AUDIO PRECISION
SYSTEM TWO

SPECIFICATIONS

(Effective with APWIN version 1.52a or higher software)

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ANALOG SIGNAL OUTPUTS

All System Two configurations, except the SYS-2300, contain an analog signal generator consisting of an ultra-low distortion analog sinewave generator and two independent transformer coupled output stages that can be driven from both the analog sources and optional hardware signal generators. Option "BUR" adds analog generated sine burst, square wave, and noise signals. Option "IMD" adds analog-generated IMD test signals. SYS-2222 and SYS-2322 configurations also contain dual channel D/A-based signal generation capability. Unless otherwise noted, all specifications are valid for outputs ≥150 μVrms [420 μVpp].

ANALOG SIGNAL GENERATOR

Low Distortion Sine Wave

Frequency Range	10 Hz to 204 kHz
Frequency Accuracy	
High-accuracy mode	±0.03%
Fast mode	±0.5%
Frequency Resolution	
High-accuracy mode	0.005%
Fast mode	0.025 Hz, 10 Hz – 204.75 Hz; 0.25 Hz, 205 Hz – 2.0475 kHz; 2.5 Hz, 2.05 kHz – 20.475 kHz; 25 Hz, 20.5 kHz – 204 kHz
Amplitude Range[1]	
Balanced	<10 μV to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 μV to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	±0.7% [±0.06 dB] at 1 kHz
Amplitude Resolution	
V_{out} ≥150 μVrms	0.003 dB
V_{out} <150 μVrms	0.05 μVrms
Flatness (1 kHz ref)	
10 Hz-20 kHz	±0.008 dB (typically <0.003 dB)
20 kHz-50 kHz	±0.03 dB
50 kHz-120 kHz	±0.10 dB
120 kHz-200 kHz	+0.2/-0.3 dB
Residual Distortion[2]	
20 Hz – 20 kHz	typically <0.0001% [-120 dBc];
at 1 kHz	typically <0.00003% [-130 dBc]
Residual THD+N[3]	
20 Hz-20 kHz	≤(0.0004% + 1 μV), 22 kHz BW [-108 dB] ≤(0.0006% + 2 μV), 80 kHz BW [-104 dB] ≤(0.0015% + 6 μV), 500 kHz BW [-96.5 dB]
10 Hz-100 kHz	≤(0.0040% + 6 μV), 500 kHz BW [-88 dB]

Note 1 *20 Hz-50 kHz only. Decrease maximum available output by a factor of 2 (-6.02 dB) for the full 10 Hz-204 kHz range.*

Note 2 *Relative amplitude of any individual harmonic ≤80 kHz measured with a passive notch filter and FFT analyzer. Not valid for outputs above 12 Vrms balanced, or 6 Vrms unbalanced.*

Note 3 *Measured with System Two analyzer (system specification). Derate 20-25 Hz THD to 0.002% for outputs >20 Vrms balanced, or >10 Vrms unbalanced.*

Intermodulation Distortion Related Signals

with option "IMD"

SMPTE (or DIN) Test Signals

LF Tone	40, 50, 60, 70, 100, 125, 250, or 500 Hz; all ±1.5%
HF Tone Range	2 kHz-200 kHz
Mix Ratio	4:1 or 1:1 (LF:HF)
Amplitude Range[4]	
Balanced	30 μVpp to 75.4 Vpp
Unbalanced	30 μVpp to 37.7 Vpp
Amplitude Accuracy	±2.0% [±0.17 dB]
Residual IMD[5]	0.0015% [-96.5 dB], 60+7 kHz or 250+8 kHz

CCIF and DFD Test Signals

Difference Frequency	80, 100, 120, 140, 200, 250, 500 or 1 kHz; all ±1.5%
Center Frequency	4.5 kHz-200 kHz
Amplitude Range[4]	
Balanced	30 μVpp to 75.4 Vpp
Unbalanced	30 μVpp to 37.7 Vpp
Amplitude Accuracy	±3.0% [±0.26 dB]
CCIF Residual IMD[5]	≤0.0004% [-108 dB], 14 kHz+15 kHz (odd order & spurious typ <0.05%)
DFD Residual IMD[5]	≤0.0002% [-114 dB], 14 kHz+15 kHz (odd order & spurious typ <0.025%)

DIM (or TIM) Test Signals

Squarewave Frequency	3.15 kHz (DIM-30 and DIM-100); 2.96 kHz (DIM-B); both ±1%
Sinewave Frequency	15 kHz (DIM-30 and DIM-100); 14 kHz (DIM-B)
Amplitude Range[4]	
Balanced	30 μVpp to 75.4 Vpp
Unbalanced	30 μVpp to 37.7 Vpp
Amplitude Accuracy	±2.0% [±0.17 dB]
Residual IMD[5]	≤0.0020% [-94 dB]

Special Purpose Signals

with option "BUR"

Sine Burst

Frequency Range	20 Hz – 100 kHz
Frequency Accuracy	Same as Sinewave
ON Amplitude Range	Bal 30 μVpp to 37.7 Vpp Unbal 30 μVpp to 18.8 Vpp
Accuracy, Flatness	Same as Sinewave
OFF Ratio Range	0 dB to -80 dB
OFF Ratio Accuracy	±0.3 dB, 0 to -60 dB
ON Duration	1-65535 cycles, or externally gated
Interval Range	2-65536 cycles

Square Wave

Frequency Range	20 Hz – 20 kHz
Frequency Accuracy	Same as Sinewave
Amplitude Range[4]	
Balanced	30 μVpp to 37.7 Vpp
Unbalanced	30 μVpp to 18.8 Vpp
Amplitude Accuracy	±2.0% [±0.17 dB] at 400 Hz
Rise/fall time	Typically 2.0 μsec

Noise Signals

White Noise	Bandwidth limited 10 Hz – 23 kHz
Pink Noise	Bandwidth limited 10 Hz – 200 kHz
Bandpass Noise	Approximately 1/3-octave (2-pole) filtered pink noise, continuously tunable from 20 Hz – 100 kHz
Generator	True random or Pseudo-random
Pseudo-Random Repeat Time	Typically 262 msec (synchronized to the analyzer 4/sec reading rate)
Amplitude Range[4]	(Approximate calibration only)
Balanced	30 μVpp to 37.7 Vpp
Unbalanced	30 μVpp to 18.8 Vpp

Note 4 *Calibration with other amplitude units is based upon an equivalent sinewave having the same Vpp amplitude.*

Note 5 *Measured with System Two analyzer (system specification).*

D/A GENERATED ANALOG SIGNALS

Signals generated by DSP and converted to analog via stereo D to A converters. Available only on models SYS-2222 and SYS-2322. All digitally-generated sine variants, MLS, and IMD signals for the D to A converter outputs are independently generated and may be selected simultaneously but independently from the concurrently available digital signals for the digital domain outputs.

D/A Converter

Resolution	18-bit dual channel delta-sigma
Data Rate	28.8 ks/sec to 52.8 ks/sec, 48.0 ks/sec for specified performance
Frequency Accuracy	±0.0002% [2 PPM] using internal reference, lockable to ext reference
D/A Distortion	-96.5 dB THD+N at 48 ks/sec sample rate. Typically -100 dB THD+N at 48 ks/sec sample rate, 20 kHz bandwidth; D/A distortion products typically ≤-106 dB

Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

Frequency Range	10 Hz to 20 kHz
Frequency Resolution	Typically 0.0078 Hz
Phase accuracy	±1°, 10 Hz – 5 kHz; ± 3°, 5 kHz – 20 kHz
Phase range	-360° to +359.9°
Amplitude Range	
Balanced	<10 µV to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 µV to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	±0.7% [±0.06 dB] at 1 kHz
Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

Stereo Sine Wave

Sine waves of independent frequency and amplitude on each channel

Frequency Range	10 Hz to 20 kHz, each channel independently settable. (Phase random if both frequencies set the same)
Frequency Resolution	Typically 0.0078 Hz
Amplitude Range	
Balanced	<10 µV to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 µV to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	±0.7% [±0.06 dB] at 1 kHz
Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

Dual Sinewave

Twin sine waves of independent frequency and settable amplitude ratio; applied to both output channels

Frequency Range	10 Hz to 20 kHz, each component independently settable
Frequency Resolution	Typically 0.0078 Hz
Amplitude Range	
Balanced	<10 µV to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 µV to 13.33 Vrms [+24.7 dBu] (Channel amplitudes individually settable)
Amplitude Accuracy	±0.7% [±0.06 dB] at 1 kHz
Amplitude Ratio	0 dB to -100 dB
Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

Shaped Sine Burst

Sine burst with raised cosine envelope (see graph on page 12)

Frequency Range	10 Hz to 20 kHz
Frequency Resolution	Typically 0.0078 Hz
Interval	2 - 65536 cycles
Burst On	1 to number of Interval cycles minus 1
Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

Multitone Signals

Stored waveform consisting of multiple sine waves, each of independent frequency, amplitude, and phase

Number of Tones	1 to 128 typical, 4095 maximum
Frequency Range	20 Hz to 50% of sample rate
Frequency Resolution	Sample Rate ÷ 2^{13} (typically 5.86 Hz at 48 ks/sec)

Arbitrary Waveforms

Record Length	256-8192 points, user specified waveform. Utility is provided to prepare a time record file from user specified frequency, amplitude, and phase data.

