APWIN INSTALLATION & GETTING STARTED FOR SYSTEM TWO

Audio precision®

System Two Description, Installation, and APWIN Software Guide

Rev 2 for APWIN Version 2.0
Aug 1999
Audio Precision PN 8211.0099

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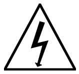

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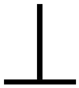

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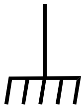

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Disclaimer

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1. Introduction

1.1 Scope of This Manual

This guide serves several purposes:

- It will help you install the hardware and software for APWIN, Audio Precision's user interface and software package for System Two .
- It describes several basic hardware considerations for installing the components, such as power line voltage settings, fuse information, APIB Interface Cable connections, and jumper and DIP switch settings.
- It contains full specifications for the System Two, including its options and ancillary components (switchers, etc).
- It contains some fundamental APWIN assistance, such as starting, setting user preferences, APWIN help files, compatibility issues, and troubleshooting.

Although intended specifically for APWIN Version 2.0, many parts of this guide are applicable to earlier versions. Notice, however, that beginning with APWIN Version 1.5, operation is no longer supported on operating systems prior to Windows 95 or Windows NT 4.0.

Section 1.2 gives a list of other System Two documents and a brief description of the contents of each.

1.2 Related Documentation

- **APWIN System Two User's Manual**– contains a comprehensive description of the full capabilities of APWIN.
- **APWIN Simplified**– designed to lead you through your first operating session with APWIN and System Two.
- **APWIN Basic User's Guide and Language Reference**– Provides a comprehensive introduction to APWIN Basic, and includes detailed descriptions and syntax for generic commands common to all platforms.
- **APWIN Basic Extensions Reference for System Two**– detailed descriptions and syntax for commands specific to System

Two . Includes a list of all APWIN system panels, an alphabetical listing of all APBASIC extensions, and technical reference information for the command extensions.

- **Audio Measurement Handbook** – intended as a practical, hands-on assistance for workers in all phases of the audio field. Describes general measurement techniques and includes a glossary of specific audio terminology and test definitions.
- **Application Notes and TECHNOTES**– See the APWIN CD-ROM for Adobe Acrobat copies of several useful technical documents.

1.3 Overview

1.3.1 General System

System Two is an audio test set with broad, high-performance capabilities for analog, digital, and mixed-signal devices. System Two includes both signal generation and analysis capability for audio stimulus-response testing. Virtually all common and many specialized tests are performed on analog domain and digital domain signals and on the digital interface signal (pulse train) itself. Control of the System Two is via software running on a Windows-based personal computer

The versatility of the System Two can be extended through major options and accessories. The SWR-2122-series of Audio Switchers are available in input, output, and insertion (patch point) versions. The DCX-127 adds dc measurement and digital generation capabilities. The SIA-2322 Serial Interface Adapter converts the System Two's parallel input and outputs to a wide variety of serial digital interface formats. These accessories are described in greater detail in the following subsections.

The System Two and its accessories are controlled by APWIN, Audio Precision's user interface and software package, which must be installed in the user's personal computer (the computer is not included).

Specifications for the System Two and its accessories are found in Section 2.

1.3.2 System Two

System Two audio test equipment provides stimulus and measurement capability. System Two extends the System Two family of product configurations, as listed below. Note that this guide applies only to System Two , running under APWIN version 2.0. For earlier System Two products or for earlier versions of APWIN, refer to *System Two Description, Installation, and APWIN Guide*, Audio Precision PN 8211.0026.

- The 2222-Series is based on the advanced platform. It provides analog stimulus and measurement capability, using analog circuits for signal generation, filtering, and measurement. It also has a dual-channel DSP analyzer and dual-channel DAC signal source. Its enhanced capability includes digital signal generation, high-resolution spectrum analysis via FFT, waveform capture and display, and fast multitone testing.
- The 2322-Series is the Dual Domain product in the System Two platform. It includes the capabilities of the 2222 series plus digital audio inputs and outputs in AES/EBU, SPDIF/EIAJ, optical, parallel, general-purpose serial formats and complete serial interface analysis per AES3. Thus, it provides stimulus and measurement in any combination of digital and analog domains.
- The 2300-Series has the same digital capabilities of 2322 series above, but no analog capabilities.

All models feature sample rates up to 48 kHz. The models described above have a suffix “A” or “G.” The “A” denotes the instrument is APIB-controlled with APWIN software; the “G” denotes the instrument is GPIB (IEEE-488)-controlled. This guide covers the APIB interface with APWIN control; other manuals cover GPIB installation and control.

System Two Cascade is normally supplied with an ISA-bus interface card for installation in the user’s PC. Alternatively, a type II PCMCIA interface card is available for use in a notebook computer (order PCM-WIN-SUB2).

This version of APWIN requires one of these cards, and will not function with earlier System One PCI-1, PCI-2, or PCI-3 interface cards or PCM-DOS PCMCIA interface cards. Also, APWIN Version 2.0 runs under Windows 95 and higher, and is not compatible with Windows 3.11.

These analog options may be installed in your System Two:

- S2-IMD Adds the IMD (InterModulation Distortion) generator and IMD analyzer.
- S2-W&F Adds the wow and flutter analyzer.
- S2-BUR Adds the tone burst, square wave, and noise generator.
- S2-EURZ Changes the generator output selections to 40/200/600 ohms, prevalent in Europe.

Additionally, your System Two may include up to seven of these optional hardware filters, or may include custom filters:

•	FIL-AWT	A-weighting filter
•	FIL-CWT	C-weighting filter
•	FIL-CCR	CCR 468-3 weighting filter
•	FIL-CIT	CCITT P.53 weighting filter
•	FIL-CMS	C-message weighting filter
•	FIL-D50F	50 μs de-emphasis filter + 19.0 kHz notch filter
•	FIL-D75	Precision 75 μs de-emphasis filter
•	FIL-D75B	75 μs de-emphasis + 15.734 kHz notch filter
•	FIL-D75F	75 μs de-emphasis + 19.0 kHz notch filter
•	FBR-15625	15.625 kHz band reject (notch) filter
•	FBR-15734	15.734 kHz band reject (notch) filter
•	FBR-19000	19 kHz band reject (notch) filter
•	FIL-RCR	200 Hz – 15 kHz bandpass with 19 kHz notch filter
•	FLP-xxx	Fixed low pass (precision band limiting filter; frequency specified as 10 kHz, 15 kHz, 19 kHz, 20 kHz, or 22 kHz. Sharp roll-off > 50 dB at $2f_0$
•	FBP-xxxxx	Fixed 1/3-octave bandpass filter; frequency specified from 100 Hz to 25000 Hz
•	FIL-USR	User-buildable filter circuit board and instructions
•	FLP-A20k	20 kHz “brick wall” filter
•	FIL2-EXT	External filter kit for System Two

A rear-panel configuration label on the System Two identifies the model number, the options and filters installed, and the warranty expiration date (domestic) or date of manufacture (export).

1.3.3 Switchers

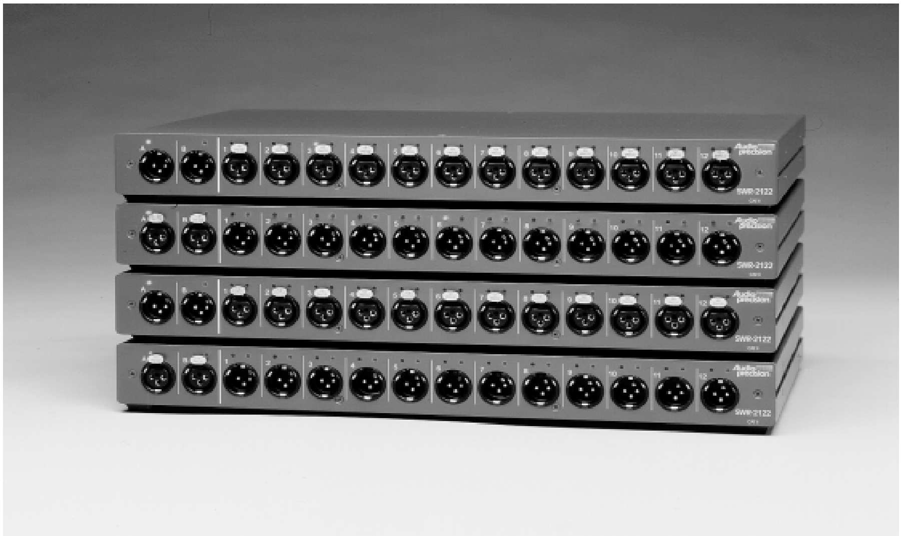

Figure 1-1. SWR-2122 Switchers

The four versions of switchers are described below. Each features 12 x 2 architecture with provisions for cascading up to 16 units, allowing up to 192 channels to be accessed. Switching is computer-controlled via the same APIB as the System Two. See Section 3.6 for further information.

- SWR-2122M Output Switcher. Routes either of the two generator output channels (A & B) to any of 12 channels. Uses male XLR connectors for balanced signals. Complement mode allows all but one channel to be driven while measuring the undriven channel for worst-case crosstalk on multichannel devices.
- SWR-2122F Input Switcher. Routes either of the two analyzer input channels (A & B) from any of 12 channels. Uses female XLR connectors for balanced signals.
- SWR-2122U Unbalanced Switcher. Can be used as either an input or output switcher. Uses floating BNC connectors for unbalanced signals to prevent ground loops.
- SWR-2122P Patch-Point Switcher. 12-point configuration allows a signal path to be interrupted and a test generator inserted while a measuring analyzer can access the output of a previous device. Path continuity is maintained in the default (non-

accessed) mode. Each of the 12 insertion points has a 5-pin XLR connector to allow balanced interface to the previous and next device.

1.3.4 DCX-127 Multi-Function Module

Figure 1-2. DCX-127 Multi-Function Module

The DCX-127 Multi-Function Module contains an autoranging 4-1/2 digit dc voltmeter-ohmmeter, two 20-bit programmable dc voltage sources, 21 bits of digital I/O, and three 8-bit programmable auxiliary output ports for device control or status indicators. Typical applications include A/D and D/A converter testing, VCA gain control linearity, VCA distortion, amplifier dc offset and power supply checks, power amplifier load switching control, loudspeaker voice coil resistance measurements, temperature measurements, and test fixture control.

The meter features 200 mV – 500 V and 200 Ω – 2 MΩ ranges, fully floating and guarded for accurate measurements in the presence of large common mode voltages. Resistance measurements can be made using either 4-wire or 2-wire techniques. Readings can be offset and scaled by the software.

The two independently programmable dc sources have a ±10.5 V bipolar range with 20 µV resolution and monotonicity to 40 µV (19 bits). The software can sweep either dc source.

The DCX-127 also contains a simplified 8-bit program control interface that can be defined to execute any pre-defined keystroke sequence. This can be used to run different software procedures based upon switch closures.

1.3.5 SIA-2322 Serial Interface Adapter

Figure 1-3. SIA-2322 Serial Interface Adapter

The SIA-2322 Serial Interface Adapter provides a means of interfacing the System Two system to a variety of data acquisition, reconstruction, and communication hardware that utilize a serial bus for data exchange. This greatly increases the system's flexibility in interfacing to serial systems for a wide range of tests and measurements.

The SIA-2322 consists of a parallel-to-serial transmitter and an independent serial-to-parallel receiver. A flexible design allows the SIA to address many serial interface requirements.

2. System Two Specifications

2.1 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].

2.1.1 Analog Signal Generator

2.1.1.1 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

[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.*

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]

2.1.2 Intermodulation Distortion Related Signals

with option "IMD"

2.1.2.1 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

2.1.2.2 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%)

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.

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.

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

5 Measured with System Two analyzer (system specification).

2.1.2.3 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 Unbalanced	 30 µVpp to 75.4 Vpp 30 µVpp to 37.7 Vpp
Amplitude Accuracy	±2.0% [±0.17 dB]
Residual IMD[5]	≤0.0020% [-94 dB]

2.1.3 Special Purpose Signals

with option "BUR"

2.1.3.1 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

2.1.3.2 Square Wave

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

2.1.3.3 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 ms (synchronized to the analyzer 4/s reading rate)
Amplitude Range[4] Balanced Unbalanced	(Approximate calibration only) 30 µVpp to 37.7 Vpp 30 µVpp to 18.8 Vpp

2.2 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.

2.2.1.1 D/A Converter

Resolution	18-bit dual channel delta-sigma
Data Rate	28.8 k samples/s to 52.8 k samples/s, 48.0 k samples/s 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 k samples/s sample rate. Typically -100 dB THD+N at 48 k samples/s sample rate, 20 kHz bandwidth; D/A distortion products typically ≤-106 dB

2.2.1.2 Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

Frequency Range	10 Hz to 20 kHz
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Phase accuracy	±1 deg., 10 Hz – 5 kHz; ± 3 deg., 5 kHz – 20 kHz
Phase range	-360 to +359.9 deg.
Amplitude Range Balanced Unbalanced	 <10 µV to 26.66 Vrms [+30.7 dBu] <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 18 kHz-20 kHz	 ±0.03 dB +0.03 / -0.15 dB

2.2.1.3 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	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Amplitude Range Balanced Unbalanced	 <10 µV to 26.66 Vrms [+30.7 dBu] <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 18 kHz-20 kHz	 ±0.03 dB +0.03/-0.15 dB

2.2.1.4 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	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Amplitude Range Balanced Unbalanced	 <10 µV to 26.66 Vrms [+30.7 dBu] <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 18 kHz-20 kHz	 ±0.03 dB +0.03/-0.15 dB

2.2.1.5 Shaped Sine Burst

Sine burst with raised cosine envelope (see graph in Section 2.6)

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 k samples/s)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Interval	2 – 65536 cycles
Burst On	1 to number of Interval cycles minus 1
Flatness (1 kHz ref) 10 Hz-18 kHz 18 kHz-20 kHz	 ±0.03 dB +0.03/-0.15 dB

2.2.1.6 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 k samples/s)

2.2.1.7 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.

2.2.1.8 Maximum Length Sequence Signals

Pseudo-random noise signal for speaker testing with MLS analyzer (Section 2.8)

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

2.2.1.9 Polarity Signal

Asymmetric waveform to facilitate polarity identification

Frequency Range	20 Hz to 23.5% of sample rate (11.28 kHz at 48 k samples/s)

2.2.2 "IMD" Related Signals

Digitally generated

2.2.2.1 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[6]	
Balanced	30 µVpp to 75.4 Vpp
Unbalanced	30 µVpp to 37.7 Vpp
Amplitude Accuracy	± 3% [± 0.26 dB]
Residual IMD[7]	≤ 0.0050% [-86 dB], 60 Hz + 7 kHz or 250 Hz + 8 kHz (measured using analog analyzer)

2.2.2.2 CCIF and DFD Test Signals

Difference Frequency	80 Hz to 2 kHz, continuously settable
Center Frequency	3 kHz-22 kHz, continuously settable
Amplitude Range[6]	
Balanced	30 µVpp to 75.4 Vpp
Unbalanced	30 µVpp to 37.7 Vpp
Amplitude Accuracy	± 3% [± 0.26 dB]
Residual IMD[7]	≤ 0.0010% [- 100 dB], 14 kHz + 15 kHz (measured using analog analyzer)

2.2.3 Output Characteristics

Source Configuration	Selectable balanced, unbalanced, or CMTST (common mode test)
Source Impedances	
Balanced or CMTST	40 Ω (±1 Ω), 150 Ω (±1 Ω)[8], or 600 Ω (±3 Ω)
Unbalanced	20 Ω (±1 Ω) or 600 Ω (±3 Ω)
Max Floating Voltage	42 V pk
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)

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

7 *Measured with System Two analyzer (system specification).*

8 *200Ω with option "EURZ"*

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

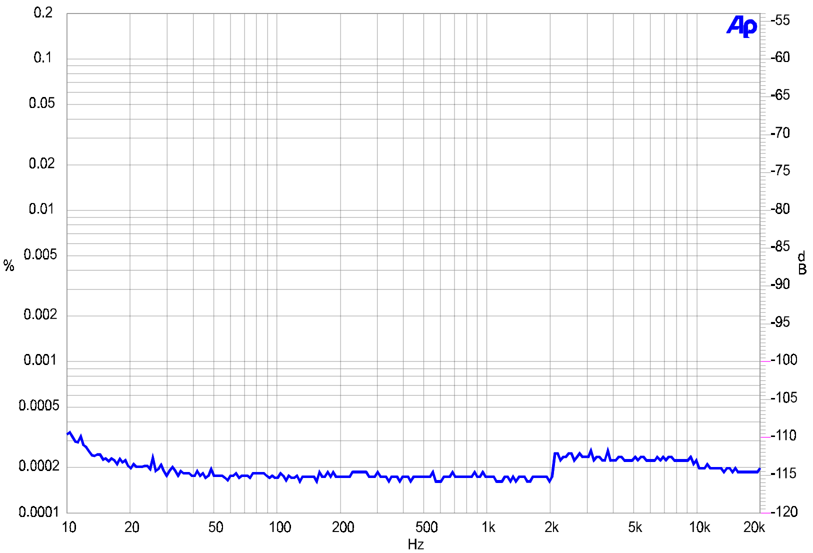

Figure 2-1. Typical total system THD+N versus frequency using analog sinewave at 2 Vrms

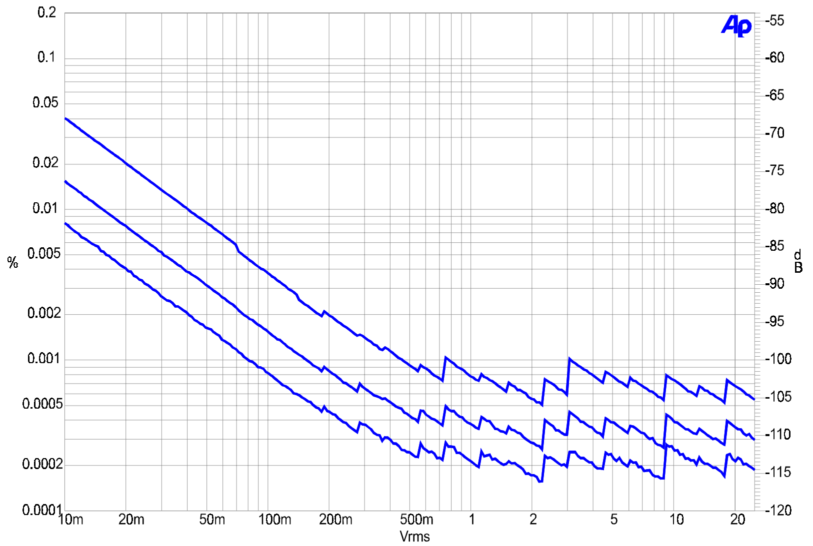

Figure 2-2. Typical THD+N versus Amplitude at 1 kHz for three different analog analyzer measurement bandwidths. Lower curve is with 22 kHz bandwidth limiting. Middle curve is with 80 kHz. Upper curve is with 500 kHz.

