

System Two Description, Installation, and APWIN Guide



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Safety Information

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.

Safety Symbols



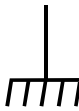
WARNING! – This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.



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.

Disclaimer

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

1. Introduction

1.1 Scope of This Manual

This guide serves several purposes:

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

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

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

1.2 Related Documentation

- **APWIN 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 Two.
- **APWIN BASIC (procedure language) User's Manual and Programmer's Reference** – includes detailed descriptions and syntax for every command.
- **System Two Service Manual** – contains detailed System Two 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.

- **SIA-2322 Serial Interface Adapter User's Manual** – details the capabilities and operation of the SIA-2322. This manual comes with the SIA-2322, 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 Two is a personal computer-based audio test set with broad, high-performance capabilities for analog, digital, and mixed-signal devices. System Two includes both signal generation and analysis capability for audio stimulus-response testing. Virtually all common and many specialized tests are performed on analog domain and digital domain signals and on the digital interface signal (pulse train) itself.

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

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

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

1.3.2 System Two

System Two audio test equipment provides stimulus and measurement capability. System Two is actually a family of products with many potential configurations:

- The 2000-Series provides analog stimulus and measurement capability, using analog capability for signal generation, filtering, and measurement.
- The 2200-Series is System Two plus a digital signal processor for enhanced capability including high-resolution spectrum analysis via FFT, waveform capture and display, and fast multitone testing.
- The 2300-Series 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.

System Two is normally supplied with an ISA-bus interface card for installation in the user's pc. Alternatively, a type II PCMCIA interface card may be furnished for use in a notebook computer. An option replaces this card with a PCM-WIN-SUB2 Type II card. Each of these cards comes with the appropriate APIB (Audio Precision Interface Bus) cable to interconnect the computer with the System Two.

This version of APWIN requires one of these cards, and will not function with earlier System One PCI-1, PCI-2, or PCI-3 interface cards or PCM-DOS PCMCIA interface cards.

These analog options may be installed in your System Two:

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

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

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

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

1.3.3 Switchers

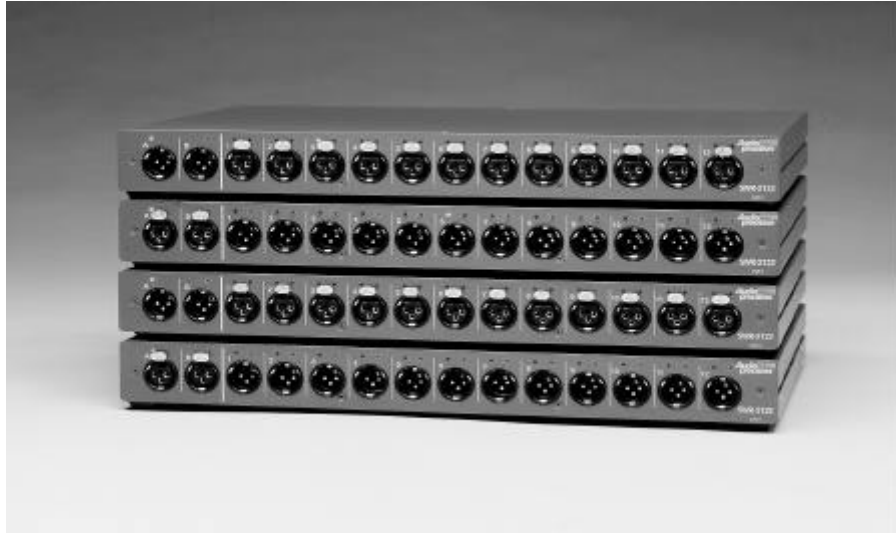


Figure 1-1. SWR-2122 Switchers

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 Two. See Sections 0 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.
- 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 M Ω ranges, fully floating and guarded for accurate measurements in the presence of large common mode voltages. Resistance measurements can be made using 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 μ V resolution and monotonicity to 40 μ V (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 2.12 for DCX-127 specifications.

1.3.5 SIA-2322 Serial Interface Adapter



Figure 1-3. SIA-2322 Serial Interface Adapter

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

The SIA-2322 consists of a parallel-to-serial transmitter and an independent serial-to-parallel receiver. A flexible design allows the SIA to address many serial interface requirements. Refer to Section 2.13 for SIA-2322 specifications.

2. System Two Specifications

2.1 Analog Signal Outputs

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

2.1.1 Analog Signal Generator

2.1.1.1 Low Distortion Sine Wave

Frequency Range	10 Hz to 204 kHz
Frequency Accuracy	
High-accuracy mode	$\pm 0.03\%$
Fast mode	$\pm 0.5\%$
Frequency Resolution	
High-accuracy mode	0.005%
Fast mode	0.025 Hz, 10 Hz-204.75 Hz; 0.25 Hz, 205 Hz-2.0475 kHz; 2.5 Hz, 2.05 kHz-20.475 kHz; 25 Hz, 20.5 kHz-204 kHz
Amplitude Range ¹	
Balanced	$< 10 \mu\text{V}$ to 26.66 Vrms [+30.7 dBu]
Unbalanced	$< 10 \mu\text{V}$ to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	$\pm 0.7\%$ [± 0.06 dB] at 1 kHz
Amplitude Resolution	
$V_{\text{out}} \geq 150 \mu\text{Vrms}$	0.003 dB
$V_{\text{out}} < 150 \mu\text{Vrms}$	0.05 μVrms
Flatness (1 kHz ref)	
10 Hz-20 kHz	± 0.008 dB (typically < 0.003 dB)
20 kHz-50 kHz	± 0.03 dB
50 kHz-120 kHz	± 0.10 dB
120 kHz-200 kHz	+0.2/-0.3 dB

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

Residual Distortion ²	
20 Hz – 20 kHz	typically <0.0001% [-120 dBc];
at 1 kHz	typically <0.00003% [-130 dBc]
Residual THD+N ³	
20 Hz-20 kHz	≤(0.0004% + 1 μV), 22 kHz BW [-108 dB]
	≤(0.0006% + 2 μV), 80 kHz BW [-104 dB]
	≤(0.0015% + 6 μV), 500 kHz BW [-96.5 dB]
10 Hz-100 kHz	≤(0.0040% + 6 μV), 500 kHz BW [-88 dB]

2.1.2 Intermodulation Distortion Related Signals

with option "IMD"

2.1.2.1 SMPTE (or DIN) Test Signals

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

2.1.2.2 CCIF and DFD Test Signals

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

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

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

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

⁵ Measured with System Two analyzer (system specification).

