

AFG 2020 Characteristics

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Waveshapes

Sine, square, triangle, ramp, pulse, and arbitrary.

Frequency/Phase

Clock: 250 MHz, 4.0 ns, 1 ppm.

Frequency:

Synthesizer On Mode:

- Frequency: 10 digits.
- Range: Sine, to 100 MHz; Other, to 2.5 MHz.

Synthesizer Off Mode:

- Frequency: 3 digits.
- Range: Square, to 50 MHz; Other, to 31.2 MHz.

Period: 10 digits, 2.0 s to 4.0 ns.

Points/Cycle: 5 digits, 250 MHz divided by frequency for <100 MHz, up to 1024 or 2048.

Phase: 4 digits.

Range: $\pm 360^\circ$.

Resolution: 0.1° .

Amplitude/Offset

Amplitude: 4 digits.

Resolution:

- $0.4 V_{p-p}$: $1 mV_{p-p}$.
- $2 V_{p-p}$: $2 mV_{p-p}$.
- $10 V_{p-p}$: $10 mV_{p-p}$.

Maximum Amplitude: $10 V_{p-p}$ into 50 ohms, 20

V_{p-p} open circuit.

Ranges: 0.4 V_{p-p} , 2.0 V_{p-p} , 10 V_{p-p} .

DC Accuracy:

0.4 V_{p-p} : $\pm(1.0\%$ of setting + 1 mV $_{p-p})$.

2.0 V_{p-p} : $\pm(1.0\%$ of setting + 5 mV $_{p-p})$.

10 V_{p-p} : $\pm(2.5\%$ of setting + 50 mV $_{p-p})$.

Offset: 4 digits.

Resolution:

- 0.4 V_{p-p} : 1 mV.
- 2 V_{p-p} : 2 mV.
- 10 V_{p-p} : 10 mV.

Maximum Offset: ± 5 V into 50 ohms; ± 10 V open circuit.

Accuracy:

- 0.4 V_{p-p} : $\pm(1.0\%$ of setting + 1 mV).
- 2.0 V_{p-p} : $\pm(1.0\%$ of setting + 5 mV).
- 10 V_{p-p} : $\pm(2.5\%$ of setting + 50 mV).

Noise Floor:

Range:

- 0.4 V_{p-p} : 128 dBm/Hz at 10 MHz.
- 2.0 V_{p-p} : 114 dBm/Hz.
- 10 V_{p-p} : 100 dBm/Hz.

Sine

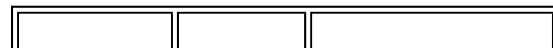
SSB Phase Noise:

Synthesizer On: 90 dBc/Hz.

Synthesizer Off: 80 dBc/Hz.

Harmonics:

Synthesizer On with 100 MHz Low Pass Filter:



	10 V_{p-p}	2 V_{p-p'} 0.4 V_{p-p}
<100 kHz	-40 dBc	-60 dBc
1 MHz	-40 dBc	-55 dBc
10 MHz	-35 dBc	-55 dBc
100 MHz	-25 dBc	-30 dBc

Synthesizer Off with 50 MHz LPF:

	10 V_{p-p}	2 V_{p-p'} 0.4 V_{p-p}
<100 kHz	-40 dBc	-55 dBc
1 MHz	-40 dBc	-55 dBc
10 MHz	-35 dBc	-40 dBc
100 MHz	-35 dBc	-40 dBc

Spurious:

	Synthesizer On	Synthesizer Off
<50 kHz	-60 dBc	-55 dBc
500 kHz	-55 dBc	-55 dBc
5 MHz	-45 dBc	-45 dBc

31.2 MHz	-40 dBc	-35 dBc
50 MHz	-40 dBc	
100 MHz	-30 dBc	

Amplitude: Flatness:
Synthesizer On with 100 MHz LPF:

	$10 V_{p-p}$	$2 V_{p-p'} \cdot 0.4 V_{p-p}$
≥ 100 kHz to ≤ 50 MHz	± 0.5 dB	± 0.5 dB
≤ 100 MHz	± 1.0 dB	± 0.5 dB

Synthesizer Off with 50 MHz LPF:

	All Ranges
≥ 100 kHz to ≤ 10 MHz	± 1.0 dB
≤ 31.2 MHz	± 3.0 dB

0.4 V_{p-p} and 2.0 V_{p-p} Accuracy: DC accuracy
 ±3.0% + Flatness.
 10 V_{p-p} Accuracy: DC accuracy ±5.0% +
 Flatness.
 Power: 4 digits up to 23.98 dBm.

Square

Amplitude:

Flatness:

	50 MHz LPF	Full Pass
</=100 kHz to	±2.0%	±2.0%
</=2.5 MHz	±5.0%	±5.0%
</=15.6 MHz	±5.0%	±5.0%
</=50 MHz	-30%	±10%

Accuracy: DC accuracy ±2% + Flatness.

