Getting Started with System Two Cascade Plus

Audio precision®

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An Introductory Guide to System Two Cascade *Plus*

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This mark signifies that the product conforms to all applicable requirements of the European Community. A Declaration of Conformance is included with the user information that describes the specifications used to demonstrate conformity.

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Contents

Do NOT service or repair this product unless properly qualified. Servicing should be performed only by a qualified technician or an authorized Audio Precision distributor.

Do NOT defeat the safety ground connection. This product is designed to operate only from a 50/60 Hz AC power source (250 V rms maximum) with an approved three-conductor power cord and safety grounding. Loss of the protective grounding connection can result in electrical shock hazard from the accessible conductive surfaces of this product.

For continued fire hazard protection, fuses should be replaced ONLY with the exact value and type indicated on the rear panel of the instrument and discussed on page 54 of this manual. The AC voltage selector also must be set to the same voltage as the nominal power source voltage (100, 120, 230, or 240 V rms) with the appropriate fuses. Different fuses are required depending on the line voltage.

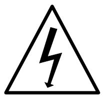
The International Electrotechnical Commission (IEC 1010-1) requires that measuring circuit terminals used for voltage or current measurement be marked to indicate their Installation Category. The Installation Category is defined by IEC 664 and is based on the amplitude of transient or impulse voltage that can be expected from the AC power distribution network. This product is classified as INSTALLATION CATEGORY II, abbreviated “CAT II” on the instrument front panel.

Do NOT substitute parts or make any modifications without the written approval of Audio Precision. Doing so may create safety hazards.

This product is for indoor use—pollution degree 2.

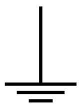
Safety Symbols

The following symbols may be marked on the panels or covers of equipment or modules, and are used in this manual:

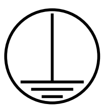


WARNING!—This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.

ATTENTION!—This symbol alerts you to important operating considerations or a potential operating condition that could damage equipment. If you see this marked on equipment, refer to the Operator's Manual or User's Manual for precautionary instructions.



FUNCTIONAL EARTH TERMINAL—A terminal marked with this symbol is electrically connected to a reference point of a measuring circuit or output and is intended to be earthed for any functional purpose other than safety.



PROTECTIVE EARTH TERMINAL—A terminal marked with this symbol is bonded to conductive parts of the instrument and is intended to be connected to an external protective earthing system.

Disclaimer

Audio Precision cautions against using their products in a manner not specified by the manufacturer. To do otherwise may void any warranties, damage equipment, or pose a safety risk to personnel.

Chapter 1

Introduction

Scope of This Manual

This guide serves several purposes:

- 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 Cascade *Plus*, and its options.

A list and a brief description of other Cascade *Plus* documents follows.

Related Documentation

- The *APWIN User's Manual for System Two Cascade* in conjunction with the *APWIN 2.22 Addendum* contain a comprehensive description of the full capabilities of APWIN software for System Two Cascade *Plus*.
- *AP Basic Language Reference,* the *AP Basic Language Extensions for System Two Cascade* and the *APWIN 2.22 Addendum* together provide detailed descriptions and syntax for all OLE commands used in APWIN automation.
- The *System Two Cascade* Plus *Service Manual* contains detailed Cascade *Plus* information, including adjustment procedures, diagnostic procedures, and drawings of electrical and mechanical parts. This manual is not required for routine understanding or operation and must be purchased separately.

Overview

General System

System Two Cascade *Plus* is an audio test set with broad, high-performance capabilities for analog, digital, and mixed-domain devices. Cascade *Plus* 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 Cascade *Plus* is via software running on a Windows-based personal computer.

The versatility of Cascade *Plus* 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 PSIA-2722 Programmable Serial Interface Adapter converts the Cascade *Plus* parallel ports to a wide variety of serial digital interface formats. These accessories are described in greater detail in the following subsections.

Cascade *Plus* 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). Alternatively, Cascade *Plus* may be ordered with GPIB capability and may be controlled by GPIB software. See **GPIB ("G") Option** on the next page.

Specifications for the System Two Cascade *Plus* and its accessories are found in Chapter 2.

System Two Cascade Plus

System Two Cascade *Plus* audio test equipment provides stimulus and measurement capability. The Cascade *Plus* family includes the following product configurations:

- **The SYS-2622**
  The 2622-Series is based on the advanced Cascade *Plus* platform. It provides analog stimulus and measurement capability, using newly-improved 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 SYS-2722**
  The 2722-Series is the Dual Domain product in the Cascade *Plus* family. It includes the capabilities of the 2622 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. These features give the 2722-Series the capability of providing stimulus and measurement in any combination of digital and analog domains.

- **The SYS-2700**
  The 2700-Series has the same digital capabilities of 2722-Series above, but no analog capabilities.

- **The SYS-2122**
  The 2122-Series has the same analog capabilities of 2622- Series and 2722-Series above, but no DSP or digital capabilities.

The models described above have a model number suffix of “A” or “G.” The “A” denotes that the instrument is APIB-controlled with APWIN software; the “G” denotes that the instrument has a GPIB (IEEE-488) interface in addition to the APIB interface. See **GPIB (“G”) Option** below.

System Two Cascade *Plus* “A” (APIB) versions are available with an ISA-bus interface card, a PCI-bus interface card, or, for use with a notebook computer, a type II PCMCIA interface adapter.

Each of these cards comes with the appropriate APIB (Audio Precision Interface Bus) cable to interconnect the computer to Cascade *Plus*.

GPIB ("G") Option

System Two Cascade *Plus* “G” with GPIB option supports all of the System Two Cascade *Plus* configurations as well as the SWR switchers and the DCX-127 Multi-function Interface. No accessories or measurement software are provided with the “G” instrument.

An optional GPIB software development kit is available for the “G” versions that includes sample files, utilities, the *System Two Cascade* Plus *GPIB Programmer’s Reference Manual* and APWIN software for test development. Contact your distributor or go to the Audio Precision Web site at audioprecision.com for more information about System Two Cascade *Plus* with GPIB.

Additional Options for System Two Cascade Plus

These analog options may be installed in your System Two Cascade *Plus*:

- **S2-IMD**
  Adds the IMD (InterModulation Distortion) generator and IMD analyzer.

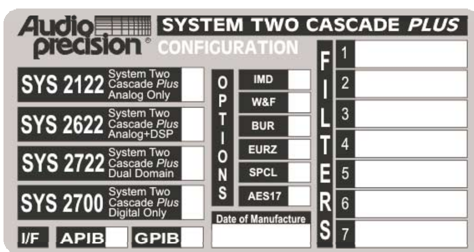
- **S2-W&F**
  Adds the wow and flutter analyzer.
- **S2-BUR**
  Adds the tone burst, square wave, and noise generator.
- **S2-EURZ**
  Changes the generator output selections to 40/200/600 Ω, prevalent in Europe.
- **S-AES17**
  Adds a special filter option for THD+N and small signal measurement of DAC output in conformance with the AES17 standard.

Additionally, your Cascade *Plus* may include up to seven optional hardware filters, or may include custom filters. Commonly installed filters include:

- **FIL-AWT**
  A-weighting filter
- **FIL-CWT**
  C-weighting filter
- **FIL-CCR**
  IEC468-3 (CCIR) weighting filter

Approximately 50 other Audio Precision option filters are available. Visit the Audio Precision Web site at audioprecision.com to view the current filter offerings.

A rear-panel configuration label on the Cascade *Plus* identifies the model number, the options and filters installed, and the date of manufacture.



Switchers

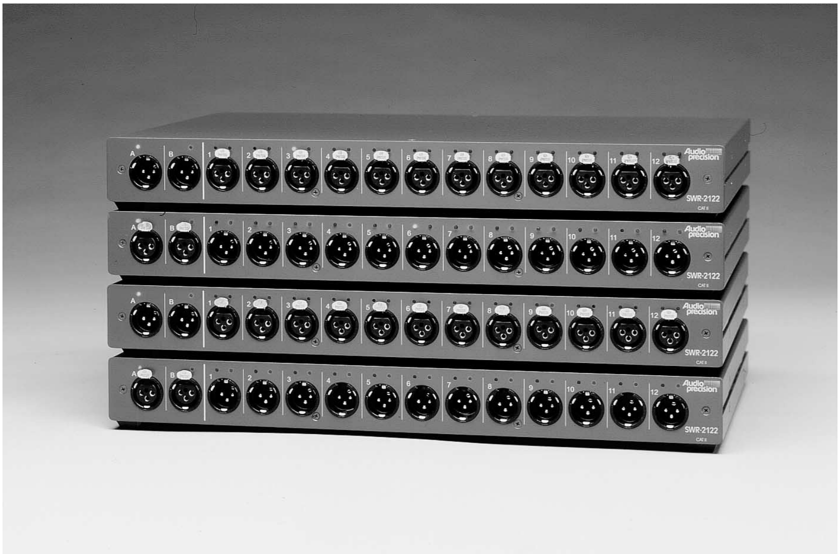


Figure 1. SWR-2122 Switchers

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 Cascade *Plus*. See Chapter 3 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.

DCX-127 Multi-Function Module

Figure 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 mV resolution and monotonicity to 40 mV (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.

PSIA-2722 Programmable Serial Interface Adapter

Figure 3. PSIA-2722 Programmable Serial Interface Adapter

The PSIA-2722 Programmable Serial Interface Adapter provides a means of interfacing System Two Cascade or Cascade *Plus* to a variety of data acquisition, reconstruction and communication hardware that use 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 PSIA consists of a parallel-to-serial transmitter and an independent serial-to-parallel receiver under APWIN software control.

A serial interface adapter such as PSIA-2722 is required to transmit or receive digital signals and associated clock inputs and outputs for the non-AES3/IEC60958 serial digital audio formats often encountered in telecommunications and in converter design and testing. The settings necessary to configure the PSIA are easily accomplished in software, and converter-specific setups can be saved, reloaded or downloaded from the Web.

PSIA-2722 requires APWIN version 2.22 or later software.

Chapter 2

Specifications

Analog Signal Outputs

All System Two Cascade *Plus* configurations except SYS-2700 contain an ultra-low distortion analog sine wave generator and two independent transformer-coupled output stages.

The SYS-2622 and SYS-2722 configurations also contain a dual-channel D/A signal generator for enhanced capabilities. Option "BUR" adds analog-generated sine burst, square wave, and noise signals. Option "IMD" adds analog-generated IMD test signals.

Unless otherwise noted, all specifications are valid only for outputs ≥150 μVrms [420 μVpp].

Analog Output Characteristics

Source Configuration	Selectable balanced, unbalanced, or CMTST (common mode test)
Source Impedances Balanced or CMTST Unbalanced	 40 Ω (±1 Ω), 150 Ω[1] (±1.5 Ω), or 600 Ω (±3 Ω) 20 Ω (±1 Ω) or 600 Ω (±3 Ω)
Max Floating Voltage	42 Vpk (outputs are isolated from each other)
Output Current Limit	Typically >80 mA
Max Output Power into 600 Ω Balanced Unbalanced	 +30.1 dBm (Rs = 40 Ω) +24.4 dBm (Rs = 20 Ω)
Output Related Crosstalk 10 Hz–20 kHz 20 kHz–100 kHz	 ≤ –120 dB or 5 μV, whichever is greater ≤ –106 dB or 10 μV, whichever is greater

Low Distortion Sine Wave Generator

Frequency Range	10 Hz–204 kHz
Frequency Accuracy High-accuracy mode Fast mode	 ±0.03% ±0.5%

[1] *200 Ω ±2 Ω with option "EURZ"*

NP0020.0001.000 R3

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[2]	
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	0.003 dB or 0.05 μVrms, whichever is larger
Flatness (1 kHz ref)	
10 Hz–20 kHz	±0.008 dB (typically <0.003 dB)
20 kHz–50 kHz	±0.03 dB
50 kHz–120 kHz	±0.10 dB
120 kHz–200 kHz	+0.2 / –0.3 dB
Residual THD+N[3,4]	
At 1 kHz	≤(0.00025% + 1.0 μV) [–112 dB], 22 kHz BW (valid only for analyzer inputs ≤8.5 Vrms)
20 Hz–20 kHz	≤(0.0003% + 1.0 μV) [–110.5 dB], 22 kHz BW ≤(0.0005% + 2.0 μV) [–106 dB], 80 kHz BW ≤(0.0010% + 5.0 μV) [–100 dB], 500 kHz BW
10 Hz–100 kHz	≤(0.0040% + 5.0 μV) [–88 dB], 500 kHz BW

Intermodulation Distortion Test Signals

with option "IMD"

SMPTE (or DIN)

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[5]	
Balanced	30 μVpp to 75.4 Vpp
Unbalanced	30 μVpp to 37.7 Vpp
Amplitude Accuracy	±2.0% [±0.17 dB]
Residual IMD[6]	0.0015% [–96.5 dB], 60+7 kHz or 250+8 kHz

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

3 System specification measured with the Cascade Plus analog analyzer set to the indicated measurement bandwidth (BW). Generator amplitude setting must be ≤12 Vrms balanced or ≤6 Vrms unbalanced for specified performance below 30 Hz. At higher amplitude settings generator THD derates to 0.0020% from 20 Hz–30 Hz.

4 Individual harmonics are typically <–130 dBc at 1 kHz, and <–120 dBc from 25 Hz to 20 kHz measured with a passive notch filter and FFT analyzer.

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

6 System specification measured with the Cascade Plus analog analyzer at any amplitude ≥200 mVrms.

CCIF and DFD

Difference Frequency	80, 100, 120, 140, 200, 250, 500 or 1 kHz; all ±1.5%
Center Frequency	4.5 kHz–200 kHz
Amplitude Range[5]	
Balanced	30 µVpp to 75.4 Vpp
Unbalanced	30 µVpp to 37.7 Vpp
Amplitude Accuracy	±3.0% [±0.26 dB]
CCIF Residual IMD[6]	≤0.0004% [–108 dB], 14 kHz+15 kHz (odd order & spurious typ <0.05%)
DFD Residual IMD[6]	≤0.0002% [–114 dB], 14 kHz+15 kHz (odd order & spurious typ <0.025%)

DIM (or TIM)

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

Special Purpose Signals

with option "BUR"

Sine Burst

Frequency Range	20 Hz–100 kHz
Frequency Accuracy	Same as Sinewave
ON Amplitude Range 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 to 65535 cycles, or externally gated
Interval Range	2 to 65536 cycles

Square Wave

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

Noise Signals

White Noise	Bandwidth limited 10 Hz–23 kHz
Pink Noise	Bandwidth limited 20 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 Interval	Typically 262 ms (synchronized to the analyzer 4/s reading rate)
Amplitude Range[5]	(Approximate calibration only)
Balanced	30 μVpp to 37.7 Vpp
Unbalanced	30 μVpp to 18.8 Vpp

Graphs of Typical Analog Generator Performance

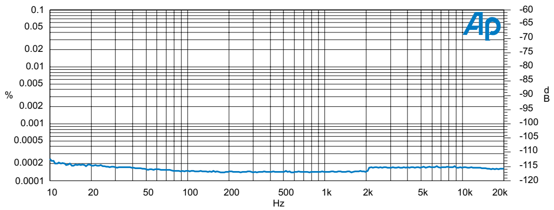


Figure 4. Typical system THD+N versus Frequency at 2 Vrms (analog sine)

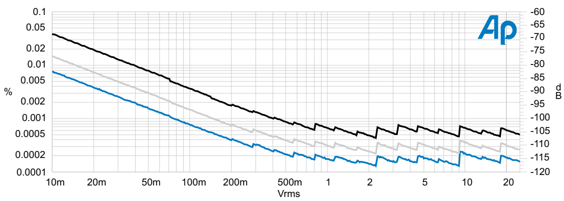


Figure 5. Typical system THD+N versus amplitude at 1 kHz. Lower trace is with 22 kHz bandwidth limiting. Middle trace is with 80 kHz.

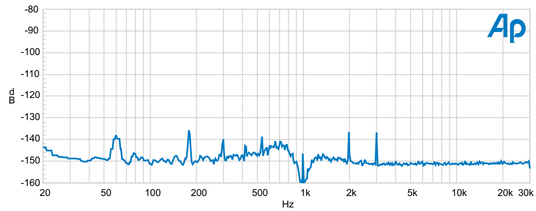


Figure 6. Typical residual THD+N spectrum at 1 kHz, 2 Vrms. (32768 point FFT of notch filter output, SR = 65.536 ks/s, 16 averages).

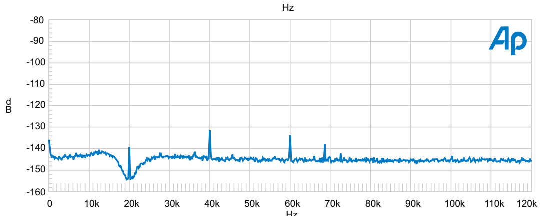


Figure 7. Typical residual THD+N spectrum at 20 kHz, 2 Vrms. (32768 point FFT of notch filter output, SR = 262 ks/s, 16 averages).

