

Keysight Technologies

## 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	±0.15 dB
Channel match	±0.04 dB and ±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 (Option 1D2), arbitrary (Option 1D4)

## Summary of Features on Standard Instrument

The following features are standard with the Keysight Technologies, Inc. 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  
 Manual Scale  
 Input range tracking  
 X & Y scale markers with expand and scroll  
 Selectable reference  
 Linear or log X-axis  
 Y-axis log

### 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  
 RMS exponential  
 Time  
 Time exponential  
 Peak hold

## 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

$\pm 4$  V or  $\pm 20$  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 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	Keysight Instrument BASIC
Waterfall display data	Programs
Data tables	Curve fit/synthesis tables

## GPIB capabilities

Conforms to IEEE 488.1/488.2  
Conforms to SCPI 1992  
Controller with Keysight 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

# Keysight 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	
<b>Maximum range**</b>	
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
<b>Spans</b>	
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
<b>Minimum resolution</b>	
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)
<b>Maximum real-time bandwidth</b> 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
<b>Measurement rate</b> (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
<b>Display update rate</b>	
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)	

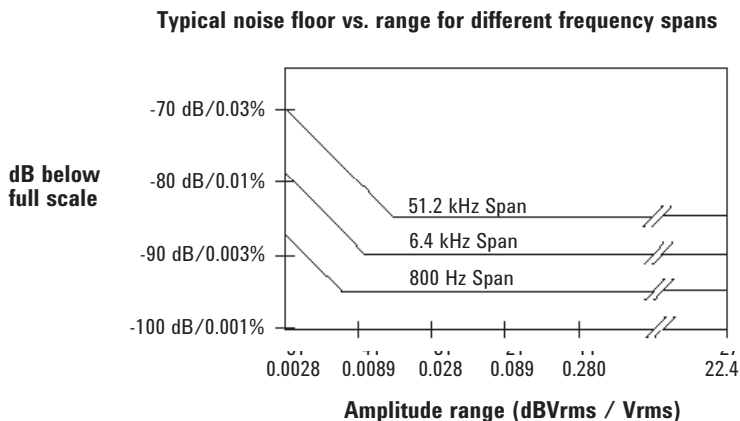
<b>Accuracy</b>
<b><math>\pm 30</math> ppm (.003%)</b>
<b>Single channel amplitude</b>
<b>Absolute amplitude accuracy (FFT)</b> (A combination of full scale accuracy, full scale flatness, and amplitude linearity.) <b><math>\pm 2.92\%</math> (0.25 dB) of reading</b> <b><math>\pm 0.025\%</math> of full scale</b>
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
<b>Amplitude resolution</b> (16 bits less 2 dB over-range) with averaging 0.0019% of full scale (typical)
<b>Residual DC response (FFT mode)</b> <b>Frequency display (excludes A-weight filter)</b> < -30 dBfs or 0.5 mVdc
<b>FFT dynamic range</b> 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.



Harmonic distortion	<-80 dBfs
Single Tone (in band), $\leq 0$ dBfs	
Intermodulation distortion	<-80 dBfs
Two tones (in-band), each $\leq -6.02$ dBfs	
Spurious and residual responses	<-80 dBfs
Source impedance = 50 $\Omega$ .	
Frequency alias responses	
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 $\pm\frac{1}{2}$ 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.

<b>Single channel phase</b>	
<b>Phase accuracy relative to external trigger</b>	$\pm 4.0$ 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.	
<b>Cross-channel amplitude</b>	
<b>FFT cross-channel gain accuracy</b>	$\pm 0.04$ 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	
<b>Cross-channel phase</b>	
<b>Cross-channel phase accuracy</b> (Same conditions as cross-channel amplitude)	$\pm 0.5$ deg
<b>Input</b>	
<b>Input ranges</b> (full scale) (Auto-range capability)	
+27 dBVrms (31.7 Vpk) to -51 dBVrms (3.99 mVpk) in 2 dB steps	
<b>Maximum input levels</b>	42 Vpk
<b>Input impedance</b>	1 M $\Omega$ $\pm$ 10% 90 $\mu$ F nominal
<b>Low side to chassis impedance</b>	1 M $\Omega$ $\pm$ 30% (typical)
Floating mode	<0.010 $\mu$ F
Grounded mode	$\leq$ 100 $\Omega$
<b>AC coupling rolloff</b> Source impedance = 50 $\Omega$	<3 dB rolloff at 1 Hz
<b>Common mode rejection ratio</b> 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

<b>Common mode range</b> (floating mode)		$\pm 4$ V pk
<b>IEPE transducer power supply</b>		
Current source		4.25 $\pm$ 1.5 mA
Open circuit voltage		+26 to +32 Vdc
<b>A-weight filter</b>		Type 0 tolerance
Conforms to ANSI Standard S1.4-1983; and to IEC 651-1979; 10 Hz to 25.6 kHz		
<b>Crosstalk</b>		
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
<b>Time domain</b>		
Specifications apply in histogram/time mode, and unfiltered time display		
<b>DC amplitude accuracy</b>		$\pm$ 5.0 %fs
<b>Rise time of -1 V to 0 V test pulse</b>		<11.4 $\mu$ Sec
<b>Settling time of -1 V to 0 V test pulse</b>		<16 $\mu$ Sec to 1%
<b>Peak overshoot of -1 V to 0 V test pulse</b>		<3%
<b>Sampling period</b>		
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* * $V_{ac_{pk}} +  V_{dc}  \leq 10$ V
<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
<b>GPIB</b>	
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>	< 45 mSec for a 401 point trace (REAL 64 Format)
<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

**Frequency ranges (at centers)**

Online (real time):

	<b>Single channel</b>	<b>2 channel</b>	<b>4 channel</b>
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, or 12; where 1000 Hz is the reference for 1/1, 1/3 octave, and  $1000 \cdot 2^{(1/4)}$  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\*

\*  $V_{ac\_pk} + |V_{dc}| \leq 10 \text{ V}$

**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

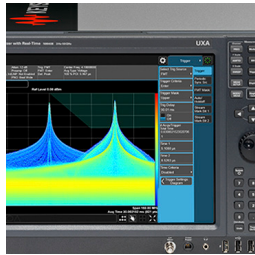
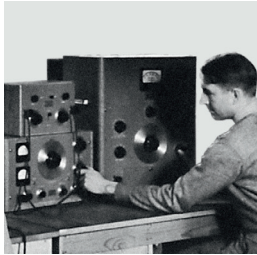
General specifications		Abbreviations	
Safety standards	CSA certified for electronic test and measurement equipment per CSA C22.2, NO. 231 This product is designed for compliance to: UL1244, Fourth Edition IEC 348, 2nd Edition, 1978	dBVrms	dB relative to 1 Volt rms.
		dBfs	dB relative to full scale amplitude range. Full scale is approx. 2 dB below ADC overload.
		Typical	Typical, non-warranted, performance specification included to provide general product information.

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.			
Environmental operating restrictions			
	Operating: Disk in drive	Operating: No disk in drive	Storage & transport
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.)

AC power	90 Vrms - 264 Vrms (47 - 440 Hz) 350 VA maximum
DC power	12 VDC to 28 VDC nominal 200 VA maximum
DC current at 12 V	Standard: <10 A typical 4 channel: <12 A typical
Warm-up time	15 minutes
Weight	15 kg (33 lb) net 29 kg (64 lb) shipping
Dimensions (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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United Kingdom	0800 0260637

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