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APWIN Installation & Getting Started For System One



Audio precision

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System One Description, Installation, and APWIN Software Guide



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Do NOT service or repair this product unless properly qualified. Only a qualified technician or an authorized Audio Precision distributor should perform servicing.

Do NOT defeat the safety ground connection. This product is designed to operate only from a 50/60 Hz AC power source (250 Vrms 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 as indicated on the rear panel and Section 3.2.3 of this document. The AC voltage selector also must be set to the same voltage as the nominal power source voltage (100, 120, 230, or 240V rms) with the appropriate fuses installed.

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 instrument front panels.

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

This product contains a lithium battery. Dispose only in accordance with all applicable regulations.

This product is for indoor use – pollution degree 2.

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Safety Symbols



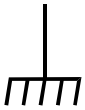
WARNING! – This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.



ATTENTION! – This symbol alerts you to important operating considerations or a potential operating condition that could damage equipment. Refer to the User's Manual or Operator's Manual for precautionary instructions.



FUNCTIONAL EARTH TERMINAL – This symbol marks a terminal that 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 – This symbol marks a terminal that is bonded to conductive parts of the instrument. Confirm that this terminal is connected to an external protective earthing system.

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1. Introduction

1.1 Scope of This Manual

This guide serves several purposes:

- It will help you install the hardware and software for APWIN, Audio Precision's user interface and software package for System One.
- 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 One, including its options and ancillary components (switchers, etc).
- It contains some fundamental APWIN assistance, such as starting, setting user preferences, APWIN help files, compatibility issues, and troubleshooting.

Although intended specifically for APWIN Version 1.5 or later, many parts of this guide are applicable to earlier versions.

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

1.2 Related Documentation

- **APWIN User's Manual** – contains a comprehensive description of the full capabilities of APWIN.
- **APWIN Tutorial** – designed to lead you through your first operating session with APWIN and System One.
- **APWIN BASIC** (procedure language**) User's Manual and Programmer's Reference** – includes detailed descriptions and syntax for every command.
- **System One Service Manual** – contains detailed System One 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.

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- **SIA-322 Serial Interface Adapter User's Manual** – details the capabilities and operation of the SIA-322. This manual comes with the SIA-322, a highly specialized optional accessory.
- **Audio Measurement Handbook** – intended as a practical, hands-on assistance for workers in all phases of the audio field. Describes general measurement techniques and includes a glossary of specific audio terminology and test definitions.

1.3 Overview

1.3.1 General System

System One is a personal computer-based audio test set with broad, high-performance capabilities for analog, digital, and mixed-signal devices. System One 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.

The versatility of the System One can be extended through major options and accessories. The SWR-2122-series of Audio Switchers are available in input, output, and insertion (patch point) versions. The DCX-127 adds dc measurement and digital generation capabilities. The SIA-322 Serial Interface Adapter converts the System One's parallel input and outputs to a wide variety of serial digital interface formats. These accessories are described in greater detail in the following subsections.

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

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

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1.3.2 System One

System One audio test equipment provides stimulus and measurement capability. System One is actually a family of products with three basic configurations:

- The SYS-22 provides analog stimulus and measurement capability, using analog capability for signal generation, filtering, and measurement.
- The SYS-222 (System One + DSP) adds a digital signal processor for enhanced capability including high-resolution spectrum analysis via FFT, waveform capture and display, and fast multitone testing.
- The SYS-322 (System One Dual Domain) includes the capabilities of the 2200 series plus digital audio inputs and outputs in AES/EBU, SPDIF/EIAJ, optical, parallel, general-purpose serial formats and complete serial interface analysis per AES3. Thus, it provides stimulus and measurement in any combination of digital and analog domains.

These major options for testing analog audio devices may be added to any of the three basic configurations listed above:

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

Additionally, your System One may include up to five of these optional hardware filters, or may include custom filters. Graphs of many of these filters are shown in Section 2.

- FBP-500HQ — 500 Hz Hi-Q bandpass filter (for CD linearity measurements)
- FBP-xxxxx — Fixed 1/3-octave bandpass filter; frequency specified from 100 Hz to 25000 Hz.
- FBR-19000 — 19 kHz band reject (notch) filter

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- FHP-xxx — High pass filter (specify frequency: 30 Hz, 70 Hz, 400 Hz, or 2 kHz)
- FIL-AWT — A-weighting filter
- FIL-CCR — CCR 468-3 weighting filter
- FIL-CIT — CCITT P.53 weighting filter
- FIL-CMS — C-message weighting filter
- FIL-CWT — C-weighting filter
- FIL-D50 — 50 μs de-emphasis filter
- FIL-D50E — 50 μs de-emphasis with 15.625 kHz notch filter
- FIL-D50F — 50 μs de-emphasis with 19.0 kHz notch filter
- FIL-D75 — 75 μs de-emphasis filter
- FIL-D75-AWT — 75 μs de-emphasis with A-weighting filter
- FIL-D75B — 75 μs de-emphasis with 15.734 kHz (NTSC) notch filter
- FIL-D75F — 75 μs de-emphasis with 19.0 kHz (FM) notch filter
- FIL-IECR — 200 Hz – 15 kHz kHz band limited with 15.625 kHz (PAL) notch receiver testing filter
- FIL-RCR — 200 Hz – 15 kHz bandpass with 19 kHz notch filter
- FIL-VID — Video notch filter (15.625 Hz or 15.734 kHz band reject)
- FLP-A20k — 20 kHz “brick wall” filter
- FLP-xxx — Fixed low pass Band Limiting filter. Specify frequency:

  5-pole Butterworth filter at 300 Hz, 400 Hz, 500 Hz, or 1 kHz;

  7-pole Butterworth filter at 3 kHz, 4 kHz, 5 kHz, or 8 kHz;

  Sharp Elliptic Response filter at 10 kHz, 12.7 kHz, 15 kHz, 18 kHz, 19 kHz, 20 kHz, or 22 kHz;

  3-pole Butterworth filter at 50 kHz.

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

System One is normally supplied with an APWIN-compatible ISA-bus interface card for installation in the user's PC. An option replaces this card with a type II PCMCIA interface card for use in a notebook computer. Each of these cards comes with the appropriate APIB (Audio Precision Interface Bus) cable to interconnect the computer with the System One. This version of APWIN requires one of these cards, and will not function with earlier System One PCI-1, PCI-2, PCI-3, or ISA-DOS interface cards, or PCM-DOS PCMCIA interface cards.

This manual (and APWIN) is not applicable for System Ones that are controlled via GPIB programming.

1.3.3 Switchers



Figure 1-1. SWR-2122 Switchers

There are four versions of switchers, as described below. Each features 12 x 2 architecture with provisions for cascading up to 16 units, allowing up to 192 channels to be accessed. Switching is computer-controlled via the same APIB as the System One. See Sections 2.4 and 3.6 for further information.

- SWR-2122M Output Switcher. Routes either of the two generator output channels (A & B) to any of 12 channels. 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.

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- SWR-2122F Input Switcher. Routes either of the two analyzer input channels (A & B) from any of 12 channels. Female XLR connectors for balanced signals.
- SWR-2122U Unbalanced Switcher. Can be used as either an input or output switcher. Floating BNC connectors for unbalanced signals to prevent ground loops.
- SWR-2122P Patch-Point Switcher. 12-point configuration allows a signal path to be interrupted and a test generator inserted while a measuring analyzer can access the output of a previous device. Path continuity is maintained in the default (non-accessed) mode. Each of the 12 insertion points has a 5-pin XLR connector to allow balanced interface to the previous and next device.

1.3.4 DCX-127 Multi-Function Module



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

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

The meter features 200 mV – 500 V and 200 Ω – 2 MΩ ranges, fully floating and guarded for accurate measurements in the presence of large common mode voltages. Resistance measurements can be made using

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either the 4-wire or 2-wire technique. Readings can be offset and scaled by the software.

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

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

Refer to Section 2.5 for DCX-127 specifications.

1.3.5 SIA-322 Serial Interface Adapter

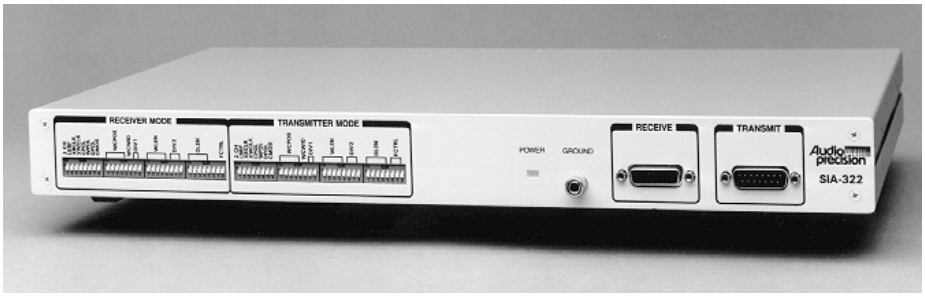


Figure 1-3. SIA-322 Serial Interface Adapter

The SIA-322 Serial Interface Adapter provides a means of interfacing System One to a variety of data acquisition, D–A, A–D converters, and communication hardware that utilize a serial bus for data exchange. This greatly increases the system's flexibility in interfacing to serial systems for a wide range of tests and measurements.

The SIA-322 consists of a parallel-to-serial transmitter and an independent serial-to-parallel receiver. A flexible design allows the SIA to address many serial interface requirements.

Refer to Section 2.6 for SIA-322 specifications. The SIA-322 is available only for the domestic (USA) market.

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1.3.6 GAT1 APIB to GPIB Translator

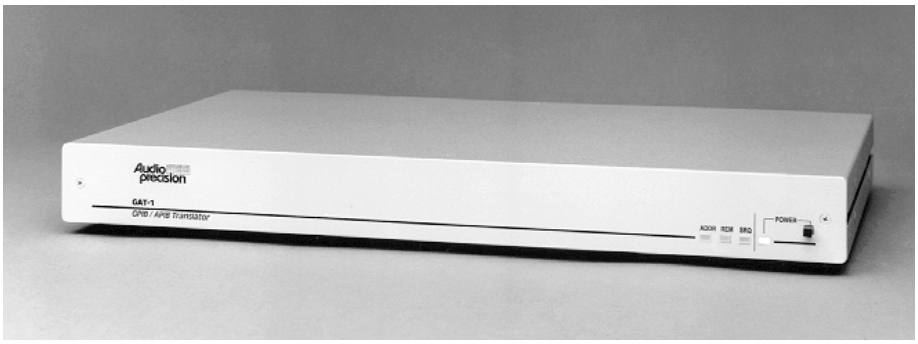


Figure 1-4.GAT1 GPIB to APIB Translator

The GAT1 interfaces between Audio Precision instruments with APIB (Audio Precision Interface Bus) and a computer with a GPIB (General Purpose Interface Bus, IEEE488.1) controller. This allows interconnecting a System One with a GPIB interface and instruments (switchers and DCX-127) with APIB interfaces. A data sheet is available to describe specific configurations and limitations.

The GAT1 is not compatible with instruments controlled by APWIN.

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2. Specifications

2.1 System One Generator Specifications

All System One configurations contain an analog signal generator consisting of an ultra-low distortion analog sinewave generator and two independent transformer coupled output stages that can be driven from both the analog sources and optional hardware signal generators. Option "BUR" adds analog-generated sine burst, square wave, and noise signals. Option "IMD" adds analog-generated IMD test signals. SYS-222 and SYS-322 configurations also contain dual channel D/A-based signal generation capability. Unless otherwise noted, all specifications are valid for outputs ≥150 µVrms [420 µVpp].

2.1.1 Frequency Related

Range	10 Hz – 204.775 kHz	
	High-Accuracy Mode	Fast Mode
Accuracy	0.03%	0.5%
Resolution	0.005%	0.025 Hz, 10 Hz to 204 Hz 0.25 Hz, 205 Hz to 2.04 kHz 2.5 Hz, 2.05 kHz to 20.4 kHz 25 Hz, 20.5 kHz to 204 kHz

2.1.2 Amplitude Related

Range[1]	
20 Hz – 50 kHz	<25 µVrms – 26.66 Vrms (<-90 dBu to +30.7 dBu)
10 Hz – 204 kHz	<25 µVrms – 13.33 Vrms (<-90 dBu to +24.7 dBu)
Maximum Output Power[2]	
Into 600 Ω	+30.0 dBm, R_s = 50 Ω; +24.7 dBm, R_s = 600 Ω
Into 150 Ω	+30.0 dBm, R_s = 50 Ω
Resolution	<0.01 dB or 1.27 µV, whichever is greater
Accuracy	±0.1 dB (1%) at 1 kHz
Flatness (1 kHz reference)	±0.03 dB, 20 Hz – 20 kHz; ±0.15 dB, 10 Hz – 120 kHz;

[1] Unloaded (open circuit). Divide maximum amplitude by 2 (-6 dB) for unbalanced or common-mode configurations.

[2] Total peak output current rating is 120mA balanced/240 mA unbalanced, 20 Hz – 20 kHz.

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2.1.3 Distortion

Measured with a passive notch filter and spectrum analyzer. Valid for any $R_{load} \geq 300\ \Omega$. *See* Section 2.2.5 for residual THD + N.

20 Hz[3]– 20 kHz	Typical 0.0005% (–106 dB)
10 Hz – 100 kHz	Typical 0.0050% (–86 dB)

2.1.4 Output Related

Configurations	Balanced, unbalanced, or common-mode test (same as balanced except generator is connected between the output common and source impedance center tap).
Source Impedance	50 – 150 – 600 Ω balanced, or 25 – 600 Ω unbalanced[4]; ±1 Ω. Source impedance does not change with output OFF.
Maximum Rated Floating Voltage	42 V peak ac, 60 V dc. True transformer isolation.

2.1.5 Auxiliary Signals

Sync Output	LSTTL-compatible squarewave signal for triggering stable oscilloscope displays with all signals.
Monitor Output	Ground-referenced replica of the generator signal. Nominally 2.8 Vpp amplitude, R_{out} = 560 Ω.
Trigger/Gate Input	LSTTL-compatible input for use with the tone burst option.

2.1.6 Dual Output Related (SYS-22 and SYS-20 only)

SYS-22 and SYS-20 configurations provide a second switchable generator output. Frequency, amplitude, impedance, and mode selection apply to both outputs simultaneously. Both outputs must be properly terminated in the A & B and A & –B modes for correct amplitude calibration using dBm or Watts units.

Output Modes	A only, B only, A & B, A & –B, or OFF
Output Separation	110 dB to 20 kHz
Maximum Output Power[2] (both channels loaded)	
Into 600 Ω	+29.4 dBm each load, Rs = 50; +24.3 dBm each load, Rs = 600.
Into 150 Ω	+24.0 dBm each load, Rs = 50

[3] 25 Hz if output open circuit voltage exceeds 20 Vrms balanced, or 10 Vrms unbalanced.

[4] Specify option EURZ to substitute <40 – 200 – 600Ω balanced, <20 – 600 Ω unbalanced impedance selections.

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2.2 Analyzer Specifications

The System One analyzer contains two independent voltmeters. The "READING" meter displays the selected measurement mode and has the greatest sensitivity and dynamic range. The "LEVEL" meter monitors the wideband-input signal following input attenuation and pre-amplification, before subsequent signal processing filtering, and additional gain stages. Its most sensitive range is 80 mV, limiting full performance to inputs ≥10 mV (-38 dBu). In the 2-CHANNEL and CROSSTALK modes, the LEVEL meter displays the amplitude of the alternate input (SYS-22 and SYS-02 only), thus enabling simultaneous amplitude measurements on both input channels.

Inputs are fully differential (balanced) with female XLR (pin 2 high) and dual banana jack connectors. (Specify Option LXPH to substitute a 1/4-in. stereo phone jack for the XLR.) An additional unbalanced and switchable Auxiliary input (Channel A only) is provided for special applications.

Amplitude can be displayed in Vrms, dBV (1.000 Vrms ref), dBu (0.7746 Vrms ref), dBr with respect to any predefined or measured reference, or dBm/watts computed into any arbitrary resistance. The READING meter has selectable rms, average, peak, Q-peak (per CCIR Rec 468-3), and S-peak detectors; the LEVEL meter detector is rms only. Measurement resolution is approx 0.004% (1/25200) of range at "4/s," varying to 0.032% (1/3150) at "32/s." All displays are rounded to four digits or 0.01 dB.