Maximum Length Sequence Signals

Pseudo-random noise signal for speaker testing with MLS analyzer (page 14)

Signals	Four pink sequences, four white sequences
Frequency Range	22 Hz-20 kHz
Repetition Rate	32767 samples

Polarity Signal

Asymmetric waveform to facilitate polarity identification

Frequency Range	20 Hz to 23.5% of sample rate (11.28 kHz at 48 ks/sec)

"IMD" RELATED SIGNALS *Digitally generated*

SMPTE (or DIN) Test Signal

LF Tone	40 Hz to 500 Hz, continuously settable
HF Tone Range	2 kHz – 20 kHz
Mix Ratio	4:1 or 1:1 (LF:HF)
Amplitude Range[4]	
Balanced	30 µVpp to 75.4 Vpp
Unbalanced	30 µVpp to 37.7 Vpp
Amplitude Accuracy	± 3% [± 0.26 dB]
Residual IMD[5]	≤ 0.0050% [-86 dB], 60 Hz + 7 kHz or 250 Hz + 8 kHz (measured using analog analyzer)

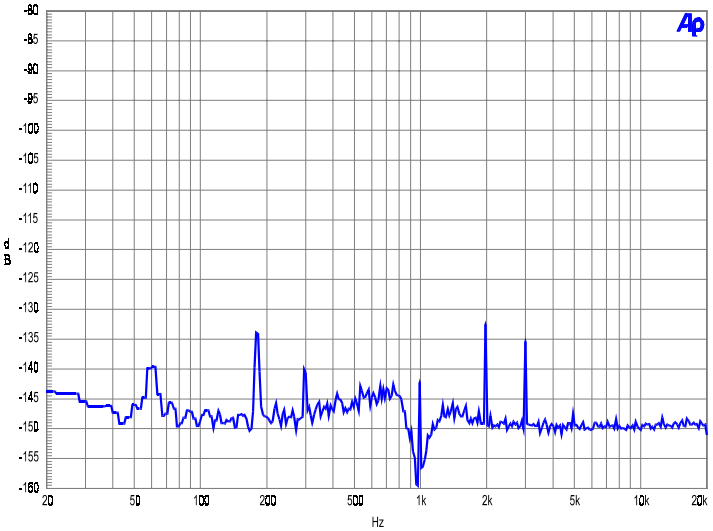
CCIF and DFD Test Signals

Difference Frequency	80 Hz to 2 kHz, continuously settable
Center Frequency	3 kHz to 22 kHz, continuously settable
Amplitude Range[4]	
Balanced	30 µVpp to 75.4 Vpp
Unbalanced	30 µVpp to 37.7 Vpp
Amplitude Accuracy	± 3% [± 0.26 dB]
Residual IMD[5]	≤ 0.0010% [- 100 dB], 14 kHz + 15 kHz (measured using analog analyzer)

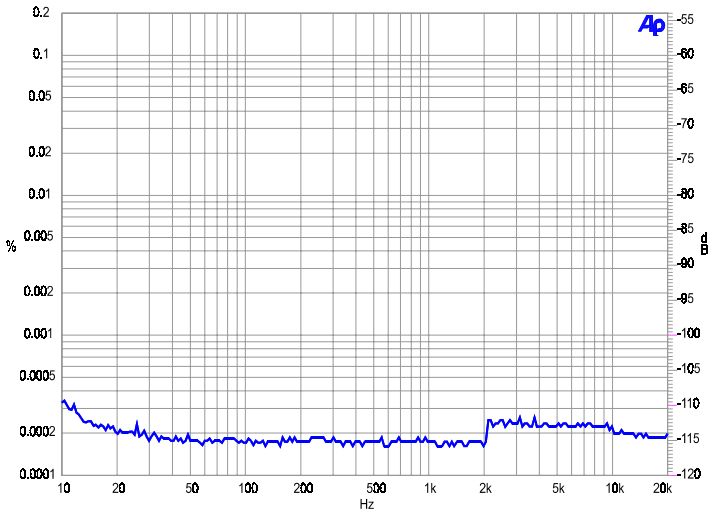
OUTPUT CHARACTERISTICS

Source Configuration	Selectable balanced, unbalanced, or CMTST (common mode test)
Source Impedances	
Balanced or CMTST	40 Ω (±1 Ω), 150 Ω[6] (±1.5 Ω), or 600 Ω (±3 Ω)
Unbalanced	20Ω (±1 Ω) or 600 Ω (±3 Ω)
Max Floating Voltage	42 Vpk
Output Current Limit	≥80 mA peak (typically >120 mA at +25°C)
Max Output Power	
Balanced	+30.1 dBm into 600 Ω (Rs = 40 Ω)
Unbalanced	+24.4 dBm into 600 Ω (Rs = 20 Ω)
Output Related Crosstalk	
10 Hz-20 kHz	≤-120 dB or 5 µV, whichever is greater
20 kHz-100 kHz	≤-106 dB or 10µV, whichever is greater

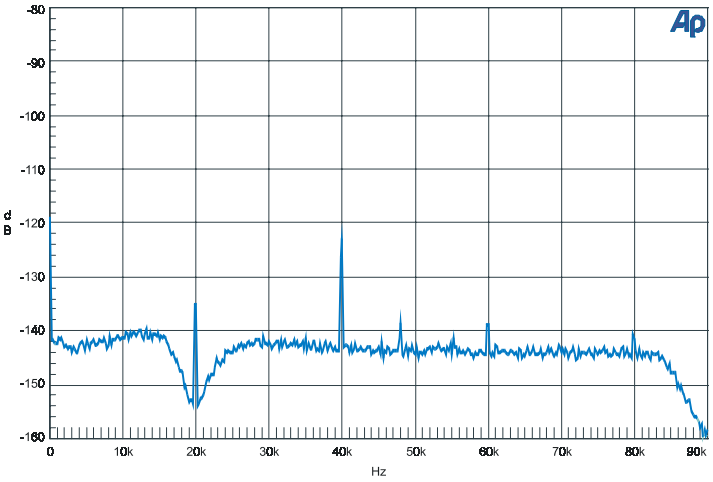
Note 6 *200Ω with option "EURZ"*



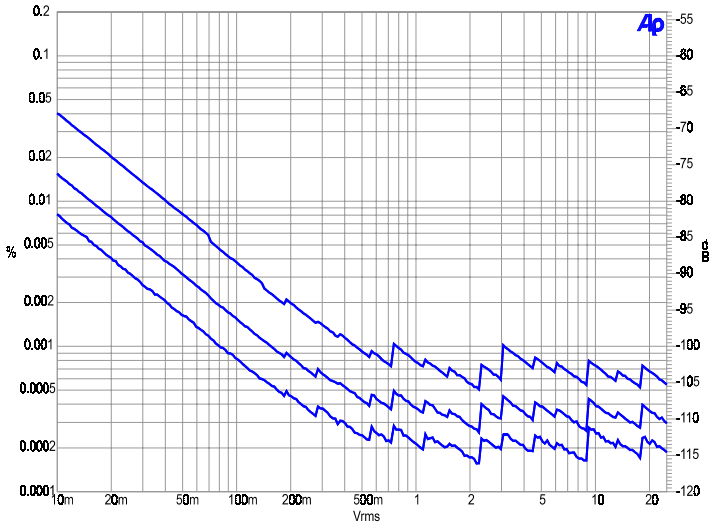
Typical analog generator residual THD+N spectrum at 1 kHz, 2 Vrms. (16384 point FFT of notch filter output, Fs = 48 kHz, 16 averages)



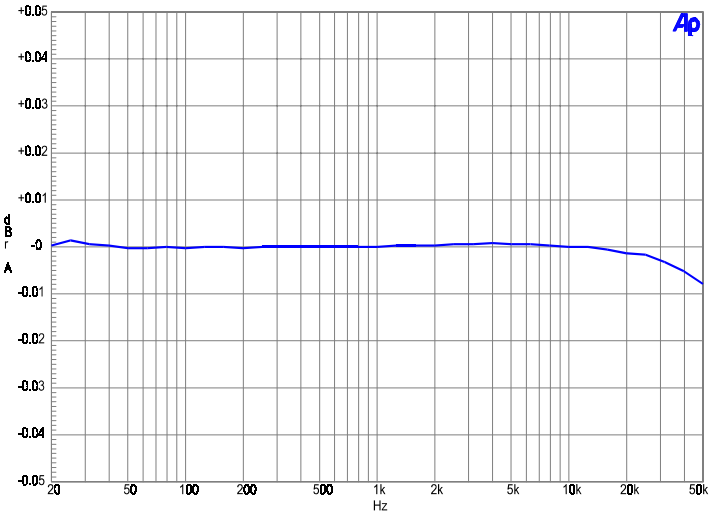
Typical total system THD+N versus Frequency using analog sinewave at 2Vrms



Typical analog generator residual THD+N spectrum at 20 kHz, 2 Vrms. (16384 point FFT of notch filter output, Fs = 192 kHz, 16 averages)



Typical THD+N versus Amplitude at 1 kHz for three different analog analyzer measurement bandwidths. Lower curve is with 22 kHz bandwidth limiting. Middle curve is with 80 kHz. Upper curve is with 500 kHz.



Typical analog System flatness at 2 Vrms signal level.

ANALOG ANALYZER

All System Two configurations, except SYS-2300, contain an analog analyzer consisting of an input module with two independent auto-ranging input stages, each having its own level (rms) and frequency meters; a phase meter connected between the channels; plus a single channel multi-function analyzer module providing additional signal processing and gain stages.

SYS-2222 and SYS-2322 configurations also include dual channel A/D converters for FFT and other special forms of analysis on the analog input and analyzer output signals. Unless otherwise noted, all specifications assume dc coupling and rms detection.

Standard analyzer functions include amplitude and noise (both wideband and selective), THD+N, and crosstalk. Option "IMD" adds intermodulation distortion (IMD) measurement capability. Option "W&F" adds wow and flutter measurement capability.

ANALOG INPUT CHARACTERISTICS

Input Ranges	40 mV to 160 V in 6.02 dB steps
Maximum Rated Input	230 Vpk, 160 Vrms (dc to 20 kHz); overload protected in all ranges
Input Impedance	
Balanced (each side)	Nominally 100 kΩ // 185 pF (typ)
Unbalanced	Nominally 100 kΩ // 185 pF (typ)
Terminations	Selectable 600 Ω or 300 Ω, ±1%; 1 Watt [+30 dBm] maximum power
CMRR[7]	
40 mV-2.5 V ranges	≥80 dB, 10 Hz-20 kHz
5 V and 10 V ranges	≥65 dB, 10 Hz-20 kHz
20 V-160 V ranges	≥50 dB, 10 Hz-1 kHz
Input Related Crosstalk	
10 Hz-20 kHz	≤-140 dB or 1 µV, whichever is greater
20 kHz-100 kHz	≤-126 dB or 2.5 µV, whichever is greater

Note 7 *Not valid below 50 Hz with ac coupling.*

Level Meter Related *(both channels)*

Measurement Range	5 mV – 160 V for specified accuracy and flatness, useable to <100 µV
Resolution (full scale)[8]	
4/sec	1/40,000 [0.00022 dB]
8/sec	1/40,000 [0.00022 dB]
16/sec	1/20,000 [0.00043 dB]
32/sec	1/10,000 [0.00087 dB]
64/sec	1/5,000 [0.0017 dB]
128/sec	1/2,500 [0.0035 dB]
Accuracy (1 kHz)	±0.5% [±0.05 dB]
Flatness (1 kHz ref)[9]	
20 Hz-20 kHz	±0.008 dB (typically <0.003 dB)
15 Hz-50 kHz	±0.03 dB
10 Hz-120 kHz	±0.10 dB
120 kHz-200 kHz	+0.2/-0.3 dB (typically <-0.5 dB at 500 kHz)

Note 8 *Resolution within a given range is equal to its full scale value divided by the full scale counts value determined by the selected reading rate. (Example: 40 mV input range reading resolution = 4 µV, using the 32/sec reading rate). Numerical displays using a dB unit are rounded to the nearest 0.001 dB.*

Note 9 *Derate flatness above 5 kHz by an additional ± 0.02 dB in the 20 V, 40 V, 80 V, and 160 V input ranges.*

Frequency Meter Related *(both channels)*

Measurement Range	10 Hz to 500 kHz
Accuracy	
SYS-2022	±0.003% [±30 PPM]
SYS-2222/2322	±0.0006% [±6 PPM]
Resolution	6 digits + 0.000244 Hz
Minimum Input	5 mV

