

### **E3632A изходни захранвания с един изход**

Тези единични изходни захранващи устройства ви дават гъвкавостта да избирате от двоен изход диапазон. Изходното натоварване е защитено срещу пренапрежение и сръхток, които са лесно се следи и регулира от предния панел и отдалечения интерфейс. Дистанционен сензор. Налично е да се отстранят грешките, причинени от спадане на напрежението на товарните проводници. Най- E3633A / 34A предлагат предни и задни изходни клеми за лесно окабеляване.

### **E3632A**

DC output 0 to 15 V/7 A или 0 to 30 V/4 A

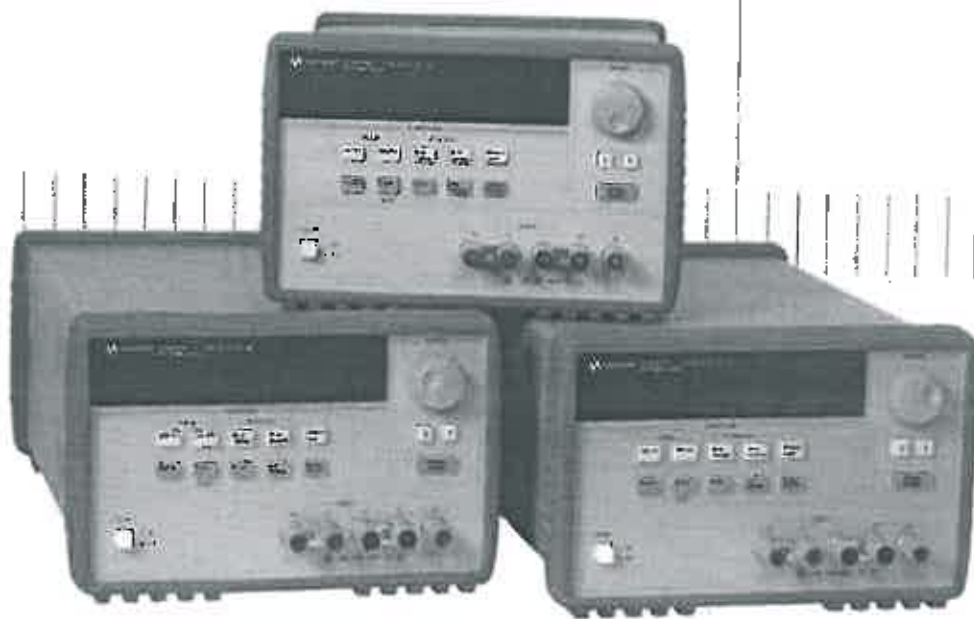
Точност 12 months (25 °C + 5 °C), ± (% output + offset)

Вградени GPIB и RS-232 интерфейси.

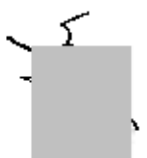


# Keysight E363xA Series Programmable DC Power Supplies

Data Sheet



 **KEYSIGHT**  
TECHNOLOGIES



## Clean and Stable Power with Programmability at an Affordable Price

### Affordable programmable power supplies to meet your needs

The Keysight Technologies, Inc. E363xA Series of programmable DC power supplies gives you the performance of the system power supplies at a decent price. All models provide clean power, excellent regulation and a fast transient response with built-in GPIB and RS-232 interfaces. The E363xA Series is designed to meet the requirements of the most demanding applications in R&D design verifications, production testing, and QA verifications with traditional quality and reliability which you can count on.

### Excellent performance you can trust

With the 0.01% load and line regulation, the E363xA Series can maintain a steady output when power line and load changes occur. The power supplies specify both normal mode voltage/current noise and common mode current noise. The low normal mode noise specification assures clean power for precision circuitry applications, and the low common mode current provides isolation from power line current injection.

### Remote interface

If you have an IEEE-488 card or RS-232 in a PC, these power supplies will work for you. Every model comes equipped with both GPIB and RS-232 as standard. All programming is done in easy-to-use SCPI (Standard Commands for Programmable Instruments). The user's guide describes the process for the first-time programmers.

### Front panel operation

A knob and self-guiding keypad allow you to set the output at your desired resolution quickly and easily. You can store and recall for up to three complete setups using the internal non-volatile memory. The output on/off button sets the output to zero.

### E3631A triple-output power supply

This famous 80-watt triple output supply offers three independent outputs: 0 to 6 V/5A, 0 to +25V/1A and 0 to -25V/1A. The 6 V output is electrically isolated from the  $\pm 25$  V supply to minimize any interference between circuits under test. The  $\pm 25$  V outputs can be set to track each other.

### E3632A/33A/34A single-output dual range power supplies

These single output power supplies give you the flexibility to select from a dual output range. The output load is protected against overvoltage and overcurrent, which are easily monitored and adjusted from the front panel and remote interface. Remote sensing is available to eliminate the errors caused by voltage drops on the load leads. The E3633A/34A offer front and rear output terminals for easy wiring.



### Reliable Power, Repeatable Results

- Single and triple output
- 80 W to 200 W output power
- Dual range output (except E3631A)
- Low noise and excellent regulation
- Remote sensing (except E3631A)
- Front and rear output terminals (E3633A/34A only)
- GPIB and RS-232 standard
- Save and recall functions
- Overvoltage protection, overcurrent protection (except E3631A)



## E3631A/32A/33A/34A Programmable DC Power Supply Specifications

Model Number	E3631A		E3632A		E3633A	E3634A
	1	2	3			
DC output	0 to +6 V,	0 to +25 V,	0 to -25 V,	0 to 15 V/7 A or	0 to 6 V/20 A or	0 to 25 V/7 A or
Rating (30 to 40 °C)	0 to 5 A	0 to 1 A	0 to 1 A	0 to 30 W/4 A	0 to 20 W/10 A	0 to 50 W/4 A
Load regulation				< 0.01% + 2 mV		
± (% of output + offset)				< 0.01% + 250 μA		
Line regulation				< 0.01% + 2 mV		
± (% of output + offset)				< 0.01% + 250 μA		
Ripple and noise (20 Hz to 20 MHz)						
Normal mode voltage		< 350 μVrms/2 mVpp			< 350 μVrms/3 mVpp	< 500 μVrms/3 mVpp
Normal mode current	< 2 mA rms	< 500 μA rms			< 2 mA rms	
Accuracy <sup>1</sup> 12 channels (25 °C ± 5 °C), ± (% output + offset)						
Programming						
Voltage	0.1% + 5 mV	0.05% + 20 mV			0.05% + 10 mV	
Current	0.2% + 10 mA	0.15% + 4 mA			0.2% + 10 mA	
Readback <sup>2</sup>						
Voltage	0.1% + 5 mV	0.05% + 10 mV			0.05% + 5 mV	
Current	0.2% + 10 mA	0.15% + 4 mA			0.15% + 5 mA	
Transient response	Less than 50 μsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa					

### Supplemental Characteristics

Model Number	E3631A		E3632A		E3633A	E3634A
	1	2	3			
AC input (47 Hz ± 30 Hz)	100 Vac ± 10% (Opt 0E9)/115 Vac ± 10% (Std)/230 Vac ± 10% (DE3)					
Dimensions	213 x mm W x 128 mm H x 348 mm D (8.4 x 5.2 x 13.7 in)					
Weight	8.2 kg (18 lbs) net, 11 kg (24 lbs) shipping			9.5 kg (21 lbs) net, 12 kg (26 lbs) shipping		
Warranty	Three years for E963xA series power supplies Three months for standard shipped accessories					
Product registration	Certified to CSA 22.2 No. 231 (for E3631A), No. 107.0.1 (for E3632A/33A/34A); conforms to IEC 1010-1; carries CE marks; complies with CISPR-11, Group 1, Class A					
Common mode current	< 1.5 μA rms					
Overload						
Program	0.5 mV/0.5 mA	1.5 mV/0.1 mA		1 mV/0.5 mA	1 mV/1 mA	3 mV/0.5 mA
Readback	0.5 mV/0.5 mA	1.5 mV/0.1 mA		0.5 mV/0.1 mA	0.5 mV/1 mA	1.5 mV/0.5 mA
Meter	1 mV/1 mA	10 mV/1 mA		1 mV/1 mA	1 mV/1 mA (< 10A), 10 mA (≥ 10A)	
Common mode rejection						
dBS		< 50 msec			< 100 msec	
OVP/OCP						
Accuracy		N/A			0.6% + 0.5 V/0.5% + 0.5 A	
± (% output + offset)						
Activation time		N/A		1.5 msec, OVP ≥ 3 V < 10 msec, OVP < 3 V and OCP < 10 msec		
Temperature coefficient per °C (% output + offset)						
Voltage	0.01% + 2 mV			0.01% + 3 mV		
Current	0.02% + 3 mA	0.02% + 0.5 mA			0.02% + 3 mA	
Stability, constant load & temperature ± (% of output + offset), 8 hrs						
Voltage	0.03% + 1 mV	0.02% + 2 mV			0.02% + 1 mV	
Current	0.1% + 3 mA	0.05% + 1 mA			0.1% + 1 mA	
Resistance (max. voltage in each lead lead)		N/A		1 V		0.7 V
Voltage drop (max. voltage drop ± 1, to within 1% of total excursion)						
Up						
Full load	11 msec	50 msec		50 msec	95 msec	80 msec
No load	10 msec	20 msec		20 msec	45 msec	100 msec
Down						
Full load	13 msec	45 msec		45 msec	30 msec	30 msec
No load	200 msec	400 msec		400 msec	450 msec	450 msec

1. Accuracy specifications are valid after a 1-hour warm-up and calibration at 25 °C.
2. Accuracy refers to readback over GPIB and RS-232 or front panel with respect to actual output.
3. Maximum time for output to change after receipt of commands.



## Ordering Information

E3630 Series Power Supplies  
E3631A 80-Watt Triple Power Supply  
E3632A 120-Watt Single Power Supply  
E3633A/34A 200-Watt Single Power Supply

## Standard Shipped Accessories

User's & Service guide, Product  
Reference CD, AC power cord

## Power Options

Opt. 0E9 230 Vac  $\pm$  10%  
Opt. 0EM 115 Vac  $\pm$  10%  
Opt. 0E9 100 Vac  $\pm$  10%

## Other Options

Opt. 0L2 Extra manual sets  
Opt. 1CM Rackmount kit\*  
Opt. UKB Commercial calibration with test result data  
E3600A-100 Test lead kit

## Rackmount Kits\*

Keysight E3631A/32A/33A/34A  
To rackmount two instruments side-by-side  
Lock-link Kit (P/N 5061-9694)  
Flange Kit (P/N 5063-9214)  
To rackmount one or two instruments in a sliding support shelf  
Support Shelf (P/N 5069-9258)  
Slide Kit (P/N 1494-0015) required for support shelf

\* Rackmounting with 1CM or lock-link/flange kit requires Keysight or customer support rails Keysight Support Rails-E3663AC



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Register your products to get up-to-date product information and find warranty information.

### KEYSIGHT SERVICES

Assurance Technology Authority  
Learn more

#### Keysight Services

[www.keysight.com/find/service](http://www.keysight.com/find/service)

Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—on-site calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.



#### Keysight Assurance Plans

[www.keysight.com/find/AssurancePlans](http://www.keysight.com/find/AssurancePlans)

Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

#### Keysight Channel Partners

[www.keysight.com/find/channelpartners](http://www.keysight.com/find/channelpartners)

Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

#### Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

#### Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 683
India	1 800 11 2626
Japan	0120 (421) 945
Korea	080 769 0800
Malaysia	1 800 899 848
Singapore	1 800 375 8100
Taiwan	0800 047 888
Other AP Countries	(86) 6375 8100

#### Europe & Middle East

Austria	0800 001122
Belgium	0800 58680
Finland	0800 523252
France	0805 880333
Germany	0800 6270889
Ireland	1800 832700
Israel	1 809 343061
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5008286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 806353
	Opt. 1 (DE)
	Opt. 2 (FR)
	Opt. 3 (IT)
United Kingdom	0800 0260837

For other unlisted countries:  
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Quality Management System



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## Технически данни на Keysight DSOX1102A

Изглед на предния панел:

### InfiniVision 1000 X-Series Oscilloscopes



2 Channel: EDUX1002A; EDUX1002G; DSOX1102A; DSOX1102A

Осцилоскопите InfiniVision 1000 X-Series на Keysight са проектирани така, че да ви дадат качество, доказано в индустриалната технология на невероятно ниски цени. Сега е лесно да получите професионални измервания и достъпна експертиза на пръстите ви. Не се задоволявайте с по-малко - и изпробвайте, за да впечатлите.