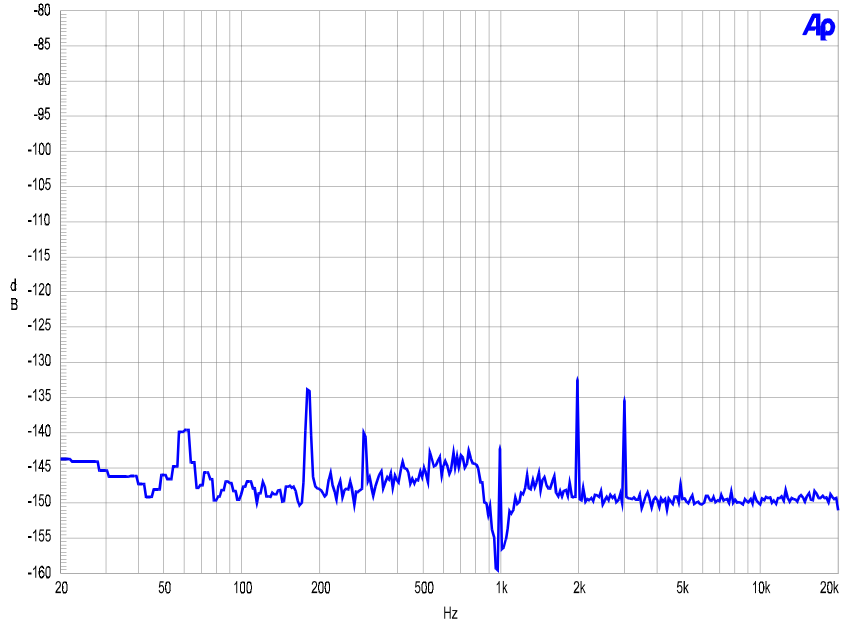

Figure 2-3. Typical analog generator residual THD+N spectrum at 1 kHz, 2 Vrms (16384 point FFT of notch filter output, Fs = 48 kHz, 16 averages)

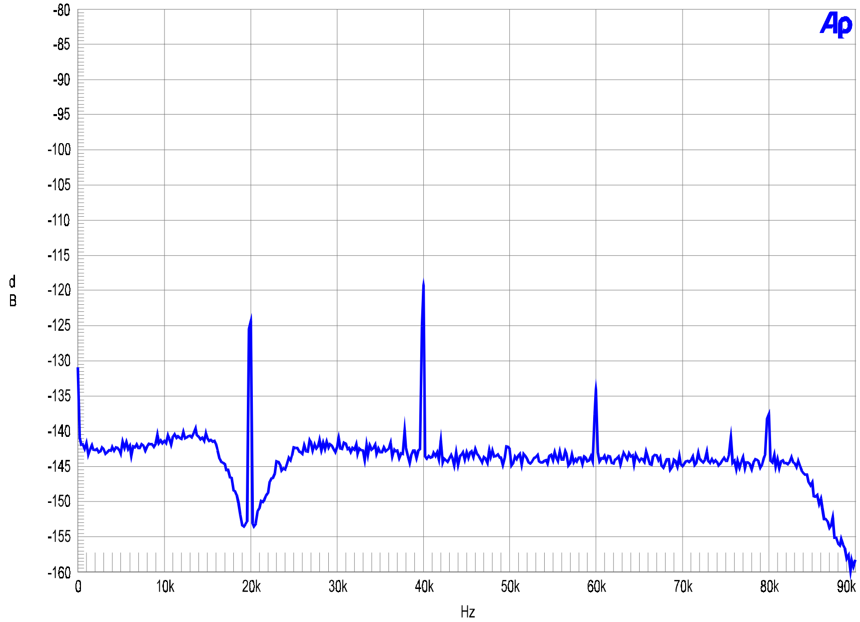

Figure 2-4. Typical analog generator residual THD+N spectrum at 20 kHz, 2 Vrms (16384 point FFT of notch filter output, Fs = 192 kHz, 16 averages)

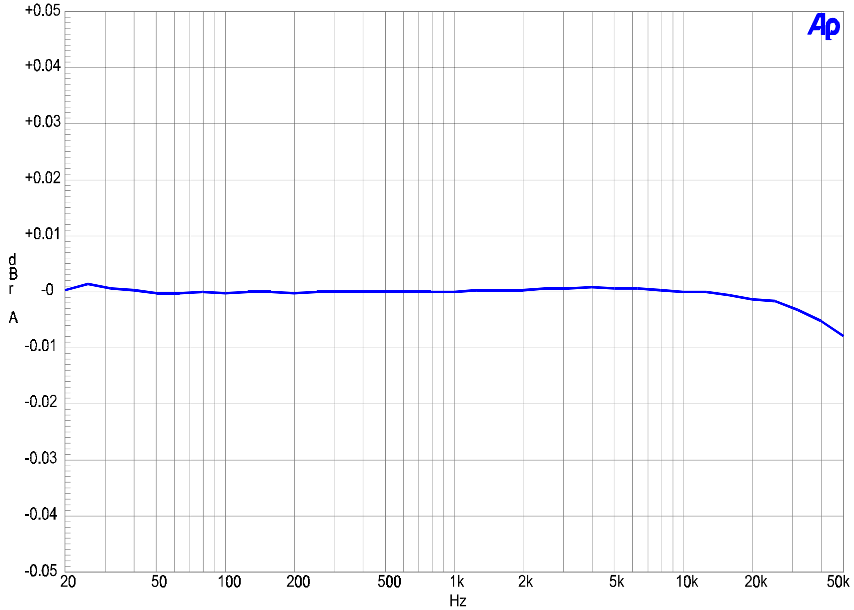

Figure 2-5. Typical analog System flatness at 2 V rms signal level

2.3 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.

2.3.1 Analog Input Characteristics

Input Ranges	40 mV to 160 V in 6.02 dB steps
Maximum Rated Input	230 Vpk, 160 V rms (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[9]	
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

2.3.1.1 Level Meter Related

(both channels)

Measurement Range	5 mV-160 V for specified accuracy and flatness, usable to <100 µV
Resolution (full scale)[10]	
4/s	1/40,000 [0.00022 dB]
8/s	1/40,000 [0.00022 dB]
16/s	1/20,000 [0.00043 dB]
32/s	1/10,000 [0.00087 dB]
64/s	1/5,000 [0.0017 dB]
128/s	1/2,500 [0.0035 dB]
Accuracy (1 kHz)	±0.5% [±0.05 dB]
Flatness (1 kHz ref)[11]	
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)

2.3.1.2 Frequency Meter Relatec *(both channels)*

Measurement Range	10 Hz-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

9 Not valid below 50 Hz with ac coupling.

10 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/s reading rate). Numerical displays using a dB unit are rounded to the nearest 0.001 dB.

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

2.3.1.3 Phase Measurement Related

Measurement Ranges	±180, -90/+270, or 0/+360 deg
Accuracy[12]	
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

2.3.2 Wideband Amplitude/Noise Function

Measurement Range	<1 µV – 160 V rms
Accuracy (1 kHz)	±1.0% [±0.09 dB]
Flatness (1 kHz ref)[13]	
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 Section 2.4)
Detection	RMS (τ = 25 ms or 50 ms), 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]

2.3.2.1 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	

12 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.

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

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]

2.3.2.2 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

2.3.2.3 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 HF -3 dB	 <10, 22, 100, or 400 Hz 22k, 30k, 80k, or >500 kHz; option filters are also functional
Residual THD+N[14] 20 Hz-20 kHz 10 Hz-100 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] ≤(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

2.3.2.4 Crosstalk Function

Frequency Range	10 Hz to 200 kHz
Accuracy[15]	±0.4 dB, 20 Hz-120 kHz
Residual Crosstalk[15] 10 Hz-20 kHz 20 kHz-100 kHz	 ≤-140 dB or 1 μV ≤-126 dB or 2.5 μV

2.3.3 IMD Measurements

with option "IMD"

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14 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.

15 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.

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.

2.3.3.1 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[16]	≤0.0015%, 60 + 7 kHz or 250 + 8 kHz

2.3.3.2 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	2^{nd} order difference frequency product relative to the amplitude of either test tone
DFD function	u_2 (2^{nd} order difference frequency product) per IEC 268-3 (1986)
Measurement Range	0 – 20%
Accuracy	±0.5 dB
Residual IMD	CCIF ≤0.0004%, 14 kHz + 15 kHz [-108 dB], DFD ≤ 0.0002%, 14 kHz + 15 kHz [-114 dB]

2.3.3.3 DIM (TIM) IMD Function

Test Signal Compatibility	2.96-3.15 kHz squarewave mixed with 14 – 15 kHz sine probe tone
IMD Measured[17]	u_4 and u_5 per IEC 268-3 (1986)
Measurement Range	0-20%
Accuracy	±0.7 dB
Residual IMD[16]	≤0.0020%

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

17 *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.*

2.3.4 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[18]	200 Hz-5 kHz
Wideband[18]	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

2.4 Option Filters

Up to seven 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.

18 *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.*

2.4.1.1 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

2.4.1.2 Precision De-emphasis Family

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

2.4.1.3 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	
FLP-40K	f_c = 40.0 kHz, quasi-elliptic

2.4.1.4 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

2.4.1.5 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%, (per AES-17)

2.4.1.6 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

2.4.1.7 Receiver Testing

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

2.4.1.8 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 in Figure 2-6.

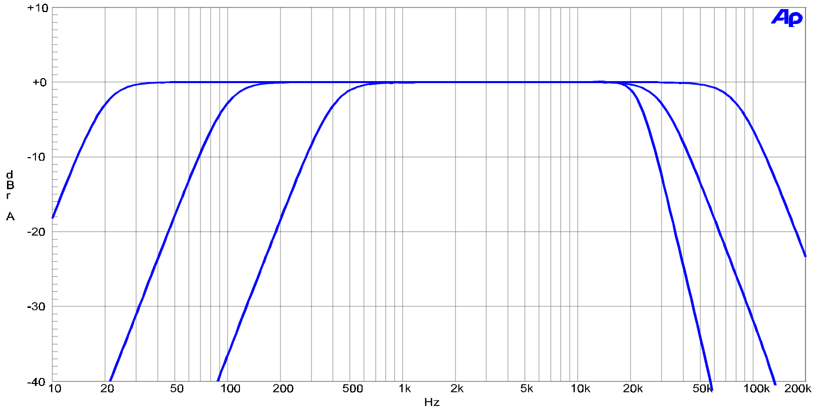


Figure 2-6. Standard Band-limiting filters included with every System Two. High pass selectable 22Hz, 100 Hz, 400 Hz; Low pass selectable 22 kHz, 30 kHz, 80 kHz.

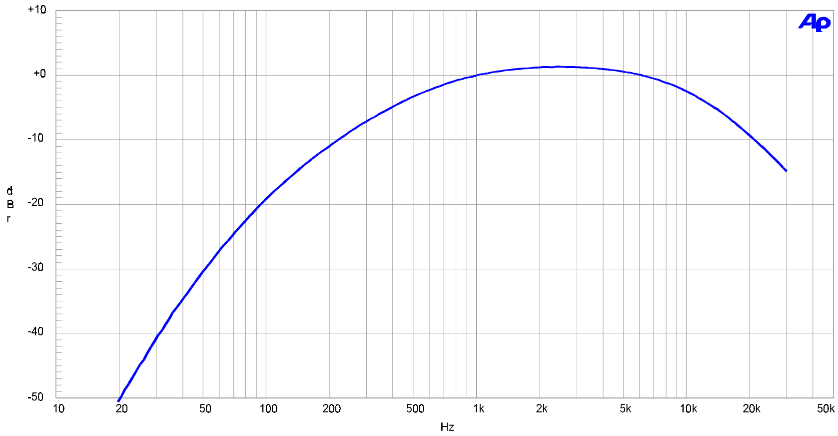


Figure 2-7. FIL-AWT ANSI-IEC "A" Weighting Filter

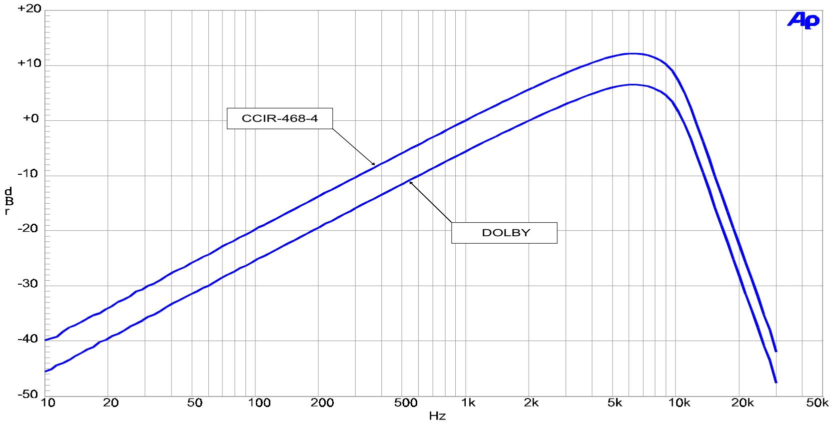


Figure 2-8. FIL-CCR CCIR-468 / DIN 45404 Noise Weighting Filter

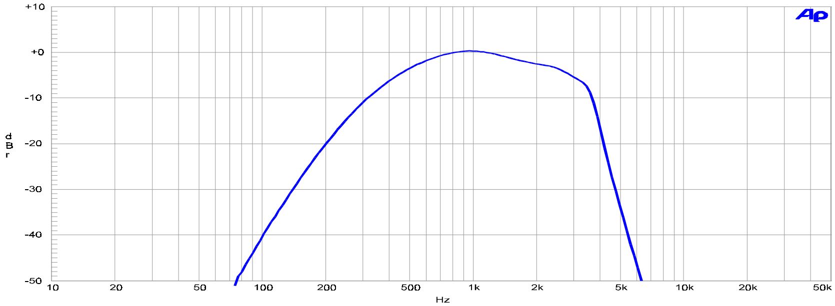


Figure 2-9. FIL-CIT CCITT P53 Noise Weighting Filter

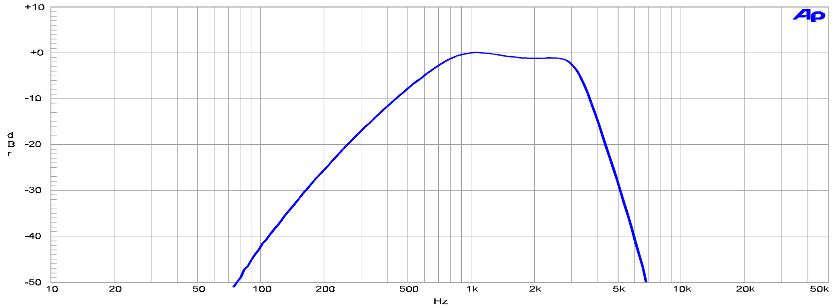


Figure 2-10. FIL-CMS C-Message Weighting Filter (ANSI/IEEE 743-1984)

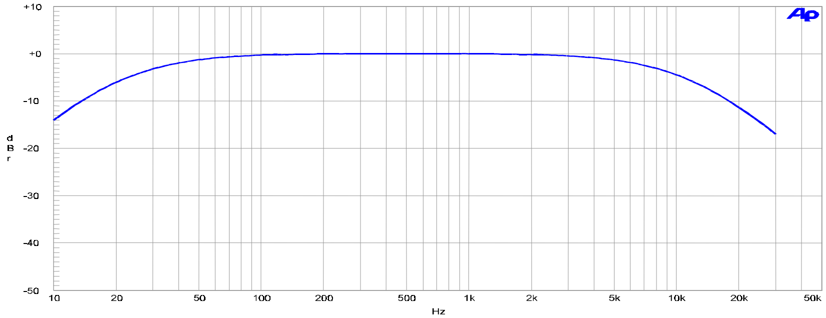


Figure 2-11. FIL-CWT “C” Weighting (IEC-179)

