DATA SHEET

EDU33210 Series

20 MHz Function / Arbitrary Waveform Generators



KEYSIGHT TECHNOLOGIES

EDU33210 Series Function / Arbitrary Waveform Generators

The Keysight EDU33210 Series function / arbitrary waveform generators offer the standard signals and features you expect — such as modulation, sweep, and burst. It also provides features that give you the capabilities and flexibility you need to get your job done quickly, no matter how complex. An intuitive, information-packed front-panel interface enables you to easily recall where you left off when your attention is focused elsewhere. And that is just the beginning.

Features

- Use the signature 7-inch color display for a simultaneous parameter set up, signal viewing, and editing.
- Get six built-in modulation types and 17 popular waveforms to simulate typical applications for testing.
- Acquire 16-bit arbitrary waveform capability with memory up to 8 M samples per channel.
- Begin using the USB and LAN IO interface for remote connectivity.
- Receive Keysight's PathWave BenchVue software to enable PC control.



Keysight EDU33211A
20 MHz, single-channel function/arbitrary waveform generator



Keysight EDU33212A
20 MHz, dual-channel function/arbitrary waveform generator

Simple set up and operation

The 7-inch wide video graphics array (WVGA) color display gives you both the waveform setting and other parameters in one view. The EDU33212A 20 MHz dual-channel function / arbitrary waveform generator can simultaneously display both channels' waveform information. Color-coded keypads along with display and output connectors help you prevent set up and connection errors.

The EDU33210 Series 20 MHz function / arbitrary waveform generators ship standard with USB and LAN connectivity, making it easy for remote access and control. It supports operation using standard commands for programmable instruments (SCPI) language, interchangeable virtual instruments (IVI) driver, web browser, or Keysight's Pathwave BenchVue software.

The EDU33210 Series 20 MHz function / arbitrary waveform generators feature a built-in USB memory port enabling you to store setup parameters with a USB flash drive. This feature maximizes efficiency when you need to restore the same setup into all the function / arbitrary waveform generators in your lab. It also enables you to load the arbitrary waveform signal to the function generator quickly.

Modulation and built-in waveforms

The EDU33210 Series 20 MHz function / arbitrary waveform generators has 17 built-in arbitrary waveforms. It comes with common waveforms — sine, square, ramp, triangle, pulse, PRBS, DC, and Gaussian noise; see Figures 1 and 2. It has specialty waveforms such as cardiac, exponential fall, exponential rise, Gaussian pulse, haversine, Lorentz, D-Lorentz, negative ramp, and sinc; see Figures 3 and 4. The six built-in modulations are AM, FM, phase modulation (PM), frequency-shift keying (FSK), binary phase shift keying (BPSK), and pulse width modulation (PWM).

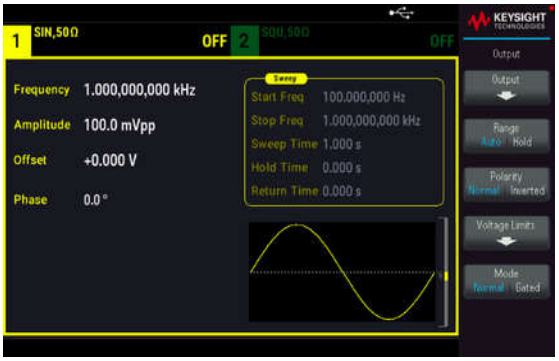


Figure 1. Standard since wave and setting



Figure 2. Dual-screen display of standard sine and square wave



Figure 3. PWM modulated with standard sine wave

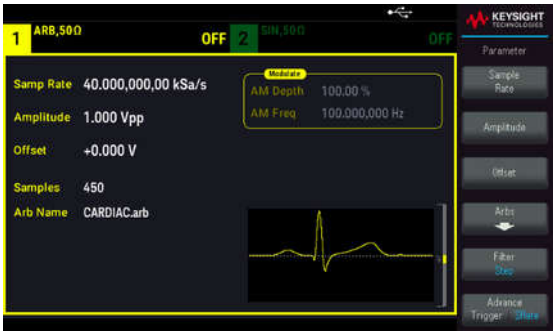


Figure 4. Cardiac specialty waveform

Signal Integrity: Outputting the Signals You Expect

If your generator is introducing spurious signals or harmonics, you will have a challenging time producing reliable designs. To be successful, you need to test with clean, precise, low-noise signals. The EDU33210 Series function / arbitrary waveform generators has 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 and not your waveform generator's measurements.