- 70 до 200 MHz
- Анализ на честотния спектър (Bode gain & phase plots), включен в моделите с WaveGen
- Вижте повече подробности за сигнала с 50 000 wfms / sec
- Имайте доверие в измерванията си с Keysight-персонализирана технология, която използва повече от 60 години опит в осцилоскопа
- Тествайте бързо и лесно с прост, интуитивен потребителски интерфейс и вградени помощни и тренировъчни сигнали
- Вземете професионална функционалност с водещи в индустриалната софтуерни анализи и б-в-1 инструмент интеграция

DSOX1102A 70/100 MHz, 2 channel

Bandwidth 70 MHz (base)

Maximum sample rate 2 GSa/s (all channels)

Maximum memory depth 1 Mpts

Integrated digital voltmeter Free with product registration

Display 7-inch TFT LCD WVGA

Waveform update rate 50,000 waveforms per second

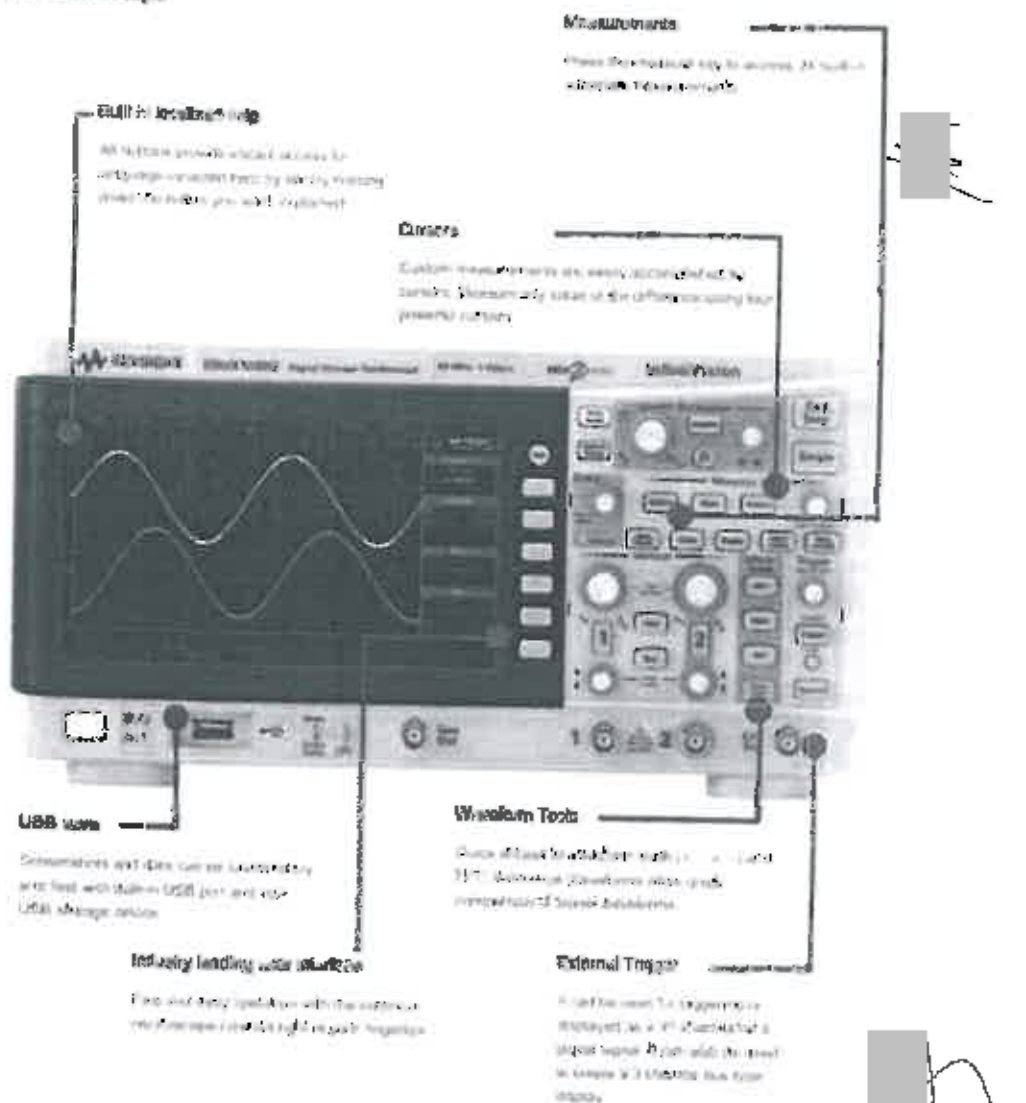


Connectivity USB 2.0 (host and device)

DC vertical accuracy  $\pm$  [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale]

DC vertical gain accuracy  $\pm$  +3% full scale (> 10 mV/div)

### A real oscilloscope



## InfiniiVision 1000 X-Series Oscilloscopes



2 Channel: EDUX1002A; EDUX1002G; DSOX1102A; DSOX1102A



4 Channel: DSOX1204A; DSOX1204G

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### Need more bandwidth, sampling rate, and analysis?



Consider the InfiniVision 3000T X-Series

- 350 MHz, 500 MHz and 1 GHz
- 5 GSa/s
- Uncompromised 1,000,000 waveform update rate
- Capacitive touch screen
- Industry exclusive zone touch trigger
- Plenty decode/trigger and gated FFT

## Leading technology in a value-priced oscilloscope

Keysight's InfiniVision 1000 X-Series oscilloscopes are engineered to give you quality, industry-proven technology at unbelievably low prices. Now it's easy to get professional measurements and accessible expertise at your fingertips. Don't settle for less – and test to impress.

- 70 to 200 MHz
- Frequency Response Analysis (Bode gain & phase plots), included in models with WaveGen
- See more signal detail with 50,000 wfms/sec update rate
- Have confidence in your measurements with Keysight-custom technology that leverages more than 80 years of oscilloscope expertise
- Test quickly and easily with a simple, intuitive user interface and built-in help and training signals
- Get professional-level functionality with industry-leading software analysis and 6-in-1 instrument integration



**DSOX1102A**  
70/100 MHz, 2 channel



**DSOX1204A**  
70/100/200 MHz, 4 channel

**DSOX1204G**  
70/100/200 MHz, 4 channel  
with function generator

	<b>DSOX1102A</b> 70/100 MHz, 2 channel	<b>DSOX1102G</b> 70/100 MHz, 2 channel with function generator	<b>DSOX1204A</b> 70/100/200 MHz, 4 channel	<b>DSOX1204G</b> 70/100/200 MHz, 4 channel with function generator
Analog channels	2	2	4	4
External trigger	1 (can be used as a 3rd digital channel at the front)	1 (can be used as a 3rd digital channel at the front)	1 (back)	1 (back)
Bandwidth	70 MHz (base) 100 MHz (DSOX1B7T102)	70 MHz (base) 100 MHz (DSOX1B7T102)	70 MHz (base) 100 MHz (D1200BW1A) 200 MHz (D1200BW2A)	70 MHz (base) 100 MHz (D1200BW1A) 200 MHz (D1200BW2A)
Maximum sample rate	2 GSa/s (all channels)	2 GSa/s (all channels)	2 GSa/s (half channels) 1 GSa/s (all channels)	2 GSa/s (half channels) 1 GSa/s (all channels)
Maximum memory depth	1 Mpts	1 Mpts	1 Mpts	1 Mpts
Segmented memory	Standard	Standard	Standard	Standard
Mask/limit testing	Standard	Standard	Standard	Standard
WaveGen	Not available	20-MHz function generator (includes Bode plot test)	Not available	20-MHz function generator (includes Bode plot test)
Serial protocol analysis	Option: I <sup>2</sup> C, SPI, UART/RS-232 - (DSOX1EMB) CAN, LIN - (DSOX1AUTO)		Option: I <sup>2</sup> C, SPI, UART/RS-232 - (D1200EMBA) CAN, LIN - (D1200AUTA)	
Waveform math	Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter			
Integrated digital voltmeter	Free with product registration			
Display	7-inch TFT LCD WVGA			
Waveform update rate	50,000 waveforms per second			
Connectivity	USB 2.0 (host and device)		USB 2.0 (host and device) LAN	



Leading technology in a value-priced oscilloscope (education model)  
 EDUX1002A and EDUX1002G



Provide a quality education for students and prepare for the industry with professional level instruments. The 1000 X-Series leverages the same technology as our higher-end oscilloscopes, allowing students to learn on the same hardware and software being used in leading R&D labs. Don't settle for less – set your students up for success

- Built-in training signals that enable students to quickly learn to capture and analyze signals.
- The educator's resource kit includes dynamic teaching labs; a comprehensive lab guide; a tutorial written specifically for undergraduate students; and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants.
- IoT systems design applied courseware. The 1000 X-Series oscilloscope can be used with the U3600A Internet of Things(IoT) Systems Design Applied Courseware.
- Bode plots are fundamental concepts. The 1000 X-Series' frequency response analyzer capability is the perfect tool to help students understand the gain and phase performance of passive LRC circuits or active op-amps.
- BenchVue Software with the BV0004B BenchVue Oscilloscope app lets you control and visualize the 1000X-Series and multiple measurements simultaneously.



EDUX1002A  
 50 MHz, 2 channel



EDUX1002G  
 80 MHz, 2 channel with function generator

	EDUX1002A 50 MHz, 2 channel	EDUX1002G 80 MHz, 2 channel with function generator
Analog channels	2	2
External trigger (or 3rd digital channel)	1	1
Bandwidth	50 MHz	80 MHz
Maximum sample rate	1 GSa/s	1 GSa/s
Maximum memory depth	100 kpts	100 kpts
WaveGen	Not available	20-MHz function generator (includes Bode plot test)
Serial protocol analysis	Options: PC, UART/RS-232 - (EDUX1EMBD)	
Waveform math	Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter	
Display	7-inch TFT LCD WVGA	
Waveform update rate	50,000 waveforms per second	
Connectivity	USB 2.0 (host and device)	

Circle these options on



Page 2

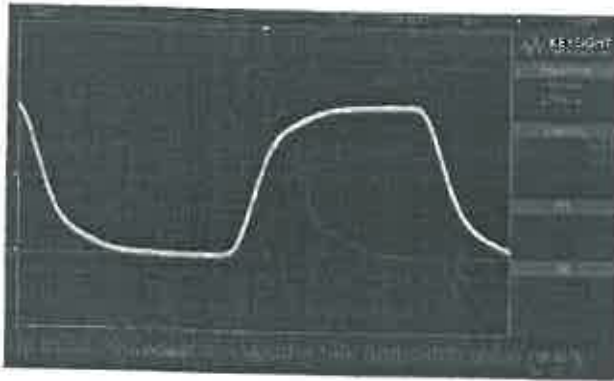


## Leading Technologies

(Click on  below, you will be redirected to VIDEO on Keysight Youtube channel)

Have confidence in your measurements with Keysight-custom technology that leverages more than 60 years of oscilloscope expertise.

Low-cost oscilloscopes don't have to be low quality. Designing premier test solutions has been the goal and passion of Keysight Technologies ever since we made our first oscilloscope in 1939, and now we're bringing you a professional-quality oscilloscope for a fraction of the price.

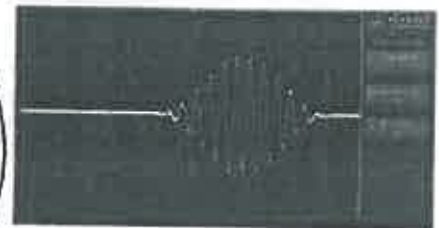


 Training Signals

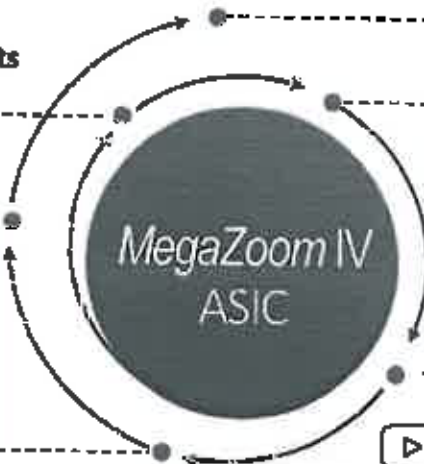
 Superior Measurements

 Memory Performance

 FFT

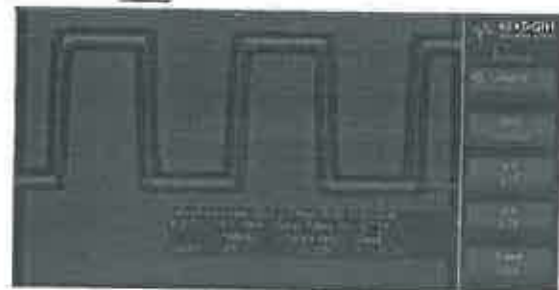


Segment Memory.



 Mask test

 Intuitive Controls / Built-in Help



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#400 8



## 6-in-1 instrument integration

Get professional-level oscilloscope functionality with industry-leading software analysis and 6-in-1 instrument integration. The 1000 X-Series gives you the following functionality, so you can save money and valuable bench space.

### OSCILLOSCOPE



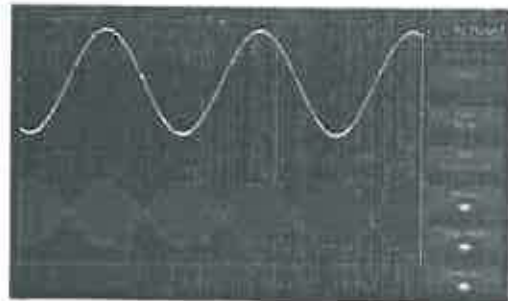
The 1000 X-Series is a family of low-cost oscilloscopes that don't compromise on quality. Each has measurement and software analysis capability that rivals oscilloscopes 3x the price.



### WaveGen (built-in 20 MHz function generator with modulation capability)

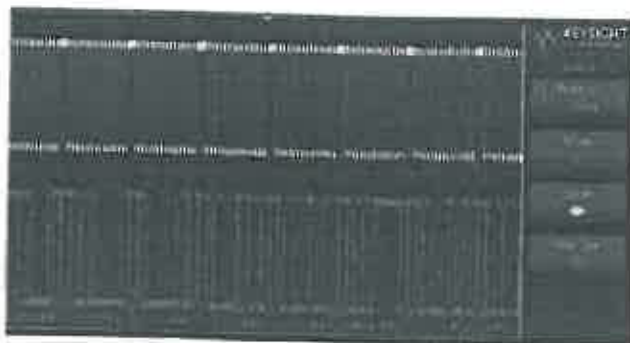
(EDUX1002G, DSOX1102G, and DSOX1204G models only)

The 1000 X-Series offers an integrated 20 MHz function generator with a signal modulation capability. It's ideal for educational or design labs where bench space and budget are at a premium. The integrated function generator provides stimulus output of sine, square, ramp, pulse, DC and noise waveforms to your device under test. Add modulation to the signal with customizable AM, FM and FSK settings. No need to buy a separate function generator when you can get one integrated into your new oscilloscope. WaveGen is available on EDUX1002G, DSOX1102G, and DSOX1204G models only.

