Agilent U8903A Audio Analyzer

Data Sheet

Make an audible difference

Whether listening to mono, stereo or surround, the human ear knows what sounds good. Measuring "how good," however, can be a challenge. Now, with a two-in-one digital audio interface card that provides AES3/SPDIF and Digital Serial Interface digital audio formats, Agilent U8903A offers you the flexibility to measure and quantify both analog and digital audio performance in applications such as analog and digital IC components and module design, wireless audio and consumer audio.

The U8903A contains the full functions of analog domain and digital domain audio measurement in one box, allowing you to perform quick and convenient complex cross-domain measurements.

The U8903A audio analyzer combines the functionality of a distortion meter, SINAD meter, frequency counter, AC voltmeter, DC voltmeter and FFT analyzer with a low-distortion audio source. On the bench or in a test system, its accuracy and versatility helps you make an audible difference in your end product.

U8903A audio analyzer key features

- Customize your unit with flexible digital audio interface options, offering AES3/SPDIF or DSI standard digital audio formats, or both in a convenient two-in-one card.
- Test a variety of current components and applications with a logic level input range of 1.2 V to 3.3 V (DSI).
- Analyze a wide range of applications with multiple DSI formats: I^2S, Left Justified, Right Justified and DSP.
- Select generator, analyzer, graph and sweep modes with one-button access.
- Measure at DC and from 10 Hz to 100 kHz.
- Characterize signal-to-noise ratios, SINAD, IMD, DFD, THD+N ratio, THD+N level, crosstalk and more.
- Apply weighting functions, standard filters and custom filters.
- Stimulate the device with high-quality signals and arbitrary waveforms.
- View numerical and graphical displays of measurement results.
- Connect to a PC through GPIB, LAN/LXI C and USB interfaces.
- Eliminate the need to rewrite programs into SCPI command with the built-in HP 8903B code compatibility mode.

Expand Your Digital Audio Test Capabilities

Cover your application needs with multiple digital audio interface options

Test a wide range of applications with the digital audio industry's standard interfaces: AES3/SPDIF and Digital Serial Interface (DSI). Used in the testing and validation of consumer electronics and digital audio related ICs, both digital audio interfaces are available with the U8903A Option 113, with further options (Option 114 and 115) giving you the flexibility to choose either interface.

The U8903A also supports multiple DSI formats, such as I²S, Left Justified, Right Justified and DSP. These formats are suitable for most digital audio design and verification applications.

Existing U8903A users can opt for a hardware upgrade to install the digital audio interfaces options. The hardware upgrade will include a digital audio card installation and calibration of your U8903A unit by Agilent's Service Solution Unit (SSU). Contact your nearest authorized Agilent service support center for more information.

Measure more applications with a wide logic level input range

Most digital audio ICs are designed to work in battery-operated devices such as cellular/mobile phones and MP3 players, leading to a downward trend in the logic level of such ICs. With a wide logic level input range of 1.2 V to 3.3 V, the U8903A is able to support and test future designs in addition to the majority of current digital audio ICs.

Easily perform manual and automated tests

View up to four channels (two for analog, two for digital) simultaneously on the U8903A's 5.7-inch color display. The display screen provides numeric readouts as well as graphical views, while one-button access makes it easy to select the four main operating modes: analyzer, generator, graph and sweep. In graph mode, choose between viewing in frequency domain or time domain.

The U8903A also supports modern SCPI commands, allowing users to easily program the audio analyzer for automated testing. Furthermore, the U8903A comes with a built-in code emulator for the legacy HP 8903B audio analyzer. The code emulator helps existing HP 8903B users to easily migrate from the old platform to the new U8903A audio analyzer without the need to rewrite all their HP 8903B programming codes.

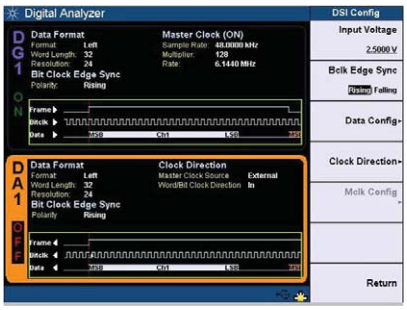

Figure 1: Configure your digital generator DSI settings, including the output format of your choice. Choose amongst four formats: I²S, Left Justified, Right Justified and DSP.

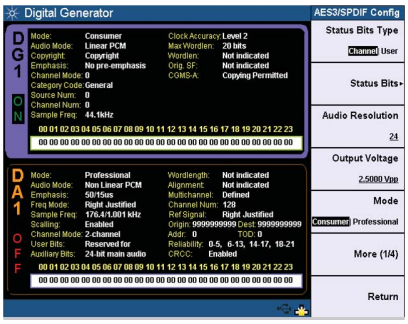

Figure 2: The general AES3/SPDIF output settings can be configured with the status bit type, status bits, audio resolution and output voltage, with mode settings set to either "Consumer" or "Professional."

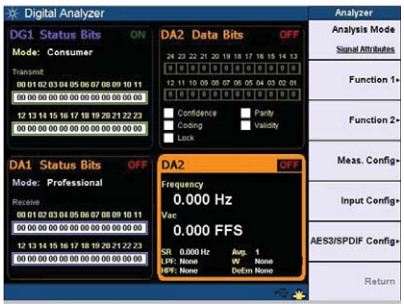

Figure 3: View up to four channels - two for analog, two for digital - at the same time for multiple analyses.

Address Challenging Audio Applications

Measure and analyze essential audio parameters

With the U8903A, you can measure below, across, and above the audio spectrum with its 10 Hz to 100 kHz frequency range and built-in DC measurements.

Easily characterize parameters such as signal-to-noise ratio, SINAD, intermodulation distortion (IMD), different-frequency distortion (DFD), total harmonic distortion (THD+N ratio, THD+N level), crosstalk, and more. Additional measurement capabilities include AC level, DC level, frequency count, frequency spectrum, and FFT analysis (Figure 4).

For all measurements, you can apply weighting functions as well as low-pass, high-pass, and standard filters (Figure 5). You can also create custom filters using MATLAB® and other applications, and upload them through the analyzer's USB port. Filters and weighting functions can be applied one, two, or three at a time.

