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.
**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.

**Measurement Characteristics**

<table>
<thead>
<tr>
<th>Waveforms</th>
<th>Standard</th>
<th>Sine, Square, Ramp, Triangle, Pulse, Noise, DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in arbitrary</td>
<td>Exponential rise, Exponential fall, Negative ramp, $\sin(x)/x$, Cardiac</td>
<td></td>
</tr>
</tbody>
</table>

**Waveforms Characteristics**

<table>
<thead>
<tr>
<th>Sine</th>
<th>Frequency Range</th>
<th>1 µHz to 20 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude Flatness$^{(1,2)}$ ($&lt; 100$ kHz)</td>
<td>0.1 dB</td>
<td></td>
</tr>
<tr>
<td>100 kHz to 5 MHz</td>
<td>0.15 dB</td>
<td></td>
</tr>
<tr>
<td>5 MHz to 20 MHz</td>
<td>0.3 dB</td>
<td></td>
</tr>
</tbody>
</table>

| Harmonic distortion$^{(1,2)}$ | $< 1 V_{pp}$ | $\geq 1 V_{pp}$ |
| DC to 20 kHz | -70 dBc | -70 dBc |
| 20 kHz to 100 kHz | -65 dBc | -60 dBc |
| 100 kHz to 1 MHz | -56 dBc | -45 dBc |
| 1 MHz to 20 MHz | -40 dBc | -35 dBc |

**Common Characteristics**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Accuracy$^{(2)}$</th>
<th>± (10 ppm + 3 pHz) in 90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>1 µHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amplitude</th>
<th>± (20 ppm + 3 pH) in 1 year</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Units</th>
<th>$V_{PP}$, $V_{rms}$, dBm</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DC Offset</th>
<th>Resolution</th>
<th>4 digits</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Main Output</th>
<th>Impedance</th>
<th>50 Ω typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection</td>
<td>Short-circuit protected, overload automatically disables main output</td>
<td></td>
</tr>
</tbody>
</table>

**External Frequency Reference (Option 001)**

<table>
<thead>
<tr>
<th>Rear Panel Input</th>
<th>Lock Range</th>
<th>10 MHz ± 500 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>100 mVpp to 5 Vpp</td>
<td></td>
</tr>
<tr>
<td>Impedance</td>
<td>1 kΩ typical, AC coupled</td>
<td></td>
</tr>
<tr>
<td>Lock Time</td>
<td>&lt; 2 seconds</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rear Panel Output</th>
<th>Frequency</th>
<th>10 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>632 mVpp (0 dBm), typical</td>
<td></td>
</tr>
<tr>
<td>Impedance</td>
<td>50 Ω typical, AC coupled</td>
<td></td>
</tr>
</tbody>
</table>
## 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, 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, 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, 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, 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)

### 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
- **Waveforms:** Sine, Square, Ramp, 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
- **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)
- **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)

<table>
<thead>
<tr>
<th>Configuration times</th>
<th>USB</th>
<th>LAN</th>
<th>GPIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function Change</td>
<td>111 ms</td>
<td>111 ms</td>
<td>111 ms</td>
</tr>
<tr>
<td>Frequency Change</td>
<td>1.5 ms</td>
<td>2.7 ms</td>
<td>1.2 ms</td>
</tr>
<tr>
<td>Amplitude Change</td>
<td>30 ms</td>
<td>30 ms</td>
<td>30 ms</td>
</tr>
<tr>
<td>Select User Arb</td>
<td>124 ms</td>
<td>124 ms</td>
<td>124 ms</td>
</tr>
</tbody>
</table>

### External Modulation Input
- **Voltage range:** ± 5 V full scale
- **Input impedance:** 5 kΩ typical
- **Bandwidth:** DC to 20 kHz

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