2.2.1 Input Related

Impedance	100 kΩ ±1%, shunted by 270 pF each side to ground. Selectable 600 – 150 Ω (±1%)[5] terminations.
Maximum Rated Input	200 Vpeak, 140 Vrms on main inputs; 100 Vpeak on auxiliary input. 1 W (+30 dBm) with terminations.
Common-Mode Rejection Ratio	70 dB, 50 Hz – 20 kHz, Vin ≤2 V; 50 dB, 50 Hz – 1 kHz, Vin >2 V.

[5] Specify Option EURZ to substitute 300 Ω for the 150 Ω termination selection.

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2.2.2 Amplitude Measurement Related

Ranges	300 µV[6] – 160 Vrms (6-dB steps above 80 mV, 12-dB steps below 80 mV). Autoranging is peak-sensitive to prevent clipping with high crest factor signals.
Accuracy[7]	±0.1 dB (1%), 20 Hz – 20 kHz
Response Flatness[7]	±0.03 dB, 20 Hz – 20 kHz; ±0.1 dB, 10 Hz – 120 kHz; +0.2/-3 dB, to 500 kHz
Residual Noise (input shorted)	1.5 µV (-114 dBu), 22 Hz – 22 kHz; 3.0 µV (-108 dBu), 22 Hz – 80 kHz; 10.0 µV (-98 dBu), full bandwidth; 1.0 µV (-118 dBu), A-wtg; 5.0 µV (-104 dBqps), Qpeak CCIR-wtg

2.2.3 Bandpass/Bandreject Related

The Bandpass/Bandreject modes provide selective amplitude measurements processed through a 4-pole constant-Q filter. Filter tuning may be directly programmed ("FIXED"), tracking ("AUTO"), or swept for spectral displays. Units selection and resolution are the same as the Amplitude Measurement mode, but with one additional range of sensitivity.

Amplitude Ranges	75 µV – 160 Vrms (6-dB steps above 80 mV; 12-dB steps below 80 mV).
Tuning range (f_0)	10 Hz – 200 kHz, ±3% accuracy
Bandpass Response (see Figure 2-1)	±0.5 dB (at f_0), 20 Hz – 120 kHz; 1/3-octave Class II response per ANSI S1.11-1975. Typically <-32 dB at 0.5 f_0 & 2.0 f_0.
Bandreject Response (see Figure 2-1)	±0.3 dB, 20 Hz – 120 kHz, excluding the band from 0.5 f_0 to 2.0 f_0. Typically -3 dB at 0.73 f_0 & 1.37 f_0, -20 dB within ±10% of f_0; and -40 dB within ±3% of f_0.

[6] 80 mV – 160 Vrms for LEVEL meter.

[7] Vin ≥5% of range, rms and average detectors only. Peak detectors are +0.2/-0.3 dB, 30Hz – 100 kHz.

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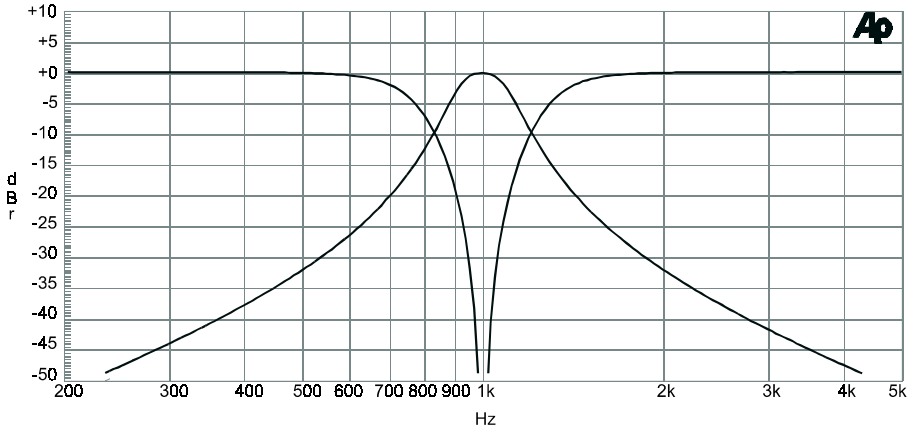


Figure 2-1. Typical bandpass and bandreject responses at 1 kHz

Bandpass Noise (input shorted) (see Figure 2-2)	0.5 µV (-124 dBu), 20 Hz – 5 kHz; 1.0 µV (-118 dBu), to 20 kHz; 2.5 µV (-110 dBu), to 120 kHz.

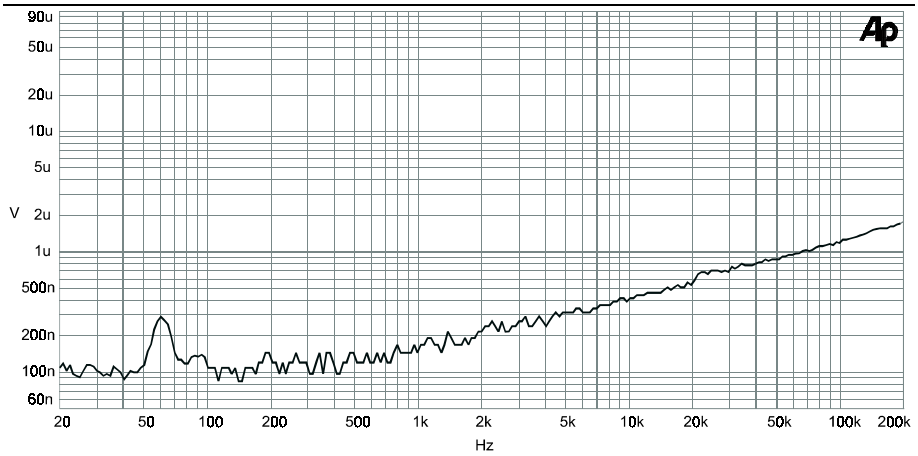


Figure 2-2. Typical residual bandpass noise vs frequency, input shorted

2.2.4 Frequency Measurement Related

Range	10 Hz to at least 500 kHz
Timebase Accuracy	0.003%
Resolution	6 digits + 0.0002 Hz
Reading Time	Determined by the nearest integral number of signal periods greater than the reading rate sample time (see Detector Characteristics).
Minimum Input	10 mV (-38 dBu), usable to <1 mV

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2.2.5 THD + N Measurement Related

THD + N mode is similar to the Bandreject mode, but with auto-nulling and fine-tuning loops activated to maintain optimum fundamental rejection. With FIXED tuning, the notch frequency may be directly programmed (±3% tracking range) for quantization distortion or SINAD tests. With AUTO tuning, the notch frequency is ganged to the GEN-1 module frequency during a generator sweep; otherwise it will track the measured input frequency (provided $V_{in} \geq 10$ mV and signal THD + N $\leq 20\%$). THD + N may be displayed as a ratio (%, dB, PPM, X/Y) of the total input signal measured by the LEVEL meter, or as an absolute amplitude (volts, dBu, dBm, etc).

Fundamental Range	10 Hz – 200 kHz
Minimum Input	<25 µV (-90 dBu) with FIXED tuning; 10 mV (-38 dBu) with AUTO tuning
THD + N Range	0 to 100%
Accuracy[8]	±0.5 dB for harmonics to 120 kHz; +0.5/-3 dB to 500 kHz
Residual THD + N[9]	
20 Hz – 20 kHz fundamentals	0.0010% + 1.5 µV, 22 Hz – 22 kHz BW; 0.0015% + 3.0 µV, 22 Hz – 80 kHz BW; 0.0040% + 10 µV, full BW <0.0010% at V_{in} = 2 Vrms, 22 Hz – 80 kHz BW.
10 Hz – 100 kHz fundamentals	0.010% + 10 µV, full BW
Auto-Nulling Time	Typically 0.3 – 0.4 s above 100 Hz, 1.5 s at 20 Hz, 3.5 s at 10 Hz. A 20 Hz – 20 kHz 16-point sweep will typically run in 9 – 11 s.

[8] Input must be ≥10 mV with a ratio unit selection.

[9] System specification including THD + N contributions from the generator (20 – 25 Hz derated near maximum output). The analyzer contribution is mainly noise with THD typically <0.0004%, 10 Hz – 20 kHz.

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2.2.6 Detector Characteristics

Five detector selections are available with the principal READING meter: rms, average, true peak, Q-peak (per CCIR Rec 468-3), and S-peak (scaled peak to read rms with sinewaves). The LEVEL meter detector is rms only. All detectors are linear with signal crest factors up to seven.

Reading rate selection determines the sample time of the measurement; and minimum recommended frequency for specified accuracy/stability:

Reading Rate	Sample Time	Minimum Frequency
"32/s"	32.8 ms	50 Hz
"16/s"	65.5 ms	30 Hz
"8/s"	131 ms	20 Hz
"4/s"	262 ms	10 Hz

Total measurement time is the sum of the sample time plus an additional 10 – 30 ms for data transfer and processing.

2.2.7 Bandwidth Limiting Filters

Full measurement bandwidth is typically 4 Hz – 600 kHz in the AMPLITUDE mode; 6 Hz – 600 kHz in the THD + N and BANDREJECT modes. Measurement bandwidth can be limited by independent high-pass and low-pass filters, or an external filter. Up to five optional filters may also be installed for weighted noise or other special measurements (see OPTION FILTERS).

High-Pass Filters	400 Hz ±5%, 3-pole Butterworth; 100 Hz ±5%, 3-pole Butterworth; 22 Hz, 3-pole within CCIR 468-3 limits for unweighted response
Low-Pass Filters	80 kHz ±5%, 3-pole Butterworth; 30 kHz ±5%, 3-pole Butterworth; 22 kHz, 6-pole within CCIR 468-3 limits for unweighted response
External Filter Connectors	
Output	560 Ω ±5%, unbalanced. Maximum signal level is 700 mVpp (-10 dBu)
Input	1 MΩ ±5%, unbalanced. Protected up to 15 V_{peak} overloads. Bandwidth is >200 kHz.

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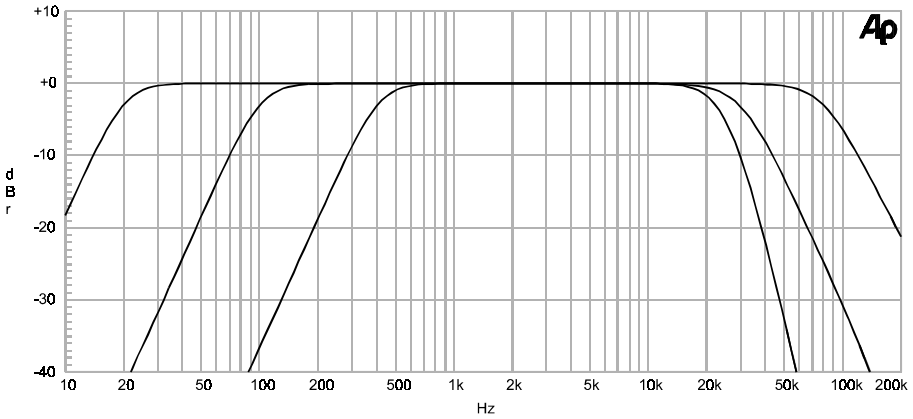


Figure 2-3. Typical responses of the bandwidth limiting filters

2.2.8 Monitor Outputs

Channel A	Buffered version of Channel-A input signal following attenuation and/or preamplification. 3 Vpp maximum, R_{out} = 560 Ω ±5%.
Channel B	Buffered version of Channel-B input signal following attenuation and/or preamplification. 3 Vpp maximum, R_{out} = 560 Ω ±5%.
Reading Signal (Processed Signal)	Buffered version of the final (Processed Signal) signal presented to the detector stages following all filtering and additional gain stages. 3 V pp maximum, R_{out} = 560 Ω ±5%.

2.2.9 Dual Input/Phasemeter Related

(SYS-22 and SYS-02 configurations only.) SYS-22 and SYS-02 configurations add a second autoranging Channel-B input and phasemeter, enabling simultaneous measurement of input amplitudes, ratio, or crosstalk. All analyzer specifications valid for either input. The "2-CHANNEL" and "CROSSTALK" measurement modes route the selected input channel through the main measurement path, and the alternate (reference) channel to the LEVEL meter and frequency counter. CROSSTALK mode additionally processes the selected input channel through the 1/3-octave bandpass filter automatically tuned to the reference channel frequency (or generator frequency).

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2.2.10 Phase Measurement

Ranges	±180° or 0 – 360°. Phase rotations beyond –180/+360° can be accumulated during sweeps.
Resolution	0.1° displayed (measurement quantization is 0.013° at “4/s”, varying to 0.10° at “32/s”)
Accuracy[10]	±1°, 20 Hz – 20 kHz; ±2°, 10 Hz – 50 kHz

2.2.11 Crosstalk/Ratio Measurement

Ratio Accuracy[11]	±0.1 dB, 20 Hz – 20 kHz; ±0.2 dB, 10 Hz – 120 kHz (typically 0.03 dB on same ranges)
Crosstalk Accuracy[11] (R_s <600 Ω)	The greater of:
10 Hz – 20 kHz	-140 dB or 1 µV (-118 dBu)
20 kHz – 100 kHz	-126 dB or 2.5 µV (-110 dBu)

2.2.12 Option Filters

Up to five option filters can be installed in the System One analyzer for weighted noise or other special measurements. Option filters function with the principal READING meter, and can be enabled (one at a time) in series with the standard bandwidth limiting filters.

Contact Audio Precision for quotations concerning other possible filter designs. Custom designs may be constructed on the FIL-USR blank card. However, please note that the system autoranging is based upon the peak value of the unfiltered signal and will limit the maximum usable dynamic range to approximately 50 dB.

Contact Audio Precision or your Audio Precision distributor for complete specifications on option filters.

2.2.12.1 Weighted Noise Measurement

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

[10] Both input signals between 10 mV – 8 Vrms. Above 8 Vrms, accuracy is ±1°, 20 Hz –5 kHz; ±2°, 10 Hz –20 kHz; ±3° to 50 kHz.

[11] Alternate channel signal must be ≥10 mV.

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2.2.12.2 Precision De-emphasis Family

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

2.2.12.3 Precision Sharp Cutoff Low-Pass Family

Family Response	-3 dB at f_c ±1.5%; ±0.2 dB to 0.5 f_c, ±0.4 dB to 0.8 f_c ; <-50 dB above 1.8 f_c
FLP-10K	f_c = 10.0 kHz, quasi-elliptic
FLP-15K	f_c = 15.0 kHz, quasi-elliptic
FLP-18K	f_c = 18.0 kHz, quasi-elliptic
FLP-19K	f_c = 19.0 kHz, quasi-elliptic
FLP-20K	f_c = 20.0 kHz, quasi-elliptic
See also FLP-A20K under Miscellaneous	
FLP-40K	f_c = 40.0 kHz, quasi-elliptic

2.2.12.4 Bandwidth Limiting, Low-Pass

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

2.2.12.5 Bandwidth Limiting, High-Pass

FHP-70	70 Hz ±3%, 8-pole
FHP-400	400 Hz ±3%, 9-pole
FHP-2K	2 kHz ±3%, 9-pole
FHP-20K	20 kHz ±3%, (per AES-17)

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2.2.12.6 1/3-Octave (Class II) Bandpass Family

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

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2.2.12.7 Receiver Testing

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

2.2.12.8 Miscellaneous

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

Note: The option filters described here can be added to the standard band-limiting filters shown in Figure 2-3.

