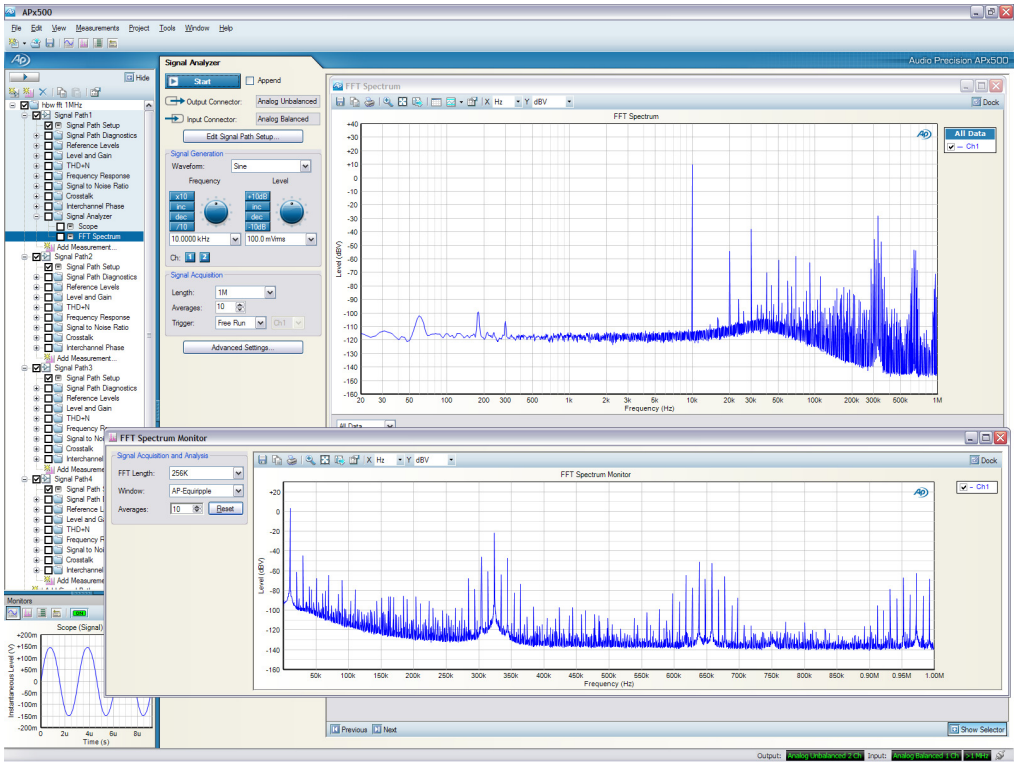
Ultra-High Bandwidth Analysis

Measuring DC to 1 MHz

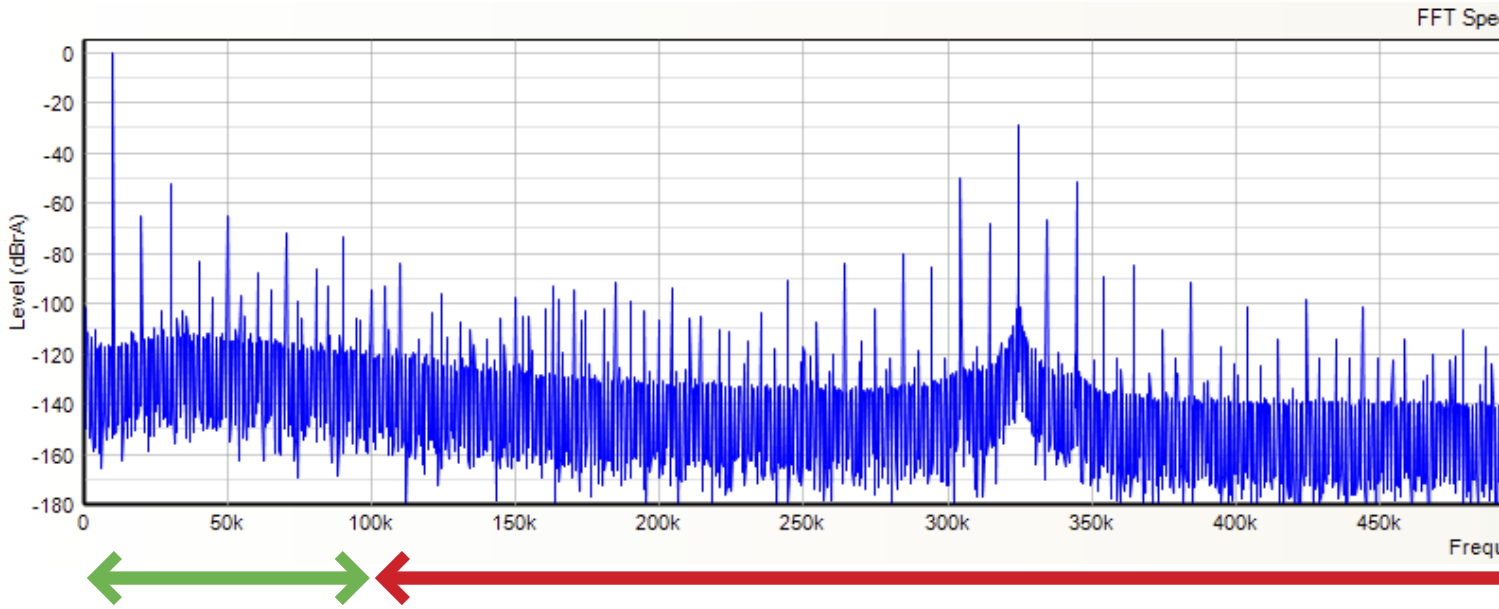


Class D amplifiers, switching power supplies, and D/A converters all produce spurious signals well outside of the 100 kHz bandwidth limit of most audio analyzers. These out-of band switching spikes, along with their harmonics and intermodulation products, can wreak havoc on audio gear and adjacent equipment. Audio signals combined with this noise can cause even more problems.

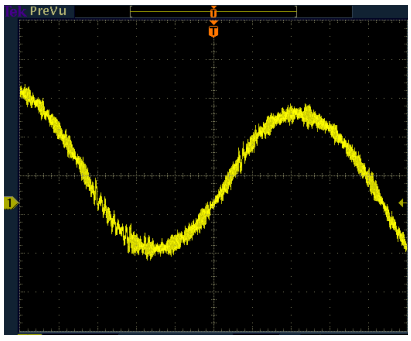
Noise that is reflected into the audible range will directly degrade the sound. Noise that remains above the audible range can also degrade the sound by causing problems such as oscillation, overheating and damage to components, loss of headroom, and interference with connected or adjacent equipment.

Ultra-high bandwidth analysis in the 100 kHz to 1 MHz band lets you to identify and correct these problems. On the pages inside, we look at the traditional ways of examining these signals, as well as the advantages of using an ultra-high bandwidth audio analyzer with full 24 bit FFT resolution from DC to beyond 1 MHz.

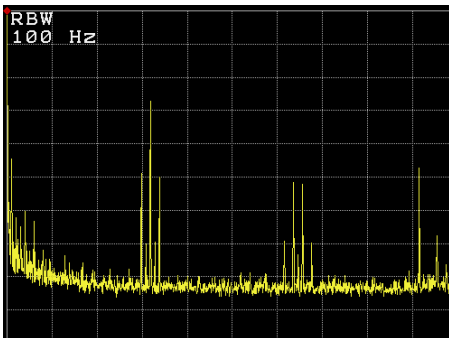
Class D Power Amplifier (10 kHz stimulus at 1 W into 8 Ω) - Linear View