2.1.2.3 DIM (or TIM) Test Signals

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

2.1.3 Special Purpose Signals

with option "BUR"

2.1.3.1 Sine Burst

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

2.1.3.2 Square Wave

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

2.1.3.3 Noise Signals

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

2.2 D/A Generated Analog Signals

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

2.2.1.1 D/A Converter

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

2.2.1.2 Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

Frequency Range	10 Hz to 20 kHz
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 k samples/s)
Phase accuracy	± 1 deg., 10 Hz – 5 kHz; ± 3 deg., 5 kHz – 20 kHz
Phase range	-360 to +359.9 deg.
Amplitude Range	
Balanced	<10 μ V to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 μ V to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	$\pm 0.7\%$ [± 0.06 dB] at 1 kHz
Flatness (1 kHz ref)	
10 Hz-18 kHz	± 0.03 dB
18 kHz-20 kHz	+0.03 / -0.15 dB

2.2.1.3 Stereo Sine Wave

Sine waves of independent frequency and amplitude on each channel

Frequency Range	10 Hz to 20 kHz, each channel independently settable. (Phase random if both frequencies set the same)
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 k samples/s)
Amplitude Range	
Balanced	<10 μ V to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 μ V to 13.33 Vrms [+24.7 dBu]
Amplitude Accuracy	$\pm 0.7\%$ [± 0.06 dB] at 1 kHz

Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

2.2.1.4 Dual Sinewave

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

Frequency Range	10 Hz to 20 kHz, each component independently settable
Frequency Resolution	Sample Rate ÷ 2 ²³ (typically 0.006 Hz at 48 k samples/s)
Amplitude Range	
Balanced	<10 µV to 26.66 Vrms [+30.7 dBu]
Unbalanced	<10 µV to 13.33 Vrms [+24.7 dBu] (Channel amplitudes individually settable)
Amplitude Accuracy	±0.7% [±0.06 dB] at 1 kHz
Amplitude Ratio	0 dB to -100 dB
Flatness (1 kHz ref)	
10 Hz-18 kHz	±0.03 dB
18 kHz-20 kHz	+0.03/-0.15 dB

2.2.1.5 Shaped Sine Burst

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

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

2.2.1.6 Multitone Signals

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

Number of Tones	1 to 128 typical, 4095 maximum
Frequency Range	20 Hz to 50% of sample rate
Frequency Resolution	Sample Rate ÷ 2 ¹³ (typically 5.86 Hz at 48 k samples/s)

2.2.1.7 Arbitrary Waveforms

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

2.2.1.8 Maximum Length Sequence Signals

Pseudo-random noise signal for speaker testing with MLS analyzer (Section 0)

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

2.2.1.9 Polarity Signal

Asymmetric waveform to facilitate polarity identification

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

Digitally generated

2.2.2.1 SMPTE (or DIN) Test Signal

LF Tone	40 Hz to 500 Hz, continuously settable
HF Tone Range	2 kHz-20 kHz
Mix Ratio	4:1 or 1:1 (LF:HF)
Amplitude Range ⁶	
Balanced	30 μ Vpp to 75.4 Vpp
Unbalanced	30 μ Vpp to 37.7 Vpp
Amplitude Accuracy	$\pm 3\%$ [± 0.26 dB]
Residual IMD ⁷	$\leq 0.0050\%$ [-86 dB], 60 Hz + 7 kHz or 250 Hz + 8 kHz (measured using analog analyzer)

2.2.2.2 CCIF and DFD Test Signals

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

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

⁷ Measured with System Two analyzer (system specification).

2.2.3 Output Characteristics

Source Configuration	Selectable balanced, unbalanced, or CMTST (common mode test)
Source Impedances	
Balanced or CMTST	40 Ω (±1 Ω), 150 Ω (±1 Ω) ⁸ , or 600 Ω (±3 Ω)
Unbalanced	20 Ω (±1 Ω) or 600 Ω (±3 Ω)
Max Floating Voltage	42 V pk
Output Current Limit	≥80 mA peak (typically >120 mA at +25°C)
Max Output Power	
Balanced	+30.1 dBm into 600 Ω (Rs = 40 Ω)
Unbalanced	+24.4 dBm into 600 Ω (Rs = 20 Ω)
Output Related Crosstalk	
10 Hz-20 kHz	≤-120 dB or 5 μV, whichever is greater
20 kHz-100 kHz	≤-106 dB or 10μV, whichever is greater

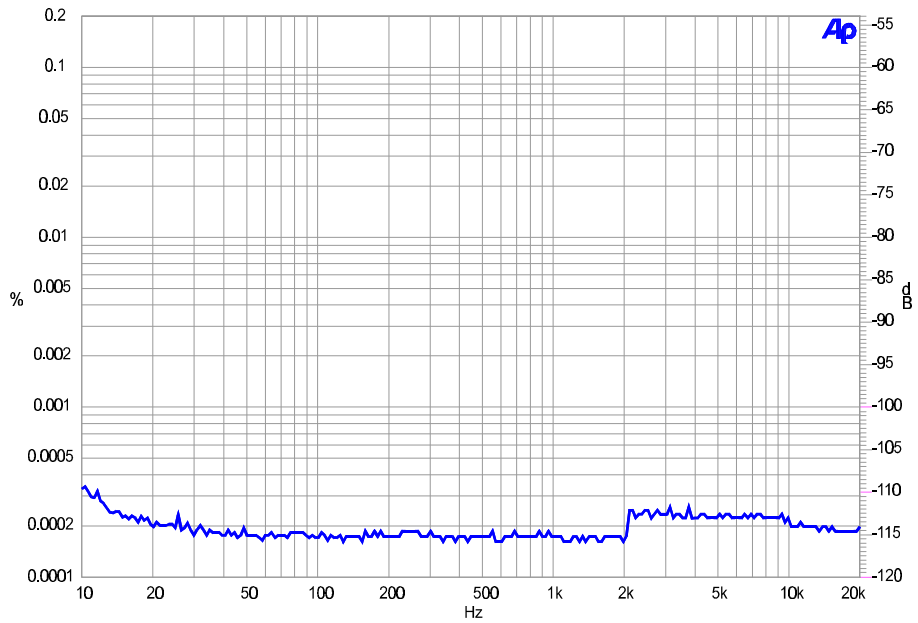


Figure 2-1. Typical total system THD+N versus frequency using analog sinewave at 2 Vrms

⁸ 200Ω with option "EURZ"

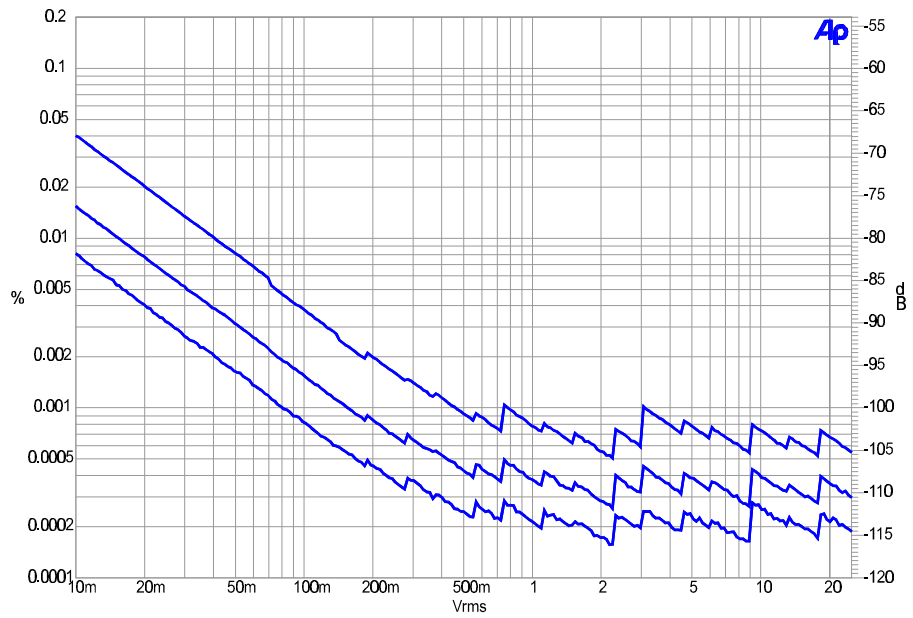


Figure 2-2. Typical THD+N versus Amplitude at 1 kHz for three different analog analyzer measurement bandwidths. Lower curve is with 22 kHz bandwidth limiting. Middle curve is with 80 kHz. Upper curve is with 500 kHz.