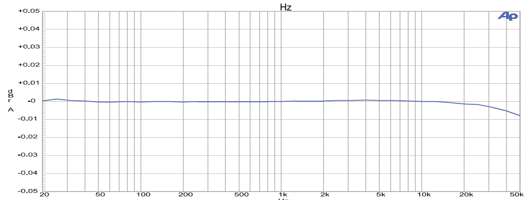


Figure 8. Typical analog system flatness at 2 Vrms signal level (measured with the analog analyzer's Level meter, dc input coupling)

D/A Generated Analog Signals

Available only in the SYS-2622 and SYS-2722 configurations. Except for arbitrary waveforms, the digitally-generated analog signals and the digital output signals are independently selectable and concurrently available. If both analog and digital outputs are selecting Arbitrary Waveform, it must be the same one.

Common Specifications

Sample Rate (SR) Sine, IMD signals Other signals	 fixed at 65.536 ks/s or 131.072 ks/s 7.2 ks/s to 108 ks/s variable; or fixed at 65.536 ks/s or 131.072 ks/s
Frequency Accuracy	±0.0002% [2 PPM] internal reference, lockable to external reference
D/A Resolution	24-bit sigma-delta

"SINE (D/A)" Signal Family

The Sine family includes "Normal," "Var Phase," "Stereo," "Dual," "Shaped Burst," and "EQ Sine." Normal and EQ Sine produce a monaural signal with the best (lowest) residual THD+N performance. EQ Sine varies the amplitude in accordance with a selected EQ file. Var Phase produces the same sine wave in both channels but with settable phase offset. Stereo provides sine waves of independently settable frequency in each channel (phase is random if both frequencies are set equal). Dual produces a monaural test signal containing a mixture of two sine waves of independently settable frequency and amplitude ratio. Shaped Burst produces a monaural sine burst signal with a raised cosine amplitude envelope (see Figure 33 on page 33).

Frequency Ranges	10 Hz to 30 kHz (65.536 ks/s), or 10 Hz to 60 kHz (131.072 ks/s)
Frequency Resolution	Sample Rate ÷ 2^{23} [0.0078 Hz in the 30 kHz range]
Flatness (1 kHz ref) 20 Hz–20 kHz 10 Hz–30 kHz 30 kHz–50 kHz	 ±0.01 dB ±0.03 dB ±0.10 dB (typically –0.5 dB at 60 kHz)
THD+N[7] (20Hz–20kHz) 30 kHz range 60 kHz range	 0.0007% [–103 dB] 0.0014% [–97 dB]
Variable Phase Range	–180.0 to +179.9 deg
Dual-Sine Ratio Range	0 dB to –100 dB, usable to –138 dB
Shaped Burst Interval	2 to 65536 cycles
Shaped Burst On Time	1 to (number of interval cycles minus 1)

[7] *System specification measured with the Cascade Plus analog analyzer set for a 22 kHz measurement BW.*

"IMD (D/A)" Signal Family

SMPTE/DIN Test Signal

LF Tone	40 Hz to 500 Hz
HF Tone	2.00 kHz to 50 kHz
Mix Ratio	4:1 or 1:1 (LF:HF)
Residual IMD[7]	≤0.0010% [–100 dB], 60/7 kHz or 250/8 kHz

CCIF/DFD Test Signal

Difference Frequency	80 Hz to 2 kHz
Center Frequency	4.50 kHz to >50 kHz
Residual CCIF IMD[8]	CCIF: ≤0.0004% [–108 dB], 14 kHz/15 kHz DFD: ≤0.0002% [–114 dB], 14 kHz/15 kHz

DIM Test Signal

Squarewave Frequency	3.15 kHz for DIM30 and DIM100; 2.96 kHz for DIMB
Sinewave Frequency	15.00 kHz for DIM30 and DIM100, 14.00 kHz for DIMB
Residual IMD[8]	≤0.0020% [–94 dB]

Other Signals

Arbitrary Waveform and Multitone ("Arb Wfm")

Signal	Determined by specified file name
Length	256 to 16384 points per channel. Utility is provided to prepare waveform from frequency, amplitude, and phase data.
Frequency Range	20 Hz to 47% of sample rate
Frequency Resolution	Sample rate ÷ Length [2.93 Hz at 48 ks/s and 16384 Length]
Maximum Number of Tones	(Length / 2) minus1 [8191 for Length = 16384]

Maximum Length Sequence ("MLS")

Sequences	Four pink, four white
Sequence Length	“32k” (32767) or “128k” (131071)
Frequency Range	10 Hz to 43% of sample rate, ±0.1 dB

Special Signals

Polarity	Sum of two sine waves phased for reinforcement with normal polarity.
Pass Thru	Passes the embedded audio signal from the rear panel Reference Input. Ratio of reference rate to output Sample Rate may not exceed 8:1.

[8] *System specification measured with the Cascade Plus analog analyzer at any voltage ≥200 mVrms.*

Squarewave

Frequency Range	20 Hz–20.0 kHz
Rise Time	Typically 2.0 μs

Noise Signal

True random white

Analog Analyzer

All System Two Cascade *Plus* configurations except SYS-2700 contain an input module with two independent auto-ranging input stages, each having its own level (rms) and frequency meters; a phase meter; plus a single channel multi-function analyzer module providing additional signal processing and gain stages. Standard analog analyzer functions include amplitude and noise (both wideband and selective), THD+N, and crosstalk.

The SYS-2622 and SYS-2722 configurations add dual-channel A/D converters for FFT and other special forms of analysis. Option “IMD” adds inter-modulation distortion measurement capability. Option “W&F” adds wow & flutter measurement capability.

Unless otherwise noted, all specifications assume dc coupling, rms detection, and auto-ranging operation.

Analog Input Characteristics

Input Ranges	40 mV to 160 V in 6.02 dB steps
Maximum Rated Input	230 Vpk, 160 Vrms (dc to 20 kHz); overload protected in all ranges
Input Impedance	
Balanced	200 kΩ / 95 pF (differential)
Unbalanced	100 kΩ / 185 pF
Terminations	Selectable 600 Ω or 300 Ω, each ±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

Level Meter Related

Measurement Range	5 mV to 160 V for specified accuracy and flatness, usable to <100 μV
Resolution (full scale)[10]	
4/s and 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]

9 *Not valid below 50 Hz with ac coupling.*

10 *Resolution within a given range is equal to its full scale value multiplied by the fraction indicated for 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.*

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)

Frequency Meter Related

Measurement Range	10 Hz–500 kHz
Accuracy	±0.0006% [±6 PPM]
Resolution	6 digits + 0.000244 Hz
Minimum Input	5 mV

Phase Measurement Related

Measurement Ranges	±180, –90 / +270, or 0 / +360 deg
Accuracy[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

Wideband Amplitude/Noise Function

Measurement Range	<1 μV to 160 Vrms
Accuracy (1 kHz)	±1.0% [±0.09 dB]
Flatness (1 kHz ref)[11]	
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	*see Figure 9*
LF –3 dB	<10 Hz, 22 Hz per IEC468 (CCIR), 100 Hz ±5% (3-pole), or 400 Hz ±5% (3-pole)

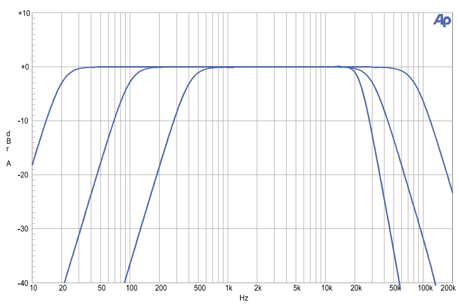


Figure 9. Typical responses of the standard band-limiting filters.

[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.*

[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.*

HF –3 dB	22 kHz per IEC468 (CCIR), 30 kHz ±5% (3-pole), 80 kHz ±5% (3-pole), or >500 kHz
Optional Filters	up to 7 *(see section on Option Filters)*
Detection	RMS (τ = 25 ms or 50 ms), Average, QPk per IEC468 (CCIR), Pk (pseudo-peak), or S-Pk (0.7071 × Pk reading)
Residual Noise	
22 Hz–22 kHz BW	≤1.0 µV [–117.8 dBu]
80 kHz BW	≤2.0 µV [–111.8 dBu]
500 kHz BW	≤6.0 µV [–103.8 dBu]
A-weighted	≤0.5 µV [–123.8 dBu]
CCIR-QPk	≤2.5 µV [–109.8 dBu]

Bandpass Amplitude Function

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

Bandreject Amplitude Function

Tuning Range (f_o)	10 Hz–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)

THD+N Function

Fundamental Range	10 Hz–200 kHz
Measurement Range	0–100%
Accuracy	±0.3 dB, 20 Hz–120 kHz harmonics
Measurement Bandwidth	
LF –3 dB	<10, 22, 100, or 400 Hz
HF –3 dB	22k, 30k, 80k, or >500 kHz (Option filter selection also affects bandwidth)
Residual THD+N[13]	
At 1 kHz	≤(0.00025% + 1.0 µV) [–112 dB], 22 kHz BW

[13] *System specification measured with the Cascade Plus analog generator and the analog analyzer set to the indicated measurement bandwidth (BW). Generator amplitude setting must be ≤12 Vrms balanced or ≤6 Vrms unbalanced for specified system performance below 30 Hz. At higher amplitude settings generator THD derates to 0.0020% from 20 Hz–30 Hz.*

	(valid only for analyzer inputs ≤8.5 Vrms.)
20 Hz–20 kHz	≤(0.0003% + 1.0 μV) [–110.5 dB], 22 kHz BW ≤(0.0005% + 2.0 μV) [–106 dB], 80 kHz BW ≤(0.0010% + 5.0 μV) [–100 dB], 500 kHz BW
10 Hz–100 kHz	≤(0.0040% + 5.0 μV) [–88 dB], 500 kHz BW
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

Crosstalk Function

Frequency Range	10 Hz–200 kHz
Accuracy[14]	±0.4 dB, 20 Hz–120 kHz
Residual Crosstalk[14]	
10 Hz–20 kHz	≤ –140 or 1 μV
20 kHz–100 kHz	≤ –126 dB or 2.5 μV

IMD Measurements

with option "IMD"

Option "IMD" adds the capability to measure intermodulation distortion (IMD) using three of the most popular techniques. The demodulated IMD signal can also be selected for FFT analysis in SYS-2622 and SYS-2722 configurations.

SMPTE (DIN) IMD Function

Test Signal Compatibility	Any combination of 40 Hz–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 to 20%
Accuracy	±0.5 dB
Residual IMD[15]	≤0.0015% [–96.5 dB], 60/7 kHz or 250/8 kHz

CCIF and DFD IMD Functions

Test Signal Compatibility	Any combination of equal amplitude tones from 4 kHz to 100 kHz spaced 80 Hz to 1 kHz
IMD Measured	
CCIF	2nd order difference frequency product relative to the amplitude of either test tone

[14] 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.

[15] System specification measured with the Cascade Plus analog generator at any valid input level ≥200 mVrms.

DFD	u_2 (2nd order difference frequency product) per IEC 268-3 (1986)
Measurement Range	0 to 20%
Accuracy	±0.5 dB
Residual IMD[15]	CCIF ≤0.0004% [–108 dB], 14 kHz + 15 kHz, DFD ≤0.0002% [–114 dB], 14 kHz + 15 kHz

DIM (TIM) IMD Function

Test Signal Compatibility	2.96 kHz–3.15 kHz squarewave mixed with 14 kHz–15 kHz sine wave (probe tone)
IMD Measured[16]	u_4 and u_5 per IEC 268-3 (1986)
Measurement Range	0 to 20%
Accuracy	±0.7 dB
Residual IMD15	≤0.0020% [–94 dB]

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-2622 and SYS-2722 configurations.

Test Signal Compatibility Normal "High-band"	 2.80 kHz–3.35 kHz 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 Unweighted Scrape[17] Wideband[17]	 4 Hz bandpass per IEC/DIN/NAB 0.5 Hz–200 Hz 200 Hz–5 kHz 0.5 Hz–5 kHz
Residual W+F Weighted Unweighted Scrape or Wideband	 ≤0.001% ≤0.002% ≤0.005%
Minimum Input	5 mV, 20 mV for specified residual
Settling Time IEC/DIN or NAB JIS	 Typically 3 to 6 seconds Typically 15 to 20 seconds

[16] IEC 268-3 defines nine possible DIM products. The Cascade Plus 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.

[17] Operational only with high-band test signals (11.5 kHz–13.5 kHz). Upper –3 dB rolloff is typically 4.5 kHz using 12.5 kHz.

Option Filters

Up to seven option filters can be installed in the analog analyzer for weighted noise or other special measurements. Only one option filter may be enabled at a time, and it is cascaded with the standard bandwidth limiting filters. The following tables list only the most popular types. Consult Audio Precision for custom designs.

Weighted Noise Measurement

FIL-AWT	"A" weighting per IEC Rec 179	*see Figure 10*
FIL-CCR	Weighting per IEC468 (CCIR) and DIN 45404 (Also for CCIR/ARM)	*see Figure 11*
FIL-CIT	Weighting per CCITT Rec P53	*see Figure 12*
FIL-CMS	"C-message" per BSTM 41004 and ANSI/IEEE Std 743-1984	*see Figure 13*
FIL-CWT	"C" weighting per IEC Rec 179	*see Figure 14*

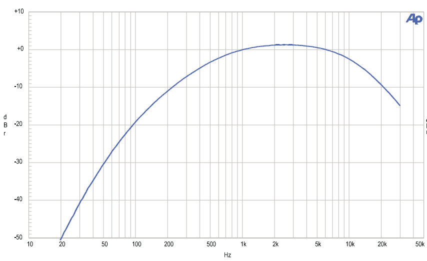


Figure 10. FIL-AWT. ANSI-IEC "A" Weighting Filter

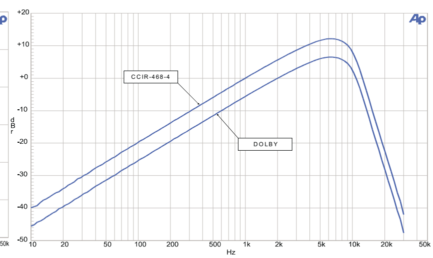


Figure 11. FIL-CCR. IEC468 (CCIR)/ DIN 45404 Noise Weighting Filter

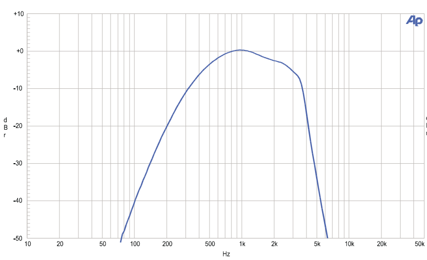


Figure 12. FIL-CIT. CCITT P53 Noise Weighting Filter

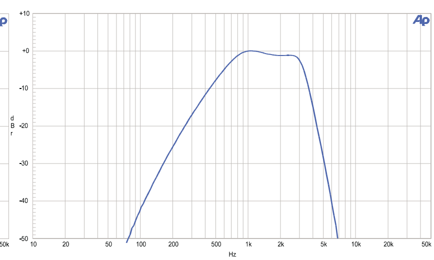


Figure 13. FIL-CMS.C-Message Weighting Filter (ANSI/IEEE 743-1984)

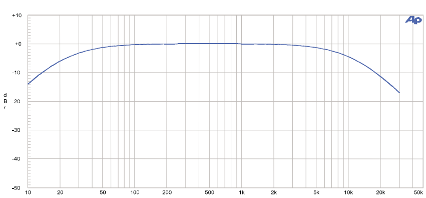


Figure 14. FIL-CWT. "C" Weighting (IEC-179)

Precision De-emphasis Family

FIL-D50	50 µs ±1%	*see Figure 15*
FIL-D50E	50 µs ±1% + 15.625 kHz notch	
FIL-D50F	50 µs ±1% + 19.0 kHz notch	*see Figure 16*
FIL-D75	75 µs ±1%	*see Figure 17*
FIL-D75B	75 µs ±1% + 15.734 kHz notch	*see Figure 18*
FIL-D75F	75 µs ±1% + 19.0 kHz notch	*see Figure 19*

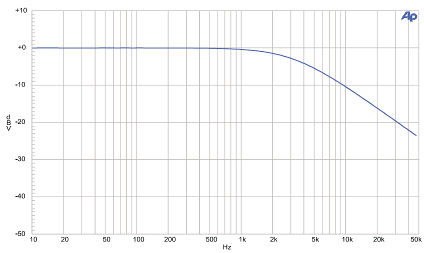


Figure 15. FIL-D50.50 µs De-emphasis Filter.

