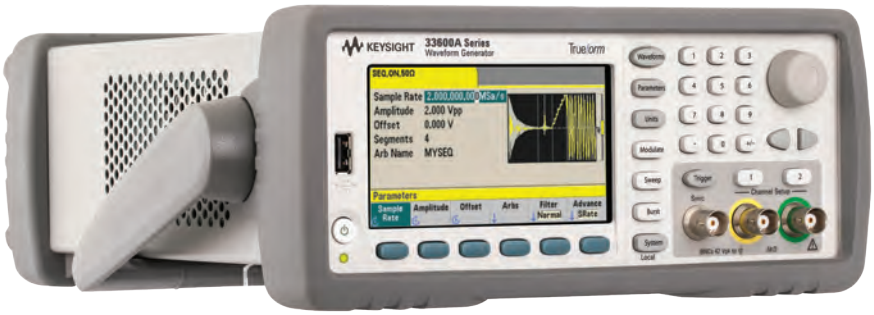
Keysight & Our Distributor Network
RIGHT *Instrument.* RIGHT *Expertise.*
Delivered RIGHT *Now.*

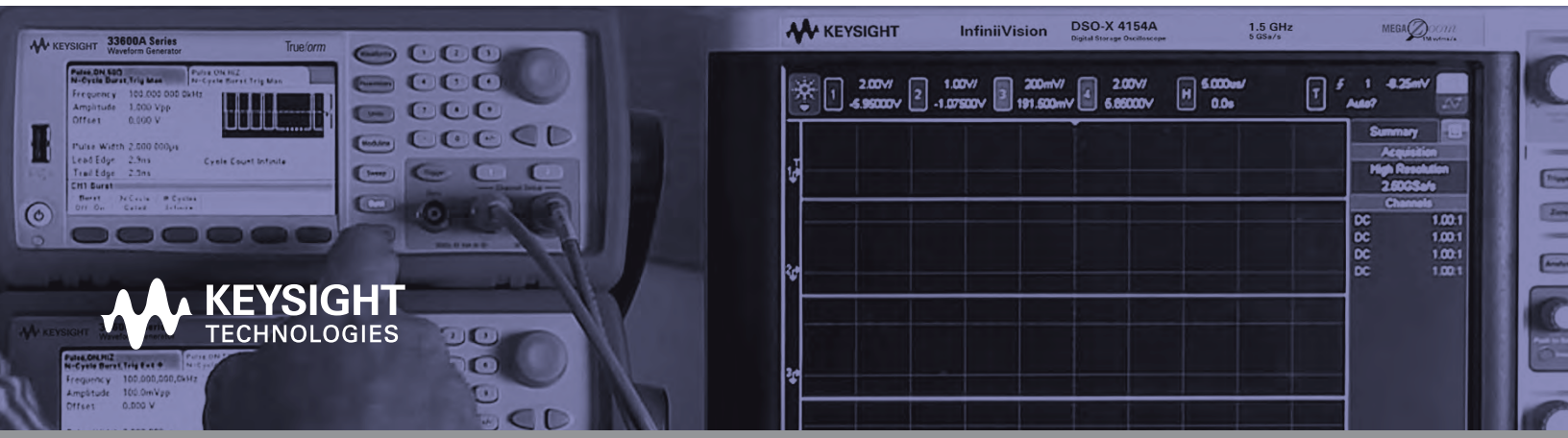
Keysight Basic Instruments

November 2016 – January 2017





Looking for a better way to couple or synchronize two signals on a waveform generator?



Agilent's Electronic Measurement Group has become **Keysight Technologies.**

SPOTLIGHT

Effortlessly Couple or Synchronize Two Signals on a Waveform Generator

Engineers often find it challenging to couple together two signals with a phase, amplitude, or frequency relationship. If a parameter changes on one signal, then it has to change on both. Even if the signals are simple, keeping track of both can be incredibly tedious. That's true unless you have a tool that has the flexibility to couple them automatically. The dual-channel True*form* waveform generator does just that—keeps track of two signals easily and accurately. Let's take a look at a few examples.