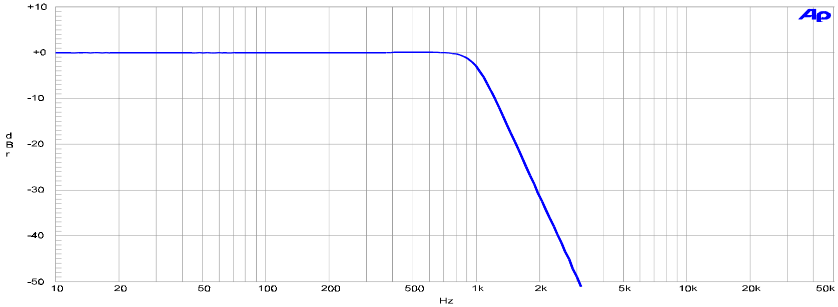


Figure 2-12. FLP-1K 1 kHz Low Pass 5-pole Butterworth Filter

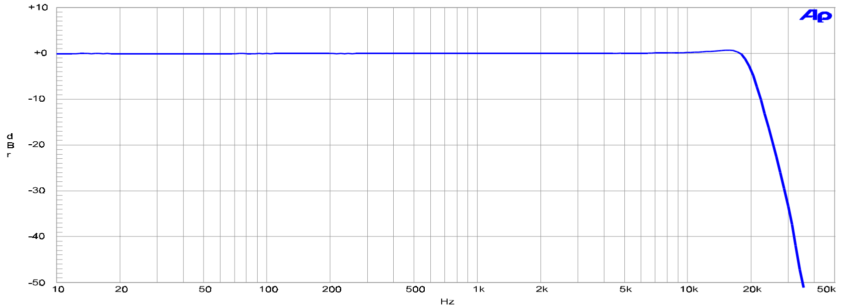


Figure 2-13. FLP-20K 20.0 kHz Quasi-elliptic sharp cutoff Low Pass Filter

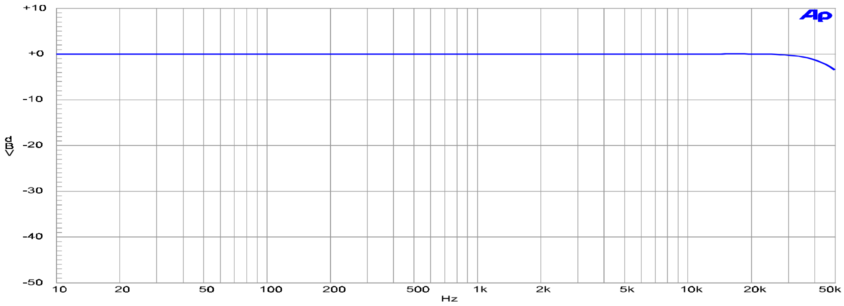


Figure 2-14. FLP-50K 50 kHz 3-pole Butterworth Low Pass Filter

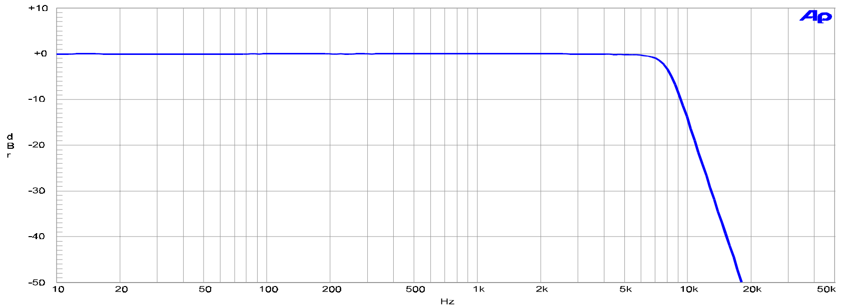


Figure 2-15. FLP-8K 8 kHz 7-pole Butterworth Low Pass Filter

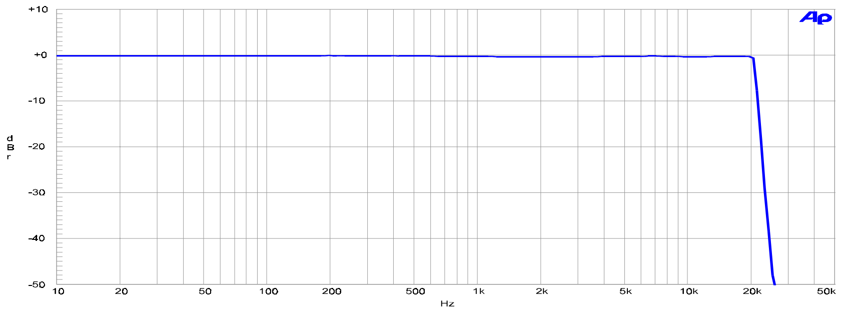


Figure 2-16. FLP-A20K Apogee “Brick-Wall” 20 kHz Low Pass Filter

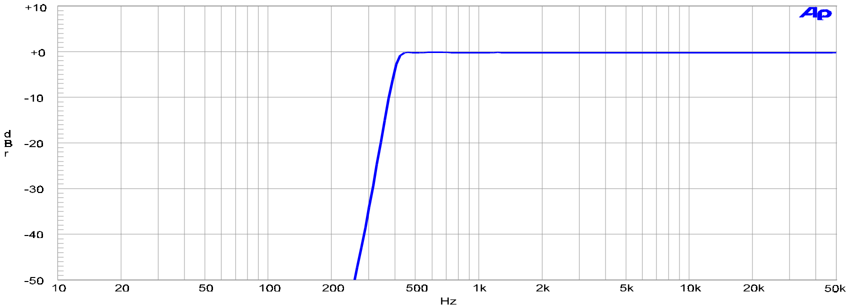


Figure 2-17. FHP-400 400 Hz 9-pole High Pass Filter

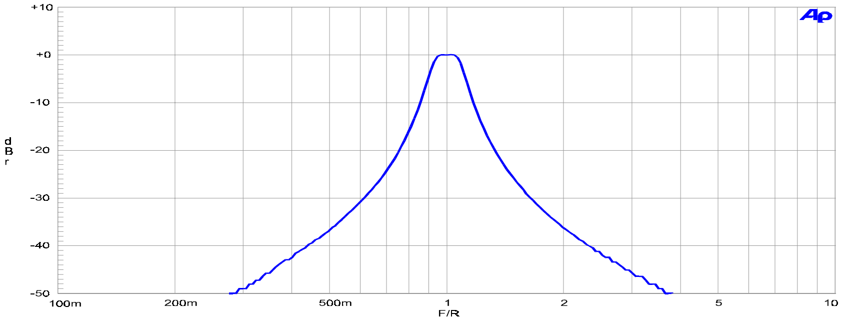


Figure 2-18. FBP-XXXX Fixed 1/3 Octave Band Pass Filter

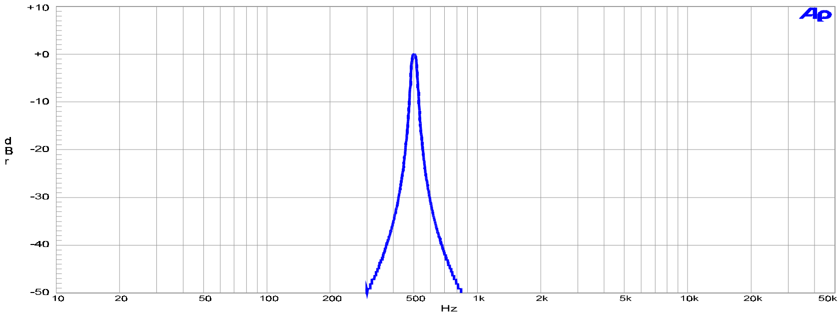


Figure 2-19. FBP-500X High-Q 500 Hz Band Pass Filter (for CD linearity testing)

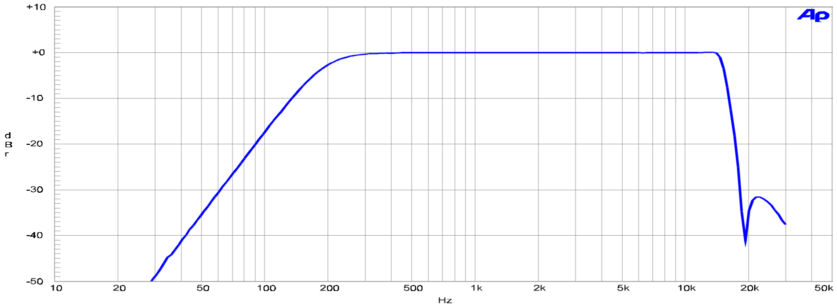


Figure 2-20. FIL-RCR 200 Hz to 15 kHz with 19 kHz (FM) notch Receiver Testing Filter

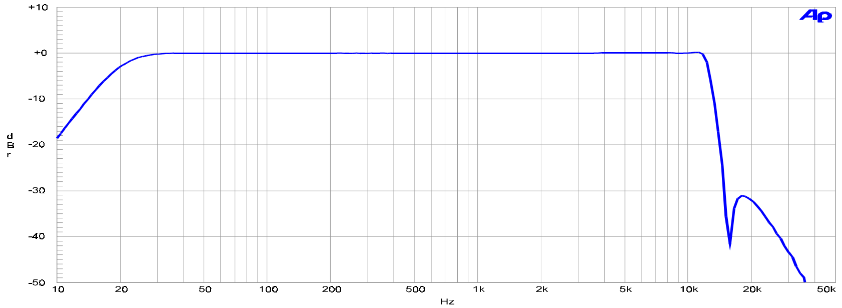


Figure 2-21. FIL-IECR 20 Hz to 15 kHz with 15.625 kHz (PAL) notch Receiver Testing Filter

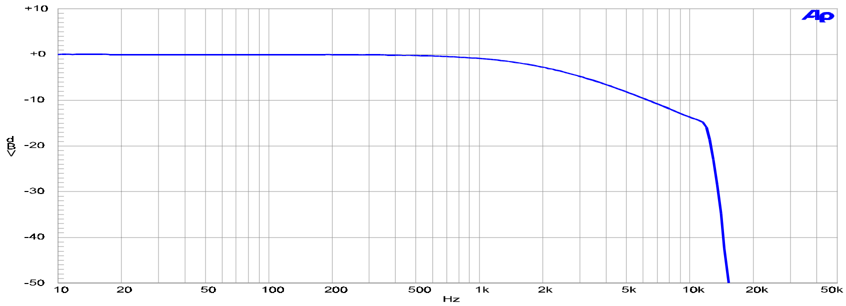


Figure 2-22. FIL-D75B 75 µs with 15.734 kHz (NTSC) notch De-emphasis Filter

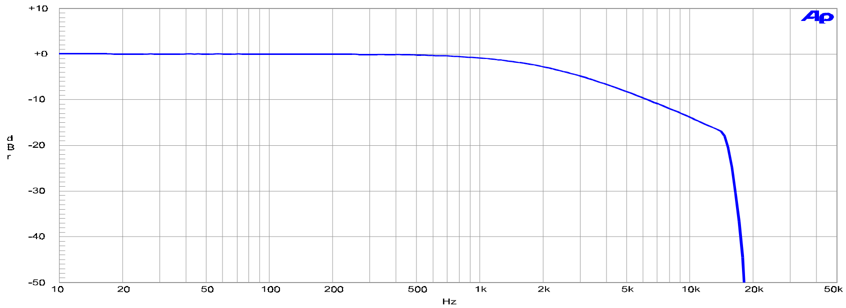


Figure 2-23. FIL-D75F 75 µs with 19 kHz (FM) notch De-emphasis Filter

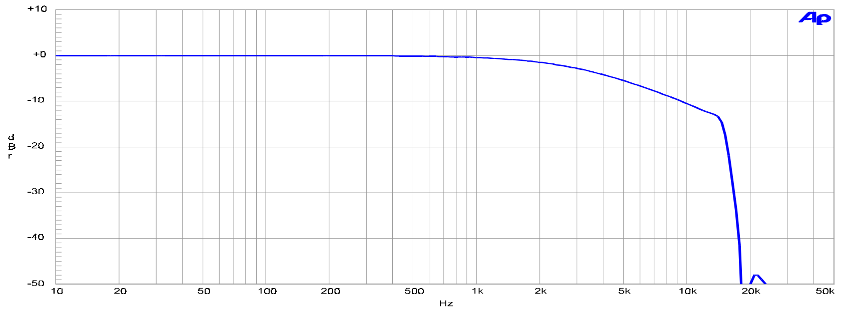


Figure 2-24. FIL-D50F 50 µs with 19 kHz (FM) notch De-emphasis Filter

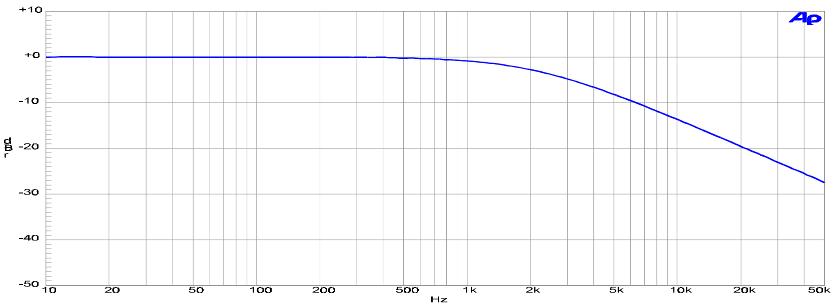


Figure 2-25. FIL-D75 75 µs De-emphasis Filter

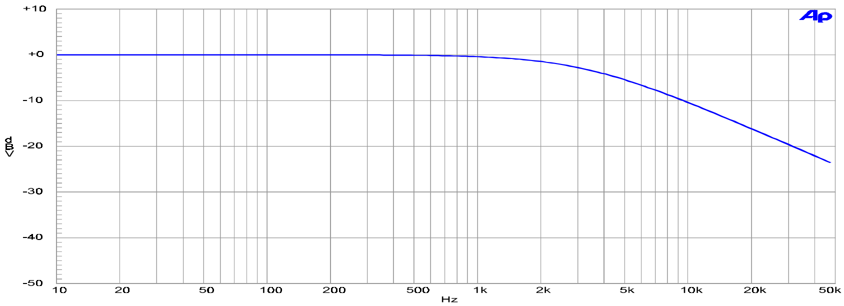


Figure 2-26. FIL-D50 50 µs De-emphasis Filter

2.5 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 Footnote 19)*. 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.

2.5.1.1 Low Bandwidth (x1 or ÷4) Converter

Available for FFT and DSP Audio Analyzers

A/D Resolution	20 bits
Sample Rates	x1 mode: 28.8 k samples/s to 52.8 k samples/s ÷ 4 mode: 7.2 k samples/s to 13.2 k samples/s
Flatness (1 kHz ref)	±0.01 dB to 0.45 ∗ sample rate
Alias Rejection[19]	Typically >100 dB for out of band signals above 0.605 ∗ sample rate
Distortion	-100 dB (relative to full scale of analyzer range)

[19] 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.

2.5.1.2 High Bandwidth (x4) Converter

Input Converter available for FFT Analyzer

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

2.5.2 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 Figure 2-27)*	Blackman-Harris (4 term with –92 dB sidelobe) Hann Flat-top (±0.02 dB) Equi-ripple (-145 dB sidelobes) None None, sync to sine

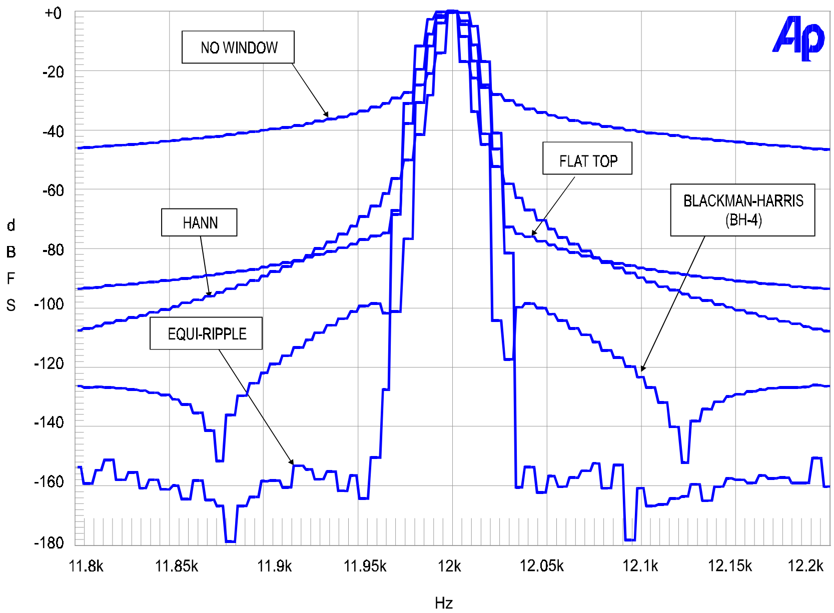


Figure 2-27. Windows available with FFT function

20 *Usable at lower sample rates with degraded alias rejection.*

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 Amplitude Accuracy	 7th bin to 45% of sample rate (21.6 kHz at 48 k samples/s) ±0.025 dB

2.5.3 DSP Audio Analyzer

("ANALYZER.AZ2")

2.5.3.1 Wideband Level/Amplitude

Frequency Range	5 Hz-22.0 kHz at 48 k samples/s
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 Figure 2-28)*

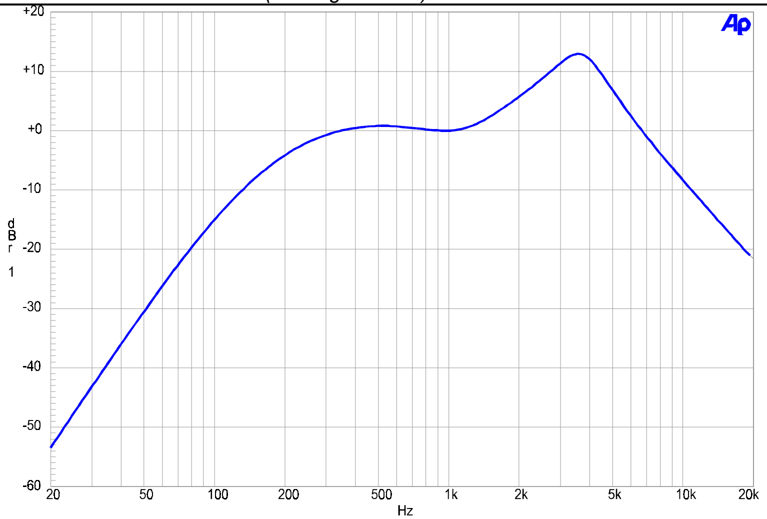


Figure 2-28. Digital Analyzer F-weighting curve

2.5.3.2 Narrow Band Amplitude

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see Figure 2-29)*

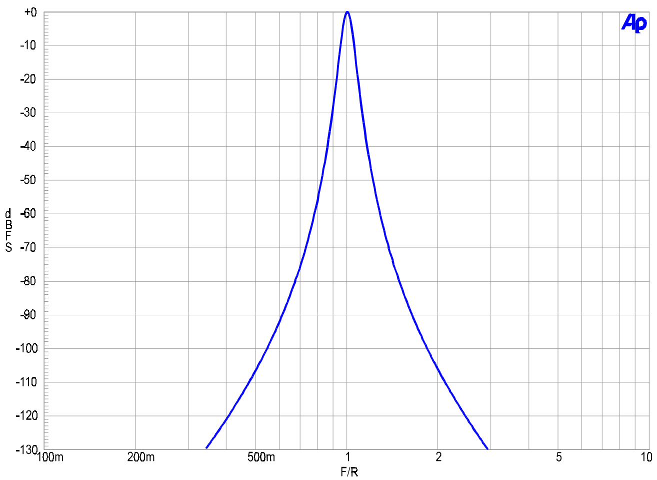


Figure 2-29. Digital Domain Band Pass filter response.