Phase Measurement Related

Measurement Ranges	±180, -90/+270, or 0/+360 deg
Accuracy[10]	
10 Hz-5 kHz	±0.5 deg
5 kHz-20 kHz	±1 deg
20 kHz-50 kHz	±2 deg
Resolution	0.1 deg
Minimum Input	5 mV, both inputs

Note 10 *Both analyzer input channels must have same coupling (ac or dc) selection. Accuracy is valid for any input signal amplitude ratio up to ± 30 dB.*

Wideband Amplitude/Noise Function

Measurement Range	<1 µV – 160 Vrms
Accuracy (1 kHz)	±1.0% [±0.09 dB]
Flatness (1 kHz ref)[9]	
20 Hz-20 kHz	±0.02 dB
15 Hz-50 kHz	±0.05 dB
50 kHz-120 kHz	±0.15 dB
120 kHz-200 kHz	+0.2 dB/-0.3 dB (typically < -3 dB at 500 kHz)
Bandwidth Limiting Filters	
LF -3 dB	<10 Hz, 22 Hz per CCIR Rec 468, 100 Hz ±5% (3-pole), or 400 Hz ±5% (3-pole)
HF -3 dB	22 kHz per CCIR Rec 468, 30 kHz ±5% (3-pole), 80 kHz ±5% (3-pole), or >500 kHz
Optional Filters	up to 7 (see pages 7, 8, and 9)
Detection	RMS (τ = 25 msec or 50 msec), AVG, QPk per CCIR Rec 468, Pk (pseudo-peak), or S-Pk (0.7071 x Pk reading)
Residual Noise	
22 Hz-22 kHz BW	≤1.0 µV [-118 dBu]
80 kHz BW	≤2.0 µV [-112 dBu]
500 kHz BW	≤6.0 µV [-102 dBu]
A-weighted	≤0.5 µV [-124 dBu]
CCIR-QPk	≤2.5 µV [-110 dBu]

Bandpass Amplitude Function

Tuning Range (f_o)	10 Hz to 200 kHz
Tuning Accuracy	±2%
Bandpass Response	1/3-octave class II (4-pole); <-32 dB at 0.5 f_o and 2.0 f_o
Accuracy (at f_o)	±0.3 dB, 20 Hz-120 kHz
Residual Noise	
10 Hz-5 kHz	≤0.25 µV [-130 dBu]
5 kHz-20 kHz	≤0.5 µV [-124 dBu]
20 kHz-200 kHz	≤1.5 µV [-114 dBu]

Bandreject Amplitude Function

Tuning Range (f_o)	10 Hz to 200 kHz
Tuning Accuracy	±2%
Bandreject Response	typically: -3 dB at 0.73 f_o & 1.37 f_o -20 dB at f_o ±10% -40 dB at f_o ±2.5%
Accuracy	±0.3 dB, 20 Hz-120 kHz (excluding 0.5 f_o to 2.0 f_o)
Residual Noise	same as Amplitude Function

THD+N Function

Fundamental Range	10 Hz to 200 kHz
Measurement Range	0 – 100%
Accuracy	±0.3 dB, 20 Hz – 120 kHz harmonics
Measurement Bandwidth	
LF -3 dB	<10, 22, 100, or 400 Hz
HF -3 dB	22k, 30k, 80k, or >500 kHz; option filters are also functional
Residual THD+N[11]	
20 Hz-20 kHz	≤(0.0004% + 1.0 μV), 22 kHz BW [-108 dB] ≤(0.0006% + 2.0 μV), 80 kHz BW [-104 dB] ≤(0.0015% + 6.0 μV), 500 kHz BW [-96.5 dB]
10 Hz-100 kHz	≤(0.0040% + 6.0 μV), 500 kHz BW [-88 dB]
Minimum Input	5 mV for specified accuracy, usable to <100 μV with fixed notch tuning
Notch Tuning Modes	Counter Tuned, Sweep Track, AGen-Track (analog generator), DGen-Track (digital generator), or Fixed (set by direct entry)
Notch Tracking Range	±2.5% from fixed setting

Note 11 *System specification including contribution from generator. Generator residual THD may limit system performance below 25 Hz if output is >20.0 Vrms balanced, or 10.0 Vrms unbalanced.*

Crosstalk Function

Frequency Range	10 Hz to 200 kHz
Accuracy[12]	±0.4 dB, 20 Hz – 120 kHz
Residual Crosstalk[12]	
10 Hz-20 kHz	≤-140 dB or 1 μV
20 kHz-100 kHz	≤-126 dB or 2.5 μV

Note 12 *Uses the 1/3-octave bandpass filter to enhance the measured range in the presence of wideband noise. Alternate (interfering) channel input must be ≥ 5 mV.*

IMD MEASUREMENTS with option "IMD"

Option "IMD" adds the capability to measure intermodulation distortion (IMD) using three of the most popular techniques. The demodulated IMD signal can also be selected for FFT analysis in SYS-2222 and SYS-2322 configurations.

SMPTE (DIN) IMD Function

Test Signal Compatibility	Any combination of 40-250 Hz (LF) and 2 kHz-100 kHz (HF) tones, mixed in any ratio from 0:1 to 8:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. -3 dB measurement bandwidth is typically 20 Hz-750 Hz
Measurement Range	0 – 20%
Accuracy	±0.5 dB
Residual IMD[13]	≤0.0015%, 60 + 7 kHz or 250 + 8 kHz

CCIF and DFD IMD Functions

Test Signal Compatibility	Any combination of equal amplitude tones from 4 kHz – 100 kHz spaced 80 Hz-1 kHz (difference frequency)
IMD Measured	
CCIF function	2nd order difference frequency product relative to the amplitude of either test tone
DFD function	u_2 (2nd order difference frequency product) per IEC 268-3 (1986)
Measurement Range	0-20%
Accuracy	±0.5 dB
Residual IMD[13]	CCIF ≤0.0004%, 14 kHz + 15 kHz [-108 dB], DFD ≤ 0.0002%, 14 kHz + 15 kHz [-114 dB]

DIM (TIM) IMD Function

Test Signal Compatibility	2.96 – 3.15 kHz squarewave mixed with 14 – 15 kHz sine probe tone
IMD Measured[14]	u_4 and u_5 per IEC 268-3 (1986)
Measurement Range	0 – 20%
Accuracy	±0.7 dB
Residual IMD[13]	≤0.0020%

Note 13 *System specification measured with the System Two generator. Valid for input levels ≥200 mVrms.*

Note 14 *IEC 268-3 defines nine possible DIM products. The System Two IMD option analyzer is sensitive only to the u4 and u5 products using the simplified measurement technique proposed by Paul Skritek. DIM measurements using this technique will typically be 6-8 dB lower (better) than the results obtained using FFT-based techniques which sum all nine products.*

WOW & FLUTTER MEASUREMENTS

with option "W&F"

Option "W&F" adds the capability to make both conventional wow & flutter and scrape flutter measurements (using the technique developed by Dale Manquen of Altair Electronics, Inc.) The demodulated W&F signal can also be selected for FFT analysis in SYS-2222 and SYS-2322 configurations.

Test Signal Compatibility	
Normal	2.80 kHz – 3.35 kHz
"High-band"	11.5 kHz – 13.5 kHz
Measurement Range	0 to 1.2%
Accuracy (4 Hz)	±(5% of reading + 0.0005%)
Detection Modes	IEC/DIN (quasi-peak per IEC-386), NAB (average), JIS (per JIS 5551)
Response Selections	
Weighted	4 Hz bandpass per IEC/DIN/NAB
Unweighted	0.5 Hz – 200 Hz
Scrape[15]	200 Hz – 5 kHz
Wideband[15]	0.5 Hz – 5 kHz
Residual W+F	
Weighted	≤0.001%
Unweighted	≤0.002%
Scrape or Wideband	≤0.005%
Minimum Input	5 mV (20 mV for specified residual)
Settling Time	
IEC/DIN or NAB	Typically 3 – 6 seconds
JIS	Typically 15 – 20 seconds

Note 15 *Operational with high-band test signals (11.5 kHz-13.5 kHz) only. Upper -3 dB rolloff is typically 4.5 kHz using 12.5 kHz.*

OPTION FILTERS

Up to 7 option filters can be installed in the System Two analyzer for weighted noise or other special measurements. Option filters are selected one at a time and are cascaded with the standard bandwidth limiting filters.

The following tables list only the most popular types. Contact Audio Precision for a quotation regarding other possible designs. The maximum usable dynamic range will be limited to about 40-50 dB because system auto-ranging is based upon the peak value of the unfiltered wideband signal. Custom designs may be constructed on the FIL-USR blank card.

Weighted Noise Measurement

FIL-AWT	"A" weighting per IEC Rec 179
FIL-CCR	Weighting per CCIR Rec 468 and DIN 45404 (Also for CCIR/ARM)
FIL-CIT	Weighting per CCITT Rec P53
FIL-CMS	"C-message" per BSTM 41004 and ANSI/IEEE Std 743-1984
FIL-CWT	"C" weighting per IEC Rec 179

Precision De-emphasis Family

FIL-D50	50 µsec ±1%
FIL-D50E	50 µsec ±1% + 15.625 kHz notch
FIL-D50F	50 µsec ±1% + 19.0 kHz notch
FIL-D75	75 µsec ±1%
FIL-D75B	75 µsec ±1% + 15.734 kHz notch
FIL-D75F	75 µsec ±1% + 19.0 kHz notch

Precision Sharp Cutoff Low-Pass Family

Family Response	-3 dB at f_c ±1.5%; ±0.2 dB to 0.5 f_c, ±0.4 dB to 0.8 f_c ; <-50 dB above 1.8 f_c
FLP-10K	f_c = 10.0 kHz, quasi-elliptic
FLP-15K	f_c = 15.0 kHz, quasi-elliptic
FLP-18K	f_c = 18.0 kHz, quasi-elliptic
FLP-19K	f_c = 19.0 kHz, quasi-elliptic
FLP-20K	f_c = 20.0 kHz, quasi-elliptic

See also FLP-A20K under Miscellaneous

Bandwidth Limiting, Low-Pass

FLP-400	400 Hz ±3%, 5-pole
FLP-500	500 Hz ±3%, 5-pole
FLP-1K	1 kHz ±3%, 5-pole Butterworth
FLP-3K	3 kHz ±3%, 7-pole Butterworth
FLP-4K	4 kHz ±3%, 7-pole Butterworth
FLP-8K	8 kHz ±3%, 7-pole Butterworth
FLP-50K	50 kHz ±5%, 3-pole Butterworth

Bandwidth Limiting, High-Pass

FHP-70	70 Hz ±3%, 8-pole
FHP-400	400 Hz ±3%, 9-pole
FHP-2K	2 kHz ±3%, 9-pole
FHP-20K	20 kHz ±3%

