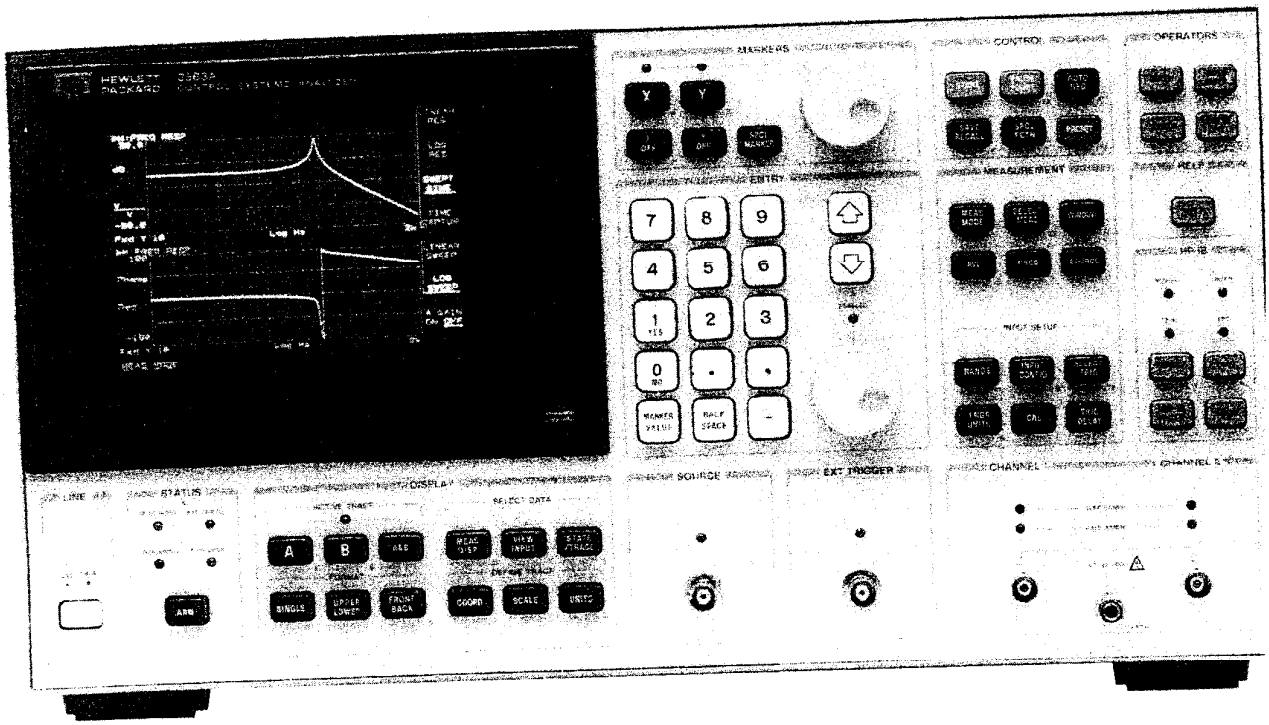
SIGNAL ANALYZERS

Dual-channel, Control Systems Analyzer 65 μHz to 100 kHz

HP 3563A

- Measure analog and digital signals
- Apply analog and digital stimulus
- Make swept sine and FFT frequency response measurements
- Measure spectra, waveforms, and transients
- Extract models with s- and z-domain curve fitting
- Model systems using frequency response synthesis



NEW

DESIGNED FOR HP-IB SYSTEMS

HP 3563A

Direct Measurement of Dynamic Analog and Digital Signals

The HP 3563A control systems analyzer is the development tool that provides test and analysis of analog, digital, and mixed analog/digital systems. In the world of electronics and control systems, designs are shifting from analog to digital. Products ranging from disk drives to robots to spacecraft use closed-loop control systems containing digital filters and microprocessors rather than analog circuitry.

Hewlett-Packard helps you analyze next generation systems with the HP 3563A control systems analyzer. A compatible superset of the popular HP 3562A dynamic signal analyzer, this FFT-based analyzer offers the versatility required to make the most difficult spectrum, network and waveform measurements in both the time and frequency domain. For analog measurements, the analyzer has two differential input channels, a 26.5 μHz-to-100 kHz frequency range, 150 dB measurement range, 80 dB dynamic range, flexible triggering, and a versatile signal source. The digital inputs accept TTL-level parallel data up to 16-bits wide with data rates as high as 256 kHz and clock rates up to 10 MHz.