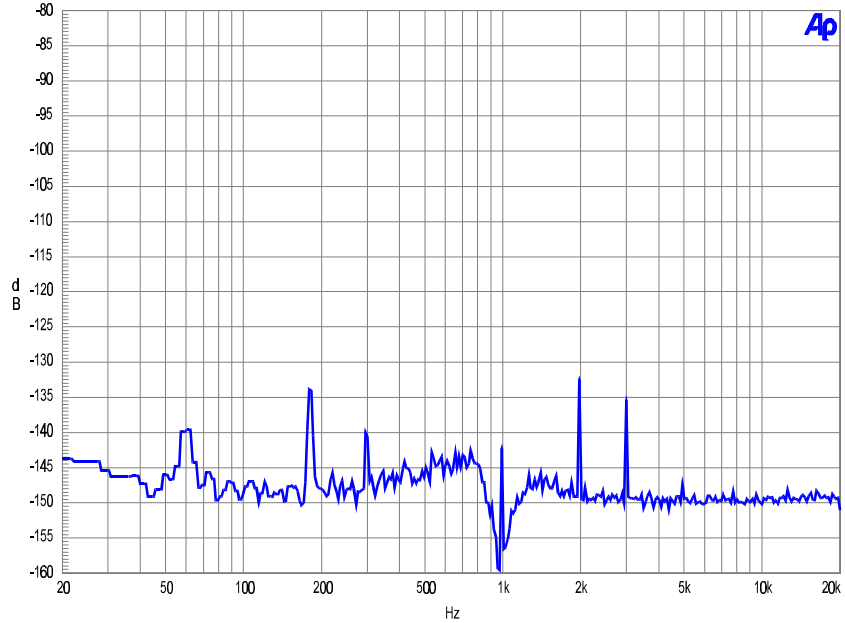


Figure 2-3. Typical analog generator residual THD+N spectrum at 1 kHz, 2 Vrms (16384 point FFT of notch filter output, $F_s = 48$ kHz, 16 averages)

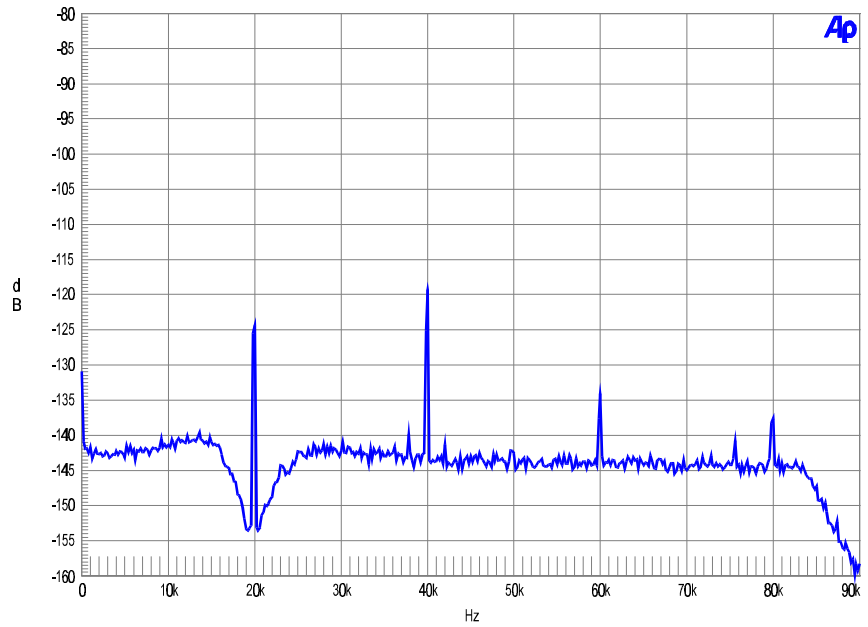


Figure 2-4. Typical analog generator residual THD+N spectrum at 20 kHz, 2 Vrms (16384 point FFT of notch filter output, Fs = 192 kHz, 16 averages)

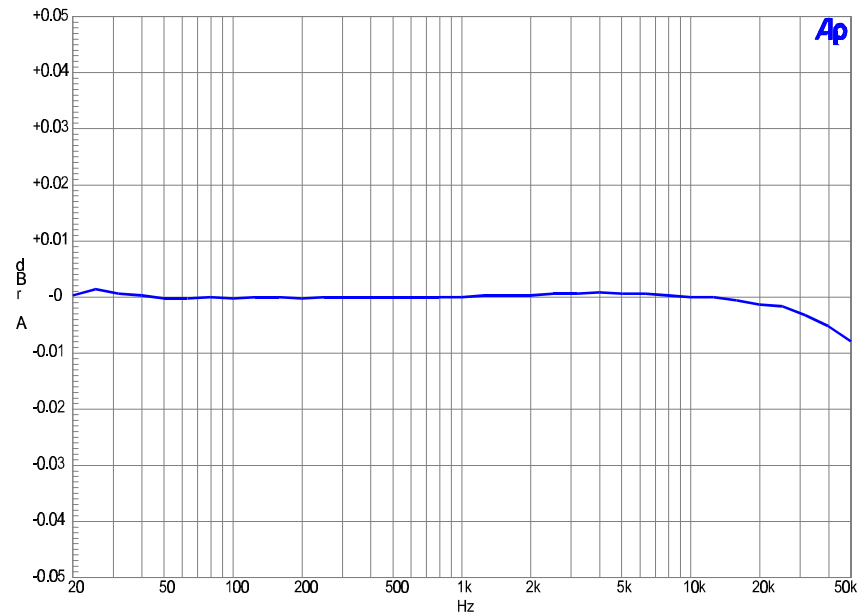


Figure 2-5. Typical analog System flatness at 2 V rms signal level

2.3 Analog Analyzer

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

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

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

2.3.1 Analog Input Characteristics

Input Ranges	40 mV to 160 V in 6.02 dB steps
Maximum Rated Input	230 Vpk, 160 V rms (dc to 20 kHz); overload protected in all ranges
Input Impedance	
Balanced (each side)	Nominally 100 k Ω // 185 pF (typ)
Unbalanced	Nominally 100 k Ω // 185 pF (typ)
Terminations	Selectable 600 Ω or 300 Ω , $\pm 1\%$; 1 Watt [+30 dBm] maximum power
CMRR ⁹	
40 mV-2.5 V ranges	≥ 80 dB, 10 Hz-20 kHz
5 V and 10 V ranges	≥ 65 dB, 10 Hz-20 kHz
20 V-160 V ranges	≥ 50 dB, 10 Hz-1 kHz
Input Related Crosstalk	
10 Hz-20 kHz	≤ -140 dB or 1 μ V, whichever is greater
20 kHz-100 kHz	≤ -126 dB or 2.5 μ V, whichever is greater

⁹ Not valid below 50 Hz with ac coupling.

2.3.1.1 Level Meter Related

(both channels)

Measurement Range	5 mV-160 V for specified accuracy and flatness, usable to <100 μ V
Resolution (full scale) ¹⁰	
4/s	1/40,000 [0.00022 dB]
8/s	1/40,000 [0.00022 dB]
16/s	1/20,000 [0.00043 dB]
32/s	1/10,000 [0.00087 dB]
64/s	1/5,000 [0.0017 dB]
128/s	1/2,500 [0.0035 dB]
Accuracy (1 kHz)	$\pm 0.5\%$ [± 0.05 dB]
Flatness (1 kHz ref) ¹¹	
20 Hz-20 kHz	± 0.008 dB (typically <0.003 dB)
15 Hz-50 kHz	± 0.03 dB
10 Hz-120 kHz	± 0.10 dB
120 kHz-200 kHz	+0.2/-0.3 dB (typically <-0.5 dB at 500 kHz)

2.3.1.2 Frequency Meter Related

(both channels)

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

2.3.1.3 Phase Measurement Related

Measurement Ranges	± 180 , -90/+270, or 0/+360 deg
Accuracy ¹²	
10 Hz-5 kHz	± 0.5 deg
5 kHz-20 kHz	± 1 deg
20 kHz-50 kHz	± 2 deg
Resolution	0.1 deg
Minimum Input	5 mV, both inputs

¹⁰ Resolution within a given range is equal to its full scale value divided by the full scale counts value determined by the selected reading rate. (Example: 40 mV input range reading resolution = 4 μ V, using the 32/s reading rate). Numerical displays using a dB unit are rounded to the nearest 0.001 dB.