1/3-Octave (Class II) Bandpass Family

Family Response	Class II (4-pole) ±0.2 dB from 0.97 f_o to 1.03 f_o ; <-12 dB at 0.8 f_o and 1.25 f_o ; <-32 dB at 0.5 f_o and 2.0 f_o
FBP-120	f_o = 120 Hz
FBP-180	f_o = 180 Hz
FBP-250	f_o = 250 Hz
FBP-300	f_o = 300 Hz
FBP-400	f_o = 400 Hz
FBP-500	f_o = 500 Hz
FBP-600	f_o = 600 Hz
FBP-666	f_o = 666 Hz
FBP-800	f_o = 800 Hz
FBP-945	f_o = 945 Hz
FBP-1000	f_o = 1.00 kHz
FBP-1200	f_o = 1.20 kHz
FBP-1500	f_o = 1.50 kHz
FBP-2000	f_o = 2.00 kHz
FBP-3000	f_o = 3.00 kHz
FBP-3150	f_o = 3.15 kHz
FBP-4000	f_o = 4.00 kHz
FBP-4500	f_o = 4.50 kHz
FBP-5000	f_o = 5.00 kHz
FBP-6000	f_o = 6.00 kHz
FBP-8000	f_o = 8.00 kHz
FBP-10000	f_o = 10.0 kHz
FBP-12500	f_o = 12.5 kHz
FBP-15000	f_o = 15.0 kHz
FBP-16000	f_o = 16.0 kHz
FBP-20000	f_o = 20.0 kHz
FBP-22000	f_o = 22.0 kHz

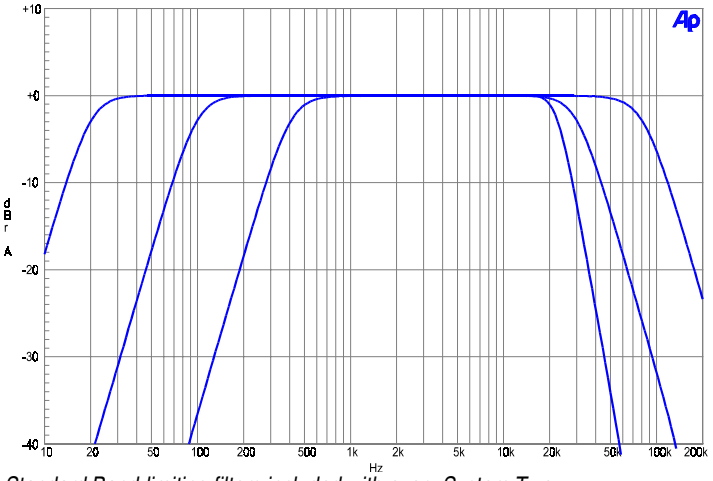
Receiver Testing

FIL-RCR	200 Hz-15 kHz + 19.0 kHz notch
FIL-IECR	20 Hz-15 kHz + 15.625 kHz notch

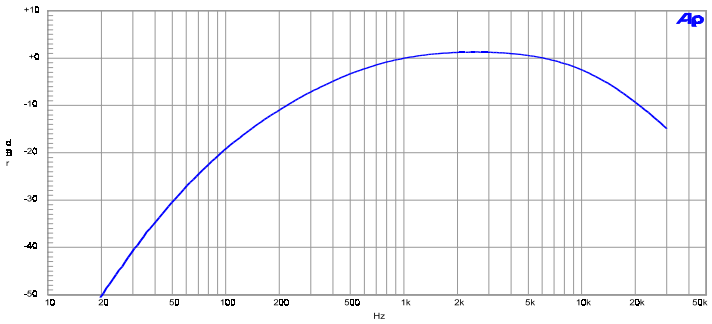
Miscellaneous

FBP-500X	High-Q 500 Hz bandpass for CD dac linearity measurements
FLP-A20K	Apogee 20 kHz "brickwall" filter (OEM design)
FIL-USR	Kit for building custom filters

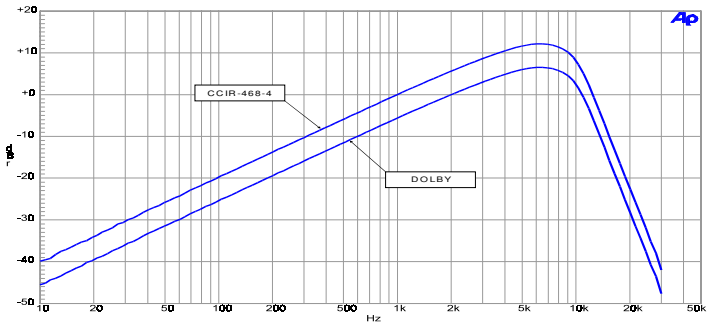
Note: the optional filters described here can be added to the standard band-limiting filters shown below



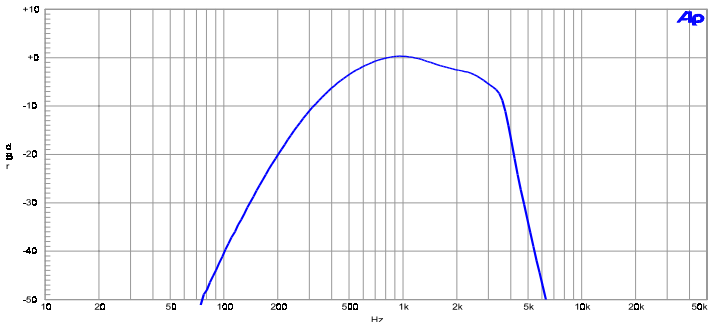
Standard Band-limiting filters included with every System Two
High pass selectable 22Hz, 100 Hz, 400 Hz
Low pass selectable: 22 kHz, 30 kHz, 80 kHz



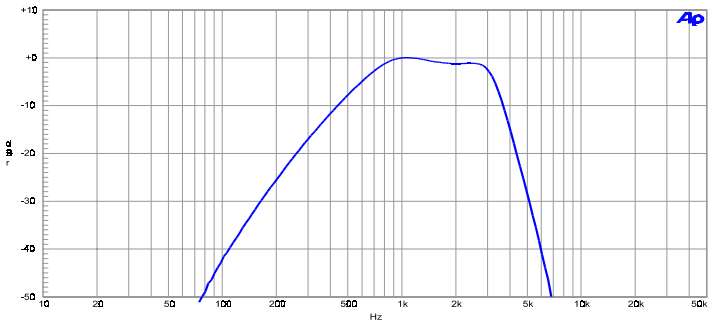
FIL-AWT ANSI-IEC "A" Weighting Filter



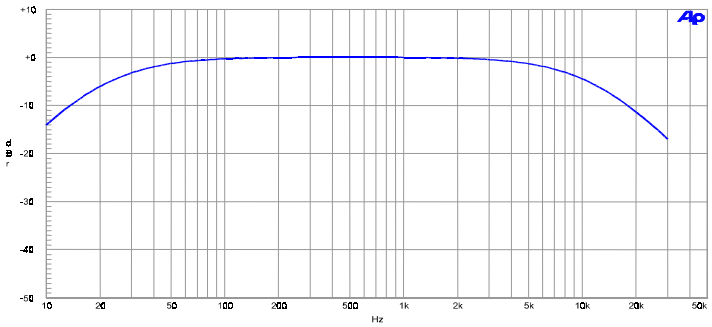
FIL-CCR CCIR-468 / DIN 45404 Noise Weighting Filter



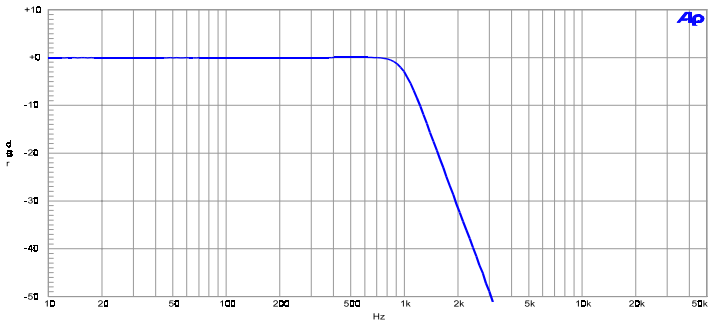
FIL-CIT CCITT P53 Noise Weighting Filter



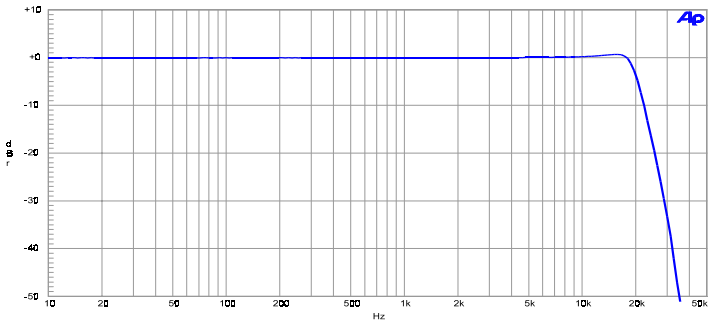
FIL-CMS C-Message Weighting Filter (ANSI/IEEE 743-1984)



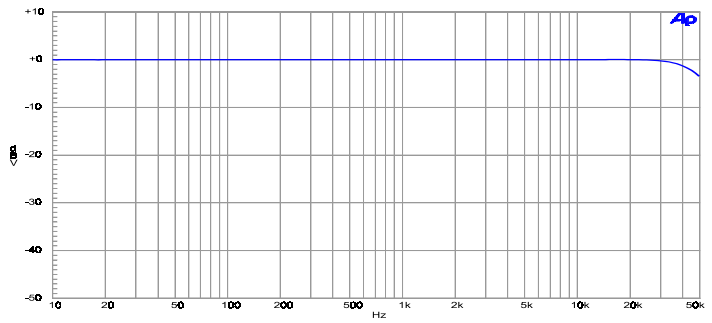
FIL-CWT "C" Weighting (IEC-179)



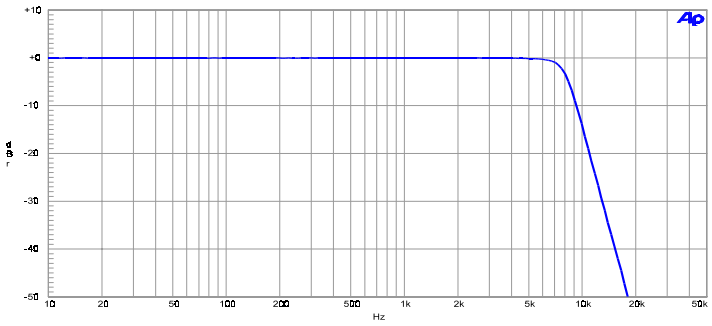
FLP-1K 1 kHz Low Pass 5-pole Butterworth Filter