Protect Your HP 3562A Investment

If you develop, design, or test control systems, chances are you own an HP 3562A dynamic signal analyzer. If your designs now call for digital measurements, you can protect your investment in the HP 3562A by converting it to the functionality of the HP 3563A. Because the control systems analyzer is compatible with auto sequence and computer programs written for the HP 3562A, your programming investment is also protected. For more information regarding 3562A, Option 063, please contact your local HP sales representat

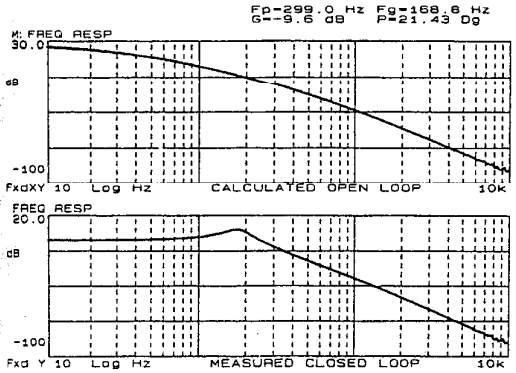
Test the Performance of Control Systems

Whether a control system is analog, digital, or mixed, you still r to characterize its stability and performance. Characterization of tem stability begins with an accurate frequency response meas ment. Measure frequency response magnitude and phase qui using the linear or logarithmic resolution FFT modes. Get a deta look at the response with the swept sine mode. Linear or logarith swept sine frequency response measurements can be made with u 140 dB dynamic range. With FFT or swept sine tests, frequenc sponse measurements are as accurate as ±0.1 dB and ±0.5 ° specifications for details).

Display measurement results in familiar formats such as Bode, quist, and Nichols. Use waveform math to compute the open-loo sponse from a closed-loop measurement. Activate the special ma function to calculate and display the gain and phase margins.

Key measures of time domain performance such as rise time, shoot, steady state deviation, and settling time are derived fror system step response. By providing a step stimulus, pre- and post ger delay, trace scaling, and separate x- and y-axis markers, th 3563A simplifies the measurement of time domain parameters.

The built-in signal source produces the stimuli commonly neec fully characterize closed-loop control systems. In analog or parallel format, the source will output swept sine, fixed sine chirp, step, pulse, ramp, random noise, and arbitrary signals. editing combined with waveform math simplifies the creation of trary waveforms such as sine chirps with shaped amplitude.



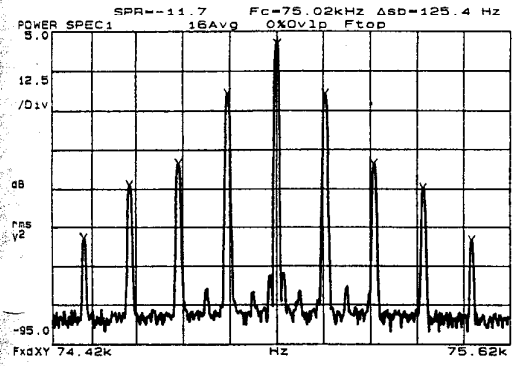
Turning Data into Information

Plots of the frequency response or step response might not be enough to describe a control system. To quickly develop a proper compensation scheme, you need to know the location of system poles and zeros. If a compensator is being added to the system, its pole/zero model should be added to the system simulation to predict its effect. The HP 3563A addresses these problems with two powerful features: curve fitting and frequency response synthesis.

Identify system poles and zeros by applying the HP 3563A curve fitter to a measured frequency response. Separate s- and z-domain curve fitters are included to handle analog and digital systems. The frequency domain multiple degree of freedom (MDOF) algorithm ...d in the curve fitters accounts for the interaction of adjacent poles ...accurately than single degree of freedom (SDOF) methods. The 3563A can fit up to 40 poles and 40 zeros simultaneously. Results are displayed in a table showing the real and imaginary parts of system poles and zeros. If needed, a pole/zero table can be converted to polynomial or pole/residue formats.

