*  $V_{ac, pk} + |V_{dc}| \leq 10 V$

**Record length** # of points = 2.56 x lines of resolution, or # of complex

points = 1.28 x lines of resolution

**DAC resolution**

0.2828 Vpk to 5 Vpk 2.5 mV

0 Vpk to 0.2828 Vpk 0.25 mV



# General Specifications

## General specifications

<b>Safety standards</b>	CSA certified for electronic test and measurement equipment per CSA C22.2, NO. 231 This product is designed for compliance to: UL1244, Fourth Edition IEC 348, 2nd Edition, 1978
<b>EMI / RFI standards</b>	CISPR 11
<b>Acoustic power</b>	LpA < 55 dB (Cooling fan at high speed setting) < 45 dB (Auto speed setting at 25 °C)

Fan speed settings of high, automatic, and off are available. The fan off setting can be enabled for a short period of time, except at higher ambient temperatures where the fan will stay on.

## Abbreviations

<b>dBVrms</b>	dB relative to 1 Volt rms.
<b>dBfs</b>	dB relative to full scale amplitude range. Full scale is approx. 2 dB below ADC overload.
<b>Typical</b>	Typical, non-warranted, performance specification included to provide general product information.

## Environmental operating restrictions

	<b>Operating: Disk in drive</b>	<b>Operating: No disk in drive</b>	<b>Storage &amp; transport</b>
Ambient temp.	4 °C to 45 °C	0 °C to 55 °C	-40 °C to 70 °C
Relative humidity (non-condensing)			
Minimum	20%	15%	5%
Maximum	80% at 32 °C	95% at 40 °C	95% at 50 °C
Vibrations (5 - 500 Hz)	0.6 Grms	1.5 Grms	3.41 Grms
Shock	5 G (10 mSec ½ sine)	5 G (10 mSec ½ sine)	40 G (3 mSec ½ sine)
Max. altitude	4600 meters (15,000 ft.)	4600 meters (15,000 ft.)	4600 meters (15,000 ft.)

<b>AC power</b>	90 Vrms - 264 Vrms (47 - 440 Hz) 350 VA maximum
<b>DC power</b>	12 VDC to 28 VDC nominal 200 VA maximum
<b>DC current at 12 V</b>	Standard: <10 A typical 4 channel: <12 A typical
<b>Warm-up time</b>	15 minutes
<b>Weight</b>	15 kg (33 lb) net 29 kg (64 lb) shipping
<b>Dimensions</b> (Excluding bail handle and impact cover)	
Height	190 mm (7.5")
Width	340 mm (13.4")
Depth	465 mm (18.3")

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Revised: October 1, 2008

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Printed in USA, January 9, 2009  
5966-3064E



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