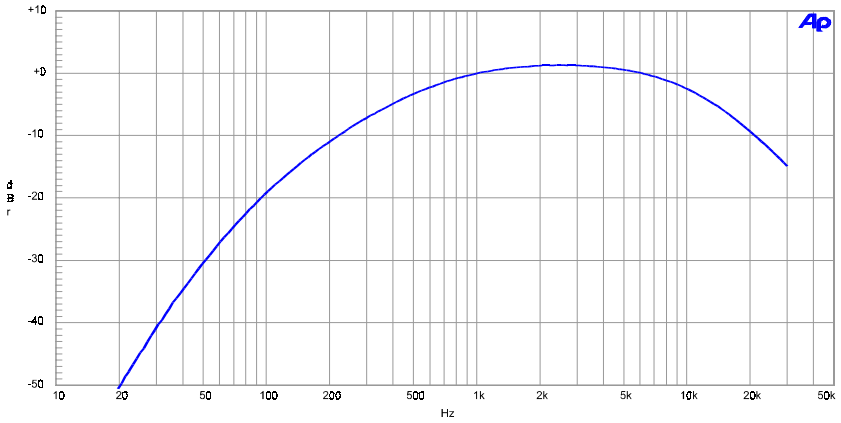


Figure 2-4. FIL-AWT ANSI-IEC “A” Weighting Filter

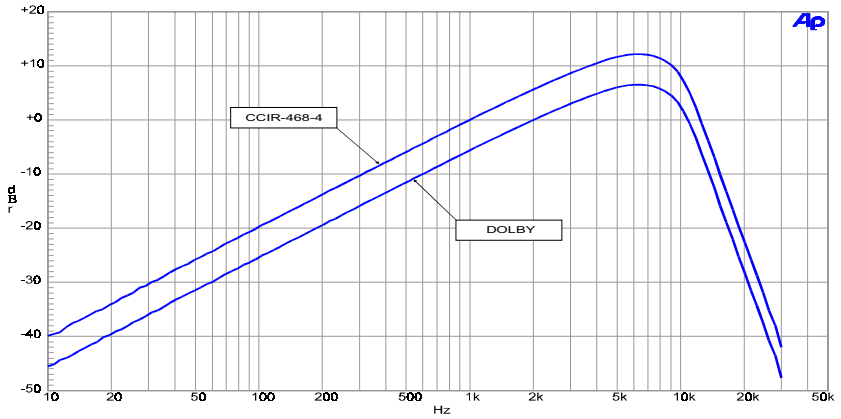


Figure 2-5. FIL-CCR CCIR-468 / DIN 45404 Noise Weighting Filter

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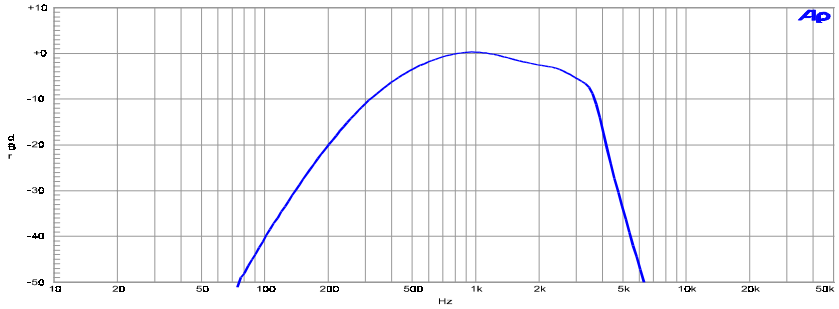


Figure 2-6. FIL-CIT CCITT P53 Noise Weighting Filter

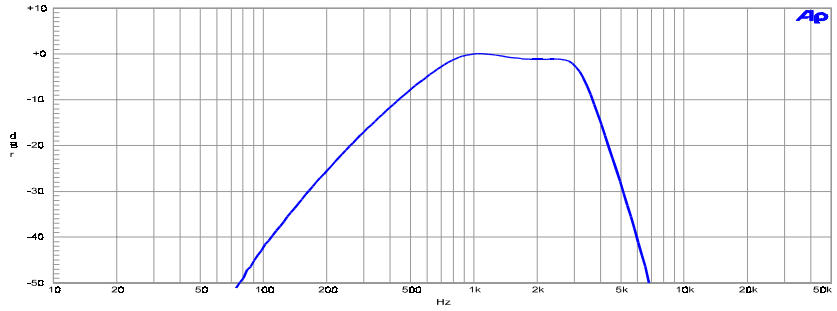


Figure 2-7. FIL-CMS C-Message Weighting Filter (ANSI/IEEE 743-1984)

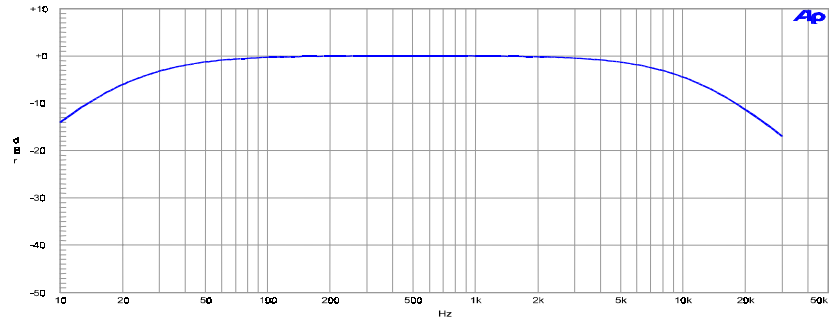


Figure 2-8. FIL-CWT "C" Weighting (IEC-179)

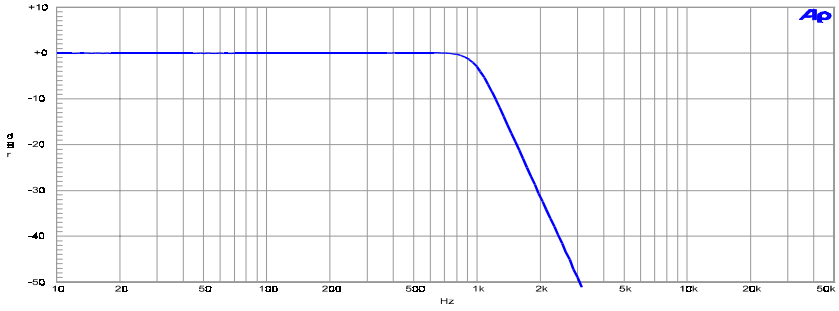


Figure 2-9. FLP-1K 1 kHz Low Pass 5-pole Butterworth Filter

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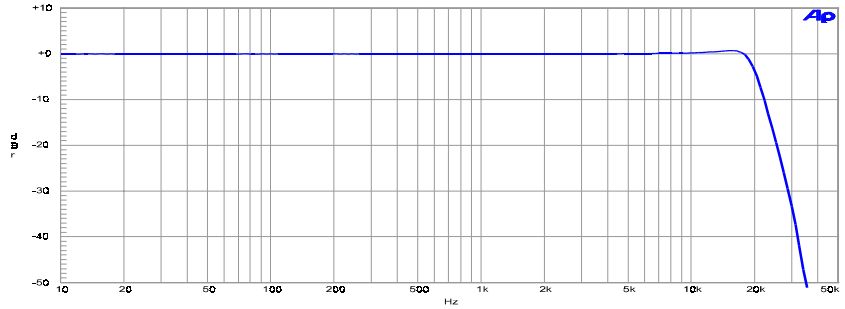


Figure 2-10. FLP-20K 20.0 kHz Quasi-elliptic sharp cutoff Low Pass Filter

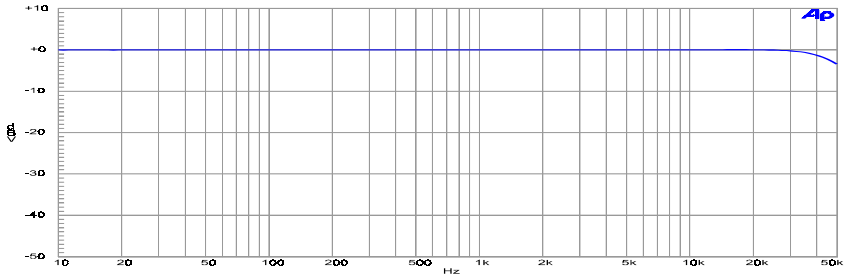


Figure 2-11. FLP-50K 50 kHz 3-pole Butterworth Low Pass Filter

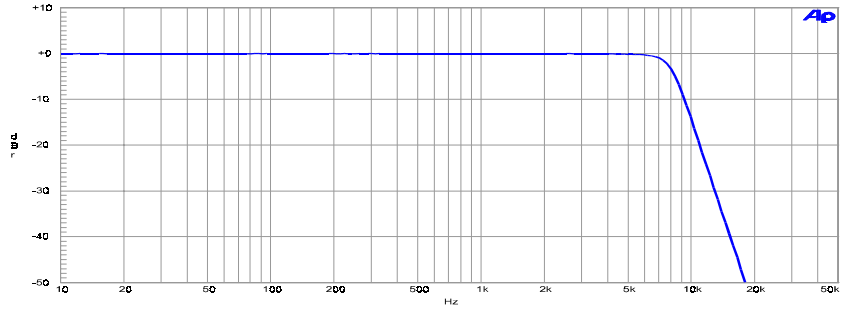


Figure 2-12. FLP-8K 8 kHz 7-pole Butterworth Low Pass Filter

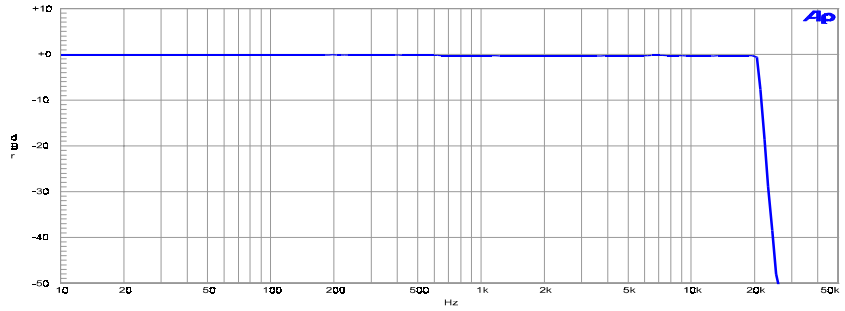


Figure 2-13. FLP-A20K Apogee "Brick-Wall" 20 kHz Low Pass Filter

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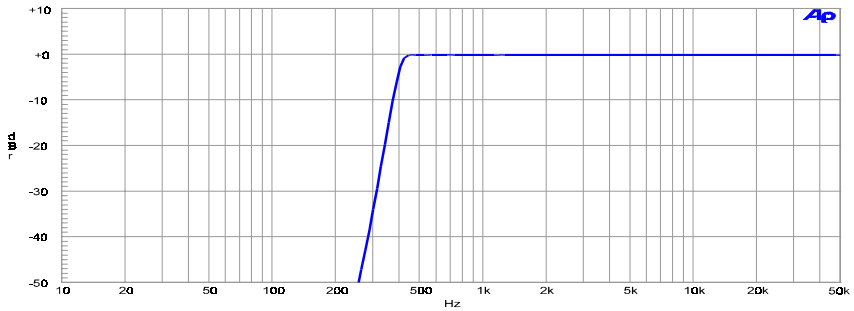


Figure 2-14. FHP-400 400 Hz 9-pole High Pass Filter

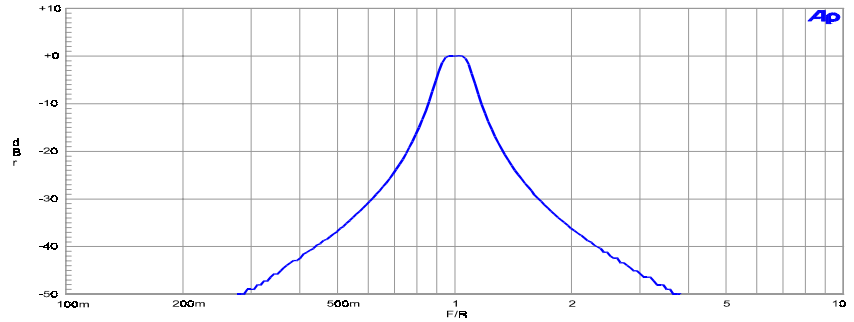


Figure 2-15. FBP-XXXX Fixed 1/3 Octave Band Pass Filter

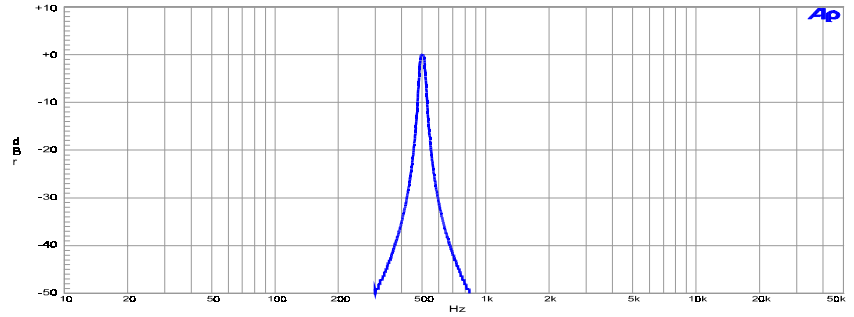


Figure 2-16. FBP-500X High-Q 500 Hz Band Pass Filter (for CD linearity testing)

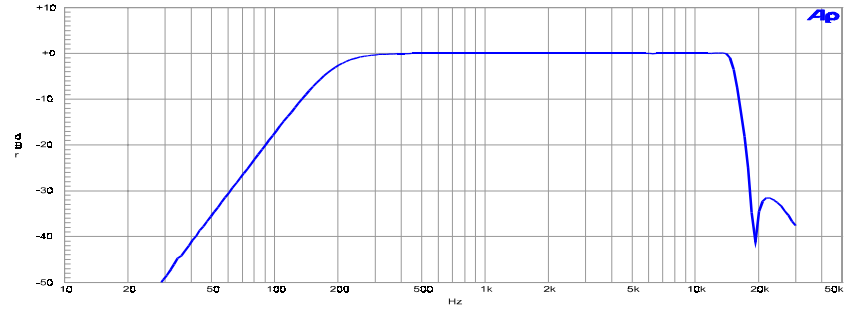


Figure 2-17. FIL-RCR 200 Hz to 15 kHz with 19 kHz (FM) notch Receiver Testing Filter

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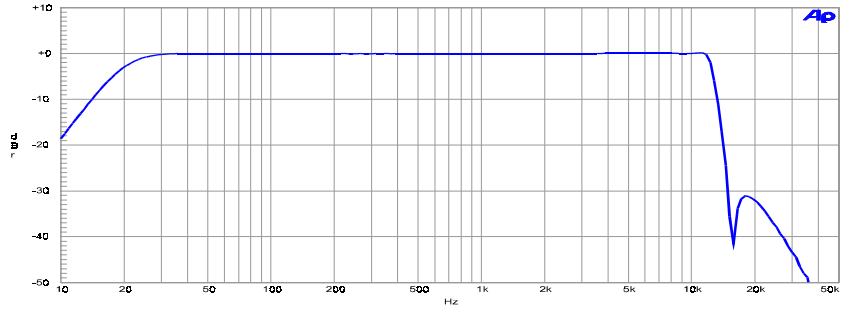


Figure 2-18. FIL-IECR 20 Hz to 15 kHz with 15.625 kHz (PAL) notch Receiver Testing Filter