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

¹² Both analyzer input channels must have same coupling (ac or dc) selection. Accuracy is valid for any input signal amplitude ratio up to ± 30 dB.

2.3.2 Wideband Amplitude/Noise Function

Measurement Range	<1 μ V – 160 V rms
Accuracy (1 kHz)	$\pm 1.0\%$ [± 0.09 dB]
Flatness (1 kHz ref) ¹³	
20 Hz-20 kHz	± 0.02 dB
15 Hz-50 kHz	± 0.05 dB
50 kHz-120 kHz	± 0.15 dB
120 kHz-200 kHz	+0.2 dB/-0.3 dB (typically < -3 dB at 500 kHz)
Bandwidth Limiting Filters	
LF -3 dB	<10 Hz, 22 Hz per CCIR Rec 468, 100 Hz $\pm 5\%$ (3-pole), or 400 Hz $\pm 5\%$ (3-pole)
HF -3 dB	22 kHz per CCIR Rec 468, 30 kHz $\pm 5\%$ (3-pole), 80 kHz $\pm 5\%$ (3-pole), or >500 kHz
Optional Filters	up to 7 (see Section 2.4)
Detection	RMS ($\tau = 25$ ms or 50 ms), AVG, QPk per CCIR Rec 468, Pk (pseudo-peak), or S-Pk (0.7071 x Pk reading)
Residual Noise	
22 Hz-22 kHz BW	≤ 1.0 μ V [-118 dBu]
80 kHz BW	≤ 2.0 μ V [-112 dBu]
500 kHz BW	≤ 6.0 μ V [-102 dBu]
A-weighted	≤ 0.5 μ V [-124 dBu]
CCIR-QPk	≤ 2.5 μ V [-110 dBu]

2.3.2.1 Bandpass Amplitude Function

Tuning Range (f_0)	10 Hz to 200 kHz
Tuning Accuracy	$\pm 2\%$
Bandpass Response	1/3-octave class II (4-pole); <-32 dB at 0.5 f_0 and 2.0 f_0
Accuracy (at f_0)	± 0.3 dB, 20 Hz-120 kHz
Residual Noise	
10 Hz-5 kHz	≤ 0.25 μ V [-130 dBu]
5 kHz-20 kHz	≤ 0.5 μ V [-124 dBu]
20 kHz-200 kHz	≤ 1.5 μ V [-114 dBu]

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

2.3.2.2 Bandreject Amplitude Function

Tuning Range (f_0)	10 Hz to 200 kHz
Tuning Accuracy	$\pm 2\%$
Bandreject Response	typically: -3 dB at $0.73 f_0$ & $1.37 f_0$ -20 dB at $f_0 \pm 10\%$ -40 dB at $f_0 \pm 2.5\%$
Accuracy	± 0.3 dB, 20 Hz-120 kHz (excluding $0.5 f_0$ to $2.0 f_0$)
Residual Noise	same as Amplitude Function

2.3.2.3 THD + N Function

Fundamental Range	10 Hz to 200 kHz
Measurement Range	0 – 100%
Accuracy	± 0.3 dB, 20 Hz – 120 kHz harmonics
Measurement Bandwidth	
LF -3 dB	<10, 22, 100, or 400 Hz
HF -3 dB	22k, 30k, 80k, or >500 kHz; option filters are also functional
Residual THD+N ¹⁴	
20 Hz-20 kHz	$\leq (0.0004\% + 1.0 \mu\text{V})$, 22 kHz BW [-108 dB] $\leq (0.0006\% + 2.0 \mu\text{V})$, 80 kHz BW [-104 dB] $\leq (0.0015\% + 6.0 \mu\text{V})$, 500 kHz BW [-96.5 dB]
10 Hz-100 kHz	$\leq (0.0040\% + 6.0 \mu\text{V})$, 500 kHz BW [-88 dB]
Minimum Input	5 mV for specified accuracy, usable to <100 μV with fixed notch tuning
Notch Tuning Modes	Counter Tuned, Sweep Track, Agen-Track (analog generator), Dgen-Track (digital generator), or Fixed (set by direct entry)
Notch Tracking Range	$\pm 2.5\%$ from fixed setting

2.3.2.4 Crosstalk Function

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

¹⁴ System specification including contribution from generator. Generator residual THD may limit system performance below 25 Hz if output is >20.0 Vrms balanced, or 10.0 Vrms unbalanced.

¹⁵ Uses the 1/3-octave bandpass filter to enhance the measured range in the presence of wideband noise. Alternate (interfering) channel input must be ≥ 5 mV.

2.3.3 IMD Measurements

with option IMD

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

2.3.3.1 SMPTE (DIN) IMD Function

Test Signal Compatibility	Any combination of 40 – 250 Hz (LF) and 2 kHz – 100 kHz (HF) tones, mixed in any ratio from 0:1 to 8:1 (LF:HF)
IMD Measured	Amplitude modulation products of the HF tone. -3 dB measurement bandwidth is typically 20 Hz – 750 Hz
Measurement Range	0-20%
Accuracy	±0.5 dB
Residual IMD ¹⁶	≤0.0015%, 60 + 7 kHz or 250 + 8 kHz

2.3.3.2 CCIF and DFD IMD Functions

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

2.3.3.3 DIM (TIM) IMD Function

Test Signal Compatibility	2.96-3.15 kHz squarewave mixed with 14 – 15 kHz sine probe tone
IMD Measured ¹⁷	u ₄ and u ₅ per IEC 268-3 (1986)
Measurement Range	0-20%
Accuracy	±0.7 dB
Residual IMD ¹⁶	≤0.0020%

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

¹⁷ IEC 268-3 defines nine possible DIM products. The System Two IMD option analyzer is sensitive only to the u₄ and u₅ products using the simplified measurement technique proposed by Paul Skritek. DIM measurements using this technique will typically be 6-8 dB lower (better) than the results obtained using FFT-based techniques which sum all nine products.

2.3.4 Wow & Flutter Measurements

with option "W&F"

Option "W&F" adds the capability to make both conventional wow & flutter and scrape flutter measurements (using the technique developed by Dale Manquen of Altair Electronics, Inc.)

The demodulated W&F signal can also be selected for FFT analysis in SYS-2222 and SYS-2322 configurations.

Test Signal Compatibility	
Normal	2.80 kHz-3.35 kHz
"High-band"	11.5 kHz-13.5 kHz
Measurement Range	0 to 1.2%
Accuracy (4 Hz)	$\pm(5\% \text{ of reading} + 0.0005\%)$
Detection Modes	IEC/DIN (quasi-peak per IEC-386), NAB (average), JIS (per JIS 5551)
Response Selections	
Weighted	4 Hz bandpass per IEC/DIN/NAB
Unweighted	0.5 Hz-200 Hz
Scrape ¹⁸	200 Hz-5 kHz
Wideband ¹⁸	0.5 Hz-5 kHz
Residual W+F	
Weighted	$\leq 0.001\%$
Unweighted	$\leq 0.002\%$
Scrape or Wideband	$\leq 0.005\%$
Minimum Input	5 mV (20 mV for specified residual)
Settling Time	
IEC/DIN or NAB	Typically 3-6 seconds
JIS	Typically 15-20 seconds

2.4 Option Filters

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

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

¹⁸ Operational with high-band test signals (11.5 kHz-13.5 kHz) only. Upper -3 dB rolloff is typically 4.5 kHz using 12.5 kHz.