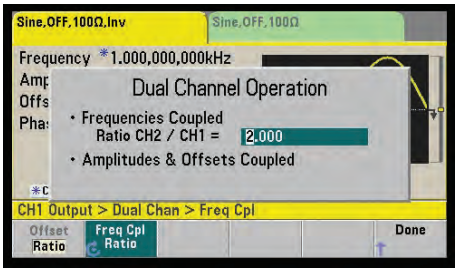


Figure 1. Frequncy coupling with the True*form* generator in dual-channel mode.

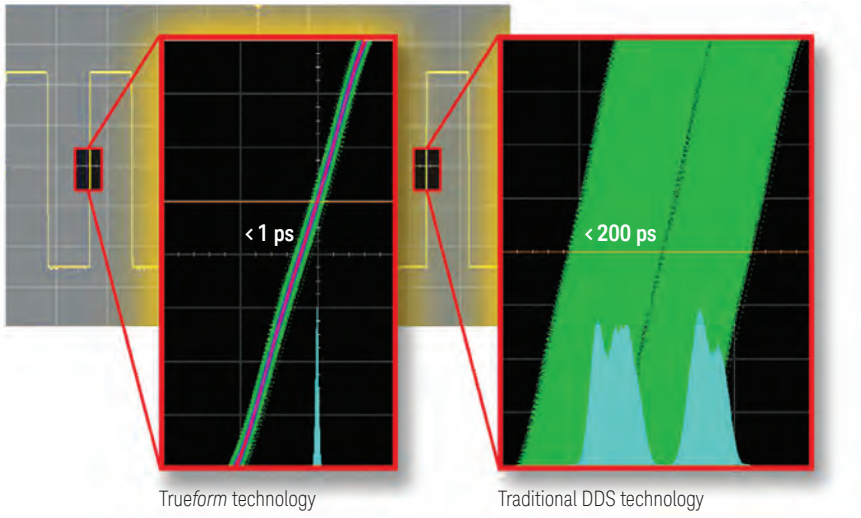
Providing a stimulus for device and trigger signals

If you're testing a semiconductor (e.g., an RFID receiver integrated circuit), you need to generate a test signal and then initiate the test with a trigger signal at the same time. Waveform generators are ideal, because you can adjust amplitude, vary trigger width, and delay signals. Add in dual-channel synchronization and phase matching, and True*form* waveform generators make it simpler still.

But as always, timing is everything—in this case, synchronizing the trigger and stimulus signals. The True*form* waveform generator handles that easily. Just change the phase to get different delays between the two channels.

IQ modulation testing

Similarly you may need to generate custom IQ signals to test your RF component or system design. You want to keep a 90-degree relationship between the I and Q channels. Test involves qualifying various parameters, such as IQ gain imbalance, frequency response, or quadrature error.



Synchronizing Multiple Waveform Generators

Figure 2. True*form* technology significantly improves jitter performance.

With built-in coupling features and incredibly low jitter, the 120-MHz bandwidth, two-channel True*form* waveform generator streamlines simulating I/Q signals. To ease the process of going from simulation to signal generation output even more, try the optional software. See measurement hint on page 3.

Simulating a differential signal pair

Finally let's look at differential signals. You may want to create complimentary signals to carry your data, which helps reject noise from external interference. Waveform generator outputs are typically configured to be a referenced signal with a single wire and a reference for the return path.

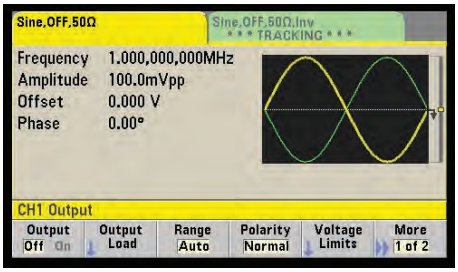


Figure 3. Easily create a differential signal in dual-channel mode.