2.5.3.3 THD+N Measurements

Fundamental Range	0.02% to 45% of sample rate (10 Hz-22.0 kHz at 48.0 k samples/s
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 Figure 2-28 on page 2-24)*

2.5.3.4 Frequency Measurements

Range	5 Hz to 47% of sample rate (5 Hz-21.0 kHz at 44.1 k samples/s) (5 Hz-23.0 kHz at 48.0 k samples/s)
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

2.5.4 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 k samples/s
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%

2.5.5 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 k samples/s 2.69 Hz with 44.1 k samples/s 2.93 Hz with 48.0 k samples/s
Frequency Error Correction Range	±3%
Distortion	≤-115 dB

2.6 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.

2.6.1 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) Unbalanced (BNC)	 110 Ω 75 Ω approx.

2.6.2 Digital Signal Generation

2.6.2.1 Sine Wave

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

2.6.2.2 Sine Burst

Sine burst with rectangular envelope

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

2.6.2.3 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 k samples/s)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Phase Range	±180 deg.
Phase Resolution	0.01 deg.
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

2.6.2.4 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 k samples/s) Stereo frequencies may be set independently for each channel
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

2.6.2.5 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 k samples/s)
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]
Amplitude ratio	0 dB to -120 dB

2.6.2.6 Sine + Offset

Sine wave plus a constant value

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

2.6.2.7 Shaped Sine Burst

Sine burst with raised cosine envelope (see Figure 2-30)

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

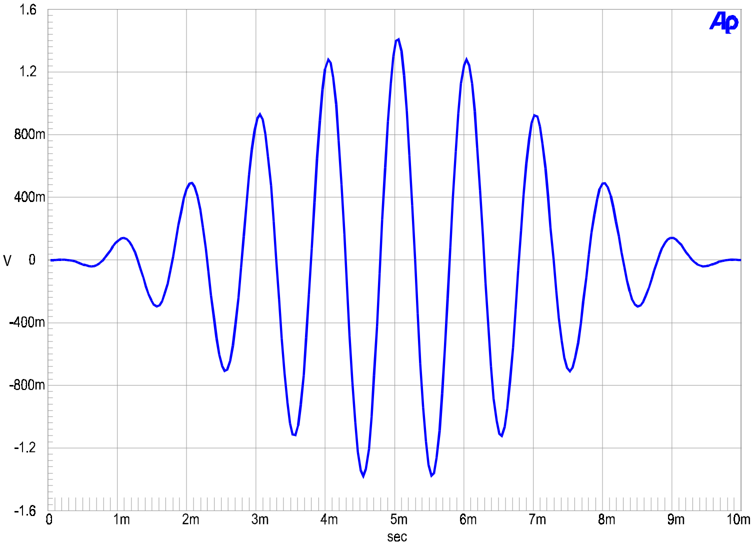


Figure 2-30. Shaped Sine Burst signal (1 kHz, 10 cycles)

2.6.2.8 Square Wave

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

2.6.2.9 SMPTE/DIN Waveform

Upper Tone Frequency Range	2 kHz to 47% of sample rate (22.56 kHz at 48 k samples/s)
Lower Tone Frequency Range	40 Hz – 500 Hz
Frequency Resolution	Sample Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)
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

2.6.2.10 CCIF and DFD IMD Waveforms

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

2.6.2.11 DIM IMD Waveform

Sine wave Frequency	100/21 ∗ squarewave frequency (15 kHz at 44.1 k samples/s; 14285.7 Hz at 48 k samples/s)
Sine wave Frequency Resolution	Data Rate ÷ 2^{23} (typically 0.006 Hz at 48 k samples/s)

Square wave Frequency sample rate	
<35 k samples/s	1/10 sample rate
35 k samples/s to 42 k samples/s	1/12 sample rate
42 k samples/s to 46 k samples/s	1/14 sample rate (3150 Hz at 44.1 k samples/s)
≥46 k samples/s	1/16 sample rate (3000 Hz at 48 k samples/s)
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]

2.6.2.12 Noise

Types	Pink, White, Burst, USASI

2.6.2.13 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

2.6.2.14 Maximum Length Sequence Signals

Pseudo random noise signal for speaker testing with MLS analyzer (Page 2-26)

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

2.6.2.15 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 k samples/s)
Flatness	±0.001 dB
Residual Distortion	≤0.00001% [-140 dB]

2.6.2.16 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.

2.6.2.17 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

2.6.2.18 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]

2.7 AES/EBU Interface Generation

2.7.1.1 Interface Signal

Amplitude Range Balanced (XLR) Unbalanced (BNC) Optical (Toslink®)	(Fixed RISE/FALL time) 0-10.24 Vpp, ±(10% + 80 mV) into 110 Ω in 40 mV steps 0 to 2.048 Vpp, ±(8% + 16 mV) into 75 Ω in 8 mV steps 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

2.7.1.2 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	0-2.55 UI (pp), ±(10% + 0.02 UI) in 0.01 UI steps 2.6-25.5 UI, ±(10%) in 0.1 UI steps[21]
Jitter Flatness (500 Hz ref.)	 ±1 dB, 50 Hz to 99 kHz
Residual Jitter, peak to peak calibrated Average response Peak response:	(total generator/analyzer) ≤0.035 UI (120 Hz-100 kHz BW), ≤0.007 UI (1.2 kHz-100 kHz BW) ≤0.09 UI (120 Hz-100 kHz BW), ≤0.03 UI (1.2 kHz-100 kHz BW)
Spurious Jitter Products Jitter & Ref Delay Off Jitter On	 ≤0.001 UI ≤-30 dB below jitter signal
Normal Mode Noise Balanced Unbalanced	 0-2.55 Vpp, ±(10% + 100 mV), in 10 mV steps 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

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

2.7.2 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 65 kHz – 256 kHz 256 kHz – 1 MHz 1 MHz – 4 MHz 4 MHz – 10 MHz	 1/128 Hz [0.0078125 Hz] 1/32 Hz [0.03125 Hz] 1/8 Hz [0.125 Hz] 1/2 Hz [0.5 Hz] 2 Hz
Minimum Input Amplitude	200 mVpp
Input Impedance AES/EBU (XLR) Video (BNC) Square wave (BNC)	 Nominally 110 Ω or >5 kΩ Nominally 75 Ω or >5 kΩ 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

2.7.3 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	≤0.01 UI p-p (120Hz-100 kHz)

2.8 Digital Analyzer

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

2.8.1 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 SPDIF-EIAJ	 110 Ω or ≥2.5 kΩ 75 Ω or ≥3 kΩ

2.8.2 Embedded Audio Measurements

2.8.2.1 Wideband Level/Amplitude

(“ANALYZER.AZ2”)

Range	0 dBFS to -140 dBFS
Frequency Range	5 Hz-22.0 kHz at 48 k samples/s
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 Figure 2-28 on page 2-24)*
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

2.8.2.2 Narrow Band Amplitude

(“ANALYZER.AZ2”)

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see Figure 2-29 on page 2-25)*
Residual Distortion	≤-150 dBFS

2.8.2.3 THD+N Measurements

("ANALYZER.AZ2")

Fundamental Range	0.02% to 45% of sample rate (10 Hz-22.0 kHz at 48.0 k samples/s
Residual THD+N	≤-130 dBFS *(see Figure 2-31 on page 2-37)*
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 Figure 2-28 on page 2-24)*
Residual Noise	Same as Wideband Level/Amplitude

2.8.2.4 Frequency Measurements

("ANALYZER.AZ2")

Range	5 Hz to 47% of sample rate (5 Hz-21.0 kHz at 44.1 k samples/s) (5 Hz-23.0 kHz at 48.0 k samples/s)
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

2.8.2.5 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 Figure 2-27on page 2-23)*	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	7^{th} bin to 45% of sample rate (21.6 kHz at 48 k samples/s)
Amplitude Accuracy	±0.025 dB

2.8.2.6 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 k samples/s 2.69 Hz with 44.1 k samples/s 2.93 Hz with 48.0 k samples/s
Frequency Error Correction Range	±3%
Distortion	≤-115 dB

2.8.2.7 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 k samples/s
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%

2.8.3 Digital Interface Measurements

2.8.3.1 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 10.24 Vpp, ±(5% + 50 mV)
Unbalanced	25 mV to 2.048 Vpp, ±(5% + 12 mV)
Jitter Amplitude (500 Hz)	(peak-peak sinewave calibrated)
Average Mode	0-10 UI, ±(10% + 0.03 UI)
Peak Mode	0-6 UI, ±(10% + 0.08 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 to peak calibrated (analyzer only)	
Average response	≤0.03 UI (120 Hz – 100 kHz BW), ≤0.006 UI (1.2 kHz – 100 kHz BW)
Peak response	≤0.08 UI (120 Hz – 100 kHz BW), ≤0.018 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)

2.8.4 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 – 10 UIpp, ±(5% + 0.03 UI)
Residual Jitter	≤0.02 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	3.9 ms / 256k

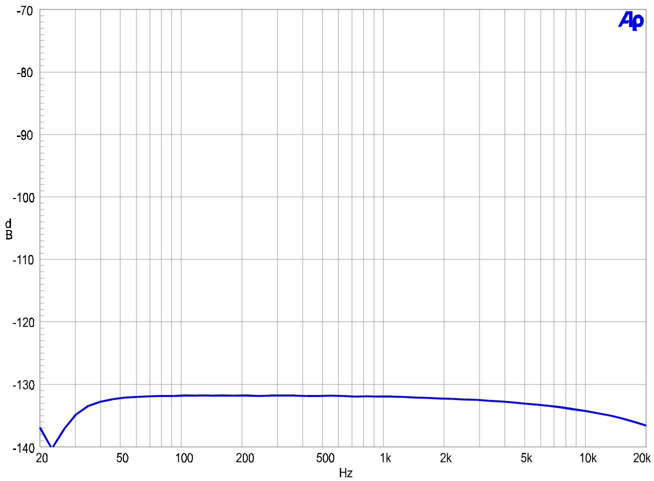


Figure 2-31. Typical Digital Domain system residual THD+N

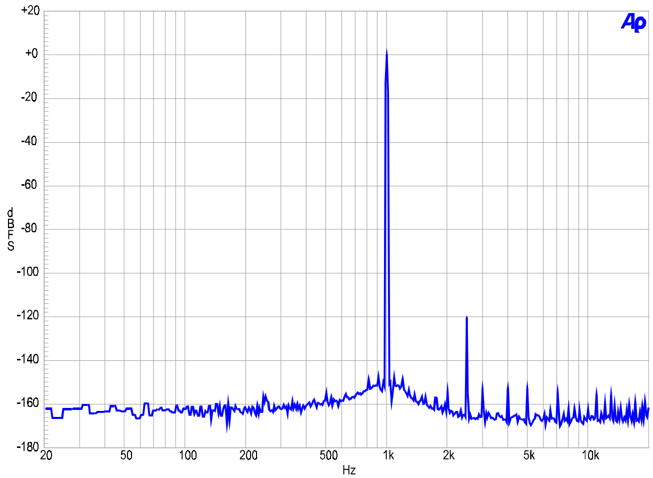


Figure 2-32. Illustration of typical Digital Domain FFT dynamic range. Signal is 0 dB 1 kHz with a secondary signal at –120 dB and 2.5 kHz. Harmonics of 1 kHz signal are visible at about –150 dB, consistent with 24-bit audio.

2.9 Auxiliary Signals

2.9.1 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.

2.9.2 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.

2.9.3 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.

2.9.4 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.

2.9.5 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.

2.9.6 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.

2.10 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 above, 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

END OF SYSTEM TWO SPECIFICATIONS

The remainder of the specifications in Section 2
are for optional system components.

2.11 Switchers Specifications

Max Voltage Rating	200 V pk, 160 V rms
Max Signal Power[22]	30 watts or 1 ampere, whichever is greater
Crosstalk[23]	
Balanced 600 Load	
20 kHz	-140 dB
100 kHz	-126 dB
Unbalanced 600 Load	
20 kHz	-120 dB
100 kHz	-106 dB
Series Resistance	Typically <0.3 ohms per side
Shunt Capacitance	Typically <90 pF, each side to ground

22 *Relay contact resistance degrades rapidly with increasing switched power. For maximum relay life (typically 20 x 106 operations) Audio Precision recommends limiting the maximum switched signal power to 5 Watts or 200 mA*

23 *Measured between any two selectable channels into the specified load impedance. SWR-2122P (patch point switcher) crosstalk from the interrupted input to output is typically 70 dB to 20 kHz.*

2.12 DCX-127 Multi-Function Module Specifications

2.12.1 DC Volts Measurements

Accuracy	**6 rdg/s**	**25 rdg/s**
200 mV range	0.05% + 0.03 mV	0.05% + 0.1 mV
2 V range	0.05% +0.1 mV	0.05% +1 mV
20 V range	0.05% +1 mV	0.05% +10 mV
200 V range	0.05% +10 mV	0.05% +100 mV
500 V range	0.05% +100 mV	0.05% +1 V
Resolution		
200 mV – 200 V ranges	0.005% of range	0.025% of range
500 V range	100 mV	500 mV
Input Resistance	10 MΩ ±1% (all ranges)	
Common Mode Rejection	>120 dB at dc and 50 Hz – 20 kHz	

2.12.2 Resistance Measurements

Accuracy	**6 rdg/s**	**25 rdg/s**
200 mV range	0.05% + 0.04 Ω	0.05% + 0.1 Ω
2 V range	0.05% +0.2 Ω	0.05% +1 Ω
20 V range	0.05% +1 Ω	0.05% +10 Ω
200 V range	0.05% +10 Ω	0.05% +100 Ω
500 V range	0.05% +100 Ω	0.05% +1 kΩ
Resolution	0.005% of range	0.025% of range
Open Circuit Voltage	< 6 V dc	

2.12.3 DC Outputs

Range	±10.5 V (bipolar output)
Resolution	20 µV (20 bits equivalent)
Accuracy	±(0.05% + 0.2 mV) absolute ±40 µV, relative to best fit line
Maximum Output Current	20 mV source; 10 mA sink
Output Floating Characteristics	Low(-) terminal can float up to 2 V pk

2.12.4 Digital Input/Output

Configuration	21 bits plus sign data valid and new data strobes, LSTTL-CMOS compatible
Maximum Data Rate	Approx 8 ms/transfer, limited by computer speed

2.12.5 Auxiliary Output Ports

Configuration	Three independent 8-bit parallel ports, LSTTL-CMOS compatible

2.13 SIA-2322 Serial Interface Adapter Specifications

Output logic rise and fall times:	≤6 ns, 3 ns typical
Maximum high frequency clock rate:	12 MHz
Maximum sample rate limited by DSP program in use:	192 kHz with FFTGEN, 48 kHz with GENANLR.

2.14 Primary Power and Fuse Information (all components)

Refer to Section 3.2 for instructions on selecting primary input voltage range, replacing fuses, and changing fuse types.

Primary Voltage Ranges, all components	100, 120, 230, or 240 V ac (-10%/+6%), 50 - 60 Hz
Power Ratings	
System Two	240 VA max
Switcher (each unit)	20 VA max
DCX	20 VA max
SIA-2322	none (powered from the System Two)

Fuse Requirements	100 or 120 V	230 or 240 V
System Two	2 A	1 A
Switchers	200 mA	100 mA
DCX	200 mA	100 mA

2.15 Environmental (all components)

Temperature Range	
Operating	+5°C to +40°C
Storage	-40°C to +75°C
Humidity	80% RH to at least +40°C (non-condensing)
Altitude	2000 m Maximum

2.16 Physical Dimensions and Weights

2.16.1 System Two

Dimensions	
Width	17.5 in. (44.4 cm), including handle and feet
Height	5.7 in. (14.5 cm), including feet
Depth	18 in. (45.7 cm), including connectors
Weight	Approximately 34 lbs [15.9 kg], depending upon options installed

2.16.2 Switchers, DCX-127, and SIA-2322

Dimensions	
Width	17.2 in. (43.7 cm)
Height	1.75 in. (4.4 cm)
Depth	10.625 in. (27 cm)

Weight	
Switchers	9.2 lbs (4.2 kg)
DC-127	9.5 lbs (4.3 kg)
SIA-2322	6.9 lbs (3.1 kg)

2.17 Regulatory Compliances (all components)

EMC[24]	Complies with FCC Part 15 Subpart J (class B), 89/336/EEC, 92/31/EEC, and 93/68/EEC, EN 50081-1 (1992) Emissions Class B, EN-50082-1 (1992) Immunity
Safety	Complies with 73/23/EEC, 93/68/EEC, EN6010-1 (1993) – IEC 1010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995) Installation category II – Pollution Degree 2

2.18 Software and Control

2.18.1 Computer Requirements

> ***Note:*** *Beginning with version 1.5, APWIN operates only under Windows 95, Windows 98, or Windows NT 4.0 (or later). APWIN operation under Windows 3.xx is no longer supported.*

The decision of what kind of computer to use to host APWIN is a complex one. Minimum performance requirements are dictated first by the operating system. APWIN is a Microsoft Windows-based program; as such, it requires that Windows 95, Windows 98, or Windows NT 4.0 (or later) be installed on the computer. Windows, in turn, has its own hardware and software requirements. Although there is a minimum configuration that will run Windows 95, practical considerations suggest a configuration exceeding this to achieve acceptable speed with most applications, including APWIN. The following table lists the minimum, recommended, and optimal requirements. These guidelines assume APWIN is the dominant application.