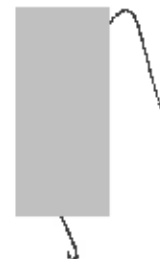


The WaveGen function enables the definition of multiple waveforms including amplitude modulated signals.

### Hardware-based serial protocol decode and triggering



When you add optional software, the 1000 X-Series is a powerful protocol analyzer that can do powerful decode and hardware-based triggering that enables specialized serial communication analysis. Other vendors' oscilloscopes use software post-processing techniques that slow down the waveform and decode update rate, but the 1000 X-Series has faster decoding by using hardware-based technology that enhances scope usability and the probability of capturing infrequent serial communication errors.



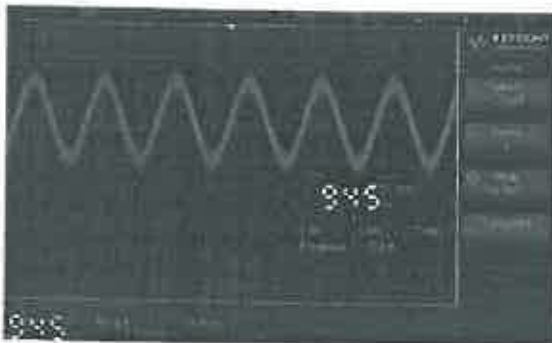
## 6-in-1 instrument integration (continued)

### Frequency Response Analyzer (EDUX1002G, DSOX1102G, and DSOX1204G models only)

Frequency response analysis is a critical measurement to characterize the stability of feedback networks and switch-mode power supplies. Bode plots are fundamental concepts that every electrical engineering student must know. The 1000 X-Series' frequency response analyzer capability is the perfect tool to help students understand the gain and phase performance of passive LRC circuits or active op-amps. This capability is achieved with a gain and phase measurement versus frequency (Bode plot). Vector network analyzers (VNAs) and low-cost frequency response analyzers are typically used for these measurements, but now an easy-to-use gain and phase analysis is possible by utilizing the 1000 X-Series' built-in WaveGen. (EDUX1002G, DSOX1102G, and DSOX1204G models only).



### Digital Voltmeter



The 1000 X-Series has an integrated 3-digit voltmeter (DVM) inside each oscilloscope. The voltmeter operates through probes connected to the oscilloscope channels, but its measurement is decoupled from the oscilloscope triggering system so both the DVM and triggered oscilloscope measurements can be made with the same connection. You can quickly measure AC RMS, DC, and DC RMS without configuring the oscilloscope capture. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips. Turn on the DVM capability for no additional cost by registering your oscilloscope.

### Frequency Counter

An integrated 5-digit frequency counter inside each oscilloscope. It operates through probes connected to the oscilloscope channels, but its measurement is decoupled from the oscilloscope triggering system, so both the counter and triggered oscilloscope measurements can be made with the same connection. You can quickly measure frequency without configuring the oscilloscope capture. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips. Turn on the counter capability for no additional cost by registering your oscilloscope.



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Page 1



## More productivity tools

### Localized GUI and help



Operate the oscilloscope in the language most familiar to you. The graphical user interface (GUI), built-in help system, front panel overlays, and user's manual are available in English, Simplified Chinese, Traditional Chinese, Japanese, Korean, French, German, Italian, Portuguese, Russian and Spanish. The GUI and front panel overlay are also available in Polish, Thai, and Czech, and the built-in help is also available in Polish and Thai. During operation, access the built-in help system by simply pressing and holding any button.

### Probe solutions



Get the most out of your 1000 X-Series oscilloscope by using the right probes and accessories for your application. Keysight offers a complete family of innovative probes and accessories for the InfiniVision 1000 X-Series.



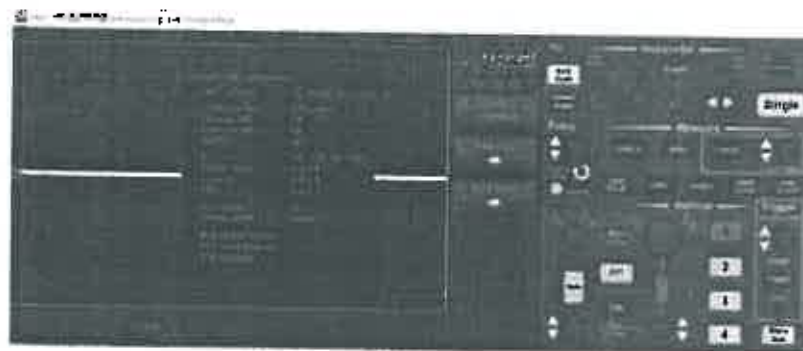
### Connectivity and remote control (LAN connectivity for DSOX1204A/G only)



Built-in USB host and USB device ports make PC connectivity easy. BenchVue Software with the BV0004B BenchVue Oscilloscope app lets you control and visualize the 1000 X-Series and multiple measurements simultaneously. Build automated test sequences just as easy as using your front panel. Save time with the ability to export measurement data to Excel, Word, and MATLAB in three clicks. Monitor and control your 1000 X-Series with a mobile device from anywhere.



Standard LAN port in the 4-channel models (DSOX1204A/G series) supports remote web-based virtual front panel to control and to save data or images.



Web-based virtual front panel. (DSOX1204A/G model only).



## More productivity tools (continued)

### Offline oscilloscope analysis software

Keysight's N8900A Infiniium Offline PC-based oscilloscope analysis software lets you do additional signal viewing, analysis, and documentation tasks while you're away from your oscilloscope. You can capture waveforms on your scope, save to a file and recall the waveforms into the Infiniium Offline software on your PC.



### BenchVue oscilloscope app

The Oscilloscope App within BenchVue enables control of oscilloscopes to quickly capture and annotate screen images, record trace data and data log measurements (included in model BV0000A). Build automated test sequences just as easy as using your front panel. Save time with the ability to export measurement data to Excel, Word, and MATLAB in three clicks. Monitor and control your 1000 X-Series with a mobile device from anywhere.



### Oscilloscope basic courseware

The Educator's Oscilloscope Training Kit provides an array of built-in training signals so that electrical engineering and physics students can learn what an oscilloscope does and how they can perform basic oscilloscope measurements. Also included in the kit is a comprehensive oscilloscope lab guide and tutorial written specifically for the undergraduate student. Keysight also provides a PowerPoint slide-set that professors and lab assistants can use as a pre-lab lecture on oscilloscope fundamentals. This lecture takes about 30 minutes and should be presented before electrical engineering and physics students begin their first circuits lab. Note that this PowerPoint slide-set also includes a complete set of speaker notes.



### IoT systems design courseware

The 1000 X-Series oscilloscope can be used with the U3800A Internet of Things (IoT) Systems Design Applied Courseware, which is designed to give students the opportunity to work with industry-grade test and measurement instruments. The IoT Systems Design Applied Courseware is a ready-to-teach package that equips students with the knowledge on how to design and develop an embedded system with IoT capabilities. Designed as a resource for educators, the courseware consists of teaching slides and a training kit and integrates hands-on industry-relevant experience and real-world applications in IoT systems design and testing.





# A real oscilloscope



## Measurements

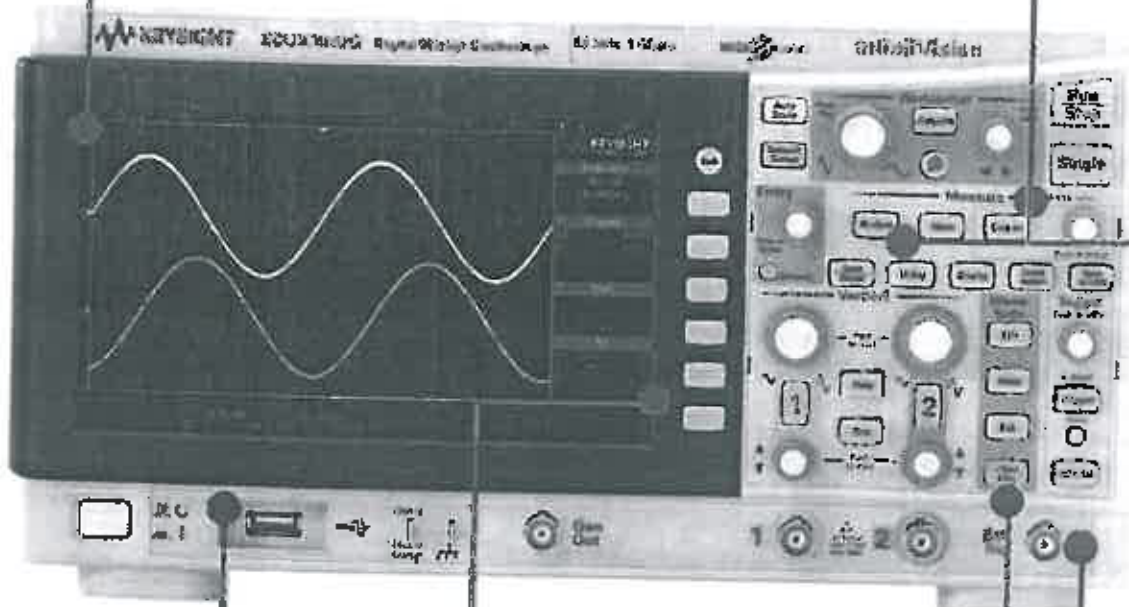
Press the measure key to access 24 built-in automatic measurements

## Built-in localized-help

All buttons provide instant access to language-localized help by simply holding down the button you want explained

## Cursors

Custom measurements are easily accomplished by cursors. Measure any value or the difference using four powerful cursors



## USB save

Screenshots and data can be saved easily and fast with built-in USB port and your USB storage device.

## Waveform Tools

Quick access to waveform math (+ - x ÷) and FFT. Reference Waveforms allow quick comparison of stored waveforms

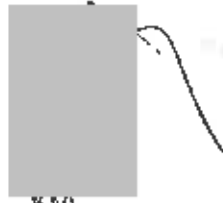
## Industry leading user Interface

Fast and easy operation with the common oscilloscope controls right at your fingertips.

## External Trigger

It can be used for triggering or displayed as a 3<sup>rd</sup> channel for a digital signal. It can also be used to create a 3-channel bus-type display

Model 1042E www.tek.com



## Технически данни на Keysight 33509A

Изглед на предния панел:



33509A Генератори на сигнали от серията с изключителен сигнал Trueform. Технологията за генериране на енергия предлага повече възможности, вярност и гъвкавост, отколкото традиционните DDS генератори. Използвайте ги, за да ускорите развитието си процес от началото до финиш.

През последните две десетилетия, директният цифров синтез (DDS) е бил технология за генериране на форма на вълната по избор в функционални генератори и икономични генератори на сигнали с произволна форма. DDS позволява вълнова форма генератори с голяма разделителна способност на честотите, удобен за обичай сигнали и ниска цена.

Както при всяка технология, DDS има присъщи недостатъци и ограничения също. Инженерите с възискателни изисквания трябва да работят около компрометираната производителност или прекарват до 10 пъти повече за висок клас генератор на сигнали от точка до точка.

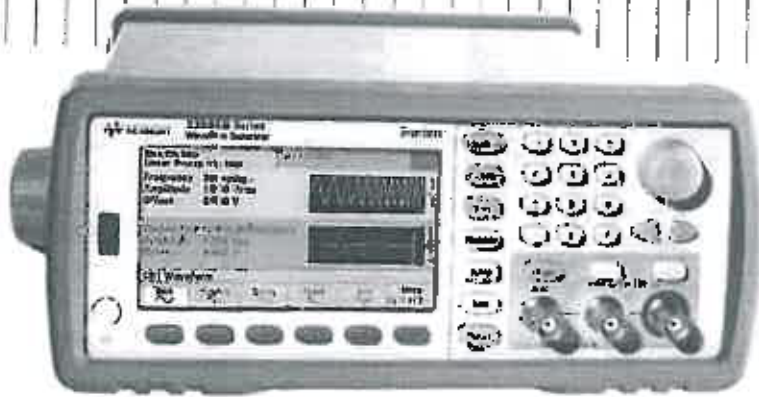
Технологията на Keysight, inc. Trueform предлага а нова алтернатива, която съчетава най-доброто от DDS и точка по точка архитектури, които ви дават предимствата и на даете без ограничения едновременно. Технологията Trueform използва изключителни цифрови извадки техника, която осигурява несравнима производителност при една и съща ниска цена сте свикнали с DDS.

Model No.	Description
33509A	1 $\mu$ Hz до 20 MHz, 1 $\mu$ Hz стъпка, 1-channel

Keysight Technologies  
33500B Series  
Waveform Generators



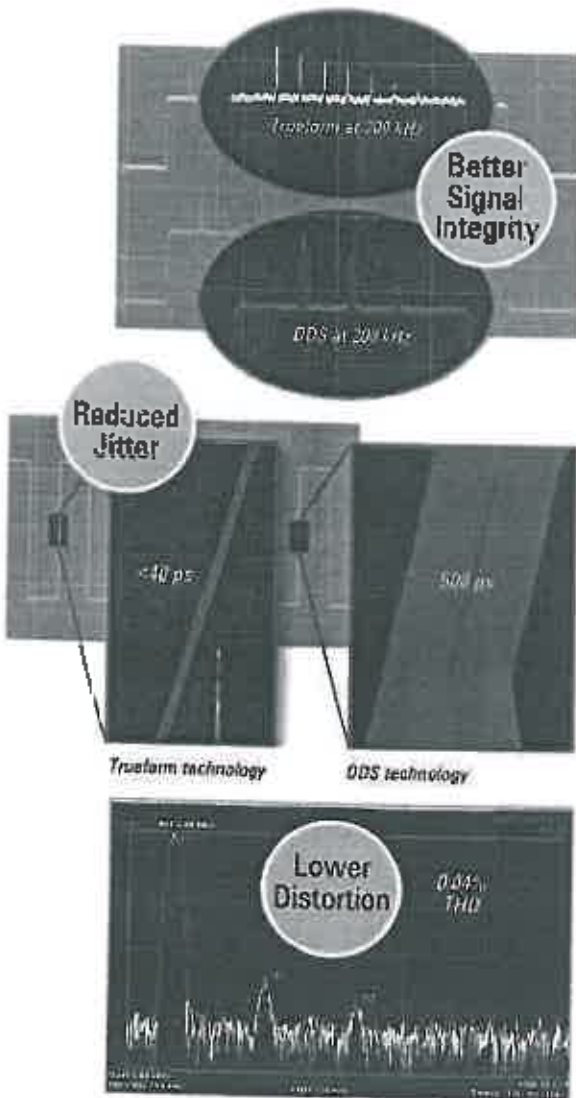
Data Sheet





Trueform Technology  
 Generate true point-by-point arbitrary waveforms with less jitter, more fidelity and greater resolution

Revolutionary advances over traditional DDS



33500B Series waveform generators with exclusive Trueform signal generation technology offer more capability, fidelity and flexibility than traditional DDS generators. Use them to accelerate your development process from start to finish.