Generate high-quality test signals

In analog generator mode, the built-in, dual-channel signal generator lets you stimulate your device with a variety of high-quality signals: sine (-105 dB noise floor), square, rectangular, noise (Gaussian and rectangular), two-tone, and multi-tone (up to 64 tones) (Figure 6). To simulate complex and real-world signals, you can also create arbitrary waveforms with up to 32,768 points and at 312.5 kHz sampling rate.

The output voltage range is 0 V to 8 Vrms with 1% accuracy. For unbalanced connections, you can select 50 or 600 Ω output impedance.

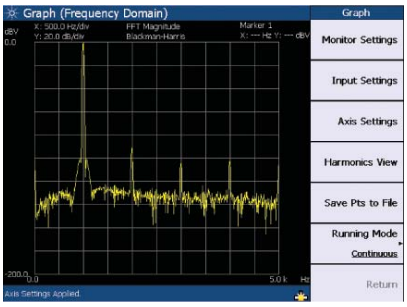

Figure 4. Perform FFT analysis with up to 32 Kpoints and a wide selection of informative graphing functions.

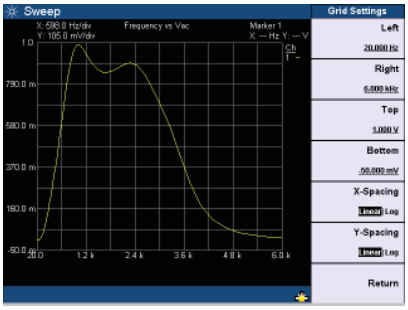

Figure 5. Apply an extensive selection of filters, including a variety of weighting functions.

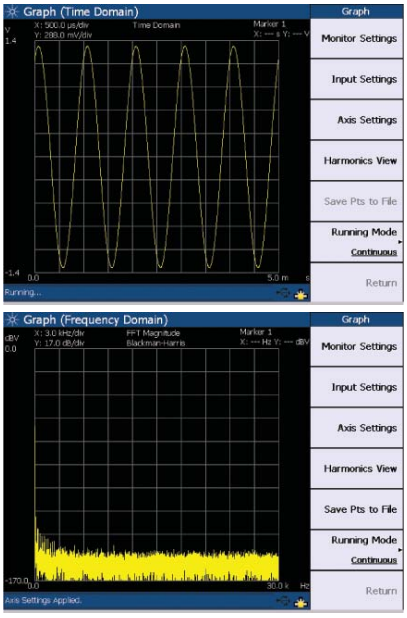

Figure 6. Utilize high-quality test signals that provide low distortion and low noise level.

