



AFG31000 Series Arbitrary Function Generator

Specification and Performance Verification Technical Reference

www.tek.com



077-148-900

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. See [Service safety summary](#) (on page 11).

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Do not use the provided power cord for other products.

Use proper voltage setting. Before applying power, make sure that the line selector is in the proper position for the source being used or make sure the line voltage is corrected based on the published specifications.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Connect and disconnect properly. Do not connect or disconnect instruments while they are connected to a voltage source.

Use only connectors and adapters supplied with the product, or indicated by Tektronix to be suitable for the product.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not float the common terminal above the rated voltage for that terminal.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Provide proper ventilation. Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product. This product is provided with handles for lifting and carrying.

Use only the Tektronix rack-mount hardware specified for this product.

Keep product surfaces clean and dry. Remove the input signals before you clean the product. Inspect the instrument as often as operating conditions require. To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the instrument with a lint-free cloth. Use care to avoid scratching the clear glass display filter.
2. Use a soft cloth dampened with water to clean the instrument. Use an aqueous solution of 75% isopropyl alcohol for more efficient cleaning.



CAUTION. Avoid getting moisture inside the unit during external cleaning. Use only enough cleaning solution to dampen the cloth or swab. To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents, and do not use any abrasive or chemical cleaning agents.

Terms in this manual

These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Service safety summary

This section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the General safety summary before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



Preface

Introduction

Thank you for choosing a Tektronix product. The Series 31000 Arbitrary Function Generator (AFG) instruments are high-performance instruments with built-in waveform generation applications, real-time waveform monitoring called InstaView™, and an improved user interface for higher test efficiency.

This manual contains instructions for verifying the performance of the AFG31000 Series Arbitrary Function Generator to the module level.

To prevent personal injury or damage to the instrument, consider the following before attempting service:

- The procedures in this manual should be performed only by qualified service personnel.
- Read the [General safety summary](#) (on page 9) and the [Service safety summary](#) (on page 11) at the beginning of this document.

General model information

This manual provides operation information for the following products. Unless otherwise noted, "AFG31000 Series" refers to the models in the following table.

Table 1: AFG31000 models

Model	Bandwidth	Sample rate	Channel	Waveform memory size	Optional
AFG31021	25 MHz	250 MS/s	1	16 MS/CH	128 MS/CH
AFG31022	25 MHz	250 MS/s	2	16 MS/CH	128 MS/CH
AFG31051	50 MHz	1 GS/s	1	16 MS/CH	128 MS/CH
AFG31052	50 MHz	1 GS/s	2	16 MS/CH	128 MS/CH
AFG31101	100 MHz	1 GS/s	1	16 MS/CH	128 MS/CH
AFG31102	100 MHz	1 GS/s	2	16 MS/CH	128 MS/CH
AFG31151	150 MHz	2 GS/s	1	16 MS/CH	128 MS/CH
AFG31152	150 MHz	2 GS/s	2	16 MS/CH	128 MS/CH
AFG31251	250 MHz	2 GS/s	1	16 MS/CH	128 MS/CH
AFG31252	250 MHz	2 GS/s	2	16 MS/CH	128 MS/CH

Each AFG31000 Series provides a:

- 25 MHz to 250 MHz function signal generator
- 20 MHz to 160 MHz pulse generator

The AFG31000 Series also provides 14-bit vertical resolution.

AFG31000 Series documentation

Complete documentation for the instruments is available at tek.com. The following is a list of available documentation.

Table 2: AFG31000 documentation

Document name	Available languages	Document number	Document description
Instructions Compliance and Safety Instructions	English French German Italian Japanese Korean Portuguese Russian Simplified Chinese Spanish Traditional Chinese	071360600	This document contains compliance and safety information for the AFG31000 Series Arbitrary Function Generator (one document).
AFG31000 Series Arbitrary Function Generator User's Manual	English	077147300	This document describes operation and installation procedures for all models of the AFG31000 Series Arbitrary Function Generator. It includes information about features, functions, and accessories.
	Japanese	077147800	
	Simplified Chinese	077147900	
	Traditional Chinese	077148000	
	German	077148100	
	French	077148200	
	Russian	077148600	
	Korean	077148700	
AFG31000 Series Arbitrary Function Generator Programmer's Manual	English	077148800	This document provides information required to use programmable interface commands for the AFG31000 Series Arbitrary Function Generator.
AFG31000 Series Arbitrary Function Generator Specification and Performance Verification Technical Reference	English	077148900	This document describes specifications and performance verification procedures for the AFG31000 Series Arbitrary Function Generator.
AFG31000 Series Arbitrary Function Generator Declassification & Security Instructions	English	077149100	This document includes information that is necessary to clear or sanitize the product so it can be removed from a secured area, such as when returning the product for repair.
Series 31000 ArbExpress Printable Help	English	077149200	This online help provides information on how to create, edit, and transfer standard waveforms to an arbitrary waveform generator, an arbitrary function generator, or an oscilloscope.
AFG31000 Series Arbitrary Function Generator Release Notes	English	077149300	Release notes

Contact information

If you have any questions after you review the information in this documentation, please contact your local Tektronix office, sales partner, or distributor. You can also call the corporate headquarters of Tektronix in North America at 1-800-833-9200. Visit tek.com to find contacts in your area.

Extended warranty

Additional years of warranty coverage are available on many products. These valuable contracts protect you from unbudgeted service expenses and provide additional years of protection at a fraction of the price of a repair. Extended warranties are available on new and existing products. Contact your local Tektronix office, sales partner, or distributor for details (refer to [Contact information](#) (on page 15) for details).

Specifications

Introduction

All specifications are guaranteed unless labeled “typical.” Typical specifications are provided for your convenience, but are not guaranteed.

All specifications apply to the arbitrary function generator unless noted otherwise. These specifications are valid under the following conditions:

- The instrument must be calibrated or adjusted at an ambient temperature between 20 °C and 30 °C.
- The instrument must be operating at an ambient temperature between 0 °C and 50 °C.
- The instrument must be warmed up for at least 20 minutes.
- The instrument must be in an environment where the temperature, altitude, and humidity levels are within the operating limits described in these specifications.

NOTE. If you are using a two-channel instrument for differential analog output and one connector is used as single-ended output, the other connector must be terminated with a 50 Ω connector.

Electrical specifications

The following tables describe the electrical specifications for the AFG31000 Series.

Operating mode

Table 3: Operating mode specifications

Characteristic	Description
Run mode	Continuous, Modulation, Sweep, and Burst
Burst count	1 to 1,000,000 cycles or infinite
Internal trigger rate	1 μ s to 500 s

Waveforms

Table 4: Waveforms specifications

Characteristic	Description
Standard	Sine, Square, Pulse, Ramp, and More (Sin(x)/x, Noise, DC, Gaussian, Lorentz, Exponential Rise, Exponential Decay, and Haversine)
Arbitrary waveform	User-defined waveforms; you can edit and save your own waveforms
Waveform length	2 to 131,072
Sampling rate	AFG31021, AFG31022 250 MS/s
	AFG31051, AFG31052, AFG31101, AFG31102 Rate changes automatically based on waveform length: ≤16,000 = 1 GS/s sampling rate >16,000 = 250 MS/s sampling rate
	AFG31151, AFG31152 Rate changes automatically based on waveform length: ≤16,000 = 2 GS/s sampling rate >16,000 = 250 MS/s sampling rate
	AFG31251, AFG31252 Rate changes automatically based on waveform length: ≤16,000 = 2 GS/s sampling rate >16,000 = 250 MS/s sampling rate
Resolution	14 bits
Non-Volatile Waveform Memory	2380M

Frequency/period

Table 5: Frequency/period specifications

Characteristic	Description	PV reference page
Frequency range		
Sine¹	AFG31021, AFG31022	1 µHz to 25 MHz
	AFG31051, AFG31052	1 µHz to 50 MHz
	AFG31101, AFG31102	1 µHz to 100 MHz
	AFG31151, AFG31152	1 µHz to 150 MHz
	AFG31251, AFG31252	1 µHz to 250 MHz
Square²	AFG31021, AFG31022	1 µHz to 20 MHz
	AFG31051, AFG31052	1 µHz to 40 MHz
	AFG31101, AFG31102	1 µHz to 80 MHz

¹ Triggered/gated burst mode: AFG31021, AFG31022: 1 µHz to 12.5 MHz; AFG31051, AFG31052: 1 µHz to 25 MHz; AFG31101, AFG31102: 1 µHz to 50 MHz; AFG31151, AFG31152: 1 µHz to 75 MHz; AFG31251, AFG31252: 1 µHz to 125 MHz.

² Triggered/gated burst mode: AFG31021, AFG31022: 1 µHz to 20 MHz; AFG31051, AFG31052: 1 µHz to 40 MHz; AFG31101, AFG31102: 1 µHz to 80 MHz; AFG31151, AFG31152: 1 µHz to 120 MHz; AFG31251, AFG31252: 1 µHz to 160 MHz.