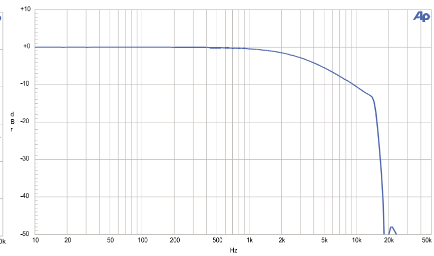


Figure 16. FIL-D50F. 50 µs with 19 kHz (FM) notch De-emphasis Filter.

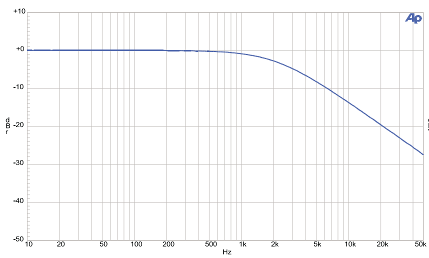


Figure 17. FIL-D75. 75 µs De-emphasis Filter.

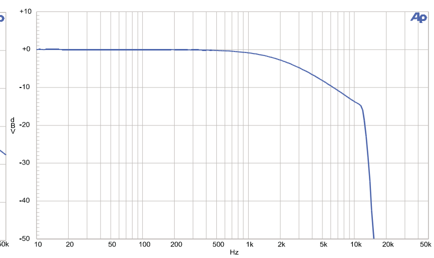


Figure 18. FIL-D75B. 75 µs with 15.734 kHz (NTSC) notch De-emphasis Filter.

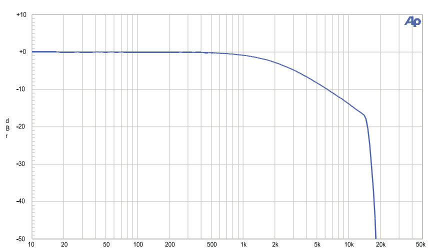


Figure 19. FIL-D75F. 75 µs with 19 kHz (FM) notch De-emphasis Filter.

Very Sharp Cutoff Low-Pass Filter Family

FLP-B20K	±0.1 dB, 10 Hz–20 kHz; >60 dB attenuation at 24 kHz and higher. Complies with AES17. *see Figure 20*
FLP-B40K	±0.1 dB, 10 Hz–40 kHz; >60 dB attenuation at 48 kHz and higher. Complies with AES17.

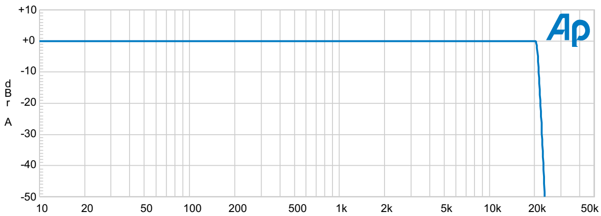


Figure 20. FLP-B20K "Brick Wall" 20 kHz low pass filter. Complies with requirements of AES17 for D/A converter THD+N measurements.

General Purpose Low-Pass

FLP-300	300 Hz ±3%, 5-pole	
FLP-400	400 Hz ±3%, 5-pole	
FLP-500	500 Hz ±3%, 5-pole	
FLP-1K	1 kHz ±3%, 5-pole	*see Figure 21*
FLP-3K	3 kHz ±3%, 7-pole	
FLP-4K	4 kHz ±3%, 7-pole	
FLP-8K	8 kHz ±3%, 7-pole	*see Figure 22*
FLP-50K	50 kHz ±5%, 3-pole	

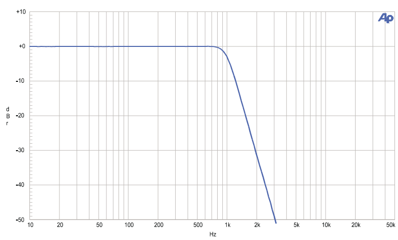


Figure 21. 1 kHz 5-pole Low Pass Filter.

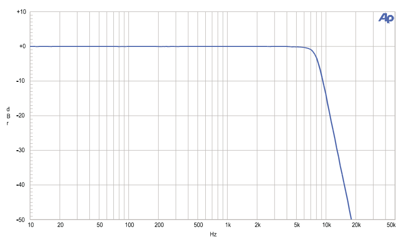


Figure 22. 8 kHz 7-pole Low Pass Filter.

General Purpose High-Pass

FHP-70	70 Hz ±3%, 8-pole	
FHP-400	400 Hz ±3%, 9-pole	*see Figure 23*
FHP-2K	2 kHz ±3%, 9-pole	

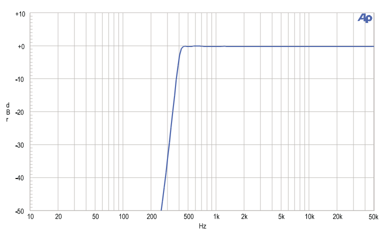


Figure 23. FHP-400. 400 Hz 9-pole High Pass Filter.

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 *see Figure 24*
FBP-120	f_o = 120 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-800	f_o = 800 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-4000	f_o = 4.00 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-20000	f_o = 20.0 kHz
FBP-30000	f_o = 30.0 kHz

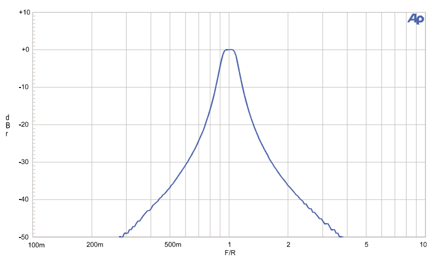


Figure 24. FBP-xxxx. Normalized Response of 1/3-Octave Band Pass Filters

Receiver Testing

FIL-RCR	200 Hz–15 kHz + 19.0 kHz notch	*see Figure 25*
FIL-IECR	20 Hz–15 kHz + 15.625 kHz notch	*see Figure 26*

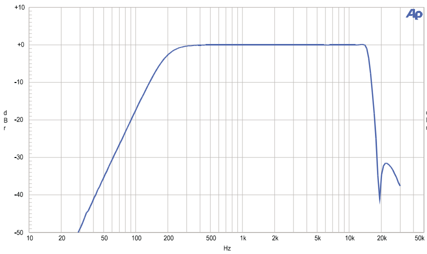


Figure 25. FIL-RCR. 200 Hz to 15 kHz with 19 kHz (FM) notch.

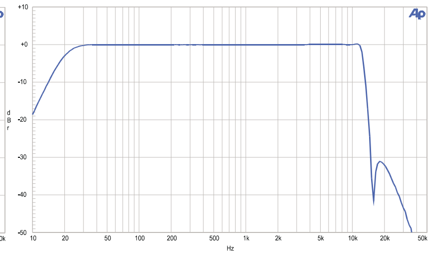


Figure 26. FIL-IECR. 20 Hz to 15 kHz with 15.625 kHz (PAL) notch.

Miscellaneous

FBP-500X	High-Q 500 Hz bandpass for CD DAC linearity measurements	*see Figure 27*
FIL-USR	Kit for building custom filters	

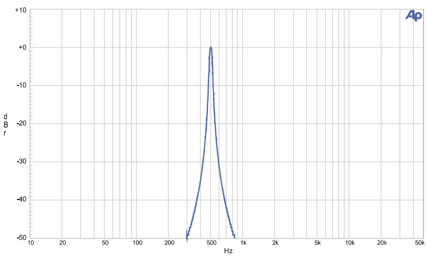


Figure 27. FBP-500X. High-Q 500 Hz Band Pass Filter (for CD linearity testing).

Option S-AES17

Option S-AES17 adds the capability to insert a 20 kHz or 40 kHz low-pass filter following the selected analog input preamplifier, but before any signal processing within the analog analyzer. It enables accurate noise and THD+N measurements of sigma-delta converters and switching power amplifiers that contain large amounts of unwanted energy above the normal audio bandwidth.

High performance sigma-delta converters and switching power amplifiers often contain out-of-band energy that can exceed the in-band audio signal. Standard bandwidth limiting and noise weighting filters will not give accurate measurements due to their relatively low roll-off rates.

Option S-AES17 also includes the FLP-B20K and FLP-B40K option filters. These have been designed to work in tandem with the selectable pre-analyzer filters to provide THD+N measurements in accordance with AES17-1998.

Pre-Analyzer Filter Response

(also affects the LEVEL and FREQUENCY meters of the selected channel)

20 kHz	±0.10 dB, 10 Hz to 20 kHz (typ –3 dB at 25 kHz, <–60 dB above 60 kHz)
40 kHz	±0.10 dB, 10 Hz to 40 kHz (typ –3 dB at 50 kHz, <–60 dB above 120 kHz)

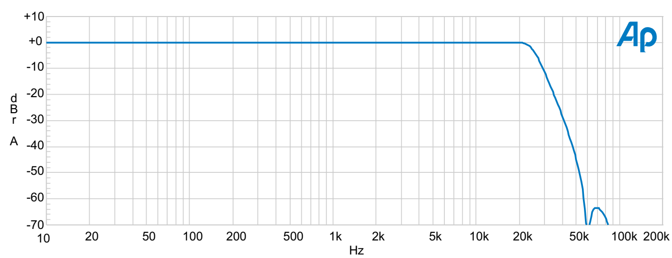


Figure 28. Typical response of 20 kHz “pre-analyzer” filter.

Residual THD+N (1 kHz)

“20k AES17” mode	≤(0.00030% + 1.0 μV) [–110.5 dB]
“40k AES17” mode	≤(0.00040% + 1.4 μV) [–108 dB]

DSP Analysis of Analog Signals

Available only in SYS-2622 and SYS-2722 configurations. Signals connected to the analog analyzer input connector may be routed through stereo A/D converters for enhanced analysis capabilities. There are two selectable converters. The high-resolution converter ("HiRes A/D") is optimized for signal analysis and FFT displays up to 30 kHz. It offers the best residual noise and distortion performance. The high bandwidth converter ("HiBW A/D") is optimized for signal analysis up to 120 kHz.

The term "SR" refers to sample rate, in hertz.

High Resolution Converter

A/D Resolution	24-bit sigma-delta
Sample Rate (SR)	7.2 ks/s to 108 ks/s variable; or 65.536 ks/s fixed
Flatness (1 kHz ref)	±0.01 dB to 0.45× SR or 20 kHz, whichever is lower
Alias Rejection[18]	typically >115 dB for signals >0.554 SR
Distortion	–105 dB for SR ≤65.536 ks/s, –102 dB for SR up to 100 ks/s

High Bandwidth Converter

A/D Resolution	16-bit sigma-delta
Sample Rate (SR)	56 ks/s to 216 ks/s variable; or 131.072 ks/s or 262.144 ks/s fixed
Flatness (1 kHz ref)	±0.01 dB to 20 kHz, ±0.10 dB to 120 kHz (262.144 ks/s)
Alias Rejection[18]	typically >85 dB for signals > 0.540× SR
Distortion	–92 dB for SR ≤216 ks/s, –90 dB with SR = 262.144 ks/s

FFT Signal Analyzer

(With "FFT" DSP program)	
Acquisition Length	800 to 4 M samples in 15 steps
Transform Length	256 to 32768 samples in binary steps
Processing	48 bit
Amplitude Accuracy	±0.05 dB, 20 Hz to 20 kHz Flat-top or Move to Bin Center windows
Averaging	1 to 4096 in binary steps. Averaging is power-based (frequency domain), or synchronous (time domain).
Waveform Display Modes	
Time Domain	Normal, Interpolate, Peak or Max
Frequency Domain	Peak pick (highest bin amplitude is displayed between the requested graph points)
Frequency Display Modes	Peak pick, individual bin

[18] *Alias rejection is provided by digital filters within the A/D converters.*

Windows *see Figure 29 and Figure 30*	Blackman-Harris (4-term with –92 dB sidelobes) Hann Flat-top Equiripple (AP design with –160 dB sidelobes) None None, move to bin center Hamming Gaussian Rife-Vincent 4-term Rife-Vincent 5-term
Move to bin center Window	
Frequency Range	±4% of input frequency, 7^{th} FFT bin (low limit); to $0.45 \times SR$ (high limit).
Spurious Products	<–120 dB

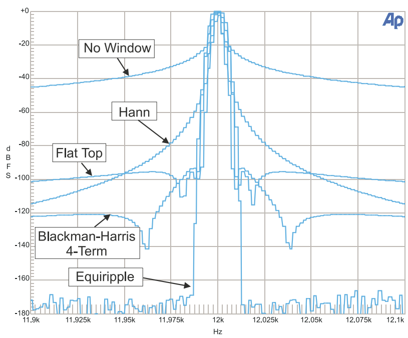


Figure 29. Windowing functions for FFT (A)

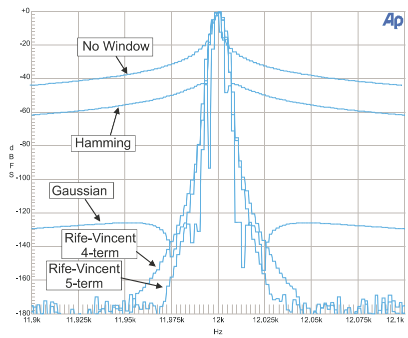


Figure 30. Windowing functions for FFT (B)

DSP Audio Analyzer

with "Analyzer" DSP program

Wideband Level/Amplitude

Frequency Range	<10 Hz to 45% of sample rate [10 Hz to 21.6 kHz at 48 ks/s]
High pass Filters	<10 Hz 4-pole 22 Hz 4-pole 100 Hz 4-pole 400 Hz 4-pole (4-pole Butterworth or 10-pole elliptic if no other filters are enabled)
Low pass Filters	Fs/2 (maximum bandwidth) 20 kHz (6-pole elliptic) 15 kHz (6-pole elliptic)
Weighting Filters	ANSI-IEC "A" weighting, per IEC Rec 179 CCIR QPk per IEC468 (CCIR) CCIR RMS per AES17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. O.41 "F" weighting corresponding to 15 phon loudness contour *see Figure 31* HI-2 Harmonic weighting

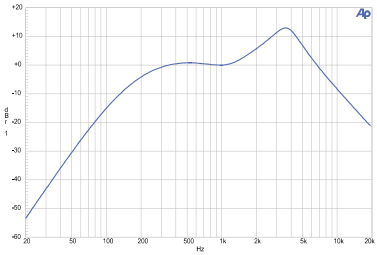


Figure 31. Digital Analyzer F-weighting curve.

Narrow Band Amplitude

Frequency Range	<10 Hz to 47% of sample rate [10 Hz to 22.56 kHz at 48 ks/s]
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *see Figure 32*

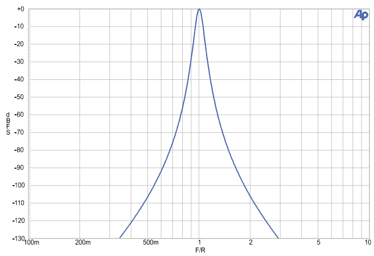


Figure 32. Digital Domain Bandpass filter response.

THD+N Measurements

Frequency Range	<10 Hz to 47% of sample rate [10 Hz to 22.56 kHz at 48 ks/s]
High pass Filters	<10 Hz (4-pole) 22 Hz (4-pole) 100 Hz (4-pole) 400 Hz (4-pole Butterworth)
Low pass Filters	Fs/2 (maximum bandwidth) 20 kHz (6-pole elliptic) 15 kHz (6-pole elliptic)
Weighting Filters	ANSI-IEC “A” weighting, per IEC Rec 179 CCIR QPk per IEC468 (CCIR) CCIR RMS per AES17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. O.41 “F” weighting corresponding to 15 phon loudness contour *see Figure 29* HI-2 Harmonic weighting

Frequency Measurements

Range	<10 Hz to 47% of sample rate [10 Hz–23.0 kHz at 48 ks/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

Phase Measurements

Measurement Ranges	±180, –90/+270, or 0/+360 degrees
Accuracy[19] 10 Hz–5 kHz 5 kHz–20 kHz 20 kHz–50 kHz	 ±0.5 degree ±1 degree ±2 degrees
Resolution	0.01 degree
Minimum Input	1 mV, both inputs

SMPTE IMD Measurements

Test Signal Compatibility	Any combination of 40 to 250 Hz (LF) and 2 kHz to 45% of sample rate (HF) tones, mixed in any ratio from 1:1 to 5:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. –3dB measurement bandwidth is 10 Hz to 750 Hz.
Measurement Range	0 to 20%
Accuracy	±0.5 dB
Residual IMD[20]	≤0.0025%, 60 + 7 kHz or 250 + 8 kHz

Quasi-Anechoic Acoustical Tester

With "MLS" DSP program

Signals	Four pink sequences, four white sequences
Frequency Range	(Sample rate ÷ 2000) to (sample rate ÷ 2)
Frequency Resolution (Max)	1.465 Hz at 48.0 ks/s
Acquisition Length	32767 samples or 131071 samples
FFT Length	32768
Energy Time Windows	half Hann Hann <240 Hz to >8 kHz <120 Hz to >16 kHz

[19] Both analog analyzer input channels must have same coupling (ac or dc) selection, and both DSP analyzer input channels must have same coupling (ac or dc) selection. Accuracy is valid for any input signal amplitude ratio up to ±30 dB. Upper frequency range limited to 45% of sample rate.