By using the inverted tracking capability in dual-channel mode, you can configure a True*form* generator to output differential signals. All you need to do is set up your signal on channel 1 and it will be inverted on channel 2 to create your differential signal. And with 14-bit amplitude resolution, the True*form* signals will be accurate enough to simulate your real-world signals.

One other popular use for the True*form* generator is frequency and amplitude coupling. To learn more about this application as well as others, see the app note *Effortlessly Couple or Synchronize Two Signals on a Waveform Generator* at www.keysight.com/find/couplesignals.

Also spend a few minutes with the YouTube video *Synchronizing Multiple Waveform Generators* at www.keysight.com/find/syncwg.

Did we say multiple waveform generators? Yes. You're not limited to just two—you can synchronize up to eight.

Keysight & Our Distributor Network

RIGHT *Instrument.* RIGHT *Expertise. Delivered* RIGHT *Now.*

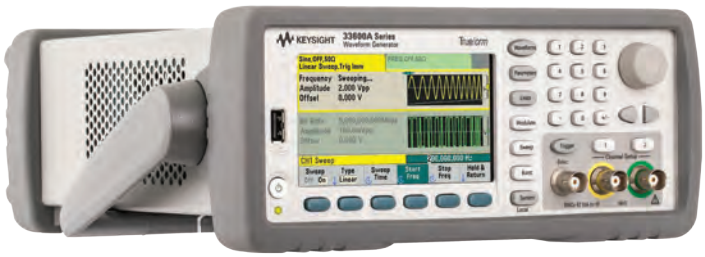
Keysight and our network of Keysight Authorized Distributors have teamed up to provide fast, easy access to the world's largest selection of off-the-shelf T&M instruments. It's the best of both worlds: Keysight's measurement expertise and product breadth combined with speed, convenience and same-day shipping from our distribution partners. It's never been easier to get the right instrument in the right hands, right away.



Waveform generators

BenchVue software enabled

Learn more about benchtop waveform generators





Model	Description	Channels	Frequency range	Pulse	Arbitrary waveforms			
					Std/Opt arb	# bits	Sample rate	Memory/Channel
33509B	Exclusive True*form* waveform technology with <40 ps jitter and <0.04% THD.	1	20 MHz	20 MHz	Opt	16	160 MSa/s	1 M Standard, 16 M Optional
33510B		2						
33511B		1			Std			
33512B		2						
33519B		1	30 MHz	30 MHz	Opt		250 MSa/s	
35520B		2						
33521B		1			Std			
33522B		2						
	33500 Series Data Sheet · Promotion: ReMEMber to Upgrade Your Bench · 33500 Series Videos							
33611A	Exclusive True*form* waveform technology at higher frequency ranges with <1 ps jitter <0.03% THD.	1	80 MHz	80 MHz	Std	14	660 MSa/s	4 M Standard, 64 M Optional
33612A		2						
33621A		1	120 MHz	100 MHz			1 GSa/s	
33622A		2						
	33600 Series Data Sheet · Promotion: ReMEMber to Upgrade Your Bench · 33600 Series Videos							

33210A 10 MHz Function/Arbitrary Waveform Generator

Uncompromising performance at a lower price for basic functions and waveforms. It is the most frequency stable and lowest distortion function generator in its class.

Learn more about the 33210A

33210A Data Sheet



Measurement Hint

If you'd like to design a signal, like one you might use for synchronization with a True*form* generator (see main article), consider building it with Keysight's 33503A BenchLink Waveform Builder Pro software. This is the first full-featured waveform creation software for pulse/function/arbitrary waveform generators. Take full advantage of the signal generation capabilities and make custom waveform creation fast and simple.

www.keysight.com/find/33503

34980A multi-function switch/measure unit



- High performance, 8-slot mainframe with 6½ digit DMM and built-in signal conditioning
- Choose from 21 plug-in modules, up to 1024 1-wire (560 2-wire) channels or 4096 cross points