Arbitrary Waveform with Deep Memory

Are you looking to test your design with long, complex waveforms with a variety of anomalies? The EDU33210 Series function / arbitrary waveform generators come standard with up to 8 M samples per channel deep memory at a maximum of 1 M sample per waveform, providing sufficient memory to overcome your test challenges.



Intuitive front panel



Label	Description
1	7-inch WVGA display
2	Function keys
3	Soft keys
4	Numeric keypad
5	Knob and cursor arrows
6	Output connectors, set up, and on / off buttons
7	Sync / trigger output connector
8	External triggering / gate / FSK / burst connector
9	CAL connector
10	USB port
11	Power switch

PathWave BenchVue Software

As Figures 5 and 6 show, PathWave BenchVue software for the PC makes it simple to connect and control your function generators. You can now quickly move past the test development phase and access results faster with just a few clicks.

- intuitive point and click user interface
- select and easily configure the waveform identified
- load custom arbitrary waveforms from files



Figure 5. Select and configure your required waveform

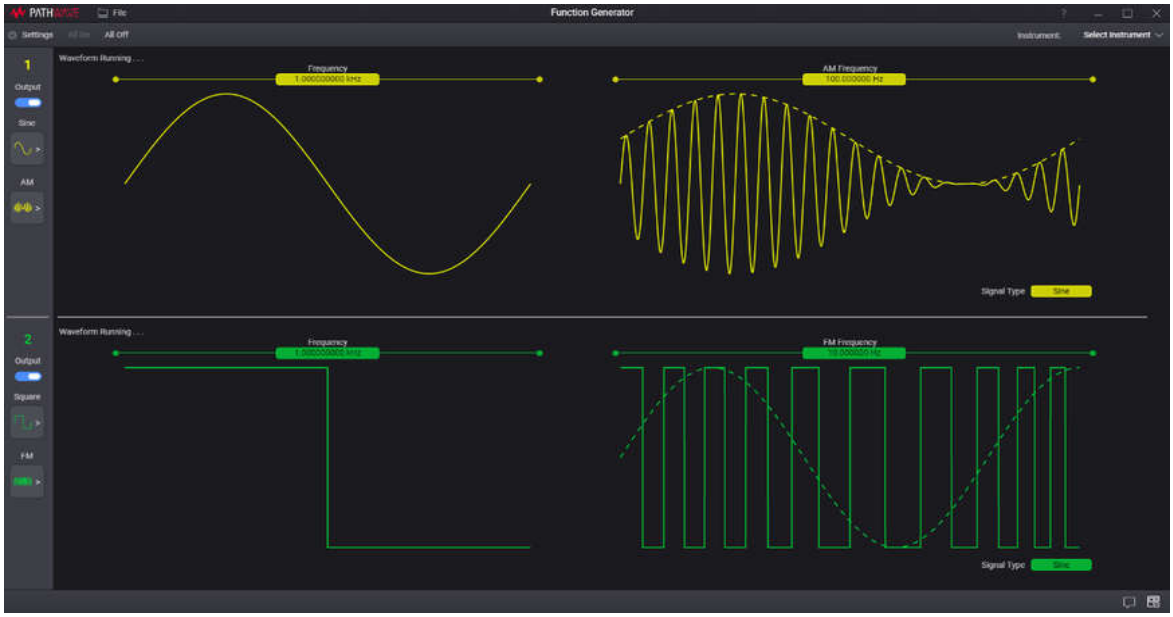


Figure 6. Setting the modulation waveform

Characteristics

Unless otherwise stated, all specifications are using a 50 Ω resistive load, and the automatic amplitude range selection is enabled.

Instrument

Models and options		
Model number	EDU33211A	EDU33212A
Maximum frequency	20 MHz	
Number of channels	1	2
Waveforms		
Standard	Sine, square, ramp, pulse, triangle, Gaussian noise, pseudorandom binary sequence (PRBS), DC	
Built-in arbitrary	Cardiac, exponential fall, exponential rise, Gaussian pulse, haversine, Lorentz, D-Lorentz, negative ramp, sinc	
User-defined arbitrary	Up to 8 MSa per channel; with up to 1 MSa per waveform	
Operating modes and modulation types		
Operating modes	Continuous, modulate, frequency sweep, gated burst	
Modulation types	Amplitude modulation (AM), frequency modulation (FM), phase modulation (PM), frequency shift keying (FSK), binary phase shift keying (BPSK), pulse width modulation (PWM)	