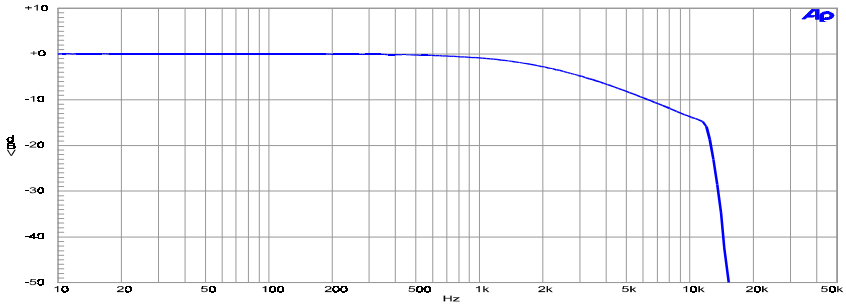


Figure 2-19. FIL-D75B 75 µs with 15.734 kHz (NTSC) notch De-emphasis Filter

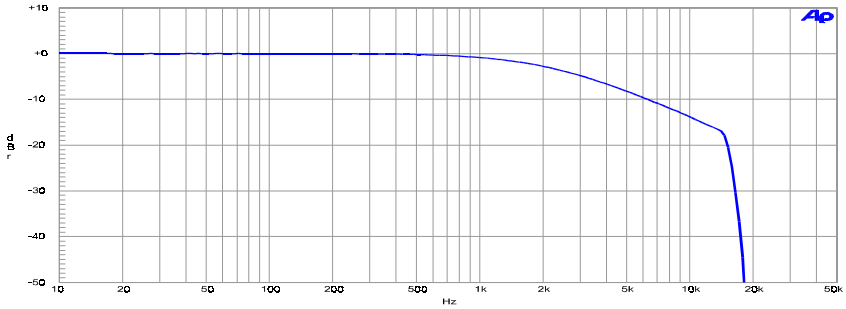


Figure 2-20. FIL-D75F 75 µs with 19 kHz (FM) notch De-emphasis Filter

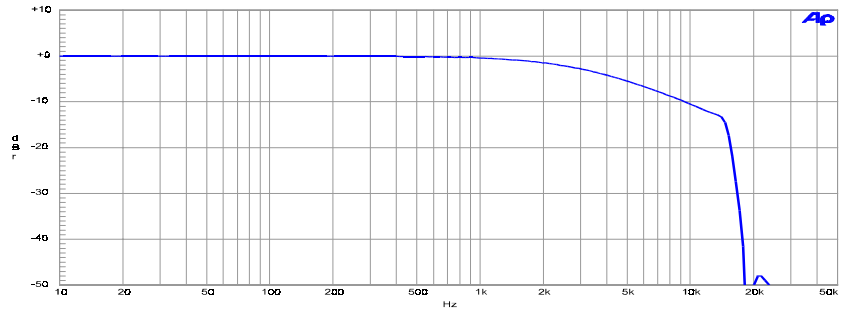


Figure 2-21. FIL-D50F 50 µs with 19 kHz (FM) notch De-emphasis Filter

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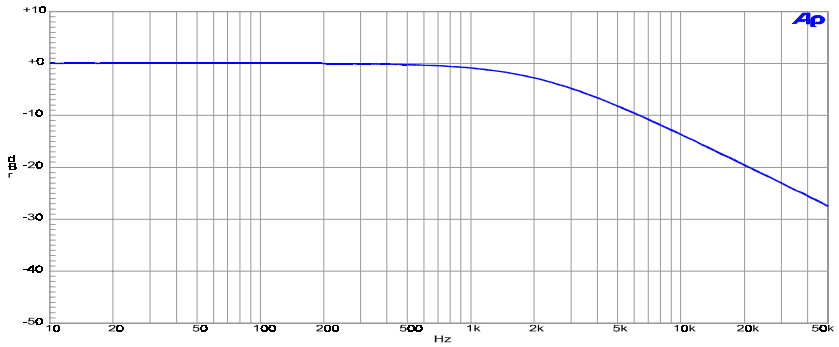


Figure 2-22. FIL-D75 75 µs De-emphasis Filter

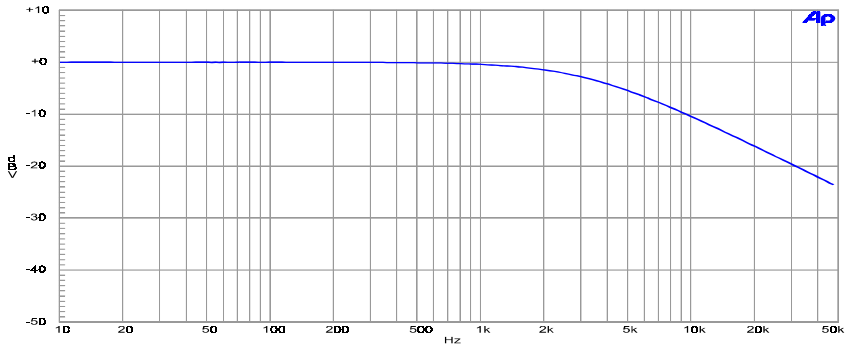


Figure 2-23. FIL-D50 50 µs De-emphasis Filter

2.2.13 IMD Option

The IMD option enables intermodulation distortion measurements to all three of the most popular methods: SMPTE (or DIN), DIM (or TIM), and CCIF difference frequency. IMD testing can reveal important forms of non-linearity that are not easy to detect with conventional THD/THD+N tests.

2.2.13.1 Option Configuration

The System One IMD Option consists of two circuit boards. The analyzer option board (IMD-DIS) mounts to the DIS-1 distortion measurement module. The generator option board (IMD-GEN) mounts to the main generator module. It contains the SMPTE and CCIF IM-frequency generator and the DIM test signal squarewave generator. The main oscillator of the generator module provides the HF tone for SMPTE, probe tone for DIM, and the carrier (or center frequency) for CCIF signals.

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2.2.13.2 Generator Related Specifications

Test Signal Modes	SMPTE1:1, SMPTE4:1, CCIF, DIM-30, DIM-100, and DIM-B
Amplitude Range[12]	<70 μVpp to 75.40 Vpp
SMPTE LF Tone	Selectable 40, 50, 60, 100, 125, 250, or 500 Hz, all ±2%.
CCIF Difference Frequency	Selectable 80, 100, 125, 250, 500 Hz, or 1 kHz, all ±2%.
DIM Squarewave	3.15 kHz (DIM-30 or DIM-100) or 2.96 kHz (DIM-B), ±1%. Squarewave is bandwidth limited with a 1-pole filter at 100 kHz in DIM-100 mode and 30 kHz in DIM-30/DIM-B modes.

2.2.13.3 Analyzer Related Specifications

Minimum Input	10 mV
IMD Range	0 – 20%
Accuracy	±1 dB for indicated IMD products
Residual IMD[13]	0.0018% SMPTE; 0.0020% DIM; 0.0005% CCIF
SMPTE Mode	
Test Signal Compatibility	40 – 500 Hz (LF) mixed with 3 – 200 kHz (HF), any ration from 0:1 to 8:1 (LF:HF)
IMD Measured[14]	40 – 500 Hz amplitude modulation products of the HF tone. Measurement bandwidth is typically 30 Hz – 700 Hz; however, the tunable 1/3-octave bandpass filter may be used for improved sensitivity or analysis of individual products.
DIM Mode	
Test Signal Compatibility	2.96 – 3.18 kHz squarewave mixed with 4 – 100 kHz sinewave; 4:1 peak-peak.
IMD Measured[15]	All products in the 750 Hz – 2.40 kHz band, expressed relative to the amplitude of the sinewave tone. Measurement bandwidth is 400 Hz – 2.45 kHz; however, the tunable 1/3-octave bandpass filter may be used for improved sensitivity or analysis of individual products.

[12] Balanced output mode only. Divide maximum amplitude by 2 (-6 dB) for unbalanced output mode. Amplitude is calibrated in V pp. Other unitsare referenced to an equivalent sinewave with the same peak-to-peak amplitude.

[13] System specification including contributions from both generator and analyzer. Valid for inputs

[14] Complies with SMPTE RP120-1983 and DIN 45403.

[15] Technique suggested by PaulSkritek of the Technical University, Vienna, Austria. For more information see "Simplified Methods" by P.Skritek, a paper presented at the 1985 Audio Engineering Society convention in Hamburg, Germany (preprint 2195); and "Practical Extended

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CCIF Mode	
Test Signal Compatibility	Two equal amplitude 4 – 200 kHz tones with 80 Hz – 1 kHz separation.
IMD Measured[16]	Difference frequency product only, expressed relative to the amplitude of either test tone. Measurement bandwidth is always 1/3-octave.

2.2.14 Wow & Flutter Analyzer Option

The Audio Precision Wow & Flutter Analyzer Option adds the capability to measure rotational wow and flutter in accordance with IEC 386, DIN 45507, CCIR 409-3, NAB, ANSI C16.5 (1971), JIS 5551 standards, and scrape flutter. Rotational wow & flutter is typically characterized by FM products in the 0.5 – 200 Hz range. Scrape flutter is caused by frictional effects of the tape sliding over guides or the tape heads and is characterized by FM products extending to 5 kHz, often peaking near 3 kHz. System One DSP configurations can perform FFT spectrum analysis of wow and flutter to 0.06-Hz resolution.

Test Signal Compatibility	
Normal	2.80 kHz – 3.35 kHz
"High-band"	10.0 kHz – 13.5 kHz for scrape flutter measurements.
Minimum Input	10 mV (-38 dBu)
Measurement Range	0 to 1%
Accuracy	±(5% of reading + 0.0005%)
Detection Modes	IEC/DIN, NAB, and JIS
Response Selections	
Weighted	4 Hz bandpass per IEC/DIN/NAB
Unweighted	0.5 Hz – 200 Hz
Scrape[17]	200 Hz – 5 kHz
Wideband[17]	0.5 Hz – 5 kHz
Residual W+F	
Weighted	≤0.001%
Unweighted	≤0.002%
Scrape or Wideband	≤0.005%

Range DIM Measurements" by Bruce EHofer, a paper presented at the 1986AES Convention in Montreux, Switzerland (preprint 2334).

[16] Complies with IEC 268.3 and IHF A202 recommendations for the difference frequency product. Odd order IMD products are not measured.

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

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2.2.15 Burst Noise-Squarewave Option (BUR)

Option BUR adds burst, noise, and squarewave signal selections to the System One generator. Typical applications include dynamic signal processor testing, absolute polarity testing, acoustic response measurements, and investigating amplifier or transducer transient response.

The tone bursts are generated by synchronously gating the generator main oscillator at zero crossings. The number of ON cycles, repetition interval, and OFF level relative amplitude are all programmable. The repetition interval can be expressed in total number of cycles, time, or burst-per-second. A front panel input is additionally provided for triggering individual bursts or gating the sinewave from an external signal.

Noise signals include white, pink, bandpass, and equalized bandpass. All of the noise signals are based upon a digital white noise generator with a choice of pseudo-random (0.262-s sequence length) or true random modes. Both modes feature excellent conformity to the ideal Gaussian distribution. The white noise signal is lowpass-filtered at 22 kHz to maximize its energy within the audio bandwidth. The pink noise signals contains energy over an extended bandwidth of 10 Hz – 200 kHz with a -3 dB/octave response characteristic. The bandpass noise signal is obtained by passing pink noise through a tunable 2-pole, constant-Q filter with approximately 1/3-octave bandwidth. All noise signals may be gated via the front panel Trigger/Gate input.

The squarewave signal is optimized for general purpose time domain testing of audio equipment. It features a controlled 2-µs risetime, very low energy content above 500 kHz, and excellent symmetry. Even harmonic components are typically below -70 dB.

2.2.15.1 Tone Burst Signal

Frequency Range	20 Hz – 100 kHz
Amplitude Range[18]	<70 µVpp – 37.70 Vpp
ON Cycle Range	1 – 65535 cycles. Programmable in cycles, seconds, or %-ON.
Interval Range	2 – 65535 cycles. Programmable in cycles, seconds, or Bursts/second.
OFF Amplitude Range and Accuracy	0 dB to <-60 dB; ±0.5 dB, 20 Hz – 20 kHz

[18] Unloaded (open circuit). Divide maximum amplitude by 2 (-6 dB) for unbalanced or common-mode configurations. Amplitude is calibrated inVpp. Other amplitude units are referenced to a sinewave with equivalentVpp.

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2.2.15.2 Noise Signals

Spectral Modes	
Pink	Bandwidth limited 10 Hz – 200 kHz
White	Bandwidth limited 10 Hz – 22 kHz
Bandpass	1/3-octave (2-pole) filtered pink noise; continuously tunable or sweepable, 20 Hz – 100 kHz
Amplitude Range[18,19]	<70 μVpp – 37.70 Vpp
Typical Crest Factor	4:1
Pseudo-Random Cycle Time	0.262 s, synchronized to the 4/s analyzer reading rate.

2.2.15.3 Squarewave Signal

Frequency Range	20 Hz – 20 kHz
Amplitude Range[18]	<70 μVpp – 37.70 Vpp
Risetime	Typically 2 μs

2.3 DSP Specifications

The Audio Precision System One is available in three levels. The first level (SYS-22 series) includes analog generation and measurement capability. Levels two (SYS-200 series) and three (SYS-300 series) retain all of the capability of level one, but add DSP (Digital Signal Processing) generation and measurement features.

System One + DSP (SYS-200 series) provides advanced signal analysis and generation for testing analog domain audio devices. System One Dual Domain (SYS-300 series) offers these same features for analog domain signals, plus digital domain inputs and outputs. System One's analog hardware generation and measurement sections operate independently and concurrently with DSP and digital domain functions, and are frequently used together for testing A/D or D/A converters or for analog pre-processing before DSP processing.

[19] Noise amplitude calibration is approximate only, and may be exceeded 0.01% of the time.

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2.3.1 Analog Input Related Specifications

Any analog domain input signal must be converted to a digital signal before either real time or block mode analysis in the DSP modules. These specifications describe the accuracy and limitations of that conversion.

A/D Converters	Dual channel independent 16 bit	
Sample Rates	192 k (80 kHz analog bandwidth), 176.4 k (80 kHz bandwidth), 48 k (22 kHz bandwidth), 44.1 k (20 kHz bandwidth), 32 k (15 kHz bandwidth), or 1 k sample/second (350 Hz bandwidth). Not all sample rates are available with all DSP programs.	
A/D Analog Sources	Selectable Channel A or B following input range sections of analog analyzer, "Reading" (analyzer output, following tunable analog bandreject or bandpass filter and all analog high-pass, low-pass, optional, and external filters), generator monitor output, or panel-mounted dc-coupled fixed-sensitivity BNC inputs.	
Worst-Case Harmonic or Spurious Product	-85 dB for in-band signals (<0.5 x sample rate); -60 dB for out-of-band signals.	
	Direct (BNC) Inputs	Input via Analog Analyzer
Amplitude Range	2.00 Vrms full scale (2.828 Vpk)	300 µV to 160 Vrms full scale, autoranging
Accuracy, Flatness	±0.25 dB dc – (0.45 x sample rate) at sample rates ≥8 kHz; for example, dc – 20 kHz @ 44.1 kHz sample rate	±0.25 dB 20 Hz – (0.45 x sample rate) at sample rates ≥8 kHz; for example, 20 Hz – 20 kHz @ 44.1 kHz sample rate

2.3.2 Analog Output Related

Four DSP programs (FFTGEN, *FAST*TEST, *FAST*TRIG, MLS) include signal generation capability and are often used to test analog domain devices. The digitally generated signal must thus be converted to the analog domain. These specifications describe the accuracy and limitations of that conversion. Note that while FFTGEN, *FAST*TEST, and *FAST*TRIG can generate two downloaded independent digital waveforms (typically multitone) from their buffers, only one D/A converter and one analog output stage exists in System One. Two waveforms are available simultaneously only at the digital outputs of System One Dual Domain.

D/A Converter	Single 16-bit, slaved to A/D sample rate
Dither	±16th bit, probability and spectral distribution choices as shown below under "Signal Output in Digital Domain"

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Worst Harmonic/Spurious Signal	-85 dB for in-band signals (<0.5 x sample rate); -60 dB for out-of-band signals.	
	Direct (BNC) Output	Output via Analog Generator Output Stage
Amplitude Range	2.00 Vrms full scale (2.828 Vpk)	Full analog output stage range of 26.66 Vrms to 25 μVrms
Accuracy, Flatness	±0.25 dB dc – (0.45 x sample rate); for example, dc – 20 kHz @ 44.1 kHz sample rate	±0.25 dB 20 Hz – (0.45 x sample rate); for example, 20 Hz – 20 kHz @ 44.1 kHz sample rate
Amplitude Resolution	$1/2^{16}$ (approx 30 μV)	<0.01 dB or 1.27 μV, whichever is greater
THD + N	≤0.01%	≤0.01%

2.3.3 Digital Input/Output Related (Dual Domain only)

Digital domain signals may be analyzed by two of the real time programs (BITTEST and GENANLR) and all of the block mode programs, with no conversions necessary. These same two real-time programs and FFTGEN, *FAST*TEST, *FAST*TRIG, and MLS can all generate signals in the digital domain to stimulate digital domain devices with no conversions. The following specifications describe the interfaces and formats available in the digital domain.

