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

<table>
<thead>
<tr>
<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>
</tr>
</tbody>
</table>

### WAVEFORM CHARACTERISTICS

#### Sine
- **Frequency Range**: 1 µHz to 20 MHz
- **Amplitude Flatness**
  - 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**
  - DC to 20 kHz: < 1 V_{pp}
  - 20 kHz to 100 kHz: -70 dBc
  - 100 kHz to 1 MHz: -50 dBc
  - 1 MHz to 20 MHz: -40 dBc
- **Total harmonic distortion**
  - DC to 20 kHz: 0.04%
- **Phasenoise**
  - (10 kHz offset): -115 dBc / Hz, typical

#### Square
- **Frequency range**: 1 µHz to 20 MHz
- **Rise/Fall time**: < 13 ns
- **Overshoot**: < 2%
- **Asymmetry (at 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
- **Non-volatile memory**: four waveforms

### 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

### COMMON CHARACTERISTICS

<table>
<thead>
<tr>
<th>Frequency</th>
<th>1 µHz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplitude</strong></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>10 mV_{pp} to 10 V_{pp} into 50Ω</td>
</tr>
<tr>
<td></td>
<td>20 mV_{pp} to 20 V_{pp} into open circuit</td>
</tr>
</tbody>
</table>
| **Accuracy**
  - 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**: ± 2% of offset setting
- ± 0.5% of amplitude ± 2 mV
- **Resolution**: 4 digits

### Internal Frequency Reference
- **Accuracy**: ± 10 ppm in 90 days
- ± 20 ppm in 1 year

### External Frequency Reference (Option 001)
- **Lock Range**: 10 MHz ± 500 Hz
- **Level**: 100 mV_{pp} to 5 V_{pp}
- **Impedance**: 50 Ω typical, AC coupled
- **Lock Time**: < 2 seconds

### Rear Panel Input
- **Frequency**: 10 MHz
- **Level**: 632 mV_{pp} (0 dBm), typical
- **Impedance**: 50 Ω typical, AC coupled

### 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
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
- 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
- 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:
  - 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)
<table>
<thead>
<tr>
<th></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>123 ms</td>
</tr>
<tr>
<td>Arb Download Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64K points</td>
<td>96.9 ms</td>
<td>191.7 ms</td>
<td>336.5 ms</td>
</tr>
<tr>
<td>16K points</td>
<td>24.5 ms</td>
<td>48.4 ms</td>
<td>80.7 ms</td>
</tr>
<tr>
<td>4K points</td>
<td>7.3 ms</td>
<td>14.6 ms</td>
<td>19.8 ms</td>
</tr>
</tbody>
</table>

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
- 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 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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