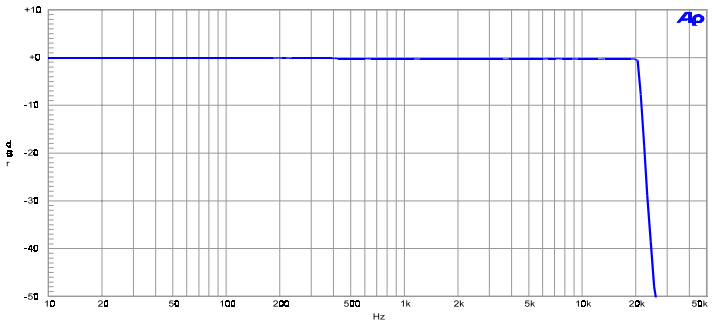
FLP-20K 20.0 kHz Quasi-elliptic sharp cutoff Low Pass Filter



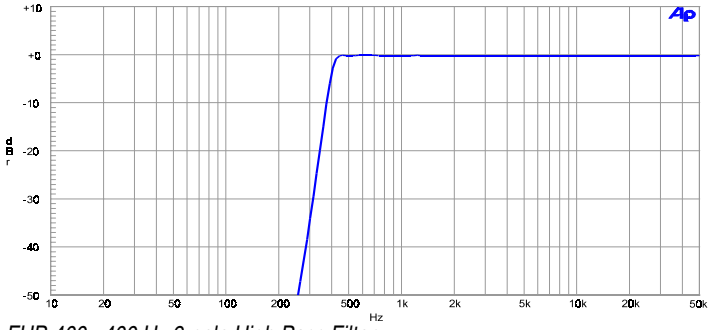
FLP-50K 50 kHz 3-pole Butterworth Low Pass Filter



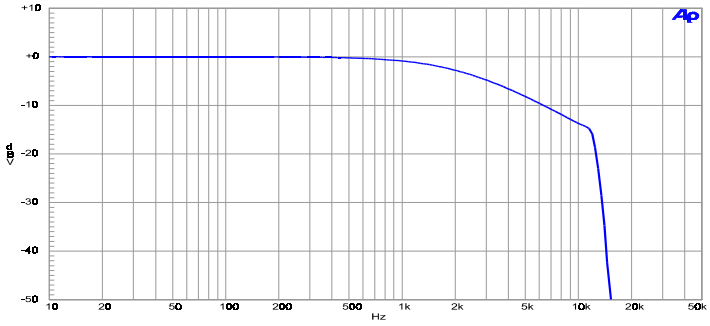
FLP-8K 8 kHz 7-pole Butterworth Low Pass Filter



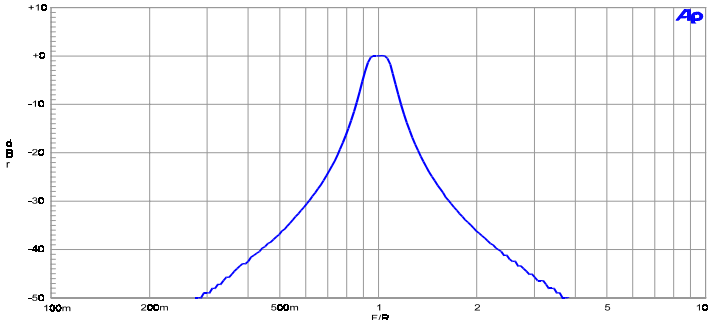
FLP-A20K Apogee "Brick-Wall" 20 kHz Low Pass Filter



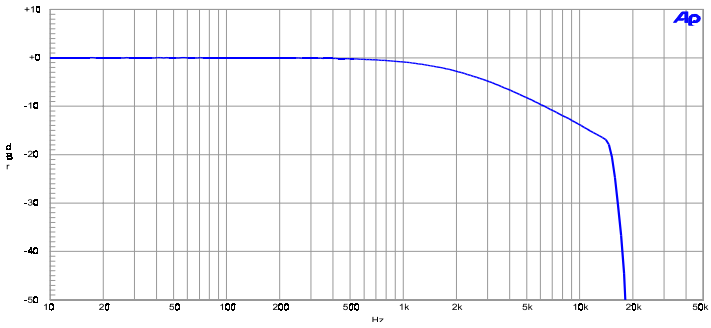
FHP-400 400 Hz 9-pole High Pass Filter



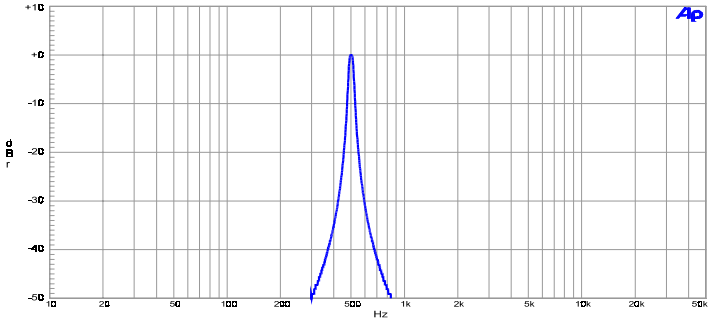
FIL-D75B 75 µsec with 15.734 kHz (NTSC) notch De-emphasis Filter



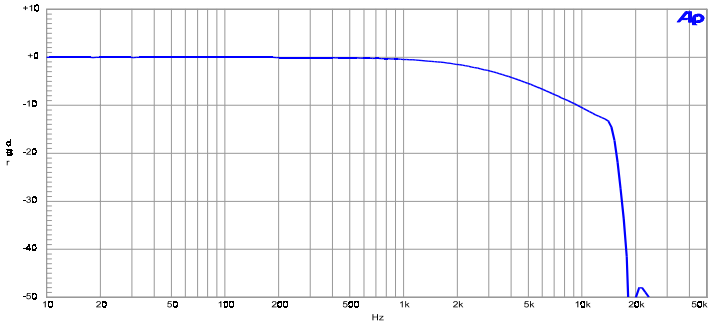
FBP-XXXX Fixed 1/3 Octave Band Pass Filter



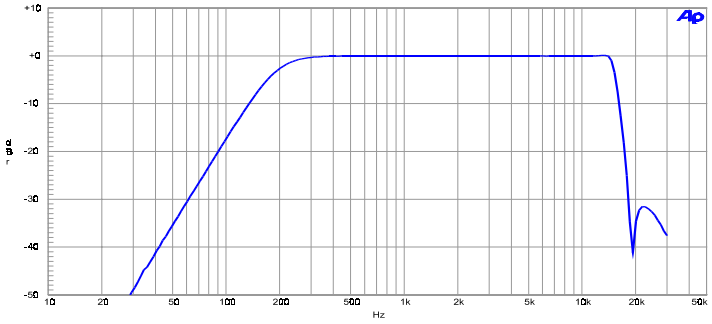
FIL-D75F 75 µsec with 19 kHz (FM) notch De-emphasis Filter



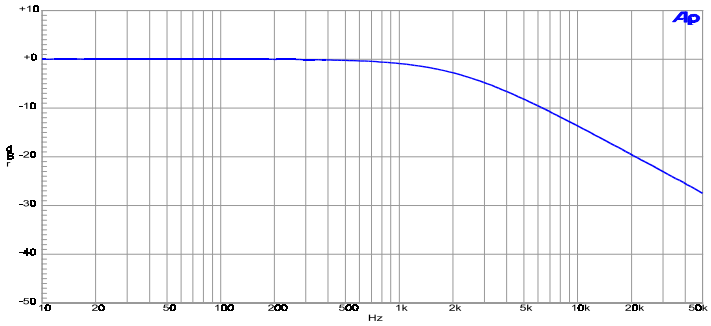
FBP-500X High-Q 500 Hz Band Pass Filter (for CD linearity testing)



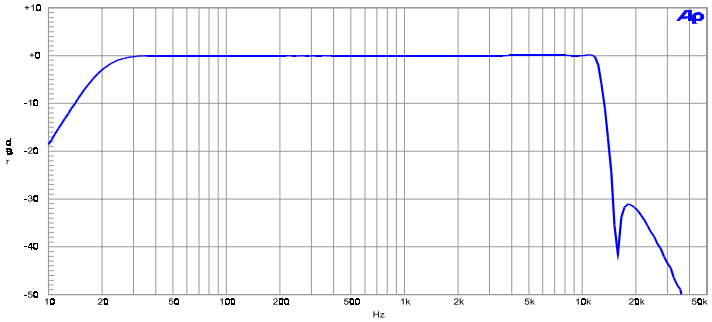
FIL-D50F 50 µsec with 19 kHz (FM) notch De-emphasis Filter



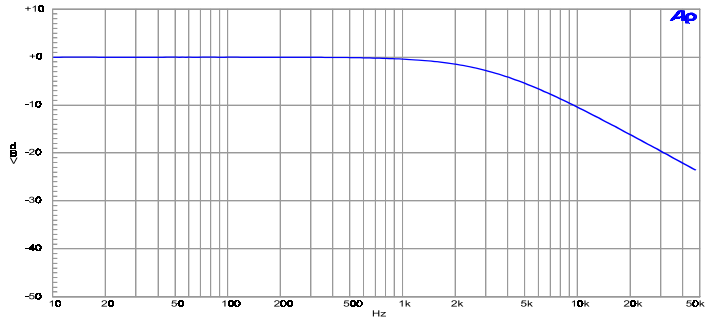
FIL-RCR 200 Hz to 15 kHz with 19 kHz (FM) notch Receiver Testing Filter



FIL-D75 75 µsec De-emphasis Filter



FIL-IECR 20 Hz to 15 kHz with 15.625 kHz (PAL) notch Receiver Testing Filter



FIL-D50 50 µsec De-emphasis Filter

DSP ANALYSIS of ANALOG SIGNALS

Available in SYS-2222 and SYS-2322 configurations only. The low bandwidth high resolution dual converters are optimized for applications up to 20 kHz and are available to convert input signals for use by the FFT, DSP, MLS, and Multitone audio analyzers. It contains a linear phase digital anti-alias filter that allows some degree of aliasing to occur near the pass-band edge *(see Note 16)*. The higher bandwidth converter contains a 9-pole analog anti-alias filter optimized for general purpose applications up to 80 kHz and is available to the FFT analyzer.

