



**This product is no longer carried in our catalog.**

## **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:  $0.1^\circ$ .

### **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<sub>p-p</sub>: ±(1.0% of setting + 1 mV<sub>p-p</sub>).
- 2.0 V<sub>p-p</sub>: ±(1.0% of setting + 5 mV<sub>p-p</sub>).
- 10 V<sub>p-p</sub>: ±(2.5% of setting + 50 mV<sub>p-p</sub>).

**Offset:** 4 digits.

Resolution:

- 0.4 V<sub>p-p</sub>: 1 mV.
- 2 V<sub>p-p</sub>: 2 mV.
- 10 V<sub>p-p</sub>: 10 mV.

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

Accuracy:

- 0.4 V<sub>p-p</sub>: ±(1.0% of setting + 1 mV).
- 2.0 V<sub>p-p</sub>: ±(1.0% of setting + 5 mV).
- 10 V<sub>p-p</sub>: ±(2.5% of setting + 50 mV).

**Noise Floor:**

Range:

- 0.4 V<sub>p-p</sub>: -128 dBm/Hz at 10 MHz.
- 2.0 V<sub>p-p</sub>: -114 dBm/Hz.
- 10 V<sub>p-p</sub>: -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 <sub>p-p</sub> | 2 V <sub>p-p</sub> , 0.4 V <sub>p-p</sub> |
|----------|---------------------|-------------------------------------------|
| <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 <sub>p-p</sub> | 2 V <sub>p-p</sub> , 0.4 V <sub>p-p</sub> |
|----------|---------------------|-------------------------------------------|
| <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 <sub>p-p</sub> | 2 V <sub>p-p</sub> , 0.4 V <sub>p-p</sub> |
|-----------------------|---------------------|-------------------------------------------|
| >=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   |
|---------------------------------|--------------|
| $\geq 100$ kHz to $\leq 10$ MHz | $\pm 1.0$ dB |
| $\leq 31.2$ MHz                 | $\pm 3.0$ dB |

0.4  $V_{p-p}$  and 2.0  $V_{p-p}$  Accuracy: DC accuracy  $\pm 3.0\%$  + Flatness.

10  $V_{p-p}$  Accuracy: DC accuracy  $\pm 5.0\%$  + Flatness.

Power: 4 digits up to 23.98 dBm.

### Square

**Amplitude:**

Flatness:

|                   | 50 MHz LPF  | Full Pass   |
|-------------------|-------------|-------------|
| $\leq 100$ kHz to | $\pm 2.0\%$ | $\pm 2.0\%$ |
| $\leq 2.5$ MHz    | $\pm 5.0\%$ | $\pm 5.0\%$ |
| $\leq 15.6$ MHz   | $\pm 5.0\%$ | $\pm 5.0\%$ |
| $\leq 50$ MHz     | -30%        | $\pm 10\%$  |

Accuracy: DC accuracy  $\pm 2\%$  + 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<sub>p-p</sub>.

- $10 V_{p-p}$ : 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:

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

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

- $\leq 100$  kHz:  $\pm 2.0\%$ .
- $\leq 2.5$  MHz:  $-5.0\%$ .
- $\leq 15.6$  MHz:  $-5.0\%$ .
- $\leq 31.2$  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:  $\leq 10$ .
- 10 Hz to 100 Hz:  $< 100$ .
- 100 Hz to 1 kHz:  $< 1000$ .
- 1 kHz to 100 MHz:  $\leq 1000$ .

**Dwell Time:** 4 digits.

Sweep: 0.5  $\mu$ s to 100 s.

Return: 0.5  $\mu$ s to 100 s.

**Marker:**

Number: 3.

Frequency: Between Start and Stop.

Time: 0.5  $\mu$ 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  $\mu$ s to 1 s every 0.2  $\mu$ s.

- Accuracy:  $\pm 0.1\%$ .
- Risetime: Within 2  $\mu\text{s}$ .
- AM Noise: Within 1% of range.

**Offset Modulation (Internal):**

High, Low: 4 digits, -5.000 V to +5.000 V<sub>p-p</sub>.

Modulation Rate:

- Period: 10  $\mu\text{s}$  to 1 s every 0.2  $\mu\text{s}$ .
- Accuracy:  $\pm 0.1\%$ .
- Risetime: Within 2  $\mu\text{s}$ .
- Modulation Noise: Within 1% of range.

**Frequency Modulation (Internal):**

Center Frequency: 9 digits.

Deviation: 6 digits.

Modulation Rate:

- Period: 10  $\mu\text{s}$  to 1 s every 0.2  $\mu\text{s}$ .
- Accuracy,  $\pm 0.1\%$ .

**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<sub>p-p</sub>.
- Offset: Within  $\pm 5$  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  $\mu\text{s}$ , every 0.1  $\mu\text{s}$ .

**Phase Shift Keying (PSK) (Internal):**

Key:

- Number of Keys: 2 to 256.
- Phase: Within  $\pm 360.0^\circ$ .
- Amplitude: Within 10 V<sub>p-p</sub>.
- Offset: Within  $\pm 5$  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  $\mu$ s, every 0.1  $\mu$ s.

### **Reference Clock**

**Type:** TCXO.

**Nominal Frequency:** 10 MHz.

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

**Stability:**  $\pm 1$  ppm/year ( $20^\circ$  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  $\pm 0.5$  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  $\pm 5$  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<sub>p-p</sub> minimum.

Bandwidth: DC to 10 MHz.

Amplitude: 30 ns, 200 mV<sub>p-p</sub> 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  $\mu$ s to 100 s.

Accuracy:  $\pm$ 0.1  $\mu$ s.

**Ext. Trigger Delay:** 5 digits, 0.7  $\mu$ s to 100 s.

Accuracy:

- Synthesizer On:  $\pm$ (0.1  $\mu$ 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:  $\leq 15^\circ\text{C}$  per hour (no condensation).

Non-operating:  $\leq 30^\circ\text{C}$  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**

| <b>Dimensions</b>     | <b>mm</b> | <b>in.</b> |
|-----------------------|-----------|------------|
| Height                | 164       | 6.4        |
| Width                 | 362       | 14.25*     |
| Depth                 | 491       | 19.25      |
| <b>Weight</b>         | <b>kg</b> | <b>lb.</b> |
| Net                   | 9.0       | 19.8       |
| <i>* With handle.</i> |           |            |

**Other**

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

**Recommended Adjustment Interval:** 12 months.



Tektronix Measurement products are manufactured in ISO registered facilities.

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