34980A Data Sheet

34980A modules

Model	Key specifications
34921A–34925A multiplexer switch modules	Up to 300 V, 40, 70 or 80 channels
34931A–34934A matrix switch modules	4x8, 4x16, up to Quad 4x32 matrix
34937A–34939A general-purpose switch modules	Up to 64 channels, and up to 300 V
34941A–34947A RF and µWave switch modules	Up to 26.5 GHz
34950A–34952A system control modules	DIO, DAC, totalizer
34959A breadboard module	For custom designs with +12 V and + 5 V supplies

34970A / 34972A data acquisition switch units



- Low-cost, 3-slot unit with 6½ digit DMM and built-in signal conditioning
- Choose from 8 plug-in modules, up to 120 1-wire (60 2-wire) channels or 96 cross points
- 34972A has built-in Web interface

BenchVue software enabled

34970A / 34972A Data Sheet

34970A/72A modules

Model	Key specifications
34901A/02A/08A multiplexers	Up to 300 V, 16, 20, or 40 channels
34903A general-purpose switch	300 V, 20 actuator channels
34904A matrix	4x8 matrix
34905A/06A RF switches	2 GHz dual, 50 and 75 Ω
34907A multi-function	DIO, DAC, totalizer

HIGH-PERFORMANCE DC POWER: Anticipate new demands with high speed, versatility, and accuracy

N6700 modular power system family



- Ideal DC power supply solution for automated test systems
- Small 1U mainframe (400, 600, 1200 W); up to four modules per mainframe
- More than 30 programmable DC power modules: basic, high performance, precision and SMU; available in 20 to 500 W

BenchVue software enabled

N6700 Series Data Sheet

N6705B DC power analyzer



- Deep insight into DUT power consumption—without assembling a complex test system
- Integrated benchtop unit holds up to four N6700 Series modules (600 W total)
- DMM, scope, arb, and data logger features
- Source/measure units and application-specific modules

BenchVue software enabled

N6705B Data Sheet

B2900 Series precision source/measure units



- Display I-V curves on the front panel
- 6.5-digit sourcing/measurement resolution
- Wide application coverage from 100 nV / 10 fA to 210 V / 3 A DC and 10.5 A pulsed
- Multiple free software control options to fit your particular application

BenchVue software enabled

B2900 Series Data Sheet

B2960 Series low noise power sources



- Precision current and voltage source with ultra-low noise 10 µVrms
- 6.5 digit resolution (100 nV / 10 fA)
- Innovative and precision ARB capability; six built-in waveforms with speeds up to 10 kHz

BenchVue software enabled

B2960 Series Data Sheet

Measurement Hint

The only thing growing faster than the capabilities of smart phones, phablets, and tablets is their power consumption. Validate adaptive fast-charge performance by equipping the N6705B DC power analyzer mainframe with the N6781A and N6785A source-measure units. Round out your solution with 14585A control-and-analysis software. Learn more about applying this solution in our app note:

Evaluating Adaptive Fast USB Battery Charging of Mobile Devices

KEYSIGHT TECHNOLOGIES

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HIGH VALUE BASIC DC POWER: Solid performance and robust features help you achieve more on lower budgets

E36100 Series DC power supplies





- 30 to 40 W outputs
- Compact, 2U ¼-rack form factor
- High-contrast OLED display viewable from any angle
- Intuitive on-screen menus

BenchVue software enabled

E36100 Series Data Sheet

Take a look at the inside of Keysight's new E36100 DC power supply

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E3600 Series DC power supplies



- Output noise as low as 1mVp-p/0.2mVrms
- Fast load transient response time (<50 µs)
- 30 to 200 W outputs

BenchVue software enabled

E3620A & E3630A Data Sheet

E3631A – E3634A Data Sheet

E3640A – E3649A Data Sheet

N5700 and N8700 Series system DC power supplies



- 45 models in compact 1U (750 and 1500 W) and 2U (3.3 and 5 kW) packages
- Up to 600 V or up to 400 A
- Programmability and built-in V & I measurements simplify test set ups

BenchVue software enabled

N5700 Series Data Sheet

N8700 Series Data Sheet

N8900 Series autoranging high-power system supplies



- 5 and 10 kW basic, single-output, autoranging programmable DC power for ATE applications
- 18 models that offer up to 1000 V or 340 A
- Easily parallel units to create "one" power supply with up to 100 kW of power