Over the past two decades, direct digital synthesis (DDS) has been the waveform generation technology of choice in function generators and economical arbitrary waveform generators. DDS enables waveform generators with great frequency resolution, convenient custom waveforms, and a low price.

As with any technology, DDS has intrinsic downsides and limitations as well. Engineers with exacting requirements have had to either work around the compromised performance or spend up to 10 times more for a high-end, point-by-point waveform generator.

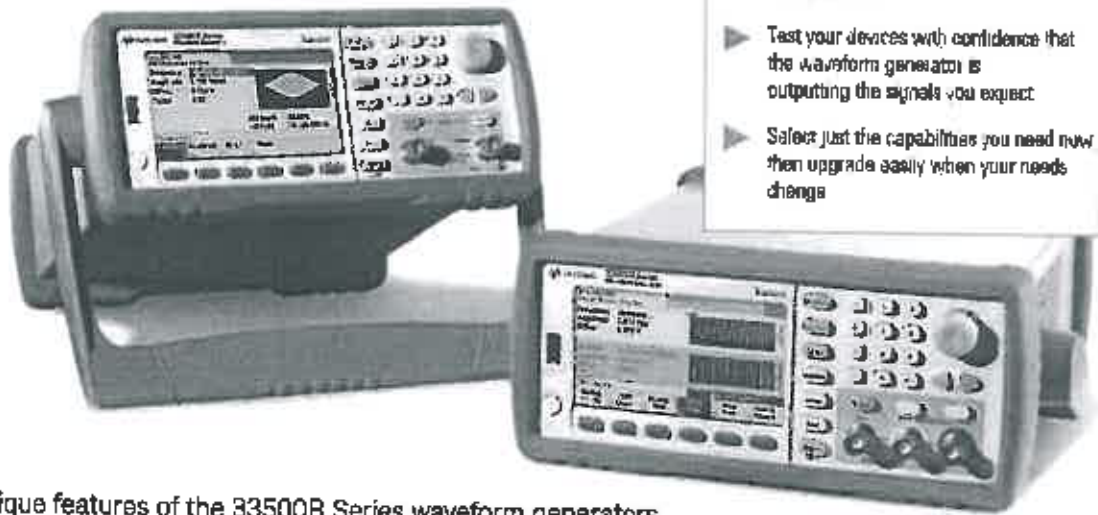
The Keysight Technologies, Inc. Trueform technology offers a new alternative that blends the best of DDS and point-by-point architectures, giving you the benefits of both without the limitations of either. Trueform technology uses an exclusive digital sampling technique that delivers unmatched performance at the same low price you are accustomed to with DDS.

The table below highlights the revolutionary capabilities of Trueform technology.

	DDS: Traditional 26 MHz waveform generator	Trueform: Keysight 30 MHz 335113 waveform generator	Improvement
Edge jitter	500 ps	40 ps	12x better
Custom waveform replication	Skips waveform points	100% point coverage	Exact waveform replication
Total harmonic distortion	0.2%	0.04%	5x better
Anti-alias filtering	Must provide externally	Always anti-aliased	No anti-aliasing artifacts
Sequenced arb	Not possible	Standard	Easily create complex waveform sequences

For more information about Keysight Trueform technology please visit: [www.keysight.com/find/trueform](http://www.keysight.com/find/trueform)

# Revolutionary signal generation with unmatched capabilities and fidelity

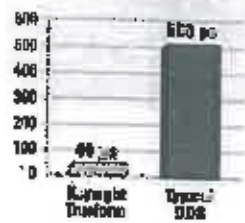


- ▶ Easily generate the full range of signals you need for the most demanding measurements
- ▶ Test your devices with confidence that the waveform generator is outputting the signals you expect
- ▶ Select just the capabilities you need now then upgrade easily when your needs change

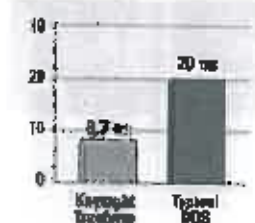
## Unique features of the 33500B Series waveform generators

Full Bandwidth Pulse	Full-bandwidth pulse to 20 or 30 MHz Set leading and trailing edge times independently
2 Channels	Dual channel coupling, frequency and amplitude equal and inverted Set start phase for each channel, set phase shift between channels
Sum Modulate	Sum two signals together, frequency and amplitude independent 2-tone, square-wave, noise on pulse
Point-By-Point Arb	Create up to 1 million samples standard, 10 million optional Connect arbs together, create up to 512 sequences
Voltage Settings	Lowest voltage range at 1 mVpp, x10x improvement Set high and low voltage limits to prevent overload on DUT
PRBS Patterns	Provides standard PRBS patterns, Pn-7 - Pn-23 Select PN type, set bit rate, set edge time

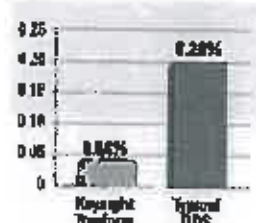
## Key attributes



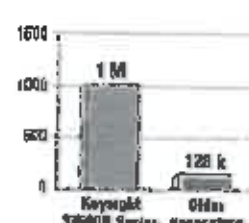
Jitter



Rise time



Total harmonic distortion



Standard memory

## Trueform Technology

Unmatched capabilities for generating a full range of signals for the most demanding requirements

The 33500B Series waveform generators offer the common signals and features you expect, such as modulation, sweep, and burst. But the 33500B Series offers many more features that give you the capabilities and flexibility you need to get your job done. Like an intuitive front-panel user interface that makes it easy to quickly relearn it when you've been focused elsewhere. Like built-in LAN, USB and GPIB interfaces that make it easy to control your instruments or transfer your waveforms to your instrument.

But the 33500B Series doesn't stop there. It offers a variety of capabilities you won't find elsewhere—capabilities that help you accelerate your testing and get your project wrapped up faster.

### Waveform summing and combining capability

Easily add noise to your signal for margin and distortion testing using only a single channel. You can create dual-tone multifrequency signals without a dual-channel generator, which means you can preserve your budget for other test needs. On a two-channel model, you can sum and combine up to four signals.

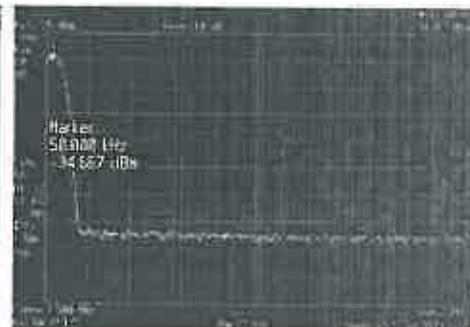
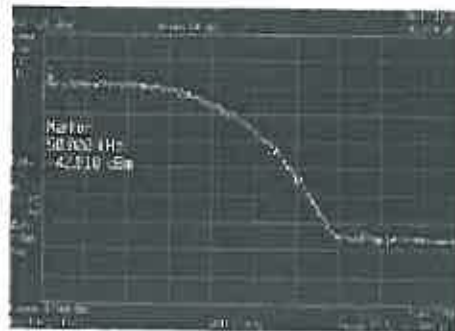
### Variable-bandwidth noise

You can adjust the bandwidth of the built-in noise generator to control the frequency content of your signal. Apply just the frequency stimulus you need so you concentrate the energy of your waveform in frequency bands of interest.

The images at right show approximately 19 dB increase in amplitude at 58 kHz when the bandwidth is reduced 10x. You can see how the signal energy is increased in the frequency of interest when the bandwidth is reduced, instead of being spread over a very wide bandwidth with lower amplitude at all frequencies.



Dual-tone signal created by summing waveforms using the modulation type, "Sum."



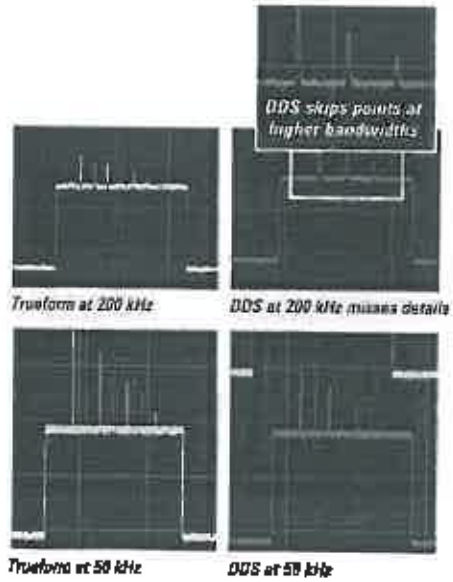
DDS technology may skip points at higher frequencies

Trueform never skips points, and is always anti-aliased

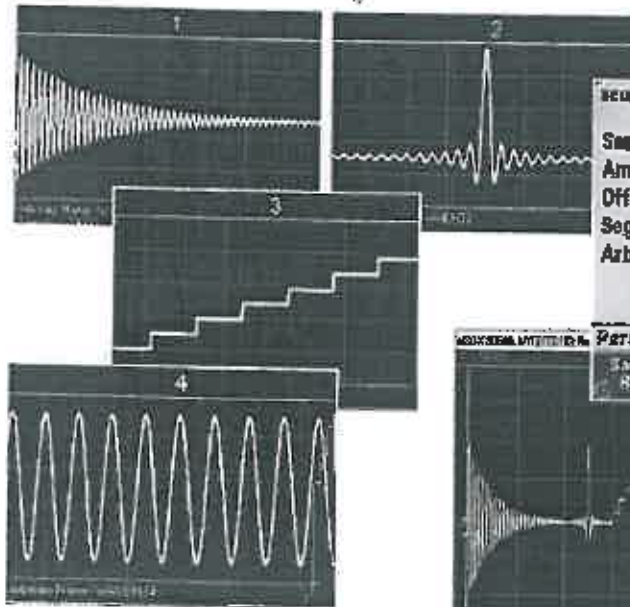
Define any waveform shape and any waveform length using point-by-point arbitrary waveform capability. Your waveforms are always anti-aliased for exceptional accuracy, and you can play them at any rate you select. Play your signals as defined, at your exact sample rate, without the chance of missing short-duration anomalies that are critical for testing device reliability.

### Waveform sequencing

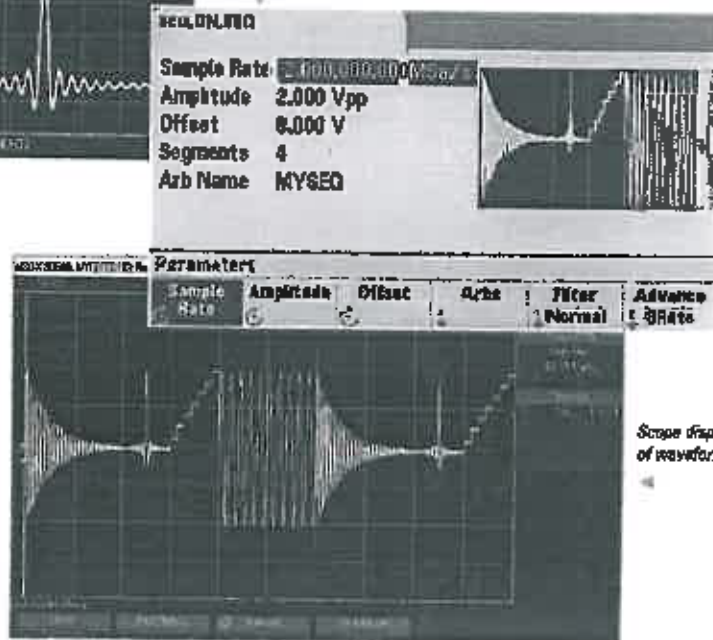
Waveform sequencing lets you create multiple configured waveforms with several common segments and lets you build long, complex waveforms using minimal instrument memory.



Create the waveform in the 25583A Waveform Builder Pro and download it to the waveform generator.



Waveform generator display with downloaded waveform.



Scope display of waveform.

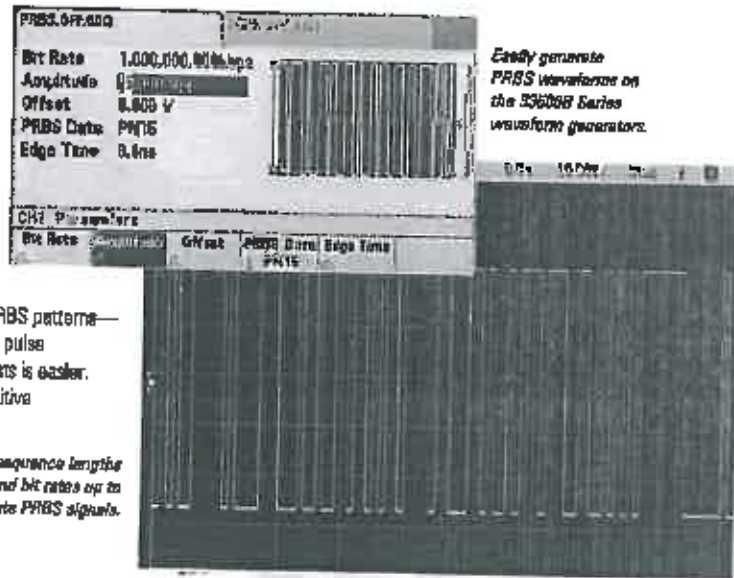


## Trueform Technology Capabilities *continued*

### Pseudo-random binary sequence (PRBS) pattern generation

Test your digital serial buses by streaming standard PRBS patterns—like PN7 and PN15—without the need for a separate pulse generator. With fewer instruments, setting up your tests is easier. You won't find these built-in PRBS patterns in competitive waveform generators.

