Keysight Technologies
35670A Dynamic Signal Analyzer

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

Data Sheet

KEYSIGHT
TECHNOLOGIES

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^2, inches/sec^2, 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^2, V^2/Hz, √Hz, V^{2}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 µHz 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^{-1}
LN	EXP
*jω or /jω	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

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

Minimimum resolution

1 channel mode	122 µHz (1600 line display)
2 channel mode	61 µHz (1600 line display)
4 channel mode (Option AY6 only)	122 µHz (800 line display)

Maximum real-time bandwidth
FFT span for continuous data acquistion)
(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	≥ 70 averages/sec
2 channel mode	≥ 33 averages/sec
4 channel mode (Option AY6 only)	≥ 15 averages/sec

Display update rate

Typical (Preset, fast average off)	≥ 5 updates/Sec
Maximum	≥ 9 updates/Sec

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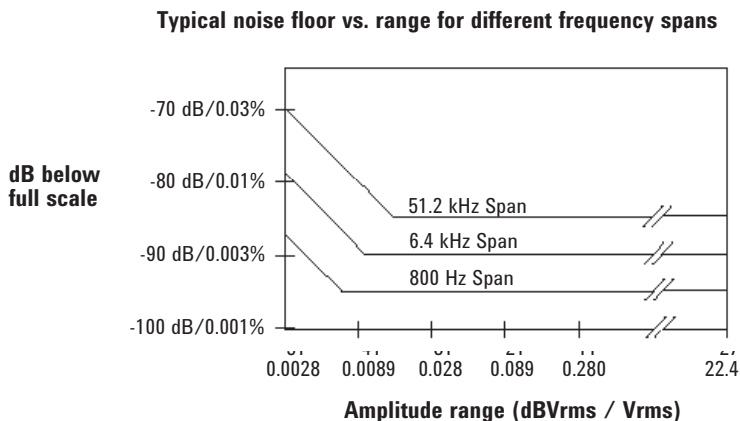
Accuracy

±30 ppm (.003%)

Single channel ampltude

Absolute amplitude accuracy (FFT)
(A combination of full scale accuracy, full scale flatness, and amplitude linearity.)
±2.92% (0.25 dB) of reading
±0.025% of full scale

FFT full scale accuracy at 1 kHz (0 dBfs)
±0.15 dB (1.74%)

FFT full scale flatness (0 dBfs) relative to 1 kHz
±0.2 dB (2.33%)

FFT amplitude linearity at 1 kHz measured on +27 dBVrms range with time avg, 0 to -80 dBs
±0.58% (0.05 dB) of reading
±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 Ω.
800 line display.
90 dB typical (<-80 dBfs)

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* 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

dB below
full scale

-70 dB/0.03%	
-80 dB/0.01%	51.2 kHz Span
-90 dB/0.003%	6.4 kHz Span
	800 Hz Span
-100 dB/0.001%	

0.0028 0.0089 0.028 0.089 0.280   22.4

Amplitude range (dBVrms / Vrms)

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 impedence = 50 Ω.	
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 Ω

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 ±½ bin	4.0 dB	1.5 dB	0.01 dB
Shape factor (-60 dB BW/-3 dB BW)	716	9.1	2.6

* 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	± 4.0 deg

16 time averages center of bin,
DC coupled 0 dBfs to -50 dBfs only
0 Hz < freq ≤ 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	± 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 (Same conditions as cross-channel amplitude)	± 0.5 deg

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 MΩ ±10% 90 μF nominal
Low side to chassis impedance Floating mode Grounded mode	1 MΩ ±30% (typical) <0.010 μF ≤100 Ω
AC coupling rolloff Source impedance = 50 Ω	<3 dB rolloff at 1 Hz

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)	± 4 V pk

IEPE transducer power supply

Current source	4.25 ± 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 Ω)	< -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	±5.0 %fs
Rise time of -1 V to 0 V test pulse	<11.4 μSec
Settling time of -1 V to 0 V test pulse	<16 μSec to 1%
Peak overshoot of -1 V to 0 V test pulse	<3%

