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Keysight 33220A
20 MHz Function/Arbitrary Waveform Generator

Data Sheet



LXI

Product Discontinuance Notice

The 33220A function generator and all associated options will be discontinued December 1, 2016. The last date this product can be ordered is November 30, 2016.

- For new product purchases, Keysight recommends the 33500B Trueform Series waveform generators.
- For more information, as well as to access to detailed migration guides, please visit **www.keysight.com/find/nextgenFGs**
- To contact a product selection expert, visit **www.keysight.com/find/contactus**

KEYSIGHT TECHNOLOGIES

Key Features

- Fully compliant to LXI Class C specification
- 20 MHz Sine and Square waveforms
- Pulse, Ramp, Triangle, Noise, and DC waveforms
- 14-bit, 50 MSa/s, 64 k-point arbitrary waveforms
- AM, FM, PM, FSK, and PWM modulation types
- Linear & logarithmic sweeps and burst operation
- 10 mV_{pp} to 10 V_{pp} amplitude range
- Graph mode for visual verification of signal settings
- Connect via USB, GPIB and LAN

Uncompromising performance for functions and waveforms

The Keysight Technologies 33220A function/arbitrary waveform generator uses direct digital synthesis (DDS) techniques to create a stable, accurate output signal for clean, low distortion sine waves. It also gives you square waves with fast rise and fall times up to 20 MHz and linear ramp waves up to 200 kHz.

Pulse generation

The 33220A can generate variable-edge-time pulses up to 5 MHz. With variable period, pulse width, and amplitude the 33220A is ideally suited to a wide variety of applications requiring a flexible pulse signal.

Custom waveform generation

Use the 33220A to generate complex custom waveforms. With 14-bit resolution, and a sampling rate of 50 MSa/s, the 33220A gives you the flexibility to create the waveforms you need. It also lets you store up to four waveforms in nonvolatile memory.

The Keysight IntuiLink arbitrary waveform software allows you to easily create, edit, and download complex waveforms using the waveform editor. Or you can capture a waveform using IntuiLink for Oscilloscope and send it to the 33220A for output. To find out more about IntuiLink, visit www.keysight.com/find/intuilink.

Easy-to-use functionality

Front-panel operation of the 33220A is straight-forward and user friendly. You can access all major functions with a single key or two. The knob or numeric keypad can be used to adjust frequency, amplitude, offset, and other parameters. You can even enter voltage values directly in V_{pp}, V_{rms}, dBm, or as high and low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Internal AM, FM, PM, FSK, and PWM modulation make it easy to modulate waveforms without the need for a separate modulation source. Linear and logarithmic sweeps are also built in, with sweep rates selectable from 1 ms to 500 s. Burst mode operation allows for a user-selected number of cycles per period of time. GPIB, LAN, and USB interfaces are all standard, plus you get full programmability using SCPI commands.

External frequency reference (Option 001)

The 33220A external frequency reference lets you synchronize to an external 10 MHz clock, to another 33220A, or to a Keysight 33250A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

Measurement Characteristics

Waveforms	
Standard	Sine, Square, Ramp, Triangle, Pulse, Noise, DC
Built-in arbitrary	Exponential rise, Exponential fall, Negative ramp, Sin(x)/x, Cardiac