Low Bandwidth (x1 or ÷4) Converter

Available for both FFT and DSP Audio Analyzers

A/D Resolution	20 bits
Sample Rates	x1 mode: 28.8 ks/sec to 52.8 ks/sec ÷4 mode: 7.2 ks/sec to 13.2 ks/sec
Flatness (1 kHz ref)	±0.01 dB to 0.45 * sample rate
Alias Rejection[16]	Typically >100 dB for out of band signals above 0.605 * sample rate
Distortion	-100 dB (relative to full scale of analyzer range)

High Bandwidth (x4) Converter

Input Converter available for FFT Analyzer

A/D Resolution	16 bits
Sample Rates[17]	192 ks/sec to 200 ks/sec
Flatness (1 kHz ref)	
10 Hz-20 kHz	±0.05 dB
20 kHz-65 kHz	±0.10 dB
65 kHz-80 kHz	±0.30 dB
Alias Rejection	≥75 dB
Distortion	-85 dB, 10 Hz – 20 kHz (relative to full scale of analyzer range)

Note 16 *From converter manufacturer's data. Rejection near the band edge is typically –80 dB at 0.600*sr decreasing to -44 dB at 0.58*sr, -26 dB at 0.56*sr, and -3 dB at 0.50*sr.*

Note 17 *Usable at lower sample rates with degraded alias rejection.*

FFT Analyzer *("FFT.AZ2")*

Acquisition Length	256 – 16384 samples in binary steps; or 24,576 samples
Transform Length	256 – 16384 samples in binary steps
Processing	48 bit
Windows *(see graph on page 15)*	Blackman-Harris (4 term with –92 dB sidelobe) Hann Flat-top (±0.02 dB) Equi-ripple (-145 dB sidelobes) None None, sync to sine
Amplitude Accuracy	±0.1 dB, 20 Hz – 20 kHz, using Flat-top window
Averaging	1 – 4096 in binary steps, averaging algorithm is power (spectrum only) or synchronous
Waveform Display Modes	Normal, interpolate, peak, max
Frequency Display Modes	Peak pick, individual bin
Sync to Sine Window	
Frequency Range	7th bin to 45% of sample rate (21.6 kHz at 48 ks/sec)
Amplitude Accuracy	±0.025 dB

DSP Audio Analyzer *("ANALYZER.AZ2")*

Wideband Level/Amplitude

Frequency Range	5 Hz – 22.0 kHz at 48 ks/sec
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth 400 Hz, 10-pole elliptical *when not using notch filter or bandpass mode* (response is -120 dB for ≤220 Hz, ±0.1 dB for ≥400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass *both: 0.1dBpp ripple, ≥110 dB stopband attenuation*
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see graph on page 12)*

Narrow Band Amplitude

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 ks/sec)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see graph page 15)*

THD+N Measurements

Fundamental Range	0.02% to 45% of sample rate (10 Hz – 22.0 kHz at 48.0 ks/sec)
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth
Low pass Filters	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass *both: 0.1dBpp ripple, ≥110 dB stopband attenuation*
Weighting Filters	ANSI-IEC "A" weighting, per IEC Rec 179 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see graph on page 12)*

Frequency Measurements

Range	5 Hz to 47% of sample rate (5 Hz – 21.0 kHz at 44.1 ks/sec) (5 Hz – 23.0 kHz at 48.0 ks/sec)
Accuracy	±0.01% of reading or 0.0001% of sample rate, whichever is greater
Resolution	0.003% of reading or 0.0001% of sample rate, whichever is greater

Maximum Length Sequence Analyzer ("MLS.AZ2") Quasi-anechoic acoustic tester

Signals	Four pink sequences, four white sequences
Frequency Range	22 Hz to 20 kHz
Frequency Resolution (Max)	2.93 Hz at 48.0 ks/sec
Acquisition Length	32767 samples
FFT Length	16384
Energy Time Windows	half Hann Hann <240 Hz > 8 kHz <120 Hz > 16 kHz
Time Windows (percent of data record to transition from 0 to full amplitude)	<5% <10% <20% <30%

Multitone Analyzer *("FASTTEST.AZ2")*

Acquisition Length	512 – 16384 samples in binary steps
Transform Length	512 – 16384 samples in binary steps
Processing	24 bit
Measurements	Level vs frequency, Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve
Frequency Resolution	1.95 Hz with 32.0 ks/sec 2.69 Hz with 44.1 ks/sec 2.93 Hz with 48.0 ks/sec
Frequency Error Correction Range	±3%
Distortion	≤-115 dB

DIGITAL SIGNAL GENERATOR

Available in the SYS-2300 and SYS-2322 configurations only. The System Two digital generator consists of a DSP signal generator, selectable pre-emphasis filters, two hardware dither generators, and several digital output stages supporting the most popular formats.

All digitally-generated sine variants, MLS, and IMD signals for the digital domain outputs are independently generated and may be selected simultaneously but independently from the concurrently available digital signals for the analog domain via the D to A converter outputs.

DIGITAL OUTPUT CHARACTERISTICS

Output Formats	AES/EBU (per AES3-1992) SPDIF-EIAJ Optical (Toslink®) General purpose serial General purpose parallel Serial interface to chip level via optional SIA-2322 accessory
Sample Rates	28.8 kHz – 52.8 kHz AES/EBU, general purpose serial; 8 kHz to 52.8 kHz parallel, SIA-2322; independent from input sample rate
Sample Rate Resolution	1/128 Hz (approx. 0.0078 Hz)
Sample Rate Accuracy	±0.0002% [±2 PPM] using internal reference, lockable to external reference
Word Width	8 to 24 bits
Output impedance	
Balanced (XLR)	110Ω
Unbalanced (BNC)	approx. 75Ω

DIGITAL SIGNAL GENERATION

Sine Wave

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Sine Burst

Sine burst with rectangular envelope

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Interval	2 – 65536 cycles
Burst On	1 to number of Interval cycles minus 1
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Phase Range	±180°
Phase Resolution	0.01°
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Stereo Sine Wave

Sine wave of independent frequency and amplitude on each channel

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec) Stereo frequencies may be set independently for each channel
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Dual Sine Wave

Twin sine waves of independent frequency and settable amplitude ratio; applied to both output channels

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]
Amplitude ratio	0 dB to -120 dB

Sine + Offset

Sine wave plus a constant value

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Offset Amplitude	Sinewave amplitude + |offset amplitude| ≤ 100% FS
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Shaped Sine Burst

Sine burst with raised cosine envelope (see graph on page 12)

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Interval	2 - 65536 cycles
Burst On	1 to number of Interval cycles minus 1
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Square Wave

Frequency Range	10 Hz to 1/6 sample rate (7350 Hz at 44.1 ks/sec, 8000 Hz at 48 ks/sec)
Frequencies available	$f_s \div 4096$ to $f_s \div 6$, in even integer divisors
Even Harmonic Content	≤0.00001% [-140 dB]

SMPTE/DIN Waveform

Upper Tone Frequency Range	2 kHz to 47% of sample rate (22.56 kHz at 48 ks/sec)
Lower Tone Frequency Range	40 Hz-500 Hz
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Flatness	±0.001 dB
Amplitude Ratio	1:1 to 10:1 [0 to 20 dB] (LF:HF)
Residual Distortion	≤0.00001% [-140 dB] at 4:1 ratio

CCIF and DFD IMD Waveforms

Center Frequency Range	3000 Hz to (47% of sample rate - ½ IM frequency) (22.51 kHz at 48 ks/sec; 20.67 kHz at 44.1 ks/sec)
IM Frequency Range	80 Hz-2000 Hz
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

DIM IMD Waveform

Sine wave Frequency	100/21 * squarewave frequency (15 kHz at 44.1 ks/sec; 14285.7 Hz at 48 ks/sec)
Sine wave Frequency Resolution	Data Rate ÷ 2^{23} (typically 0.006 Hz at 48 ks/sec)
Square wave Frequency	
sample rate < 35 ks/sec	1/10 sample rate
35 ks/sec to 42 ks/sec	1/12 sample rate
42 ks/sec to 46 ks/sec	1/14 sample rate (3150 Hz at 44.1 ks/sec)
≥ 46 ks/sec	1/16 sample rate (3000 Hz at 48 ks/sec)
Amplitude Ratio	4:1 (squarewave:sinewave)
Residual Distortion	≤0.00001% [-140 dB]
Frequencies available	$f_s \div 4096$ to $f_s \div 6$, in even integer divisors
Even Harmonic Content	≤0.00001% [-140 dB]

Noise

Types	Pink, White, Burst, USASI

Special Signals

Monotonicity	Low level staircase waveform for D/A linearity testing
J-Test	Produces a maximum amount of data-induced jitter on low-bandwidth transmission links
Polarity	Two sinewaves phased for reinforcement with normal polarity
Walking Ones	A single binary one value "walked" from LSB to MSB
Walking Zeros	A single binary zero value "walked" from LSB to MSB
Constant Value	(Digital DC)
Resolution	32 bit when using triangular dither

Maximum Length Sequence Signals

Pseudo random noise signal for speaker testing with MLS analyzer (Page 14)

Signals	Four pink sequences, four white sequences
Frequency Range	DC to 50% of sample rate
Repetition Rate	32767 samples

Multitone Signals

Stored waveform consisting of multiple sine waves, each at independent frequency, amplitude, and phase

Number of Tones	1 to 128 typical, 4095 maximum
Frequency Range	DC to $f_s \div 2$
Frequency Resolution	Sample Rate ÷ 2^{13} (typically 5.86 Hz at 48 ks/sec)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

Arbitrary Waveforms

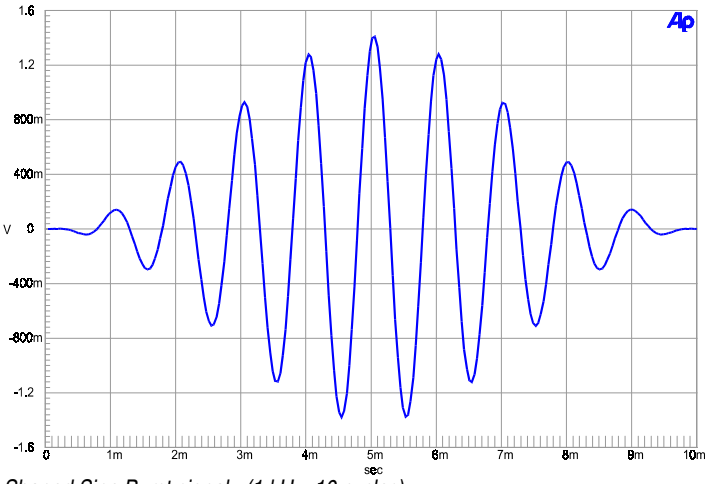
Length	256-8192 points per channel, user specified waveform. Utility is provided to prepare a time record file from user specified frequency, amplitude, and phase data.