Waveform

Sine	
Frequency range	1 µHz to 20 MHz, 1 µHz resolution
Amplitude flatness (specification) [1, 2, 12] (relative to 1 kHz)	**1 Vpp < = Vout < = 10 Vpp (50 Ohm load)** f_{OUT} < = 100 KHz: ±0.1 dB 100 KHz < f_{OUT} < = 5 MHz: ±0.15 dB 5 MHz < f_{OUT} < = 20 MHz: ±0.3 dB
Harmonic distortion (typical) [1, 12]	**1 Vpp < = Vout < = 10Vpp (50 Ohm load)** f_{OUT} < = 100 KHz: -60 dBc 100 KHz < f_{OUT} < = 1 MHz: -50 dBc 1 MHz < f_{OUT} < = 20 MHz: -40 dBc
THD (typical) [1]	f_{OUT} = 10 Hz to 20 kHz: < 0.075%
Non-harmonic spurious (typical) [1, 3, 12]	f_{OUT} ≤ 2 MHz: <- 70 dBc f_{OUT} > 2 MHz: < - 70 dBc + 20 dB / decade
Phase noise (SSB) (typical) [4]	10 kHz offset: -105 dBc / Hz
Square and pulse	
Frequency ranges	1 µHz to 10 MHz, 1 µHz resolution
Rise and fall times (nominal)	Square at 8.4 ns, fixed Pulse at 8.4 ns to 1 us, independently variable, 100 ps resolution
Overshoot (typical)	≤ 3%

Waveform continued

Square and pulse	
Duty cycle [5]	0.01% to 99.99%, 0.01% resolution
Pulse width	16 ns minimum (adjustable with 100 ps resolution)
Jitter (rms) (measured) [4]	≤ 5 MHz: 2 ppm of the period + 100 ps > 5 MHz: 100 ps
Ramp and triangle	
Frequency range	1 µHz to 200 kHz, 1 µHz resolution
Ramp symmetry	0% to 100%, 0.1% resolution, (0% is negative ramp, 100% is positive ramp, 50% is triangle)
Linearity (typical)	≤ 0.1% from 5% to 95% of the signal amplitude (Vout ≥ 1 Vpp)
Gaussian Noise	
Variable bandwidth	1 MHz to 20 MHz
Crest factor (nominal)	4.6
Repetition period	> 50 years
Pseudorandom binary sequence (PRBS)	
Bit rate	1 Mbps to 50 Mbps, 1 Mbps resolution
Sequence length	2 m - 1, m = 7, 9, 11, 15, 20, 23
Rise and fall times	8.4 ns to 1 µS, independently variable, 100 ps resolution
Arbitrary waveforms	
Waveform length	8 Sa to 8 MSa per channel (maximum up to 1 MSa per waveform)
Sample rate	1 µSa/s to 250 MSa/s, 1 µSa/s resolution
Voltage resolution	16 bits
General	
Connector	Front-panel BNC, shell connected to chassis; all inputs and output BNC connectors are chassis referenced
Function	On, off, or inverted
Output impedance (nominal)	50 Ω
Isolation	Connector shells for channel output(s), sync, and modulation "in" are connected.
Overload protection	Output turns off automatically when an overload is applied; the instrument will tolerate a short circuit to ground indefinitely
Amplitude	
Range [6]	1 mVpp to 10 Vpp into 50 Ω, 4-digit resolution 2 mVpp to 20 Vpp into open circuit, 4-digit resolution
Units	Vpp, Vrms, or dBm
Accuracy (at 1 kHz sine) (specification) [2,12]	± (2% of setting in Vpp) ± (1 mVpp)
Accuracy (at 1 kHz Sine) (typical) [12]	± (1% of setting in Vpp) ± (1 mVpp)
Voltage limit function	User-definable maximum and minimum voltage limits

Waveform continued

DC offset	
Range [13]	± (5 VDC minus peak AC) into 50 Ω, 4-digit resolution ± (10 VDC minus peak AC) into open circuit, 4-digit resolution
Units	VDC
Accuracy (specification) [2,12]	± (1% of offset setting) ± (1% of amplitude in Vpp) ± (5 mV)
Frequency accuracy (spec)	
Standard frequency reference	± (1 ppm of setting + 15 pHz), 1 year, 23 ºC ± 5 ºC ± (2 ppm of setting + 15 pHz), 1 year, 0 ºC to 55 ºC