Characteristic	Description	PV reference page
Pulse	AFG31151, AFG31152	1 μ Hz to 120 MHz
	AFG31251, AFG31252	1 μ Hz to 160 MHz
	AFG31021, AFG31022	1 mHz to 20 MHz
	AFG31051, AFG31052	1 mHz to 40 MHz
	AFG31101, AFG31102	1 mHz to 80 MHz
	AFG31151, AFG31152	1 mHz to 120 MHz
	AFG31251, AFG31252	1 mHz to 160 MHz
Ramp, Sin(x)/X, Gaussian, Lorentz, Exponential Rise, Exponential Decay, Haversine	AFG31021, AFG31022	1 μ Hz to 500 kHz
	AFG31051, AFG31052	1 μ Hz to 800 kHz
	AFG31101, AFG31102	1 μ Hz to 1 MHz
	AFG31151, AFG31152	1 μ Hz to 1.5 MHz
	AFG31251, AFG31252	1 μ Hz to 2.5 MHz
Arbitrary ³	AFG31021, AFG31022	1 mHz to 12.5 MHz
	AFG31051, AFG31052	1 mHz to 25 MHz
	AFG31101, AFG31102	1 mHz to 50 MHz
	AFG31151, AFG31152	1 mHz to 75 MHz
	AFG31251, AFG31252	1 mHz to 125 MHz
Noise bandwidth (–3 dB)	AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	150 MHz
	AFG31151, AFG31152, AFG31251, AFG31252	360 MHz
Resolution	1 μ Hz or 12 digits	
✓ Accuracy	$\pm 10^{-6}$ setting (except Arbitrary), 0 °C to 50 °C $\pm 10^{-6}$ setting $\pm 1 \mu$ Hz (ARB), 0 °C to 50 °C	Frequency/period test (on page 39)
✓ Stability ⁴	$\pm 1.6 \times 10^{-6}$ /year	
Accuracy aging	$\pm 1.0 \times 10^{-6}$ /year	

Phase (except DC, noise, and pulse)

Table 6: Phase specifications

Characteristic	Description
Range ⁵	–180° to 180°

³ Triggered/gated burst mode: AFG31021, AFG31022: 1 mHz to 6.25 MHz; AFG31051, AFG31052: 1 mHz to 12.5 MHz; AFG31101, AFG31102: 1 mHz to 25 MHz; AFG31151, AFG31152: 1 mHz to 37.5 MHz; AFG31251, AFG31252: 1 mHz to 62.5 MHz.

⁴ Total reference frequency error one year after factory adjustment at any temperature within operating limits.

⁵ Resolution: 0.01° (sine), 0.1° (other standard waveforms)

Lead delay (pulse)

Table 7: Lead delay specifications

Characteristic	Description
Range	
Continuous mode	0 ps to period
Triggered/Gated Burst mode	0 ps to period – [pulse width + 0.8 × (leading edge time + trailing edge time)]
Resolution	10 ps or 8 digits

Skew

Table 8: Skew specifications for 2-channel model

Characteristic	Description
Pulse function	
Frequency	1MHz
Amplitude	1V _{pp}
Leading/trailing time	18.00ns
Skew	<1ns

Amplitude

Table 9: Amplitude specifications

Characteristic	Description	PV reference page
Range⁶		
AFG31021, AFG31022, AFG31051, AFG31052	1 mV _{pp} to 10 V _{pp} 2 mV _{pp} to 20 V _{pp} (into open circuit load)	
AFG31101, AFG31102	1 mV _{pp} to 10 V _{pp} 2 mV _{pp} to 20 V _{pp} (into open circuit load) Sine wave at >60 MHz to 80 MHz: 1 mV _{pp} to 8 V _{pp} into 50 Ω 2 mV _{pp} to 16 V _{pp} (into open circuit load) Sine wave at >80 MHz to 100 MHz: 1 mV _{pp} to 6 V _{pp} into 50 Ω 2 mV _{pp} to 12 V _{pp} (into open circuit load) Square/pulse at >40 MHz to 80 MHz: 1 mV _{pp} to 5 V _{pp} into 50 Ω 2 mV _{pp} to 10 V _{pp} (into open circuit load)	
AFG31151, AFG31152, AFG31251, AFG31252	1 mV _{pp} to 5 V _{pp} 2 mV _{pp} to 10 V _{pp} (into open circuit load)	

⁶ AFG31251, AFG31252 at frequency >200 MHz to 250 MHz: 1 mV_{pp} to 4 V_{pp} into 50 Ω, 2 mV_{pp} to 8 V_{pp} into opencircuit load.

Characteristic	Description	PV reference page
✓ Accuracy	$\pm(1\%$ of setting +1 mV) at 1 kHz sine waveform, amplitude >1 mV _{pp} , 0 V offset	Amplitude test (on page 40)
Resolution	0.1 mV _{pp} , 0.1 mV _{rms} , 1 mV, 0.1 dBm or 4 digits	
Units ⁷	V _{pp} , V _{rms} , dBm, and volt (high level and low level)	
Output impedance	50 Ω	
Isolation	42 V peak maximum to earth	

DC offset

Table 10: DC offset specifications

Characteristic	Description
Range	
AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	± 5 V peak AC + DC into 50 Ω
AFG31151, AFG31152, AFG31251, AFG31252	± 2.5 V peak AC + DC into 50 Ω
✓ Accuracy ⁸	$\pm(1\%$ of setting +1 mV + 0.5% of amplitude V _{pp})
Resolution	1 mV
Output impedance	50 Ω

Internal noise add

Table 11: Internal noise add specifications

Characteristic	Description
Type	White
Range	0% to 50% of amplitude setting
Resolution	1%

⁷ dBm is only for sine waveforms. V_{rms} is not available for arbitrary and noise waveforms.

⁸ Add 0.5 mV per °C for operation outside of 20 °C to 30 °C.

Output characteristics

Table 12: Sine wave output specifications

Characteristic	Description	PV reference page
Sine wave (50 Ω)		
✓ Flatness (at 1.0 V _{pp} amplitude, relative to 1 kHz)	AFG31021, AFG31022	<5 MHz: ± 0.2 dB ≥ 5 MHz to ≤ 25 MHz: ± 0.3 dB
	AFG31051, AFG31052	<5 MHz: ± 0.2 dB ≥ 5 MHz to ≤ 50 MHz: ± 0.3 dB
	AFG31101, AFG31102	<5 MHz: ± 0.2 dB ≥ 5 MHz to ≤ 100 MHz: ± 0.3 dB
	AFG31151, AFG31152	<5 MHz: ± 0.2 dB ≥ 5 MHz to < 25 MHz: ± 0.3 dB ≥ 25 MHz to < 100 MHz: ± 0.5 dB ≥ 100 MHz to ≤ 150 MHz: ± 1.0 dB
	AFG31251, AFG31252	<5 MHz: ± 0.2 dB ≥ 5 MHz to < 25 MHz: ± 0.3 dB ≥ 25 MHz to < 100 MHz: ± 0.5 dB ≥ 100 MHz to < 200 MHz: ± 1.0 dB ≥ 200 MHz to ≤ 250 MHz: ± 2.0 dB
✓ Harmonic distortion (at 1.0 V _{pp} amplitude)	AFG31021, AFG31022	10 Hz to < 20 kHz: < -70 dBc ≥ 20 kHz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 5 MHz: < -50 dBc ≥ 5 MHz to ≤ 25 MHz: < -37 dBc
	AFG31051, AFG31052	10 Hz to < 20 kHz: < -70 dBc ≥ 20 kHz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 5 MHz: < -50 dBc ≥ 5 MHz to ≤ 50 MHz: < -37 dBc
	AFG31101, AFG31102	10 Hz to < 20 kHz: < -70 dBc ≥ 20 kHz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 5 MHz: < -50 dBc ≥ 5 MHz to ≤ 100 MHz: < -37 dBc
	AFG31151, AFG31152	10 Hz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 5 MHz: < -50 dBc ≥ 5 MHz to < 25 MHz: < -37 dBc ≥ 25 MHz to ≤ 150 MHz: < -30 dBc
	AFG31251, AFG31252	10 Hz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 5 MHz: < -50 dBc ≥ 5 MHz to < 25 MHz: < -37 dBc ≥ 25 MHz to ≤ 250 MHz: < -30 dBc
✓ Spurious⁹ (nonharmonic) (at 1.0 V _{pp} amplitude)	AFG31021, AFG31022	10 Hz to < 1 MHz: < -60 dBc ≥ 1 MHz to ≤ 25 MHz: < -50 dBc
	AFG31051, AFG31052	10 Hz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 25 MHz: < -50 dBc ≥ 25 MHz to ≤ 50 MHz: < -50 dBc + 6 dBc per octave
	AFG31101, AFG31102	10 Hz to < 1 MHz: < -60 dBc ≥ 1 MHz to < 25 MHz: < -50 dBc ≥ 25 MHz to ≤ 100 MHz: < -50 dBc + 6 dBc per octave

⁹ Exclude harmonics and channel crosstalk.

Characteristic	Description	PV reference page
	AFG31151, AFG31152	10 Hz to <1 MHz: <−60 dBc ≥1 MHz to <25 MHz: <−47 dBc ≥25 MHz to ≤150 MHz: <−47 dBc + 6 dBc per octave
	AFG31251, AFG31252	10 Hz to <1 MHz: <−60 dBc ≥1 MHz to <25 MHz: <−47 dBc ≥25 MHz to ≤250 MHz: <−47 dBc + 6 dBc per octave
Phase noise (at 1.0 V _{pp} amplitude)	20 MHz: <−110 dBc per Hz at 10 kHz offset	
Residual clock noise (typical)	AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	−63 dBm
	AFG31151, AFG31152, AFG31251, AFG31252	−63 dBm

Table 13: Square wave output specifications

Characteristic	Description
Square wave	
✓ Rise time/fall time	AFG31021, AFG31022 Amplitude >5 V _{pp} : 8.0 ns Amplitude ≤5 V _{pp} : 7.0 ns
	AFG31051, AFG31052 Amplitude >5 V _{pp} : 6.0 ns Amplitude ≤5 V _{pp} : 5.0 ns
	AFG31101, AFG31102 Amplitude >5 V _{pp} : 4.2 ns Amplitude ≤5 V _{pp} : 3.5 ns
	AFG31151, AFG31152, AFG31251, AFG31252 Amplitude >5 V _{pp} : 3.0 ns Amplitude ≤5 V _{pp} : 2.0 ns
Overshoot	<5%
Jitter (RMS), typical	2.5 ps RMS