[20] System specification measured with the System Two Cascade Plus analog generator. Valid for input levels ≥200 mVrms.

Time Windows (percent of data record to transition from 0 to full amplitude)	<5% <10% <20% <30%
Averaging	1 to 4096 in binary steps. Averaging algorithm is synchronous.

Multitone Audio Analyzer

With "FASTTEST" DSP program

Acquisition Length	512 to 32768 samples in binary steps
Transform Length	512 to 32768 samples in binary steps
Processing	48 bit
Measurements	Level vs frequency (Response), Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve
Frequency Resolution	(Sample Rate ÷ Transform Length) [1.465 Hz with SR = 48 ks/s & Transform Length = 32768]
Frequency Correction Range	±3%
Distortion	≤–115 dB

Digital Signal Generator

Available only in the SYS-2700 and SYS-2722 configurations. The System Two Cascade *Plus* 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.

Except for arbitrary waveforms, the digital outputs and the digitally generated analog signals are independently selectable and concurrently available. If both digital and analog outputs are selecting arbitrary waveform, it must be the same one.

Digital Output Characteristics

Output Formats	AES/EBU (per AES3-1992) SPDIF-EIAJ per IEC 60958 Optical (Toslink®) per IEC 60958 General purpose serial General purpose parallel Serial interface to chip level via optional PSIA-2722
Sample Rates	11 kHz–108 kHz AES/EBU, 22 kHz–216 kHz dual connector AES/EBU, general purpose serial; 8 kHz to 216 kHz parallel; independent of input sample rate
Sample Rate Resolution	1/64 Hz (approx. 0.0156 Hz)
Sample Rate Accuracy	±0.0002% [±2 PPM] using internal reference, lockable to external reference
Word Width	8 to 24 bits
Encoding	Linear, µ-Law, A-Law
Nominal Output Impedance Balanced (XLR) Unbalanced (BNC)	 110 Ω 75 Ω

Digital Signal Generation

Sine Family Common Characteristics

Waveforms	Sine, Sine Burst (rectangular envelope), Variable Phase Sine (two sine waves of same frequency but settable phase), Stereo Sine (independent frequency and amplitude in each channel), Dual Sine (sum of two sine waves with variable ratio), Sine + Offset, and Shaped Sine Burst (raised cosine envelope)
Frequency Range	10 Hz to <50% of Sample Rate [<24 kHz at 48 ks/s]
Frequency Resolution	Sample Rate ÷ 2^{23} [0.006 Hz at 48 ks/s]
Flatness	±0.001 dB
Harmonics/Spurious Products	≤0.000001% [–160 dB]

Variable Phase Sine Wave

Phase Range	±180 deg.
Phase Resolution	0.01 deg.

Sine + Offset

Offset Amplitude	Sine amplitude + |offset amplitude| ≤100% Fs

Sine Burst and Shaped Sine Burst

Envelope	Rectangular for Sine Burst, Raised cosine for Shaped Burst *see Figure 33*
Interval	2 to 65536 cycles
Burst On	1 to (number of Interval cycles minus 1)

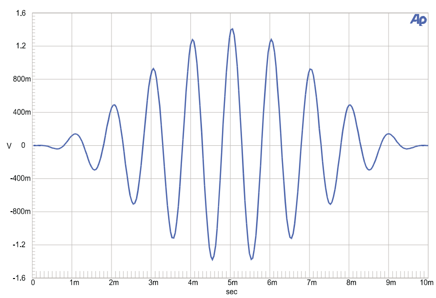


Figure 33. Shaped Sine Burst signal. (1 kHz, 10 cycles)

Square Wave

Frequency Range	≤1 Hz to 1/6 sample rate. Frequencies are limited to even integer sub-multiples of the Sample Rate.
Even Harmonic Content	≤0.000001% [–160 dB]

SMPTE/DIN Waveform

Upper Tone Range	2 kHz to <50% of sample rate [<24 kHz at 48 ks/s]
Lower Tone Range	40 Hz–500 Hz
Amplitude Ratio	1:1 or 4:1 (LF:HF)
Distortion/Spurious	≤0.000001% [–160 dB] at 4:1 ratio

CCIF and DFD IMD Waveforms

Center Frequency Range	3000 Hz to (<50% of sample rate –½ IM freq.)
IM Frequency Range	80 Hz–2.00 kHz
Distortion/Spurious	≤0.000001% [–160 dB]

DIM IMD Waveform

Square/Sine Frequencies	Determined by Sample Rate (see Note below)
Distortion/Spurious	≤0.000001% [–160 dB]

The DIM test signal consists of a square wave and a sine wave mixed in a 4:1 amplitude ratio. Since digital square waves are generated by alternately turning the output on and off for the same number of sample periods, the frequencies achievable are limited to even sub-multiples of the Sample Rate. Because of this constraint, the square wave frequency is chosen first to be as close to the "ideal" analog test frequency as possible. The sine wave frequency is then chosen based upon the ideal sine/square frequency ratio. The following table lists some examples for the DIM and DIMB signals:

DIM: "ideal" square frequency = 3150, sine/square frequency ratio = 100/21		
Sample Rate	Square Wave Frequency	Sine Wave Frequency
44100	3150	15000
48000	3000	14285.7
DIMB: "ideal" square frequency = 2960, sine/square frequency ratio = 175/37		
44100	3150	14898.65
48000	3000	14189.19

Noise

Types	Pink, white, burst USASI

Special Signals

Monotonicity	Low level staircase waveform for D/A linearity testing
J-Test	Produces a maximum amount of data-induced jitter on low-bandwidth transmission links
Polarity	Two sinewaves phased for reinforcement with normal polarity
Walking Ones	A single binary one value "walked" from LSB to MSB
Walking Zeros	A single binary zero value "walked" from LSB to MSB
Constant Value (applies only to DC)	(Digital DC)
Bittest Random	Random binary states of all bits
Pass Thru	Passes the signal from the rear panel Ref Input. Accepts sample rates from 27 kHz to 100 kHz and outputs at programmed sample rate. Ratio of rates may not exceed 8:1.
Resolution	32 bit when using triangular dither

Quasi-Anechoic Acoustical Tester (MLS)

(Also see MLS in Digital Analyzer section, page 41)

Signals	Four pink sequences, four white sequences
Frequency Range	DC to 50% of sample rate
Sequence Length	32767 samples or 131071 samples, automatically selected between 32 k or 131 k sequence as supplied by generator

Multitone Signals

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

Maximum Number of Tones	Up to 8191 (maximum length)
Frequency Range	DC to Sample Rate ÷ 2
Frequency Resolution	Sample Rate ÷ 2^{14} (typically 2.93 Hz at 48 ks/s)

Arbitrary Waveforms ("Arb Wfm")

Signal	Determined by the associated file specified in the panel drop-down box.
Length	256 to 16384 points per channel. Utility is provided to prepare waveform from user specified frequency, amplitude, and phase data.
Frequency Resolution	Sample Rate ÷ Length [typically 2.93 Hz at 48 ks/s]

Dither

(may be enabled for all waveforms except Monotonicity, J-Test, Walking Ones and Zeroes, and Random)

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

Pre-Emphasis Filters

(all waveforms)

Filter Shape	50/15 µs or J17
Response Accuracy	±0.02 dB, 10 Hz to 45% of Sample Rate
Residual Distortion	≤0.00003% [–130 dB]

AES/EBU Interface Generation

Interface Signal

Amplitude Range	
Balanced (XLR)	0 to 10.16 Vpp, ±(10% + 80 mV) into 110 Ω. 4 mV steps below 1 Vpp, 40 mV steps above.
Unbalanced (BNC)	0 to 2.54 Vpp, ±(8% + 20 mV) into 75 Ω. 1 mV steps below 0.25 Vpp, 10 mV steps above.
Optical (Toslink®)	0 to 256% of nominal intensity in 1% steps
Channel Status Bits	Full implementation per IEC 60958, English language decoded, Professional or consumer or hex formats; independent in each channel
User Bits	set to 0
Validity Flag	selectable, set or cleared

AES/EBU Impairments

Variable rise/fall time	16 ns–400 ns, ±20%
Induced Jitter	Selectable sinewave, squarewave, or wideband noise
Jitter Freq Range[21]	2.00 Hz–200 kHz, <0.1 Hz resolution
Jitter Ampl Range[21]	0–1.27 UI (peak) in 0.005 UI steps; 1.3–12.7 UI (peak) in 0.05 UI steps
Jitter Accuracy	±(10% + 0.005 UI)
Jitter Flatness[22]	±1 dB, 100 Hz–20 kHz
Residual Jitter[23]	
48 ks/s	≤0.010 UI [1.6 ns]
96 ks/s	≤0.020 UI [1.6 ns]
Spurious Jitter Products	typically 30 dB below jitter signal or <0.001 UI, whichever is larger
Normal Mode Noise	
Balanced	0 to 2.55 Vpp, in 10 mV steps; ±(10% + 100 mV)
Unbalanced	0 to 635 mVpp, in 2.5 mV steps; ±(10% + 25 mV)
Common Mode Freq	20 Hz–40 kHz, <0.1 Hz resolution
Common Mode Ampl	0 to 20 Vpp, in 80 mV steps, ±(10% + 200 mV)
Cable Simulation	Multi-pole fit to AES3-1992 filter to simulate the response degradation of a long cable.
Offset from reference	–64 to +63.5 UI, in 0.5 UI steps

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

[22] *System specification including generator and analyzer contributions valid only at 32.0, 44.1, 48.0, 64.0, 88.2, and 96.0 ks/s only. Flatness may be degraded at other sample rates*

[23] *System specification including analyzer contribution. The following conditions must be met: (1) the jitter generator amplitude must be turned off or set for 0.0000 UI, (2) all other forms of impairment must be off or disabled, and (3) the digital output must be ≥1.0 Vpp (XLR) or ≥250 mVpp (BNC).*

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 (ISR) is not dependent upon the rate or characteristics of the external reference. OSR need not be at 1:1 ratio to reference but will be phase-locked to reference over full specified range of OSR and Reference inputs. Phase lock loop bandwidth is approximately 5 Hz.

Input Formats	AES/EBU (per AES3-1992), NTSC/PAL/SECAM video, or squarewave
Input Sample Rates/ Frequency Range	28.8 kHz–100 kHz AES/EBU, 8.0 kHz–10.0 MHz squarewave
Sample Rate Resolution	
8 kHz–65 kHz	1/128 Hz [0.0078125 Hz]
65 kHz–256 kHz	1/32 Hz [0.03125 Hz]
256 kHz–1 MHz	1/8 Hz [0.125 Hz]
1 MHz–4 MHz	½ Hz [0.5 Hz]
4 MHz–10 MHz	2 Hz
Minimum Input Amplitude	200 mVpp
Nominal Input Impedance	
AES/EBU (XLR)	110 Ω or >5 kΩ
Video, square wave (BNC)	75 Ω or >5 kΩ
Lock Range	±0.0015% [±15 PPM]
Input Delay from Reference Display	Measures delay from 0 to 127.9 UI in seconds, ±60 ns
Reference Rate Display	Measures approximate reference input rate

Reference Output Characteristics

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

Output Format	AES/EBU (per AES11-1994)
Output Sample Rates	28.8 kHz–100 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, in 0.5 UI steps; ±(5% + 0.5 UI)
Residual jitter	≤0.005 UI pk (120 Hz–100 kHz BW)

Digital Analyzer

Available only in the SYS-2700 and SYS-2722 configurations.

Digital Input Characteristics

Input Formats	AES/EBU (per AES3-1992) Dual Connector AES/EBU SPDIF-EIAJ per IEC-60958 Dual Connector SPDIF-EIAJ Optical (Toslink®) per IEC-60958 General purpose serial General purpose parallel Serial interface to chip level via optional PSIA-2722
Sample Rates	28.8 kHz–100 kHz AES/EBU, 64 kHz–200 kHz Dual Connector AES/EBU, 8 kHz to 200 kHz parallel or via PSIA-2722 (independent of output sample rate)
Word Width	8 to 24 bits
Nominal Input impedance	
AES/EBU	110 Ω or ≥2.5 kΩ
SPDIF-EIAJ	75 Ω or ≥3 kΩ

Embedded Audio Measurements

With "Analyzer" DSP program

Wideband Level/Amplitude

Range	–120 dBFS to 0 dBFS (usable to –140 dBFS)
Frequency Range	<10 Hz to 45% of sample rate [10 Hz–21.6 kHz at 48 ks/s]
Accuracy	±0.01 dB
Flatness	±0.01 dB, 15 Hz–22 kHz (<10 Hz high-pass filter selection)
High pass Filters	<10 Hz (4-pole) 22 Hz (4-pole) 100 Hz (4-pole) 400 Hz (4-pole Butterworth, or 10-pole elliptic if no other filters are enabled)
Low pass Filters	Fs/2 (maximum bandwidth) 20 kHz (6-pole elliptic) 15 kHz (6-pole elliptic)
Weighting Filters	ANSI-IEC "A" weighting, per IEC Rec 179 CCIR QPk per IEC468 (CCIR) CCIR RMS per AES17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. O.41 "F" weighting corresponding to 15 phon loudness contour *see Figure 31, page 29* HI-2 Harmonic weighting
Residual Noise (at 48 ks/s and 96 ks/s SR)	–141 dBFS unweighted

	–144 dBFS A-weighted –140 dBFS CCIR RMS –130 dBFS CCIR QPk –142 dBFS 20 kHz LP –143 dBFS 15 kHz LP –139 dBFS "F" weighting –152 dBFS CCITT –151 dBFS C Message

Narrow Band Amplitude

Frequency Range	<10 Hz to 47% of sample rate [10 Hz to 22.56 kHz at 48 ks/s]
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *see Figure 32, page 29*
Residual Distortion	≤–150 dBFS

THD+N Measurements

Frequency Range	<10 Hz to 47% of sample rate [10 Hz to 22.56 kHz at 48 ks/s]
Residual THD+N	≤–138 dBFS *see Figure 34, page 43*
High pass Filters	<10 Hz (4-pole) 22 Hz (4-pole) 100 Hz (4-pole) 400 Hz (4-pole Butterworth)
Low pass Filters	Fs/2 (maximum bandwidth) 20 kHz (6-pole elliptic) 15 kHz (6-pole elliptic)
Weighting Filters	Same as Wideband Level/Amplitude
Residual Noise	Same as Wideband Level/Amplitude

Frequency Measurements

Range	<10 Hz to 47% of sample rate [<10 Hz–22.56 kHz at 48.0 ks/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

Phase Measurements

Measurement Ranges	±180, –90/+270, or 0/+360 degrees
Accuracy[24]	±2 degrees, 10 Hz to 45% of Sample Rate
Resolution	0.01 degree
Minimum Input	–60 dBFS, both inputs

[24] *Both DSP analyzer input channels must have the same coupling (ac or dc) selection.*

SMPTE IMD Measurements

Test Signal Compatibility	Any combination of 40 to 250 Hz (LF) and (2 kHz to <50% of sample rate) (HF) tones, mixed in any ratio from 1:1 to 5:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. (–3 dB measurement bandwidth is typically 20 Hz–750 Hz.)
Measurement Range	0 to 20%
Accuracy	±0.5 dB
Residual IMD	≤–130 dB at 0 dBFS, 60 + 7 kHz or 250 + 8 kHz ≤–110 dB at –25 dBFS, 60 + 7 kHz or 250 + 8 kHz

FFT Spectrum Analyzer

with "FFT" DSP program (48 bit processing)

Acquisition Length	800 to 256 k samples in 11 steps
Transform Length	256 to 32768 samples in binary steps
Processing	48 bit
Windows (see Figures 29 and 30, page 28)	Blackman-Harris (4-term with –92 dB sidelobes) Hann Flat-top Equiripple (–160 dB sidelobes) None None, move to bin center Hamming Gaussian Rife-Vincent 4-term Rife-Vincent 5-term
Amplitude Accuracy	±0.001 dB, 20 Hz to 20 kHz, with Flat-top window
Phase Accuracy[25]	±0.05 degree, 10 Hz to 45% of Sample Rate
Resolution	0.01 degree
Averaging	1 to 4096 in binary steps. Averaging is power-based (frequency domain), or synchronous (time domain)
Distortion Products	≤–160 dB
Frequency Display Modes Time Domain Frequency Domain	 Normal, interpolate, peak or max Peak pick, individual bin
Move to bin center Window Frequency Range Amplitude Accuracy Spurious Products	 ±4% of input frequency, 7th FFT bin (low limit); to 0.45× SR (high limit). ±0.025 dB ≤–120 dB

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

Multi-Tone Audio Analyzer

with "FASTTEST" DSP program (48 bit processing)

Acquisition Length	512 to 32768 samples in binary steps
Transform Length	512 to 32768 samples in binary steps
Processing	48 bit
Measurements	Level vs frequency, Total distortion vs frequency, Noise vs frequency, Phase vs frequency, Crosstalk vs frequency, Masking curve
Frequency Resolution	Sample Rate ÷ 2^{15} [1.465 Hz with 48.0 ks/s]
Frequency Correction Range	±3%
Distortion	≤–140 dB

Quasi-Anechoic Acoustical Tester

with "MLS" DSP program

Signals	Four pink sequences, four white sequences
Frequency Range	Sample rate/2000 to sample rate/2
Frequency Resolution (Max)	1.465 Hz at 48.0 ks/s
Acquisition Length	32767 samples, 131071 samples, automatically selected between 32 k or 131 k sequence as supplied by generator
FFT Length	32768
Energy Time Windows	half Hann Hann <240 Hz to >8 kHz <120 Hz to >16 kHz
Time Windows (percent of data record to transition from 0 to full amplitude)	<5% <10% <20% <30%
Averaging	1 to 4096 in binary steps, synchronous

Digital Interface Analyzer

with "INTERVU" DSP program

INTERVU operates in conjunction with an autoranged 8-bit A/D converter clocked at 80.0 MHz, providing interface signal measurements with >30 MHz bandwidth. INTERVU can display the interface signal in time or frequency domain, as an eye pattern, or as probability graphs of amplitude or pulse width. INTERVU also can demodulate the jitter signal and display it in the time or frequency domain or as a histogram. The jitter signal or the data on the interface may be reproduced through the monitor loudspeaker.