BenchVue software enabled

N8900 Series Data Sheet

AC Source/Analyzers

STABLE, RELIABLE AC POWER: Make sure your designs can handle unpredictable real-world power

AC6800 Series basic AC sources



- Four models, 500 to 4000 VA (dual range 135/270 Vrms, up to 120 A)
- Intuitive user interface
- Access and control the source remotely using a standard Web browser

AC6800 Series Data Sheet

See an AC6800 Series AC Power Source Product Overview

6800B Series performance AC sources/analyzers



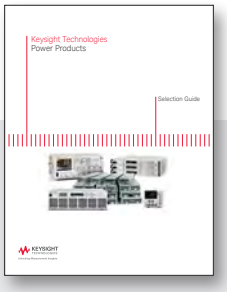
- Complete AC power test solution
- Three models, up to 1750 VA (300 Vrms, up to 80 A)
- Extensive power measurement capabilities (rms, peak, DC, AC+DC, THD, and more)
- Built-in arbitrary waveform generator to simulate many types of power waveforms

6800B Series Data Sheet

Keysight offers more than 300 power products to meet your specific needs.

The Keysight Power Products Selection Guide helps you choose your instrument by the number of outputs, output power characteristics, packaging, special features and application specific solutions.

Power Products Brochure



BenchVue Software

BenchVue software for the PC makes it simple to connect, record and achieve results with your instruments without programming



Look for this icon throughout this flyer to identify BenchVue enabled instruments (450+ Keysight instruments).

- Visualize multiple measurements simultaneously
- Easily capture data, screen shots and system state
- Rapidly prototype custom test sequences
- Measurement data export to Excel, Word and MATLAB in only three clicks
- Monitor and control your bench from mobile devices

BenchVue Software Data Sheet

Play BenchVue examples and learn how to increase your productivity and make the most of your bench

Download the *no cost* version today

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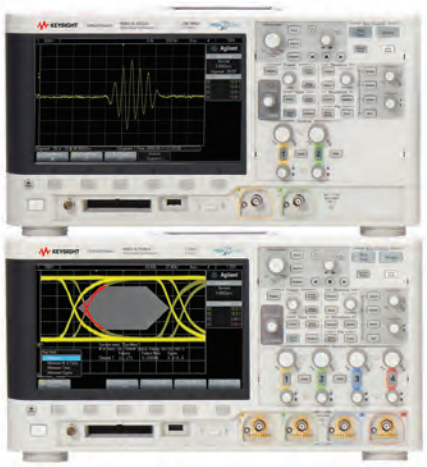
InfiniiVision X-Series oscilloscopes

Learn more about InfiniiVision X-Series oscilloscopes

- Up to 1,000,000 waveforms/sec update rate
- MegaZoom IV responsive, uncompromised smart memory
- 5 or 6 instruments in 1 oscilloscope
- Fully upgradable—bandwidth, MSO, serial analysis, built-in WaveGen function generator, or digital voltmeter and counter

BenchVue software enabled







Oscilloscope how-to video series, new videos every Tuesday! The basics for beginners and some helpful tips for more advanced users.