Modulation, burst, and sweep

Amplitude modulation (AM)	
Source	Internal only
Carrier waveform	Sine, square, ramp, arb
Modulating waveform	Sine, square, ramp, noise, arb
Depth [2, 8]	0% to 120%, 0.01% resolution
Frequency modulation (FM) [9]	
Source	Internal only
Carrier waveform	Sine, square, ramp, arb
Modulating waveform	Sine, square, ramp, noise, arb
Deviation	1 µHz to 15 MHz, 1 µHz resolution
Phase modulation (PM)	
Source	Internal only
Carrier waveform	Sine, square, ramp, arb
Modulating waveform	Sine, square, ramp, noise, arb
Modulation frequency	2 MHz to 1 MHz
Deviation	0º to 360º, 0.1º resolution
Frequency-shift key Modulation (FSK) [12]	
Source	Internal or external connector
Rate	≤ 1 MHz
Binary phase-shift key Modulation (BPSK)	
Source	Internal or external connector
Phase shift	0º to 360º, 0.1º resolution
Rate	≤ 1 MHz
Pulse width modulation (PWM)	
Source	Internal, external connector
Carrier waveform	Pulse
Modulating waveform	Sine, square, ramp, noise, arb
Deviation [5]	0% to 100% of pulse width, 0.01% resolution
Burst characteristics [7]	
Type	Counted or gated
Counted burst operation	Each trigger event causes the instrument to produce from 1 to 108 or an infinite number of waveform cycles

Gated burst operation	Instrument produces waveforms while the trigger is in the "on" state. For Gaussian noise, waveform generation stops immediately when the trigger is in the "off" state; all other waveforms stop after the completion of a cycle; more than one cycle might elapse before generation stops
Start / stop phase [14]	-360° to +360°, 0.1° resolution
Trigger source	Internal timer or rear-panel connector
Marker	Indicated by the trailing edge of the sync pulse; adjustable to any cycle of the burst
Sweep characteristics [9]	
Type	Linear, logarithmic, or list (up to 128 user-defined frequencies)
Operation	Characterization of linear and logarithmic sweeps occur 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
Direction	Up (start frequency < stop frequency) or down (start frequency > stop frequency)
Sweep time	
Linear	1 millisecond to 3,600 seconds, 1 ms resolution
Logarithmic	3,601 seconds to 250,000 seconds, 1 second resolution
Hold time	1 millisecond to 500 seconds, 1 ms resolution
Return time	0 to 3,600 seconds, 1 ms resolution
Trigger source [10, 11]	0 to 3,600 seconds, 1 ms resolution

Two-channel characteristics — EDU33212A only

Standard	
Operating modes	Independent, coupled parameter(s), combined (Channels 1 and 2); equal (Channel 1 = Channel 2) or differential (Ch 1 = -Ch 2)
Parameter coupling	None, frequency (ratio or difference) and / or amplitude and DC offset
Relative phase	0° to 360°, 0.1° resolution
Channel-to-channel skew (typical); both channels configured identically	< 0.8 ns
Crosstalk (typical)	< -75 dB

Sync out / trigger out

General	
Connector	Front BNC, chassis-referenced; functions as an output
Minimum output high voltage	Minimum 1.3 V
Maximum output low voltage	Maximum 0.1 V

External trigger input / gate; input / burst; input / FSK input

General	
Connector	Front BNC, chassis-referenced; functions as input
Polarity	Positive or negative slope
Maximum rate	1 MHz
Input	
Minimum input high voltage	2.2 V
Maximum input low voltage	0.6 V
Minimum pulse width	16 ns
Variable trigger delay	0 to 1,000 s; 4 ns resolution
Latency (typical)	< 160 ns with trigger delay set to zero
Jitter	< 2.5 ns, rms

Memory

Instrument state	
Store / recall	User-defined instrument states with user-defined names in the file system
Power-on state	Default settings or state at power-off, selectable
USB file system	
Front-panel port	USB 2.0 high-speed mass storage class (MSC) device
Capability	Read or write instrument configuration settings, instrument states, arbitrary waveform
Speed (nominal)	10 MB/s