- *Minimum Requirement* is a list of main features to be used to qualify an existing machine as able to provide acceptable performance.
- *Recommended Configuration* defines a minimum set of cost-effective features to be specified when purchasing a new machine.

24 Emission and Immunity levels are influenced by the shielding performance of the connecting cables. The shielding performance of the cable will depend on the internal design of the cable, connector quality, and the assembly methods used. EMC compliance was evaluated using Audio Precision XLR type cables.

- *Optimal Configuration* defines an ideal configuration to achieve the best performance and speed.

These requirements may be affected by what other software needs to run on the same machine and if this software needs to run at the same time as APWIN.

Hard drive sizes have been specified based somewhat on practical commercial availability. Although a 500-MB hard drive should be adequate to host Windows 95 and APWIN, as of this writing nothing less than about 2 GB is commonly available and the cost difference between a 2-GB and an 8-GB drive is less than 10% the cost of the complete computer. This suggests that the larger size makes more economic sense.

Hardware	Minimum Requirement	Recommended Configuration	Optimal Configuration
CPU type	486 DX-2 or DX-4	Pentium, K6, Cyrix 6x86	Pentium II, K6-2, or Celeron
CPU speed	66MHz or 100 MHz	150 MHz to 300 MHz	300 to 400 MHz
RAM memory	16 MB	32 MB	64 to 128 MB
Hard Drive size	500 MB	4 GB	6 to 8 GB
Free hard drive space	100 MB	100 MB	100 MB
Graphic Card RAM	1 MB	2 to 4 MB	8 MB
Video Resolution	640 x 480	1024 x 768	1024 x 768
Monitor	14”	15”	17”

2.18.2 ISA-WIN APIB Card

The ISA-WIN APIB Card is installed in the user’s PC and interfaces between the PC and the APIB (Audio Precision Interface Bus). The ISA-WIN card is a half-size, 8-bit card and includes jumpers to set the computer address and an APIB cable to connect to the first device. Refer to Section 3.3 for further information.

2.18.3 PCM-WIN Card

The PCM-WIN Card interfaces between a portable computer and the APIB. The computer must have a Type II PCMCIA slot. Refer to Section 3.4 for further information.

2.18.4 Cables and Adapters

2.18.4.1 Analog Audio Cables

These cables provide a convenient method to connect Audio Precision measurement equipment with a device under test. These cable kits consist of four cables, each with a unique color band at the connector ends to facilitate identification. The cables are high quality Mogami NEGLEX super flexible shielded cable, and are 8 ft (2.4 m) long. The cables and connector shells are satin black, and all connectors have gold plated contacts.

- CAB-XMF consists of a set of four XLR male to XLR female cables.
- CAB-XBR consists of a set of four cables: two with RCA/PHONO male to XLR male connectors, and two with RCA/PHONO male to XLR female connectors. Also provided are four adapters, from RCA female to BNC male. The cables are wired with pin 2 of the XLR connector as “hot” (center pin of the RCA connector) and pins 1 and 3 connected to ground and shield, to agree with the unbalanced wiring convention of Audio Precision instruments. See Figure 2-33 and Figure 2-34.

Figure 2-33. CAB-XBR cable kit

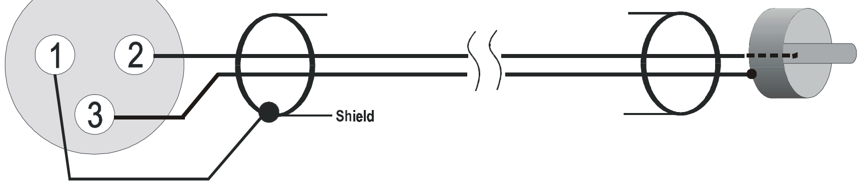


Figure 2-34. XLR to BNC wiring

2.18.4.2 Digital Audio Cables

These cables are designed for digital audio connections using the AES/EBU format, XLR connectors, 110-ohm cable, double-shielded for improved EMII performance.

- CAB-AES: Set of two AES/EBU cables, 39 in. (1 m) long. See Figure 2-35.
- CAB-AES2: Set of two AES/EBU cables, 6.5 ft (2 m) long.
- CAB-AES4: Set of two AES/EBU cables, 13 ft (4 m) long.

Figure 2-35. CAB-AES cable set

- CAB-DIO: Set of two interface cables, 4.25 ft (1.3 m) long, to connect between the SYS-2522 rear panel 50-pin ribbon input/output connectors to a DUT fixture with 0.1-in. spaced 2 x 25-pin headers. See Figure 2-36.

Figure 2-36. CAB-DIO Cables

2.18.4.3 Cable Adapters

- CAD-RCA: set of 14 RCA/Phono female to BNC male adapters, intended primarily for use with the SWR-2122U Unbalanced Switcher.

2.18.4.4 Digital Control (APIB) Cables

These cables can be used as extensions or replacements for the APIB cables that come with each instrument or ISA APIB controller card.

- CAB-D0: Extension APIB Interface cable, 20 in. (0.5 m).
- CAB-D2: Extension APIB Interface cable, 6.5 ft. (2 m).
- CAB-D6: Extension APIB Interface cable, 12.7 ft. (6 m).

3. Hardware Installation

Hardware setup involves installing an interface card in the computer and connecting a cable from this interface card to the System Two. Every copy of APWIN comes with an ISA-bus half-size interface card or, as a option, a PCMCIA interface card. One of these cards is required for APWIN to communicate with System Two. (Earlier Audio Precision PCI-1, PCI-2, or PCI-3 cards or current ISA-DOS or PCM-DOS interface cards will not work with APWIN.)

For table top use, the System Two can be stacked with switchers or other instruments.

3.1 Rack Mounting

There are two styles of rackmount kits available to rack mount the System Two: fixed, and slide-out.

3.1.1 Fixed Rack-Mounting Brackets

Install the fixed installation rackmounting kit as shown in Figure 3-1. The parts required are identified in Table 3-1.

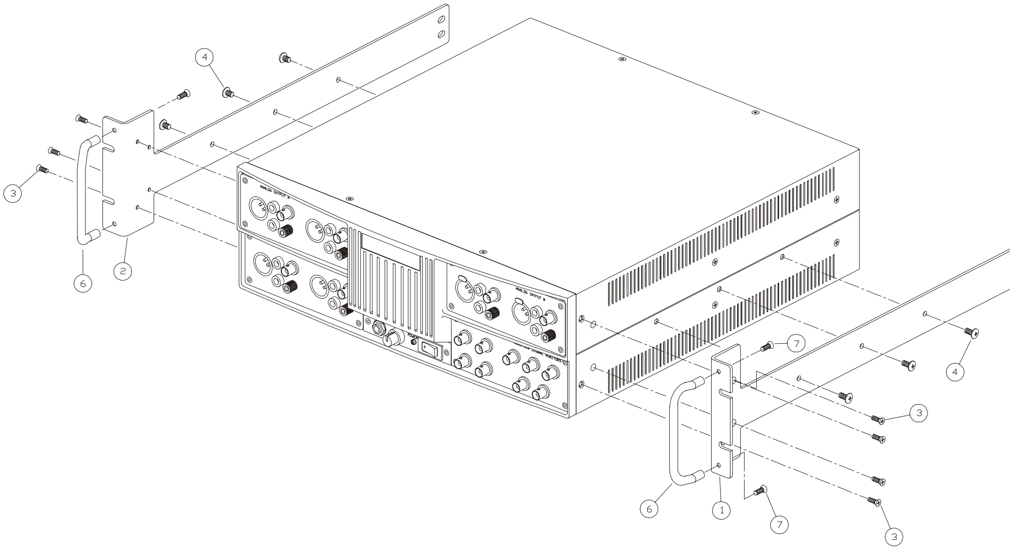


Figure 3-1. Fixed installation rackmounting kit

Table 3-1. Parts list for fixed installation rackmounting

ITEM	A-P NUMBER	DESCRIPTION
-1	7170.XXXX	RACK EAR BRACKET, RH
-2	7170.XXXX	RACK EAR BRACKET, LH
-3	5113.1110.6	SCREW #6-32X5/16 MC FLT PH DGY
-4		SCREW #10-32X3/8 MC TRUSS PH DGY
-6	7320.0006	HANDLE
-7	5114.1108	SCREW MC FLT PH ZN #8-32X1/4

3.1.2 Sliding Rack-Mounting Brackets

The slide rackmounting kit is intended to be used with Chassis Track C-300-S Series non-pivoting solid bearing chassis sections from General Devices Inc, Indianapolis, IN. These chassis sections are available in several lengths to fit a wide variety of racks.

Install the sliding installation rackmounting kit as shown in Figure 3-2. The parts required are identified in Table 3-2.

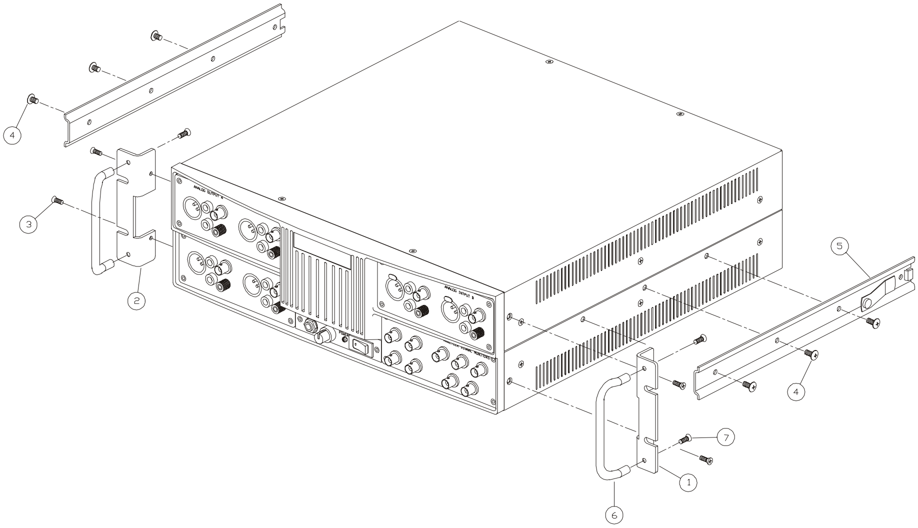


Figure 3-2. Sliding rack mount installation kit

Table 3-2. Parts list for sliding installation rackmounting

ITEM	A-P NUMBER	DESCRIPTION
-1	7170.0202	RACK EAR BRACKET, RH
-2	7170.0201	RACK EAR BRACKET, LH
-3	5113.1110.6	SCREW #6-32X5/16 MC FLT PH DGY
-4		SCREW #10-32X5/16 MC TRUSS PH DGY
-5		SLIDE - STATIONARY SECTION
-6	7320.0006	HANDLE
-7	5114.1108	SCREW MC FLT PH ZN #8-32X1/4

3.1.3 Rackmounting the Switchers, SIA-2322, and DCX-127

To rack mount the switchers, SIA-2322, and DCX-127, note that the rackmounting brackets can be installed in two ways:

- To mount the front panels flush with the front of the rack, or
- To mount the instruments with the panels recessed, which allows space for the connectors inside the rack.

For the switchers, be sure to observe the instruction given in Section 3.2.1 when rackmounting.

3.2 Primary Power Considerations

Refer to fuse specifications on the rear-panel label for all power line-powered instruments. Unplug the power cord from the instrument before changing fuses or performing any other operations described in this section.

3.2.1 AC Mains Switch Required

The SWR-2122-Series switchers do not have individual power switches and are intended for continuous operation. However, they should be plugged into a switched power source or mounted to give the user access to the mains cable for disconnect.

3.2.2 Checking or Changing Power Line Voltage

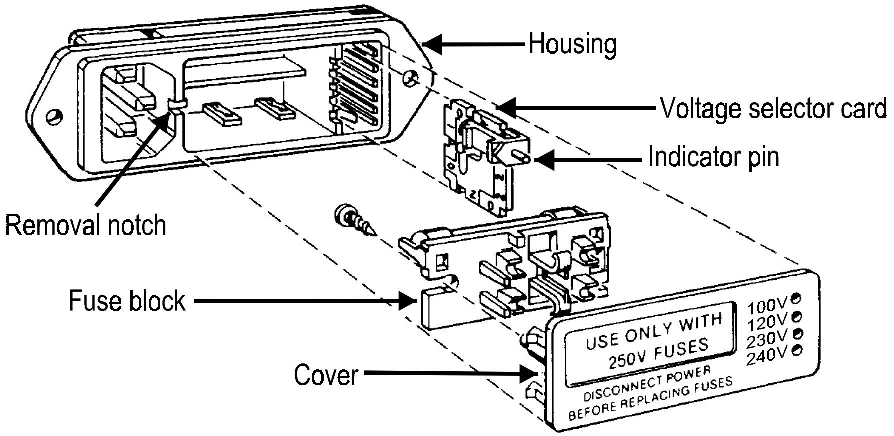


Figure 3-3. Changing power line voltage

The AC Mains input to each instrument is made through a connector/fuse block/voltage selector assembly. Before connecting the power cord, confirm that the input voltage selection is correct for your power source. An indicator pin shows the selected input voltage in one of the four holes in the cover (see Figure 3-3).

To change the input voltage, refer to Figure 3-3 and proceed as follows:

1. Remove the AC power cord from the AC Mains Connector.
2. Open the cover, using a small blade screwdriver or similar tool. Set aside the cover/fuse block assembly.
3. Pull the voltage selector card straight out of the housing, using the indicator pin.

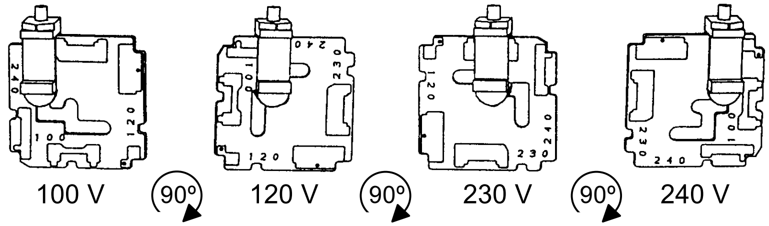


Figure 3-4. Voltage selector card positions

4. Orient the selector card so that the desired input voltage is readable at the bottom (see Figure 3-4). Then orient the indicator pin to point up when the desired voltage is readable at the bottom, with the indicator pin assembly seated in the notch on the board edge.
5. Insert the voltage selector card into the housing with the printed side of the card facing toward the connector, and the edge indicating the desired voltage first.
6. Confirm that the correct fuse is installed for the intended input voltage (refer to fuse ratings marked on the rear panel). If necessary, change the fuse type as described in the following section.
7. Replace the cover and verify that the indicator pin shows the desired voltage.

3.2.3 Fuse Information

The connector/fuse block/voltage selector assembly allows two fusing arrangements: North American (see Figure 3-5), and European (seeFigure 3-6). The North American fusing arrangement uses a single type 3AG (0.25 x 1.25 in.) SB ("slow blow") fuse; the European fusing arrangement uses two 5 x 20 mm IEC-approved type T fuses. Refer to the label on the rear panel for fuse current ratings.

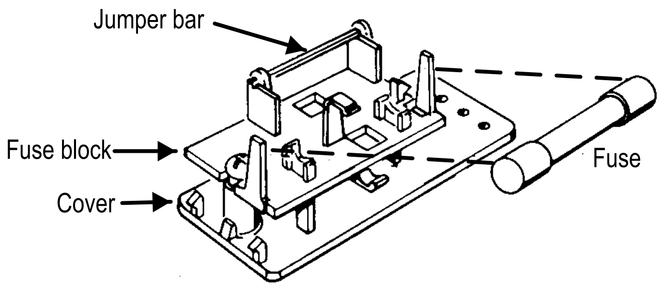


Figure 3-5. North American fusing arrangement

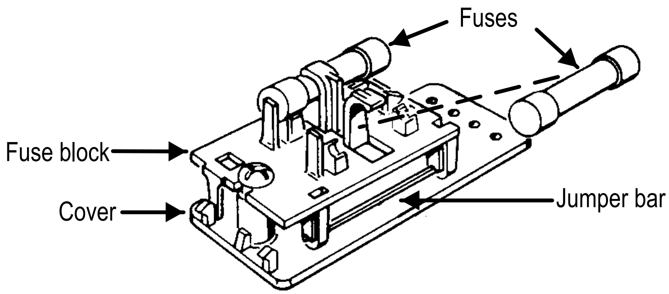


Figure 3-6. European fusing arrangement

3.2.4 Changing Fusing Arrangement

To change from one fusing arrangement to the other:

1. Remove the AC power cord from the AC Mains Connector.
2. Open the cover of the connector/fuse block/voltage selector assembly with a small blade screwdriver or similar tool.
3. On the back of the cover, loosen the Phillips screw two turns, then remove the fuse block by sliding up, then away from the screw and lifting from pedestal at the other end (refer to Figure 3-7).

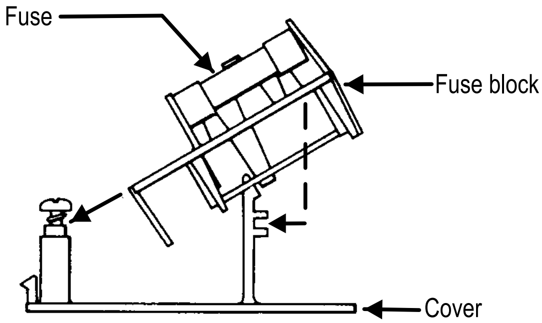


Figure 3-7. Changing fuse types

4. Invert the fuse holder and reassemble it on the Phillips screw and pedestal, and tighten the screw.
5. Change or add the correct fuses as necessary (again, refer to rear panel for the correct fuse current rating).
6. Confirm the line voltage setting as described in the previous section, then replace the cover.

3.2.5 Proper Environment

All Audio Precision System One, System Two, and System Two products are intended for use indoors, in a normal environment. Refer to Section 2.15 for temperature range and humidity specifications.

3.3 Installing ISA-WIN APIB Card

The ISA-WIN card, shown in Figure 3-8, is a half size (8-bit) card that must be installed in the host PC to interface the ISA Bus in the PC to the APIB. Included with the card is an APIB interconnecting cable.