Model	Description	Bandwidth	Channels	Sample rate	Memory depth	Standard warranty	Calibration period	Special triggers	Built-in instruments
2000 X-Series 2000 Data Sheet	Basic R&D bench – 50,000 wfms/s update rate – 8.5-inch display – Serial bus options	70 MHz to 200 MHz	2, 2+8, 4, 4+8	Up to 2 GSa/s	Up to 1 Mpts	5 years	2 years	Serial protocol	8 digital channels, 20 MHz FG, 5-digit counter, 3-digit DVM
3000T X-Series 3000T Data Sheet Videos	Everything the 2000X has plus – 1,000,000 wfms/s update rate – Advanced math and power analysis – Capacitive touch screen	100 MHz to 1 GHz	2, 2+16, 4, 4+16	Up to 5 GSa/s	4 Mpts and segmented memory standard	3 years	3 years	Serial protocol Zone touch	16 digital channels, 20 MHz AWG, 8-digit counter and totalizer, 3-digit DVM
4000 X-Series 4000 Data Sheet	Everything the 3000T has plus – 12.1-inch capacitive touch screen – FFT, USB 2.0 pre-compliance and FPGA applications – Up to four active probes	200 MHz to 1.5 GHz					2 years		16 digital channels, Dual 20 MHz AWG, 5-digit counter, 3-digit DVM
6000 X-Series 6000 Data Sheet	Everything the 4000X has plus – 450,000 wfms/s update rate – Multi-touch display – Voice control – Jitter and real-time eye diagram analysis	1 GHz to 6 GHz		Up to 20 GSa/s					16 digital channels, Dual 20 MHz AWG, 10-digit counter and totalizer, 3-digit DVM



InfiniiVision Software Applications

Serial protocols and triggering	Features
I^2C, SPI, RS232, UART, USB 2.0, CAN, LIN, FlexRay, Audio, MIL-STD 1553, ARINC 429	Dual-channel WaveGen, jitter, real-time eye diagram, integrated voltmeter, 10-digit counter, mask limits, USB signal quality, video/TV, FPGA dynamic probe, power analysis

Learn more about oscilloscope software applications

DOWNLOAD YOUR NEXT INSIGHT
Keysight software is downloadable expertise. www.keysight.com/find/software

Big scope performance with a small scope price

1000 Series oscilloscopes



- 50 to 200 MHz, 2- and 4-channel DSO models with up to 20 kpts memory
- 5.7-inch color display offers powerful signal capture and display
- Up to 2 GSa/s sample rate
- Accelerate your productivity with 23 automatic measurements, an 11-language user interface, USB connectivity, and a standard educator's kit

1000 Series Data Sheet

Extreme temperature tools: N7007A passive probe and N7014A adapter



- Temperature range: -40 to +85 °C
- Low-cost, high-impedance probe with rugged tip perfect for general-purpose applications
- 2-meter cable length ideal for hard-to-reach automotive test points
- Banana-to-socketed tip adapter compatible with differential active probes

Extreme Temperature Tools Data Sheet

Learn more and see the complete list of available probes

Measurement Hint

If you need to verify product performance over a wide temperature range or find the cause of failure at high or low temperatures, you know most probes are limited to 0 to 50 °C. Operate them outside that range and you risk damage. No need to take the risk, Keysight offers extreme-temperature probing solutions that operate at -40 to +85 °C and beyond. Measure with the probe head and accessories inside the temperature chamber and the probe pod and scope outside. Learn More

Retool your expectations

These handheld tools are ready for real-world conditions—and many offer unique functions such as:

- Clear readouts from a high-contrast OLED display
- Continuity checks with audible and flashing alerts
- Low-light troubleshooting with a built-in flashlight

Handheld Test Tools Brochure

U5850 Series True*IR* thermal imagers



- 4X more in-camera fine resolution to identify abnormalities faster
- Image logging and temperature trending to monitor temperature changes
- High-temperature range (up to 1200 °C)
- Long standard product warranty – 3 years

U5850 Series Data Sheet

Insulation resistance testers



- Wireless insulation resistance testing via PC and smart phone / tablet applications
- Automatic test report generation
- 50 V/100 V/250 V/500 V/1000 V test voltages
- Keysight Remote Link solution, with an optional U1117A Infrared (IR)-to-*Bluetooth*® adapter

U1450A/60A Series Data Sheet

Digital multimeters



- Data logging capability
- Long battery life
- CAT III 600 V overvoltage protection or higher
- Keysight Remote Link solution, with an optional U1117A Infrared (IR)-to-*Bluetooth* adapter

U1240 Series Data Sheet

U1250 Series Data Sheet

U1270 Series Data Sheet

U1280 Series Data Sheet

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Quickly and accurately characterize your electronics design.