AES/EBU or SPDIF/EIAJ	Supports the full implementation of the AES/EBU digital interface. Data may be 20/24-bits wide. Channel status bit display is provided for Channel A. User-specified channel status bits are transmitted on both channels simultaneously. The user bits are not supported. Electrically compatible with the Sony Philips Digital Interface (SPDIF) and EIAJ interface at both coaxial (RCA) and optical Toshlink® connectors. The transmitter and receiver may operate at 32 k, 44.1 k, or 48 k. The transmitter may be slaved to the internal clock or house sync.
Parallel I/O	24-bit dual channel available on two 34-conductor connectors on rear panel (one input, one output). Two channels are multiplexed on each connector. Data rates are selectable 32 k, 44.1 k, or 48 k. Data strobe is included or may be externally supplied.
General-Purpose Serial via SIA-322 Serial Interface Adapter Option	Refer to Section 2.6.

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2.3.4 Signal Output in Digital Domain

Real-Time Sinewave Frequency Range vs Sample Rate	(FFTGEN, GENANLR): 10 Hz – 15 kHz @ 32 kHz; 10 Hz – 20.67 kHz @ 44.1 kHz; 10 Hz – 22.5 kHz @ 48 kHz
Frequency Resolution, Real Time Sinewave Generation	(Sample Rate)/2^{24} (approx 0.003 Hz @ 48 kHz rate)
Frequency Resolution from Downloaded Waveform Files (FFTGEN, *FAST*TEST, *FAST*TRIG)	(sample rate/waveform record length); for example, 5.86 Hz at 48 kHz sample rate with maximum 8192-sample record length.
Amplitude Range	Full 24-bit amplitude range from 100% FS to ≤0.00003% FS (0.00 dB FS to <-130 dB FS)
Amplitude Resolution	1 LSB (1/2^{24})
Flatness and Accuracy	Unmeasurable
Distortion	≤0.00003% FS (-130 dB FS)
Rounding/Truncation	Rounded to user-selected word width from 8 through 24 bits, or truncated
Dither Probability Distribution	Triangular or rectangular probability
Dither Spectral Distribution	Flat (white) or shaped (6 dB/octave rising at high frequency)
Dither Amplitude	Selectable from ±1 LSB of 8 bit though 24 bit word, or OFF

2.3.5 Real-Time Program Descriptions

2.3.5.1 HARMONIC

HARMONIC provides single-channel frequency-selective amplitude measurement of analog signals. The center frequency of a tunable bandpass filter may be steered by manual panel entry, track analog genrator frequency, or track analog analyzer bandpass-bandreject filter frequency. The filter can tune directly to the steering source frequency, to 2nd through 9th harmonic of that frequency, or to a user-entered offset frequency. A DSP-implemented RMS detector follows the filter.

	48 kHz Sample Rate	192 kHz Sample Rate
Range	20 Hz – 21.75 kHz	80 Hz – 80 kHz
Filter Shapes	6-pole 1/8-octave (Q = 12, -3-dB BW 8% of center frequency) or 10-pole 1/10-octave Q = 15, -3-dB BW 6.7% of center frequency)	6-pole 1/8-octave (Q = 12, -3-dB BW 8% of center frequency)

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2.3.5.2 GENANLR

GENANLR is a real-time two-channel digital input-output program designed for use only with System One Dual Domain. It generates a sinewave of any amplitude and frequency, acquires digital-format audio data on two channels simultaneously, has two DSP-implemented RMS detectors, and offers a selection of filters including selectable highpass, tunable bandpass or bandreject, A-weighting and CCIR weighting filters plus a quasi-peak detector for noise measurements. It thus emulates in the digital domain most of the common analog domain audio measurements. Belw are the digital analyzer specifications; for digital generator specifications, see the real-time sections of "Signal Output in Digital Domain."

Level Measurement Related	
Range	0 dB FS to -125 dB FS
Resolution	±0.01 dB
Accuracy and Flatness	±0.02 dB
Units	%FS, dB FS
Filtered Level Measurement Related	
Filter Shapes	Bandpass (Q = 19, BW 5.3% of center frequency), band reject, highpass at 22 Hz, 100 Hz, or 400 Hz, A weighting, CCIR weighting. 400 Hz highpass is 10-pole elliptical when no other filters are in use. 22 Hz and 100 Hz highpass are four poles (24 dB/octave) when BP/BR filter is not in use. All highpass filters two poles (12 dB/octave) when BP/BR filter is in use.
Bandpass Frequency Range	0.04% to 40% of sample; for example, 20 Hz – 19.2 kHz @ 48 kHz sample rate
Bandreject Frequency Range	0.1% to 40% of sample; for example, 50 Hz – 19.2 kHz @ 48 kHz sample rate
Residual THD + N	-120 dB
Measurement Units	%FS, dB FS, BITS, dB (ref LEVEL measurement)
Frequency Measurement Related	
Range	5 Hz to 40% of sample rate for rated accuracy
Accuracy	0.01% of reading or 0.0001% at 4 readings/second
Resolution	Maximum of 0.003% of reading or 0.0001% of sample rate

2.3.5.3 BITTEST

BITTEST is a real-time two-channel digital input-output program designed for use only with System One Dual Domain. It generates five waveforms. The analyzer section measures any of these waveforms and duisplays bit errors. Any amount of time delay is permissible through the device under test, so signals may be recorded and played back to measure bit errors of digital storage media.

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Sample Rates	48, 44.1, 32 kHz
Signal Waveforms	Sinewave (range 60 Hz – 6 kHz), pseudorandom noise, constant values (“digital DC”), and walking one and walking zero patterns
Analysis	Two-channel displays of input value (decimal or hex) and errors, sampled 4 or 32 times per second
Error Display	Errors during most recent sampling period (1/4 or 1/32 second), or largest number of errors in any sampling period, or total cumulative errirs since beginning of analysis

2.3.6 Block Mode Program Descriptions

The five block mode DSP programs (FFTGEN, FFTSLIDE, FASTTEST, FASTTRIG, and MLS) all contain certain common features, but differ in detail. The table on the following page compares major features. “Full memory” describes either System One Dual Domain or System One + DSP with MEM option. “Small memory” refers to System One + DSP without MEM option. Small memory units cannot run *FAST*TRIG and MLS programs. All five programs can perform Fourier Transforms of 16,384 samples maximum (assuming full memory), producing 2.92 Hz resolution at 48 kHz sample rate. All programs have an FFT dynamic range in the digital domain of about 110 dB below the largest signal for 0.25 dB amplitude error. The A/D converters further limit this range when analyzing analog signals.

Principal Intended Applications:

FFTGEN	Spectrum analysis & waveform display plus digital domain signal generation
FFTSLIDE	Spectrum analysis & waveform display
FASTTEST	Rapid testing of typical electronic devices with input & output at same location, no time delay
FASTTRIG	Rapid testing of broadcast links, recorded media or other devices with time delay or frequency shift
MLS	Quasi-anechoic frequency & phase response of loudspeakers

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	FFTGEN	FFTSLIDE	FASTTEST	FASTTRIG	MLS
Maximum acquisition record length (samples) with full memory	16,384	30,720	16,384	16,384	32,768
Maximum acquisition record length (samples) with small memory	4,096	8,192	4,096	NA	NA
Maximum full memory acquisition time, 48 kHz sample rate (scales inversely with sample rate except at 1 kHz sample rate)	341 MS	640 ms	341 ms	341 ms	683 ms
Maximum full memory acquisition time, 1 kHz sample rate	16.384 sec.	24.576 sec	NA	NA	NA
Waveform display modes	Normal, interpolate, peak max	Normal, interpolate, peak, max	NO	NO	Normal, interpolate, peak
FFT spectrum analysis	YES	YES	YES	YES	YES, by cross correlation of MLS signal
FFT of any arbitrary section of record	NO (beginning of record only)	YES	NO (beginning of record only)	NO (beginning of record only)	YES
Sample rates for acquisition & analysis	192,176.4,48, 44.1, 32, 8, 1 kHz	192,176.4, 48, 44.1, 32, 8, 1 kHz	48, 44.1, 32 kHz	48,44.1, 32 kHz	48, 44.1, 32 kHz
Selectable hardware trigger source (external, generator, etc.), slope	NO	YES	NO	NO	NO
Pre-triggering	NO	YES	NO	NO	NO
FFT averaging	4,16,64,256, 1024x	NO	NO	NO	NO
FFT window selections	Blackman-Harris, Hann, Flattop, none	Blackman-Harris, Hann, Flattop, none	Blackman-Harris, Hann, Flattop, none	Hann, none	Hann, half Hann, 240-8 kHz, 120-16 kHz, none
FFT phase measurement (absolute & interchannel)	NO	NO	YES	YES (interchannel only on Chan. B)	YES
Distortion & noise measurements from multitone signals	NO	NO	YES	YES	NO
Recognize & trigger on multitone signals	NO	NO	NO	YES	NO
Frequency error correction by comparison to stored signal	NO	NO	NO	YES	NO
Real-time high-resolution sinewave generator	YES	NO	NO	NO	NO
Generate signals from downloaded waveform (multitone, etc.)	YES	NO	YES	YES	NO
Generate Maximum Length Sequence noise	NO	NO	NO	NO	YES

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END OF SYSTEM ONE SPECIFICATIONS

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

2.4 Switchers Specifications

Max Voltage Rating	200 V pk, 160 V rms
Max Signal Power[20]	30 watts or 1 ampere, whichever is greater
Crosstalk[21]	
Balanced 600 Load	
20 kHz	-140 dB
100 kHz	-126 dB
Unbalanced 600 Load	
20 kHz	-120 dB
100 kHz	-106 dB
Series Resistance	Typically <0.3 ohms per side
Shunt Capacitance	Typically <90 pF, each side to ground

2.5 DCX-127 Multi-Function Module Specifications

2.5.1 DC Volts Measurements

Accuracy[22]	**6 rdg/s**	**25 rdg/s**
200 mV range	0.05% + 0.03 mV	0.05% + 0.1 mV
2 V range	0.05% +0.1 mV	0.05% +1 mV
20 V range	0.05% +1 mV	0.05% +10 mV
200 V range	0.05% +10 mV	0.05% +100 mV
500 V range	0.05% +100 mV	0.05% +1 V
Resolution		
200 mV – 200 V ranges	0.005% of range	0.025% of range
500 V range	100 mV	500 mV
Input Resistance	10 MΩ ±1% (all ranges)	
Common Mode Rejection	>120 dB at dc and 50 Hz – 20 kHz	

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

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

[22] Valid from +15°C to +30°C, <80% RH, for one year. Derate linearly to two times indicated values at +5°C to +40°C.

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2.5.2 Resistance Measurements

Accuracy[22, 23]	**6 rdg/s**	**25 rdg/s**
200 Ω range	0.05% + 0.04 Ω	0.05% + 0.1 Ω
2 kΩ range	0.05% +0.2 Ω	0.05% +1 Ω
20 kΩ range	0.05% +1 Ω	0.05% +10 Ω
200 kΩ range	0.05% +10 Ω	0.05% +100 Ω
2 MΩ range[24]	0.15% +100 Ω	0.15% +1 kΩ
Resolution	0.005% of range	0.025% of range
Open Circuit Voltage	< 6 Vdc	

2.5.3 DC Outputs

Range	±10.500 V (bipolar output)
Resolution	20 µV (20 bits equivalent)
Accuracy	±(0.05% + 0.2 mV) absolute; Typical ±40 µV, relative to best fit line
Maximum Output Current	20 mA source; 10 mA sink
Output Floating Characteristics	Low(-) terminal can float up to 2 Vpk

2.5.4 Digital Input/Output

Configuration	22 bit (21 bits data plus sign) words, plus data valid and new data strobes. LSTTL-CMOS compatible. 25-pin D-subminiature connectors.
Maximum Data Rate	Approx 8 ms/transfer, limited by computer speed

2.5.5 Auxiliary Output Ports

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

[23] With both 2-wire or 4-wire configurations. When using 4-wire configuration, lead resistance must be ≤1.5 Ω.

[24] Full scale on the 2 MΩ range is 2.50 MΩ.

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2.6 SIA-322 Serial Interface Adapter Specifications

General-Purpose Serial via SIA-322 Serial Interface Adapter Option	Connects serial-interface digital device inputs and outputs to System One Dual Domain parallel inputs and outputs. Switches on SIA-322 front panel provide control of: • one vs two channel operation, • LSB first vs MSB first within serial frame, • internal vs external bit clock, • internal vs external word clock, • high vs low bit clock polarity, • high vs low word clock polarity, • high vs low serial data polarity, • CMOS vs TTL logic levels, • position of word clock transition within serial word, • width of word clock pulse, • ratio of oversampled clock to sample rate (1, 2, 4, or 8), • ratio of bit clock to oversampled clock frequency, • word length from 8 to 32 bits, • data length within word, • right-justified vs left-justified data within frame, and • (for the digital output) zero vs one padding or sign extending of out-of-bounds data.
Output logic rise and fall times:	≤6 ns; 3 ns typical
Maximum high frequency clock rate:	12 MHz
Maximum sample rate limited by DSP program in use:	192 kHz with FFTGEN, 48 kHz with GENANLR.

2.7 Primary Power and Fuse Information (all components)

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

Primary Voltage Ranges, all components	100, 120, 230, or 240 V ac (-10%/+6%), 50 – 60 Hz
Power Ratings	
System One	240 VA max
Switcher (each unit)	20 VA max
DCX	20 VA max
SIA-322	none (powered from the System One)

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

2.8 Environmental (all components)

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

2.9 Physical Dimensions and Weights

2.9.1 System One

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

2.9.2 Switchers, DCX-127, and SIA-322

Dimensions	
Width	17.2 in. (43.7 cm)
Height	1.75 in. (4.4 cm)
Depth	10.625 in. (27 cm)
Weight	
Switchers	9.2 lbs (4.2 kg)
DC-127	9.5 lbs (4.3 kg)
SIA-322	6.9 lbs (3.1 kg)

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2.10 Regulatory Compliances (all components)

EMC[25]	Complies with FCC Part 15 Subpart J (class B), 89/336/EEC, 92/31/EEC, and 93/68/EEC, EN 50081-1 (1992) Emissions Class B, EN-50082-1 (1992) Immunity
Safety	Complies with 73/23/EEC, 93/68/EEC, EN6010-1 (1993) – IEC 1010-1 (1990) + Amendment 1 (1992) + Amendment 2 (1995) Installation category II – Pollution Degree 2

2.11 Software and Control

2.11.1 Computer Requirements

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

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

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

[25] Emission and Immunity levels are influenced by the shielding performance of the connecting cables. The shielding performance of the cable will depend on the internal design of the cable, connector quality, and the assembly methods used. EMC compliancewas evaluated using Audio Precision XLR type cables, part number CABAES.

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

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

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

2.11.2 ISA-WIN APIB Card

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

2.11.3 PCM-WIN Card

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

2.11.4 Cables and Adapters

2.11.4.1 Analog Audio Cables

These cables provide a convenient method to connect Audio Precision measurement equipment with a device under test. These cable kits consist of four cables, each with a unique color band at the connector

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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-XLR consists of a set of four XLR male to XLR female cables.
- CAB-XBR consists of a set of four cables: two with RCA/PHONO male to XLR male connectors, and two with RCA/PHONO male to XLR female connectors. Also provided are four adapters, from RCA female to BNC male. The cables are wired with pin 2 of the XLR connector as "hot" (center pin of the RCA connector) and pins 1 and 3 connected to ground and shield, to agree with the unbalanced wiring convention of Audio Precision instruments. See Figure 2-24 and Figure 2-25.



Figure 2-24. CAB-XBR cable kit

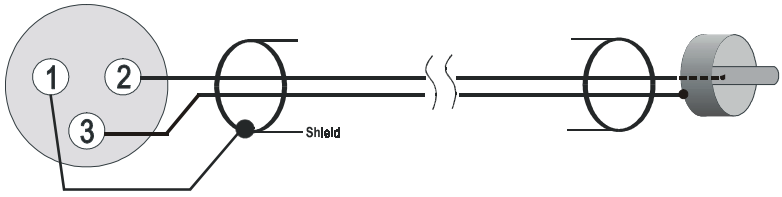


Figure 2-25. XLR to BNC wiring

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2.11.4.2 Digital Audio Cables

These cables are designed to meet CE EMI emission requirements.

- CAB-AES: Set of two AES/EBU cables, 39 in. (1 m) long. See Figure 2-26.
- CAB-AES2: Set of two AES/EBU cables, 6.5 ft (2 m) long.
- CAB-AES4: Set of two AES/EBU cables, 13 ft (4 m) long.