AES/EBU Input Voltage Balanced Unbalanced	 0 to 20.48 Vpp, ±(10% + 50 mV) 0 to 4.096 Vpp, ±(8% + 12 mV)
Jitter Amplitude	0 to 5 UI pk, ±(5% + 0.015 UI)
Residual Jitter	≤0.01 UI (50 Hz–1 MHz BW)
Spurious Jitter Products	≤0.001 UI, or ≤–60 dB below jitter signal
Common Mode Amplitude	0 to 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	32768 bins
Rise Time	≤20 ns
Acquisition time / memory	19.66 ms / 1,572,864 samples

Digital Interface Measurements

AES/EBU Impairments, real time displays

Input Sample Rate	±0.0003% [±3 ppm] internal reference, ±0.0001% [±1 ppm] external reference
Output to Input Delay	Measures status propagation from the AES/EBU output to the input. Range is 0 to 1 frame, resolution ±60 ns.
AES/EBU Input Voltage XLR BNC	 100 mV to 10.16 Vpp, ±(5% + 50 mV) 50 mV to 2.54 Vpp, ±(5% + 12 mV)
Jitter Amplitude[26] 50 Hz–100 kHz BW Other BW selections	 0 to 3.00 UI, ±(10% + 0.01 UI) 0 to 1.00 UI, ±(10% + 0.005 UI)
Jitter Flatness[27]	±1 dB, 100 Hz–20 kHz
Residual Jitter[28]	≤1.6 ns [0.010 UI at 48 ks/s, 0.020 UI at 96 ks/s]

[26] *Jitter amplitude is peak calibrated.*

[27] *System specification including generator and analyzer contributions at 32.0, 44.1, 48.0, 64.0, 88.2, and 96.0 ks/s only. Flatness may be degraded at other sample rates.*

[28] *System specification including generator contribution. The following conditions must be met: (1) the jitter generator amplitude must be turned off or set for 0.0000 UI, (2) all other forms of impairment must be off or disabled, and (3) the digital input must be ≥1.0 Vpp (XLR) or ≥250 mVpp (BNC).*

Jitter Spectrum	Spurious products are typically 40 dB below jitter signal or <0.0003 UI [–70 dBUI], whichever is larger
Common Mode Ampl	0 to 20.48 Vpp, ±(10% + 300 mV), 315 Hz–200 kHz
Cable Equalization	Per AES3-1992
Channel Status Bits	Full implementation, English language decoded (Professional or Consumer) 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)

Graphs of Typical Digital Domain Performance

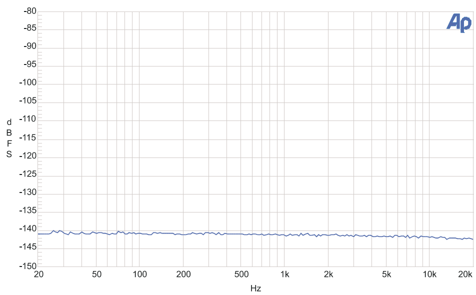


Figure 34. Typical Digital Domain system residual THD+N showing components below –140 dB.

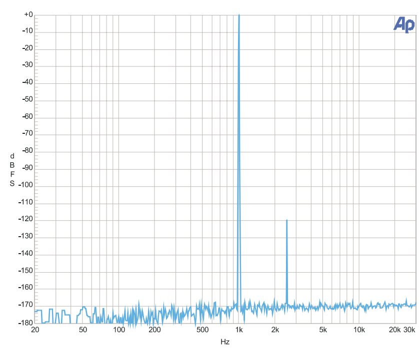


Figure 35. Illustration of typical Digital Domain FFT dynamic range. Signal is 0 dB 1 kHz with a secondary signal at –120 dB and 2.5 kHz.

Auxiliary Signals

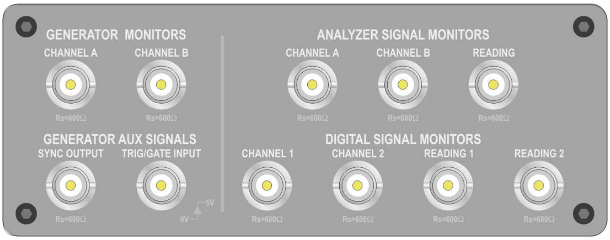


Figure 36. Monitors panel

Generator Signal Monitors

(All units except SYS-2700. See Figure 36)

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

Generator Auxiliary Signals

(All units except SYS-2700. See Figure 36)

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

Analyzer Signal Monitors

(All units except SYS-2700. See Figure 36)

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

Digital Signal Monitors

(SYS-2700.& SYS-2722 only. See Figure 36)

Via four 24-bit D/A converters. Function monitored depends upon analyzer program loaded; for example, noise and distortion products after notch filter are monitored with “DSP Audio Analyzer” 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
Reading 1	Distortion of the digital channel 1 signal
Reading 2	Distortion of the digital channel 2 signal

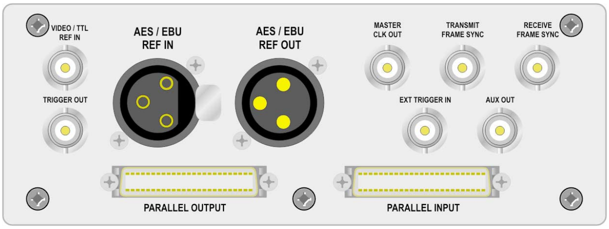


Figure 37. Miscellaneous digital I/O Panel (rear of instrument)

Digital Interface Monitors

(SYS-2700.& SYS-2722 only. See Figure 37)

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	A squarewave at a multiple of the programmed output sample rate (SRO). The multiple is 1024x for sample rates of 6.8 kHz–12 kHz; 512x for sample rates of 12 kHz–24 kHz; and 256x for sample rates of 24 kHz–96 kHz. Selectable between jittered and unjittered signals.

Miscellaneous Digital I/O

(SYS-2700.& SYS-2722 only. See Figure 37)

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

Audio Monitor

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

Power Output	Typically 1 Watt

General/Environmental

Power Requirements	100/120/230/240 Vac (–10%/+6%), 50/60 Hz, 240 VA max
Temperature Range	
Operating	+5°C to +40°C
Storage	–40°C to +75°C
Humidity	90% RH to at least +40°C (non-condensing)
Altitude	2000 m (operating)
EMC[29]	Complies with 89/336/EEC, EN 61326-1 Class B/CISPR 22, and FCC 15 subpart J (class B)
Dimensions	
Width	41.9 cm [16.5 inches]
Height	14.6 cm [5.75 inches] bench-top (with feet) 3U [5.25 inches] rack-mount
Depth	34.5 cm [13.6 inches]
Weight	Approximately 15.4 kg [34 lbs]
Safety	Complies with 73/23/EEC and 93/68/EEC. EN61010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995) Installation Category II—Pollution Degree 2.

[29] *Emission and immunity levels are influenced by the shielding performance of the connecting cables. The shielding performance of the cables will depend on the internal design of the cable, connector quality, and the assembly methods used. EMC compliance was demonstrated using Audio Precision cables CAB-XMF and CAB-AES2.*

Cables and Adapters

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 Figures 38 and 39.

Figure 38. CAB-XBR cable kit

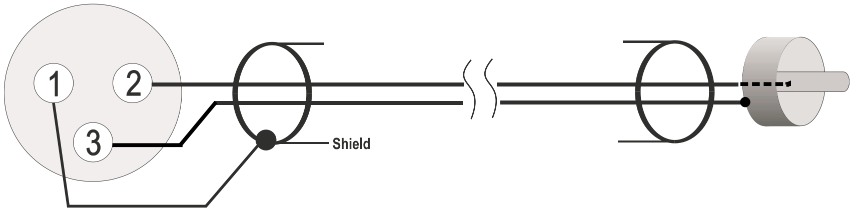


Figure 39. XLR to BNC wiring

Digital Audio Cables

Figure 40. CAB-AES cable set

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

- CAB-AES: Set of two AES/EBU cables, 39 in (1 m) long. See Figure 40.
- 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.
- CAB-DIO: Set of two interface cables, 4.25 ft (1.3 m) long, to connect between the SYS-2722 rear panel 50-pin ribbon input/output connectors to a DUT fixture with 0.1 in spaced 2 x 25-pin headers. See Figure 41.

Figure 41. CAB-DIO cables

Cable Adapters

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

Digital Control (APIB) Cables

These cables can be used as extensions or replacements for the APIB cables that come with each switcher or DCX-127.

- 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).

Chapter 3

Hardware Installation

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

Rack Mounting

There are two styles of rack mount kits available to rack mount Cascade *Plus*: fixed, and slide-out.

Fixed Rack-Mounting Brackets

Install the fixed installation rack mounting kit as shown in Figure 42. The parts required are identified in the table in Figure 43.

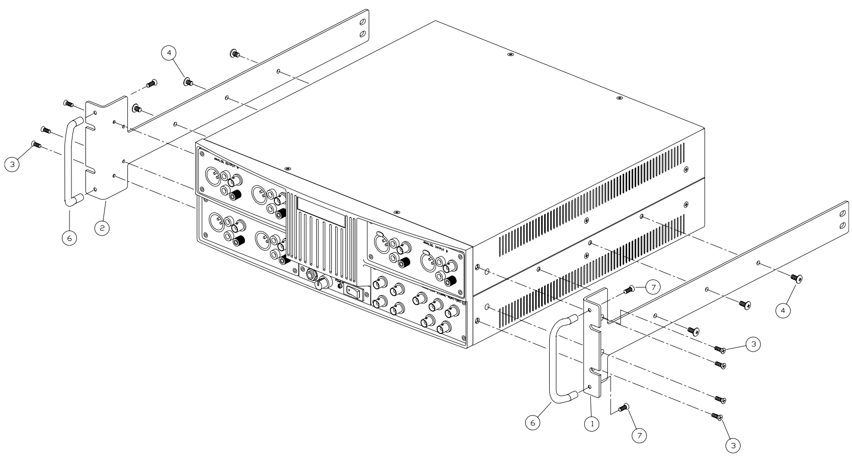


Figure 42. Fixed installation rack mounting kit

Figure 43. Parts list for fixed installation rack mounting

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

Sliding Rack-Mounting Brackets

The slide rack mounting 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 rack mounting kit as shown in Figure 44. The parts required are identified in the table in Figure 45.

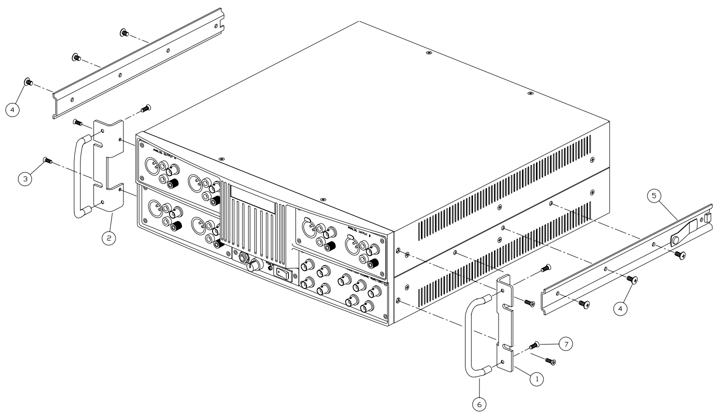


Figure 44. Sliding rack mount installation kit

Figure 45. Parts list for sliding rack mounting installation

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

Checking or Changing Power Line Voltage

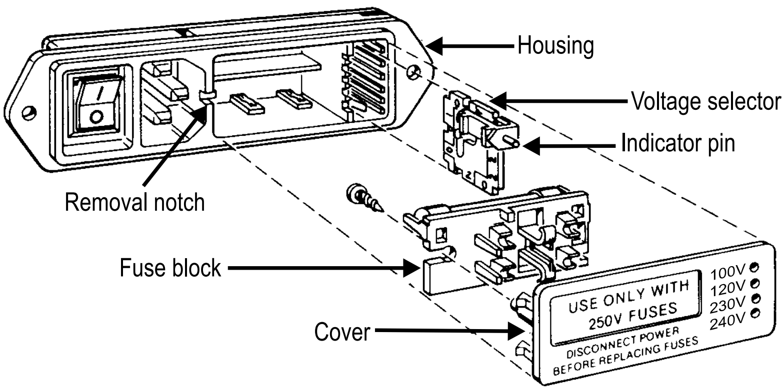


Figure 46. Changing power line voltage

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 46).

To change the input voltage, refer to Figure 46 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.

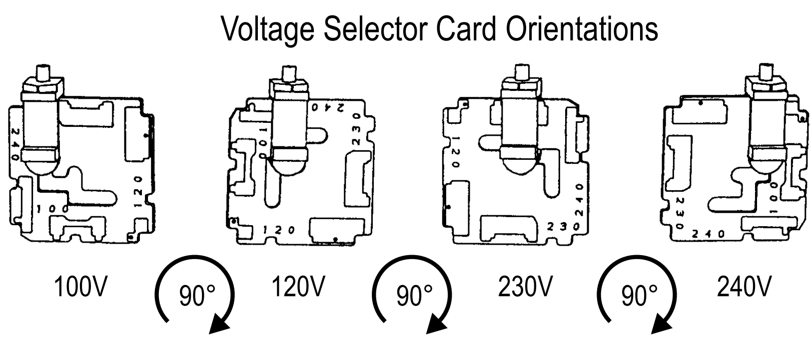


Figure 47. Voltage selector card positions

4. Orient the selector card so that the desired input voltage is readable at the bottom (see Figure 47). 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.

Fuse Information

The connector/fuse block/voltage selector assembly allows two fusing arrangements: North American (see Figure 48), and European (see Figure 49). 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.

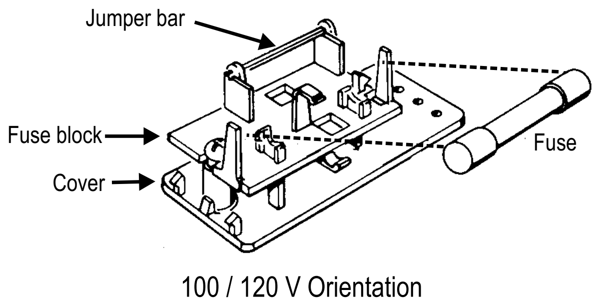


Figure 48. North American fusing arrangement

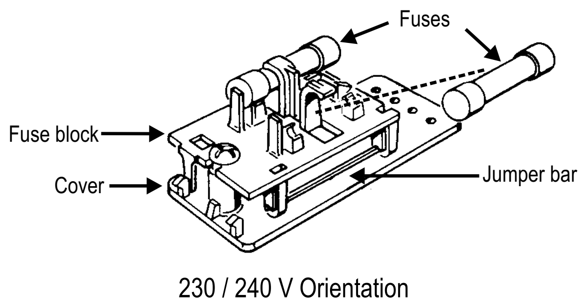


Figure 49. European fusing arrangement

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 50).

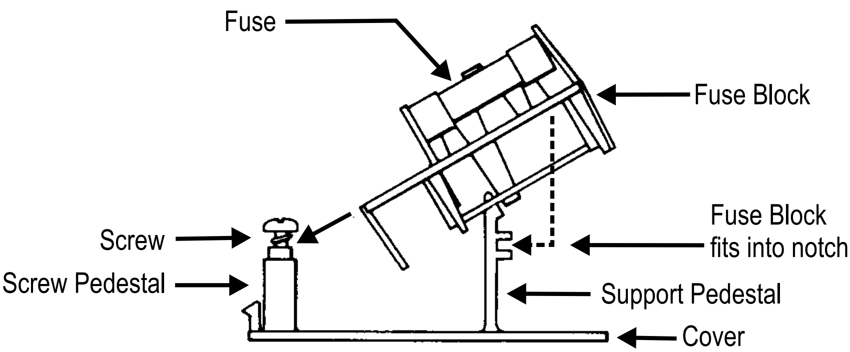


Figure 50. Changing fuse types

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.