Rise/Fall Time:

With 50 MHz LPF: Within 9.0 ns.

With Full Pass: Within 4.0 ns.

Aberrations:

With 50 MHz LPF:

- 0.4 V_{p-p} and 2 V_{p-p}: Within 5% + 2 mV_{p-p}.
- 10 V_{p-p}: Within 7% + 10 mV_{p-p}.

With Full Pass:

- 0.4 V_{p-p} and 2 V_{p-p}: Within 7% + 2 mV_{p-p}.
- 10 V_{p-p}: Within 12% + 10 mV_{p-p}.

Triangle

Amplitude:

Flatness with 50 MHz LPF:

- ≤ 100 kHz: $\pm 2.0\%$.
- ≤ 2.5 MHz: 7.0% .
- ≤ 15.6 MHz: 20% .
- ≤ 31.2 MHz: 40% .

Accuracy: DC accuracy $\pm 4.0\%$ + Flatness.

Ramp

Timing:

Rise/Fall: 4 digits, 0% to 100% of period.

Amplitude:

Flatness with 50 MHz LPF:

- ≤ 100 kHz: $\pm 2.0\%$.
- ≤ 2.5 MHz: -8.0% .
- ≤ 15.6 MHz: -25% .
- ≤ 31.2 MHz: -45% .

Accuracy: DC accuracy $\pm 4.0\%$ + Flatness.

Pulse

Pulse Width: 20% to 50.0% of period.

Transition: 0% to 35.0% of pulse width.

Amplitude:

Flatness with 50 MHz LPF:

- ≤ 100 kHz: $\pm 2.0\%$.
- ≤ 2.5 MHz: -5.0% .
- ≤ 15.6 MHz: -5.0% .
- ≤ 31.2 MHz: -20% .

Accuracy: DC accuracy $\pm 2\%$ + Flatness.

Arbitrary

Maximum Points:

Any periodic waveform described with 12 bits

and 1024 points.

Number of Waveforms: 16.

Sweep

Type: Linear, log.

Frequency: 5 digits.

- Start, Stop: Sine: 1.0 Hz to 100 MHz.
- Others: 1.0 Hz to 2.5 MHz.

Step (Linear): Within 2.5 MHz, 5 digits.

Points/decade (Log): 10 to 1000, 1-2-5 sequence.

- 1.0 Hz to 10 Hz: ≤ 10 .
- 10 Hz to 100 Hz: < 100 .
- 100 Hz to 1 kHz: < 1000 .
- 1 kHz to 100 MHz: ≤ 1000 .

Dwell Time: 4 digits.

Sweep: 0.5 μ s to 100 s.

Return: 0.5 μ s to 100 s.

Marker:

Number: 3.

Frequency: Between Start and Stop.

Time: 0.5 μ s to 100 s.

Points:

Sweep: 2 to 5001.

Return: 1 to 5000.

Maximum Period: 2048 seconds \leq Sweep + Return Time.

Modulation

Amplitude Modulation (Internal and External):

Amplitude: 4 digits, 10.00 V_{p-p} to +10.00 V_{p-p}.

External Channel 2 Amplitude: 1 V_{p-p} typical.

Depth: 3 digits, 0 to 100%.

Double Sideband Suppressed Carrier: ON/OFF.

Modulation Rate:

- Period: 10 μs to 1 s every 0.2 μs.
- Accuracy: ±0.1%.
- Risetime: Within 2 μs.
- AM Noise: Within 1% of range.

Offset Modulation (Internal):

High, Low: 4 digits, 5.000 V to +5.000 V_{p-p}.

Modulation Rate:

- Period: 10 μs to 1 s every 0.2 μs.
- Accuracy: ±0.1%.
- Risetime: Within 2 μs.
- Modulation Noise: Within 1% of range.

Frequency Modulation (Internal):

Center Frequency: 9 digits.

Deviation: 6 digits.

Modulation Rate:

- Period: 10 μs to 1 s every 0.2 μs.
- Accuracy, ±0.1%.

Frequency Shift Keying (FSK) (Internal):

Key:

- Number of Keys: 2 to 256.
- Frequency: Within 100 MHz (sine) or 2.5 MHz (other).
- Amplitude: Within 10 V_{p-p}.
- Offset: Within ±5 V.

Data:

- Number of Data, 2 to 2,048.
- Frequency Transition Time: 4 ns.
- Data Rate: 1 to 2,500,000.

- Period: 1 s to 0.4 μ s, every 0.1 μ s.

Phase Shift Keying (PSK) (Internal):

Key:

- Number of Keys: 2 to 256.
- Phase: Within $\pm 360.0^\circ$.
- Amplitude: Within 10 V_{p-p} .
- Offset: Within ± 5 V.