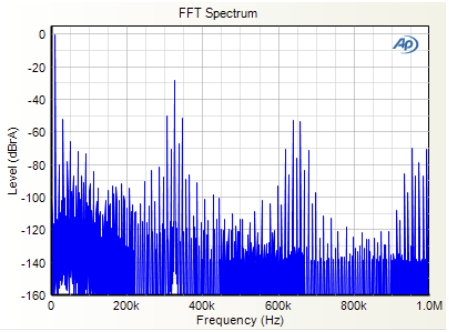
Ultra-High Bandwidth Analysis Methods



Oscilloscope: The scope's time domain view doesn't give us much information about the noise riding on this 10 kHz audio signal. Zooming in doesn't help. And the 8-bit vertical resolution obscures low level detail.



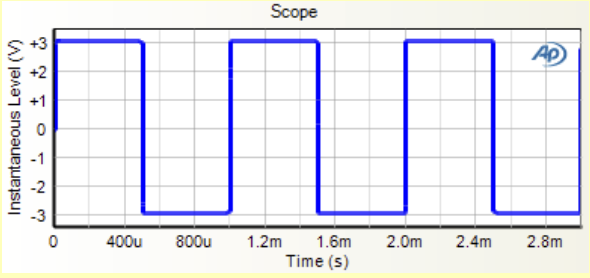
Spectrum Analyzer: Most of the detail is obscured by noise, and the resolution bandwidth is only 100 Hz across the 9 kHz to 1 MHz sweep. It takes 200 seconds to traverse the spectrum and display the image.