*You can select multiple sequence lengths (such as PN15) and bit rates up to 50 Mbit/sec to create PRBS signals.*



### Smart phone and tablet access to full documentation

Need a quick answer? Get instant access to instrument documentation in seven different languages in smart-phone-friendly WebHelp format. You can access *all* user documentation in the palm of your hand—no PC or hardcopy manuals required. Another feature you won't find in competitive function/arb generators.

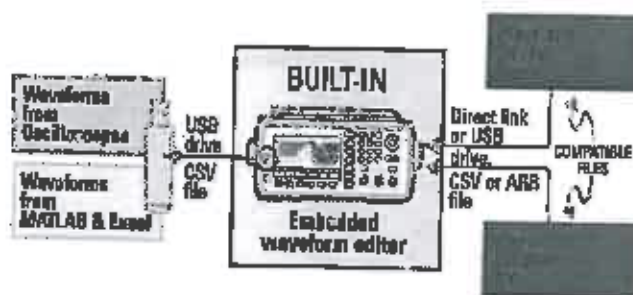


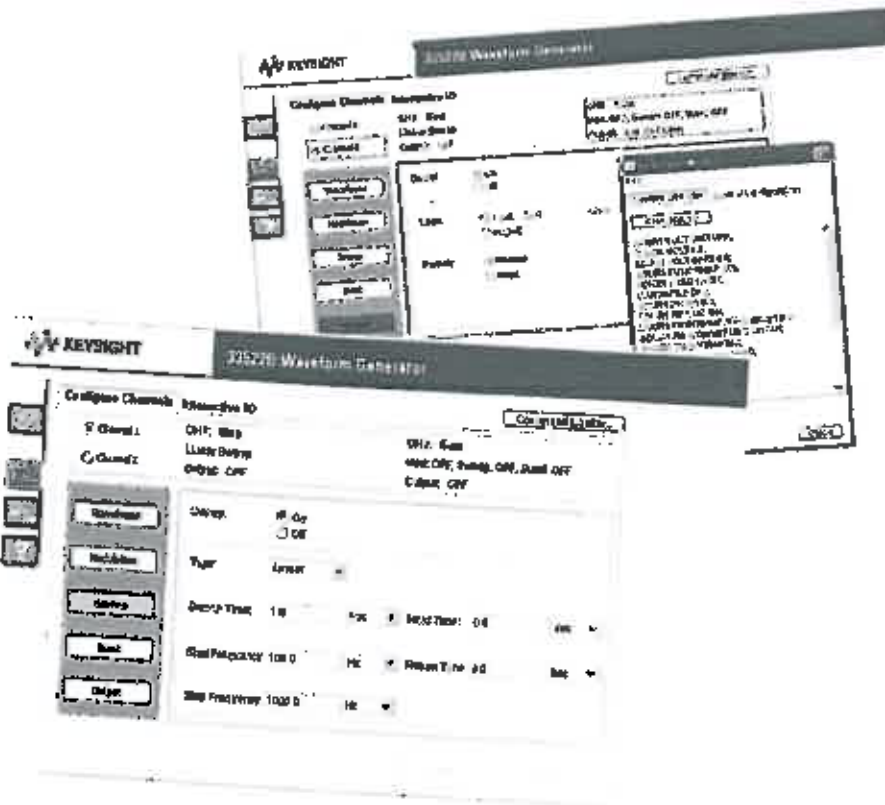
### Flexibility in creating and playing waveforms

There are five ways to create arbitrary waveforms for use with the 33600 generator.

1. Use the included Waveform Builder Basic software to edit and download a waveform file to the generator
2. Use 33603A Waveform Builder Pro software to create more complex waveforms and sequencing
3. Capture a waveform from an oscilloscope and download it to the generator
4. Create a waveform in MATLAB, Excel, etc. and download it to the generator
5. Use the generator's front panel to edit a waveform once it is in the generator

You have lots of flexibility to choose the way you want to work.





### Built-in Web browser

Easily set up and control your 33500B Series generator remotely over a LAN connection using the built-in LXI Web browser. You can monitor your tests and adjust settings from another office or room, or even from home.

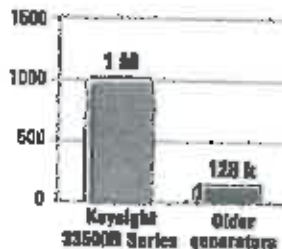
### Use the optional high-stability timebase for even better accuracy

Get improved timebase stability and frequency accuracy using the optional high-stability timebase. The optional timebase offers 0.1 ppm stability, which is 20x more stable than the standard timebase over one year.

### Standard deep memory

If you want to test your design with long, complex waveforms with a variety of anomalies, you need to make sure your waveform generator has sufficient memory. The 33500B Series' standard memory is 1 MSamples deep.

Typical DDS generators offer only a fraction of that amount but with the 33500B Series there is even a 16 MSample memory option available.



# Trueform Technology

## Signal integrity: Test your devices with confidence that your signal generator is outputting the signals you expect

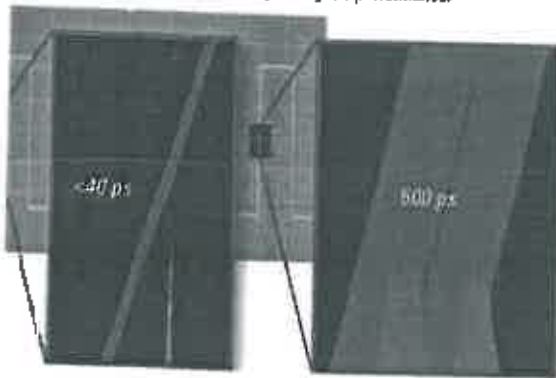
If your generator is introducing spurious signals or harmonics, you'll have a hard time producing reliable designs. To be successful, you need to test with clean, precise, low-noise signals. Keysight 33500B Series waveform generators offer the highest signal fidelity so you can generate the exact waveforms you need for your most challenging measurements. You can be confident you are seeing your design's characteristics, not your waveform generator's, in your measurements.

33500B Series waveform generators offer the following advantages:

### Lowest jitter

With 12x better jitter than anything in their class, 33500B Series waveform generators offer unparalleled edge stability. You can even use them as a system clock for timing and triggering your other instruments. With better jitter performance, you can place edges more accurately, helping you reduce timing errors in your circuit design.

*Trueform technology significantly improves jitter performance.*



*Trueform technology.*

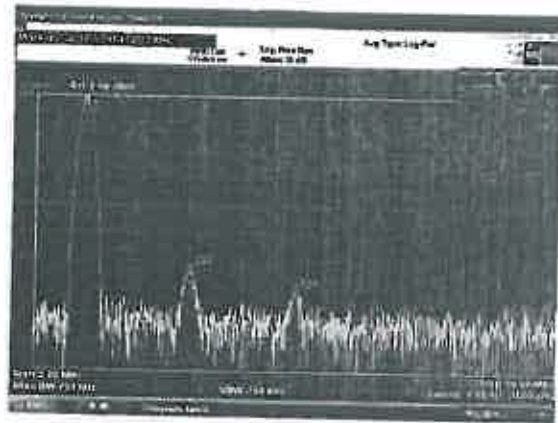
*Traditional DDS technology.*

### Faster edge times

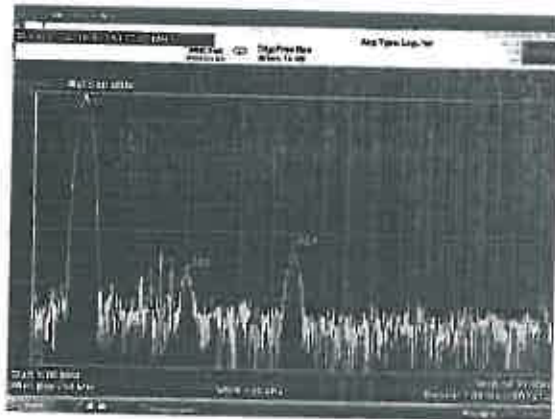
The 33500B Series' 8.4-ns rise and fall times are more than twice as fast as you'll find in typical waveform generators. You can place edges with more confidence and more accurately set trigger points. Because of the faster transition, higher harmonic content is created, which helps you expand your understanding of your circuit.

### Lowest harmonic distortion

With total harmonic distortion of just 0.04%, the 33500B Series offers 6x better fidelity than other generators. Clean, spurious-free signals don't introduce noise or artifacts. See your design's characteristics, not the waveform generator's, in your measurements.



*Keysight 33500B Series waveform generators offer the lowest total harmonic distortion (THD) in its class.*



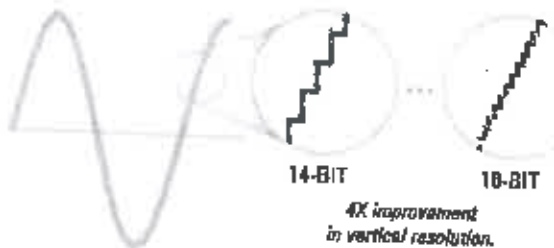
*Typical DDS generator has a higher noise floor and greater harmonics.*

## Reproduce lower-voltage output signals

Today's ultra-low-power products such as pacemakers, hearing aids and remote sensors use very low voltages. The 33500B Series lets you create signals as low as 1 mV<sub>pp</sub>. That's 10x better amplitude resolution than typical waveform generators offer.

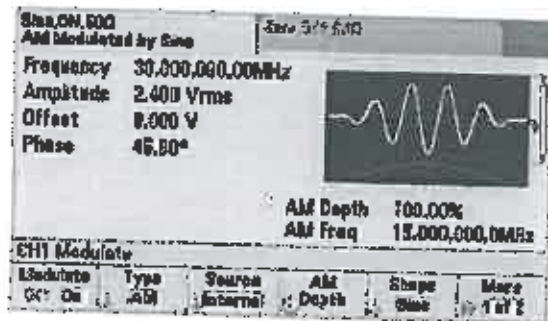
## Highest amplitude resolution

The 33500B Series' 16 bits of resolution is 4x that of most waveform generators. You can make output changes all the way down to 1  $\mu$ V—exactly what you need for testing today's low-voltage circuits and designs.



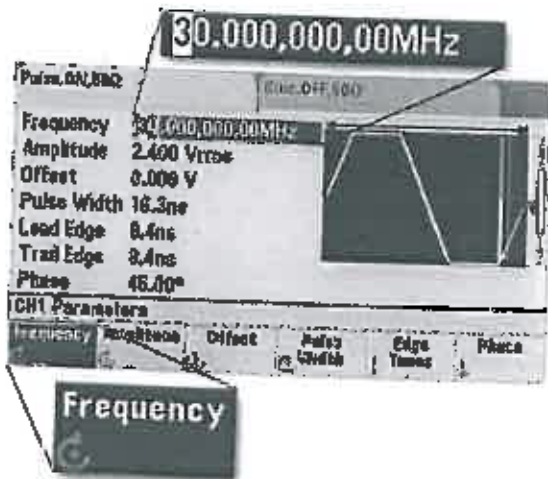
## Full bandwidth modulation sources

Eliminate the need for an external modulation source. The 33500B Series has a modulation frequency up to the frequency of the waveform being modulated. Existing DDS-based generators have a much lower internal modulation frequency. Now you can create your complex signals all within a single generator.



## Full bandwidth pulses

Create pulses up to 30 MHz with the 33500B Series. Most DDS-based generators offer reduced bandwidth when generating pulses. With a broader operating range, you have the frequency you need for a wider range of applications.



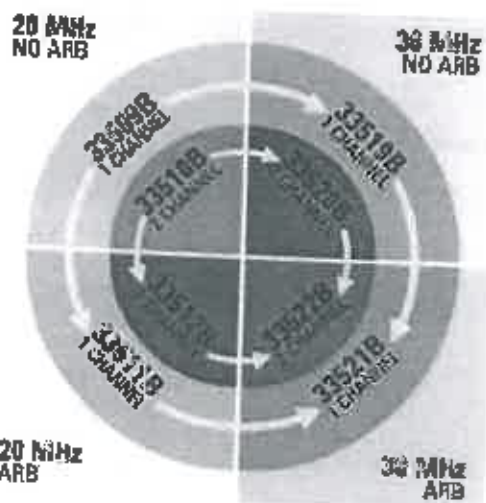


Trueform Technology  
 Select the capabilities you need now,  
 then upgrade easily when  
 your needs change



### Investment protection

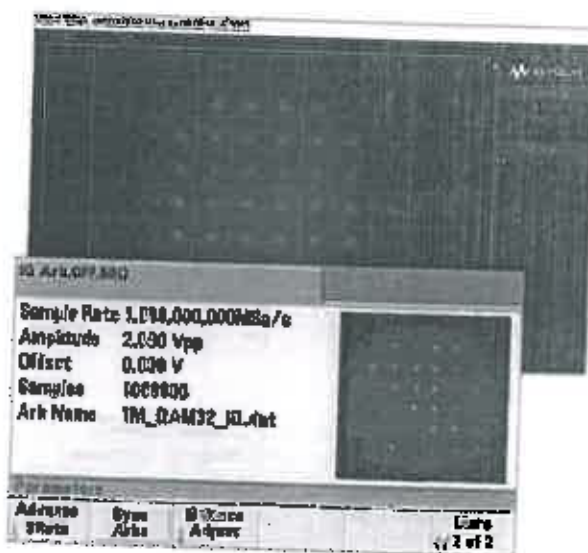
With most waveform generators, you get only what you pay for when you buy your instrument. But with 33600B Series waveform generators, there are eight different models to choose from so you can purchase the capability you need now and upgrade later when your project needs change. Your investment in test equipment is protected. If you need to generate 30 MHz waveforms or arbitrary waveforms, or if you need deeper memory for generating more complex signals, you can easily add the capability after the fact with software upgrades. And there's no price penalty for adding the capability later.