Waveforms Characteristics

Sine		
Frequency Range	1 µHz to 20 MHz	
Amplitude Flatness[1], [2] (relative to 1 kHz)		
	< 100 kHz	0.1 dB
	100 kHz to 5 MHz	0.15 dB
	5 MHz to 20 MHz	0.3 dB
Harmonic distortion[2], [3]		
	< 1 V_{PP}	≥ 1 V_{PP}
DC to 20 kHz	–70 dBc	–70 dBc
20 kHz to 100 kHz	–65 dBc	–60 dBc
100 kHz to 1 MHz	–50 dBc	–45 dBc
1 MHz to 20 MHz	–40 dBc	–35 dBc
Total harmonic distortion[2], [3]		
DC to 20 kHz	0.04%	
Spurious (non-harmonic)[2], [4]		
DC to 1 MHz	–70 dBc	
1 MHz to 20 MHz	–70 dBc + 6 dB/octave	
Phase noise (10 kHz offset)	–115 dBc / Hz, typical	
Square		
Frequency range	1 µHz to 20 MHz	
Rise/Fall time	< 13 ns	
Overshoot	< 2%	
Variable duty cycle	20% to 80% (to 10 MHz) 40% to 60% (to 20 MHz)	
Asymmetry (@ 50% duty)	1% of period + 5 ns	
Jitter (RMS)	1 ns + 100 ppm of period	
Ramp, Triangle		
Frequency range	1 µHz to 200 kHz	
Linearity	< 0.1% of peak output	
Variable Symmetry	0.0% to 100.0%	
Pulse		
Frequency range	500 µHz to 5 MHz	
Pulse width (period ≤ 10s)	20 ns minimum, 10 ns resolution	
Variable edge time	< 13 ns to 100 ns	
Overshoot	< 2%	
Jitter (RMS)	300 ps + 0.1 ppm of period	

Noise	
Bandwidth	9 MHz typical
Arbitrary	
Frequency range	1 µHz to 6 MHz
Waveform length	2 to 64 k points
Amplitude resolution	14 bits (including sign)
Sample rate	50 MSa/s
Min. Rise/Fall Time	35 ns typical
Linearity	< 0.1% of peak output
Settling Time	< 250 ns to 0.5% of final value
Jitter (RMS)	6 ns + 30 ppm
Non-volatile memory	four waveforms

Common Characteristics

Frequency	
Accuracy[5]	± (10 $_{ppm}$ + 3 pHz) in 90 days ± (20 $_{ppm}$ + 3 pHz) in 1 year
Resolution	1 µHz
Amplitude	
Range	10 mV_{PP} to 10 V_{PP} into 50 Ω 20 mV_{PP} to 20 V_{PP} into open circuit
Accuracy[1], [2] (at 1 kHz)	± 1% of setting ± 1 mV_{PP}
Units	V_{PP}, V_{rms}, dBm
Resolution	4 digits
DC Offset	
Range (peak AC + DC)	± 5 V into 50 Ω ± 10 V into open circuit
Accuracy[1], [2]	± 2% of offset setting ± 0.5% of amplitude ± 2 mV
Resolution	4 digits
Main Output	
Impedance	50 Ω typical
Isolation	42 Vpk maximum to earth
Protection	Short-circuit protected, overload automatically disables main output

External Frequency Reference (Option 001)	
Rear Panel Input	
Lock Range	10 MHz ± 500 Hz
Level	100 mV_{PP} to 5 V_{PP}
Impedance	1 kΩ typical, AC coupled
Lock Time	< 2 seconds

Rear Panel Output	
Frequency	10 MHz
Level	632 mV_{PP} (0 dBm), typical
Impedance	50 Ω typical, AC coupled

Phase Offset	
Range	+ 360° to - 360°
Resolution	0.001°
Accuracy	20 ns

Modulation

AM	
Carrier waveforms	Sine, Square, Ramp, Arb
Source	Internal/External
Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
Depth	0.0% to 120.0%
FM	
Carrier waveforms	Sine, Square, Ramp, Arb
Source	Internal/External
Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
Deviation	DC to 10 MHz
PM	
Carrier waveforms	Sine, Square, Ramp, Arb
Source	Internal/External
Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
Deviation	0.0 to 360.0 degrees
PWM	
Carrier waveform	Pulse
Source	Internal/External
Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
Deviation	0% to 100% of pulse width
FSK	
Carrier waveforms	Sine, Square, Ramp, Arb
Source	Internal/External
Internal modulation	50% duty cycle square (2 mHz to 100 kHz)
External Modulation Input[6] (for AM, FM, PM, PWM)	
Voltage range	± 5 V full scale
Input impedance	5 kΩ typical
Bandwidth	DC to 20 kHz

Measurement Characteristics (Continued)

