Agilent 33220A 20 MHz Function/Arbitrary Waveform Generator

Data Sheet

- **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 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**.

Easy-to-use functionality

Front-panel operation of the 33220A is straightforward 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

WAVEFORM 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	10 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	
Resolution	1 µHz
Amplitude	
Range	10 mV_{PP} to 10 V_{PP} into 50Ω 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 50Ω ± 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
Internal Frequency Reference	
Accuracy[5]	± 10 ppm in 90 days ± 20 ppm in 1 year
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

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 Agilent 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
64K points	96.9 ms	191.7 ms	336.5 ms
16K points	24.5 ms	48.4 ms	80.7 ms
4K points	7.3 ms	14.6 ms	19.8 ms

GENERAL	
Power Supply	CAT II 100 - 240V @ 50/60Hz (-5%, +10%) 100 - 120V @ 400Hz (±10%)
Power Consumption	50 VA max
Operating Environment	IEC 61010 Pollution Degree 2 Indoor Location
Operating Temperature	0°C to 55°C
Operating Humidity	5% to 80% RH, non-condensing
Operating Altitude	Up to 3000 meters
Storage Temperature	-30°C 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	261.1mm x 103.8mm 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
Warranty	1 year

Footnotes

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

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