Proper Environment

All Audio Precision System One, System Two, System Two Cascade and System Two Cascade *Plus* products are intended for use indoors, in a normal environment. Refer to Chapter 2 for temperature range and humidity specifications.

Connecting Cascade Plus to Your PC

Before connecting System Two Cascade *Plus* to your PC, install the APWIN software. See Chapter 4 for details.

The APWIN software communicates with the Cascade *Plus* chassis through the Audio Precision Interface Bus (APIB). We offer three options for the APIB interface:

- The ISA card. Older PCs use the ISA bus exclusively.
- The PCI card. Some newer PCs use the PCI bus exclusively; many PCs have a mix of both ISA and PCI bus slots available.
- The PCMCIA card. This card allows you to use an existing PCMCIA interface found in many laptop computers. We offer an adapter for desktop PCs without a PCMCIA slot.

Your system was shipped with an APIB interface cable and with the interface option you ordered. Refer to the appropriate section for your interface below.

Installing the ISA-WIN APIB Card

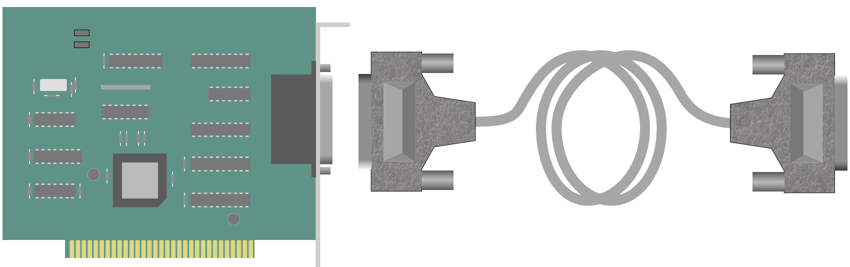


Figure 51. ISA card and APIB cable.

The Audio Precision ISA-WIN card is a half-size, 8-bit ISA card. To install the ISA card, use the following procedure:

- Turn off your computer, remove the cover, and install the ISA APIB interface card in an open ISA bus slot. Remember to handle the card properly to minimize static electricity discharges while installing it. Be sure the card is well seated in the slot; it should snap down firmly into the bus connector.
- Secure the card bracket with the mounting screw and replace the computer cover.
- Connect the APIB cable between Cascade *Plus* and the ISA card.

- Turn on the computer.

ISA Card Address Jumper Settings

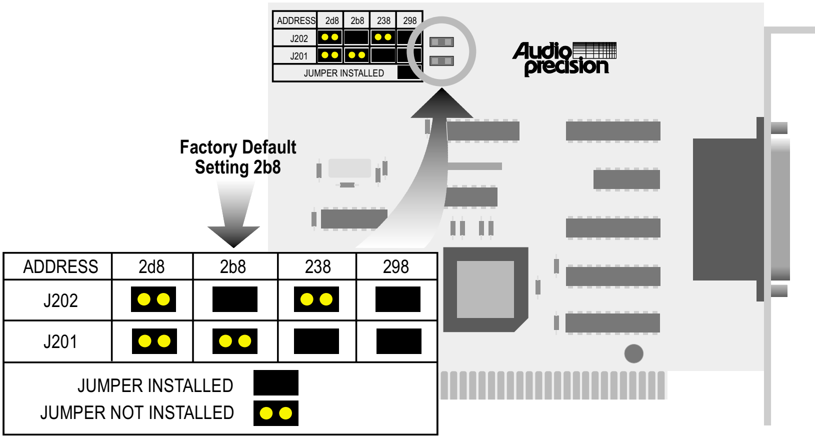


Figure 52. ISA card address jumper settings.

The ISA bus requires a unique hardware address setting for each device sharing the bus. The ISA APIB interface card uses jumpers to select one of four possible addresses, as shown in Figure 52.

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

The card is shipped with the jumpers in the factory default position shown in the table above. If there is a device conflict with the installation of the ISA APIB card, that is, if another device is already using the address, move the jumpers to change the card's address.

Installing a PCI-WIN APIB Card

The PCI interface is compatible with Windows 98, Windows 2000, Windows ME, and Windows NT 4.0. See the Compatibility Chart in the Software area of the Audio Precision Web site for current compatibility listings.

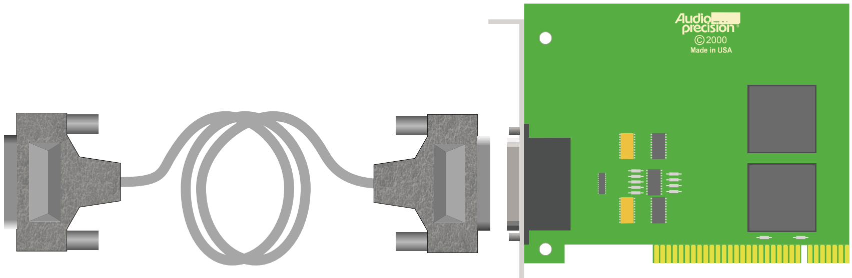


Figure 54. PCI card and APIB cable.

To install the PCI card, use the following procedure:

- Turn off your computer, remove the cover, and install the PCI APIB interface card in an open PCI bus slot. Remember to handle the card properly to minimize static electricity discharges while installing it. Be sure the card is well seated in the slot; it should snap down firmly into the bus connector.
- Secure the card bracket with the mounting screw and replace the computer cover.
- Connect the APIB cable between Cascade *Plus* and the PCI card.

Turn on the computer. Windows should automatically find and identify the APIB interface and install the correct driver.

Using the PCM-WIN PCMCIA Interface Card

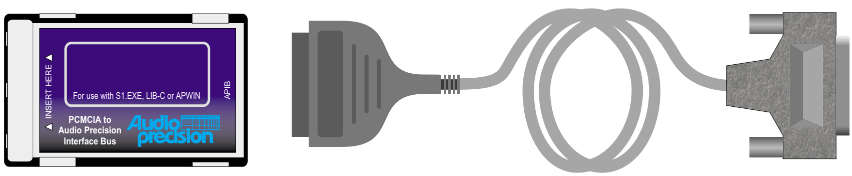


Figure 53. PCMCIA card and APIB cable.

The APWIN PCMCIA interface is most commonly used with laptop computers, but can be used in other computers with the appropriate adapter.

To use the PCMCIA card, you must have a working PCMCIA interface already installed in your computer. If you do not have a PCMCIA interface, Audio Precision offers two adapters: one for an ISA slot, and one for a PCI slot. Please contact Audio Precision Technical Support for details, or visit the Audio Precision Web site.

To install the PCMCIA card, use the following procedure:

- Install the PCMCIA adapter and drivers if necessary by following the instructions supplied with the adapter.
- Insert the PCMCIA card into the PCMCIA interface.

Connect the APIB cable between Cascade *Plus* and the PCMCIA card.

Connecting the APIB Interface

Simply connect the cable from the APIB Interface card in the PC to System Two Cascade *Plus*. If your system includes Audio Precision auxiliary devices such as switchers, a DCX-127 or a PSIA-2722, notice that each device 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 Cascade *Plus* APIB connector. The device's connectors pass the APIB lines through, and the device responds only when specifically addressed. Normally, the computer will be connected to the first device with a digital interface cable, the first device connects to the second, etc, and the last device connects to the System Two Cascade *Plus* digital interface (APIB) connector.

When the APIB bus is connected to more than one device in this manner, be sure that all devices are turned on.

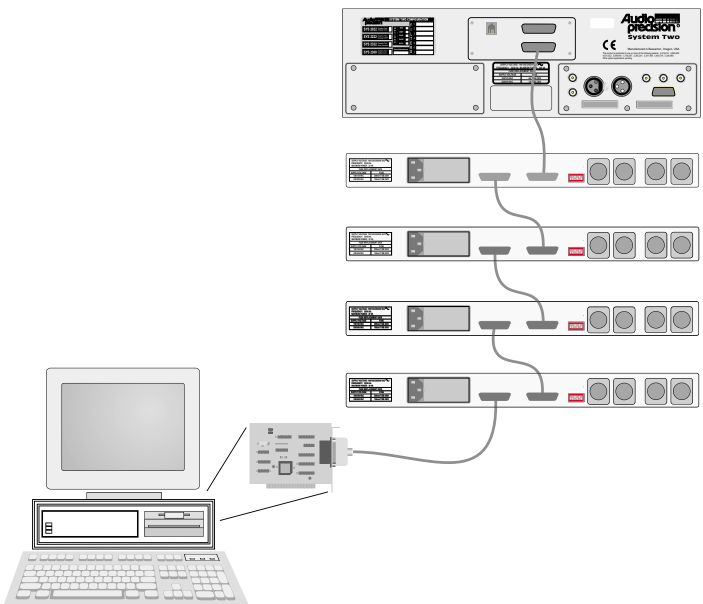


Figure 55. APIB connections block diagram (typical).

Chapter 4

Software Installation

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.

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 58. Otherwise, from Windows Explorer, browse to the file SETUP.EXE in the disk's root directory, and double-click.

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 58. APWIN installation setup screen.

Click on the Install APWIN X.XX 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 57) when you try to install:

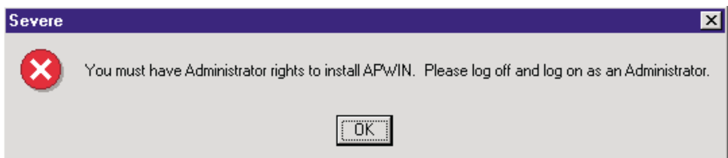


Figure 57. Windows NT administrator rights warning screen

The following screen appears:

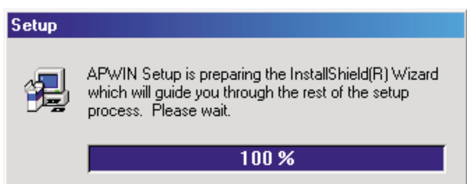


Figure 56. Setup progression screen

After the setup progression screen completes, you should see the Welcome screen of Figure 60:

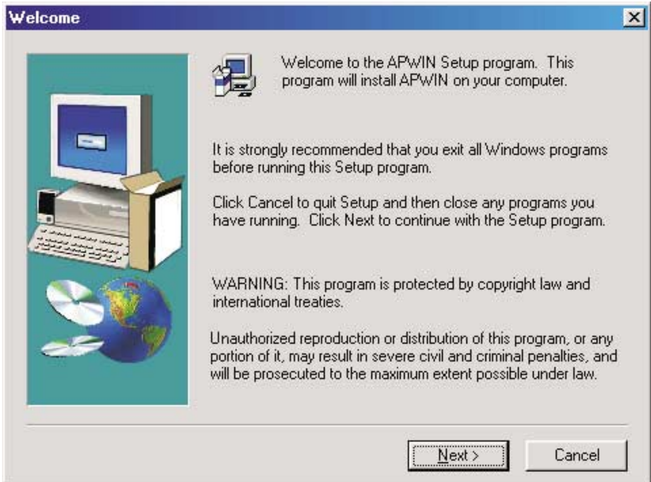


Figure 60. Welcome screen

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

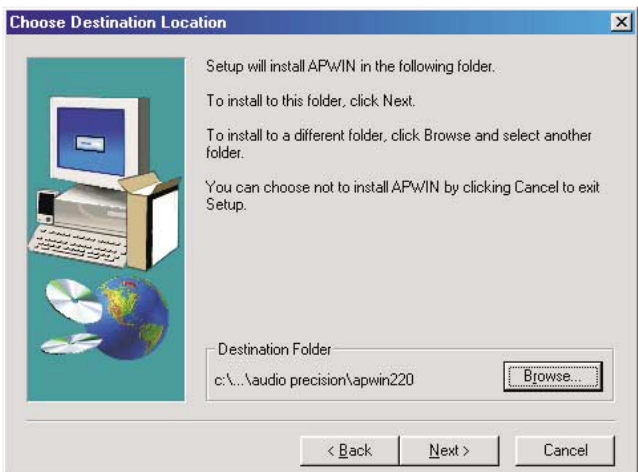


Figure 59. Choose destination location for APWIN

This screen (Figure 59) 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 62 will appear.

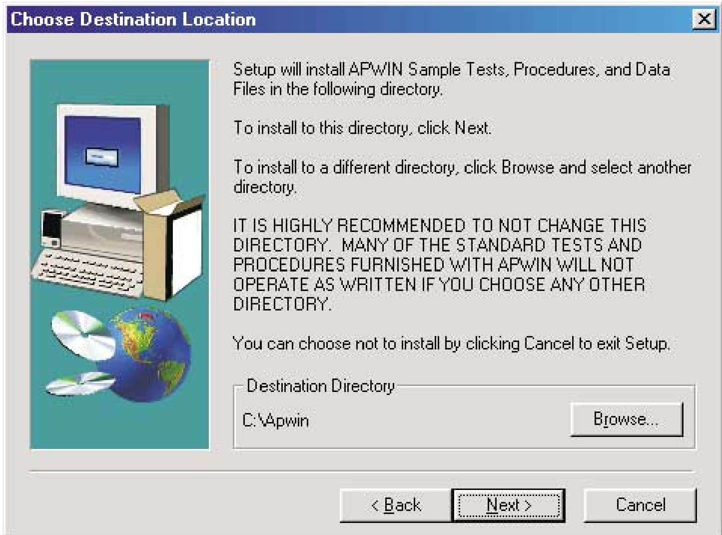


Figure 62. Choose destination location for samples

This screen will suggest a location for all the sample tests, procedures, and data 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 61 will appear.

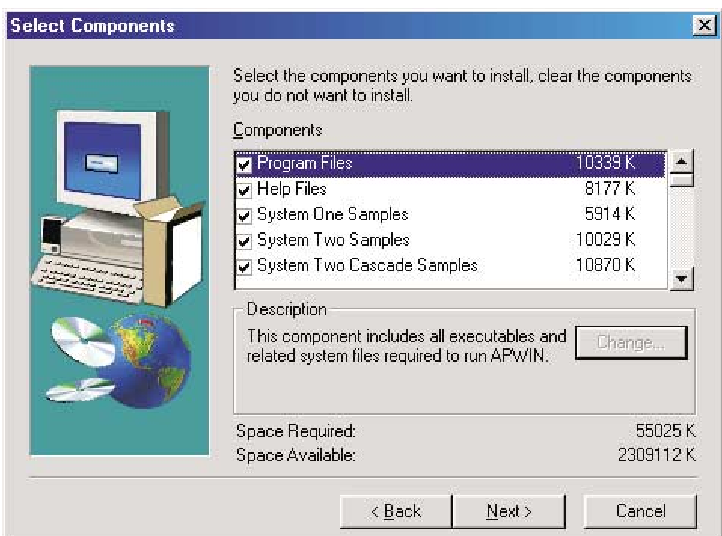


Figure 61. Choose components to install

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.

The next dialog box (Figure 64) 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. 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.

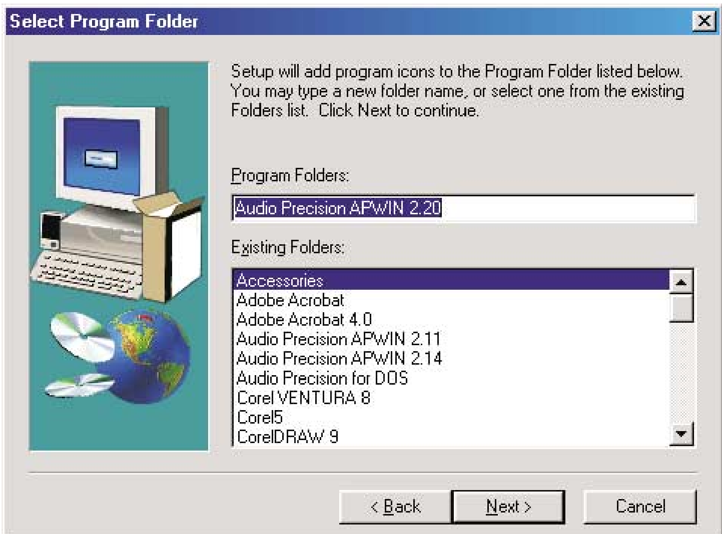


Figure 64. Choose Start Menu group

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

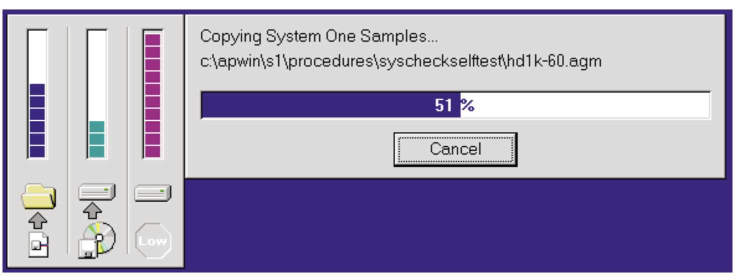


Figure 63. Installation progress screen

After APWIN is successfully installed, the following message window (Figure 65) 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 65. Setup complete message screen

Using the 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 Chapter 3. If you are running Windows NT 4.0, turn off the power to the computer before removing or inserting a PCMCIA card. Windows NT 4.0 does not support hot swapping.