Dither (all waveforms)

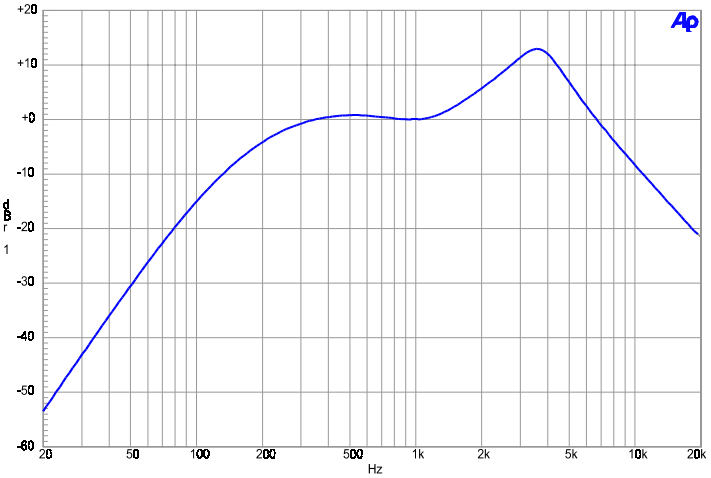
Probability Distribution	Triangular or rectangular; true random; independent for each channel
Spectral Distribution	Flat (white) or Shaped (+6 dB/oct)
Amplitude	8-24 bit or off

Pre-Emphasis Filters (all waveforms)

Filter Shape	50/15 µs or J17
Response Accuracy	±0.02 dB 10 Hz to 45% sample rate
Residual Distortion	≤0.00003% [-130 dB]



Shaped Sine Burst signal. (1 kHz, 10 cycles)



Digital Analyzer F-weighting curve

AES/EBU INTERFACE GENERATION

Interface Signal

Amplitude Range	(Fixed RISE/FALL time)
Balanced (XLR)	0 – 10.16 Vpp, ±(10% + 80 mV) into 110 Ω in 40 mV steps
Unbalanced (BNC)	0 to 2.54 Vpp, ±(8% + 20 mV) into 75 Ω in 10 mV steps
Optical (Toslink®)	0 to 256% of nominal intensity in 1% steps
Channel Status Bits	Full implementation, English language decoded, Pro or consumer or hex formats; independent in each channel
User Bits	set to 0
Validity Flag	selectable, set or cleared

AES/EBU Impairments

Variable rise/fall time	16 ns to 400 ns, ±20%
Induced Jitter	Selectable sinewave, squarewave lowpass noise, or wideband noise
Jitter Freq Range	10 Hz – 99.864 kHz
Jitter Freq Accuracy	±0.0002% [±2 PPM]
Jitter Amplitude	0 – 1.27 UI (pk), ±(10% + 0.01 UI) in 0.005 UI steps 1.3 – 12.7 UI, ±(10%) in 0.05 UI steps *18*
Jitter Flatness (500 Hz ref.)	±1 dB, 50 Hz to 20 kHz
Residual Jitter, peak calibrated	(total generator/analyzer)
Average response	≤0.0175 UI (120 Hz – 100 kHz BW), ≤0.0035 UI (1.2 kHz – 100 kHz BW)
Peak response:	≤0.045 UI (120 Hz – 100 kHz BW), ≤0.015 UI (1.2 kHz – 100 kHz BW)
Spurious Jitter Products	
Jitter & Ref Delay Off	≤0.001 UI
Jitter On	≤-30 dB below jitter signal
Normal Mode Noise	
Balanced	0 – 2.55 Vpp, ±(10% + 100 mV), in 10 mV steps
Unbalanced	0 – 635 mVpp, ±(10% + 25 mV), in 2.5 mV steps
Common Mode Freq	20 Hz to 40 kHz in octave steps
Common Mode Ampl	0 – 20.48 Vpp, ±(10% + 200 mV), in 80 mV steps
Cable Simulation	Multi-pole fit to AES 3-1992 filter to simulate the response degradation of a typical long cable
Offset from reference	-64 to +63.5 UI

Note 18 *Combinations of jitter amplitude and frequency may not result in greater than 50% reduction in transmitted bit width.*

REFERENCE INPUT CHARACTERISTICS

A rear panel reference input is provided to synchronize the internal sample clock generator to an external signal. The internal sample rate is not dependent upon the rate or characteristics of the external reference. Reference input jitter below 5 Hz will pass to the output; jitter above 5 Hz is attenuated 6 dB/octave.

Input Formats	AES/EBU (per AES 3-1992), NTSC/PAL/SECAM video, or squarewave
Input Sample Rates/ Frequency Range	28.8 kHz – 52.8 kHz AES/EBU, 8.0 kHz – 10.0 MHz squarewave
Sample Rate Resolution	
8 kHz – 65 kHz	1/128 Hz [0.0078125 Hz]
65 kHz – 256 kHz	1/32 Hz [0.03125 Hz]
256 kHz – 1 MHz	1/8 Hz [0.125 Hz]
1 MHz – 4 MHz	1/2 Hz [0.5 Hz]
4 MHz – 10 MHz	2 Hz
Minimum Input Amplitude	200 mVpp
Input Impedance	
AES/EBU (XLR)	Nominally 110 Ω or >5 kΩ
Video (BNC)	Nominally 75 Ω or >5 kΩ
Square wave (BNC)	Nominally 75 Ω or >5 kΩ
Lock Range	±0.0015% [±15 PPM]
Input Delay from Reference Display	Measures delay from 0 to 127.9 UI in seconds, ±60 ns
Reference Rate Display	Measures approximate reference input rate

REFERENCE OUTPUT CHARACTERISTICS

A rear panel reference output is provided to drive devices under test that require their own reference input. The reference output signal is not jittered.

Output Format	AES/EBU (per AES 11-1994)
Output Sample Rates	28.8 kHz – 52.8 kHz AES/EBU; locked to front panel output
Status Bits	Format "Professional" Sample Rate indicates closest rate Type "Grade 2 reference" Origin "SYS2" Reliability flags implemented CRCC implemented Time of Day not implemented Sample Count not implemented
Output Delay from Reference Output	-64/+63.5 UI, ±(5% + 0.5 UI), in 0.5 UI steps
Residual jitter	≤0.005 UI pk (120Hz – 100 kHz)

DIGITAL ANALYZER

Available in the SYS-2300 and SYS-2322 configurations only.

DIGITAL INPUT CHARACTERISTICS

Input Formats	AES/EBU (per AES 3-1992) SPDIF-EIAJ Optical (Toslink®) General purpose serial General purpose parallel Serial interface to chip level via optional SIA-2322 accessory
Sample Rates	28.8 kHz-52.8 kHz AES/EBU, 8 kHz to 52.8 kHz parallel, general purpose serial, SIA-2322; independent from sample rate
Word Width	8 to 24 bits
Input impedance	
AES/EBU	110 Ω or ≥ 2.5 kΩ
SPDIF-EIAJ	75 Ω or ≥ 3 kΩ

EMBEDDED AUDIO MEASUREMENTS

Wideband Level/Amplitude *("ANALYZER.AZ2")*

Range	0 dBFS to -140 dBFS
Frequency Range	5 Hz – 22.0 kHz at 48 ks/sec
Accuracy	±0.01 dB, ≥-90 dBFS
Flatness	±0.01 dB, 15 Hz – 22 kHz, with <10 Hz high-pass filter selection
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth

	400 Hz, 10-pole elliptical *when not using notch filter or bandpass mode* (response is -120 dB for ≤220 Hz, ±0.1 dB for ≥400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see graph on page 12)*
Residual Noise	-140 dBFS unweighted -142 dBFS A-weighted -134 dBFS CCIR RMS -127 dBFS CCIR QPk -139 dBFS 20 kHz LP -140 dBFS 15 kHz LP -138 dBFS "F" weighting

Narrow Band Amplitude *("ANALYZER.AZ2")*

Frequency Range	0.02% to 40% of sample rate (10 Hz – 19.2 kHz at 48.0 ks/sec)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see graph page 15)*
Residual Distortion	≤-150 dBFS

THD+N Measurements *("ANALYZER.AZ2")*

Fundamental Range	0.02% to 45% of sample rate (10 Hz – 22.0 kHz at 48.0 ks/sec)
Residual THD+N	≤-130 dBFS *(see graph on page 15)*
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth
Low pass Filters	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass *both: 0.1 dBpp ripple, ≥110 dB stopband attenuation*
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see graph on page 12)*
Residual Noise	Same as Wideband Level/Amplitude

Frequency Measurements *("ANALYZER.AZ2")*

Range	5 Hz to 47% of sample rate (5 Hz – 21.0 kHz at 44.1 ks/sec) (5 Hz – 23.0 kHz at 48.0 ks/sec)
Accuracy	±0.01% of reading or 0.0001% of sample rate, whichever is greater
Resolution	0.003% of reading or 0.0001% of sample rate, whichever is greater

FFT Analyzer *("FFT.AZ2")*

Acquisition Length	256 – 16384 samples in binary steps; or 24,576 samples
Transform Length	256 – 16384 samples in binary steps
Processing	48 bit
Windows *(see graph on page 15)*	Blackman-Harris (4 term with -92 dB sidelobe) Hann Flat-top (±0.02 dB) Equi-ripple (-145 dB sidelobes) None None, sync to sine
Amplitude Accuracy	±0.02 dB, 20 Hz to 20 kHz, using Flat-top window
Averaging	1 – 4096 in binary steps, averaging algorithm is power based or synchronous
Distortion	≤-140 dB
Waveform Display Modes	Normal, interpolate, peak, max
Frequency Display Modes	Peak pick, individual bin
Sync to Sine Window	
Frequency Range	7th bin to 45% of sample rate (21.6 kHz at 48 ks/sec)
Amplitude Accuracy	±0.025 dB

Multitone Analyzer *("FASTTEST.AZ2")*

Acquisition Length	512 – 16384 samples in binary steps
Transform Length	512 – 16384 samples in binary steps
Processing	24 bit
Measurements	Level vs frequency, Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve
Frequency Resolution	1.95 Hz with 32.0 ks/sec 2.69 Hz with 44.1 ks/sec 2.93 Hz with 48.0 ks/sec
Frequency Error Correction Range	±3%
Distortion	≤-115 dB

Maximum Length Sequence Analyzer *("MLS.AZ2")*

Quasi-anechoic acoustic tester

Signals	Four pink sequences, four white sequences
Frequency Range	22 Hz to 20 kHz
Frequency Resolution (Max)	2.93 Hz at 48.0 ks/sec
Acquisition Length	32767 samples
FFT Length	16384
Energy Time Windows	half Hann Hann <240 Hz > 8 kHz <120 Hz > 16 kHz
Time Windows (percent of data record to transition from 0 to full amplitude)	<5% <10% <20% <30%