Using a thermal imaging camera, coupled with a data acquisition box, you can perform a thorough thermal analysis of your device under test.

Electronics Thermal Characterization: Quick and Accurate Method



Clamp meters



- Full-featured digital multimeter capabilities
- CAT III 600 V overvoltage protection or higher
- Keysight wireless remote connectivity solution on some models

U1190 Series Data Sheet

U1210 Series Data Sheet

Oscilloscopes



- 20 to 200 MHz bandwidth
- Large color display
- High sampling rate and recording length

U1600 Series Data Sheet

Capacitance/LCR meters



- 20,000 counts resolution, 0.2% basic accuracy
- Wide LCR ranges with 3 to 5 selectable test frequencies (Up to 100 kHz for U1733C)
- Battery life of 16 hours/AC-powered
- IR-to-USB connectivity for data logging to PC

U1701B Data Sheet

U1730C Series Data Sheet

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More resolution and speed with graphical display offers more insights

53200A Series RF and universal frequency counters



- Frequency, frequency ratio, time interval, rise/fall time, phase, and much more
- Histograms, trend charts, data logging, and built-in math and statistical functions
- 53230A offers: 20 ps single-shot, burst microwave, and continuous gap-free measurements
- Optional 6 or 15 GHz RF channel

BenchVue software enabled

53200A Series Data Sheet

Model	Key specifications
53210A	350 MHz RF frequency counter, 10 digits/s
53220A	350 MHz universal frequency counter/timer, 12 digits/s, 100 ps
53230A	350 MHz universal frequency counter/timer, 12 digits/s, 20 ps

Speed, accuracy and measurement versatility

E4980AL precision LCR meter



- 20 Hz to 300 kHz / 500 kHz / 1 MHz
- Exceptionally low noise at both low and high impedance to improve test quality; 0.05% basic impedance accuracy
- High speed at an affordable price:
  12 ms (SHORT), 118 ms (MED), 343 ms (LONG) @ 1 MHz
- 201-point programmable list sweep

E4980AL Data Sheet

Professional performance and compact size for general-purpose testing needs

N9310A RF signal generator



- 9 kHz to 3 GHz CW output, 20 Hz to 80 kHz low frequency (LF) output
- -127 to +13 dBm output level range (max +20 dBm settable)
- - 95 dBc/Hz SSB phase noise
- Extensive analog modulation: AM, FM, phase, and pulse modulation

N9310A Data Sheet

Streamlined for straightforward, efficient operation

Basic spectrum analyzers (BSAs)



- Increase productivity on a budget with reliable performance up to 7 GHz
- Tracking generator up to 7 GHz for stimulus/response measurements
- ASK/FSK demodulation analysis capability

BenchVue software enabled

Learn more about basic spectrum analyzers

Model	Key specifications
N9320B	9 kHz to 3 GHz frequency, -145 dBm DANL @ 1 GHz
N9322C	9 kHz to 7 GHz frequency, -152 dBm DANL @ 1 GHz

34460A and 34470A Series True*volt* DMMs

Learn more about True*volt*

- 6½ digit 7½ digit performance
- Graphical capabilities such as trend and histogram charts
- Measure very low current, 1 µA range with pA resolution, allowing measurements on very low power devices.
- Auto calibration to compensate for temperature drift
- Basic measurements: DCV, ACV, DCI, ACI, 2- and 4-wire resistance, frequency, period, continuity, diode, temperature, capacitancel

BenchVue software enabled





Model	Description	Digits of resolution	Max reading rate at 4½ digits (rdgs/s)	Built-in PC interfaces
34460A	New industry standard. Display DMM results in ways you never have before and measure with unquestioned True*volt* confidence.	6½	300	USB; optional GPIB, LAN
34461A			1,000	USB, LAN; optional GPIB
34465A	More measurements, higher speed, better accuracy, more memory than 34461A.	6½	5,000; optional 50,000	USB, LAN; optional GPIB
34470A		7½		

34460A, 34461A, 34465A, 34470A Data Sheet

Benchtop (DMMs)

Keysight offers exceptional performance and reliability at a great price. Highlights from our complete portfolio include:



U3400 Series 4½ and 5½ digit multimeters

- Elegantly simple and affordable DMMs with basic capabilities, including dual display.