Figure 2-26. CAB-AES cable set

2.11.4.3 Cable Adapters

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

2.11.4.4 Digital Control (APIB) Cables

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

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

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3. Hardware Installation

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

For tabletop use, the System One can be stacked with switchers or other instruments.

3.1 Rack Mounting

3.1.1 System One

A kit is available to allow rackmounting in a standard 19-inch equipment rack. Contact Audio Precision for further information.

3.1.2 Switchers, SIA-322, and DCX-127

To rack mount the switchers, SIA-322, and DCX-127, note that the rackmounting brackets can be installed in two ways:

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

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

3.2 Primary Power Considerations

Refer to Section 2.7 or the rear-panel label for fuse specifications. Unplug the power cord from the instrument before changing fuses or performing any other operations described in this section.

3.2.1 AC Mains Switch Required

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

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3.2.2 Checking or Changing Power Line Voltage

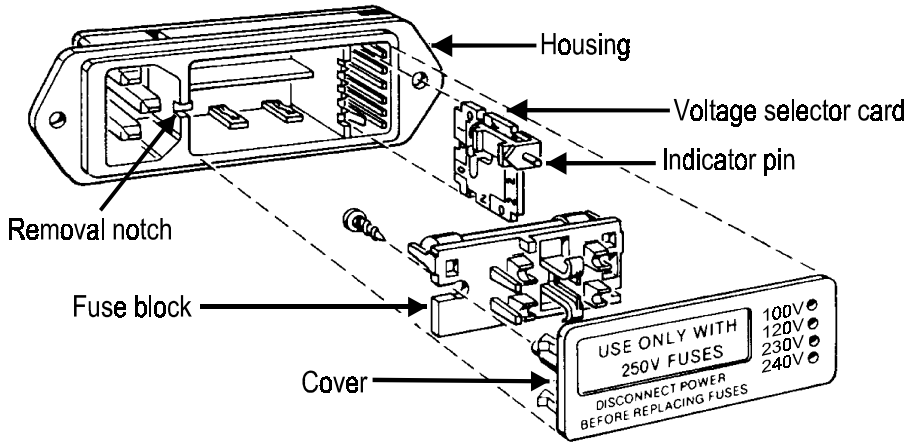


Figure 3-1. Changing power line voltage

The AC Mains input to each instrument is made through a connector/fuse block/voltage selector assembly. Before connecting the power cord, confirm that the input voltage selection is correct for your power source. An indicator pin shows the selected input voltage in one of the four holes in the cover (see Figure 3-1).

To change the input voltage, refer to Figure 3-1 and proceed as follows:

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

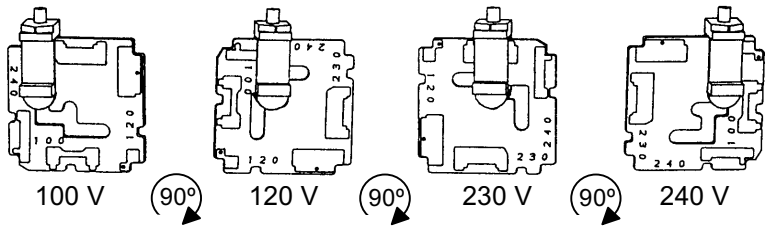


Figure 3-2. Voltage selector card positions

4. Orient the selector card so that the desired input voltage is readable at the bottom (see Figure 3-2). Then orient the indicator pin to point

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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 in Section 2.7 or marked on the rear panel). If necessary, change the fuse type as described in the following section.
7. Replace the cover and verify that the indicator pin shows the desired voltage.

3.2.3 Fuse Information

The connector/fuse block/voltage selector assembly allows two fusing arrangements: North American (see Figure 3-3), and European (seeFigure 3-4). The North American fusing arrangement uses a single type 3AG (0.25 x 1.25 in.) SB ("slow blow") fuse; the European fusing arrangement uses two 5 x 20 mm IEC-approved type T fuses. Refer to the label on the rear panel for fuse current ratings.

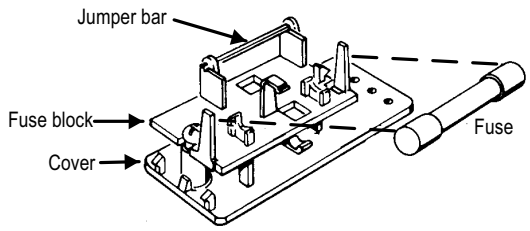


Figure 3-3. North American fusing arrangement

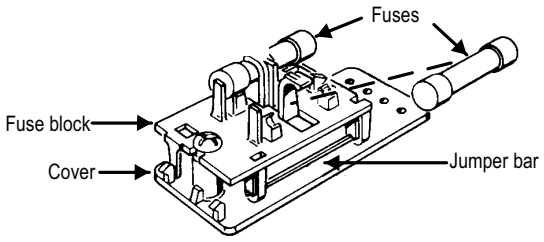


Figure 3-4. European fusing arrangement

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3.2.4 Changing Fusing Arrangement

To change from one fusing arrangement to the other:

1. Remove the AC power cord from the AC Mains Connector.
2. Open the cover of the connector/fuse block/voltage selector assembly with a small blade screwdriver or similar tool.
3. On the back of the cover, loosen the Phillips screw two turns, then remove the fuse block by sliding up, then away from the screw and lifting from pedestal at the other end (refer to Figure 3-5).

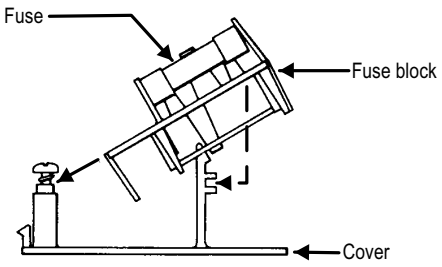


Figure 3-5. Changing fuse types

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

3.2.5 Proper Environment

All Audio Precision System One and System Two products are intended for use indoors, in a normal environment.

3.3 Installing ISA-WIN APIB Card

The ISA-WIN card, shown in Figure 3-6, is a half size (8-bit) card that must be installed in the host PC to interface the ISA Bus in the PC to the APIB. Included with the card is an APIB interconnecting cable.

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

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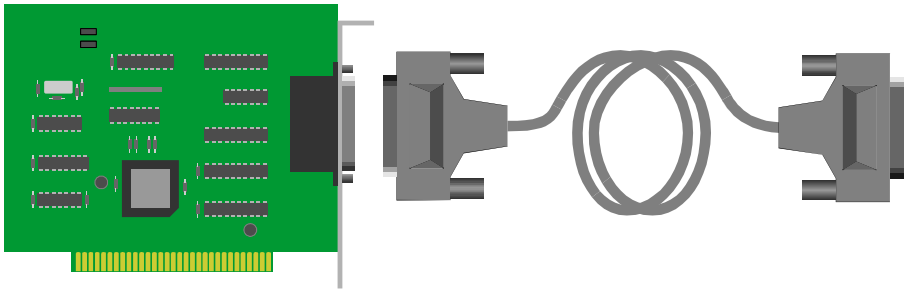


Figure 3-6. ISA-WIN Interface Card and cable

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

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

3.3.1 Address Jumper Settings

You will notice two jumpers near the top edge of the card. In most cases, these will not have to be changed. They define the address location of the card and can be used to change the default address if conflicts arise. Unless you know of a conflict, leave the jumpers in the factory default position. After installation, if conflicts arise, these jumpers can be changed to define an alternate location. To change jumpers, turn off power to the computer, remove the cover and remove the card. Use caution handling the card to avoid static discharge. Refer to Figure 3-7 and set the jumpers to an alternate location. Replace the card and cover.

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

(Memory space required: eight address locations.)

> ***NOTE***
>
> *When APWIN starts, it will automatically look through the possible address locations to find an ISA-WIN or PCM-WIN card. In the unlikely event that this auto-detect does not function correctly, you can force the software to utilize a specific address location using command line start-up switches. To do this, see Section 5.1.1.2*

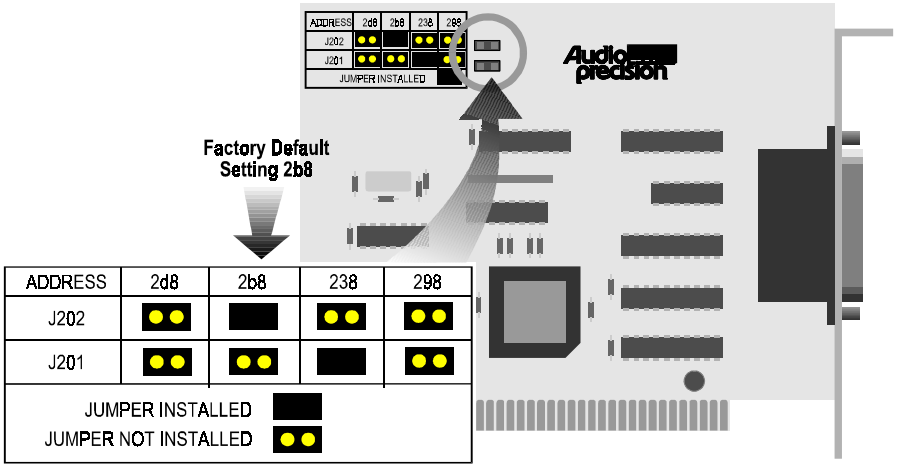


Figure 3-7. ISA-WIN APIB Card with address jumper selections shown

3.4 Installing PCM-WIN PCMCIA Interface Card

The Audio Precision PCM-WIN card is a PCMCIA to APIB interface adapter. It can be used to connect a PC or notebook computer equipped with a PCMCIA type II slot and version 2.1 or later Card and Socket Services to Audio Precision instruments via the Audio Precision Interface Bus (APIB). It functions the same as the ISA-WIN interface card that is used with ISA bus PCs.

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

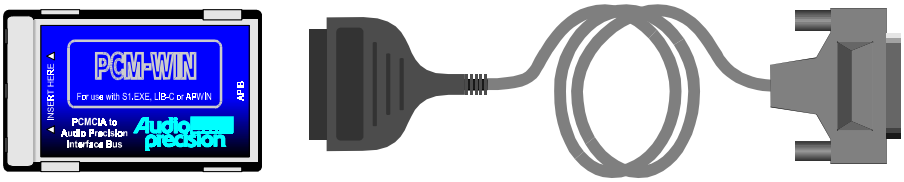


Figure 3-8. PCMCIA to APIB interface card and cable

Refer to Section 4.1 to install the associated PCMCIA drivers for Windows 95.

3.5 Connecting the APIB Interface

Simply connect the cable from the APIB Interface card in the PC to the System One. If your system includes switchers, notice that each SWR-2122 switcher has two APIB connectors on its rear panel. This is to permit connecting them in a "daisy-chain" fashion between the computer's APIB card connector and the System One APIB connector (see Figure 3-9). The switcher's connectors pass the APIB lines through, and the switchers respond only when specifically addressed, as described below. Normally, the computer will be connected to the first switcher with a digital interface cable, the first switcher connects to the second, etc, and the last switcher connects to the System One digital interface (APIB) connector.

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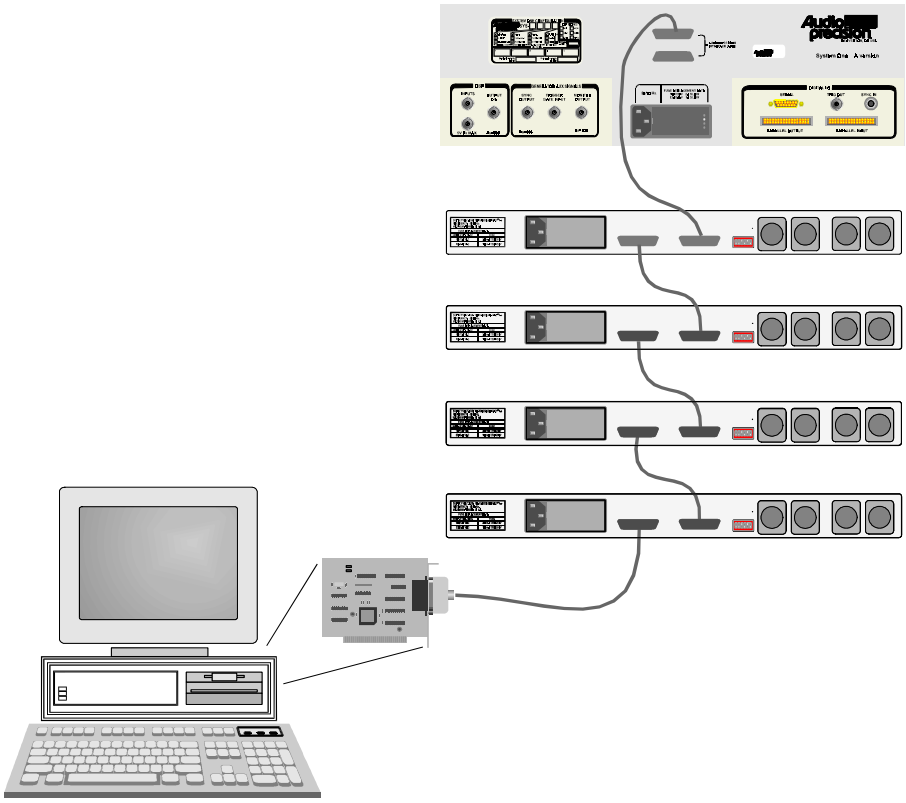


Figure 3-9. APIB connections block diagram (typical)

3.6 Setting Switcher Addresses and Modes

A six-switch binary switch bank is located on the rear panel. The first four switches on this bank select which group of channel numbers the module responds to as described in Table 3-1. The last two switches function as described in the appropriate subsection below.

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

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

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3.6.1 Switcher Address Settings

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

Figure 3-10 shows a typical rear-panel APIB Address switch. Table 3-1 shows relationships among APIB Address switch positions, binary codes, and channel numbers on the APWIN software "panels."

Table 3-1. APIB Address switch settings

Channel Numbers	Rear Switch Settings				Binary Code
	1 (Switch 1)	2 (Switch 2)	4 (Switch 3)	8 (Switch 4)	
1 – 12	Up	Up	Up	Up	0000
13 – 24	Down	Up	Up	Up	0001
25 – 36	Up	Down	Up	Up	0010
37 - 48	Down	Down	Up	Up	0011
49 - 60	Up	Up	Down	Up	0100
61 - 72	Down	Up	Down	Up	0101
73 - 84	Up	Down	Down	Up	0110
85 - 96	Down	Down	Down	Up	0111
97 - 108	Up	Up	Up	Down	1000
109 - 120	Down	Up	Up	Down	1001
121 - 132	Up	Down	Up	Down	1010
133 - 144	Down	Down	Up	Down	1011
145 - 156	Up	Up	Down	Down	1100
157 - 168	Down	Up	Down	Down	1101
169 - 180	Up	Down	Down	Down	1110
181 - 192	Down	Down	Down	Down	1111

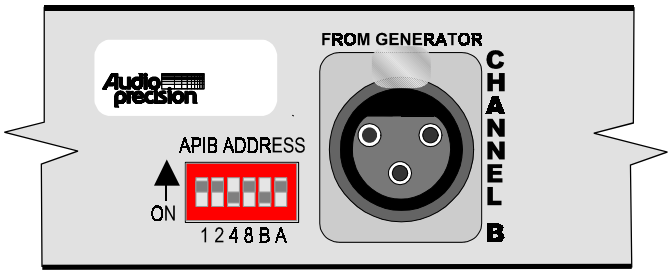


Figure 3-10. Rear panel DIP switch (typical)

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3.6.2 Input, Output, and Patch Point Switcher Mode Switches

Switches 5 and 6 of the switch bank set the switcher mode as described in Table 3-2. The modes are defined below.

Table 3-2. Patch point switcher mode settings

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

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

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

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

Off: Neither channel responds to any address.

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3.6.3 Unbalanced Switcher Mode Switch

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

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

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

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

Also note the labeling on the rear panel describing the difference in cable connections to the four rear-panel BNCs when used as an input versus output switcher. See Figure 3-11.