Table 14: Pulse output specifications

Characteristic	Description
Pulse	
Pulse width (resolution: 10 ps or 5 digits)	AFG31021, AFG31022 16 ns to 999.99 s
	AFG31051, AFG31052 10 ns to 999.99 s
	AFG31101, AFG31102 6 ns to 999.99 s
	AFG31151, AFG31152 5 ns to 999.99 s
	AFG31251, AFG31252 4 ns to 999.99 s
Pulse duty	0.001% to 99.999%
Leading/trailing edge transition time (at 10% to 90% of amplitude, respectively); resolution 10 ps or 4 digits	AFG31021, AFG31022 8 ns to 0.625 × pulse period
	AFG31051, AFG31052 6 ns to 0.625 × pulse period
	AFG31101, AFG31102 4 ns to 0.625 × pulse period
	AFG31151, AFG31152 3 ns to 0.625 × pulse period
	AFG31251, AFG31252 2 ns to 0.625 × pulse period

Characteristic	Description
Overshoot, typical	<5%
Jitter (RMS), typical	2.5 ps RMS

Table 15: Ramp output specifications

Characteristic	Description	
Ramp		
Linearity (at 1 kHz frequency, amplitude 1 V _{pp} , symmetry 100%)	AFG31021, AFG31022, AFG31051, AFG31052	≤ 0.1% of peak output at 10% to 90% of amplitude range
	AFG31101, AFG31102	≤ 0.15% of peak output at 10% to 90% of amplitude range
	AFG31151, AFG31152, AFG31251, AFG31252	≤ 0.2% of peak output at 10% to 90% of amplitude range
Symmetry	0% to 100%	

Table 16: Arbitrary output specifications

Characteristic	Description	
Arbitrary		
Rise/fall time, typical	AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	Amplitude ≥ 5 V _{pp} : 4.2 ns Amplitude < 5 V _{pp} : 3.5 ns
	AFG31151, AFG31152, AFG31251, AFG31252	≤ 2 ns
Jitter (RMS)	AFG31021, AFG31022	3.0 ps RMS
	AFG31051, AFG31052	2.5 ps RMS
	AFG31101, AFG31102	2.0 ps RMS
	AFG31151, AFG31152, AFG31251, AFG31252	1.6 ps RMS

Table 17: DC output specifications

Characteristic	Description	PV reference page
DC		
Range (resolution 1 mV or 4 digits)	AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	–5 V to 5 V into 50 Ω –10 V to 10 V into open-circuit load
	AFG31151, AFG31152, AFG31251, AFG31252	–2.5 V to 2.5 V into 50 Ω –5 V to 5 V into open-circuit load
	Accuracy ¹⁰ (50 Ω load)	±(1% of DC setting + 1 mV DC)
		DC test

¹⁰ Add 0.5 mV per °C for operation outside of 20 °C to 30 °C.

Table 18: Amplitude modulation (AM) specifications

Characteristic	Description
Amplitude modulation (AM)	
Carrier waveforms	Standard waveforms (except pulse, DC, and noise) and arbitrary waveforms
Modulation source	Internal or external (from modulation input)
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary ¹¹
Internal modulating frequency	1 mHz to 1 MHz
Depth	0% to 120%

Table 19: Frequency modulation (FM) specifications

Characteristic	Description
Frequency modulation (FM)	
Carrier waveforms	Standard waveforms (except pulse, DC, and noise) and arbitrary waveforms
Modulation source	Internal or external (from modulation input)
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary ¹² Maximum effective points: 2048
Internal modulating frequency	1 mHz to 1 MHz
Peak deviation	AFG31021, AFG31022 DC to 12.5 MHz
	AFG31051, AFG31052 DC to 25 MHz
	AFG31101, AFG31102 DC to 50 MHz
	AFG31151, AFG31152 DC to 75 MHz
	AFG31251, AFG31252 DC to 125 MHz

Table 20: Phase modulation (PM) specifications

Characteristic	Description
Phase modulation (PM)	
Carrier waveforms	Standard waveforms (except pulse, DC, and noise) and arbitrary waveforms
Modulation source	Internal or external (from modulation input)
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary ¹³ Maximum effective points: 2048
Internal modulating frequency	1 mHz to 1 MHz
Phase deviation range	0 to 180 degrees

¹¹ For amplitude modulation, the maximum effective points for arbitrary waveforms is 128,000. Waveform data above 128,000 points is ignored.

¹² For FM, PM, and PWM modulation types, the maximum effective points for arbitrary waveforms is 2048. Waveform data above 2048 points is ignored.

¹³ For FM, PM, and PWM modulation types, the maximum effective points for arbitrary waveforms is 2048. Waveform data above 2048 points is ignored.

Table 21: Frequency shift keying (FSK) modulation specifications

Characteristic	Description
Frequency shift keying (FSK)	
Carrier waveforms	Standard waveforms (except pulse, DC, and noise) and arbitrary waveforms
Modulation source	Internal or external (from modulation input)
Internal key rate	1 mHz to 1 MHz
Number of keys	2

Table 22: Pulse width modulation (PWM) specifications

Characteristic	Description
Pulse width modulation (PWM)	
Carrier waveforms	Pulse
Modulation source	Internal or external (from modulation input)
Internal modulating waveforms	Sine, square, ramp, noise, arbitrary ¹⁴
Internal modulating frequency	1 mHz to 1 MHz
Deviation range	0% to 50% of pulse period

Table 23: Sweep modulation specifications

Characteristic	Description	
Sweep		
Type	Linear or logarithmic	
Start/stop frequency ¹⁵	AFG31021, AFG31022	1 μHz to 25 MHz (except arbitrary: 1 mHz to 25 MHz)
	AFG31051, AFG31052	1 μHz to 50 MHz (except arbitrary: 1 mHz to 50 MHz)
	AFG31101, AFG31102	1 μHz to 100 MHz (except arbitrary: 1 mHz to 100 MHz)
	AFG31151, AFG31152	1 μHz to 150 MHz (except arbitrary: 1 mHz to 150 MHz)
	AFG31251, AFG31252	1 μHz to 250 MHz (except arbitrary: 1 mHz to 250 MHz)
Sweep/hold/return time	Range	Sweep time: 1 ms to 500 s Hold/return time: 0 ms to 500 s
	Resolution	1 ms or 4 digits
Interval	Range	1 μs to 500 s

¹⁴ For FM, PM, and PWM modulation types, the maximum effective points for arbitrary waveforms is 2048. Waveform data above 2048 points is ignored.

¹⁵ Pulse, DC, and noise waveforms are not available. Start and stop frequencies depend on the waveform shape.

Characteristic	Description	
	Resolution	1 ms or 4 digits
Total sweep time accuracy	< 0.4%	

Input and output specifications

The following tables contain input and output specifications for the AFG31000 Series.

Front panel

Table 24: Front-panel input and output specifications

Characteristic	Description	
Trigger input		
Input level	TTL compatible	
Pulse width	100 ns minimum	
Impedance	10 kΩ	
Trigger delay		
Resolution (100 ps or 5 digits)	0.0ns to 85.000s	
Trigger output		
Level	Positive TTL level pulse into 1 kΩ	
Impedance	50 Ω, AC coupled	
Jitter (RMS), range	AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102	10 ps
	AFG31151, AFG31152	10 ps
	AFG31251, AFG31252	10 ps

Rear panel

Table 25: Rear-panel input and output specifications

Characteristic	Description
External modulation input	
Input range	-1.0 V to 1 V full scale (except FSK), 3.3 V logic level
Input impedance	5.2 k Ω
Frequency range	AM, FM, PM, FSK, PWM: DC to 125 kHz (sampling rate: 1 MS/s)
Jitter (RMS), range	Trigger to signal output (signal output with external trigger input in burst mode) 100 ps
External reference output	AFG31101, AFG31102, AFG31151, AFG31152, AFG31251, AFG31252
Impedance	50 Ω , AC coupled
Amplitude, typical	1.2 V _{pp} into 50 Ω
External reference input	
Impedance	1 k Ω
Required input voltage swing	100 mV _{pp} to 5 V _{pp}
Lock range	10 MHz \pm 35 kHz
CH1 additional input	AFG31101, AFG31102, AFG31151, AFG31152, AFG31251, AFG31252
Impedance	50 Ω
Input range	-1 V to 1 V (DC + peak AC)
Bandwidth	DC to 10 MHz (-3 dB) at 1 V _{pp}

General specifications

The following topics describe the general specifications of the AFG31000 Series.

Power

Table 26: Power specifications

Characteristic	Description
Source voltage and frequency	100 V to 240 V, 47 Hz to 63 Hz 115 V, 360 to 440 Hz
Power consumption	Less than 120 W
Surge current	30 A peak (25° C) for \leq 5 line cycles, after product has been turned off for at least 30 s

Environmental

Table 27: Environmental specifications

Characteristic	Description
Temperature range	
Operating	0 °C to 50 °C
Nonoperating	–30 °C to 70 °C
Humidity	
Operating (noncondensing)	≤ 80% relative humidity, 0 °C to 40 °C ≤ 60% relative humidity, < 40 °C to 50 °C, noncondensing
Nonoperating (noncondensing)	5% to 90% relative humidity, < 40 °C, noncondensing 5% to 80% relative humidity, ≥ 40 °C to 60 °C, noncondensing 5% to 40% relative humidity, > 60 °C to 70 °C, noncondensing
Altitude	
Operating	Up to 3,000 meters (9,843 feet)
Nonoperating	Up to 12,000 meters (39,370 feet)

Physical characteristics

Table 28: Physical characteristics

Characteristic	Description
Net weight, typical	4.85 kg (10.68 lbs)
Net weight with packaging, typical	7.00 kg (15.42 lbs)
Dimensions	Height: 191.8 mm (7.55 in.) Width: 412.8 mm (16.25 in.) Depth: 143.3 mm (5.64 in.)
Clearance required for cooling	50 mm (2.0 in)

System characteristics

Table 29: System characteristics

Characteristic	Description		
Warm-up time, typical	20 minutes minimum		
Power on self-diagnostics, typical	< 24 s		
Configuration times, typical	USB	LAN	GPIB
Function change	61 ms	61 ms	63 ms
Frequency change (except pulse)	3 ms	4 ms	6 ms
Frequency change (pulse)	2.5 ms	3 ms	8 ms
Amplitude change	65 ms	66 ms	77 ms
Select user Arbitrary waveform¹⁶ (USB memory)	43 ms	40 ms	53 ms
Select user Arbitrary waveform¹⁷ (USB memory)	86 ms	92 ms	92 ms
Data download, 4,000 points of arbitrary waveform data (8 Kb)	21 ms	21 ms	36 ms
Acoustic noise, typical	< 50 dBA		
Weight (approximate)	4.7 kg (10.36 lbs)		
Dimensions	Refer to the illustrations in Dimensions (on page 31)		

¹⁶ Arbitrary waveform is 4000 points.