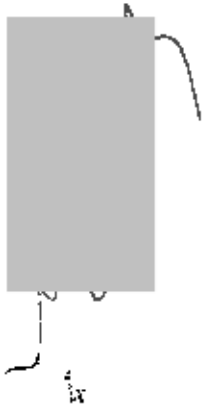
Select from eight models to get the capability that fits your budget now—then take advantage of easy software upgrades to expand your instrument's capabilities when you are ready.

### Application-specific options

If you are doing simple experiments in digital communications, use the optional IQ player to play IQ files on your 2-channel function generator.



Optional IQ player allows you to play IQ files on your 2-channel Arb function generator.



Model No.	Description	ARB
33609B	20 MHz, 1-channel	
33610B	20 MHz, 2-channel	
33611B	20 MHz, 1-channel	☑
33612B	20 MHz, 2-channel	☑
33618B	30 MHz, 1-channel	
33620B	30 MHz, 2-channel	
33621B	30 MHz, 1-channel	☑
33622B	30 MHz, 2-channel	☑



LAN (10/100 Class C), USB and GPIB connectivity for quick and easy connectivity to a PC or network.

### 8 models to choose from

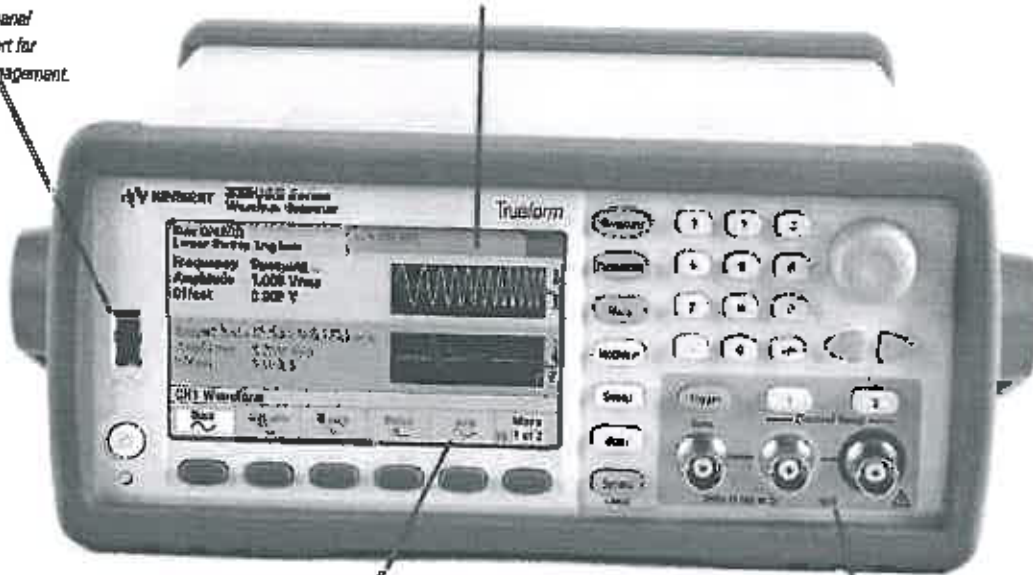
Choose the model with the capability you need now, knowing you can upgrade later. All models come with a rich set of built-in, standard features, including LAN, USB and GPIB interfaces, 1 MSample of memory, an external timebase input, and basic waveform generation software. You get everything you need to generate clean, precise, low-noise signals for testing your designs.

Large, color, graphical display offers simultaneous parameter setup, signal viewing and editing for easy operation.



Supports remote operation using a web browser to connect to a built-in web page.

Front-panel USB port for file management.



True point-by-point arbitrary waveforms with sequencing for more accurate representation of user-defined signals.

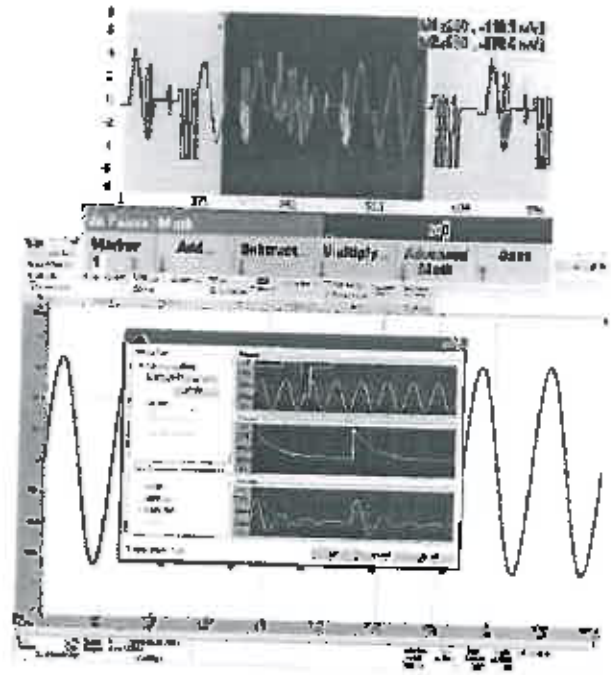
Dual-channel mode with independent or coupled channels.

## Other Productivity tools

### Easily create custom waveforms with advanced waveform creation and editing software

Get advanced signal creation/editing capability without tedious programming with optional 33503A BenchLink Waveform Builder Pro software. The Microsoft Windows-based program provides easy-to-use creation tools, such as an equation editor, waveform math and drawing tools, that make it easy to create custom signals. It features a standard function library, waveform sequencer and filters as well as windowing functions that allow you to easily modify and further refine your waveform. A library of built-in signals helps you quickly create more complex waveforms.

The result is quicker, easier creation of custom waveforms, coupled with deeper analysis insight into your signals. For additional information and to download a 30-day trial version of the software, visit: [www.keysight.com/find/33503trial](http://www.keysight.com/find/33503trial).



Creates and edit complex waveforms using 33503A Waveform Builder Pro software.

# Configuration Guide

## Step 1. Choose your bandwidth, channel count, and arbitrary waveforms

33500B Series waveform generators with Trueform technology

Bandwidth	20 MHz	20 MHz	30 MHz	30 MHz
Number of channels	1	2	1	2
Waveform generator	33509B	33510B	33519B	33520B
Waveform generator with arb capability	33511B	33512B	33521B	33522B

## Step 2. Tailor your waveform generator for more demanding applications

Application	Order option
Additional memory for long waveforms	MEM (only available on models with arb)
Baseband IQ Player with adjustments	IQP (only available on 33512B/33522B)
Security features with NISPODM	SEC
Ultra-high stability timebase	DCX

## Step 3. Upgrade your waveform generator in the future

Upgrade desired	Order upgrade option
Increase bandwidth to 30 MHz	335BW1U on 1-channel models 335BW2U on 2-channel models
Add arbitrary waveform capability	335ARB1U on 1-channel models 335ARB2U on 2-channel models
Add 16M memory to arb	335MEM1U on 1-channel arb models 335MEM2U on 2-channel arb models
Add NISPODM and file security	335SECU
Add IQ baseband signal player to 2-channel arb	335IQPU
Add high-stability timebase	335DCU-DCX (Must return to Keysight)

NOTE: Cannot upgrade a 1-channel generator to a 2-channel generator

## Specifications

Unless otherwise stated, all specifications apply with a 50  $\Omega$  resistive load and auto range ON.

### Instrument characteristics

<b>Models &amp; options</b>	
33609B/11B/19B/21B	1-channel
33610B/12B/20B/22B	2-channel
<b>Option MEM</b>	Increases arbitrary waveform memory to 16 MSA/channel*
<b>Option OCX</b>	OCXO timebase for ultra-high stability
<b>Option IQP</b>	IQ player (Only available on 33612B and 33622B)
<b>Waveforms</b>	
Standard	Sine, square, ramp, pulse, triangle, Gaussian noise, PRBS (Pseudorandom Binary Sequence), DC
Built-in arbitrary*	Carrier, exponential fall, exponential rise, Gaussian pulse, Haversine, Lorentz, D-Lorentz, negative ramp, sinc
User-defined arbitrary*	Up to 1 MSA (16 MSA with Option MEM) with multi-segment sequencing
<b>Operating modes &amp; modulation types</b>	
<b>Operating modes</b>	Continuous, modulate, frequency sweep, burst, output gate
<b>Modulation types</b>	AM, FM, PM, FSK, BPSK, PWM, Sum (carrier + modulation)

### Waveform characteristics

<b>Sine</b>		
<b>Frequency range</b>	1 $\mu$ Hz to 20 MHz or 30 MHz, 1 $\mu$ Hz resolution	
<b>Amplitude flatness (apoc)<sup>1,2</sup></b> (relative to 1 kHz)	< 100 kHz:	$\pm 0.15$ dB
	100 kHz to 5 MHz:	$\pm 0.15$ dB
	5 to 20 MHz:	$\pm 0.30$ dB
	20 to 30 MHz**:	$\pm 0.40$ dB
<b>Harmonic distortion (typ)<sup>1,3</sup></b>	< 20 kHz:	< -70 dBc
	20 to 100 kHz:	< -65 dBc
	100 kHz to 1 MHz:	< -50 dBc
	1 to 20 MHz:	< -40 dBc
	20 to 30 MHz**:	< -35 dBc
<b>THD (typ)</b>	20 Hz to 20 kHz:	< 0.04%
<b>Non-harmonic spurious (typ)<sup>2,3</sup></b>	Standard: < -75 dBc, increasing +20 dB/decade above 2 MHz Option OCX: < -76 dBc, increasing +20 dB/decade above 10 MHz (or < -108 dBm, whichever is greater, below 500 MHz)	
<b>Phase noise (SSB) (typ)</b>	Standard	
	1 kHz offset:	Option OCX
	10 kHz offset:	-110 dBc/Hz
	100 kHz offset:	-125 dBc/Hz
	Standard	-135 dBc/Hz

\*Only available on 33611B/12B/21B/22B

\*\*Only available on 33618B/20B/21B/22B

NOTE: See page 22 for footnotes 1 through 10

# Specifications

## Waveform characteristics, *continued*

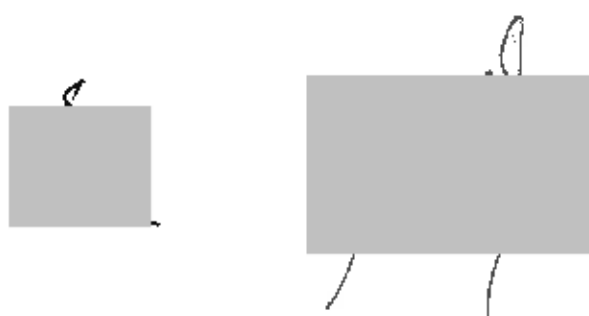
<b>Square &amp; pulse</b>	
Frequency range	1 $\mu$ Hz to 20 MHz or 30 MHz, 1 $\mu$ Hz resolution
Rise and fall times (nom)	Square: 8.4 ns, fixed Pulse: 8.4 ns to 1 $\mu$ s, independently variable, 100-ps or 3-digit resolution
Overshoot (typ)	< 2%
Duty cycle	0.01% to 99.99% <sup>1</sup>
Pulse width	18 ns minimum, 100-ps resolution
Jitter (cycle-to-cycle, typ)	< 40 ps rms
<b>Ramp &amp; triangle</b>	
Frequency range	1 $\mu$ Hz to 200 kHz, 1 $\mu$ Hz resolution
Ramp symmetry	0.0% to 100.0%, 0.1% resolution (0% is negative ramp, 100% is positive ramp, 50% is Triangle)
Nonlinearity (typ)	< 0.05% from 5% to 95% of the signal amplitude
<b>Gaussian noise</b>	
Bandwidth (typ)	1 mHz to 20 MHz or 30 MHz, variable
Crest factor (nom)	4.8
Repetition period	> 50 years
<b>Pseudorandom binary sequence (PRBS)</b>	
Bit rate	1 mbps to 50 Mbps, 1 mbps resolution
Sequence length	2 <sup>m</sup> -1, m=7, 8, 11, 15, 20, 23
Rise and fall times (nom)	8.4 ns to 1 $\mu$ s, variable, 100-ps or 3-digit resolution

## Arbitrary waveform characteristics

<b>General</b>	
Waveform length	8 Sa to 1 MSa per channel (18 MSa with Option OCX) in increments of 1 sample
Sample rate	1 $\mu$ Sa/s to 250 MSa/s, 1 $\mu$ Sa/s resolution
Voltage resolution	16 bits
Bandwidth (-3 dB, nom)	Filter Off: 40 MHz "Normal" Filter On: 0.27 x (Sample Rate) "Step" Filter On: 0.13 x (Sample Rate)
Rise and fall time	0.35 / Bandwidth (10 ns min) with "Normal" or "Step" filter On
Settling time (typ)	< 200 ns to 0.5% of final value
Jitter (typ)	Filter Off: < 40 ps rms "Normal" or "Step" filter On: < 5 ps

## IQ Player Characteristics

<b>Balance Adjust</b>	
Amplitude Gain (channel to channel amplitude balance)	-30% to +30%
Delta Offset Ch 1 and Ch 2	$\pm$ (5 VDC - Peak AC) into 50 $\Omega$ $\pm$ (10 VDC - Peak AC) into open circuit
IQ Signal Skew (adjusts channel to channel skew)	-4.00 ns to +4.00 ns
<b>Views</b>	
Amplitude vs. Time	
X-Y (constellation diagram)	



## Specifications

### Arbitrary waveform characteristics, continued

#### Waveform sequencing (Available only on 33511B-12B/21B/22B)

Operation	Individual arbitrary waveforms (segments) can be combined into user-defined lists (sequences) to form longer, more complex waveforms. Each sequence step specifies whether to repeat the associated segment a certain number of times, to repeat it indefinitely, to repeat it until a Trigger event occurs, or to stop and wait for a Trigger event. Additionally, the behavior of the Sync output can be specified in each step. To improve throughput, up to 32 sequences totalling up to 1,024 segments can be pre-loaded into volatile memory.
Segment length	8 Sa to 1 MSa per channel (18 MSa with Option MEM) in increments of 1 sample
Sequence length	1 to 512 steps
Segment repeat count	1 to $1 \times 10^9$ , or Infinite

### Output characteristics

#### Isolation

##### Outputs

Connector shells for channel output(s), Sync, and Mod in are connected together but isolated from the instrument's chassis. Maximum allowable voltage on isolated connector shells is  $\pm 42$  Vpk.