2.4.1.1 Weighted Noise Measurement

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

2.4.1.2 Precision De-emphasis Family

FIL-D50	50 μ s \pm 1%
FIL-D50E	50 μ s \pm 1% + 15.625 kHz notch
FIL-D50F	50 μ s \pm 1% + 19.0 kHz notch
FIL-D75	75 μ s \pm 1%
FIL-D75B	75 μ s \pm 1% + 15.734 kHz notch
FIL-D75F	75 μ s \pm 1% + 19.0 kHz notch

2.4.1.3 Precision Sharp Cutoff Low-Pass Family

Family Response	-3 dB at $f_c \pm 1.5\%$; ± 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
<i>See also FLP-A20K under Miscellaneous</i>	

2.4.1.4 Bandwidth Limiting, Low-Pass

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

2.4.1.5 Bandwidth Limiting, High-Pass

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

2.4.1.6 1/3-Octave (Class II) Bandpass Family

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

2.4.1.7 Receiver Testing

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

2.4.1.8 Miscellaneous

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

Note: The optional filters described here can be added to the standard band-limiting filters shown in Figure 2-6.

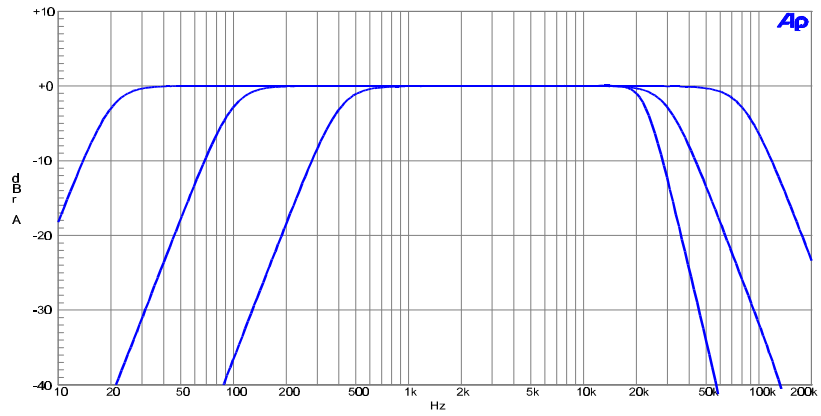


Figure 2-6. Standard Band-limiting filters included with every System Two. High pass selectable 22Hz, 100 Hz, 400 Hz; Low pass selectable 22 kHz, 30 kHz, 80 kHz.

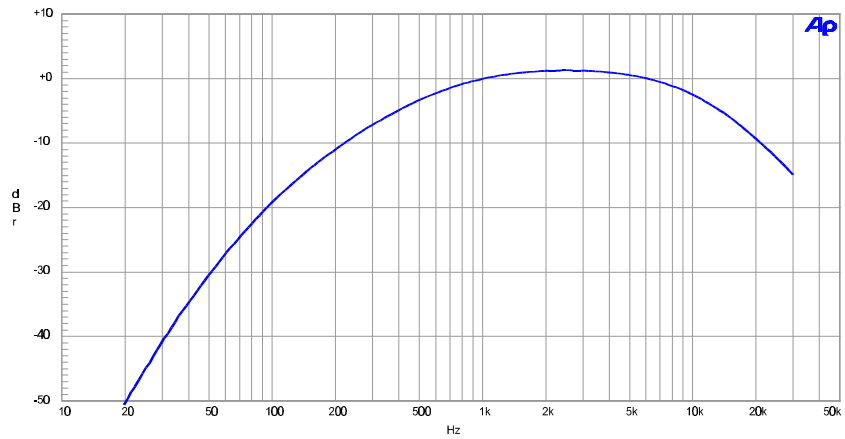


Figure 2-7. FIL-AWT ANSI-IEC "A" Weighting Filter

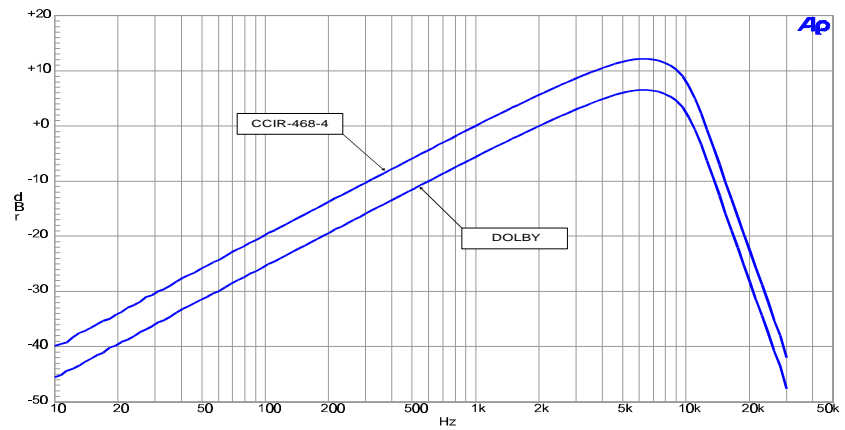


Figure 2-8. FIL-CCR CCIR-468 / DIN 45404 Noise Weighting Filter

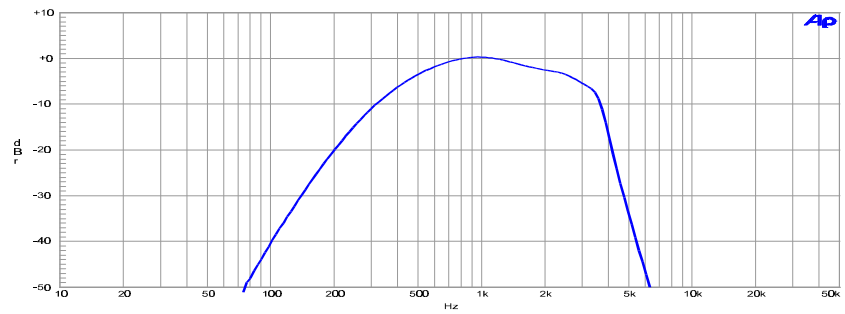


Figure 2-9. FIL-CIT CCITT P53 Noise Weighting Filter

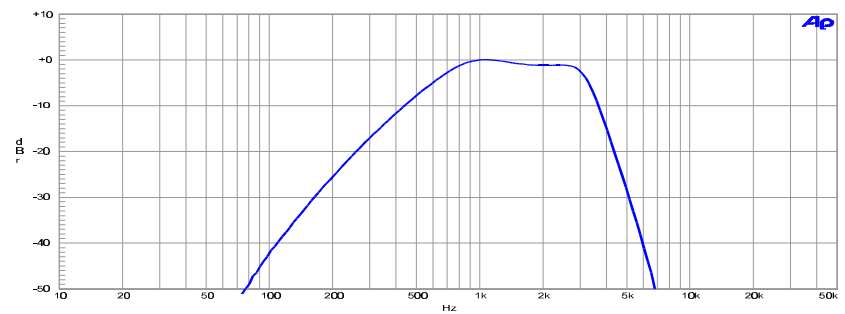


Figure 2-10. FIL-CMS C-Message Weighting Filter (ANSI/IEEE 743-1984)