Data:

- Number of Data: 2 to 2,048.
- Phase Transition Time: 800 ns (200 clocks).
- Data Rate: 1 to 50,000.
- Period: 1 s to 20 μ s, every 0.1 μ s.

Reference Clock

Type: TCXO.

Nominal Frequency: 10 MHz.

Accuracy: ± 1 ppm (0° C to $\sim 50^\circ$ C).

Stability: ± 1 ppm/year (20° C to $\sim 30^\circ$ C).

Main Output

Filters:

100 MHz Brick Wall:

- To 100 MHz: Within 1 dB.
- 125 MHz to 1 GHz: Less than 40 dB

50 MHz Linear Phase: 3 dB ± 0.5 dB at 50 MHz.

Output Impedance: 50 ohms typical.

Output Protection: Instrument is non-destructively protected against short circuits or accidental voltage of up to ± 5 V DC plus peak AC applied to the main output connector.

Auxiliary Outputs

Sync Output:

Level: Positive TTL.
Minimum Pulse Width: 400 ns.
Output Impedance: 51 ohms nominal.

Marker Output:

Level: Positive TTL.
Minimum Pulse Width: 100 ns.
Output Impedance: 51 ohms nominal.

10 MHz Output:

Level: TTL square wave.
Duty Cycle: 50% to 75%.
Output Impedance: 51 ohms nominal.

Auxiliary Inputs

Trigger/Gate In:

Sensitivity: 200 mV_{p-p} minimum.
Bandwidth: DC to 10 MHz.
Amplitude: 30 ns, 200 mV_{p-p} amplitude.
Input Impedance: 1 kohm \pm 5%.
Maximum Input Voltage: \leq 10 V DC + peak AC.
Threshold: Positive slope for Arming and Time Burst, and positive true for Gate. Negative slope for Arming and Time Burst, and negative true for Gate.
Range: \pm 9.90 V.
Resolution: 0.1 V.
Accuracy: \pm 10% \pm 100 mV.

AM Input:

Input Impedance: 10 kohms \pm 5%.
Maximum Input Voltage: 10 V DC + peak AC.

REF IN:

Level: TTL compatible.
Range: 10 MHz \pm 10 kHz.
Input Impedance: 10 kohms \pm 5%.

Maximum Input Voltage: 0 V to +5 V.

Operating Modes

Continuous: Generates the waveform continuously.

Triggered Continuous: Output quiescent until triggered by an external, GPIB, or manual trigger; then generates an output after pre-defined delay and stops by pressing STOP button or GPIB command.

Gated: Same as triggered mode except output is executed after the pre-defined delay for the duration of the gated signal.

Time Burst: Output quiescent until triggered by an external, GPIB, or manual trigger; then outputs for pre-defined duration.
Output: 3 digits, 0.4 μ s to 100 s.
Accuracy: $\pm 0.1 \mu$ s.

Ext. Trigger Delay: 5 digits, 0.7 μ s to 100 s.
Accuracy:

- Synthesizer On: $\pm(0.1 \mu\text{s} + 0.01\%)$.
- Synthesizer Off: $\pm(0.2 \mu\text{s} + 0.01\%)$.

Programmable Interface

GPIB: IEEE-488.2-1987 compatible.

General Characteristics

Environmental

Temperature:

Operating: +10° C to +40° C.

Non-operating: 20° C to +45° C.

Temperature Change:

Operating: $\leq 15^\circ$ C per hour (no condensation).

Non-operating: $\leq 30^{\circ}$ C per hour (no condensation).

Humidity: Up to 80% RH.

Altitude:

Operating: 4.6 km (15,000 ft).

Non-operating: 15 km (50,000 ft).

Vibration: 0.003 in. p-p, 5 Hz to 55 Hz (0.5 g at 55 Hz).

Shock: 20 g (1/2 sine) 11 ms duration.

EMC: Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE 0871/6.78, Class B.

Electrical Discharge:

Operating Maximum Test Voltage: 15 kV (150 pF through 150 ohms).

Safety: Designed to meet UL 1244 and CSA 22.2 No. 231.

Power

Source Power:

Voltage Ranges: Selectable from 90 to 127 V AC or 180 to 250 V AC with internal jumper.

Line Frequency: 48 to 63 Hz.

Power Dissipation: 300 W.

Maximum Current: 5 amps.

Physical

Dimensions	mm	in.
Height	164	6.4

Width	362	14.25*
Depth	491	19.25
Weight	kg	lb.
Net	9.0	19.8
* <i>With handle.</i>		

Other

Display: 7-inch diagonal, electro-magnetic deflection CRT.

Recommended Adjustment Interval: 12 months.