##### Signal output

Output impedance (nom)	50 $\Omega$
On, off, inverted	User-selectable for each channel
Voltage limit	User-definable VMAX and VMIN limits
Overload protection	Output turns off automatically when an overload is applied. Instrument will tolerate a short-circuit to ground indefinitely.
Amplitude range	1 mVpp to 10 Vpp into 50 $\Omega$ 2 mVpp to 20 Vpp into open circuit
Resolution	4 digits
Units	Vpp, Vrms, or dBm, selectable
Accuracy <sup>1,2</sup> (spec)	$\pm 1\%$ of setting $\pm 1$ mVpp at 1 kHz
DC offset range <sup>3</sup>	$\pm 5$ VDC - Peak AC into 50 $\Omega$ $\pm 10$ VDC - Peak AC into open circuit
Resolution	4 digits
Units	VDC
Accuracy <sup>1,4</sup> (spec)	$\pm 1\%$ of Offset setting $\pm 0.25\%$ of Amplitude setting $\pm 2$ mV

#### Frequency accuracy

##### Standard frequency reference (spec)

1 year, 23° C $\pm$ 5° C	$\pm 1$ ppm of setting $\pm 16$ $\mu$ Hz
1 year, 0° C to 55° C	$\pm 2$ ppm of setting $\pm 16$ $\mu$ Hz

##### High-stability frequency reference (spec): Option DCX

1 year, 0° C to 66° C	$\pm 0.1$ ppm of setting $\pm 16$ $\mu$ Hz
-----------------------	--



# Specifications

## Modulation types and operating modes

Carrier	AM	FM	PM	FSK	BPSK	PWM	Sum	Burst	Sweep
Sine and Square	*	*	*	*	*	*	*	*	*
Pulse	*	*	*	*	*	*	*	*	*
Triangle and Ramp	*	*	*	*	*	*	*	*	*
Gaussian Noise	*	*	*	*	*	*	*	*	*
PRBS	*	*	*	*	*	*	*	*	*
Single ARB <sup>a</sup>	*	*	*	*	*	*	*	*	*
Sequenced ARB <sup>b</sup>	*	*	*	*	*	*	*	*	*

<sup>a</sup> Gated burst only. <sup>b</sup> Applies to sample clock, not whole waveform.

## Modulating signals

Carrier	Sine	Square	Triangle / Ramp	Noise	PRBS	ARB <sup>a</sup>	External
Sine	*	*	*	*	*	*	*
Square and Pulse	*	*	*	*	*	*	*
Triangle and Ramp	*	*	*	*	*	*	*
Gaussian Noise	*	*	*	*	*	*	*
PRBS	*	*	*	*	*	*	*
ARB <sup>a</sup>	*	*	*	*	*	*	*

<sup>a</sup> Only applies to 33611B/12B/21B/22B

## Modulation characteristics

<b>Amplitude modulation (AM)</b>	
Source	Internal or external, or either channel with 2-channel models
Type	Full-carrier or double-sideband suppressed-carrier
Depth <sup>1</sup>	0% to 120%, 0.01% resolution
<b>Frequency modulation (FM) <sup>2</sup></b>	
Source	Internal or external, or either channel with 2-channel models
Deviation	1 µHz to 15 MHz, 1 µHz resolution
<b>Phase modulation (PM) <sup>3</sup></b>	
Source	Internal or external, or either channel with 2-channel models
Deviation	0° to 360°, 0.1° resolution
<b>Frequency shift key modulation (FSK) <sup>4</sup></b>	
Source	Internal timer or ext trig connector
Mark & space	Any frequency within the carrier signal's range
Rate	0 Hz to 1 MHz
<b>Binary phase shift key modulation (BPSK) <sup>5</sup></b>	
Source	Internal timer or ext trig connector
Phase shift	0° to 360°, 0.1° resolution
Rate	0 Hz to 1 MHz
<b>Pulse width modulation (PWM)</b>	
Source	Internal or external, or either channel with 2-channel models
Deviation <sup>6</sup>	0% to 100% of pulse width, 0.01% resolution
<b>Additive modulation (sum)</b>	
Source	Internal or external, or either channel with 2-channel models
Ratio <sup>1</sup>	0% to 100% of carrier amplitude, 0.01% resolution





## Specifications

### Burst <sup>6</sup>

Type	Counted or gated
Count	1 to $1 \times 10^6$ cycles, or infinite
Gated	Produces complete cycles while Ext Trig is asserted
Start/stop phase <sup>4</sup>	$-360^\circ$ to $360^\circ$ , $0.1^\circ$ resolution
Trigger source	Internal Timer or Ext Trig connector
Marker	Adjustable to any cycle; Indicated by the trailing edge of the Sync pulse

### Sweep <sup>7</sup>

Type	Linear, Logarithmic, List (up to 128 user-defined frequencies)
Operation	Linear and Logarithmic sweeps are characterized by a Sweep time (during which the frequency changes smoothly from Start to Stop), a Hold time (during which the frequency stays at the Stop frequency), and a Return time (during which the frequency changes smoothly from Stop to Start). Returns are always linear.
Direction	Up (Start freq < Stop freq) or Down (Start freq > Stop freq)
Start and stop frequencies	Any frequency within the waveform's range
Sweep time	Linear: 1 ms to 3900 s, 1 ms resolution; 3501 s to 250,000 s, 1 s resolution Logarithmic: 1 ms to 500 s
Hold time	0 s to 3900 s, 1 ms resolution
Return time	0 s to 3600 s, 1 ms resolution
Trigger source <sup>4</sup>	Immediate (continuous), external, single, linc, or timer
Marker	Adjustable to any frequency between Start and Stop for Linear and Logarithmic types or any frequency in the list for List type; indicated by the trailing edge of the sync pulse

### Internal timer for FSK, BPSK, BURST, and SWEEP

Range	1 $\mu$ s to 6000s, 8-digit or 4 ms resolution
-------	--

### 2-channel characteristics (Only applies to 33519B/20B/21B/22B)

Operating modes	Independent, coupled parameter(s), combined (Ch 1 + Ch 2), Equal (Ch 2 = Ch 1), or differential (Ch 2 = -Ch 1)
Parameter coupling	None, frequency (ratio or difference) and/or amplitude and DC offset
Relative phase	$0^\circ$ to $360^\circ$ , $0.1^\circ$ resolution
Skew (typ)	< 200 ps (when performing identical operations)
Crosstalk (typ)	< -65 dB

## Specifications

### Sync/marker output

Connector	Front-panel BNC, isolated from chassis
Functions	Sync, sweep marker, burst marker, or arbitrary waveform marker
Assignment	Channel 1 or channel 2
Polarity	Normal or inverted
Voltage level (nom)	3 Vpp into open circuit, 1.5 Vpp into 50 $\Omega$
Output impedance (nom)	50 $\Omega$
Minimum pulse width (nom)	16 ns

### External trigger/gate

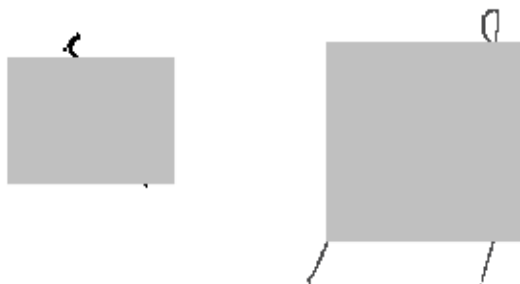
Connector	Rear-panel BNC, chassis-referenced
Function	Input or output
Assignment	Channel 1, channel 2, or both (as input) Channel 1 or channel 2 (as output)
Polarity	Positive or negative slope
Voltage level (nom)	0 V to 0.4 V for low, > 2.8 V for high, 3.5 V maximum (as input) 3 Vpp (nom) into open circuit, 1.5 Vpp (nom) into 50 $\Omega$ (as output)
Impedance (nom)	10k $\Omega$ , DC-coupled (as input) 50 $\Omega$ (as output)
Minimum pulse width (nom)	16 ns
Input rate	DC to 1 MHz
Minimum pulse width	100 ns (as input)
Duty cycle (nom)	50% (as output)
Trigger delay	0 ns to 1000 ns, 4 ns resolution; applies to all trigger events
Input latency (typ)	< 135 ns with Trigger Delay set to zero
Input jitter (typ)	< 2.5 ns, rms
Fanout	$\leq$ 4 total Keysight 33500B Series waveform generators

### Modulation input

Connector	Rear-panel BNC, isolated
Assignment	Channel 1, Channel 2, or both
Voltage level	$\pm$ 5 V full-scale
Input impedance (nom)	5k $\Omega$
Bandwidth (-3 dB, typ)	0 Hz to 100 kHz

### Frequency reference input

Connector	Rear-panel BNC, isolated from chassis and all other connectors
Reference selection	Internal, external, or auto
Frequency range	Standard: 10 MHz $\pm$ 20 Hz Option DCX: 10 MHz $\pm$ 1 Hz
Lock time (typ)	< 2 s
Voltage level	200 mVpp to 5 Vpp
Input impedance (nom)	1k $\Omega$    20 pF, AC-coupled



## Specifications

### Frequency reference output

Connector	Rear-panel BNC, chassis-referenced
Frequency (nom)	10 MHz
Output impedance (nom)	50 $\Omega$ , AC-coupled
Level (nom)	0 dBm, 632 mV <sub>rms</sub> into 50 $\Omega$

### Real-time clock/calendar

Set and read	Year, month, day, hour, minute, second
Battery	CR-2032 coin-type, replaceable, >5-year life (typ)

### Programming times (meas.)

#### Configuration change speed

	LAN (socket)	LAN (VXI-11)	USB 2.0	GPIO
Change function	5 ms	5 ms	5 ms	5 ms
Change frequency	2 ms	3 ms	2 ms	3 ms
Change amplitude	20 ms	20 ms	18 ms	22 ms
Select user arb (15 k)	9 ms	11 ms	9 ms	9 ms

#### Arbitrary waveform download speed to volatile

(binary transfer)	LAN (socket)	LAN (VXI-11)	USB 2.0	GPIO
4 k sample	6 ms	18 ms	8 ms	39 ms
1 M sample	1.3 s	2.8 s	13 s	8.1 s

## Memory

### Arbitrary waveform and instrument state memory

Volatile	1x10 <sup>4</sup> samples per channel or 16x10 <sup>4</sup> samples per channel (Option MEM) 612 sequence steps per channel
Non-volatile	File system file space is limited to 64 MB (~82 Msa of arbitrary waveform records)
Instrument state	
Store / Recall	User defined instrument states
Power Off	Power Off state automatically saved
Power On	Factory default settings or last power off settings
USB File System	
Front-panel port	USB 2.0 high-speed mass storage (MSC) class device
Capability	Read or write instrument configuration settings, instrument states and user arbitrary waveform and sequence files.
Speed	10 MB/s (nom)

## Specifications

### General characteristics

<b>Computer interfaces</b>	
LXI-C (rev1.3)	10/100Base-T Ethernet (Sockets & VX-11 protocol) USB2.0 (USB-TMC400 protocol) GPIB/IEEE-488.1, IEEE-488.2
<b>Web user interface</b>	Remote operation and monitoring
<b>Programming language</b>	SCPI-1998, IEEE-488.2 Keysight 33210A / 33220A compatible
<b>Graphical display</b>	4.3" Color TFT WVGA (480x272) with LED backlight
<b>Mechanical</b>	
<b>Size</b>	281.1mm W x 103.8mm H x 303.2mm D (with bumpers installed) 212.8mm W x 88.3mm H x 272.3mm D (with bumpers removed) 2U x 1/4 rack width
<b>Weight (nom)</b>	3.3 kg (7.2 lbs)
<b>Environmental</b>	
<b>Storage temperature</b>	-40°C to 70°C
<b>Warm-up time</b>	1 hour
<b>Operating environment</b>	EN61010, pollution degree 2; indoor locations
<b>Operating temperature</b>	0°C to 66°C
<b>Operating humidity</b>	5% to 80% RH, non-condensing
<b>Operating altitude</b>	up to 3000 meters
<b>Regulatory</b>	
<b>Safety</b>	Complies with European Low Voltage Directive and carries the CE-marking. Conforms to UL 61010-1, CSA C22.2 61010-1, and IEC 61010-1:2001
<b>EMC</b>	Complies with European EMC Directive for test and measurement products. - IEC/EN 61326-1 - CISPR Pub 11 Group 1, class A - AS/NZS CISPR 11 - ICES/NMB-001 <i>Complies with Australian standard and carries C-Tick mark</i> <i>This ISM device complies with Canadian ICES-001.</i> <i>Cet appareil ISM est conforme à la norme NMB-001 du Canada</i>
<b>Acoustic Noise (nom)</b>	SPL 35 dB(A)
<b>Line power</b>	
<b>Voltage</b>	100 V - 240 V 50/60 Hz -5% +10% 100 V - 120 V 400 Hz ±10%
<b>Power consumption (typ)</b>	< 45 W, < 130 VA

## Definitions

### Specification (spec)

The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0° C – 55° C and after a 45-minute warm up period. All specifications include measurement uncertainty and were created in compliance with ISO-17025 methods.