Use frequency response synthesis to model s- or z-domain control elements, actuators, and compensators. To create more accurate models, enter a time delay to simulate computational delays. Include a zero-order hold in a z-domain synthesis table to model the effect of a digital-to-analog converter in the control system. Synthesis plus waveform math lets you try a compensator design before it is built. Use waveform math to combine a synthesized response with a measured frequency response and predict the compensator's effect on system stability. If the predicted stability margins do not meet the design criteria, revise the model as many times as needed before building the compensation network.

To handle systems with a mixture of analog and digital subsystems, curve fit and synthesis tables can be transformed between the s- and z-domains. A choice of impulse invariant, step invariant, and bilinear transformations lets you use the method that matches the characteristics of your system.

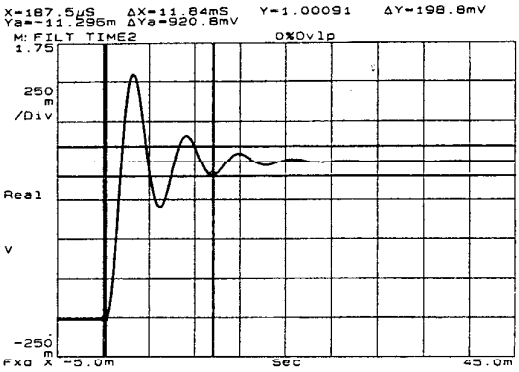


Characterize Electronic Networks and Signals

Whether you develop digital signal processing ICs and data conversion devices or analyze the processed signals, the HP 3563A can simplify the task. Two inputs that accept analog and digital signals make the HP 3563A a powerful spectrum and waveform analyzer. Measure frequency spectra with 801 lines of resolution, ±0.15 dB accuracy, and 80 dB dynamic range. Special trace markers simplify analysis of distortion, sidebands, and band power. The built-in demodulation capability helps you analyze complex modulated signals in the time and frequency domains.

Perform waveform analysis by capturing signals in the internal 20K-sample capture buffer, or use time throughput to save longer events in an external HP-IB disk drive. Data scrolling and trace expansion help you locate and analyze the important parts of captured waveforms.

With a built-in signal source that generates analog and digital stimulus signals, the HP 3563A is also a versatile network analyzer. Measure the response of analog filters and devices. Test the frequency response of digital filters with a digital-in/digital-out measurement. Test the accuracy of analog-to-digital converters by applying analog stimulus and measuring the digital output directly.



Troubleshoot Noise and Vibration Problems

Mechanical resonance problems often appear in electromechanical control system designs. The HP 3563A provides the measurements you need to identify structural resonances, analyze motor vibration, and locate noise sources. Improve the quality of frequency response impact testing with functions such as data previewing and automatic overload rejection. Simplify interpretation of vibration measurements by selecting RPM or orders as the frequency axis and by using engineering units scaling to display amplitude in appropriate units such as displacement or velocity.

Test accessories such as impact hammers and accelerometers are available through the HP test & measurement accessories catalog, and from third-party vendors. For detailed noise and vibration analysis, software solutions are available from third-party software suppliers.

Automation Makes it Easy

Increase your productivity when automating testing or documenting results with versatile automation capabilities such as auto sequence programming and direct control of HP-IB disk drives and plotters. Auto sequence programming (ASP) lets you reduce a series of front-panel operations to a single keystroke. In addition to automating analyzer functions, an ASP can send commands over the HP-IB to control external devices such as programmable switch banks and programmable loads. With ASP and a sheet-fed plotter such as the HP 7550A plotter, the HP 3563A can perform batch plotting of files saved on disk.

For computer-aided testing, the HP 3563A is also HP-IB programmable. If you use a personal computer, the PC file conversion option (Option 921) is useful. This set of utilities runs on a PC and converts HP 3563A and 3562A files to MS-DOS® format. Conversion utilities are also included to make analyzer files compatible with MATRIX$_X$ from Integrated Systems, and PC-Matlab from The Mathworks.

Note: See page 137 for specifications. A data sheet with complete specifications is available from your HP sales representative.