Alternatively, a PCMCIA interface card is available for use with laptop computers. See Section 3.4.

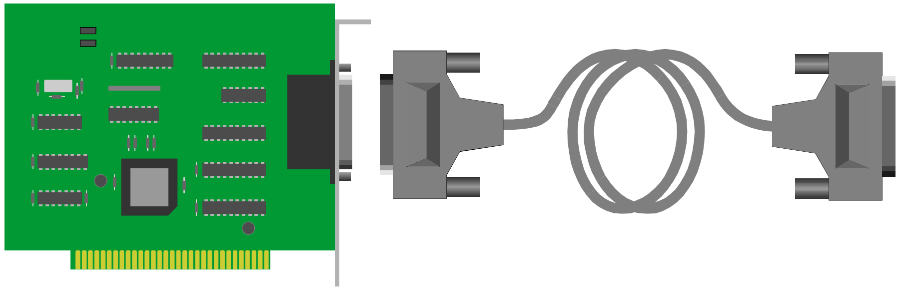


Figure 3-8. ISA-WIN Interface Card and cable

> ***TIP:***
>
> *Whenever handling electronic components such as this interface card, it is necessary to avoid static electricity discharge that can permanently damage the card. Always leave the card in the protective static bag prior to actual insertion. Before picking up the card to install it in the computer, drain any static charge in your body by touching the chassis of the computer. Pick up the card by the metal bracket and avoid touching any of the components on the card. The "snap" discharge you may notice when you touch a metal object after walking across a carpet can be several thousand Volts (although at a very low current) and can do catastrophic damage to unprotected integrated circuits such as those on this interface card.*

Disconnect the power to the computer, remove the cover and install the card in an unused slot. Be sure the card is well seated; it should snap down into the connector of the mother board of the computer. Install the hold-down screw on the card bracket and replace the cover.

3.3.1 Address Jumper Settings

You will notice two jumpers near the top edge of the card. In most cases, these will not have to be changed. They define the address location of the card and can be used to change the default address if conflicts arise. Unless you know of a conflict, leave the jumpers in the factory default position. After installation, if conflicts arise, these jumpers can be changed to define an alternate location. To change jumpers, turn off power to the computer, remove the cover and remove the card. Use caution handling the card to avoid static discharge. Refer to Figure 3-9 and set the jumpers to an alternate location. Replace the card and cover.

Address Location	J202	J201	Notes
238	Removed	Installed	
298	Installed	Installed	
2b8	Installed	Removed	Factory Default
2d8	Removed	Removed	

(Memory space required: eight address locations.)

> ***Note:***
>
> *When APWIN starts, it will automatically look through the possible address locations to find an ISA-WIN or PCM-WIN card. In the unlikely event that this auto-detect does not function correctly, you can force the software to utilize a specific address location using command line start-up switches. To do this, see Section 5.1.1.*

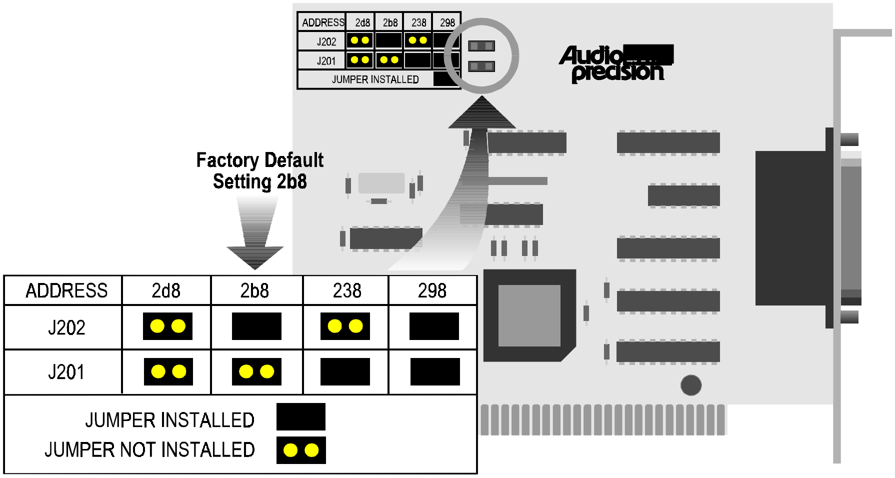


Figure 3-9. ISA-WIN APIB Card with address jumper selections shown

3.4 Installing PCM-WIN PCMCIA Interface Card

The Audio Precision PCM-WIN card is a PCMCIA to APIB interface adapter. It can be used to connect a PC or notebook computer equipped with a PCMCIA type II slot to Audio Precision instruments via the Audio Precision Interface Bus (APIB). It functions the same as the ISA-WIN interface card that is used with ISA bus PCs.

> ***Note:***
>
> *If you are using the PCM-WIN card, do NOT install it until after the APWIN software is installed. See Section 4.*

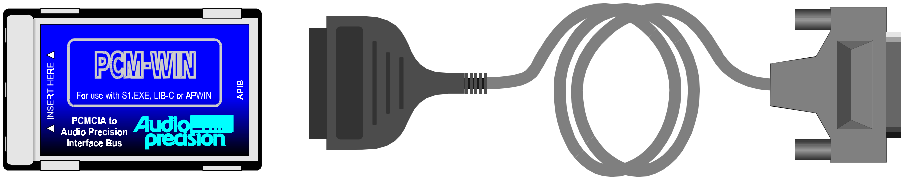


Figure 3-10. PCMCIA to APIB interface card and cable

Refer to Section 4.1 to install the associated PCMCIA drivers.

3.5 Connecting the APIB Interface

Simply connect the cable from the APIB Interface card in the PC to the System Two. If your system includes switchers, notice that each SWR-2122 switcher has two APIB connectors on its rear panel. This permits connecting them in a “daisy-chain” fashion between the computer’s APIB card connector and the System Two APIB connector (see Figure 3-11). The switcher’s connectors pass the APIB lines through, and the switchers respond only when specifically addressed, as described below. Normally, the computer will be connected to the first switcher with a digital interface cable, the first switcher connects to the second, etc, and the last switcher connects to the System Two digital interface (APIB) connector.

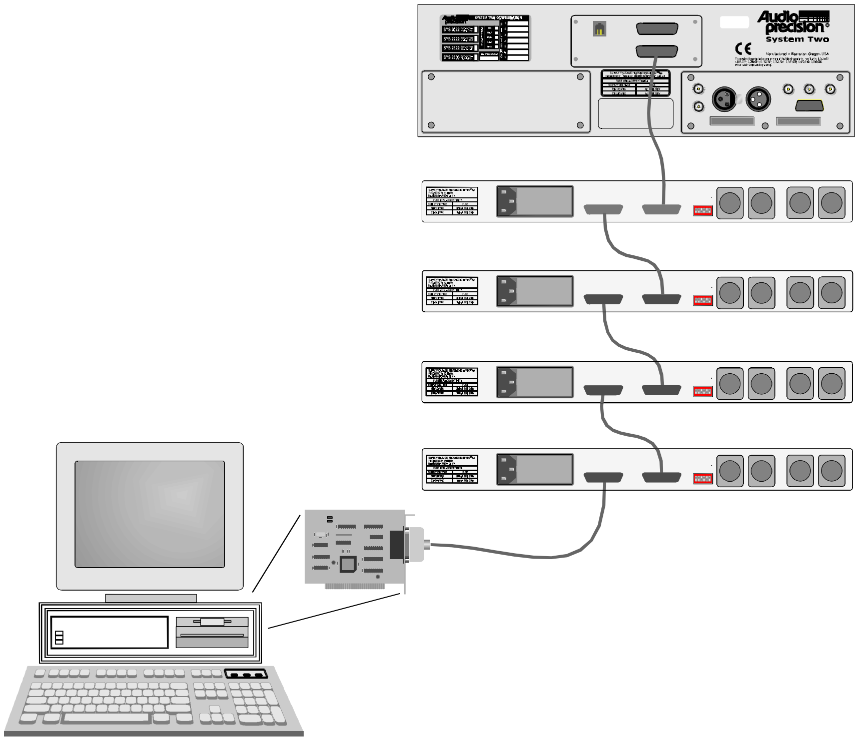


Figure 3-11. APIB connections block diagram (typical)

3.6 Setting Switcher Addresses and Modes

A six-switch binary switch bank is located on the rear panel. The first four switches on this bank select which group of channel numbers the module responds to as described in Table 3-3. The last two switches function as described in the appropriate subsection below.

These switches are marked 1 through 6 on the switch itself; on the panel, the first four are labeled 1, 2, 4, and 8, which corresponds to their bit value in the address word. The up, or ON, position corresponds to a logic 0 (low).

Input, Output, and patch point switchers may all be combined in the same system. Input and output switchers may share the same addresses. A patch point switcher must not have the same addresses as either an input or output switcher. Two patch point switchers may be set to the same address if one is set as Channel A and the other as Channel B (see Section 3.6.2).

3.6.1 Switcher Address Settings

Each switcher module consists of 12 channels. Up to 16 modules may be stacked to provide up to 192 channels. Rear panel address switches must be set to select to which channel commands from the software each switcher module should respond. For example, the first switcher is normally set to channels 1-12, the second module to channels 13-24, etc.

Figure 3-12 shows a typical rear-panel APIB Address switch. Table 3-3 shows relationships among APIB Address switch positions, binary codes, and channel numbers on the APWIN software “panels.”

Table 3-3. APIB Address switch settings

Channel Numbers	Rear Switch Settings				Binary Code
	8 (Switch 4)	4 (Switch 3)	2 (Switch 2)	1 (Switch 1)	
1 – 12	Up	Up	Up	Up	0000
13 – 24	Up	Up	Up	Down	0001
25 – 36	Up	Up	Down	Up	0010
37 - 48	Up	Up	Down	Down	0011
49 - 60	Up	Down	Up	Up	0100
61 - 72	Up	Down	Up	Down	0101
73 - 84	Up	Down	Down	Up	0110
85 - 96	Up	Down	Down	Down	0111
97 - 108	Down	Up	Up	Up	1000
109 - 120	Down	Up	Up	Down	1001
121 - 132	Down	Up	Down	Up	1010
133 - 144	Down	Up	Down	Down	1011
145 - 156	Down	Down	Up	Up	1100
157 - 168	Down	Down	Up	Down	1101
169 - 180	Down	Down	Down	Up	1110
181 - 196	Down	Down	Down	Down	1111

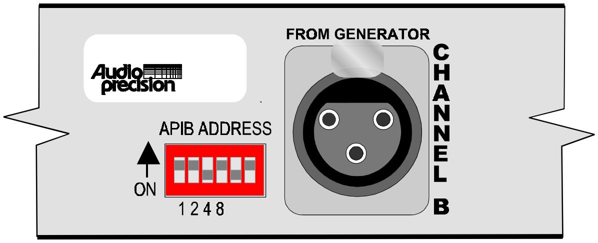


Figure 3-12. Rear panel DIP switch (typical)

3.6.2 Input, Output, and Patch Point Switcher Mode Switches

Switches 5 and 6 of the switch bank set the switcher mode as described in Table 3-4. The modes are defined below.

Table 3-4. Switcher mode settings

Input, Output Mode	Rear Switch	
	Switch 5	Switch 6
Either A or B*	Up	Up
Channel A	Down	Up
Channel B	Up	Down
Off	Down	Down

***Either A or B:** This mode is valid only for Input and Output switchers. The switcher's channel A responds to the A channel addresses, and channel B responds to B channel addresses. This is the normal mode.

Channel A: The switcher's channel A and channel B both respond to A channel addresses.

Channel B: The switcher's channel A and channel B both respond to B channel addresses.

Off: Neither channel responds to any address.

3.6.3 Unbalanced Switcher Mode Switch

The SWR-2122U unbalanced switcher may be used for generator output or analyzer input switching. Switch 6 of the six-switch binary switch bank selects between these modes:

Set Switch 6 to the UP position to operate as an input switcher (switcher will use Input switch channel numbers for Channel A and Channel B on A Channel and B Channel addresses).

Set Switch 6 to the DOWN position to operate as an output switcher (switcher will use Output switch channel numbers for Channel A and Channel B on A Channel and B Channel addresses).

Switch 5 disables the switcher; in the DOWN position, the switcher will not respond to any addresses.

Also note the labeling on the rear panel describing the difference in cable connections to the four rear-panel BNCs when used as an input versus output switcher. See Figure 3-13.

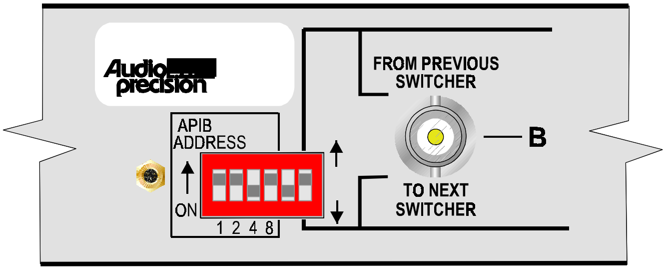


Figure 3-13. Unbalanced switcher address/mode switch

3.6.4 Switcher Circuit Board Jumpers

Remove the AC power cord from the AC Mains Connector before removing the cover to inspect or change the jumper settings.

A common circuit board design is used in all models of the switchers. Two jumpers on the circuit board, marked P62 and P63, select whether the switcher functions as an input switcher, output switcher, unbalanced switcher, or patch point switcher. These jumpers are shown in Figure 3-14. The jumper positions are shown for reference only and will normally not need to be changed.

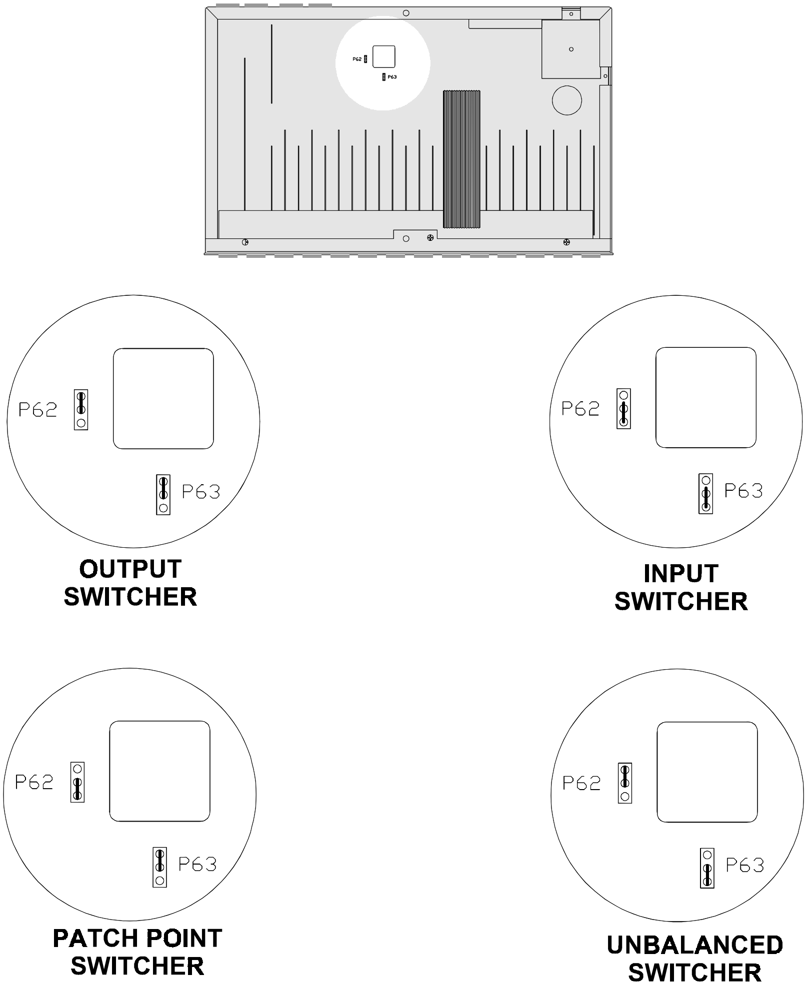


Figure 3-14. Switcher mode jumper positions

4. Software Installation– Windows 95, 98, and NT

APWIN comes with an easy to use setup utility that will perform the complete installation. All options and system dependent variances are handled automatically.

APWIN uses the standard Windows Notepad or Wordpad program for its error-reporting file. Notepad and Wordpad are automatically installed when you install Windows but if you have removed them for some reason, you must reinstall one of these editor programs to be able to use the error file feature of APWIN.

> ***Note:***
>
> *APWIN will run in any video resolution supported by Windows including 640 x 480, 800 x 600, 1024 x 768, and 1280 x 1024. If your system has the capability, we find that the 1024 x 768 resolution gives the best visual presentation and functionality.*

To begin APWIN installation, insert the CD-ROM into the appropriate drive. If your CD-ROM's Autostartup feature is enabled, you should see the screen shown in Figure 4-1. Otherwise, from Windows Explorer, browse to the file SETUP.EXE in the disk's root directory, and double-click.