¹⁷ Arbitrary waveform is 128,000 points.

Dimensions

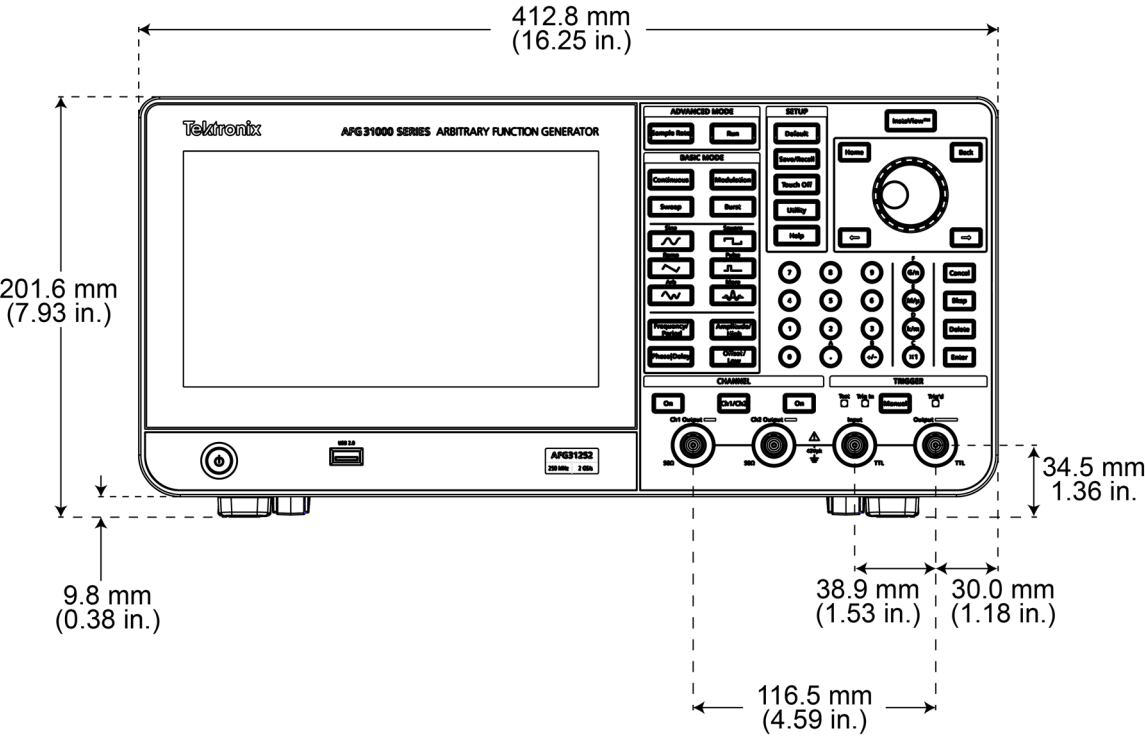


Figure 1: AFG31000 Series front view

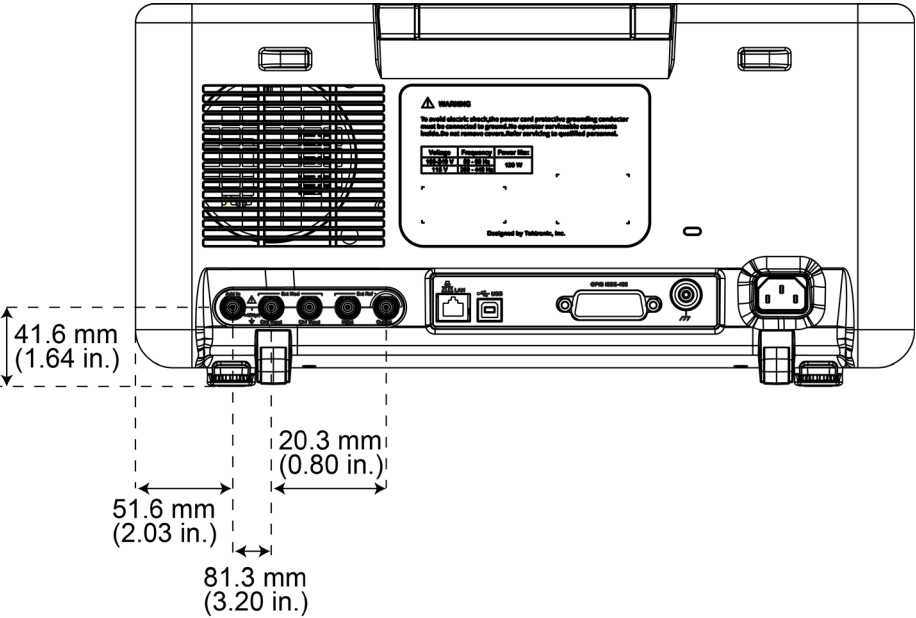


Figure 2: AFG31000 Series dimensions rear view

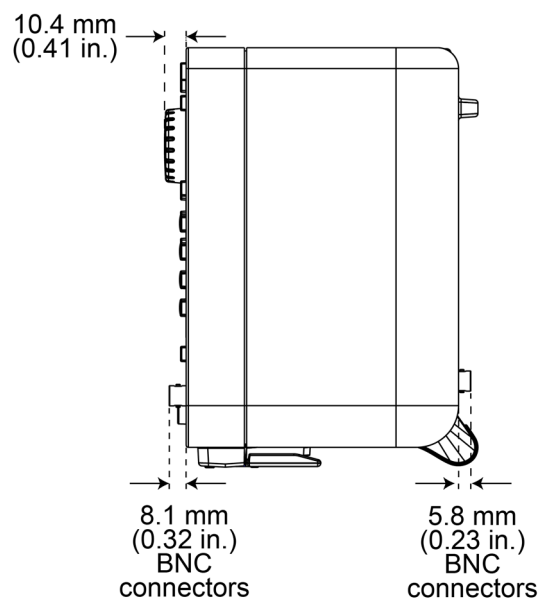


Figure 3: AFG31000 Series dimensions side view

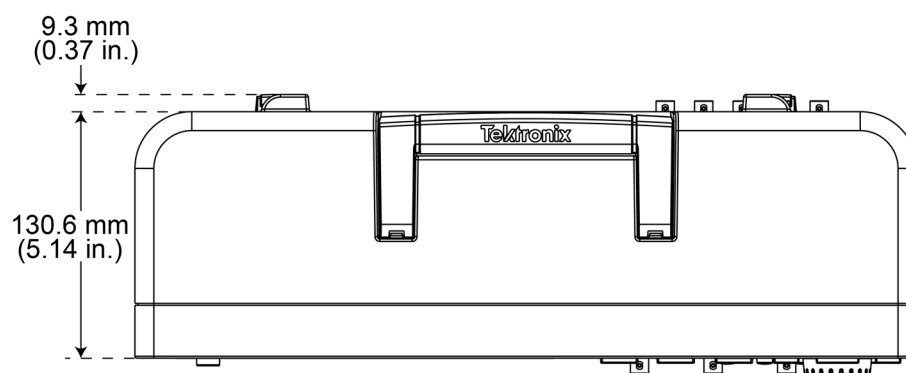


Figure 4: AFG31000 Series dimensions top view

Performance verification

Introduction

You can do two different types of performance verification on the AFG31000 Series:

- **Self-tests:** Quickly confirm that the AFG31000 Series internal hardware is operating properly.
- **Performance tests:** Do a more thorough check of functionality and calibration to warranted specifications.

NOTE. First complete the self-tests, then complete the performance tests. The performance tests require a controlled test environment and more time to execute than the self-tests. See [Performance conditions](#) (on page 37) for details about the required test environment.

Self-tests

The following AFG31000 Series self-tests provide a quick way to confirm basic functionality and proper adjustment:

- **Self-Diagnostics:** Internal diagnostics routine that verifies that the instrument passes initial circuit tests.
- **Self-Calibration:** Internal calibration routine that checks and adjusts the internal calibration constants.

NOTE. You must run the self-tests before you can run the performance tests.

Diagnostics self-test

This self-test uses internal routines to verify that the instrument is operating correctly.

Equipment required	None
Prerequisites	<ul style="list-style-type: none">▪ Power on the instrument and allow it to warm up for 20 minutes before running the self-tests.▪ Make sure the instrument is operating in an ambient temperature between 0 °C and 50 °C.

To run the diagnostics self-test:

1. On the display, select **Utility > Diagnostics/Calibration**.
2. Next to Self-Diagnostics, select **Run**.
3. Make sure all cables are disconnected from the instrument and select **OK**.
4. Wait until the test is complete (the test will take several minutes).
5. Review the results of the test on the display and select **Close** when you are done.