U3400 Series Data Sheet

U3606B multimeter | DC power supply

- Two instruments in one; 5½ digit DMM with built-in 30 W power supply. Cuts required rack space in half.

U3606B Data Sheet

34450A bench digital multimeter

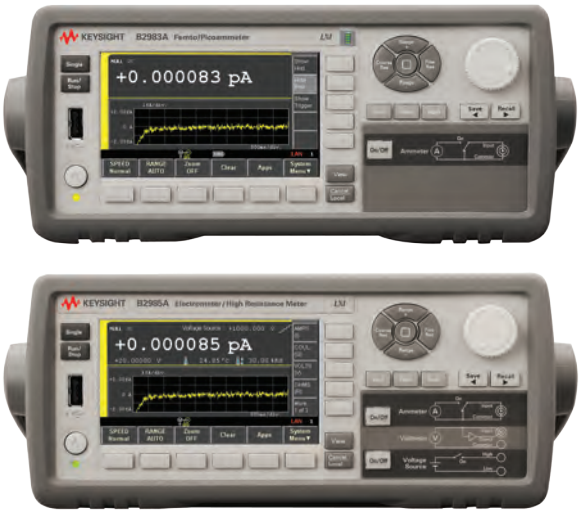
- Turbo charge your measurements with one of the fastest tools in its class. 5½ digit bench digital multimeter with OLED dual display.

BenchVue software enabled

34450A Data Sheet

Learn more about Benchtop DMMs

B2980A Series Femto/Picoammeter and Electrometer/High Resistance Meters



- The world's only graphical picoammeter / electrometer that can confidently measure down to 0.01 fA and up to 10 PΩ
- Four models available:
  B2981A / B2983A* femto / picoammeter
  B2985A / B2986A* electrometer / high resistance meter
- 0.01 fA (10^{-17} A) minimum measurement resolution and 2 pA to 20 mA current measurement ranges with 6.5 digits resolution
- < 20 µV burden voltage in its lowest current range
- High-speed reading rate up to 20,000 rdg/s

**Battery operated models for line noise free measurements.*

B2980 Series Data Sheet

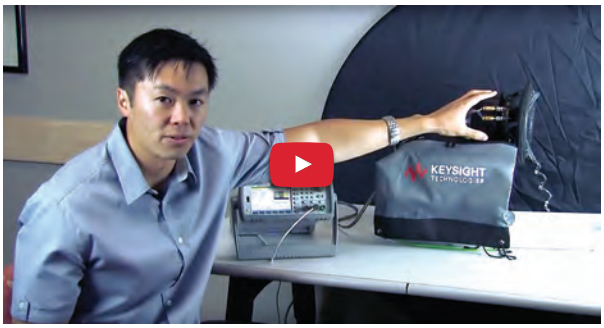
KEYSIGHT TECHNOLOGIES

P.O. Box 4026, Englewood, CO 80155-4026
www.keysight.com/find/contactus

See the entire video playlist –

True*form* generators sweep, pulse, IQ capabilities and interesting water tricks at:

www.keysight.com/find/33600videos



Promotions

Supercharge your new oscilloscope to an MSO for FREE

Add 16 digital channels to any 3000T, 4000 or 6000 X-Series oscilloscope you purchase for FREE. Integrate 4 traditional analog channels with 16 digital channels, and you get 20 channels of time-correlated signals that save time, effort, and bench space.

Promo code: 6.004 Valid through 31 December 2016

Availability: US, Canada, Latin America, Europe, Middle East, Africa, India and Asia Pacific excluding China, Hong Kong, Taiwan and Japan.

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Get Greater Reliability– Standard

You've come to expect the highest quality from Keysight. We stand behind our products with a three-year warranty that's standard on all instruments, worldwide.

www.keysight.com/find/ThreeYearWarranty

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