> ***Note:***
>
> *If your system is to be controlled via a PCM-WIN card, do NOT install the card until AFTER the APWIN software is installed (the ISA-WIN card can be installed either before or after the following APWIN installation).*

Figure 4-1. APWIN installation Setup screen

Click on the **Install APWIN 2.00 Software** button. If you are installing under Windows NT 4.0, your account must have Administrator rights. Otherwise, you will get the following screen (Figure 4-2) when you try to install:

Figure 4-2. Windows NT Administrator rights warning screen

The following screen appears (Figure 4-3):

Figure 4-3. Setup progression screen

After the setup progression screen completes, you should see the Welcome screen of Figure 4-4:

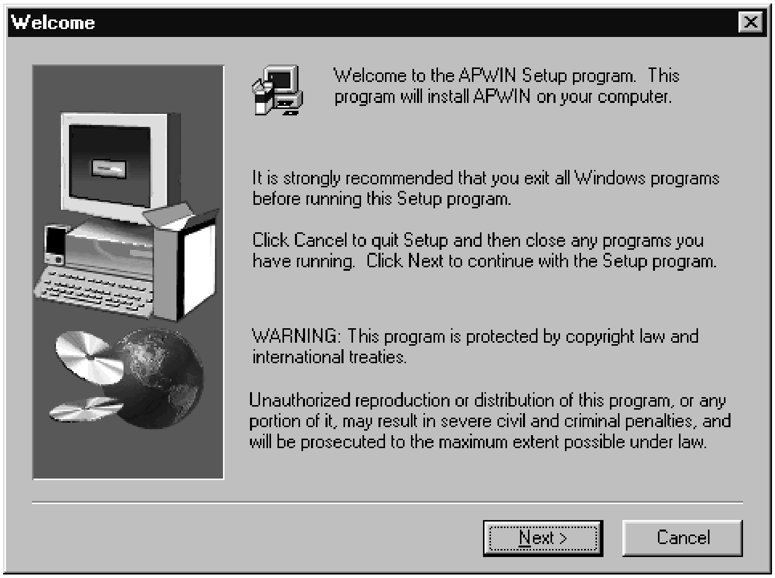


Figure 4-4. Welcome screen

Click the Next > button. The following dialog box appears:

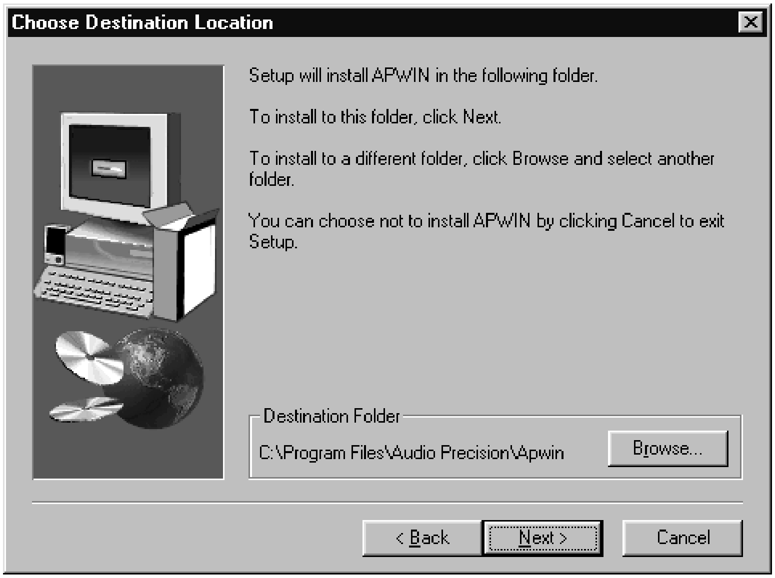


Figure 4-5. Choose Destination Location for APWIN dialog box

This screen (Figure 4-5) will suggest location for the APWIN program files. If you wish to choose an alternate location, click on the Browse ... button. When you click the Next > button, the dialog shown in Figure 4-6 will appear.

Figure 4-6. Choose Destination Location for sample tests, procedures, and data files dialog box

This screen (Figure 4-6) will suggest a location for all the sample tests, procedures, and data files. If you wish to choose an alternate location, click on the 

button. When you click the 

button, the dialog shown in Figure 4-7 will appear.

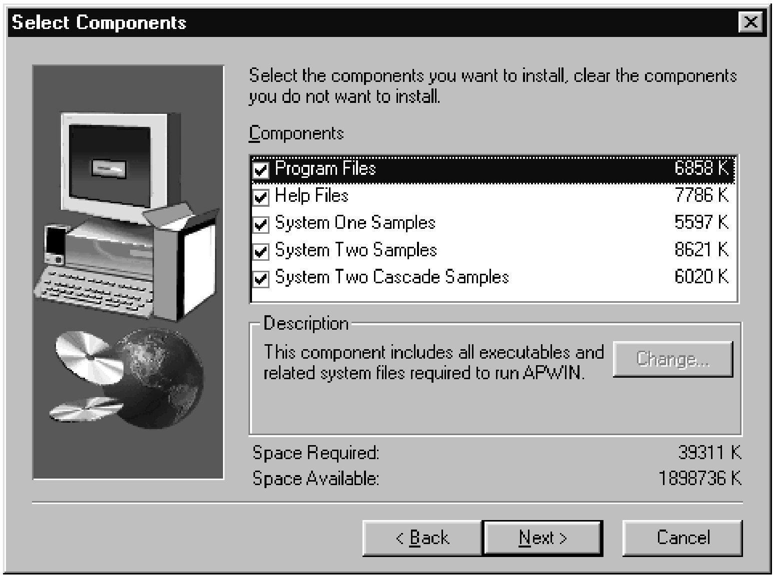


Figure 4-7. Choose Components to Install dialog box

Here you have a choice of what to install and how much space will be required. If you are tight on space or you are re-installing part of the software, you can selectively turn off any of the items shown by clicking on the check boxes (an ✗ or ✓ means install, a blank box means don't install).

The next dialog box (Figure 4-8) will suggest a new Program Manager Group name and show a list of all your existing program groups. If you accept the default new name, APWIN will create a new Program Group called Audio Precision APWIN 2.0. If you choose one of the existing Program Groups, the new icons will be added to that group rather than put in a new group.

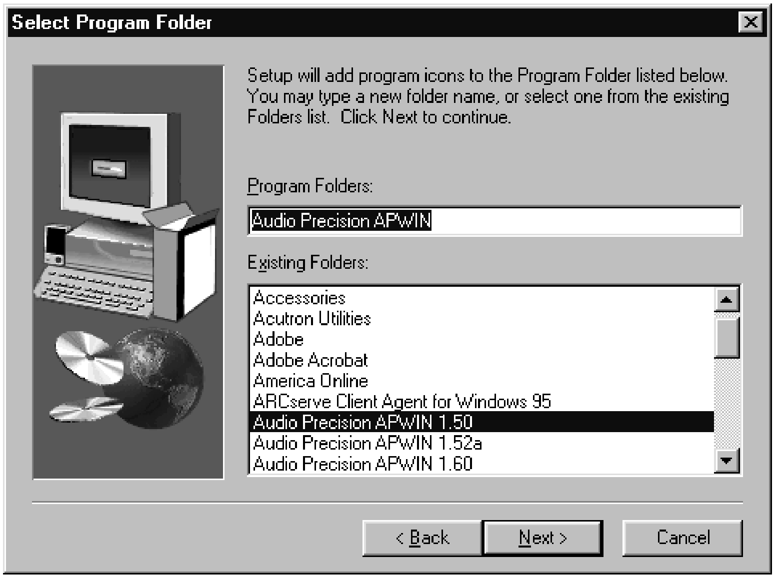


Figure 4-8. Select Program Manager Group dialog box

Now that all of the installation questions have been answered, APWIN will proceed with the installation. You should see the following screen:

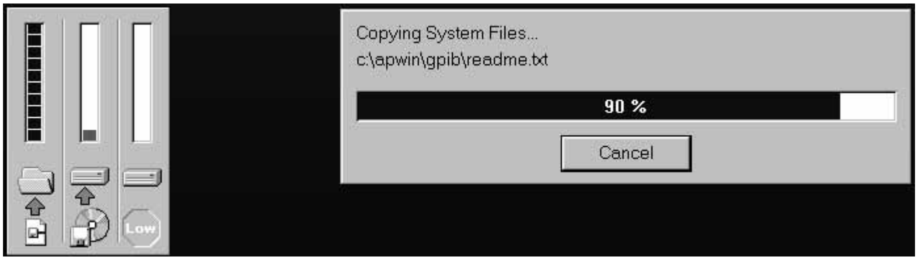


Figure 4-9. Installing progress screen

If you are installing APWIN from diskettes, you will be prompted to insert each diskette as necessary.

After APWIN is successfully installed, the following message window (Figure 4-10) will appear. This completes the installation and you should now be able to start APWIN unless you are using the PCM-WIN PCMCIA interface. If you are using the PCM-WIN card with Windows 95 or 98, you can now insert the PCM-WIN card and Windows 95 or 98 will install the card using the Audio Precision driver.

Figure 4-10. Setup Complete message window

4.1 Using PCM-WIN card with Windows 95 or NT

As noted earlier, if your system is to be controlled via a PCM-WIN PCMCIA card, the card itself should not be installed until AFTER the APWIN software is installed. **If you are running Windows 95 or 98**, You may now insert the PCM-WIN APIB card in its slot, and connect its cable as described in Section 3.4. **If you are running Windows NT 4.0**, the computer should be switched off before removing or inserting a PCMCIA card (the Windows NT 4.0 system does not support hot swapping).

5. Getting Started with APWIN

5.1 Starting APWIN

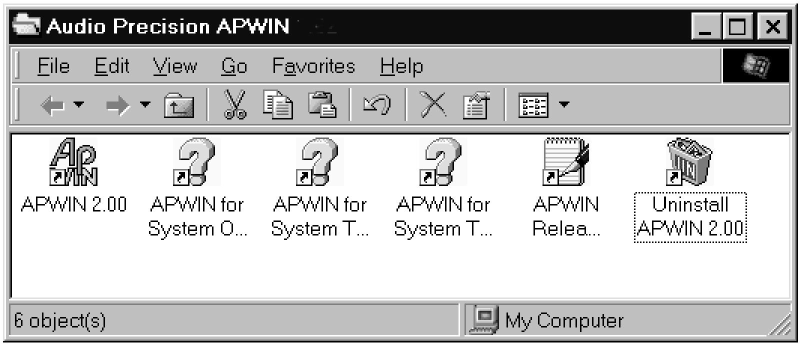


Figure 5-1. APWIN directory window

To start APWIN, double click on the APWIN 2.0 icon shown in Figure 5-1. During startup, APWIN loads several files and checks for the presence of the Audio Precision hardware. It will “look for” an ISA-WIN or PCM-WIN interface card and then for a system. It is able to automatically identify System One, System Two, or System Two Cascade. Depending on the configuration (See section 5.2 and Figure 5-10), the following window may ask you to choose which System to set up for.

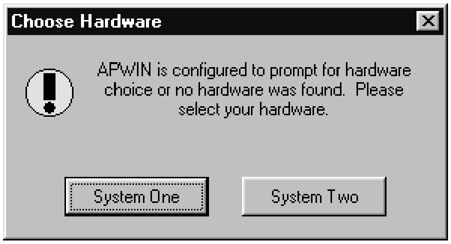


Figure 5-2. Choose Hardware window

If APWIN does not find an interface card and then a system, it will announce this and indicate that it will run in Demo mode (see Figure 5-3). Demo mode allows all program functions to be used except those requiring communication with the instrument. All reading fields will display random numbers.

Figure 5-3. Demo Mode warning window

After APWIN is loaded, you can load sample tests, sample procedures, change instrument settings on the various panels, run tests and run procedures. See the User's Manual for complete instructions or use the on-line Help system explained later.

APWIN Tests (named with the extension .AT1, .AT2, or .AT2C) are files that contain the complete setup of the hardware, the layout of the panels, the appearance of the graph, and even measured data from the last-saved results. Loading a test sets up all of these conditions to allow a user to "run" a new test with all hardware and software conditions correctly established. Procedures (named with the extension .APB) are "scripts" that will perform several operations in succession. This might include loading and running a series of tests in sequence, comparing measured results against predetermined acceptance limits, and displaying and/or printing results.

For a quick look at APWIN and an opportunity to see some tests and procedures in action, several examples have been provided. These examples illustrate generic tests such as frequency response, distortion, and noise, and more complex digital audio tests such as codec and AES/EBU interface tests. These procedures load several tests in sequence and illustrate user interaction, limits testing, and graphical presentation.

To load these examples, select FILE from the top menu bar and select OPEN from the list. This will present a secondary selection of file types. Select PROCEDURE to run a short menu-driven procedure that will be able to select all of the available sample tests.

After selecting the file type (Procedure), the Windows File Open dialog will appear (Figure 5-4):

Navigate to the S2 directory (folder) using the normal Windows method. If you installed APWIN with the default file locations, you should find it under the APWIN directory. Double click on the System2.apb procedure. This will then open the Procedure window. At the top of this window will be the Procedure tool bar shown in Figure 5-5 (which may also be at the top or side of the APWIN desktop if you have this tool bar turned on).

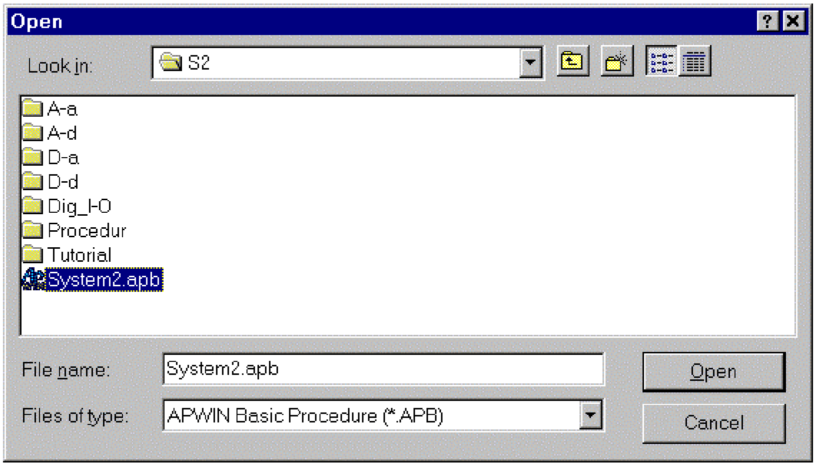


Figure 5-4. Windows 95 File Open dialog box

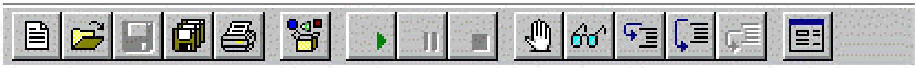
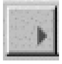


Figure 5-5. Procedure tool bar

Notice that, as you "park" the cursor over each of the buttons, a "tool tip" pops up, giving the name of the button. Also notice that a brief definition of the button is shown at the bottom of the screen.

Click the Play  button (approximately the middle of the bar) to start this procedure. This will then bring up the following menu box:

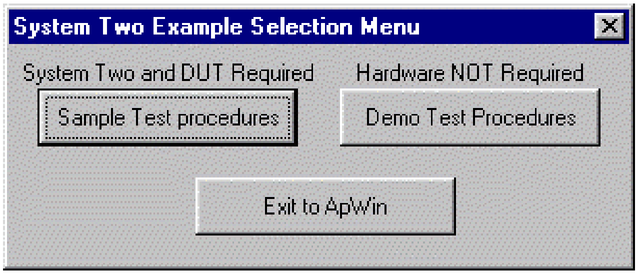


Figure 5-6. System Two Example Selection Menu window

You can now select from two groups of procedures: Demo Test Procedures includes stored sample data and can be used without a device under test connected (and even without a system connected); Sample Test Procedures requires measurement hardware and the specific device under test to make actual measurements. After selecting one of these choices, the following menu box should appear:

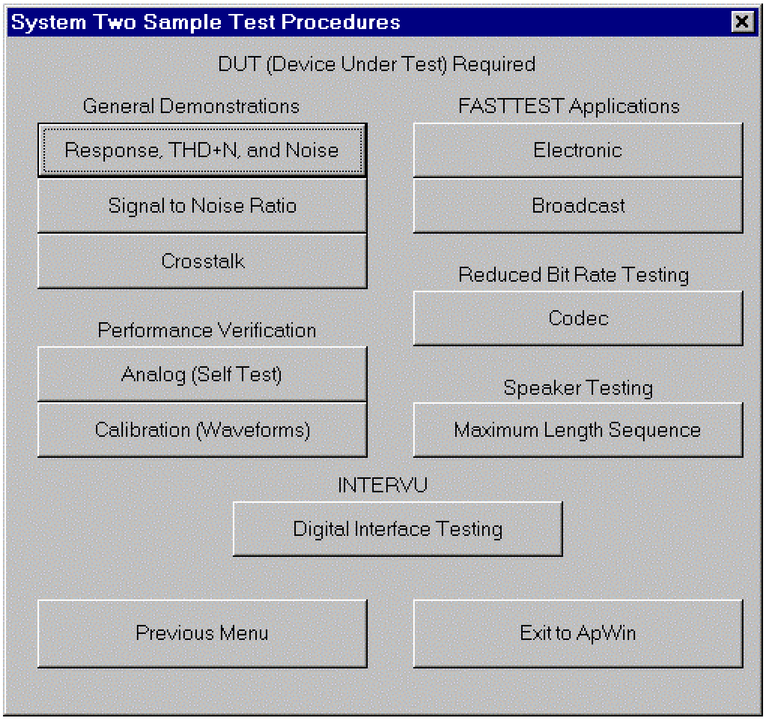


Figure 5-7. System Two Sample Test Procedures window

Here you will find a collection of several sample procedures that will run various illustration tests. Also shown is a Performance Verification procedure that is an excellent example of a detailed test procedure that will make several measurements, test against limits, display measurement graphs, and display a results log. It can also be used to verify the conformance to specification of System One, System Two, or System Two Cascade. This can be quite handy if you ever see unusual test results and would like to be sure that the measurement hardware is functioning correctly.

5.1.1 Automating APWIN Startup

APWIN can be started in a way that forces certain conditions. These include automatically loading a specific test or procedure and automatically running that test or procedure. Adding Options and Switches force these conditions to the command line that launches APWIN. For example, if you follow the APWIN.EXE program with the argument /RUNPRO followed by the procedure name with its path, that procedure will be loaded and started automatically as soon as APWIN itself starts. If that procedure is a menu selection (similar to the SYSTEM1.APB or SYSTEM2.APB samples provided with APWIN), the user need only choose from a predetermined set of choices to begin testing.

5.1.1.1 Windows 95, 98, and NT

Since Windows starts automatically, put APWIN in the STARTUP group. By selecting PROPERTIES (right mouse button) on the APWIN icon, you can specify a command line option in the TARGET line. This is where to put the /RUNPRO path\filename line. The exact syntax for the target line is:

```
"C:\PROGRAM FILES\APWINBIN\APWIN.EXE" /RUNPRO
C:\APWIN\APWIN\S2\SYSTEM2.APB
```

(this will actually be all on one line)

The quote marks around the first argument are because of the space between PROGRAM and FILES. Change paths and files names to suit your particular setup.