If the diagnostics self-test completes without finding any problems, the message **PASSED** is displayed.

When an error is detected during diagnostics execution, the instrument displays an error code. Error codes are described in [Error codes](#) (on page 35).

Calibration self-tests

This self-test uses an internal calibration routine that checks and adjusts the internal calibration constants.

Equipment required	None
Prerequisites	<ul style="list-style-type: none">■ Power on the instrument and allow it to warm up for 20 minutes before running the self-tests.■ Make sure the instrument is operating in an ambient temperature between 0 °C and 50 °C.

To run the calibration self-test:

1. On the display, select **Utility > Diagnostics/Calibration**.
2. Next to Self-Calibration, select **Run**.
3. Make sure all cables are disconnected from the instrument and select **OK**.
4. Wait until the test is complete (the test will take several minutes).
5. Review the results of the test on the display and select **Close** when you are done.

If the diagnostics self-test completes without finding any problems, the message `PASSED` is displayed.

When an error is detected during diagnostics execution, the instrument displays an error code. Error codes are described in [Error codes](#) (on page 35).

NOTE. Do not turn off the power while running self-calibration. If the power is turned off during calibration, data stored in internal nonvolatile memory may be lost.

Self-test error codes

If the self-tests detect a malfunction, the AFG31000 Series displays [name of the test] failed! and the error code. The following table lists the error codes with a description of the error and modules related to the error.

Table 30: Output diagnostics error codes

Error code	Description
2301	CH1 internal offset failure
2302	CH2 internal offset failure
2303	CH1 output offset failure
2304	CH2 output offset failure
2305	CH1 output gain failure
2306	CH2 output gain failure
2401	CH1 x12 dB attenuator failure
2402	CH2 x12 dB attenuator failure
2403	CH1 x20 dB K13 attenuator failure
2404	CH2 x20 dB K23 attenuator failure
2405	CH1 x20 dB K14 attenuator failure
2406	CH2 x20 dB K24 attenuator failure
2407	CH1 x14 dB/20 dB K15 attenuator failure (14 dB for AFG31151, AFG31152, AFG31251, AFG31252; 20 dB for AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102)
2408	CH2 x14 dB/20 dB K25 attenuator failure
2409	CH1 x20 dB K18 attenuator failure
2410	CH2 x20 dB K28 attenuator failure
2411	CH1 filter failure
2412	CH2 filter failure
2501	CH1 ASIC failure
2502	Ch2 ASIC failure
2503	Ch1 ADC failure
2504	Ch2 ADC failure

Table 31: Calibration error codes

Error code	Description
1101	CH1 internal offset calibration failure
1102	CH2 internal offset calibration failure
1103	CH1 output offset calibration failure
1104	CH2 output offset calibration failure
1105	CH1 output gain calibration failure
1106	CH2 output gain calibration failure
1201	CH1 x12 dB attenuator calibration failure
1202	CH2 x12 dB attenuator calibration failure
1203	CH1 x20 dB K13 attenuator calibration failure
1204	CH2 x20 dB K23 attenuator calibration failure
1205	CH1 x20 dB K14attenuator calibration failure
1206	CH2 x20 dB K24attenuator calibration failure
1207	CH1 x14 dB/20dB K15 attenuator calibration failure
1208	CH2 x14 dB/20dB K25 attenuator calibration failure
1209	CH1 x20 dB 2 attenuator calibration failure
1210	CH2 x20 dB 2 attenuator calibration failure
1211	CH1 filter calibration failure
1212	CH2 filter calibration failure
3001	Error code of Offset_DAC correction for CH1 about X4 attenuation
3002	Error code of Offset_DAC correction for CH2 about X4 attenuation
3003	Error code of Offset_DAC correction for CH1 about X16 attenuation
3004	Error code of Offset_DAC correction for CH2 about X16 attenuation
3005	Error code of variable gain correction for CH1 about X4 attenuation
3006	Error code of variable gain correction for CH2 about X4 attenuation
3007	Error code of variable gain correction for CH1 about X16 attenuation
3008	Error code of variable gain correction for CH2 about X16 attenuation
3009	Error code of attenuation circuit coefficient's correction for CH1 about X4 attenuation
3010	Error code of attenuation circuit coefficient's correction for CH2 about X4 attenuation
3011	Error code of attenuation circuit coefficient's correction for CH1 about X16 attenuation
3012	Error code of attenuation circuit coefficient's correction for CH2 about X16 attenuation

Performance tests

The performance tests include two types of tests:

- **Functional tests.** Verify that the AFG31000 Series functions operate. They do not verify that they operate within limits.
- **Performance tests.** Verify that the AFG31000 Series performs as warranted. These tests check the characteristics listed in [Specifications](#) (on page 17).

Table 32: Performance tests

Test title	What is tested
Frequency/period test (on page 39)	Internal clock output frequency accuracy
Amplitude test (on page 40)	Amplitude accuracy
DC test (on page 43)	DC accuracy
AC flatness test (on page 45)	AC flatness

Performance conditions

The tests in this section provide extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet covers are installed on the AFG31000 Series.
- The instrument has passed all of the self-tests (for more information, see [Self-tests](#) (on page 33)) at an ambient temperature between 20 °C and 30 °C.
- The instrument is operating at an ambient temperature between 0 °C and 50 °C.
- The instrument has been warmed-up for at least 20 minutes.

Equipment required

The following table lists the equipment necessary to complete the performance tests.

Table 33: Test equipment for performance tests

Description	Minimum requirements	Recommended equipment	Purpose
Digital multimeter (DMM)	AC volts, true RMS AC-coupled accuracy: $\pm 0.1\%$ to 1 kHz DC volts accuracy: 50 ppm, resolution 100 μV Resistance Accuracy: $\pm 0.05\ \Omega$	Keithley Model 2002	Measures voltage. Used in multiple procedures.
Power meter	100 kHz to 250 MHz 1 μW to 100 mW (-30 dBm to +20 dBm) Accuracy: 0.02 dB Resolution: 0.01 dB	R&S NRVS	Measures voltage. Used in multiple procedures.
Power head	100 kHz to 250 MHz 1 μW to 100 mW (-30 dBm to 20 dBm)	R&S NRV-Z5	Measures voltage. Used in multiple procedures.
Frequency counter	Accuracy: 0.01 ppm Phase measurement	Tektronix FCA3100	Checks clock frequency.
Oscilloscope	1 GHz bandwidth, 50 Ω input termination	Tektronix TDS5104B	Checks output signals. Used in multiple procedures.
Spectrum analyzer	1 GHz bandwidth, 50 Ω input termination	Tektronix RSA3303A	Checks output signals. Harmonics spurious.
BNC coaxial cable	50 Ω , male-to-male BNC connector, 91 cm	Tektronix part number 012-0482-00	Interconnects signals.
BNC terminator	50 Ω , $\pm 1\ \Omega$, 2 W, DC to 1 GHz, BNC	Tektronix part number 011-0049-02	Interconnects signals.
Attenuator	50 Ω , x10, BNC	Tektronix part number 011-0059-03	Interconnects signals.
Adapter Dual-Banana Plug	BNC (female) to dual banana	Tektronix part number 103-0090-00	Signal interconnection to a DMM.
Adapter	BNC(female)-N(male)	Tektronix part number 103-0045-00	Signal interconnection to a spectrum analyzer.

Test records

This manual contains test records that you can use to record the performance test results for your AFG31000 Series Arbitrary Function Generator. These test records are in the [Test records](#) (on page 51) section of this manual.

The test records are organized by model number. Some models have different test parameters than others, so make sure you use the ones that apply to your arbitrary function generator model.

The following list contains links to each of the test records.

- [AFG31021 and AFG31022 test record](#) (on page 52)
- [AFG31051 and AFG31052 test record](#) (on page 54)
- [AFG31101 and AFG31102 test record](#) (on page 58)
- [AFG31151 and AFG31151 test record](#) (on page 61)
- [AFG31251 and AFG31252 test record](#) (on page 64)

Frequency/period test

This test verifies the frequency accuracy of the AFG31000 Series. All output frequencies are derived from a single generated frequency; you only need to check one frequency point on channel 1.

NOTE. Record the results of this test in the test record for your model in [Test records](#) (on page 51).

To verify frequency accuracy:

1. Connect the AFG31000 Series to the frequency counter as shown in the following figure.

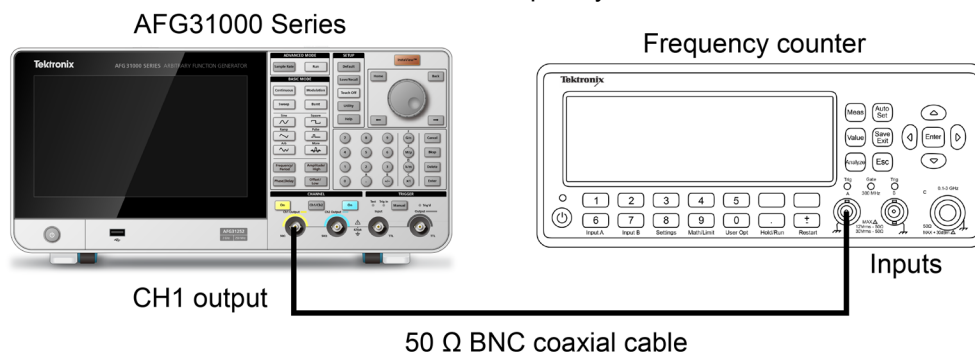


Figure 5: Connections for the frequency/period test

2. Press the **Default** key on the AFG31000 Series front panel. A dialog box is displayed.
3. Select **OK** to recall the AFG31000 Series default setup.