Take a Closer Look

Front panel

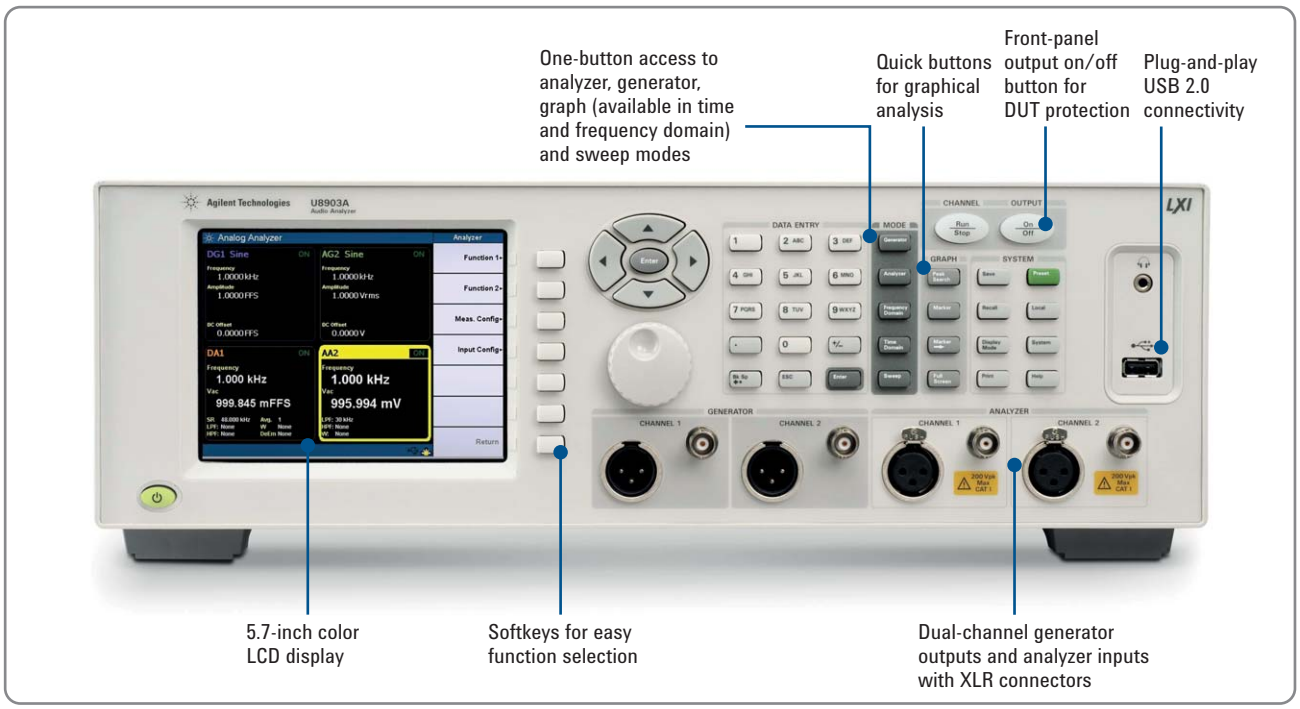

Figure 7. U8903A audio analyzer, front view

Back panel

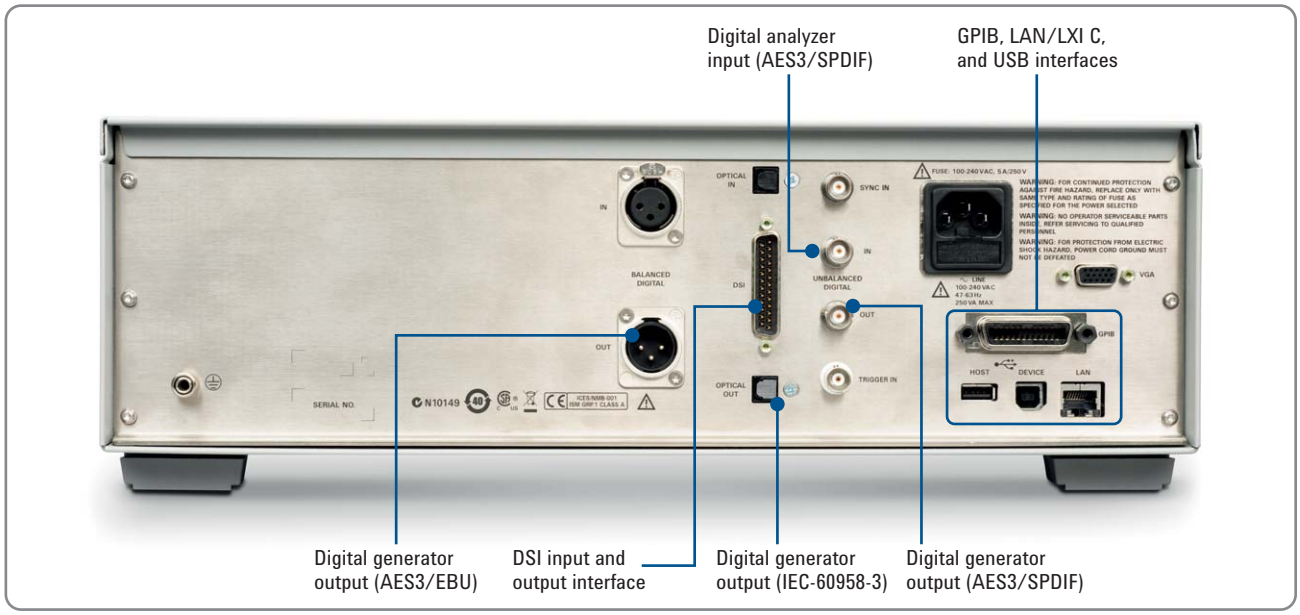

Figure 8. U8903A audio analyzer, rear view

Advance Measurement Testing

General audio testing

The U8903A provides essential measurement capabilities that enable efficient analysis of audio amplifiers and other devices in the audio chain. For example, the analyzer includes balanced and unbalanced outputs and inputs. It also provides a wide selection of filters and enhances your flexibility by making it easy to upload customized filters. With an array of sweep functions and flexible data display formats for each measurement, you'll be ready to address a wide range of challenging audio applications.

Balanced inputs

In the quest for higher output power, many audio amplifiers use bridged output stages. Such amplifiers can be difficult to characterize because their outputs cannot be grounded. To test these devices, the usual approach has been to use a balanced, calibrated isolation transformer connected to an analyzer with an unbalanced input.

With the U8903A, simply make a balanced connection with an XLR connector and make measurements—no floating required.

Standard and custom filters

A selection of built-in filters simplifies audio measurements by providing weighting networks required by international standards. These include CCIR, CCIR/ARM, and CCIT weighting filters; a C message filter; and an ANSI "A" weighting filter. In addition to the standard filters, you can create custom filters using applications such as MATLAB or Agilent VEE and upload the filters through the analyzer's USB port. The U8903A also includes selectable 15, 20, and 30 kHz low-pass filters to reject unwanted, out-of-band signals and noise.

Display scaling and formatting

U8903A gives you flexible control over data displays. For example, you can choose volts, millivolts, dBm into 600 Ω (or other resistance values), or watts for AC level measurements, and select percent or dB for distortion measurements.

Swept measurements

With its internal audio source and precise digital control, the U8903A can perform automatic swept measurements of frequency response, distortion, and signal-to-noise. For example, to check the frequency response of an active filter, only a few steps are required. After connecting the device and setting the required source level, simply press the "sweep" key to enter the start and stop frequencies(Figure 10).

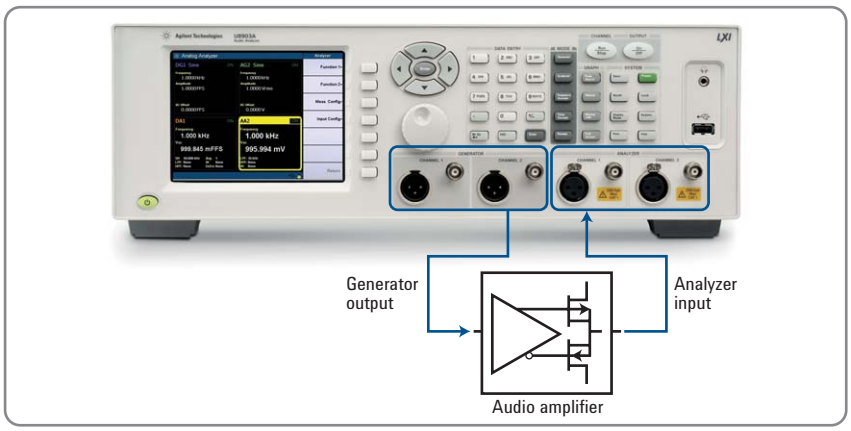

Figure 9. Audio testing using the U8903A.

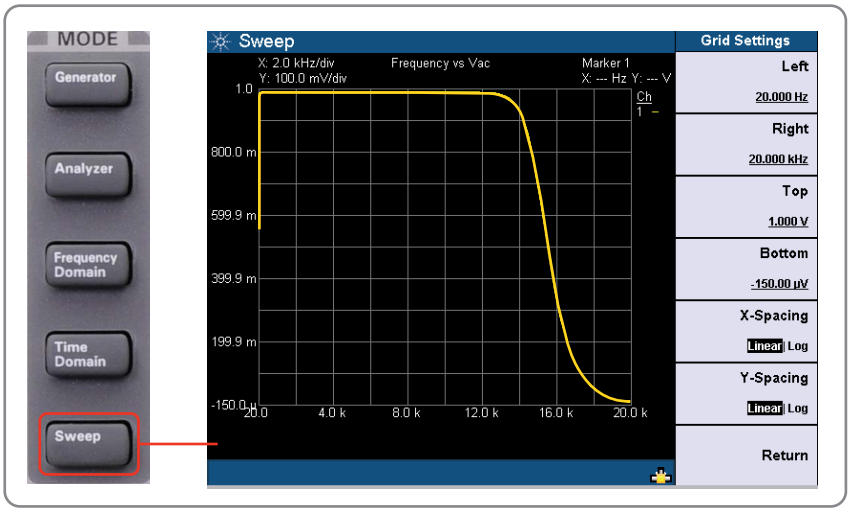

Figure 10. Use a single button to access the swept measurement mode.