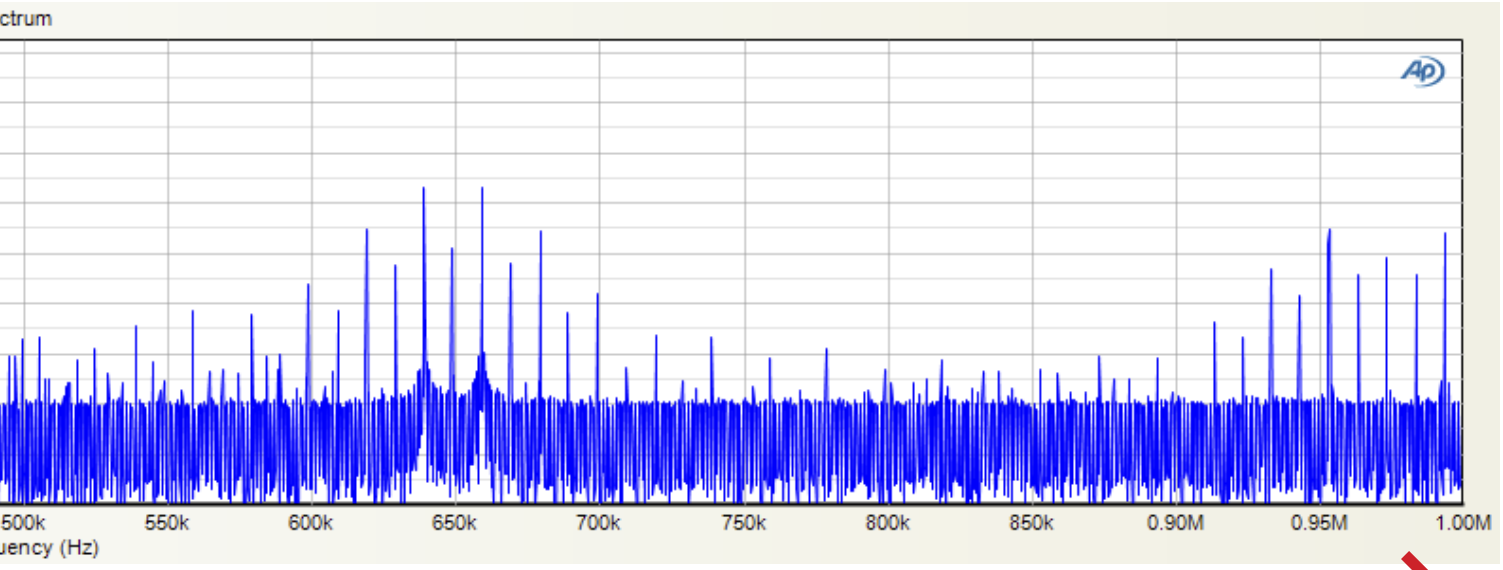


Ultra-High Bandwidth Audio Analyzer [APx525 with BW52 option]: Horizontal resolution (FFT bin width) is about 2 Hz, and the vertical resolution is 24 bits from DC to 1 MHz, allowing fine detail and low level signals to be seen. Measurement and display of a 1 MS acquisition takes 3 seconds.

Square Wave Analysis

Square waves show the transient response of a circuit. In order to accurately see overshoot, undershoot, and ringing in a device under test, the audio analyzer must generate near-perfect square waves and have ultra-high bandwidth analysis. The image on the right was produced by an APx525 with the AG52 analog generator and BW52 ultra-high bandwidth options, after passing through a power amplifier with a switching power supply. The fast rise-time square wave shows excellent transient response.

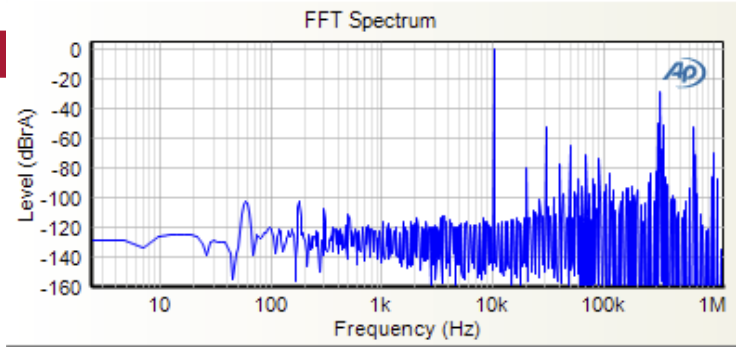




Extended response region of the APx525 family analyzers with the BW52 ultra-high bandwidth option.

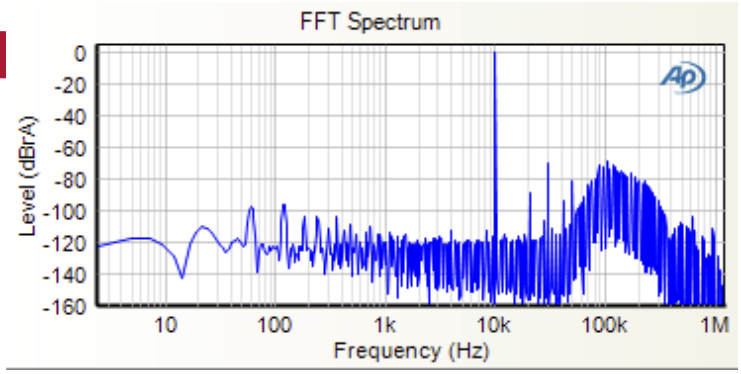
Use Case:
Class D Power Amplifier

The 324 kHz switching frequency of this Class D amp can clearly be seen, along with its second and third harmonics. The switching fundamental is only 30 dB down from 1 W, and the sidebands are caused by intermodulation with the 10 kHz audio fundamental. High frequency detail is expanded in the linear scaled view shown above.