4. Set up the AFG31000 Series as shown in the following table.

Select menu	Setting	Operation
Function	Sine	Sine key (front panel)
Frequency	1.000000 MHz	Frequency/Period key (front panel)
Amplitude	1.00 V _{pp}	Amplitude/High key (front panel)
Channel 1 Output	On	Ch1 Output On key (front panel)

5. Verify that the reading on the frequency counter is between 0.9999984 MHz and 1.0000016 MHz.
6. Set up the AFG31000 Series as shown in the following table.

Select menu	Setting	Operation
Function	Pulse	Pulse key (front panel)

7. Verify that the reading on the frequency counter is between 0.9999984 MHz and 1.0000016 MHz.

Amplitude test

This test verifies the amplitude accuracy of the AFG31000 Series by checking specific amplitude points. All output amplitudes are derived from a combination of attenuators and a 3 dB variable gain.

This test uses a 50 Ω terminator. Because the accuracy of the terminator is used as a calibration factor, you must know the accuracy of the 50 Ω terminator before running the amplitude test.

NOTE. Record the results of this test in the test record for your model in [Test records](#) (on page 51).

To verify amplitude accuracy:

1. Connect the 50 Ω terminator to the DMM (as shown in the following figure) and measure the register value.

Model 2002 DMM

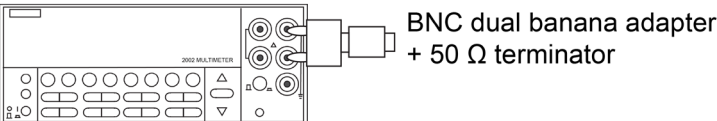


Figure 6: Connections for the 50 ohm terminator measurement

- Calculate the 50 Ω calibration factor (CF) from the reading value and record it, as shown in the following table.

50 Ω calibration factor

$$(\text{Calibration factor (CF)} = 2 / (1 + 50 \Omega / \text{Measurement } \Omega) =)$$

Measurement (DMM reading)	CF
Ω	
Examples	
50.50 Ω	1.0050 (= 2 / (1 + 50 / 50.50))
49.62 Ω	0.9962 (= 2 / (1 + 50 / 49.62))

- Connect the AFG31000 Series to the DMM as shown in the following figure. Be sure to connect the 50 Ω terminator to the Ch1 (or Ch2) output connector on the AFG31000 Series.

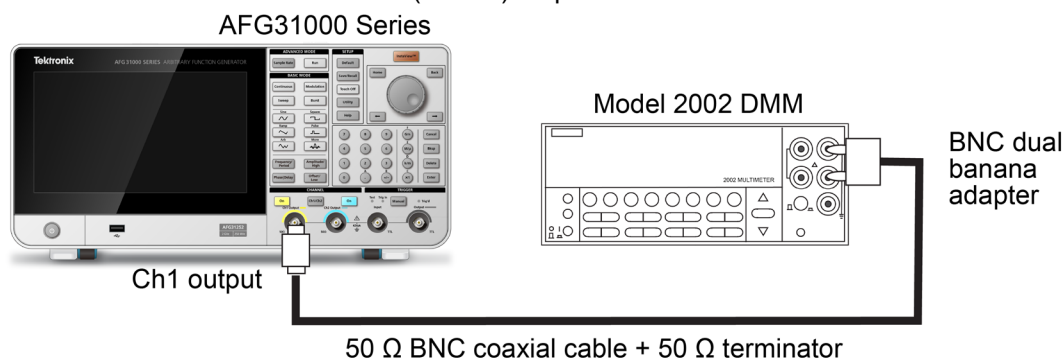


Figure 7: Connections for the amplitude test

- Set up the AFG31000 Series as shown in the following table.

Select menu	Setting	Operation
Function	Sine	Sine key (front panel)
Frequency	1.000000 kHz	Frequency/Period key (front panel)
Amplitude units	Vrms	Ch1 (or Ch2) menu > Amplitude/Level menu > Units > Vrms (touch screen)
Ch1 (or Ch2) Output	On	Ch1 (or Ch2) Output On key (front panel)

- Verify that each amplitude measurement is within the range specified for your AFG31000 Series instrument in the following tables.
- (Two-channel models only) Repeat steps 4 through 5 for channel 2 output.

Models AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, and AFG31102

Function	Frequency	Amplitude	Measurement	Range
Sine	1.000 kHz	3.000 mV _{rms}	mV _{rms}	(3.000×CF±0.384) mVrms
Sine	1.000 kHz	30.000 mV _{rms}	mV _{rms}	(30.000×CF±0.654) mVrms
Sine	1.000 kHz	300.000 mV _{rms}	mV _{rms}	(300.000×CF±3.354) mVrms
Sine	1.000 kHz	800.000 mV _{rms}	mV _{rms}	(800.000×CF±8.354) mVrms
Sine	1.000 kHz	1.500 V _{rms}	V _{rms}	(1.500×CF±0.015) Vrms
Sine	1.000 kHz	2.000 V _{rms}	V _{rms}	(2.000×CF±0.020) Vrms
Sine	1.000 kHz	2.500 V _{rms}	V _{rms}	(2.500×CF±0.025) Vrms
Sine	1.000 kHz	3.500 V _{rms}	V _{rms}	(3.500×CF±0.035) Vrms

Models AFG31151, AFG31152, AFG31251, and AFG31252

Function	Frequency	Amplitude	Measurement	Range
Sine	1.000 kHz	3.000 mV _{rms}	mV _{rms}	$(3.000 \times CF \pm 0.384) \text{ mV}_{\text{rms}}$
Sine	1.000 kHz	30.000 mV _{rms}	mV _{rms}	$(30.000 \times CF \pm 0.654) \text{ mV}_{\text{rms}}$
Sine	1.000 kHz	300.000 mV _{rms}	mV _{rms}	$(300.000 \times CF \pm 3.354) \text{ mV}_{\text{rms}}$
Sine	1.000 kHz	800.000 mV _{rms}	mV _{rms}	$(800.000 \times CF \pm 8.354) \text{ mV}_{\text{rms}}$
Sine	1.000 kHz	1.500 V _{rms}	V _{rms}	$(1.500 \times CF \pm 0.015) \text{ V}_{\text{rms}}$

DC test

This test verifies the DC accuracy of the AFG31000 Series.

This test uses a 50 Ω terminator. You must know the accuracy of the 50 Ω terminator in before running this test. This accuracy is used as the calibration factor.

NOTE. Record the results of this test in the test record for your model in [Test records](#) (on page 51).

To verify DC accuracy:

1. Connect the 50 Ω terminator to the DMM as shown in the following figure and measure the register value.

Model 2002 DMM

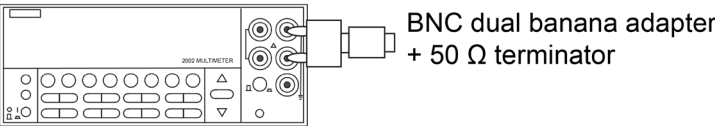


Figure 8: Connections for the 50 ohm terminator measurement

2. Calculate the 50 Ω calibration factor (CF) from the reading value and record, as shown in the following table.

50 Ω calibration factor ($\text{calibration factor (CF)} = 2 / (1 + 50 \, \Omega / \text{measurement } \Omega) =$)

Measurement (DMM reading)	CF
Ω	
Examples	
50.50 Ω	1.0050 (= 2 / (1 + 50 / 50.50))
49.62 Ω	0.9962 (= 2 / (1 + 50 / 49.62))

3. Connect the AFG31000 Series to the DMM as shown in the following figure. Be sure to connect the 50 Ω terminator to the AFG31000 Series Ch1 (or Ch2) output connector.

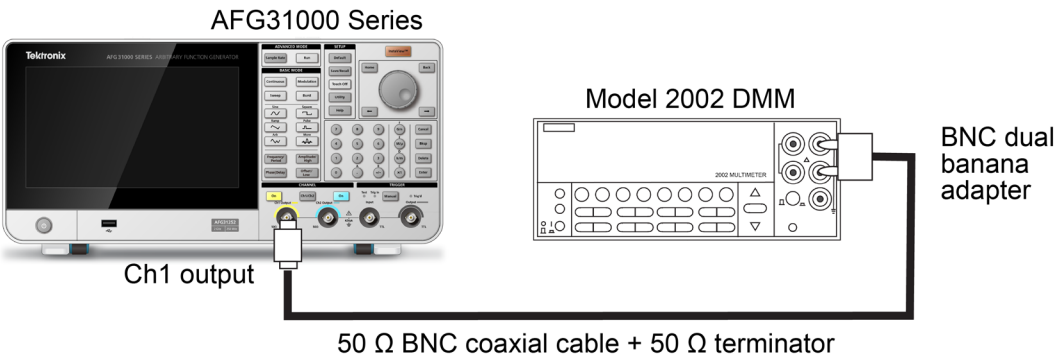


Figure 9: Connections for the DC test

4. Set up the AFG31000 Series as shown in the following table.

Select menu	Setting	Operation
Function	DC	More key (front panel) > Ch1 function > DC
Offset¹⁸	5.000 V 2.500 V (AFG31151, AFG31152, AFG31251, AFG31252)	Offset/Low key (front panel) > Offset (touch screen)
Ch1 (or Ch2) Output	On	Ch1 (or Ch2) Output On key (front panel)

5. Verify that each offset measurement is within the range specified in the following tables.
 6. (Two-channel models only) Repeat steps 4 through 5 for channel 2 output.

Models AFG31021, AFG31022, AFG31051, AFG31052, AFG31101, AFG31102

Function	Offset	Measurement	Range
DC	5.000 VDC	VDC	$(5.000 \times CF \pm 0.051)$ VDC
DC	0.000 VDC	VDC	± 0.001 VDC
DC	-5.000 VDC	VDC	$(-5.000 \times CF \pm 0.051)$ VDC

Models AFG31151, AFG31152, AFG31251, AFG31252

Function	Offset	Measurement	Range
DC	2.500 VDC	VDC	$(2.500 \times CF \pm 0.026)$ VDC
DC	0.000 VDC	VDC	± 0.001 VDC
DC	-2.500 VDC	VDC	$(-2.500 \times CF \pm 0.026)$ VDC

¹⁸ Add 0.5 mV per °C for operation outside of 20 °C to 30 °C.