Advance Measurement Testing (continued)

SINAD and THD+N measurement

U8903A gives you the flexibility to lock down the generator frequency under the Frequency Lock features. With this feature, users can set the generator frequency in order to tell the location of the fundamental signal. In this case, users have the flexibility to lock the external source's fundamental frequency to make SINAD and THD+N measurements more accurately because the measurements are based on the actual source fundamental signal rather than the detected fundamental signal. Sometimes the other order signal and noise is stronger than the actual source fundamental signal which will impact the measurement reading.

Transmitter and receiver testing

The U8903A includes several measurement features that simplify the testing of the transceivers used in devices such as car radios, telephones, mobile radios, broadcast radios, FM tuners, and television. The U8903A can handle all of these applications when combined with a modulating signal generator for receiver testing and a signal analyzer for transmitter testing (see diagrams on next page).

True-RMS detection

To accurately characterize signals with high noise content, true-RMS detection is required. The U8903A employs true-RMS detection for all signals with crest factor less than three. In addition, quasi-peak detection (CCIR 468-4) and peak-to-peak detection are also available through softkey selections.

Built-in filters

The U8903A includes a variety of essential filters for transmitter and receiver testing. Its CCITT, CCIR, and C-message weighting filters meet international standards for receiver testing. For transmitter testing, the seven-pole 400 Hz high-pass filter provides better than 40 dB rejection of signals up to 250 Hz, letting you measure transmitter audio distortion to 1% without disabling squelch signals.

For even greater flexibility, you can apply custom filters created using applications such as MATLAB and Agilent VEE. Once you've uploaded a filter via the U8903A's USB port, it can be applied to your measurements through a softkey selection. In all, you can apply up to three filters at a time.

Reference/relative measurements

This features allows users to perform measurement on level, frequency, and ratio based on the selected impedance value, frequency, or ratio reference value. This simplifies manual data measurement and data collection because the calculations are automatically generated inside the equipment in real time. This feature provides users with the flexibility to decided which signal sources to perform Signal-to-Noise (SNR) measurement without solely depending on the U8903A generator source.

SINAD measurements

Commonly used to test FM receivers, SINAD measurements must be made repeatedly when checking receiver sensitivity or adjacent-channel selectivity. To smooth out the typically noisy signals that are present during receiver testing, the analyzer's SINAD mode employs extra filtering circuits. These are optimized for high speed and excellent repeatability: the U8903A provides distortion and SINAD measurements with an acquisition time of less than 1.5 seconds and a measurement rate of greater than two reading per second after locking.

Signal-to-noise ratio

To characterize signal quality in AM receivers, the U8903A can automatically make the necessary signal-to-noise ratio measurements. It does this by monitoring the incoming AC signal level while turning its lowdistortion source on and off.

The U8903A provides the average point features which allows users to set the number of readings used for averaging. The display value will be the averaged value based on the number of points selected. This allows users to analyze noisy signals using an increased number of average points for greater accuracy.

Replace your HP 8903B and add next-generation capabilities

For nearly two decades, the legacy HP 8903B provided unparalleled versatility and performance in audio applications. The U8903A builds on the legacy of the 8903B by offering faster single-point measurements (0.4 sec versus 3.0 sec) as well as a wider frequency range, expanded performance, and greater functionality (Tables 1, 2, and 3). With the U8903A, you can configure measurements faster through its graphical user interface (GUI) and one-button selection of major operating modes. The color LCD screen lets you view up to four channels on the same screen as well as graphical displays of sweeps, frequency spectra and more (Figure 13).

To ease the transition, the U8903A features a built-in code emulator which automatically converts HP 8903B R2D2 code directly into SCPI commands used by the U8903A. The Agilent application note *Migrating Code from the 8903A to U8903A* (5990-4135EN) and the *U8903A Programming Guide* (U8903-90027) are additional resources to help you get the most from this new class of audio analyzer.

Table 1. Comparison of frequency range and accuracy

	U8903A	HP 8903B
Frequency range	DC and 10 Hz to 100 kHz	20 Hz to 100 kHz
Frequency accuracy	5 ppm (0.0005%)	0.004%

Table 2. Comparison of accuracy and ranges in AC and DC level measurements

	U8903A	HP 8903B
AC voltage input range	0 V to 140 V_{rms}	0.3 m V_{rms} to 300 V_{rms}
AC accuracy	± 1%	± 4%
DC voltage input range	0 to ± 200 V	4 to ± 300 V
DC accuracy	± 1%	± 1%

Table 3. Comparison of range and residual THD+N measurements

	U8903A	HP 8903B
Frequency range	10 Hz to 100 kHz	20 Hz to 100 kHz
Residual THD+N (signal distortion) at 80 kHz BW	≤ -101 dB (at 1 kHz, 1 V_{rms}), 20 Hz to 20 kHz	-80 dB (or 15 µV), 20 Hz to 20 kHz
Accuracy	± 0.5 dB (< 20 kHz)	± 1 dB (20 Hz to 20 kHz)
	± 0.7 dB (< 100 kHz)	± 2 dB (20 to 100 kHz)

Figure 13. The new U8903A audio analyzer (top) offers numerous improvements over the widely used HP 8903B (bottom).

Product Characteristics

	Description
Power consumption	250 VA
Power requirements	• 100 V_{ac} to 240 V_{ac} • 47 Hz to 63 Hz
Operating environment	• Operating temperature from 0 °C to 55 °C • Relative humidity at 20% to 80% RH (non-condensing) • Altitude up to 3000 m • Pollution Degree 2 • Installation Category II
Storage compliance	-55 °C to 75 °C
Safety compliance	Certified with: • IEC 61010-1:2001/EN61010-1:2001 (2nd Edition) • Canada: CAN/CSA-C22.2 No. 61010-1-04 • USA: ANSI/UL 61010-1:2004
EMC compliance	• IEC 61326-1:2005/EN 61326-1:2006 • Canada: ICES-001:2004 • Australia/New Zealand: AS/NZS CISPR11:2004
U8903A instrument dimensions (W x D x H)	425.60 mm (16.76 in) x 405.00 mm (15.94 in) x 133.60 mm (5.25 in)
Digital interface board dimensions (W x D x H)	110.00 mm (4.33 in) x 303.60 mm (11.95 in) x 29.90 mm (1.18 in)
Weight	8.5 kg (without digital interface board)
	8.747 kg (with digital interface board)
Warranty	One year for product
	Three months for product accessories

Specifications

The following specifications are based on performance with 30 minutes warm- up time and at a temperature of 0 °C to 55 °C unless stated otherwise.