Sampling period

1 channel mode	3.815 μSec to 2 Sec in 2x steps
2 channel mode	7.629 μSec to 4 Sec in 2x steps
4 channel mode (Option AY6 only)	15.26 μSec to 8 Sec in 2x steps

Trigger	
Trigger modes	Internal, source, external (analog setting) GPIB
Maximum trigger delay Post trigger Pre trigger No two channels can be further than ±7168 samples from each other.	8191 seconds 8191 sample periods
External trigger max. input	±42 Vpk
External trigger range Low range High range	-2 V to +2 V -10 V to +10 V
External trigger resolution Low range High range	15.7 mV 78 mV
Tachometer	
Pulses per Revolution	0.5 to 2048
RPM	$5 \leq RPM \leq 491,519$
RPM Accuracy	±100 ppm (0.01%) (typical)
Tach level range Low range High range	-4 V to +4 V -20 V to +20 V
Tach level resolution Low range High range	39 mV 197 mV
Maximum tach input level	±42 Vpk
Minimum tach pulse width	600 nSec
Maximum tach pulse rate	400 kHz (typical)

Source output	
Source types	Sine, random noise, chirp, pink noise, burst random, burst chirp
Amplitude range	AC: ±5 V peak* DC: ±10 V* * Vac_{pk} + |Vdc| ≤ 10 V
AC amplitude resolution Voltage > 0.2 Vrms Voltage < 0.2 Vrms	2.5 mVpeak 0.25 mVpeak
DC offset accuracy	±15 mV ± 3% of (|DC| + Vac_{pk}) settings
Pink noise adder	Add 600 mV typical when using pink noise
Output impedance	< 5 Ω
Maximum loading Current Capacitance	±20 mA peak 0.01 µF
Sine amplitude accuracy at 1 kHz	±4% (0.34 dB) of setting
Rload > 250 Ω	0.1 Vpk to 5 Vpk
Sine Flatness (relative to 1 kHz)	±1 dB
	0.1 V to 5 V peak
Harmonic and sub-harmonic distortion and spurious signals (In band)	
0.1 Vpk to 5 Vpk sine wave Fundamental < 30 kHz Fundamental > 30 kHz	< -60 dBc < -40 dBc
Digital interfaces	
External keyboard	Compatible with PC-style 101-key keyboard

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

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

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

Online (real time)	1 channel mode	25,600 Hz
	2 channel mode	12,800 Hz
	4 channel mode	6,400 Hz
Capture playback	1 channel mode	102,400 Hz
	2 channel mode	51,200 Hz
	4 channel mode	25,600 Hz

Number of orders ≤ 200	5 ≤ RPM ≤ 491,519
(Maximum useable RPM is limited by resolution, tach pulse rate,pulses/revolution and average mode settings.)	
Delta order	1/128 to 1/1
Resolution	≤ 400
(Maximum order)/(Delta order)	
Maximum RPM ramp rate	1000 RPM/second real-time (typical)

1000 - 10,000 RPM run up

Maximum order	10
Delta order	0.1
RPM step	30 (1 channel)
	60 (2 channel)
	120 (4 channel)
Order track amplitude accuracy	±1 dB (typical)

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):

	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, or 12; where 1000 Hz is the reference for 1/1, 1/3 octave, and $1000*2^{(1/24)}$ Hz is the reference for 1/12 octave. The marker returns the ANSI standard preferred frequencies.

Dynamic range	130 dB

Tested with 11 dBVrms source level at: 100 mSec integration

20 Poles/20 zeroes curve filter frequency response synthesis pole/zero, pole residue & polynomical format

Amplitude range	AC: ±5 V peak*
	DC: ±10 V*
	* Vac_{pk} + |Vdc| ≤ 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	
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
EMI / RFI standards	CISPR 11
Acoustic power	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	
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.

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
D**imensions** (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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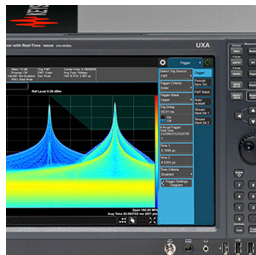
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