AC flatness test

This test verifies the flatness of a sine wave. There are two different test setups for this test:

- 1 kHz reference waveform test setup; uses a high-performance digital multimeter (DMM)
- >100 kHz waveform test setup; uses a power meter with a power head

AC flatness test: 1 kHz

For this test, use a high-performance (5.5-digit or higher) digital multimeter (DMM) with a 50 Ω terminator.

NOTE. Record the results of this test in the test record for your model in [Test records](#) (on page 51).

To verify AC flatness at 1 kHz:

1. Connect the 50 Ω terminator to the DMM (as shown in the following figure) and measure the register value.

Model 2002 DMM

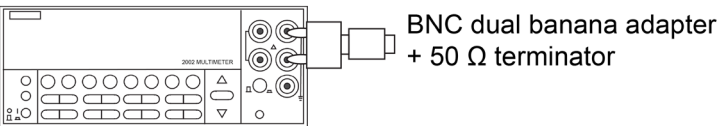


Figure 10: Connections for the 50 ohm terminator measurement

2. Calculate the 50 Ω calibration factor (CF) from the reading value and record as shown in the following table.

50 Ω calibration factor

(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

Measurement (DMM reading)	CF
Ω	
Examples	
50.50 Ω	1.0050 (= $2 / (1 + 50 / 50.50)$)
49.62 Ω	0.9962 (= $2 / (1 + 50 / 49.62)$)

3. Connect the AFG31000 Series to the DMM as shown in the following figure. Be sure to connect the 50 Ω terminator to the Ch1 (or Ch2) output connector on the AFG31000 Series.

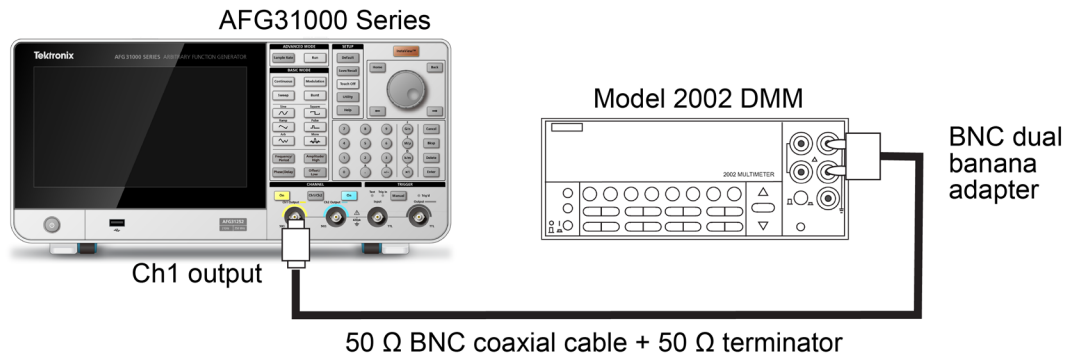


Figure 11: Connections for the AC flatness test: 1 kHz test setup

4. Generate a 1 kHz, 4 dBm sine waveform with the AFG31000 Series.
5. Read the AC V_{rms} value on the DMM.
6. Find the reference for flatness at 1 kHz by converting V_{rms} to dBm as follows:

$$P(dBm) = 10 \times \lg(20(V_{rms}/CF)^2)$$

AC flatness test: >100 kHz

For this test, use a power meter with a power head.

NOTE. Record the results of this test in the test record for your model in [Test records](#) (on page 51).

To verify AC flatness at >100 kHz:

1. Connect the AFG31000 Series to the power meter with a power head as shown in the following figure.

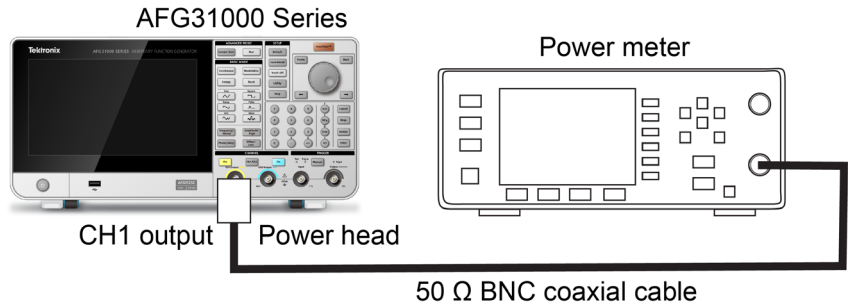


Figure 12: Connections for the AC flatness test: >100 kHz test setup

2. Set up the AFG31000 Series as shown in the following table.

Select menu	Setting	Operation
Function	Sine	Sine key (front panel)
Frequency	500 kHz	Frequency/Period key (front panel)
Amplitude Units	dBm	Ch1 (or Ch2) menu > Ampl > Units > dBm (touch screen)
Amplitude	4.0 dBm	Amplitude/High key (front panel)
Ch1 (or Ch2) Output	On	On key (front panel)

3. Set the frequency of the power meter to match the frequency setting of the AFG31000 Series.
4. Verify that the power measurement is within the limits specified in the following tables (relative to the 1 kHz reference power level).
5. Repeat steps 3 and 4 with the AFG31000 Series set to each of the other frequencies specified in the following tables.
6. (Two-channel models only) Repeat steps 2 through 5 for channel 2 output.

Models AFG31021, AFG31022

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	1.00 kHz	= Reference	-----
Sine	4.0 dBm	1.00 MHz		Reference ± 0.20
Sine	4.0 dBm	5.00 MHz		Reference ± 0.30
Sine	4.0 dBm	15.00 MHz		Reference ± 0.30
Sine	4.0 dBm	25.00 MHz		Reference ± 0.30

Models AFG31051, AFG31052

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	1.00 kHz	= Reference	-----
Sine	4.0 dBm	1.00 MHz		Reference ± 0.20

Models AFG31051, AFG31052

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	5.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	15.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	25.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	50.00 MHz		Reference \pm 0.30

Models AFG31101, AFG31102

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	1.00 kHz	= Reference	-----
Sine	4.0 dBm	1.00 MHz		Reference \pm 0.20
Sine	4.0 dBm	5.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	15.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	25.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	50.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	100.00 MHz		Reference \pm 0.30

Models AFG31151, AFG31152

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	1.00 kHz	= Reference	-----
Sine	4.0 dBm	1.00 MHz		Reference \pm 0.20
Sine	4.0 dBm	5.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	15.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	25.00 MHz		Reference \pm 0.50
Sine	4.0 dBm	50.00 MHz		Reference \pm 0.50
Sine	4.0 dBm	100.00 MHz		Reference \pm 1.00
Sine	4.0 dBm	150.00 MHz		Reference \pm 1.00

Models AFG31251, AFG31252

Function	Amplitude	Frequency	Measurement (dB)	Range (dB)
Sine	4.0 dBm	1.00 kHz	= Reference	-----
Sine	4.0 dBm	1.00 MHz		Reference \pm 0.20
Sine	4.0 dBm	5.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	15.00 MHz		Reference \pm 0.30
Sine	4.0 dBm	25.00 MHz		Reference \pm 0.50
Sine	4.0 dBm	50.00 MHz		Reference \pm 0.50
Sine	4.0 dBm	100.00 MHz		Reference \pm 1.00
Sine	4.0 dBm	150.00 MHz		Reference \pm 1.00
Sine	4.0 dBm	200.00 MHz		Reference \pm 2.00
Sine	4.0 dBm	250.00 MHz		Reference \pm 2.00

Test records

Using the test records

You can photocopy or print the test records in this section to record your performance verification test results.

The test records are organized by model number. Some models have different test parameters than others, so make sure you use the ones that apply to your arbitrary function generator model.

The following list contains links to each of the test records.

- [AFG31021 and AFG31022 test record](#) (on page 52)
- [AFG31051 and AFG31052 test record](#) (on page 54)
- [AFG31101 and AFG31102 test record](#) (on page 58)
- [AFG31151 and AFG31151 test record](#) (on page 61)
- [AFG31251 and AFG31252 test record](#) (on page 64)

AFG31021 and AFG31022 test record

Test information

Instrument serial number:

Certificate number:

Temperature:

Relative humidity %:

Date of calibration:

Technician:

Frequency test record

Frequency	Minimum	Test result	Maximum
Sine at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz
Pulse at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz

Amplitude test record: CH1

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000 V _{rms} at 1.00kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500 V _{rms} at 1.00kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}
3.500 V _{rms} at 1.00kHz	(3.500×CF-0.035) V _{rms}		(3.500×CF+0.035) V _{rms}

Amplitude test record: CH2

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000 V _{rms} at 1.00 kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500 V _{rms} at 1.00 kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}

Amplitude test record: CH2**Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =**

Amplitude	Minimum	Test result	Maximum
3.500 V _{rms} at 1.00 kHz	$(3.500 \times CF - 0.035) \text{ V}_{\text{rms}}$		$(3.500 \times CF + 0.035) \text{ V}_{\text{rms}}$

DC test record: CH1**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000 VDC	$(5.000 \times CF - 0.051) \text{ VDC}$		$(5.000 \times CF + 0.051) \text{ VDC}$
0.000 VDC	-0.001 VDC		0.001 VDC
-5.000 VDC	$(-5.000 \times CF - 0.051) \text{ VDC}$		$(-5.000 \times CF + 0.051) \text{ VDC}$