Data published in this document are specifications (spec) only where specifically indicated.

### Typical (typ)

The characteristic performance, which 80% or more of manufactured instruments will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23°C).

### Nominal (nom)

The mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed.

This data is not warranted and is measured at room temperature (approximately 23°C).

### Measured (meas)

An attribute measured during development for purposes of communicating the expected performance. This data is not warranted and is measured at room temperature (approximately 23°C).

### Accuracy

Represents the traceable accuracy of a specified parameter. Includes measurement error and timebase error, and calibration source uncertainty.

Random measurement errors are combined using the root-sum-square method and are multiplied by M for the desired Confidence Level. Systematic errors are added linearly and include time skew errors, trigger timing errors, and timebase errors as appropriate for each measurement type.

### Confidence Level

For 99% Confidence use  $k=2.5$  in accuracy calculations.

For 95% Confidence use  $k=2.0$  in accuracy calculations.

1. Add 1/10th of the output amplitude and offset accuracy specification per °C for operation at temperatures beyond 23°C ± 5°C.
2. Auto range ON.
3. DC Offset set to zero.
4. Limited to arbitrary waveforms that are < 1 million points; phase resolution limited by number of points in arbitrary waveforms < 3,600 points.
5. Output noise is typically 20 dB lower when (DC + Peak AC) < 320 mV (into 60 Ω) or 640 mV (into open circuit).
6. Subject to maximum output voltage limits.
7. All frequency changes are phase-continuous.
8. Subject to pulse width limits.
9. Coupled Burst operation is not allowed for Gaussian Noise.
10. External trigger only for sweep time > 8000 sec.

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## Технически данни Weller модел WE 1010

Изглед:

**Weller**

### WE 1010

1-Channel Power Unit, digital, 70 W  
Product no.: T0053298699



- Захранващ блок, 1 канал с поялник WEP 70 и предпазна стойка PH 70
- Поялник от 70 W с ергономична дръжка и смяна на върха без инструменти
- ESD безопасна станция, желязо и топлоустойчива силиконов кабел за безопасна работа
- Използване на съвети за ET сляване
- Режимът на готовност и автоматичното намаляване на скоростта спестяват енергия, предпазват оборудването
- Защитена с парола за запазване на настройките
- Сменяйте горещите съвети с ръка, като завъртите пластмасовата гайка на молив за запояване без допълнителен инструмент.

Захранващо напрежение 230 V

Мощност 85 W

Канали: 1

Температурен обхват °C 100 – 450

Температурна точност °C ± 5

Температурна стабилност °C ± 6

Дисплей: цифров LC дисплей

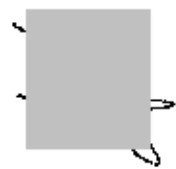
# WE 1010

1-Channel Power Unit, digital, 70 W  
Product no.: T0053298699



## Benefits

- > Power unit, 1 channel with soldering iron WEP 70 and safety rest PH 70
- > 70 W solder iron with ergonomic handle and providing toolless tip change
- > ESD safe station, iron and heat-resistant silicon cable for safe handling
- > Using ET soldering tips
- > Standby mode and auto setback conserves energy, protects equipment
- > Password-protected to preserve settings
- > Change hot tips out by hand by twisting the plastic knurled nut on the soldering pencil without an additional tool



For this purpose, we recommend:



Solder fume extractors



Soldering Irons



Cleaning



Pre-heating plates





## Technical Data

Dimensions L x W x H (mm)	150 x 120 x 98
Dimensions L x W x H (inches)	5.91 x 4.72 x 3.86
Weight (approx.) In kg	1.4
Voltage	230 V
Power	85 W
Channels	1
Temperature range (depends on tool) °C	100 - 450
Temperature range (depends on tool) °F	200 - 850
Temperature accuracy °C	± 5
Temperature accuracy °F	± 9
Temperature stability °C	± 6
Temperature stability °F	± 10
Equipotential bonding socket	--
Display	Digital LC Display
Air consumption l/min	---
Operating pressure in bar/psi	---
Capacity l/min	---
Vacuum	---

## Owning the bench



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## Предложение за изпълнение на обособената позиция

Предложението за изпълнение на обособената позиция е съобразено с насоките, дадени в Указанията за подготовка на офертите и Техническите спецификации. Ние представяме предложение и приложения за изпълнение на обособената позиция 2 които съответстват на изискванията на Възложителя.

В следващата таблица представяме таблица за съответствие с изискванията на Възложителя. Предложеното оборудване покрива и надвишава изискванията, заложиени в техническата спецификация за доставка на специализирано изследователско работно място.

Цялото оборудване ще бъде доставяно, според спецификацията, която съответства на техническата и на ценовата спецификация:

Изискване	предложение	Съответства
ESD защитена работна маса; възможност за вграждане на специализирани контролно-измервателни уреди;	EUROSTAT	Да, съответства
цифров мултимер "true RMS", с обхват по напрежение от 100 mV до 600 V DC и от 100 mV до 600 V AC, обхват по ток от 10 µA до 10 A DC и от 10 µA до 10 A AC, с възможност за интегриране в графични програмни среди;	Keysight 34450A, Digital Multimeter, 5.5 digit	Да, съответства
лабораторен постоянен ток захранващ блок, с регулируеми изходи по ток и напрежение, минимум 30 V, 2 A, с възможност за интегриране в графични програмни среди;	Keysight E3632A, DC power supply. Single output, dual range: 0-15V, 7A; 0-30V, 4A 105/120W. GPIB	Да, съответства
осцилоскоп, с минимум 2 канала, с честотен обхват поне 60 MHz, с честота на дискретизация 0.8Gs/s, DC грешка: ± 3 %, с възможност за интегриране в графични програмни среди;	Keysight DSOX1102A, InfiniVision 1000 X-Series Digital Storage Oscilloscope, 70 MHz, 2Ch	Да, съответства
функционален генератор с честотен обхват 0,1Hz – 20MHz, амплитуда на изходното напрежение над 5V, с възможност за интегриране в графични програмни среди;	Keysight 33509B, 33500B Series Waveform generator, 20 MHz, 1-channel	Да, съответства
поялна станция с възможност за регулиране на температурата от 0 до 350 градуса, с точност поне 0.5 градуса;	Weller WE-1010 1-channel power unit, digital, 70 W	Да, съответства
вградени контакти за еднофазно напрежение 230AC, поне 5 броя;	EUROSTAT	Да, съответства
модул за защита (аварийен стоп), светодиодно осветление	LED	Да, съответства

Дата: 28.02.2019

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 Добромир Добрев - управител



Тест Солюшънс ООД





ЕВРОПЕЙСКИ СЪЮЗ  
ЕВРОПЕЙСКИ ФОНД ЗА  
РЕГИОНАЛНО РАЗВИТИЕ



ЗАЕДНО СЪЗДАВАМЕ



НАУКА И ОБРАЗОВАНИЕ ЗА  
ИНТЕЛИГЕНТЕН РАСТЕК



## ТЕХНИЧЕСКИ УНИВЕРСИТЕТ - СОФИЯ

ОБРАЗЕЦ № 3-2

Наименование на участника:  
Тест Солжунънс ООД

Правно-организационна  
форма на участника: ООД

Седалище по регистрация: Бул. Александър Малинов № 87, офис 24, етаж 7,  
Младост 4, Бизнес център Ситикорп,  
София 1715

ВИК / Булстат: 130083177

До  
Технически университет - София  
гр. София  
Р. България

### ЦЕНОВО ПРЕДЛОЖЕНИЕ ЗА ОБОСОБЕНА ПОЗИЦИЯ № 2

Наименование на  
поръчката: „Доставка на специализирано технологично оборудване за  
нуждите на Технически университет – София по проект  
„Национален център по мехатроника и чисти технологии“,

[www.efunds.bg](http://www.efunds.bg)

Проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии“, финансиран от Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Този документ е създаден с финансовата подкрепа на Оперативна програма „Наука и образование за интелигентен растеж“, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Цялата отговорност за съдържанието на документата се носи от Технически университет - София и при всички обстоятелства не може да се припише, че този документ отразява официалното становище на Европейския съюз и Управляващия орган.

финансиран чрез Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020“  
обособена позиция № 2:

Доставка на специализирано изследователско работно място

**УВАЖАЕМИ ГОСПОДА,**

С настоящото представяме нашето ценово предложение за изпълнение предмета на горепосочената обособена позиция, както следва:

Потвърждаваме, че сме запознати с всички условия на изпълнение на поръчката, които произтичат от изискванията на Възложителя в документацията и в предложената цена сме отделили всички разходи за изпълнение на обособената позиция в съответствие с посочените изисквания, както и всякакви други изисквания в нормативната уредба, които са задължителни за спазване при изпълнение на поръчката.

Предлагаме да изпълним поръчката при следните единични цени:

№	ОБОРУДВАНЕ СЪГЛАСНО ТЕХНИЧЕСКОТО ПРЕДЛОЖЕНИЕ НА УЧАСТНИКА	МЯРКА	КОЛИЧЕСТВО	ЕД. ЦЕНА В ЛЕВА БЕЗ ДДС	ОБЩА СТОЙНОСТ В ЛЕВА БЕЗ ДДС
1	2	3	4	5	6
1	EUROSTAT защитена работна маса	Брой	2	3720	7440
2	34450A - Digital Multimeter, 5.5 digit	Брой	2	1355	2710
3	E3632A - DC power supply. Single output, dual range: 0-15V, 7A; 0-30V, 4A 105/120W. GPIB	Брой	2	2118	4236
4	DSOX1102A - InfiniVision 1000 X-Series Digital Storage Oscilloscope, 70 MHz, 2Ch	Брой	2	1142	2284
5	33509B - 33500B Series Waveform generator, 20 MHz, 1-channel	Брой	2	2849	5698
6	Weller WE-1010 1-channel power unit, digital, 70 W	Брой	2	305	610
7	EUROSTAT - вградени контакти за еднофазно напрежение 230АС, поне 5 броя;	Брой	2	90	180
8	LED - модул за защита (аварен стоп), светодиодно осветление	Брой	2	68	136
<b>ОБЩА ЦЕНА (В ЛЕВА БЕЗ ДДС)</b>					<b>23294</b>
<b>СЛОВОМ: двайсет и три хиляди двеста деветдесет и четири лева</b>					
<b>ЛЕВА БЕЗ ДДС</b>					



## ПРЕДЛАГАМЕ:

1. Общата стойност за изпълнение на горепосочената обособена позиция възлиза на:

23294 лева без ДДС

Словом: двайсет и три хиляди двеста деветдесет и четири лева,  
посочва се цифром и словом стойността в лева без ДДС

представляваща крайна фиксирана цена за изпълнение на всички дейности, включени в предмета на поръчката по обособената позиция.

Заявяваме, че:

1. Тази оферта ще бъде валидна, ако бъде приета от Възложителя преди изтичането на 6 (шест) месеца от датата на изтичане на срока за подаване на оферти. До подписването на договор, тази оферта и решението на Възложителя за избор на изпълнител на поръчката ще формират обвързващо споразумение между нас и Възложителя.
2. Посочените цени включват всички разходи за точното и качествено изпълнение на поръчката по обособената позиция. Цените са посочени в български лева, без ДДС.
3. Предложените цени са определени при пълно съответствие с условията от документацията и техническата спецификация.
4. Задължаваме се, ако нашата оферта бъде приета и сме определени за изпълнители, да изпълним поръчката в сроковете и условията, залегнали в договора.
5. Съгласни сме заплащането да става съгласно клаузите, залегнали в проекта на договора, като всички наши действия подлежат на проверка и съгласуване от страна на Възложителя.
6. За обезпечаване на задълженията си по договора за възлагане на обществената поръчка, преди подписване на договора ще предоставим на Възложителя гаранция за изпълнение в размер на 3% (три процента) от стойността на договора без ДДС, както и гаранция за авансово предоставените средства, при условията, посочени в проекта на договор към документацията за участие. *Ако Изпълнителят не желае авансово плащане, отпада задължението на последният да осигури гаранция обезпечаваша авансово предоставени средства.*
7. Запознати сме, че ако участник включи елементи от ценовото си предложение извън шийка с надпис „Предлагани ценови параметри“, ще бъде отстранен от участие в процедурата по обособената позиция.

**ЗАБЕЛЕЖКА:** Този документ задължително се поставя от участника в отделен запечатан непрозрачен плик с надпис „Предлагани ценови параметри“ с обозначаване на обособената позиция, за която се отнася и наименованието на участника. Участниците

задължително изготвят ценовото си предложение при съобразяване с максималната прогнозна стойност, определена в документацията за участие. При изготвяне на ценовото предложение, участниците задължително следва да включат пълния обем дейности по техническата спецификация. Ценовото предложение на участниците не може да надхвърля максималната обща стойност на поръчката по обособената позиция. Оферти надхвърлящи максимално заложената стойност ще бъдат предложени за отстраняване, поради несъответствие с това предварително обявено условие. Ценовото предложение трябва да съответства на предложението за изпълнение на поръчката по отношение на дейностите за изпълнение на поръчката за обособената позиция. В противен случай, участникът се отстранява. Участникът е единствено отговорен за евентуално допуснати грешки и пропуски в изчисленията на предложението от него цени. При всяка допусната от участника грешка спрямо посочените по-горе условия, когато грешката е установена от комисията за оценка и класиране на офертите на участниците, ще се счита че ценовото предложение на участника не отговаря на предварително обявените условия на възложителя и такъв участник ще бъде отстранен от по-нататъшно участие.

Запознати сме, че ако участник включи елементи от ценовото си предложение извън съответния плик, ще бъде отстранен от участие в процедурата по обособената позиция.

Дата: 28.02.2019

  
Добримил Добреа - управител



Тест Соловьевс ООД