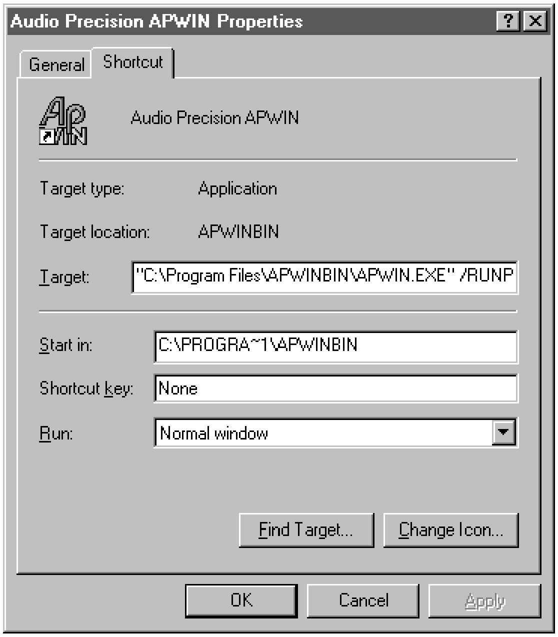


Figure 5-8. APWIN Properties dialog box

The above examples illustrate the use of command line parameters and switches to automate or control the starting of APWIN. Section 5.1.1.2 lists and describes all of the available command line options and switches.

5.1.1.2 Command Line Options and Switches

Syntax:

APWIN [TESTNAME.AT1] [TESTNAME.AT2] [PROCEDUR.APB] [DATAFILE.ADA] [/OPTION] [/OPTION] ...

(again, the above will actually be all on one line), Where

- **TESTNAME.AT1** is any valid System One test file. When specified on the command line, this test file will be loaded with APWIN.
- **TESTNAME.AT2** is any valid System Two test file. When specified on the command line, this test file will be loaded with APWIN.
- **PROCEDUR.APB** is any valid procedure file. When specified on the command line, this procedure file will be loaded with APWIN.
- **DATAFILE.ADA** is any valid APWIN data file. When specified on the command line, this data file will be loaded with APWIN.

Note that file extensions (**.AT1, .AT2, .APB, .ADA**) must be supplied.

OPTIONS are any of the following:

- **S1** forces APWIN to be configured for System One.
- **S2** forces APWIN to be configured for System Two.
- **nologo** suppresses the APWIN logo at startup (for faster startup)
- **runpro** causes a procedure loaded with APWIN to run.
- **runsweep** causes a test file loaded with APWIN to run the sweep.
- **apib238** forces APWIN to communicate with the interface card at address 238.
- **apib298** forces APWIN to communicate with the interface card at address 298.
- **apib2b8** forces APWIN to communicate with the interface card at address 2b8 (the factory default setting).
- **apib2d8** forces APWIN to communicate with the interface card at address 2d8.

Example:

APWIN TESTNAME.AT2 PROCEDUR.APB /runpro /apib2b8

5.2 User Preferences

APWIN allows the user to customize several aspects of the program. Many of these are in a Configuration dialog that can be accessed under the Utilities menu item. Click on Utilities to drop down a menu list, then click on Configuration to bring up the Configuration dialog box. There are five tabs on this dialog box, as shown in Figure 5-9 through Figure 5-13.

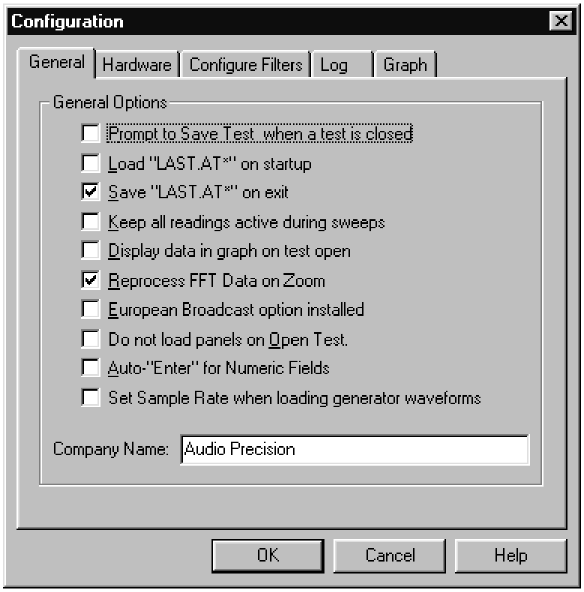


Figure 5-9. Configuration dialog box, General tab

Figure 5-10. Configuration dialog box, Hardware tab

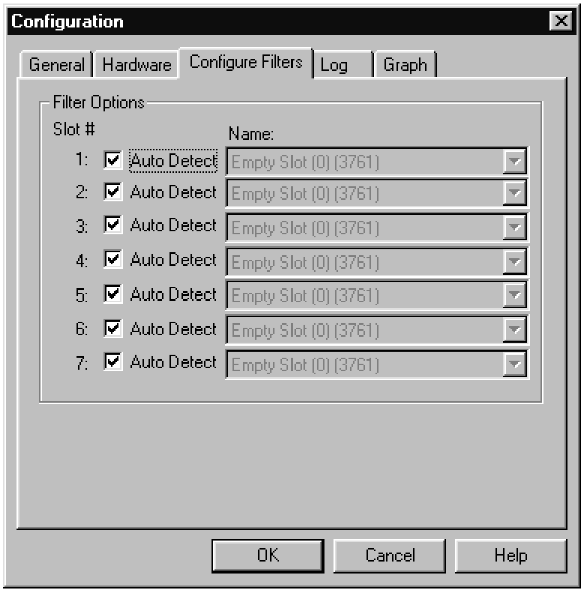


Figure 5-11. Configuration dialog box, Configure Files tab

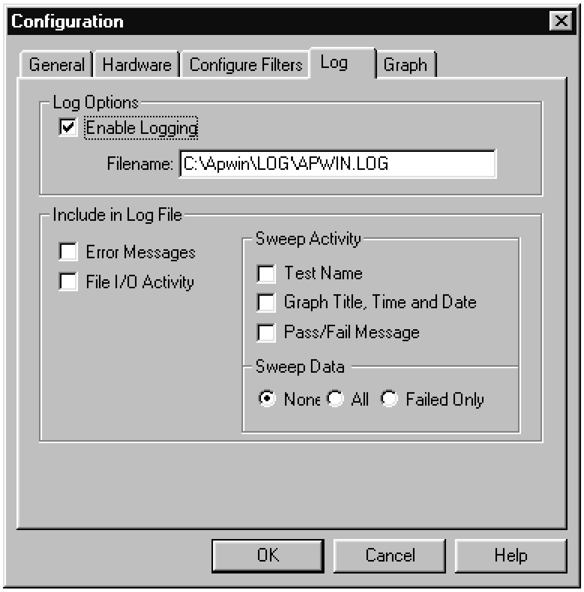


Figure 5-12. Configuration dialog box, Log tab

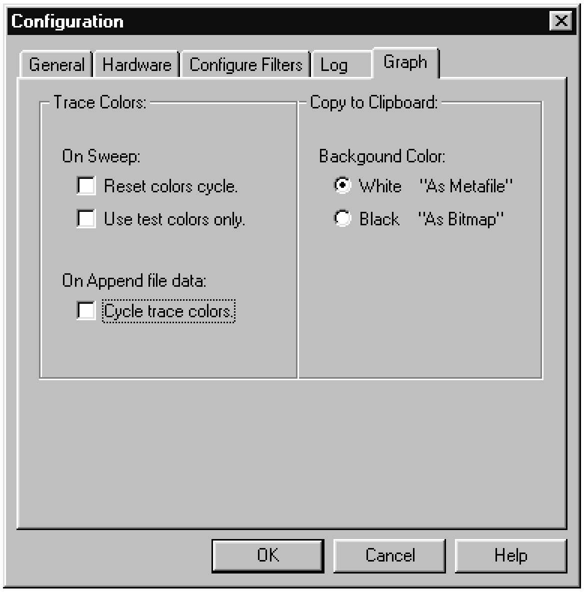


Figure 5-13. Configuration dialog box, Graph tab

Most of the items in these dialog boxes are self explanatory. See the Utilities Configuration section in the MENU chapter of the APWIN User's Manual for a more complete explanation of the various items in this dialog. The Hardware choices allow the user to override the automatic System detection. If set to Auto Detect, APWIN loads with the correct panels for the attached System (One or Two). If you set the choice to a System different from that connected, the software will run but you will not have proper instrument operation. For example, most readings and generator settings will be erroneous. The forced System One and System Two choices were included primarily to allow System One users to evaluate features on System Two while running in demo mode.

If your system has the EURZ option installed, you must check the European Broadcast option installed box. The EURZ option in the hardware changes the available analog generator output source impedances from the default values of 600, 150, and 50 ohms to 600, 200, and <40 ohms. APWIN needs to know these values in order to set properly the analog generator output level. The rear panel should have a CONFIGURATION label that will identify the presence of the EURZ option.

The “Company” box defines what name will appear on the graph header.

All of the choices entered in this box are saved in a configuration file and will be in place every time the program is loaded.

5.3 APWIN Help

APWIN includes virtually the entire User’s Manual in a convenient on-line format allowing rapid access to answers to operational questions. The help system includes hypertext capability that allows the user to quickly jump between primary and related topics. For a more detailed discussion of how to use the Microsoft Windows Help system which all Windows applications including APWIN use, drop down the Help menu and select Using Help. The following pages illustrate the Help information menus in Windows.

There are two ways to bring up help on a particular subject. One method is to bring up the Contents list and search for a particular topic. A second method is Context Sensitive Help. Simply highlight a particular field on any panel and push the F1 key. A dialog box will pop up with help information on that particular section.

You may click on any of the several topics listed to get specific instructions on that topic. Within each topic there are several places where a deeper treatment of a subject is available. Click on any green and underlined words or sentences to find additional information. Various other navigation tools are available within the Windows Help system as explained in the How To Use Help dialog, which is accessed via the Windows Program Manager Help menu.

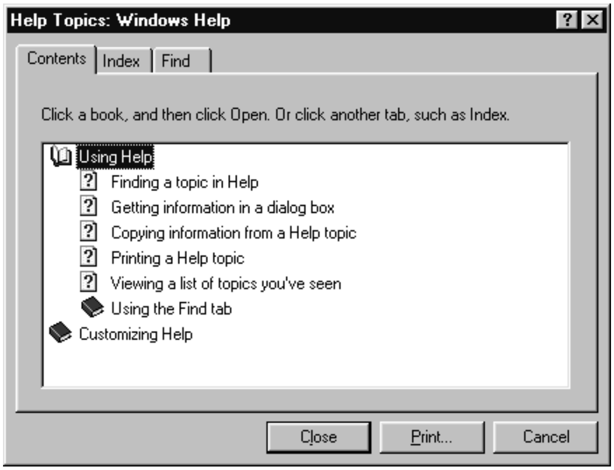


Figure 5-14. Windows 95 Windows Help screen

To bring the APWIN on-line help files to the screen, click on Help and then select Index in the drop down menu list. This will bring up the Contents list of available topics.

5.4 Using Printers with APWIN

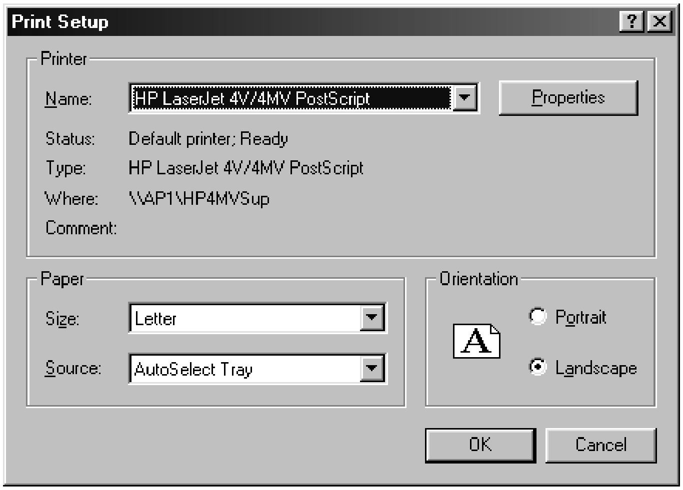


Figure 5-15. Printer Setup dialog box (typical)

APWIN runs under Microsoft Windows and therefore is able to use any printer supported by Windows. To select a specific printer that has been previously installed on your computer, select PRINT SETUP under the FILE menu in APWIN. This will show a dialog box that contains a list of all the installed printers including the printer that is currently set as the DEFAULT printer. APWIN will print to either the DEFAULT printer or a Specific Printer depending on which radio button is indicated. To change the Specific Printer, click on the down arrow at the right of the box and select a new printer from the list of installed printers.

To install a new printer in Windows (and therefore have it available to all Windows applications including APWIN), you will need a Windows driver for that printer. These are created by the manufacturer of the printer and normally are supplied on a disk with the printer. Additionally, the Windows installation disks include some drivers for many common printers, although more recent updated versions of particular drivers are often available directly from the printer manufacturer.

To install a new printer, refer to your Windows documentation for complete instructions. Briefly, click the START button, select SETTINGS, then select PRINTERS. In the window that appears, double-click ADD PRINTER. This will bring up the Add Printer wizard with a long list of printers. If you do not find your particular printer listed and you have a disk from the manufacturer, click the Have Disk button. This will guide you through the process of installation including Setup (which configures the driver for the options installed on the printer) and Connect (which determines to which port the printer will print). *Again, refer to your Windows documentation for more details.*

5.5 Compatibility with S1.EXE

The S1.EXE DOS-based program has been the user interface since the introduction of System One in 1985. APWIN provides substantial improvements in capabilities, ease of use, features, and appearance compared to S1.EXE. The powerful graphic capabilities in Windows make a friendlier environment and provide the ability to customize many attributes of the user interface to suit your personal taste. Graphs can be extensively customized in color, line style or line thickness, size and other visual attributes. You can print graphs with any Windows-supported printer including color printers.

APWIN's scripting language, based on Visual Basic, is far more powerful than the language provided with S1.EXE. This makes it compatible with a large number of other applications such as word processors, spreadsheets, and databases. APWIN Basic also has several new commands that have been requested by S1.EXE users.

APWIN's Learn Mode provides a fast and error-free method to create or augment a procedure. You can enable Learn Mode via the Procedure menu or tool bar selections, then manually go through the test scenario to create a test procedure.

5.5.1 Utilizing S1.EXE Test and Procedures

Test and Procedure files created with the S1.EXE software version 2.10A and later may be imported into APWIN. Under the File menu select the Import – S1.EXE Test or S1.EXE Procedure to convert these files to APWIN Tests and Procedures files.

5.5.2 MAKEWAVE Utility Program

The S1.EXE utility MAKEWAVE has been integrated into APWIN. Run MAKEWAVE through the APWIN menu selection UTILITIES – MULTITONE CREATION.

5.6 Publishing Graphs

There are several ways to capture a graph, depending upon your requirements. One simple method is to use the Windows clipboard feature. With the graph visible on screen, push Alt + Prnt Scrn to copy the entire screen to the clipboard, or from the menu select Edit-Copy Panel to copy the active window to the clipboard. Then, in any desktop publishing application, from the EDIT menu paste the contents of the clipboard to the location desired.

To save a graph to a file in Windows 95 or NT, from the menu select File-Export-Graphic, and choose the file format: either WMF (Windows MetaFile) or EMF (Enhanced MetaFile). A dialog box will ask for a path and file name.

Another method is to “print” to a file in APWIN. Depending upon the printer driver used, the file can be saved in PostScript or HPGL. Note that it is not necessary to actually have the physical printer connected, it is only necessary to have its driver installed in Windows. When you select Print, you will be prompted for a filename. Enter the name and a suitable extension. With either of these latter methods, the resulting file can then be imported into a graphics or publishing program.

5.7 Technical Support

If all else fails and you still have problems installing or running APWIN, call our technical support team for assistance. We can be reached during the following hours Monday through Friday except holidays: 8:30 am to 5:00 p.m. Pacific Time. You can reach us in any of the following ways:

- U.S. Toll Free Phone: 800-231-7350
- Phone: 503-627-0832
- Fax: 503-641-8906
- Email: techsupport@audioprecision.com
- Web: www.audioprecision.com

When you call or fax, please have the following information available:

- Your computer: CPU type and speed (e.g.: 386, 486, Pentium; 33MHz, 66MHz, 90MHz, etc.)
- Amount of RAM installed (typically 8, 12, 16, or 32 Meg)
- System Two configuration (SYS-22, SYS-222, SYS-322, options such as DSP, Dual Domain, BUR-GEN, IMD).

If you call, we strongly recommend that you have the computer keyboard and monitor at the same location as the telephone as we will likely ask you to try several things to assess the situation.

If you need to determine which version of APWIN is loaded, click on the Help menu item and then About APWIN in the pull-down menu. A dialog box similar to the following will appear:

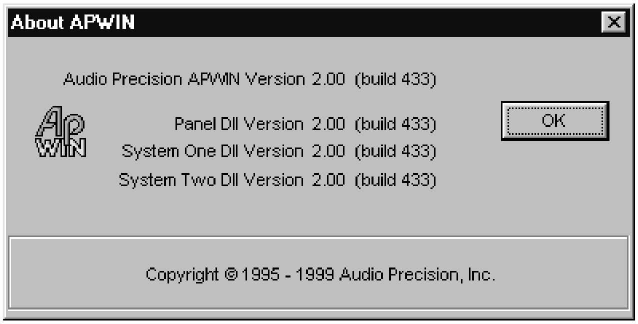


Figure 5-16. About APWIN window (typical-- your version and build numbers may be different)

Audio Precision
PO Box 2209
Beaverton, Oregon 97075-2209
Tel: (503) 627-0832 Fax: (503) 641-8906
US Toll Free: 1-800-231-7350
email: techsupport@audioprecision.com
Web: www.audioprecision.com