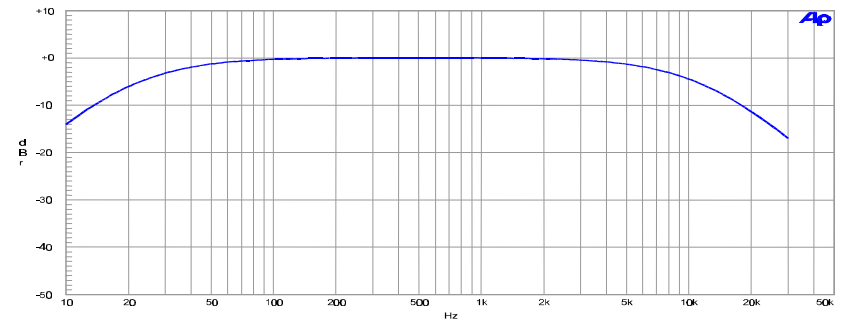


Figure 2-11. FIL-CWT "C" Weighting (IEC-179)

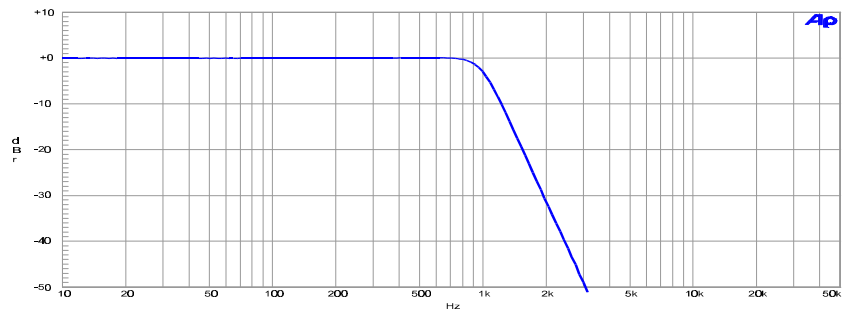


Figure 2-12. FLP-1K 1 kHz Low Pass 5-pole Butterworth Filter

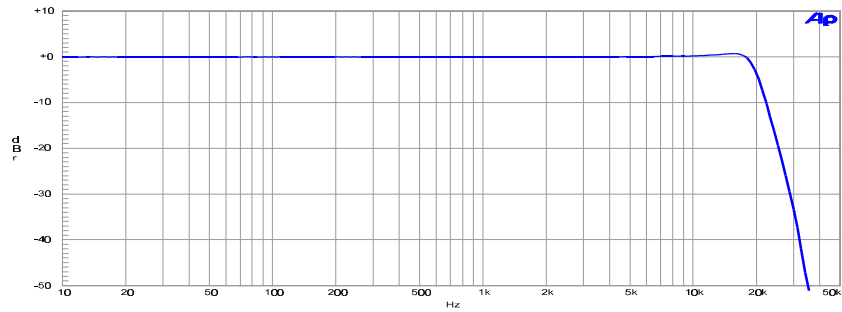


Figure 2-13. FLP-20K 20.0 kHz Quasi-elliptic sharp cutoff Low Pass Filter

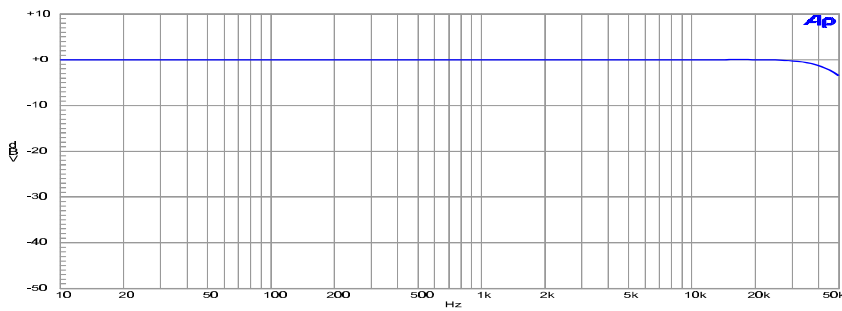


Figure 2-14. FLP-50K 50 kHz 3-pole Butterworth Low Pass Filter

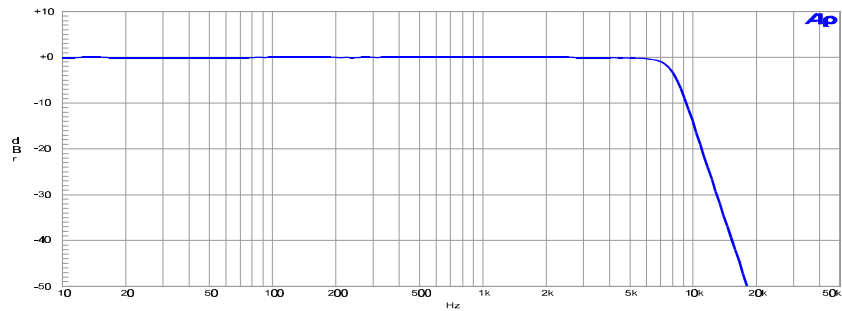


Figure 2-15. FLP-8K 8 kHz 7-pole Butterworth Low Pass Filter

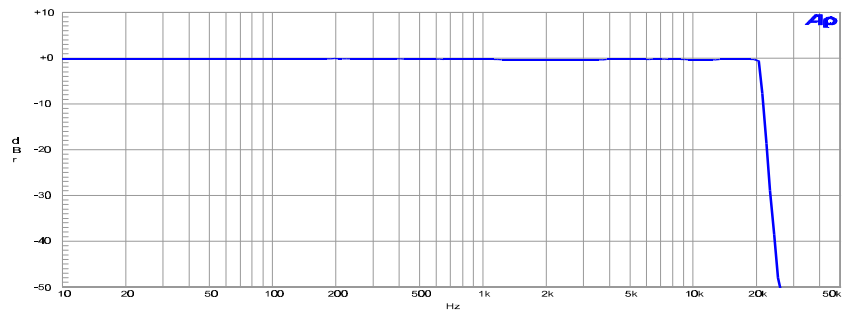


Figure 2-16. FLP-A20K Apogee "Brick-Wall" 20 kHz Low Pass Filter