General characteristics

USB file system	
LXI-C (rev1.5)	10/100Base-T (sockets and VXI-11 protocols); USB 2.0 (USB-TMC488 protocol)
Web user interface	Remote operation and monitoring
Programming language	SCPI-1999, IEEE-488.2
Real-time clock / calendar battery	CR-2032 coin type, replaceable, > 5-year life (typical)
Mechanical	
Size (nominal)	314 mm W x 130 mm H x 165 mm D (12.36 in W x 5.12 in H x 6.50 in D)
Weight (nominal)	3.1 kg (6.8 lbs.)
Environmental	
Storage temperature	-40 °C to 70 °C
Warm-up time	1 hour
Operating environment	Indoor use, installation category II for AC input; pollution degree 2
Operating temperature	0 °C to 55 °C
Operating humidity	Up to 80% RH at 40 °C non-condensing
Altitude	Up to 3,000 meters (9842.5 ft)
Regulatory	
Electromagnetic compatibility	Compliant with EMC directive (2014/30/EU) IEC 61326-1/EN 61326-1 Group 1 Class A Canada: ICES/NMB-001 Australia / New Zealand: AS/NZS CISPR 11 South Korea: KC mark (South Korean Class A EMC declaration: Information to the user: This equipment has been conformity assessed for use in business environments. In a residential environment, this equipment may cause radio interference.)
Safety	IEC 61010-1 / EN 61010-1 USA: ANSI/UL Std. No. 61010-1 Canada: CAN/CSA-C22.2 No.61010-1
Acoustic noise	Sound pressure level (1 m free field) (nominal) 31 dB(A) at ambient ≤ 28 °C
Line power	
Line voltage	100 to 240 V, 50 / 60 Hz; 100 to 120 V, 50 / 60 Hz
Power consumption	< 45 W

1. DC offset set to zero.
2. Add 1/10 of the specification per °C for operation at temperatures below 18 °C or above 28 °C.
3. At low amplitude, the non-harmonic spurious level is -100 dBm (typical).
4. Measured with a Keysight N9030B PXA X-Series signal analyzer.
5. Subject to pulse width limits.
6. Maximum amplitude is less at high frequency for specific waveforms.
7. Counted burst is not available for Gaussian noise.
8. Subject to amplitude limits.
9. All frequency changes are phase continuous.
10. External trigger only for sweep time > 8,000 seconds.
11. Measured with a square or pulse waveform, edge time set to minimum, and trigger delay set to zero. Trigger latency is generally greater for other instrument settings. For some waveforms, trigger latency is a function of the output frequency.
12. Auto range "on."
13. Output noise is typically 20 dB lower when DC and peak AC are < 320 mV and 50 Ω or 640 mV into open circuits.
14. Limited to arbitrary waveforms that are < 1 million points; phase resolution limited by the number of points in arbitrary waveforms < 3,600 points.

Definitions

Specification (spec)

The specification refers to the warranted performance of a calibrated instrument stored for a minimum of two hours within the operating temperature range of 0 to 55 ºC and after a one-hour warm-up period. Measurement and calibration uncertainties comply with ISO-17025 methods. Data published in this document are specifications as indicated.

Typical (typ)

The characteristic performance that 80% or more manufactured instruments will meet. Warranty for this is not available and does not include measurement or calibration uncertainty, and is valid only at approximately 23 ºC (room temperature).

Nominal (nom)

Nominal represents the mean or average characteristic performance, or the value of an attribute determined by design such as a connector type, physical dimension, or operating speed. Warranty for this data is not available, and the measurement is at approximately 23 ºC (room temperature).

Measured (meas)

Measured is an attribute taken during product development to communicate expected performance. Warranty for this data is not available, and the measurement is at approximately 23 ºC (room temperature).

Ordering Information

EDU33210 Series Function / Arbitrary Waveform Generators

EDU33211A	Waveform generator, 20 MHz, 1-channel
EDU33212A	Waveform generator, 20 MHz, 2-channel

Standard shipped accessory

AC power cord (based on destination country)

Optional accessory

EDU190A	Instrument stacking kit (to use with other education series instruments)

Other education series products

EDU34450A	Digital multimeter, 5.5 digit
EDU36311A	90 W DC power supply, triple-output, 6 V, 5 A, and 2x 30 V, 1 A, LAN, USB
EDUX1052A	Keysight InfiniiVision 1000 X-Series oscilloscope, 50 MHz, analog channels
EDUX1052G	InfiniiVision 1000 X-Series oscilloscope, 50 MHz, two analog channels, with a built-in waveform generator

To learn more, please visit:

www.keysight.com/find/EDU33211A

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