


# Agilent 33220A 20 MHz Function/Arbitrary Waveform Generator

Data Sheet



- 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<sub>pp</sub> to 10 V<sub>pp</sub> amplitude range
- Graph mode for visual verification of signal settings
- Connect via USB, GPIB and LAN

## Uncompromising performance for functions and waveforms

The Agilent 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 Agilent 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.agilent.com/find/intuilink](http://www.agilent.com/find/intuilink).



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## Measurement Characteristics

### 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 an Agilent 33250A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

| 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 $\mu$ Hz to 20 MHz   |
| Amplitude Flatness <sup>(1),(2)</sup> (relative to 1 kHz) | < 100 kHz 0.1 dB<br>100 kHz to 5 MHz 0.15 dB<br>5 MHz to 20 MHz 0.3 dB |
| Harmonic distortion <sup>(2),(3)</sup>                    | < 1 $V_{pp}$ $\geq$ 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 <sup>(2),(3)</sup>              | DC to 20 kHz 0.04%   |
| Spurious (non-harmonic) <sup>(2),(4)</sup>                | DC to 1 MHz -70 dBc<br>1 MHz to 20 MHz -70 dBc + 6 dB/octave           |
| Phase noise (10 kHz offset)                               | -115 dBc / Hz, typical   |
| Square  |  |
| Frequency range   | 1 $\mu$ Hz to 20 MHz   |
| Rise/Fall time  | < 13 ns  |
| Overshoot   | < 2%   |
| Variable duty cycle                                       | 20% to 80% (to 10 MHz)<br>40% to 60% (to 20 MHz)                       |
| Asymmetry (@ 50% duty)                                    | 1% of period + 5 ns  |
| Jitter (RMS)  | 1 ns +<br>100 ppm of period  |
| Ramp, Triangle  |  |
| Frequency range   | 1 $\mu$ Hz to 200 kHz  |
| Linearity   | < 0.1% of peak output  |
| Variable Symmetry   | 0.0% to 100.0%   |
| Pulse   |  |
| Frequency range   | 500 $\mu$ Hz to 5 MHz  |
| Pulse width (period $\leq$ 10s)                           | 20 ns minimum,<br>10 ns resolution                                     |
| Variable edge time  | < 13 ns to 100 ns  |
| Overshoot   | < 2%   |
| Jitter (RMS)  | 300 ps +<br>0.1 ppm of period  |

| Noise                |                                 |
|----------------------|---------------------------------|
| Bandwidth            | 9 MHz typical                   |
| Arbitrary            |                                 |
| Frequency range      | 1 $\mu$ Hz 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 <sup>(5)</sup>                   | $\pm$ (10 ppm + 3 pHz) in 90 days<br>$\pm$ (20 ppm + 3 pHz) in 1 year   |
| Resolution                                | 1 $\mu$ Hz  |
| Amplitude                                 |   |
| Range                                     | 10 mV <sub>pp</sub> to 10 V <sub>pp</sub> into 50 $\Omega$<br>20 mV <sub>pp</sub> to 20 V <sub>pp</sub> into open circuit |
| Accuracy <sup>(1),(2)</sup> (at 1 kHz)    | $\pm$ 1% of setting<br>$\pm$ 1 mV <sub>pp</sub>   |
| Units                                     | $V_{pp}$ , $V_{rms}$ , dBm  |
| Resolution                                | 4 digits  |
| DC Offset                                 |   |
| Range (peak AC + DC)                      | $\pm$ 5 V into 50 $\Omega$<br>$\pm$ 10 V into open circuit  |
| Accuracy <sup>(1),(2)</sup>               | $\pm$ 2% of offset setting<br>$\pm$ 0.5% of amplitude<br>$\pm$ 2 mV   |
| Resolution                                | 4 digits  |
| Main Output                               |   |
| Impedance                                 | 50 $\Omega$ 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 $\pm$ 500 Hz   |
| Level                                     | 100 mV <sub>pp</sub> to 5 V <sub>pp</sub>   |
| Impedance                                 | 1 k $\Omega$ typical, AC coupled  |
| Lock Time                                 | < 2 seconds   |
| Rear Panel Output                         |   |
| Frequency                                 | 10 MHz  |
| Level                                     | 632 mV <sub>pp</sub> (0 dBm), typical   |
| Impedance                                 | 50 $\Omega$ typical, AC coupled   |

## Measurement Characteristics (Continued)

### 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<sup>[6]</sup> (for AM, FM, PM, PWM)

|                 |                  |
|-----------------|------------------|
| Voltage range   | ± 5 V full scale |
| Input impedance | 5 kΩ typical     |
| Bandwidth       | DC to 20 kHz     |

### 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<sup>[7]</sup>

|                  |   |
|------------------|---|
| 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 Agilent 33220As           |

### Programming Times (typical)

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

### Footnotes

<sup>[1]</sup> add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18°C to 28°C

<sup>[2]</sup> Autorange enabled

<sup>[3]</sup> DC offset set to 0 V

<sup>[4]</sup> spurious output at low amplitude is -75 dBm typical

<sup>[5]</sup> add 1 ppm/°C average for operation outside the range of 18°C to 28°C

<sup>[6]</sup> FSK uses trigger input (1 MHz maximum)

<sup>[7]</sup> Sine and square waveforms above 6 MHz are allowed only with an "infinite" burst count

## Ordering Information

### Agilent 33220A

20 MHz Function/Arbitrary  
Waveform 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. 0B0** Delete manual
- Opt. 1CM** Rackmount kit  
(also sold as Agilent 34190A)
- 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

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