Chapter 5

Getting Started with APWIN

This section will get your system up and running and will put results on the screen for you in mere moments. For more detailed information about APWIN, System Two Cascade *Plus*, and all the options available, see the *APWIN User's Manual* or APWIN Help.

If you haven't done so yet, unpack and install the System Two Cascade *Plus* and APWIN software and hardware components. To mount the APIB interface card, see Chapter 3. To install APWIN software on your computer, see Chapter 4.

Turn on System Two Cascade *Plus* with the rocker switch on the front panel. The blue POWER indicator will light, and you will hear a brief clatter of relay switches from within the unit.

Now launch APWIN on your computer. You should find a shortcut icon on your desktop, or choose **Start > Programs > Audio Precision APWIN 2.2 > APWIN 2.2x**

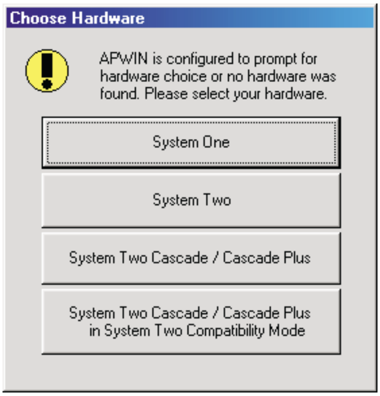


Figure 66. Choose hardware dialog box.

If the dialog box in Figure 66 appears on your screen, APWIN is not exchanging information with System Two Cascade *Plus*. Check your APIB connections and be sure power is applied to System Two Cascade *Plus*. If System Two Cascade *Plus* is not available, you won't be able to perform the tests described here, but you can run APWIN in Demo Mode to become familiar with its interface and capabilities.

If Figure 66 did not appear on your screen, you are properly connected to System Two Cascade *Plus*. As APWIN initializes, you will see the APWIN startup screen and hear the relays click once again. The main APWIN Screen will appear, as shown in Figure 67. Like most Windows programs, the APWIN Screen has a title bar, a menu bar and a collection of toolbars.

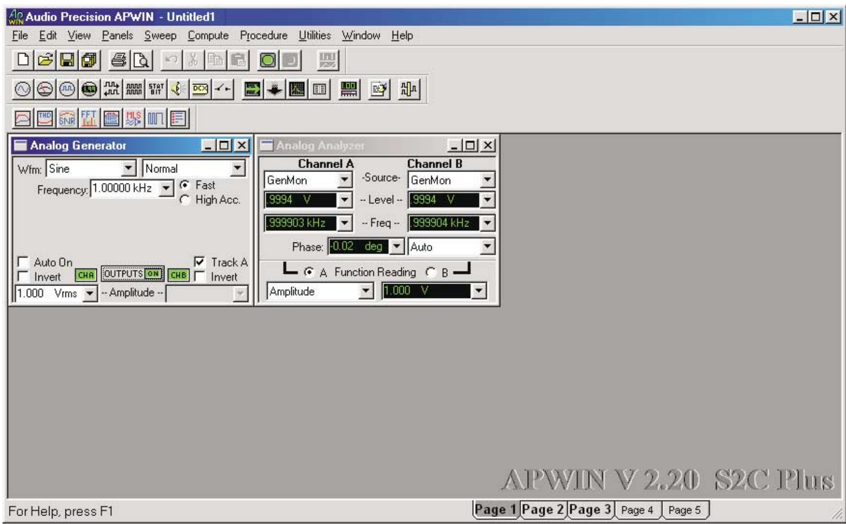


Figure 67. APWIN screen

The APWIN Screen has five tabbed pages for display of its various test panels. By default, APWIN launches with the Analog Generator and Analog Analyzer panels on Page 1, the Sweep panel and an empty Graph on Page 2, and the Digital I/O panel on Page 3. APWIN panels can be opened, closed, expanded or contracted (double-click the panel's title bar) and placed on any page (or even repeated on several pages).

Running Your First Tests

This section discusses three different ways to use APWIN and System Two Cascade *Plus* to test your DUT. (DUT means Device Under Test, the unit you are subjecting to measurement. Sometimes it's called the EUT, for

Equipment Under Test.) First we will run a test manually, then load a saved test, and finally use the Quick Launch toolbar.

Use balanced or unbalanced connections between your equipment and System Two Cascade *Plus* as appropriate. Most professional and broadcast audio equipment uses balanced connections ("high" and "low" audio signal lines plus ground for each channel) with "XLR" connectors; most consumer audio equipment uses unbalanced connections (a "high" audio signal line plus ground, which also carries the audio "low" signal) with ¼" phone, RCA or 3.5 mm mini jacks.

System Two Cascade *Plus* uses both XLR and "banana" connectors (connected in parallel, with both active in the balanced configuration) to carry its balanced inputs and outputs. Unbalanced inputs and outputs are carried on BNC connectors. The balanced and unbalanced designations on System Two Cascade *Plus* are mutually exclusive. You must select one or the other for each input and output.

Figure 68 shows some common cable hookups.

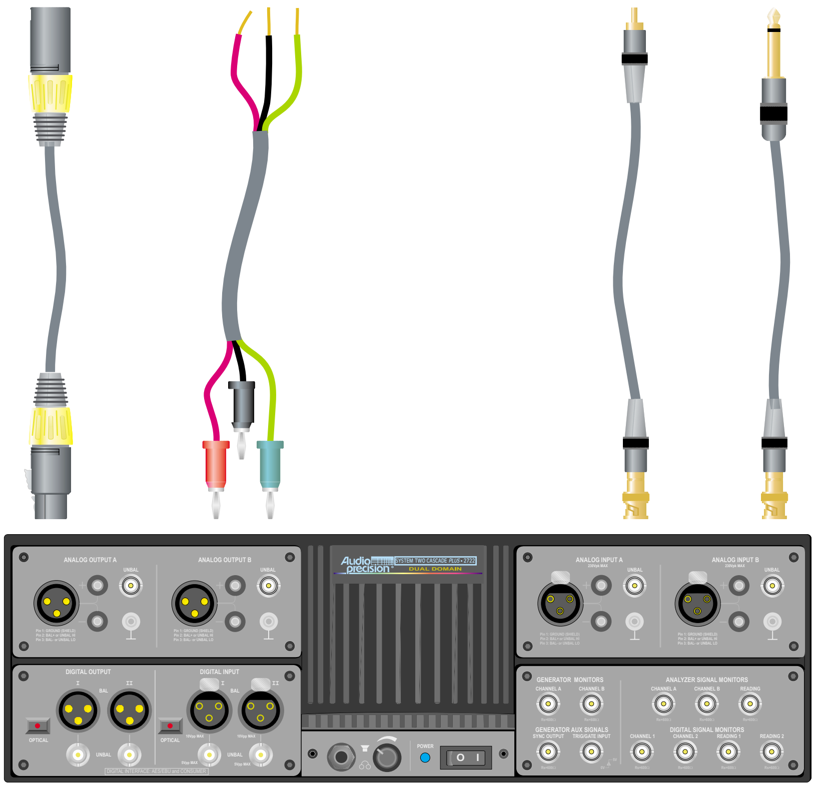


Figure 68. Typical balanced and unbalanced connections

Remember that by default, APWIN selects the balanced input and output connectors. If you use unbalanced inputs or outputs, you must choose these options in the software as well.

Choose a piece of equipment to test as a DUT. It could be an equalizer, a limiter, a line amplifier or mixer, or perhaps an audio recorder in the “source” or “EE” mode. Connect your equipment to the System Two Cascade Plus inputs and outputs, and turn on the power.

By default, the Analog Generator in System Two Cascade Plus is set to generate test signals at a voltage level of 1 V rms. This voltage is safe for most professional and consumer audio equipment, but it can overload many devices. Be sure your equipment will safely handle a 1 V rms input, or set the generator level lower. See the following Note for information on resetting output levels.

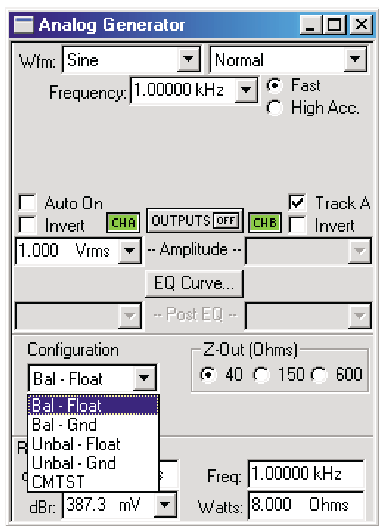
If you have no equipment to test, you can loop the System Two Cascade Plus inputs to outputs by connecting an XLR cable from the balanced Analog Output A and B connectors to the balanced Analog Input A and B connectors.

Running a Test Manually

We will start by manually setting up a tone, applying it to your DUT, and measuring the DUT output level.

Go the **Page 1** on the APWIN Workspace (see Figure 69). The first panel on the page is the Analog Generator. The **Wfm** (waveform) and **Frequency** boxes near the top of the panel show that the generator is set

Figure 69. Configuring generator outputs



to produce a 1 kHz sine wave, and the **Amplitude** box shows an output level of 1 V rms.

*If 1 V rms is too high a voltage to apply to the inputs of your DUT, click the mouse cursor on the Amplitude box (currently set at 1.000 V rms). This will highlight the box for entry. Type in a lower value (perhaps .1 or .01) and press **Enter** to set the output voltage to your new value.*

Double-click on the panel title bar to expand the panel. About half-way down on the left is a box labeled **Configuration**. Click on the arrow to see the list of options. Then choose **Bal - Float** or **Unbal - Float** to select the balanced (XLR / banana) or unbalanced (BNC) generator outputs to match your DUT connections.

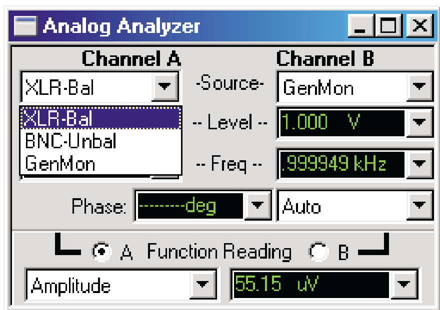


Figure 70. Choosing analyzer source

Now go to the second panel, the Analog Analyzer (see Figure 70). Click the **Source** arrow under Channel A and choose your input configuration (**XLR-Bal** or **BNC-Unbal**) from the list. Repeat this for Channel B, if you are using a stereo DUT.

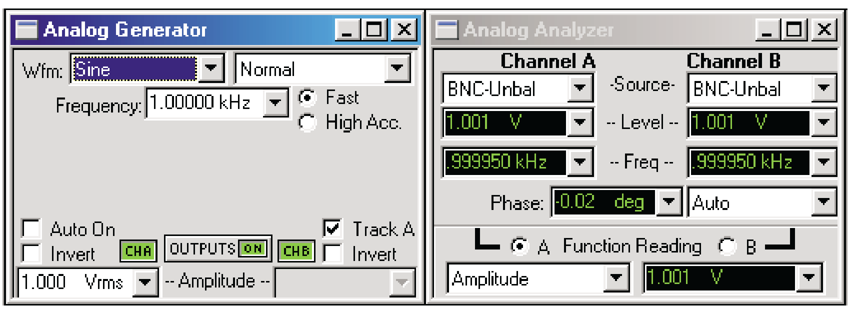


Figure 71. Running a tone through the DUT

On the Analog Generator panel, click the **ON** button. The readings in the **Level** and **Freq** boxes in the Analog Analyzer panel should read the output voltages of the DUT and a frequency very close to 1 kHz.

To hear the tone, click the speaker icon on the toolbar to bring up the Headphone/Speaker panel (see Figure 72).

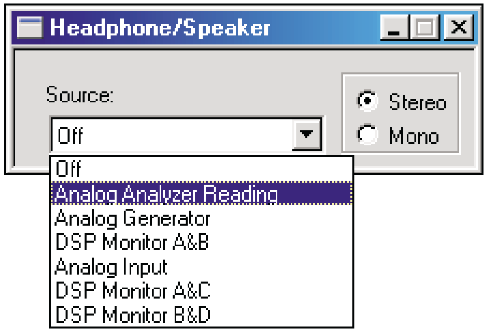


Figure 72. Speaker On

Then select **Analog Analyzer Reading** from the **Source** list. Make sure the volume control on the front panel of System Two Cascade *Plus* (the physical knob, not a software setting) is turned up.

Try turning the Analog Generator **OFF** and **ON**. The tone should go off and on, too, and you will hear the relay clatter of the ranging switches in the input circuitry of System Two Cascade *Plus* reacting to the presence and absence of the test signal.

You can manually set up almost any test you can imagine using APWIN and System Two Cascade *Plus*. But there can be a lot of steps in a complicated setup, so we have preset and saved many useful tests for you. You can edit and re-save these tests to quickly customize them to your requirements.

Running a Saved Test

Go to the Menu Bar and choose **File > Open > Test**. A browser will appear showing the folder Apwin. Select the folders S2Cascade and then A-a. This directs you to the tests designed for System Two Cascade *Plus* Analog-to-Analog measurements. You should see a number of test files (*.at2c) in the folder (see Figure 73). If the folder appears empty, be sure the browser is set to view “Files of type: S2C Test Files (*.at2c)."

Open the file named A-A THD+N VS FREQ.at2c.

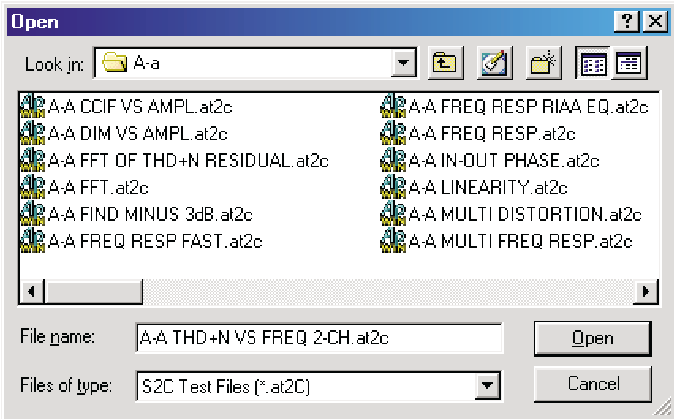


Figure 73. Opening a test

Whenever you open an existing test file, all the parameters previously set in the test are now set again in APWIN; not only voltage, frequency, and other settings but window, page and panel views as well. Also, the results of the last test run before saving are included in the test file. Depending upon APWIN configuration, you can see these old results displayed when the test is first opened. Settings in the furnished tests include Analog Generator Configuration set to **Bal-Float** and Analog Analyzer Source set to **XLR-Bal**.

Improperly set configuration is one of the most common reasons for a saved test not performing as you expect. Always be sure to verify that the input and output configurations in APWIN correspond to the connections you have made.

A-A THD+N VS FREQ.at2c first displays Workspace **Page 2**, where you see the Sweep panel and a graph that may show the previously saved test results. If your DUT connections are balanced inputs and outputs, you can simply click the **Go** button on the Sweep panel (look for the traffic light). A new sweep will be run and the results will be graphed.

If your connections are different (unbalanced, for example), go to **Page 1** where you will find the Analog Generator and Analog Analyzer panels. Set your connections in **Configuration** (on the generator panel) or **Source** (on the analyzer panel). Then return to **Page 2** and click **Go** on the Sweep panel and watch your graph.

Notice that the Sweep panel has been duplicated on **Page 1** and **Page 2** for convenience, and that a larger version of the graph has been placed on **Page 3**.

Using the Quick Launch Menu

A third way to start tests is to click on a Quick Launch icon, which are found on the Quick Launch tool bar. Each of these icons starts a "Quick Launch" procedure, which is an AP Basic macro written to automate a test or series of tests.

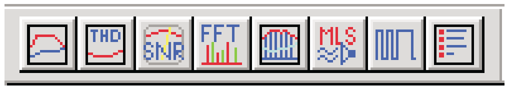


Figure 74. Quick Launch toolbar

You can also run a Quick Launch procedure by choosing **File > Quick Launch**. A submenu will appear with a number of selections (see Figure 5?10).

APWIN comes with eight Quick Launch procedures. You can modify these or add your own by selecting Customize Quick Launch from the Quick Launch submenu.