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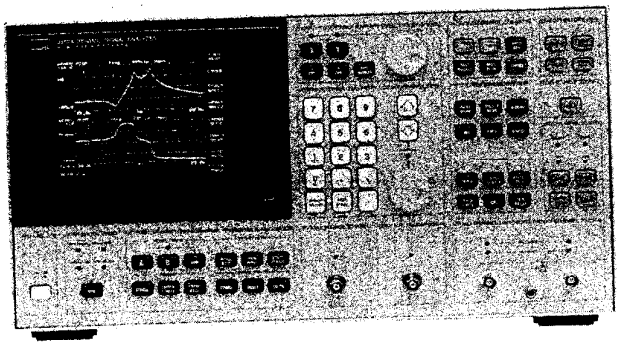
SIGNAL ANALYZERS

Dual-channel, Control Systems Analyzer 64μHz to 100 kHz

HP 3562A

- Network, spectrum, waveform, transient analysis
- Linear, logarithmic, swept sine modes



DESIGNED FOR HP-IB SYSTEMS

HP 3562A

- 80 dB dynamic range with full alias protection
- High accuracy (±0.15 dB)

HP 3562A Dynamic Signal Analyzer

The HP 3562A dynamic signal analyzer is well suited for design test and analysis of electronics, mechanical systems, and electromechanical control systems. Two input channels, 26.5 μHz-to-100 kHz frequency range, 150 dB measurement range, and 80 dB dynamic range on this FFT-based analyzer offer versatility and performance for even the most difficult network, spectrum, and waveform measurements, in both time and frequency domains.

The two high-performance input channels and a built-in signal source (noise and sine signals) address network analysis needs on the bench or in a test system. Vector averaging, waveform math, 40-pole/40-zero curve fitter, and frequency response synthesis enhance network measurements with a full range of analysis and modeling capabilities. Zoom analysis with frequency resolution to 26.5 μHz plus a powerful AM, FM, and PM demodulation function make the HP 3562A a versatile spectrum analyzer. For transient or waveform analysis, signals can be sampled, digitized, then stored in internal memory, or sent via HP-IB to an external disk drive (without a computer). Stored waveforms can be recalled and analyzed in the time, frequency and amplitude domains (baseband and zoom analysis).

Frequency Response Measurements

You can make accurate, high-resolution frequency response measurements of electronic and mechanical systems with linear resolution FFT, logarithmic resolution and swept sine analysis. A built-in signal source provides a variety of random noise and sine wave signals to meet the requirements of the system under test.

Linear resolution is the measurement technique common to all dynamic signal analyzers. In the HP 3562A, 2048-point time records are Fourier-transformed into 801-line frequency spectra. For network analysis, frequency response magnitude and phase, as well as input and output power spectra, can be measured with 801 lines of resolution. Accuracy for the frequency response magnitude and phase is ±0.1 dB and ±0.5°.

The swept sine mode configures the HP 3562A as a powerful swept sine frequency response analyzer. The source can generate linear or logarithmic sweeps with increasing or decreasing frequency; user-selectable sweep rate and resolution are also standard source functions. Input channel functions include user-selectable averaging and integration time; automatic input ranging can be activated to provide over 140 dB of dynamic range for measurements of high performance systems.

Spectrum Analysis

On-line analysis of distortion, drift, modulation, and phase noise can benefit from the speed and accuracy of the HP 3562A. High resolution measurements are typically 100 times faster than tuned spectrum analyzers. Because the HP 3562A is an FFT-based analyzer, you can see transient events a tuned analyzer would probably miss.

The HP 3562A is essentially a dual-channel spectrum analyzer that provides resolution to 26.5 Hz anywhere within the 64 μHz-to-100 kHz measurement range. Single-channel accuracy is ±0.15 dB with 80 dB of dynamic range. Modulation analysis can be performed on either or both channels with harmonic and sideband markers as well as with the built-in demodulation capability: zoom measurement can be AM, FM, or PM demodulated with carrier frequencies up to 99.9 kHz.

Waveform and Transient Analysis

Perform complete analysis of waveforms and transients in the time and frequency domains. Store sampled and digitized waveforms in internal memory (single-channel time capture) or on disk in an external disk drive (single-or dual-channel time throughput). Recall data for time domain analysis as single time records or as a compressed display of up to 10 time records (time capture mode). Data can also be recalled for baseband and zoom analysis in the frequency domain, with vector averaging if needed.