Analog generator specifications

Output specifications	
Connection type	
Balanced	XLR
Unbalanced	BNC
Common mode	XLR
Impedance	
Balanced	100 Ω, 600 Ω
Unbalanced	50 Ω, 600 Ω
Output current limit (typical)	
	50 mA
Maximum output power into 600 Ω	
Balanced (600 Ω)	20 dBm
Unbalanced (600 Ω)	14 dBm
Crosstalk	
20 Hz to 20 kHz	≤ -101 dB (at 23 °C ± 5 °C)
	≤ -99 dB (from 0 °C to 55 °C)
20 kHz to 80 kHz	≤ -85 dB
Generated waveforms	
	Sine, dual sine, variable phase, square, noise (Gaussian and rectangular), arbitrary, DC, multitone, SMPTE IMD (1:1, 4:1, and 10:1), DFD (IEC 60118/IEC 60268)
Sine, dual sine, and variable phase	
Frequency	
Range	5 Hz to 80 kHz
Accuracy	5 ppm
Resolution	0.1 Hz
Output	
Range (balanced)	0 to 16 V_{rms}
Range (unbalanced/common)	0 to 8 V_{rms}
Amplitude accuracy	±1%
Amplitude resolution	1 μV_{rms} (limited to five digits of resolution)
Flatness	
• 5 Hz to 20 kHz • 5 Hz to 80 kHz	• ±0.01 dB • ±0.1 dB
THD + N at 1 kHz, 1 V_{rms}	≤ -95 dB (at 23 °C ±5 °C)
20 Hz to 20 kHz bandwidth	≤ -92 dB (from 0 °C to 55 °C)
Dual sine ratio range	
	0% to 100%
Phase	
	-180 ° to 179.99 °
Sweep	
	Frequency, amplitude, phase

Specifications (continued)

Analog generator specifications (continued)

Square	
Frequency range	
	5 Hz to 30 kHz
Output	
Range (balanced)	0 to 45.2 V_{pp}
Range (unbalanced/common)	0 to 22.6 V_{pp}
Amplitude accuracy	± 2% (for 1 kHz)
Rise time	
	< 2 µs
SMPTE IMD (1:1/4:1/10:1)	
Frequency	
Low frequency (LF) tone	40 Hz to 500 Hz
High frequency (HF) tone	2 kHz to 60 kHz
Output	
Range (balanced)	0 to 16 V_{rms}
Range (unbalanced/common)	0 to 8 V_{rms}
Mixed ratio (LF:HF)	
	10:1, 4:1, or 1:1
Residual IMD (20 Hz to 20 kHz)	
	≤ -92 dB
Sweep	
	Upper frequency, lower frequency, amplitude
DFD (IEC 60118/IEC 60268)	
Frequency	
Difference frequency	80 Hz to 2 kHz
Upper frequency	3 kHz to 80 kHz
Center frequency	3 kHz to 79 kHz
Output	
Range (balanced)	0 V to 16 V_{rms}
Range (unbalanced/common)	0 V to 8 V_{rms}
Inherent distortion (20 Hz to 20 kHz)	
	≤ -101 dB
Sweep	
	Upper frequency, center frequency, amplitude
Noise	
Type	
	Gaussian, rectangular
Output	
Range (balanced)	0 to 7.2 V_{rms} (Gaussian), 0 to 10 V_{rms} (Rectangular)
Range (unbalanced/common)	0 to 3.6 V_{rms} (Gaussian), 0 to 5 V_{rms} (Rectangular)

Specifications (continued)

Analog generator specifications (continued)

Arbitrary	
Signal	Determined by the user selected file
Sample rate	312.5 kHz
Length	32 to 32768 points/channel
Maximum number of tones	(length/2) - 1
Multitone	
Signal	Determined by the user specified frequency, amplitude and phase data
Sample rate	312.5 kHz
Length	256 to 32768 points/channel
Maximum number of tones	64
DC	
Output	
Range (balanced)	-22.6 V to 22.6 V
Range (unbalanced/common)	-11.3 V to 11.3 V
Amplitude accuracy	±1.5%
DC offset	
Applicable for all waveform types except variable phase, DC, and square	
Output level	
Range	-11.3 V to 11.3 V
Amplitude accuracy [1]	±1.5% (±250 mV to ±11.3 V)

1. DC output and DC offset output are functional from 0 to ±250 mV. The amplitude accuracy for this range is not warranted.

Specifications (continued)

Analog analyzer specifications

Input specifications	
Connection type	
Balanced	XLR
Unbalanced	BNC
Coupling	
	DC, AC
Measurement bandwidth	
Low	30 kHz
High	100 kHz
Input ranges	
	400 mV to 140 V_{rms} [1]
Measurement range	
	< 1 µV [2] to 140 V_{rms}
Maximum rated input	
	200 Vp for altitude up to 3000 m
Impedance	
Balanced	200 kΩ
Unbalanced	100 kΩ
Flatness	
20 Hz to 20 kHz	±0.01 dB [3] (at 23 °C ±5 °C)
	±0.012 dB [4] (from 0 °C to 55 °C)
20 kHz to 100 kHz	±0.1 dB (at 23 °C ±5 °C)
	±0.15 dB (from 0 °C to 55 °C)
THD + N (at 1 kHz, 1 V_{rms}, 20 Hz to 20 kHz bandwidth)	
	≤ -101 dB
CMRR	
≤ 20 kHz (input range ≤ 6.4 V)	≥ 70 dB [5]
≤ 20 kHz (input range > 6.4 V)	≥ 40 dB [5]
Crosstalk	
20 Hz to 20 kHz	≤ -101 dB
Input protection	
	Overload protection for all ranges, onscreen warning message on the front panel

THD + N and SINAD	
Fundamental frequency range	10 Hz to 100 kHz
Display range	-999.999 dB to 0 dB
Accuracy	
• < 20 kHz	±0.5 dB
• < 100 kHz	±0.7 dB
Input voltage range	< 1 µV to 140 V_{rms}
Residual distortion (at 1 kHz, 1 V_{rms} 20 Hz to 20 kHz bandwidth)	≤ -101 dB
3 dB measurement bandwidth	> 130 kHz