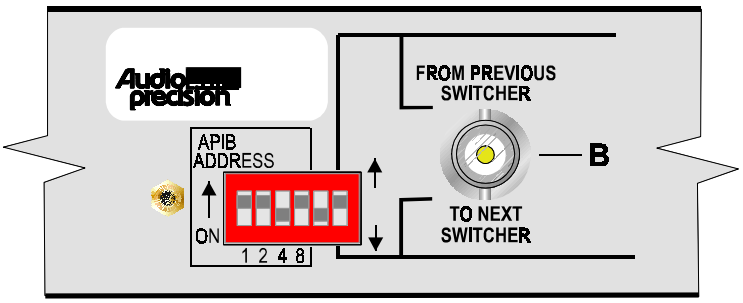


Figure 3-11. Unbalanced switcher address/mode switch

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3.6.4 Board Jumpers

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

A common circuit board design is used in all models of the switchers; two jumpers on the circuit board select whether the switcher functions as an input switcher, output switcher, unbalanced switcher, or patch point switcher. These jumpers, marked P62 and P63, are shown in Figure 3-12. The jumper positions are shown for reference only and will normally not need to be changed.

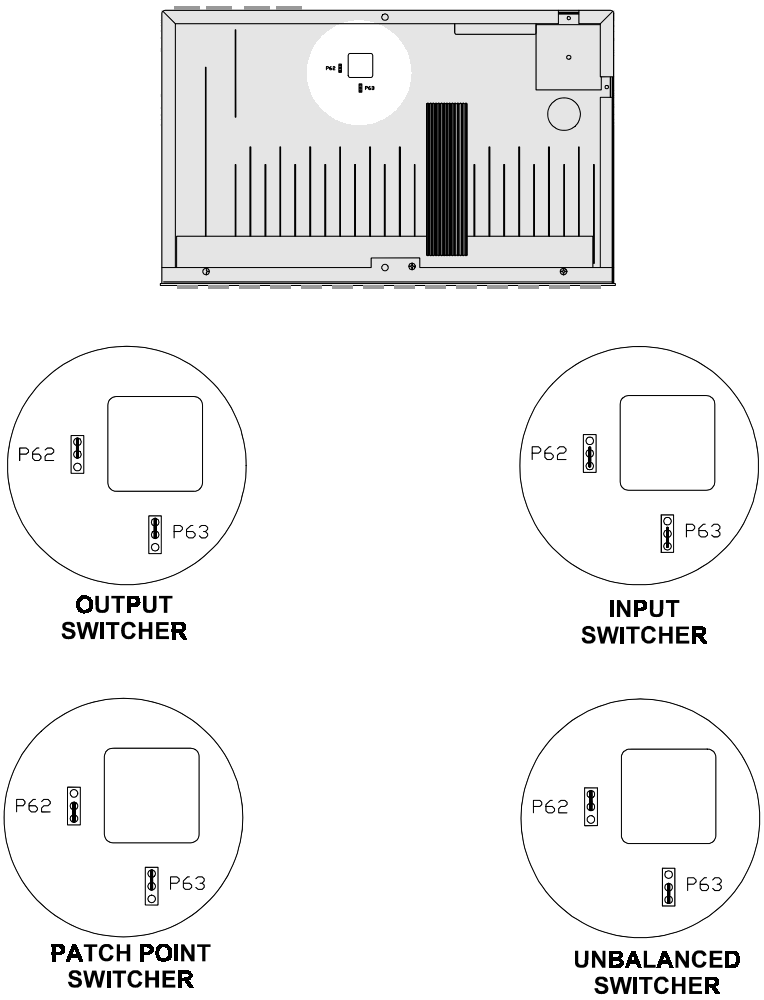


Figure 3-12. Switcher mode jumper positions

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4. Software Installation- Windows 95 and NT

APWIN comes with an easy to use setup utility that will perform the complete installation. The installation handles all options and system dependent variances automatically.

APWIN uses the standard Windows Notepad program for its error reporting file. Your Windows installation automatically installs Notepad, but if you have removed it for some reason, you must reinstall this editor program to be able to use the error file feature of APWIN.

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

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

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

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Figure 4-1. APWIN installation Setup screen

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

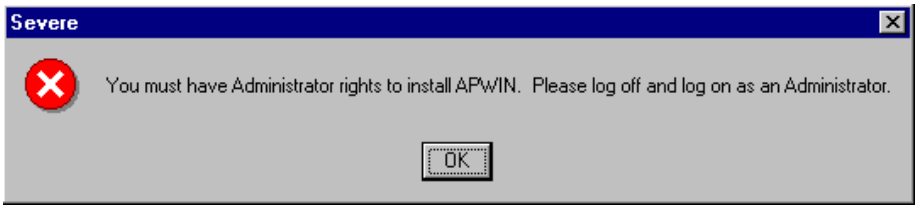


Figure 4-2. Windows NT Administrator rights warning screen

The following screen appears (Figure 4-3):



Figure 4-3. Setup progression screen

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

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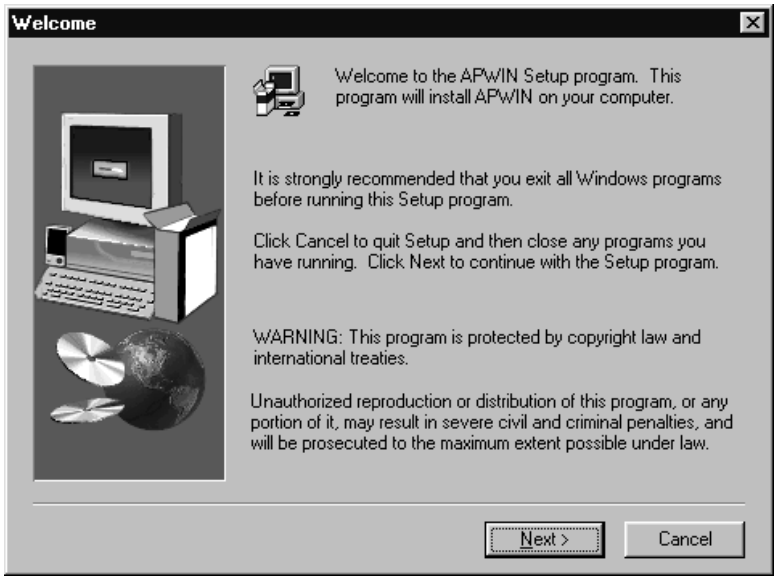


Figure 4-4. Welcome screen

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

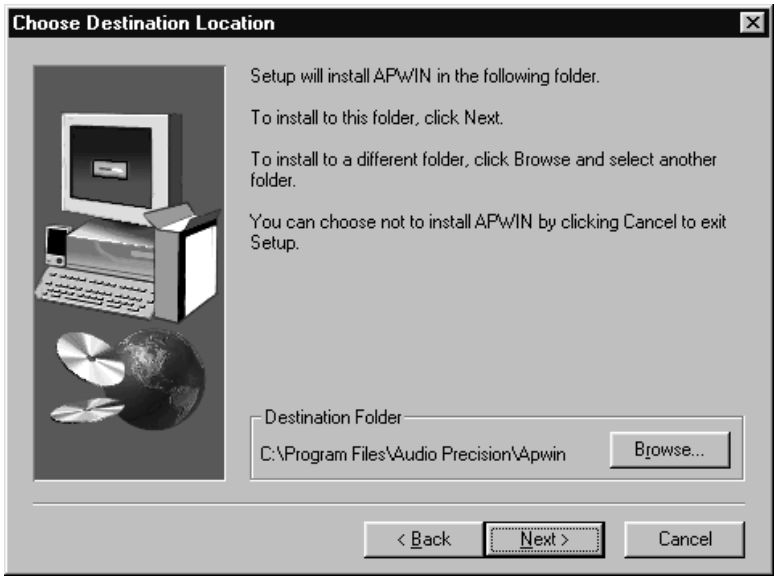


Figure 4-5. Choose Destination Location for APWIN dialog box

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

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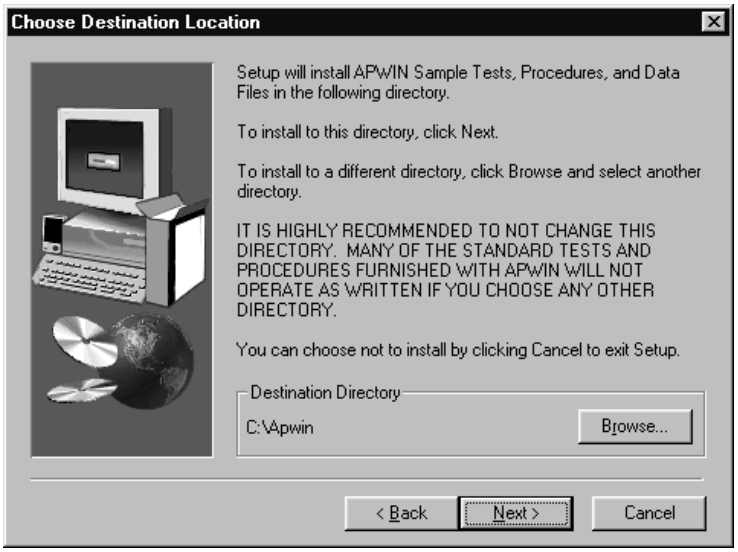


Figure 4-6. Choose Destination Location for sample tests, procedures, and data files dialog box

This screen (Figure 4-6) will suggest a location for all the sample tests, procedures, and data files. If you wish to choose an alternate location, click on the Browse ... button. When you click the Next > button, the dialog shown in Figure 4-7 will appear.

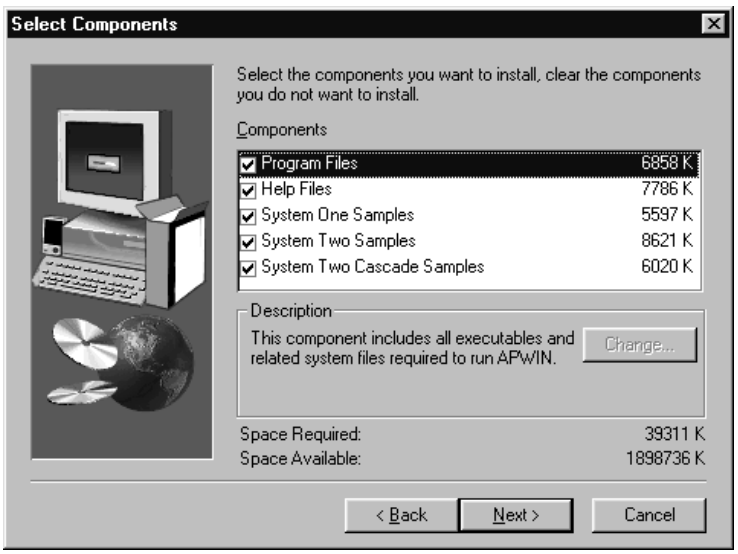


Figure 4-7. Choose Components to Install dialog box

Here you have a choice of what to install and how much space will be required. If you are tight on space or you are re-installing part of the software, you can selectively turn off any of the items shown by clicking

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on the check boxes (an ✗ or ✓ means install, a blank box means don't install).

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

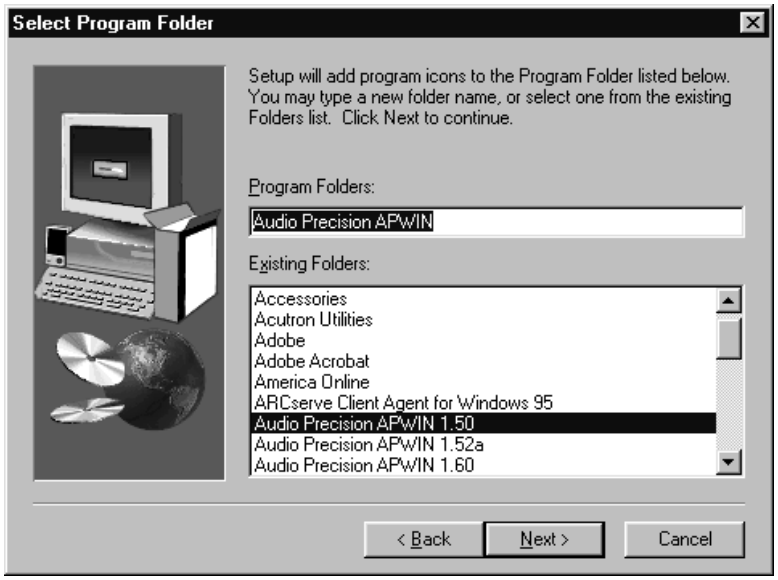


Figure 4-8. Select Program Manager Group dialog box

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

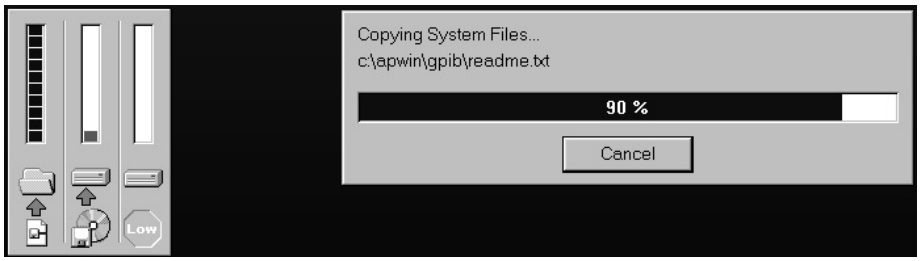


Figure 4-9. Installing progress screen

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



Figure 4-10. Setup Complete message window

4.1 Using PCM-WIN card with Windows 95 or NT

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

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5. Getting Started with APWIN

5.1 Starting APWIN

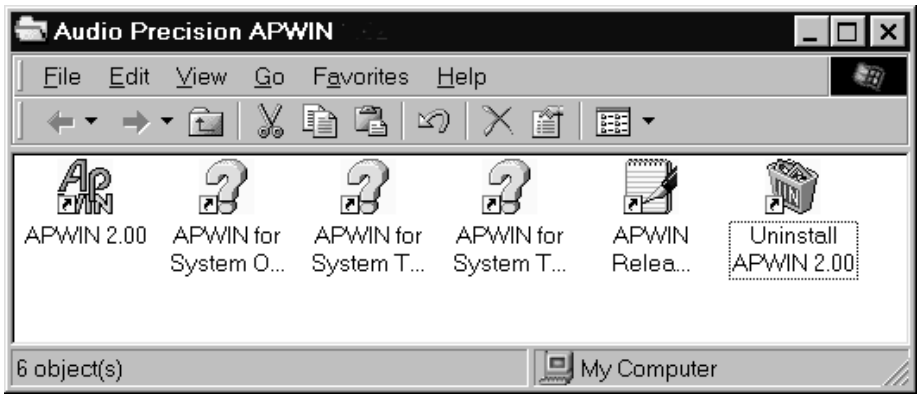


Figure 5-1. APWIN directory window

To start APWIN, double click on the APWIN 2.0 icon shown in Figure 5-1. During startup, APWIN loads several files and checks for the presence of the Audio Precision hardware. It will "look for" an ISA-WIN or PCM-WIN interface card and then for a system. It is able to automatically identify System One, System Two, or System Two Cascade. Depending on the configuration (See section 5.2 and Figure 5-13), the following window may ask you to choose which System to set up for.



Figure 5-2. Choose Hardware window

(See Configuration preferences below). If APWIN does not find an interface card and then a System, it will announce this and indicate that it will run in Demo mode. Demo mode allows all program functions to be used except those requiring communication with the instrument. All Reading fields will display random numbers.

After APWIN is loaded, you can load sample tests, sample procedures, change instrument settings on the various panels, run tests

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and run procedures. See the User's Manual for complete instructions or use the on-line Help system explained later.

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

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

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

After selecting the file type (Procedure), the Windows File Open dialog will appear (Figure 5-3):

Navigate to the S1 directory (folder) using the normal Windows method. If you installed APWIN with the default file locations, you should find it under the APWIN directory. Double click on the System1.apb procedure. This will then open the Procedure window. At the top of this window will be the Procedure tool bar shown in Figure 5-4 (which may also be at the top or side of the APWIN desktop if you have this tool bar turned on).