The array of triggering capabilities enhances both waveform recording modes. Pre- and post-trigger delays can be specified to capture the rising edge of a transient or to compensate for delays in the system under test.

Hardcopy and Mass Storage

When access to prototypes is limited, make your test time more efficient with the time throughput capability; through direct control of external disk drives, the HP 3562A stores time data directly to disk without a computer.

HP-IB is a standard feature to speed and simplify documentation of results with direct control of plotters and disk drives. Anything displayed on the analyzer screen can be plotted or saved on disk: measurement results, setup state table, synthesis tables, curve fit tables, and auto sequence or auto math program listing.

Automation for Improved Productivity

As a stand-alone solution, the analyzer can "learn" a series of keystrokes and then perform them on command (auto sequence programming). Up to five auto sequence programs can be stored internally, with additional programs stored on an external disk drive. For networked HP-IB systems, the HP 3562A provides complete HP-IB programmability. Custom display graphics messages can be created with direct programming of the display, and user-defined softkey menus can be created to simplify interactive testing.

Specifications (HP 3562A, 3563A)

Contact your local HP sales office for more information, including a data sheet with complete specifications.

Frequency

Measurement range: 64 μHz to 100 kHz. Both channels, single- o dual-channel operation.

Resolution: span/800. Both channels, single- or dual-channel ope ation, linear resolution mode.

Spans	Baseband	Zoom
# of spans	66	64
min span	10.24 mHz	20.48 m
max span	100 kHz	100 kHz
time record (sec)	800/span	800/spa

Window functions: flat top, hann, uniform, force, exponential, t er-defined

Typical real-time bandwidths:

Single-channel, fast averaging 10 kHz

Throughput to CS/80 disk

Single-channel	12.5 kHz
Dual-channel	6.25 kHz

Amplitude

Accuracy: defined as full scale accuracy at any of the calcula frequency points. Overall accuracy for the linear or logarithmic r olution modes is the sum of the absolute accuracy, window flatn and noise level. Overall accuracy for swept sine mode is the sum absolute accuracy and noise level.

Absolute accuracy: single channel (channel 1 or 2)
±0.15 dB ±0.015% of input range (+27 dBV to −40 dBV)
±0.25 dB ±0.025% of input range (−41 dBV to −51 dBV)
Window flatness:
Flat top +0, −0.01 dB
Hann +0, −1.5 dB
Noise floor: with flat top window, 50Ω source impedance and input set to −51 dBV range
20 Hz to 1 kHz (1 kHz span) < −126 dBV (−134 dBV/ΩHz)
1 kHz to 100 kHz (100 kHz span) < −115 dBV (−144 dBV/ΩHz)
Frequency response channel match:
Analog/analog: input signals at full scale on any pair of ranges, accuracy is ±0.1 dB, ±0.5 degree.
Digital/digital: for simultaneous sampling on channels 1 and 2, accuracy is ±0.1 dB, ±0.5 degree. If sampling is not simultaneous, the HP 3563A can partially correct for skew in the system under test. With skew correction activated, nominal accuracy is ±0.1 dB, ±1.0 degree from 320 mHz to 10 kHz and ±0.1 dB, ±4.0 degrees from 10 kHz to 100kHz.
Mixed analog/digital: With full-scale inputs on both channels, no skew between the analog and digital inputs, 1:1 sampling ratio, and 8 averages, nominal accuracy is ±0.2 dB, ±2.0 degrees from 320 mHz to 20 kHz and ±0.4 dB, ±6.0 degrees from 20 kHz to 100 kHz
Dynamic range: All distortion (intermodulation and harmonic), spurious, and alias products are ≥ 80 dB below full scale input range (16 averages)

Analog input (HP 3563A and 3562A)

Input impedance: 1MΩ ±5% shunted by < 100 pF
Input coupling: inputs can be ac or dc coupled — ac rolloff in <3 dB at 1 Hz
Crosstalk: −140 dB (50Ω source, 50Ω input termination, input connectors shielded)
Common mode rejection:
0 Hz to 66 Hz 80 dB
66 Hz to 500 Hz 65 dB
External sampling input: TTL compatible input for signals ≤ 256 kHz (nominal maximum sampling rate)

Digital input (HP 3563A)

Measurement data signals can be up to 16 bits wide and must be parallel data in two's complement or offset-binary format. (User selects truncation of unused upper bits or rounding of the three lowest bits for data more than 13 bits wide.) The data qualifier input accepts 8 qualifier lines, a trigger, and 1 clock signal.