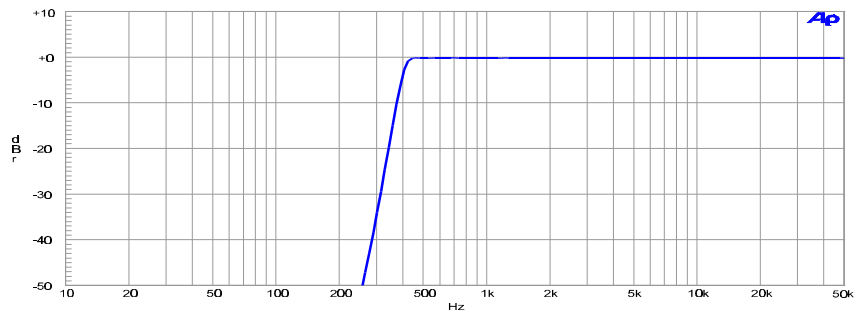


Figure 2-17. FHP-400 400 Hz 9-pole High Pass Filter

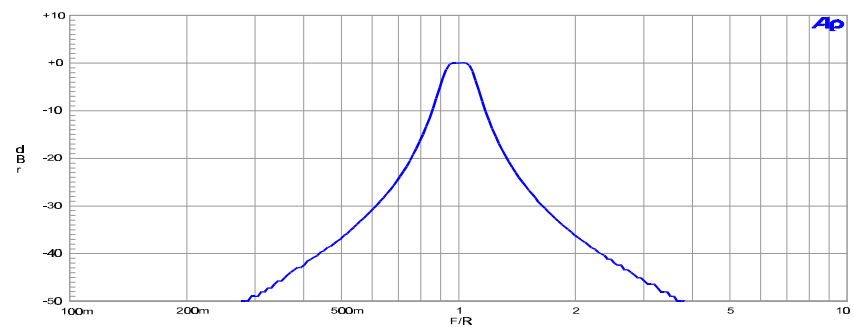


Figure 2-18. FBP-XXXX Fixed 1/3 Octave Band Pass Filter

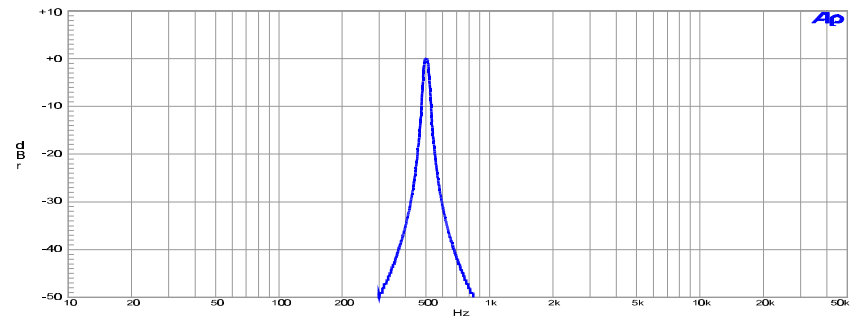


Figure 2-19. FBP-500X High-Q 500 Hz Band Pass Filter (for CD linearity testing)

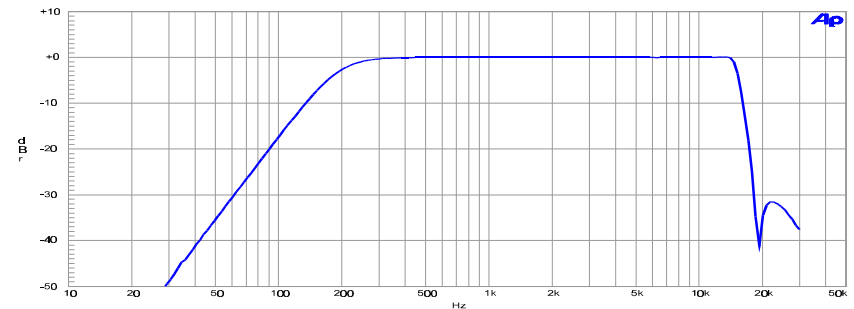


Figure 2-20. FIL-RCR 200 Hz to 15 kHz with 19 kHz (FM) notch Receiver Testing Filter

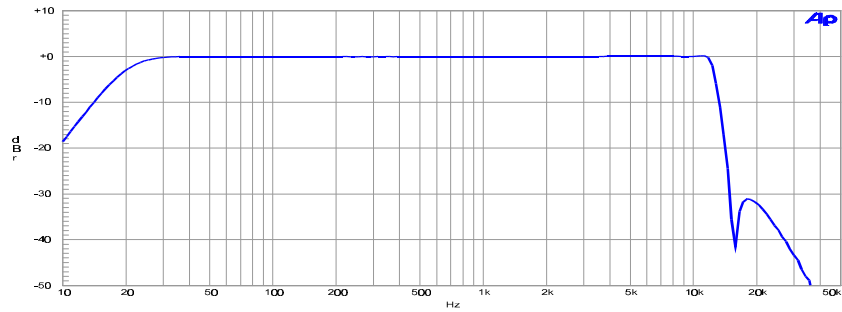


Figure 2-21. FIL-IECR 20 Hz to 15 kHz with 15.625 kHz (PAL) notch Receiver Testing Filter