Sweep

Waveforms	Sine, Square, Ramp, Arb
Type	Linear or Logarithmic
Direction	Up or Down
Sweep time	1 ms to 500 s
Trigger	Single, External, or Internal
Marker	falling edge of sync signal (programmable frequency)

Burst[7]

Waveforms	Sine, Square, Ramp, Triangle, Pulse, Noise, Arb
Type	Counted (1 to 50,000 cycles), Infinite, Gated
Start/Stop Phase	–360° to +360°
Internal Period	1 µs to 500 s
Gate Source	External trigger
Trigger source	Single, External or Internal

Trigger Characteristics

Trigger input	
Input level	TTL compatible
Slope	Rising or Falling, selectable
Pulse width	> 100 ns
Input impedance	>10 kΩ, DC coupled
Latency	< 500 ns
Jitter (rms)	6 ns (3.5 ns for pulse)
Trigger output	
Level	TTL compatible into ≥ 1 kΩ
Pulse width	> 400 ns
Output Impedance	50 Ω, typical
Maximum rate	1 MHz
Fanout	≤ 4 Keysight 33220As

Programming Times (typical)

Configuration times	USB	LAN	GPIB
Function Change	111 ms	111 ms	111 ms
Frequency Change	1.5 ms	2.7 ms	1.2 ms
Amplitude Change	30 ms	30 ms	30 ms
Select User Arb	124 ms	124 ms	123 ms
Arb Download Times (binary transfer)	**USB**	**LAN**	**GPIB**
64 k points	96.9 ms	191.7 ms	336.5 ms
16 k points	24.5 ms	48.4 ms	80.7 ms
4 k points	7.3 ms	14.6 ms	19.8 ms

General

Power Supply	CAT II 100 - 240 V @ 50/60 Hz (–5%, +10%) 100 - 120 V @ 400 Hz (±10%)
Power Consumption	50 VA max
Operating Environment	IEC 61010 Pollution Degree 2 Indoor Location
Operating Temperature	0 to 55 °C
Operating Humidity	5% to 80% RH, non-condensing
Operating Altitude	Up to 3000 meters
Storage Temperature	–30 to 70 °C
State Storage Memory	Power off state automatically saved. Four user-configurable stored states
Interface	USB, GPIB, and LAN standard
Language	SCPI - 1993, IEEE-488.2
Dimensions (W x H x D)	
Bench top	261.1 mm x 103.8 mm x 303.2mm
Rack mount	212.8mm x 88.3mm x 272.3mm
Weight	3.4 kg (7.5 lbs)
Safety Designed to	UL-1244, CSA 1010, EN61010
EMC Tested to	MIL-461C, EN55011, EN50082-1
Vibration and Shock	MIL-T-28800, Type III, Class 5
Acoustic Noise	30 dBa
Warm-up Time	1 hour

Footnotes

1. Add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18 to 28 °C

2. Autorange enabled

3. DC offset set to 0 V

4. Spurious output at low amplitude is –75 dBm typical

5. Add 1 ppm/°C average for operation outside the range of 18 to 28 °C

6. FSK uses trigger input (1 MHz maximum)

7. Sine and square waveforms above 6 MHz are allowed only with an "infinite" burst count

Ordering Information

Keysight 33220A

20 MHz function/arbitrary wavefrom generator

Accessories included

Operating manual, service manual, quick reference guide, IntuiLink waveform editor software, test data, USB cable, and power cord (see language option).

Options

Opt. 001	External timebase reference
Opt. A6J	ANSI Z540 calibration
Opt. AB0	Taiwan: Chinese manual
Opt. AB1	Korea: Korean manual
Opt. AB2	China: Chinese manual
Opt. ABA	English: English manual
Opt. ABD	Germany: German manual
Opt. ABF	France: French manual
Opt. ABJ	Japan: Japanese manual

Other Accessories

34131A	Carrying case
34161A	Accessory pouch
34190A	Rackmount kit
34191A	Dual flange kit, 2U
34194A	Dual lock link kit

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