Trigger

Trigger modes: free run, input channel 1, input channel 2, source and external trigger. Free run applies to all measurement modes. Input channel 1, input channel 2, source and external trigger apply to the linear resolution, time capture, and time throughput measurement modes.
Trigger delay: pre- and post-trigger delay resolution is 1 sample (1/2048 of a time record)
Pre-trigger: a measurement can be based on data that starts from 1 to 4096 samples (1/2048 to 2 time records) before trigger conditions are met
Post-trigger: a measurement is initiated from 1 to 65,536 samples (1/2048 to 32 time records) after the trigger conditions are met

Analog source (HP 3563A and 3562A)

Random noise, burst random, sine chirp, burst chirp, fixed sine, and swept sine are available from the front panel source of the HP 3562A and HP 3563A. The HP 3563A also provides step, pulse, ramp and arbitrary signals from the same front panel source output. Users can select dc offset.
Output impedance: 50Ω (nominal)
Output level: between +10 and −10 Vpeak (ac + dc) into a ≥ 10 kΩ, < 1000 pF load. Maximum current is 20 mA.
ac level: ±5 Vpeak (≥ 10kΩ, < 1000 pF load)
dc offset: ±10 Vpeak in 100 mV steps. Residual offset at 0V offset ≤ 10 mV
Distortion: including subharmonics
26.5 μHz to 10 kHz −55 dB
10 kHz to 100 kHz −40 dB
Pulse: nominally 1 sample wide and bandlimited
Digital source (HP 3563A)
All analog signal types can be output from the digital source connector. Data format is 16-bit parallel in either two's complement or offset binary. Output level is TTL compatible.
Maximum load: 8 LSTTL
Maximum output rate: 256 kHz

General

Specifications apply when AUTO CAL is enabled or within 5°C and 2 hours of last internal calibration
Ambient temperature: 0 to 55C
Relative humidity: ≤ 95% at 40C
Altitude: ≤ 4570 m (15,000 ft)
Storage:
Temperature: −40 to 175C
Altitude: ≤ 15240 m (50,000 ft)
Power: 90-132 V ac, 48 to 66 Hz
198-264 V ac, 48 to 66 Hz
450 VA maximum
Weight: net, 27kg (58lb); shipping, 36kg (79lb)
Size: 222H x 426W x 578mmD (8.75″ x 16.75″ x 22.75″)

Accessories Included

HP 3563A: HP 01650-61607 16-bit probe cable: 3 each
HP 03563-61605 16-bit probe pod: 3 each
HP 03563-61604 8-bit probe cable: 3 each
HP 10347A pattern generator probe lead set: 3 each
HP 5959-0288 grabber (package of 20): 80 each (4 packages)
Pouch for cables and probes
HP 3563A/HP 3562A: getting started guide, operating manual, programming reference

Accessories Available

HP 3563A: HP 10346A 8-Channel TTL tristate buffer pod
HP 01650-63201 termination adapter
HP 3563A/HP 3562A: transit case for one HP 3563A: HP p/n 9211-2663

Ordering Information	Price
HP 3563A Control Systems Analyzer	$24,900
Opt 907 Front Handle kit	+$77
Opt 908 Rack Mount kit	+$41
Opt 909 Rack Mount and Front Handle kit	+$102
Opt 910 extra Getting Started, Operating, Programming manuals	+$179
Option 915 add Service manual and kit	+$100
Opt 921 PC File Utilities	+$150
Opt 922 delete cables, pods, and pouch	−$1,400
Opt W30 Extended Repair Service. See page 725.	625
HP 3562A Dynamic Signal Analyzer	$19,900
Opt 907 Front Handle kit	+$77
Opt 908 Rack Mount kit	+$41
Opt 909 Rack Mount add Front Handle kit	+$102
Opt 910 Extra Operating manuals	+$179
Opt 914 Delete Service manuals	−$100
Opt W30 Extended Repair Service. See page 725.	+$500