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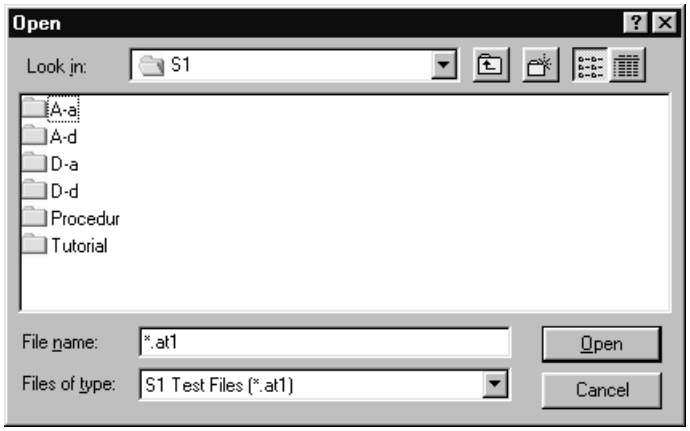


Figure 5-3. Windows 95 File Open dialog box



Figure 5-4. Procedure tool bar

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

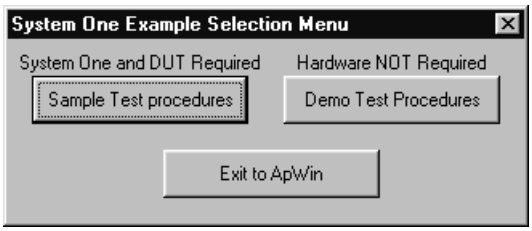


Figure 5-5. System One Example Selection Menu window

You can now select from two groups of procedures: Demo Test Procedures includes stored sample data and can be used without a device under test connected (and even without a System One or Two connected); Sample Test Procedures requires measurement hardware and the specific device under test to make actual measurements. After selecting one of these choices, the menu box of Figure 5-6 should appear.

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

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handy if you ever see unusual test results and would like to be sure that the measurement hardware is functioning correctly.

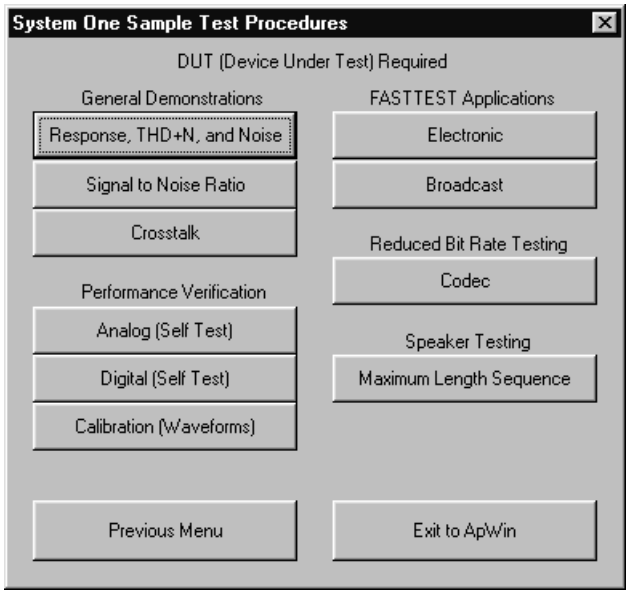


Figure 5-6. System One Sample Test Procedures window

5.1.1 Automating APWIN Startup

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

5.1.1.1 Windows 95 and NT

For Windows 95 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:

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```
"C:\PROGRAM FILES\APWINBIN\APWIN.EXE" /RUNPRO
C:\APWIN\S1\SYSTEM1.APB
```

(this will actually be all on one line)

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

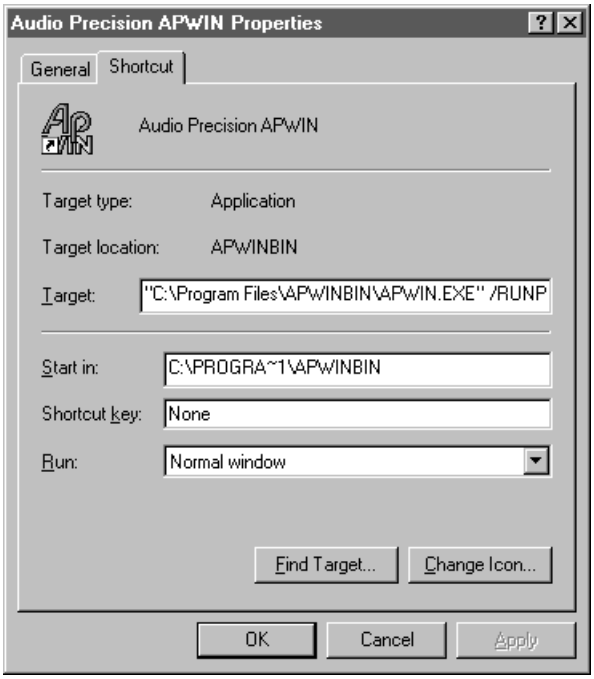


Figure 5-7. APWIN Properties dialog box

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

5.1.1.2 Command Line Options and Switches

Syntax:

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

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

Where

TESTNAME.AT1 is any valid System One test file. When specified on the command line, this test file will be loaded with APWIN.

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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
```

5.2 User Preferences

APWIN allows the user to customize several aspects of the program. Many of these are in a Configuration dialog that can be accessed under the Utilities menu item. Click on Utilities to drop down a menu list, then click on Configuration to bring up the Configuration dialog box. There are five tabs on this dialog box, as shown in Figure 5-8 through Figure 5-12.

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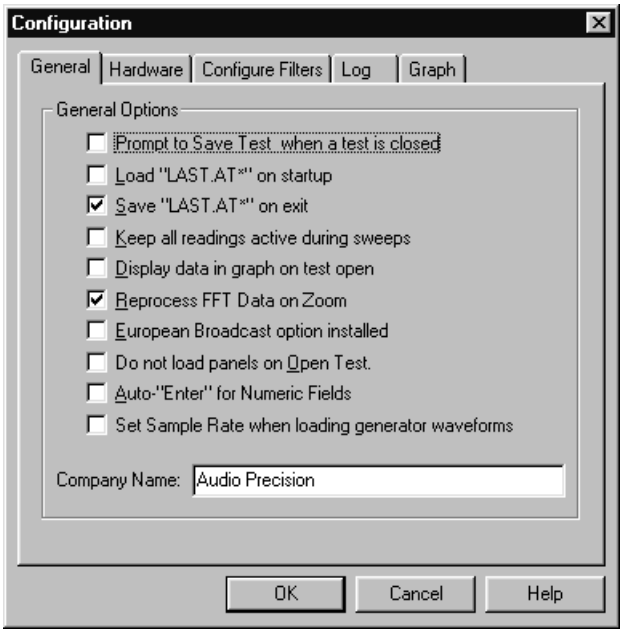


Figure 5-8. Configuration dialog box, General tab



Figure 5-9. Configuration dialog box, Hardware tab

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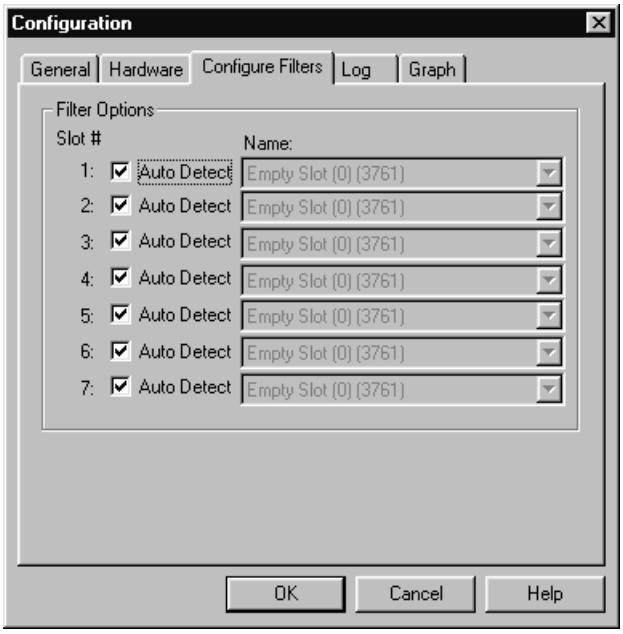


Figure 5-10. Configuration dialog box, Configure Files tab

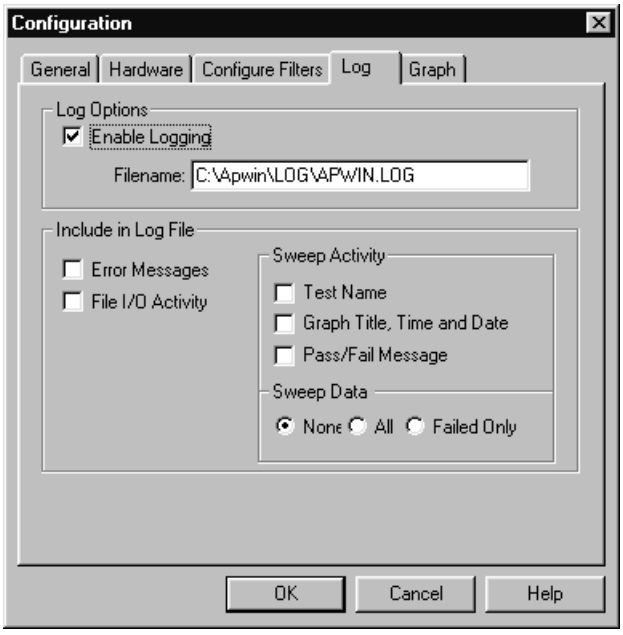


Figure 5-11. Configuration dialog box, Log tab

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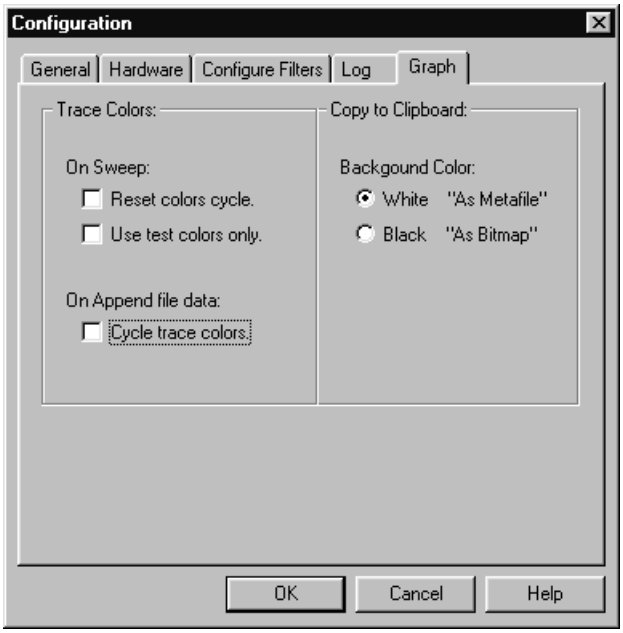


Figure 5-12. Configuration dialog box, Graph tab

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

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

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

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

5.3 APWIN Help

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

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

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

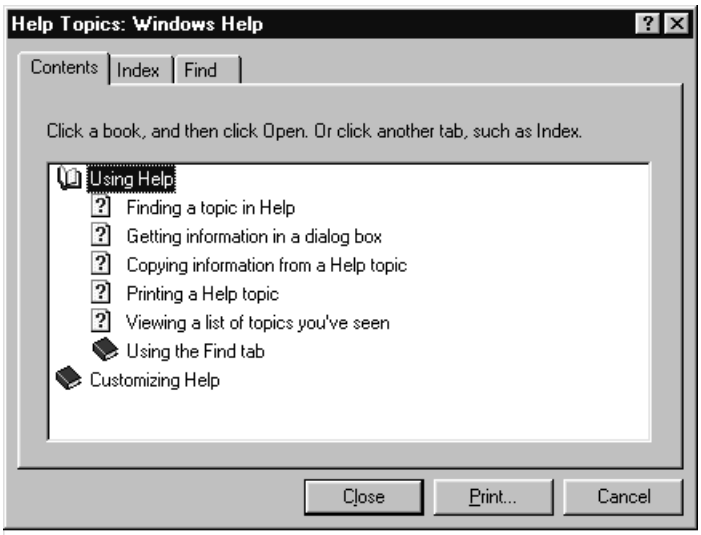


Figure 5-13. Windows 95 Windows Help screen

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

5.4 Using Printers with APWIN

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

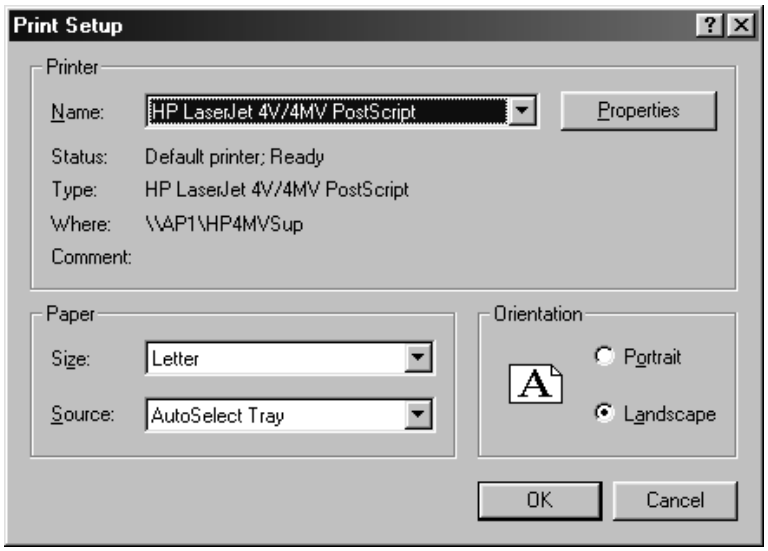


Figure 5-14. Printer Setup dialog box

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

To install a new printer, refer to your Windows documentation for complete instructions. Briefly, from the PROGRAM MANAGER, open the CONTROL PANEL and select PRINTERS. In the dialog box select

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ADD>. This will bring up a long list of printers. If you do not find your particular printer listed and you have a disk from the manufacturer, select the first item: Install Unlisted or Updated Printer and click on Install. This will guide you through the process of installation including Setup (which configures the driver for the options installed on the printer) and Connect (which determines to which port the printer will print). *Again, refer to your Windows documentation for more details.*

5.5 Compatibility with S1.EXE

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

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

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

5.5.1 Utilizing S1.EXE Test and Procedures

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

5.5.2 Remote Operation via RS-232 Inteface

In the S1.EXE software users had to create executable (.EXE) files to access the RS-232 port. This type of serial communication via the RS-232 interface can be done totally within APWIN Basic.

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5.5.3 S1.EXE Utility Programs

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

The PLOT and POST programs that would take a graphics file produced by S1.EXE and create an HPGL plotter file or Postscript file respectively are not available in APWIN. APWIN has access to the powerful printing features of Windows, supported printers (or plotters) can be driven directly from within APWIN without having to use an external utility. It is also possible to produce HPGL "plotter" and Postscript files from APWIN by simply "printing" to file with an HPGL plotter or Postscript printer selected as the default printer.

5.6 Publishing Graphs

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

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

Another method is to "print" to a file in APWIN. Depending upon the printer driver used, the file can be saved in PostScript or HPGL. Note that it is not necessary to actually have the physical printer connected, it is only necessary to 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.

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5.7 Technical Support

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

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

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

Your computer: CPU type and speed (e.g.: 386, 486, Pentium; 33MHz, 66MHz, 90MHz etc.)

Amount of RAM installed (typically 8, 12, 16 or 32Meg)

System One or System Two configuration (SYS-22, SYS-222, SYS-322, options such as DSP, Dual Domain, BUR-GEN, IMD).

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

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

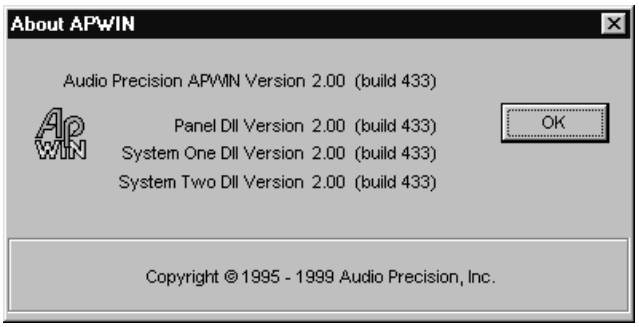


Figure 5-15. About APWIN window (typical-- your version and build numbers may be different)

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