Specifications (continued)

Analog analyzer specifications (continued)

THD + N and SINAD (continued)	
Detection	RMS
Display resolution	% up to 3 decimal places (dB up to 2 decimal places)
SNR	
Fundamental frequency range	10 Hz to 100 kHz
Display range	-999.999 dB to 0 dB
Accuracy	
• < 20 kHz • < 100 kHz	±0.5 dB ±0.7 dB
Input voltage range	< 1 µV to 140 V_{rms}
Residual distortion (at 1 kHz, 1 V_{rms} 20 Hz to 20 kHz bandwidth)	≤ -101 dB
Triggering	
Type	Free Run, External
Level	5 V
Minimum trigger high voltage	1.25 V
Maximum trigger low voltage	0.5 V
Input impedance	> 50 kΩ
Amplitude	
DC measurement range	0 V to ±200 V
DC accuracy	±1%
AC accuracy (20 Hz to 100 kHz)	±1% (at 23 °C ±5 °C)
	±2% (from 0 °C to 55 °C)
AC level detection	RMS, Peak-to-Peak, Quasi Peak
Frequency	
Range	10 Hz to 100 kHz
Minimum input	1 mV (S/N > 40 dB)
Accuracy	5 ppm
Resolution	6 digits
Phase	
Accuracy	
• < 20 kHz • < 100 kHz	• ±2 ° • ±4 °
Minimum input	1 mV (S/N > 40 dB)
Resolution	0.01 °
SMPTE IMD	
Residual IMD	≤ 0.0025% (-92 dB)

1. *For the available input ranges, refer to the U8903A User Guide.*
2. *Defined by the 24-bit measurement.*
3. *±0.01 dB -0.001 dB/Hz below 50 Hz.*
4. *±0.012 dB -0.001 dB/Hz below 50 Hz.*
5. *When AC coupled, CMRR will deteriorate at low frequencies.*

Specifications (continued)

Digital generator specifications [1]

Dither	
Distribution	None, triangular, or rectangular
Level	0.5 LSB
Sine, dual sine, and variable phase	
Frequency	
Range	5 Hz to 0.45 sampling rate (Fs)
Accuracy	±10 ppm
Flatness	
	±0.001 dB
Residual THD + N	
	≤ -140 dB
Square	
Frequency range	5 Hz to 0.45 Fs
SMPTE IMD (1:1/4:1/10:1)	
Frequency	
Low frequency (LF) tone	40 Hz to 500 Hz
High frequency (HF) tone	2 kHz to 60 kHz, or 0.45 Fs (whichever is lower)
Mixed ratio (LF:HF)	
	10:1, 4:1, or 1:1
Sweep	
	Upper frequency, lower frequency, and amplitude
DFD (IEC 60118/IEC 60268)	
Frequency	
Difference frequency	80 Hz to 2 kHz
Upper frequency	3 kHz to 80 kHz, or 0.45 Fs (whichever is lower)
Center frequency	3 kHz to 79 kHz, or 0.45 Fs (whichever is lower)
Sweep	
	Upper frequency, lower frequency, and amplitude
Noise	
Type	Rectangular, Gaussian, Triangular, and Pink
Amplitude	0 to 1 FFS
Arbitrary	
Signal	Determined by the user selected file
File format	WAVE (.wav)
Maximum file size	5.0 MB
File resolution	8, 16, or 24 bits
Frequency range	2 Hz to 0.45 Fs

1. Digital generator specifications refer to 24 bits FFS.

Specifications (continued)

Digital generator specifications [1] (continued)

Multitone	
Signal	Determined by the user specified frequency, amplitude, and phase data
Frequency rate	2 Hz to 0.45 Fs
Maximum number of tones	64
Sine burst	
Period	2 cycles to 65535 cycles
Burst on	1 cycles to (65534 or period – 1, whichever is lower)
Burst on to burst off ratio	0 to 100%
Monotonicity	
Samples/Step	1 to 32768
Walking one and walking zero	
Samples/Step	1 to 65535
Constant value	
Amplitude	-1 FFS to 1 FFS
DC offset	
DC offset	-1 FFS to 1 FFS

1. Digital generator specifications refer to 24 bits FFS.

Specifications (continued)

Digital analyzer specifications

AC/DC	
AC level range	< -120 dBFS to 0 dBFS
DC level range	±1 FFS
AC accuracy	±0.001 dB (at 1 kHz)
DC accuracy	±0.001 dB
AC flatness	±0.001 dB (10 Hz to 0.45 Fs)
Unit (reference)	FFS, %FS, V, dBFS, LSB, dBr, dBu, dBV, Hex, Dec, and x
Frequency	
Range	5 Hz to 0.45 Fs
Accuracy	±5 ppm (10 Hz to 0.45 Fs)
Phase	
Accuracy	±0.005 °
Resolution	±0.001 °
THD+N	
Range	10 Hz to 0.45 Fs
Accuracy	±0.3 dB
Residual distortion	≤ -140 dB
IMD	
SMPTE IMD	1:1/4:1/10:1
High frequency	2 kHz to 60 kHz, or 0.45 Fs (whichever is lower)
Low frequency	40 Hz to 500 Hz
Accuracy	±0.5 dB
DFD	
Frequency difference	80 Hz to 2 kHz
Center frequency	3 kHz to 79 kHz, or 0.45 Fs (whichever is lower)
Accuracy	±0.5 dB

Specifications (continued)

AES3/SPDIF interface specifications

Input/Output specifications	
Input connector type	
Balanced	XLR (transformer coupling)
Unbalanced	BNC (grounded)
Optical	TOSLINK connector
Output connector type	
Balanced	XLR (transformer coupling)
Unbalanced	BNC (grounded)
Optical	TOSLINK connector
Input impedance	
Balanced	110 Ω or high impedance (> 2 kΩ)
Unbalanced	75 Ω or high impedance (20 kΩ typical)
Output impedance	
Balanced	110 Ω
Unbalanced	75 Ω
Input level	
Balanced	0.3 V_{pp} to 5.1 V_{pp}
Unbalanced	0.3 V_{pp} to 2.5 V_{pp}
Output level	
Balanced	0.3 V_{pp} to 5.1 V_{pp}
Unbalanced	0.3 V_{pp} to 2.5 V_{pp}
Sampling rate	
Input	28 kHz to 192 kHz
Output	28 kHz to 192 kHz
Output level accuracy	
	±1 dB (typical), ±1.5 dB
Audio bit	
	8 bits to 24 bits
Sampling rate accuracy	
	±5 ppm
Inherent jitter (typical)	
Balanced	≤ 1.5 ns
Unbalanced	≤ 1.5 ns
Optical	≤ 5 ns