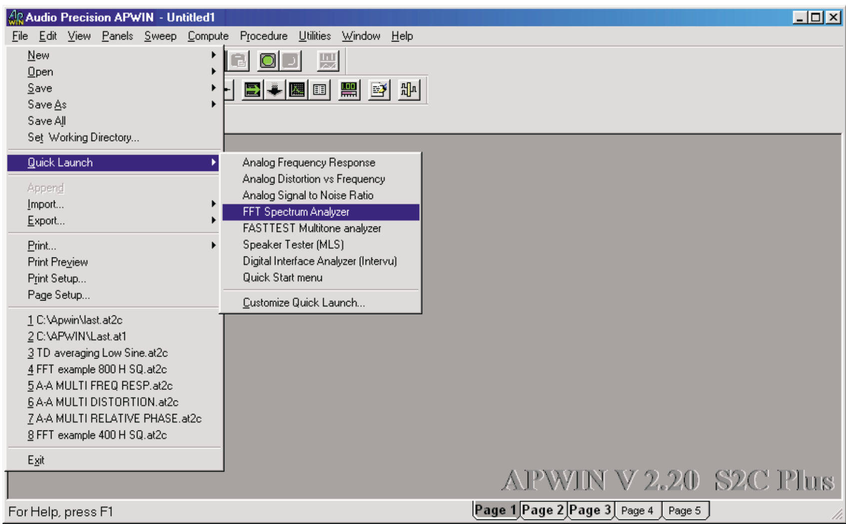


Figure 75. Opening Quick Launch procedure

Click on **FFT Spectrum Analyzer** on the Quick Launch submenu, or on the Quick Launch **FFT** icon. As in the previous example, you will see the Sweep panel and a graph on **Page 2**. Once again, if your connections are balanced, you can continue; if not, go to **Page 1** and make the changes on the Analog Generator and Analog Analyzer panels. Then come back to **Page 2**.

Click **Go** on the Sweep panel. A new graph will replace the saved graph result, which is an FFT spectrum analysis of the output of your DUT with a 1 kHz sine wave applied.

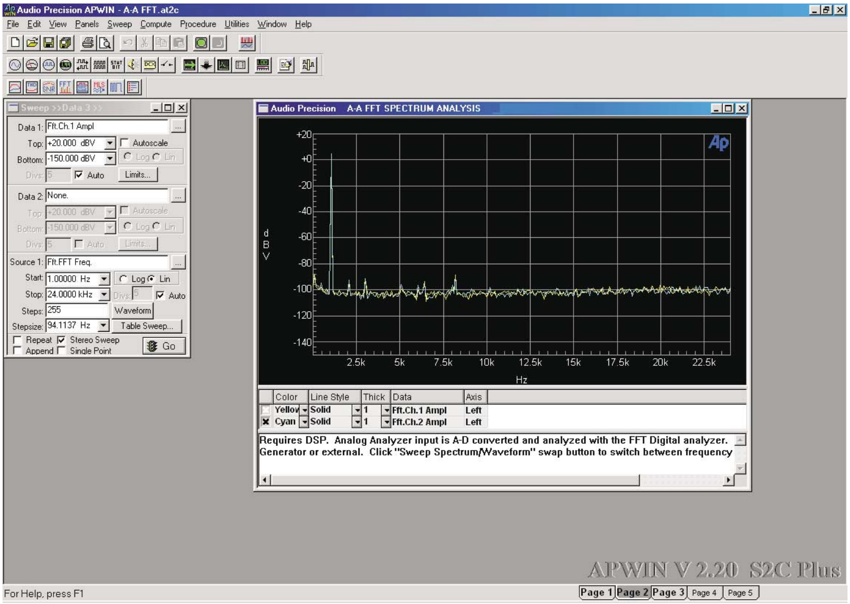


Figure 76. FFT Spectrum Analysis

Let's visit the other pages in this test. Once again, there is a large graph on **Page 3**. However, in this setup the Sweep panel is not duplicated on **Page 1**. Instead, there is a new panel: the Digital Analyzer. Since an FFT is digitally implemented adjustments were made to the Digital Analyzer during the test setup, and the panel is displayed so you can view or modify these settings.

Let's change the generator frequency and run the test again. On the Analog Generator panel on **Page 1**, click in the **Frequency** box near the top of the panel. The current setting, 1.00000 kHz, will be highlighted, waiting for your input. Type "5000" and then push **Enter**. This will reset the generator frequency to 5.00000 kHz.

Now return to **Page 2** and click **Go** on the Sweep panel. You will see a new graph drawn, this time with the fundamental frequency spike centered at 5 kHz rather than 1 kHz.

Moving On

Now that you have a feel for APWIN and System Two Cascade *Plus*, we suggest you work your way through the Tutorial in the *APWIN Simplified Manual*, or consult the *APWIN User's Manual* while you actually have the program running and a DUT in front of you.

To begin testing actual equipment, it's often easiest to start with an existing test file. You can modify the test to suit your needs and then re-save it under a new name. Audio Precision provides a great number of test files and procedures for noise testing, frequency response measurements, THD+N tests, jitter, digital interface measurements and so on, all sorted into directories and carefully described at the end of the *APWIN User's Manual*.

APWIN and System Two Cascade *Plus* comprise a very powerful test set, and all the information you will need to operate the system is in the furnished manuals and help files. We also offer excellent technical support, with experienced engineers surrounded by Audio Precision equipment and DUTs just waiting for your phone call. See Technical Support on page 77.

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 that 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.

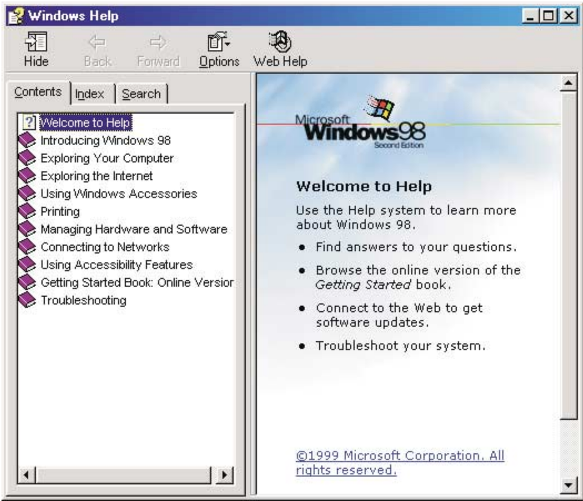


Figure 77. Windows 98 Help screen

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.

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:

- Email: techsupport@audioprecision.com
- Web: audioprecision.com
- U.S. Toll-Free Phone: 1-800-231-7350
- Phone: +1-503-627-0832
- Fax: +1-503-641-8906

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

- APWIN version number (see Figure 78)
- System Two Cascade *Plus* configuration SYS-2122, SYS-2622, SYS-2722, SYS-2700; (options such as DSP, Dual Domain, BUR-GEN, IMD)
- System Two Cascade *Plus* serial number (located on a tag on the rear of the instrument)

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:

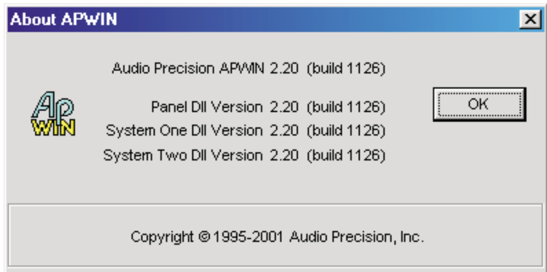


Figure 78. Typical About APWIN screen

Chapter 6

Supplemental Information

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 79 through Figure 83.

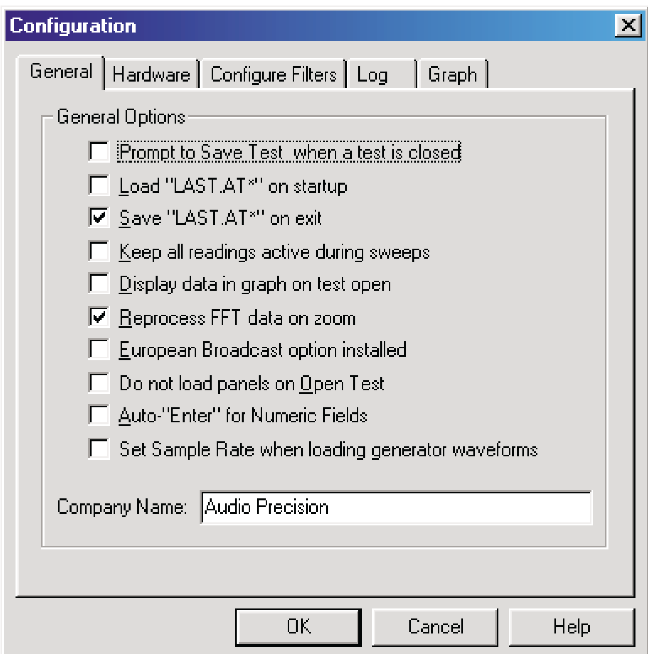


Figure 79. Configuration dialog box, General tab

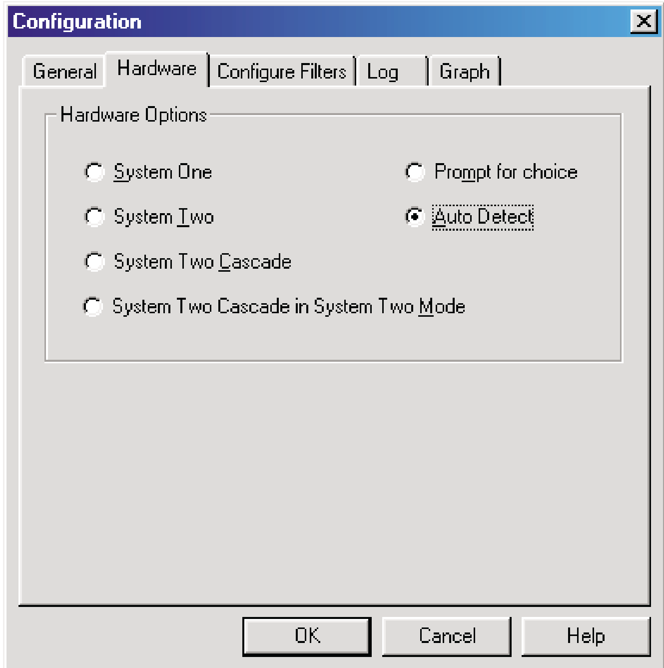


Figure 80. Configuration dialog box, Hardware tab

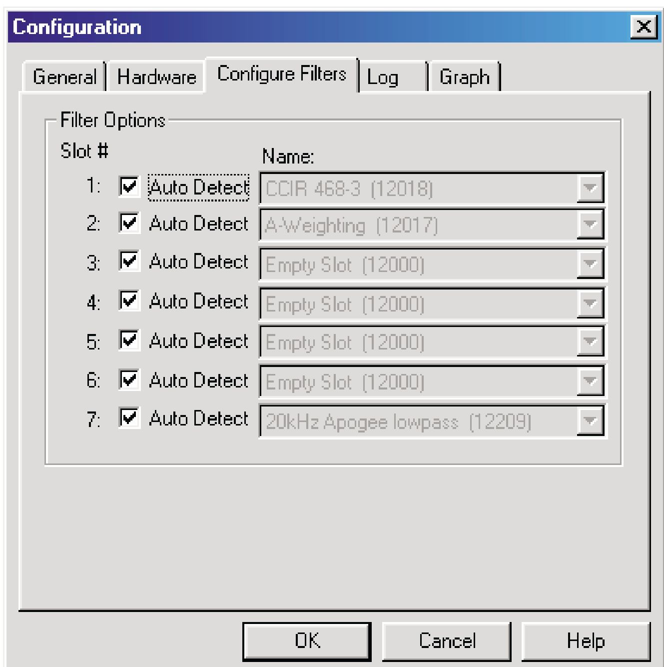


Figure 81. Configuration dialog box, Configure Files tab

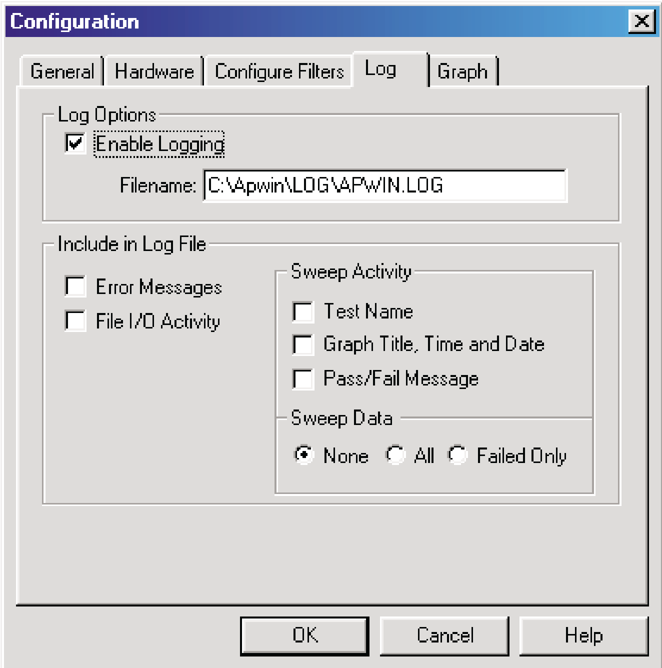


Figure 82. Configuration dialog box, Log tab

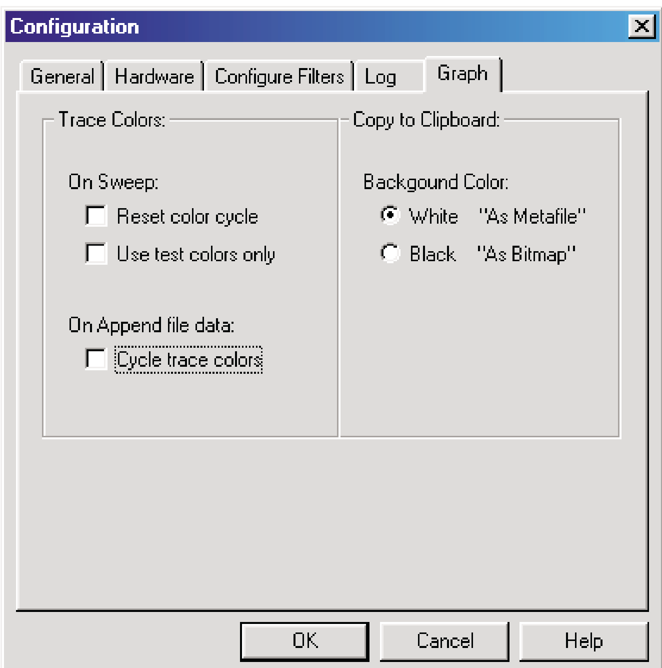


Figure 83. Configuration dialog box, Graph tab

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 to 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 Ω to 600, 200, and < 40 Ω. 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.

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.

Windows 95, 98, 2000, and NT

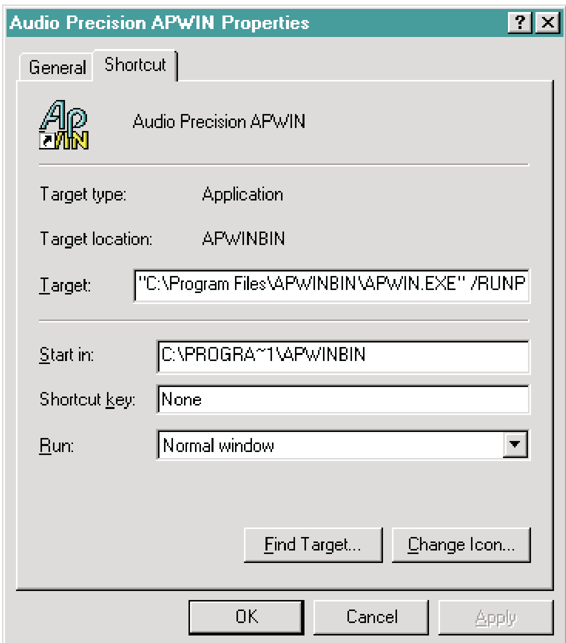
Since Windows starts automatically, put APWIN in the STARTUP group. By selecting PROPERTIES (right mouse button) on the APWIN icon, you can specify a command line option in the TARGET line. This is where to put the /RUNPRO path\filename line. The exact syntax for the target line is:

"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.



The above examples illustrate the use of command line parameters and switches to automate or control the starting of APWIN. Section 6.2.2 lists and describes all of the available command line options and switches.

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 interface card at address 238

apib298 forces APWIN to communicate with interface card at address 298

apib2b8 forces APWIN to communicate with interface card at address 2b8 (the factory default setting)

apib2d8 forces APWIN to communicate with interface card at address 2d8

Example:

```
APWIN TESTNAME.AT2 PROCEDUR.APB /runpro /apib2b8
```

Using Printers with APWIN

APWIN runs under Microsoft Windows and is able to use any printer supported by Windows and installed on your system.

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 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, go to the Main menu and 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 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.