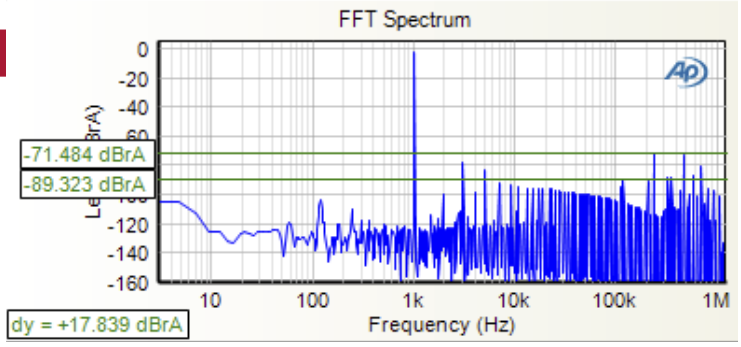
Use Case:
192 kHz D/A Converter

This 192 kHz delta-sigma D/A converter in a multi-channel receiver uses noise shaping to move noise out of the audio band. But notice that the peak is centered around 100 kHz, and a considerable amount of noise is actually below the 96 kHz upper audio frequency limit.



Use Case:
Amplifier with Switching Power Supply

A stimulus of 1 kHz is followed by a series of harmonics that gradually roll off until they enter the switching region over 100 kHz. The switching fundamental at 115 kHz is about 18 dB lower than its second harmonic at 230 kHz, and this varies with changes in the audio fundamental.



APx525

APx525 Family Audio Analyzer Key Specifications

SYSTEM PERFORMANCE

Residual THD+N (20 kHz BW)
–105 dB + 1.3 µV
Typical <–108 dB (1 kHz, 2.5 V)
Typical <–110 dB (1 kHz, 2.5 V) [with AG52]

GENERATOR PERFORMANCE

Sine Frequency Range
0.1 Hz to 80.1 kHz

Square Frequency Range [requires AG52]
10.0 Hz to 20.1 kHz

Frequency Accuracy
2 ppm

IMD Test Signals
SMPTE, MOD, DFD

DIM Test Signals [requires AG52]
3.15 kHz / 15.0 kHz (DIM100" or "DIM30)
2.96 kHz / 14.0 kHz (DIM-B)
2.96 kHz / 8.0 kHz (DIM-B8)

Maximum Amplitude (balanced)
21.21 Vrms
26.66 Vrms bal, 13.33 Vrms unbal,
when Fs ≥10 Hz [with AG52]

Amplitude Accuracy
±0.05 dB

Flatness (20 Hz–20 kHz)
±0.008 dB

Analog Output Configurations
Unbalanced & Balanced

Digital Output Sampling Rate
22 kHz–192 kHz

Dolby / dts Generator
Yes

ANALYZER PERFORMANCE

Maximum Rated Input Voltage
300 Vrms (bal)
160 Vrms (unbal)

Maximum Bandwidth
>90 kHz
>1 MHz [with BW52]

IMD Measurement Capability
SMPTE, MOD, DFD

Amplitude Accuracy (1 kHz)
±0.05 dB

Amplitude Flatness (20 Hz–20 kHz)
±0.008 dB

Residual Input Noise (20 kHz BW)
1.3 µV

Individual Harmonic Analyzer
d2–d10

Max FFT Length
1024K points

DC Voltage Measurement
Yes

ACCREDITED
Accredited by A2LA
under ISO/IEC: 17025
for equipment calibration

BW52 Ultra-High Bandwidth Option

The BW52 ultra-high bandwidth option extends analog signal analysis to over 1 MHz. It is available at time of purchase or as an upgrade to the APx525 family audio analyzers.

AG52 Analog Generator Option

The AG52 analog generator option complements the BW52 by generating exceptionally clean square waves with a rise time of better than 2 µS. It also improves the system THD+N to –110 dB (typical); generates DIM 100, 30, and B square plus sine waveforms; and the maximum output level is increased to 26.66 Vrms (balanced).

AO52 Option Package

The AO52 option combines the BW52 and the AG52. It is available at time of purchase or as an upgrade to the APx525 family audio analyzers.

Web Resources

APx500 Series Audio Analyzers
http://ap.com/products/apx

For more information or a demonstration, please contact your local AP sales partner.
http://ap.com/contact

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