DIGITAL INTERFACE MEASUREMENTS

AES/EBU Impairments, real time displays

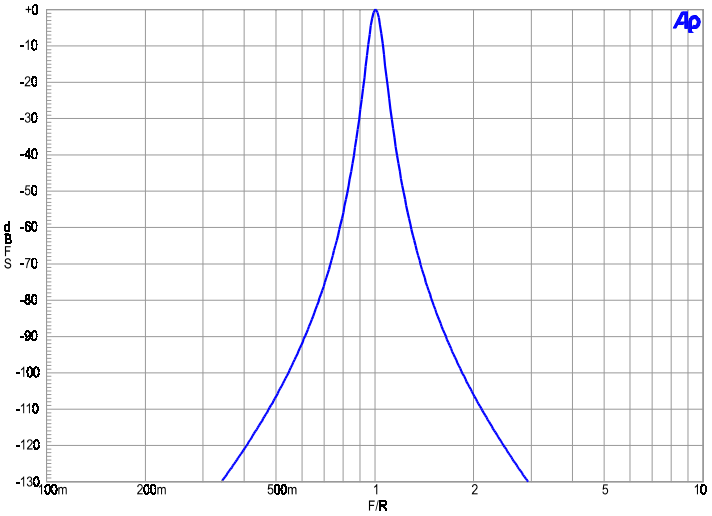
Input Sample Rate	±0.0003% [±3 PPM] internal ref, ±0.0001% [±1 PPM] external ref
Output to Input Delay	Measures status propagation from the AES/EBU output to the input. Range is 0 – 192 samples (frames), resolution ±60 ns.
AES/EBU Input Voltage	
Balanced	100 mV to 10.16 Vpp, ±(5% + 50 mV)
Unbalanced	25 mV to 2.54 Vpp, ±(5% + 12 mV)
Jitter Amplitude (500 Hz)	(peak sinewave calibrated)
Average Mode	0 – 5 UI, ±(10% + 0.015 UI)
Peak Mode	0 – 3 UI, ±(10% + 0.040 UI)
Jitter Flatness	±1.0 dB, 100 Hz – 80 kHz (50 Hz – 100 kHz BW selection, average detection, 48 kHz sample rate)

Residual Jitter, peak calibrated (analyzer only)	
Average response	≤0.015 UI (120 Hz – 100 kHz BW), ≤0.003 UI (1.2 kHz – 100 kHz BW)
Peak response	≤0.04 UI (120 Hz – 100 kHz BW), ≤0.009 UI (1.2 kHz – 100 kHz BW)
Spurious Jitter Products	≤0.002 UI (>1.2 kHz) or <-40 dB below jitter signal
Common Mode Amplitude	0-20.48 Vpp, ±(10% + 300 mV), 315 Hz – 1 MHz, peak reading
Cable Equalization	Per AES 3-1992
Channel Status Bits	Full implementation, English language decoded (Professional or Consumer) or hex formats, independent in each channel
User Bits	Not displayed
Validity Flag	Displayed for each channel
Parity	Displayed for total signal (both channels combined)
Signal Confidence	Displayed for total signal (both channels combined)
Receiver Lock	Displayed for total signal (both channels combined)
Coding Error	Displayed for total signal (both channels combined)

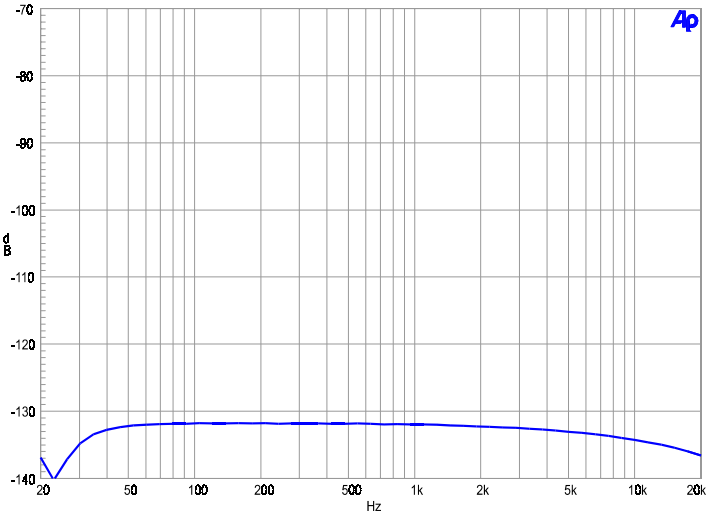
AES/EBU Interface Analyzer *("INTERVU.AZ2")*

INTERVU operates in conjunction with an autoranged 8-bit A/D converter clocked at 67.108864 MHz, providing interface signal measurements with >20 MHz bandwidth. INTERVU can display the interface signal in time or frequency domain, as an *eye* pattern, or probability graphs of amplitude or pulse width. INTERVU also can demodulate the jitter signal and display it in time or frequency domain or as a probability graph. The jitter signal or the data on the interface may be reproduced through the monitor loudspeaker.

AES/EBU Input Voltage	
Balanced	0 – 20.48 Vpp, ±(10% + 50 mV)
Unbalanced	0 – 4.096 Vpp, ±(8% + 12 mV)
Jitter Amplitude	0 – 5 UI (pk), ±(5% + 0.03 UI)
Residual Jitter	≤0.01 UI (250 Hz – 1 MHz BW)
Spurious Jitter Products	≤0.001 UI, or ≤-60 dB below jitter signal
Common Mode Amplitude	0 – 20.48 Vpp, ±(30% + 50 mV), 20 kHz – 1 MHz
Jitter Probability Display	256 bins, autoranging
Input Probability Display	256 bins, autoranging
Bit Width Probability Display	8192 bins
Risetime	≤20 ns
Acquisition time/memory	3.9ms / 256k



Digital Domain Band Pass filter response.



Typical Digital Domain system residual THD+N

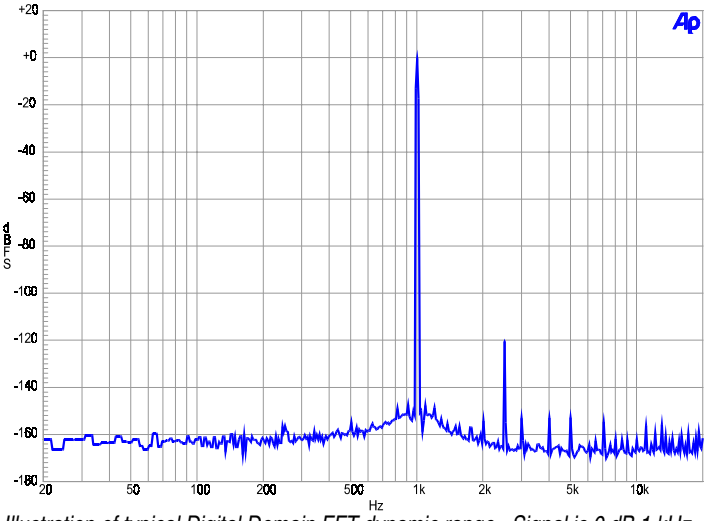
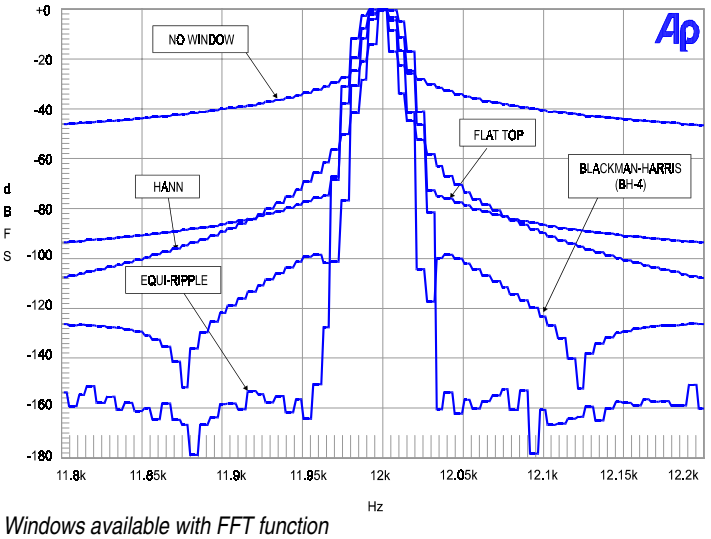


Illustration of typical Digital Domain FFT dynamic range. Signal is 0 dB 1 kHz with a secondary signal at –120 dB and 2.5 kHz. Harmonics of 1 kHz signal are visible at about –150 dB, consistent with 24-bit audio.



Windows available with FFT function

AUXILIARY SIGNALS

Generator Signal Monitors (all units except SYS-2300)

Channel A	Buffered version of the channel A analog generator signal. Amplitude is typically 2.8 Vpp.
Channel B	Buffered version of the channel B analog generator signal. Amplitude is typically 2.8 Vpp.

Generator Auxiliary Signals *(all units except SYS-2300)*

Sync Output	LSTTL compatible signal that is intended to be used as a trigger for stable oscilloscope displays.
Trig/Gate Input	LSTTL compatible input, functional with option "BUR" only.

Analyzer Signal Monitors (all units except SYS-2300)

Channel A	Buffered version of the channel A analog input signal. Amplitude is typically 0 – 3.6 Vpp.
Channel B	Buffered version of the channel B analog input signal. Amplitude is typically 0 – 3.6 Vpp.
Reading	Buffered version of the analog analyzer output signal after all filtering and gain stages. Amplitude is typically 0 – 3.6 Vpp.

Digital Signal Monitors (SYS-2222 & SYS-2322 only)

Via stereo 16-bit D/A converters. Function monitored depends upon analyzer program loaded; for example, noise and distortion products after notch filter are monitored with "ANALYZER.AZ2" in its THD+N function.

Channel 1	Buffered version of the digital channel 1 signal.
Channel 2	Buffered version of the digital channel 2 signal.

Digital Interface Monitors *(SYS-2322 & SYS-2300 only)*

Transmit Frame Sync	Squarewave at the programmed internal sample rate
Receive Frame Sync	Squarewave at the rate of the received AES/EBU signal
Master Clock Out	Squarewave at 256 x the programmed internal sample rate. Selectable between jittered and unjittered signals.

Miscellaneous Digital I/O (SYS-2322 & SYS-2300 only)

Auxiliary Input	LSTTL compatible trigger input for dsp program data acquisition
Auxiliary Output	HCMOS signal, function under dsp program control
Trigger Output	HCMOS signal, pulse coincident with period of generated signal waveform

AUDIO MONITOR

All System Two configurations contain an internal loudspeaker and headphone jack for listening to the generator, analyzer, or digital signal monitor points described at left, including noise and distortion following analog or digital notch filters or the AES/EBU jitter signal. Use of the audio monitor does not preclude the use of any measurements.

Power Output	Typically 1 Watt

GENERAL / ENVIRONMENTAL

Power Requirements	100/120/230/240 Vac (-10%/+6%), 50 – 60 Hz, 240 VA max
Temperature Range	
Operating	5°C to +40°C
Storage	-40°C to +75°C
Humidity	90% RH to at least +40°C (non-condensing)
EMC[19]	Complies with 89/336/EEC, CISPR 22 (class B), and FCC 15 subpart J (class B)
Dimensions	16.5 x 6.0 x 13.6 inches [41.9 x 15.2 x 34.5 cm]
Weight	Approximately 34 lbs [15.9 kg]
Safety	Complies with 73/23/EEC, 93/68/EEC, EN61010, and IEC 1010 (including Amendments 1 and 2)

Note 19 *The SYS-2300 and SYS-2322 configurations require high quality shielded cables when using any of the digital audio I/O ports. All XLR cables must be constructed with conductive shells that are connected to both pin 1 and the cable shield through the shortest distance possible.*

Specifications subject to change without notice.
S2S-0124-17-T-0999-1C