Specifications (continued)

AES3/SPDIF interface specifications (continued)

Clock and sync	
Internal master clock	
Maximum clock rate	192 kHz
Accuracy	±5 ppm
Inherent jitter	≤ 1 ns
Sync clock input	
Connector type	BNC (SYNC IN on the rear panel)
Impedance	10 kΩ
Input level	3.3 V (non-adjustable, LVCMOS IO standard)
Polarity	Normal or Invert
Sync clock output	
Connector type	25-pin male D-SUB connector pin-1
Impedance	50 Ω
Output level	3.3 V (non-adjustable, LVCMOS IO standard)
Polarity	Normal or invert
Output type	Bit clock (128 Fs)
Protocol	
Channel status bits	Professional or consumer (all applicable bits are editable for advanced settings)
Format	Professional or consumer
User bits	Set or cleared
Validity flag	Set or cleared

Specifications (continued)

DSI specifications

Input/Output specifications	
Connector type	
Input	25-pin male D-SUB connector
	25-pin female D-SUB to BNC connector (optional accessories)
Output	25-pin male D-SUB connector
	25-pin female D-SUB to BNC connector (optional accessories)
Impedance	
Input	≥ 10 kΩ
Output	50 Ω
Logic level	
Input	1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, or user-defined (LVCMOS standard)
Output	1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, or user-defined (LVCMOS standard)
Sampling frequency rate	
Input	6.75 kHz to 400 kHz
Output	6.75 kHz to 400 kHz
Master-clock	
Multiplier	64 to 1024 (depends on the Word Length)
Maximum frequency	51.2 MHz
Maximum bit clock	51.2 MHz
Maximum sampling rate	400 kHz
Data format	
	Left Justified, Right Justified, I^2S, or DSP
Word length	
	8 bits to 32 bits per channel
Audio bit	
	8 bits to 24 bits (step by 1 bit)
Sampling rate accuracy	
	±5 ppm
Word clock rate	
	6.75 kHz to 400 kHz

Specifications (continued)

DSI specifications (continued)

Clock and sync	
Internal master clock	
Maximum clock rate	10 MHz
Stability	±5 ppm
Inherent jitter	≤ 1 ns
Clock source setting (analyzer and generator)	
	Incoming bit clock from DUT
	Internal clock
	External clock from external sync clock input
DSI clock input	
Impedance	10 kΩ typical
Input level	1.2 V_{pp} to 3.3 V_{pp}
Polarity	Normal or Invert
DSI clock output	
Impedance	10 kΩ typical
Output level	1.2 V_{pp} to 3.3 V_{pp}
Polarity	Normal or invert
Word clock polarity	
	Leading edge or falling edge (with respect to bit clock)

Analog audio filters

Low pass filter	
	15 kHz low pass
	20 kHz low pass
	30 kHz low pass
	80 kHz low pass
	User-defined [1]
High pass filter	
	22 Hz high pass
	100 Hz high pass
	400 Hz high pass
	User-defined [1]
Weighting filter	
	A weighting (ANSI-IEC "A" weighted, per IEC Rec 179)
	CCIR 1K weighted (CCIR Rec. 468)
	CCIR 2K weighted (Dolby 2K)
	C-Message (C-Message per IEEE 743)
	CCITT (ITU-T Rec. O.41, ITU-T Rec. P.53)
	User-defined [1]

1. *User-defined filters can be uploaded through standard I/O connections.*

Specifications (continued)

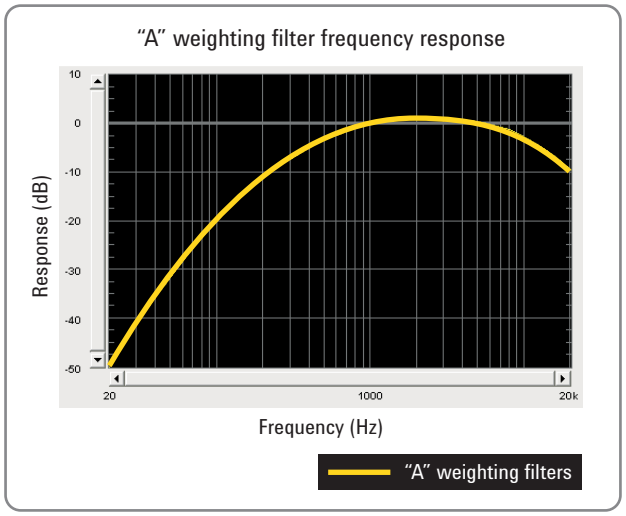

Figure 14. "A"weighting filter frequency response

- "A" weighting filter (ANSI-IEC "A" weighted, per IEC Rec. 179)
- Deviation from ideal response:
  - ±0.1 dB at 1 kHz
  - ±0.5 dB, 20 Hz to 10 kHz
  - ±1.0 dB, at 10 to 20 kHz

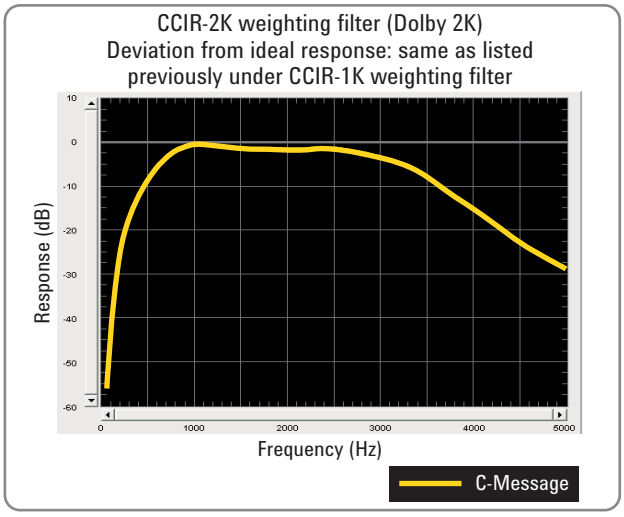

Figure 15. CCIR-2K weighting filter

- C-Message weighting filter (C-Message per IEEE 743)
- Deviation from ideal response:
  - ±0.1 dB, at 1 kHz
  - ±1.0 dB, 60 Hz to 5 kHz