DC test record: CH2**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000Vdc	$(5.000 \times CF - 0.051) \text{ Vdc}$		$(5.000 \times CF + 0.051) \text{ VDC}$
0.000 VDC	-0.001 VDC		0.001 VDC
-5.000 VDC	$(-5.000 \times CF - 0.051) \text{ VDC}$		$(-5.000 \times CF + 0.051) \text{ VDC}$

AC flatness test record: CH1

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 kHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB

AC flatness test record: CH2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 kHz	Reference - 0.20 dB	dB	Reference + 0.20 dB

AC flatness test record: CH2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB

AFG31051 and AFG31052 test record

Test information

Instrument serial number:

Certificate number:

Temperature:

Relative humidity %:

Date of calibration:

Technician:

Frequency test record

Frequency	Minimum	Test result	Maximum
Sine at 1.000000 MHz	0.9999984MHz		1.0000016MHz
Pulse at 1.000000 MHz	0.9999984MHz		1.0000016MHz

Amplitude test record: CH1

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000V _{rms} at 1.00 kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500V _{rms} at 1.00 kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}
3.500V _{rms} at 1.00 kHz	(3.500×CF-0.035) V _{rms}		(3.500×CF+0.035) V _{rms}

Amplitude test record: CH2**Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =**

Amplitude	Minimum	Test result	Maximum
3.000mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000V _{rms} at 1.00 kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500V _{rms} at 1.00 kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}
3.500V _{rms} at 1.00 kHz	(3.500×CF-0.035) V _{rms}		(3.500×CF+0.035) V _{rms}

DC test record: CH1**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000 VDC	(5.000 × CF – 0.051) VDC		(5.000 × CF + 0.051) VDC
0.000 VDC	–0.001 VDC		0.001 VDC
–5.000 VDC	(–5.000 × CF – 0.051) VDC		(–5.000 × CF + 0.051) VDC

DC test record: CH2**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000 VDC	(5.000 × CF – 0.051) VDC		(5.000 × CF + 0.051) VDC
0.000 VDC	–0.001 VDC		0.001 VDC
–5.000 VDC	(–5.000 × CF – 0.051) VDC		(–5.000 × CF + 0.051) VDC

AC flatness test record: CH 1

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 kHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 50.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 kHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 50.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB

AFG31101 and AFG31102 test record

Test information

Instrument serial number:

Certificate number:

Temperature:

Relative humidity %:

Date of calibration:

Technician:

Frequency test record

Frequency	Minimum	Test result	Maximum
Sine at 1.000000 MHz	0.9999984MHz		1.0000016MHz
Pulse at 1.000000 MHz	0.9999984MHz		1.0000016MHz

Amplitude test record:CH1

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000V _{rms} at 1.00 kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500V _{rms} at 1.00 kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}
3.500V _{rms} at 1.00 kHz	(3.500×CF-0.035) V _{rms}		(3.500×CF+0.035) V _{rms}

Amplitude test record:CH2

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}
2.000V _{rms} at 1.00 kHz	(2.000×CF-0.020) V _{rms}		(2.000×CF+0.020) V _{rms}
2.500V _{rms} at 1.00 kHz	(2.500×CF-0.025) V _{rms}		(2.500×CF+0.025) V _{rms}
3.500V _{rms} at 1.00 kHz	(3.500×CF-0.035) V _{rms}		(3.500×CF+0.035) V _{rms}

DC test record: CH1**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000 VDC	$(5.000 \times \text{CF} - 0.051) \text{ VDC}$		$(5.000 \times \text{CF} + 0.051) \text{ VDC}$
0.000 VDC	-0.001 VDC		0.001 VDC
-5.000 VDC	$(-5.000 \times \text{CF} - 0.051) \text{ VDC}$		$(-5.000 \times \text{CF} + 0.051) \text{ VDC}$

DC test record: CH2**(Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)**

DC offset	Minimum	Test result	Maximum
+5.000 VDC	$(5.000 \times \text{CF} - 0.051) \text{ VDC}$		$(5.000 \times \text{CF} + 0.051) \text{ VDC}$
0.000 VDC	-0.001 VDC		0.001 VDC
-5.000 VDC	$(-5.000 \times \text{CF} - 0.051) \text{ VDC}$		$(-5.000 \times \text{CF} + 0.051) \text{ VDC}$

AC flatness test record: CH1

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 KHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 50.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 100.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 KHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 50.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 100.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB

AFG31151 and AFG31152 test record

Test information

Instrument serial number:

Certificate number:

Temperature:

Relative humidity %:

Date of calibration:

Technician:

Frequency test record

Frequency	Minimum	Test result	Maximum
Sine at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz
Pulse at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz

Amplitude test record: CH1

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}

Amplitude test record: CH2

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}

DC test record: CH1 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

DC offset	Minimum	Test result	Maximum
+2.500 VDC	(2.500 × CF – 0.026) VDC		(2.500 × CF + 0.026) VDC

DC test record: CH1 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

DC offset	Minimum	Test result	Maximum
0.000 VDC	–0.001 VDC		0.001 VDC
–2.500 VDC	$(-2.500 \times CF - 0.026) \text{ VDC}$		$(-2.500 \times CF + 0.026) \text{ VDC}$

DC test record: CH2 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

DC offset	Minimum	Test result	Maximum
+2.500 VDC	$(2.500 \times CF - 0.026) \text{ VDC}$		$(2.500 \times CF + 0.026) \text{ VDC}$
0.000 VDC	–0.001 VDC		0.001 VDC
–2.500 VDC	$(-2.500 \times CF - 0.026) \text{ VDC}$		$(-2.500 \times CF + 0.026) \text{ VDC}$

AC flatness test record: CH 1

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Amplitude: 4.0 dB)	_____	dB (= Reference)	_____
Frequency 500 KHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 50.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 100.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB
Frequency 150.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Amplitude: 4.0 dBm)	_____	dB (= Reference)	_____
Frequency 500 KHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference – 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 25.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 50.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 100.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB
Frequency 150.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB

AFG31251 and AFG31252 test record

Test information

Instrument serial number:

Certificate number:

Temperature:

Relative humidity %:

Date of calibration:

Technician:

Frequency test record

Frequency	Minimum	Test result	Maximum
Sine at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz
Pulse at 1.000000 MHz	0.9999984 MHz		1.0000016 MHz

Amplitude test record: CH1

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}

Amplitude test record: CH2

Calibration factor(CF)= $2/(1+50\Omega/\text{Measurement}\Omega)$ =

Amplitude	Minimum	Test result	Maximum
3.000 mV _{rms} at 1.00 kHz	(3.000×CF-0.384) mV _{rms}		(3.000×CF+0.384) mV _{rms}
30.000 mV _{rms} at 1.00 kHz	(30.000×CF-0.654) mV _{rms}		(30.000×CF+0.654) mV _{rms}
300.000 mV _{rms} at 1.00 kHz	(300.000×CF-3.354) mV _{rms}		(300.000×CF+3.354) mV _{rms}
800.000 mV _{rms} at 1.00 kHz	(800.000×CF-8.354) mV _{rms}		(800.000×CF+8.354) mV _{rms}
1.500 V _{rms} at 1.00 kHz	(1.500×CF-0.015) V _{rms}		(1.500×CF+0.015) V _{rms}

DC test record: CH1 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement} \Omega)$ =)

DC offset	Minimum	Test result	Maximum
+2.500 VDC	(2.500 × CF – 0.026) VDC		(2.500 × CF + 0.026) VDC
0.000 VDC	–0.001 VDC		0.001 VDC

DC test record: CH1 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

DC offset	Minimum	Test result	Maximum
-2.5000 VDC	$(-2.500 \times CF - 0.026) \text{ VDC}$		$(-2.500 \times CF + 0.026) \text{ VDC}$

DC test record: CH2 (Calibration factor (CF) = $2 / (1 + 50 \Omega / \text{Measurement } \Omega)$ =)

DC offset	Minimum	Test result	Maximum
+2.500 VDC	$(2.500 \times CF - 0.026) \text{ VDC}$		$(2.500 \times CF + 0.026) \text{ VDC}$
0.000 VDC	-0.001 VDC		0.001 VDC
-2.5000 VDC	$(-2.500 \times CF - 0.026) \text{ VDC}$		$(-2.500 \times CF + 0.026) \text{ VDC}$

AC flatness test record: CH 1

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Ampl: 4.0 dBm)	_____	dB (= Reference)	_____
Frequency 500. KHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 15.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference - 0.50 dB	dB	Reference + 0.50 dB
Frequency 50.00 MHz	Reference - 0.50 dB	dB	Reference + 0.50 dB
Frequency 100.00 MHz	Reference - 1.00 dB	dB	Reference + 1.00 dB
Frequency 150.00 MHz	Reference - 1.00 dB	dB	Reference + 1.00 dB
Frequency 200.00 MHz	Reference - 2.00 dB	dB	Reference + 2.00 dB
Frequency 250.00 MHz	Reference - 2.00 dB	dB	Reference + 2.00 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 1.00 kHz (Ampl: 4.0 dBm)	_____	dB (= Reference)	_____
Frequency 500. KHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 1.00 MHz	Reference - 0.20 dB	dB	Reference + 0.20 dB
Frequency 5.00 MHz	Reference - 0.30 dB	dB	Reference + 0.30 dB

AC flatness test record: CH 2

AC flatness	Minimum	Test result	Maximum
Frequency 15.00 MHz	Reference – 0.30 dB	dB	Reference + 0.30 dB
Frequency 25.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 50.00 MHz	Reference – 0.50 dB	dB	Reference + 0.50 dB
Frequency 100.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB
Frequency 150.00 MHz	Reference – 1.00 dB	dB	Reference + 1.00 dB
Frequency 200.00 MHz	Reference – 2.00 dB	dB	Reference + 2.00 dB
Frequency 250.00 MHz	Reference – 2.00 dB	dB	Reference + 2.00 dB