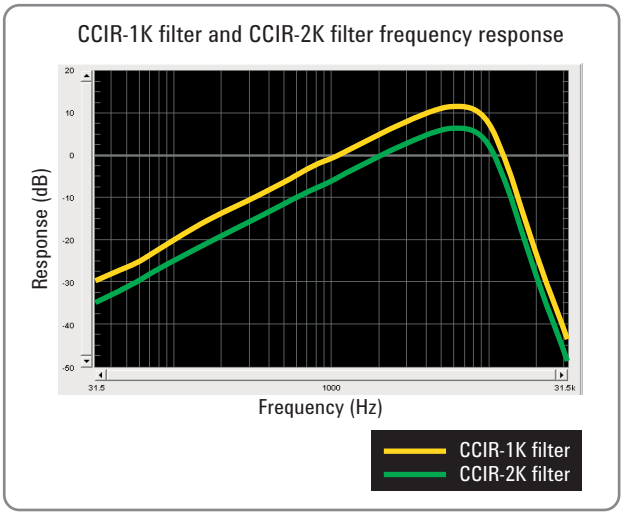

Figure 16. CCIR-1K filter and CCIR-2K filter frequency response

- CCIR-1K weighting filter (CCIR Rec. 468)
- Deviation from ideal response:
  - ±0.1 dB, at 6.3 kHz
  - ±0.2 dB, at 6.3 to 7.1 kHz
  - ±0.4 dB, at 7.1 to 10 kHz
  - ±0.5 dB, at 200 Hz to 6.3 kHz
  - ±1.0 dB, at 31.5 to 200 kHz, 10 to 20 kHz
  - ±2.0 dB, at 20 to 31.5 kHz

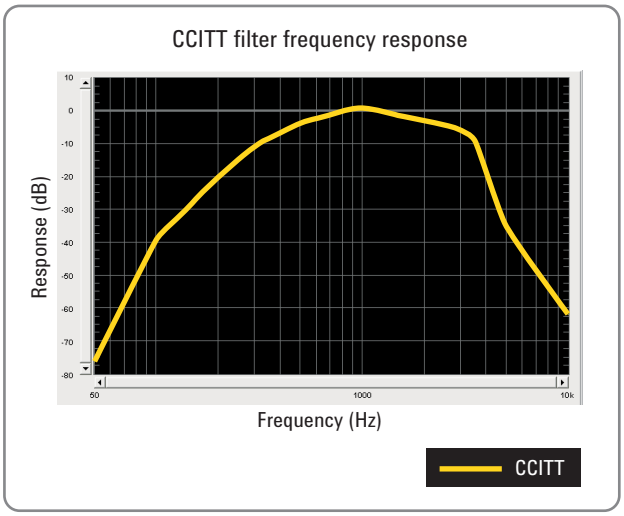

Figure 17. CCITT filter frequency response

- CCITT message weighting filter (ITU-T Rec. 0.41, ITU-T Rec. P.53)
- Deviation from ideal response:
  - ±0.2 dB, at 800 Hz
  - ±1.0 dB, at 300 Hz to 3 kHz
  - ±2.0 dB, at 50 Hz to 3.5 kHz
  - ±3.0 dB, at 3.5 to 5 kHz

Specifications (continued)

Digital audio filters

Low pass filter	
	15 kHz low pass
	20 kHz low pass
	22 kHz low pass
	30 kHz low pass
	User-defined [1, 2]
High pass filter	
	20 Hz high pass
	100 Hz high pass
	400 Hz high pass
	User-defined [1, 2]
Weighting filter	
	A weighting (ANSI-IEC "A" weighted, per IEC Rec 179)
	CCIR 1K weighted (CCIR Rec. 468)
	CCIR 2K weighted (Dolby 2K)
	C-Message (C-Message per IEEE 743)
	CCITT (ITU-T Rec. O.41, ITU-T Rec. P.53)
	User-defined [1, 2]
De-emphasis	50 µs, 75 µs, and user-defined [1, 2]
Sample rate support	
	32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, 192 kHz (subject to filter cut-off)

1. *User-defined filters can be uploaded through standard I/O connections.*
2. *User-defined filter with coefficients limit of up to 252.*

Graph mode

Size/Acquisition length	256, 512, 1024, 2048, 4096, 8192, 16384, 32768
Window	Rectangular, hann, hamming, blackman-harris, rife-vincent 1 and 3, flattop
Amplitude accuracy (flattop window)	±0.1 dB (±1.2%)
Display mode	
Time domain	Normal, interpolate, peak, absolute value
Frequency domain	Displays highest FFT bin between graph points

Generator sweep

Parameters	Frequency, amplitude, phase
Sweep spacing	Linear, logarithmic
Sweep mode	Auto sweep, auto list
Hold	None, max, min

Ordering Information

Product model	Description
U8903A-200	Analog audio analyzer, two channels
Standard-shipped accessories	• LAN and USB cables
	• Power cord
	• Agilent U8903A audio analyzer Quick Start Guide
	• Agilent U8903A audio analyzer Product Reference CD-ROM (contains *U8903A User Guide*)
	• Certificate of calibration
Digital audio interface options	
U8903A-113	U8903A audio analyzer, with U8903A-200, AES3/SPDIF, and DSI digital audio interfaces
U8903A-114	U8903A audio analyzer, with U8903A-200 and AES3/SPDIF digital audio interface
U8903A-115	U8903A audio analyzer, with U8903A-200 and DSI digital audio interface
Optional accessories	
U8903A-101	Male BNC to male BNC cable; 1.2 m
U8903A-102	Male BNC to male RCA cable; 2 m
U8903A-103	Male XLR to female XLR cable; 2 m
U8903A-908	Rack mount kit – standard 3U
U8903A-105	Digital serial interface cable
Warranty and service	
U8903A-1A7	ISO17025 compliant calibration with test data
U8903A-A6J	ANSI Z540 compliant calibration with test data
R-50C-011-3	Agilent calibration - 3 years
R-50C-011-5	Agilent calibration - 5 years
R-51B-001-3C	Return to Agilent Warranty - 3 years
R-51B-001-5C	Return to Agilent Warranty - 5 years

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