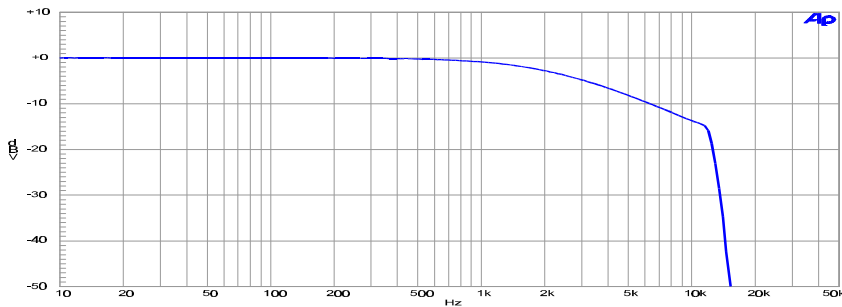


Figure 2-22. FIL-D75B 75 μ s with 15.734 kHz (NTSC) notch De-emphasis Filter

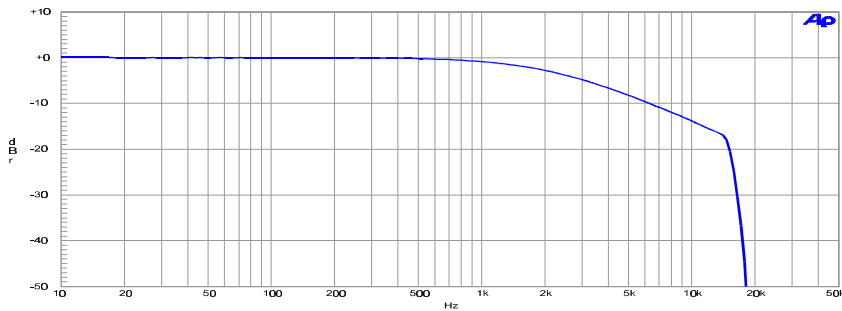


Figure 2-23. FIL-D75F 75 μ s with 19 kHz (FM) notch De-emphasis Filter

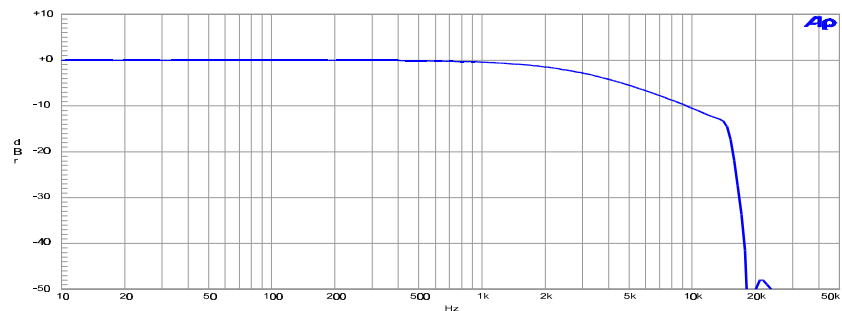


Figure 2-24. FIL-D50F 50 μ s with 19 kHz (FM) notch De-emphasis Filter

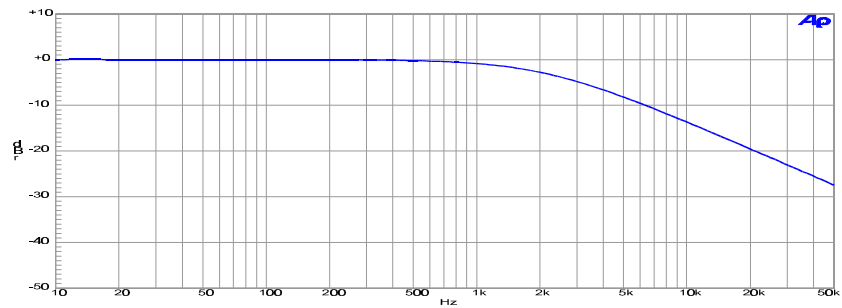


Figure 2-25. FIL-D75 75 ms De-emphasis Filter

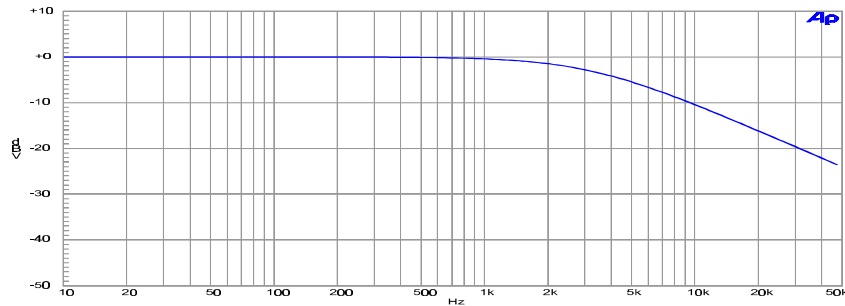


Figure 2-26. FIL-D50 50 ms De-emphasis Filter

2.5 DSP Analysis of Analog Signals

Available in SYS-2222 and SYS-2322 configurations only. The low bandwidth high resolution dual converters are optimized for applications up to 20 kHz and are available to convert input signals for use by the FFT, DSP, MLS, and Multitone audio analyzers. It contains a linear phase digital anti-alias filter that allows some degree of aliasing to occur near the pass-band edge (see Footnote 19). The higher bandwidth converter contains a 9-pole analog anti-alias filter optimized for general purpose applications up to 80 kHz and is available to the FFT analyzer.

2.5.1.1 Low Bandwidth (x1 or ÷4) Converter

Available for FFT and DSP Audio Analyzers

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

2.5.1.2 High Bandwidth (x4) Converter

Input Converter available for FFT Analyzer

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

2.5.2 FFT Analyzer

("FFT.AZ2")

Acquisition Length	256-16384 samples in binary steps; or 24,576 samples
Transform Length	256-16384 samples in binary steps
Processing	48 bit
Windows (see Figure 2-27)	Blackman-Harris (4 term with -92 dB sidelobe) Hann Flat-top (±0.02 dB) Equi-ripple (-145 dB sidelobes) None None, sync to sine

¹⁹ From converter manufacturer's data. Rejection near the band edge is typically -80 dB at 0.600*sr decreasing to -44 dB at 0.58*sr, -26 dB at 0.56*sr, and -3 dB at 0.50*sr.

²⁰ Usable at lower sample rates with degraded alias rejection.

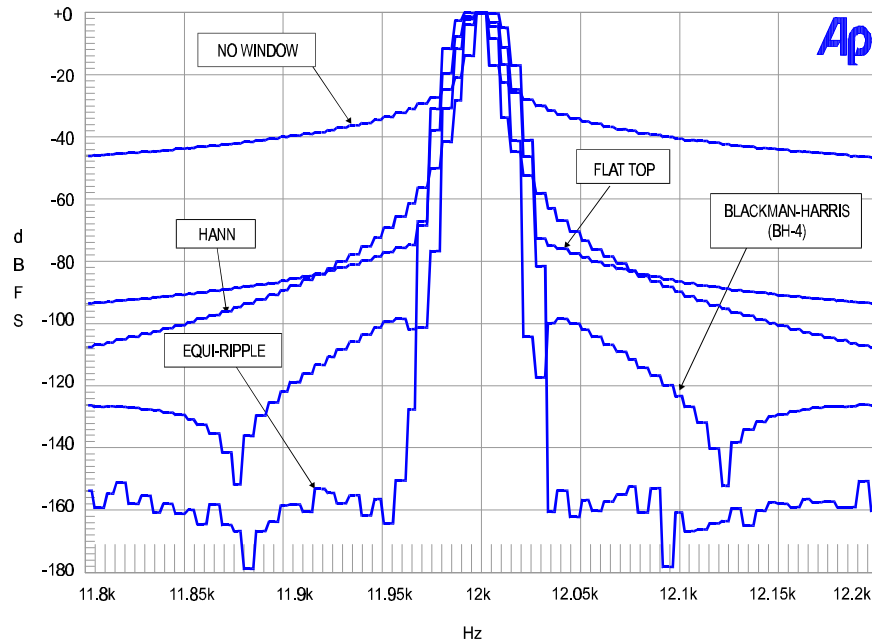


Figure 2-27. Windows available with FFT function

Amplitude Accuracy	±0.1 dB, 20 Hz-20 kHz, using Flat-top window
Averaging	1-4096 in binary steps, averaging algorithm is power (spectrum only) or synchronous
Waveform Display Modes	Normal, interpolate, peak, max
Frequency Display Modes	Peak pick, individual bin
Sync to Sine Window	
Frequency Range	7 th bin to 45% of sample rate (21.6 kHz at 48 k samples/s)
Amplitude Accuracy	±0.025 dB

2.5.3 DSP Audio Analyzer

(ANALYZER.AZ2)

2.5.3.1 Wideband Level/Amplitude

Frequency Range	5 Hz-22.0 kHz at 48 k samples/s
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth 400 Hz, 10-pole elliptical <i>when not using notch filter or bandpass mode</i> (response is -120 dB for ≤220 Hz, ±0.1 dB for ≥400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass <i>both: 0.1dBpp ripple, ³110 dB stopband attenuation</i>

Weighting Filters ANSI-IEC "A" weighting, Type 0
 CCIR QPk per CCIR Rec 468
 CCIR RMS per AES 17
 C-message per IEEE Std 743-1978
 CCITT per CCITT Rec. P.53
 "F" weighting corresponding to 15 phon loudness contour (see Figure 2-28)

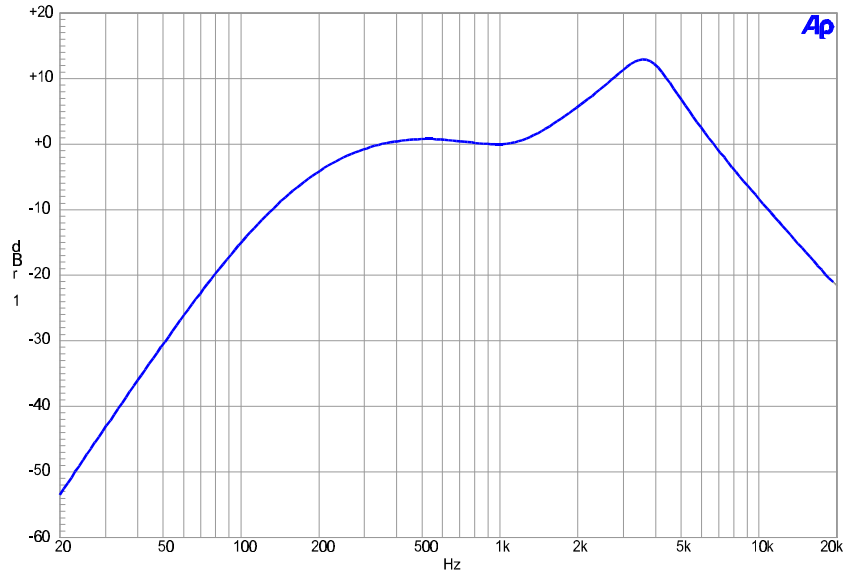


Figure 2-28. Digital Analyzer F-weighting curve

2.5.3.2 Narrow Band Amplitude

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_0) (see Figure 2-29)

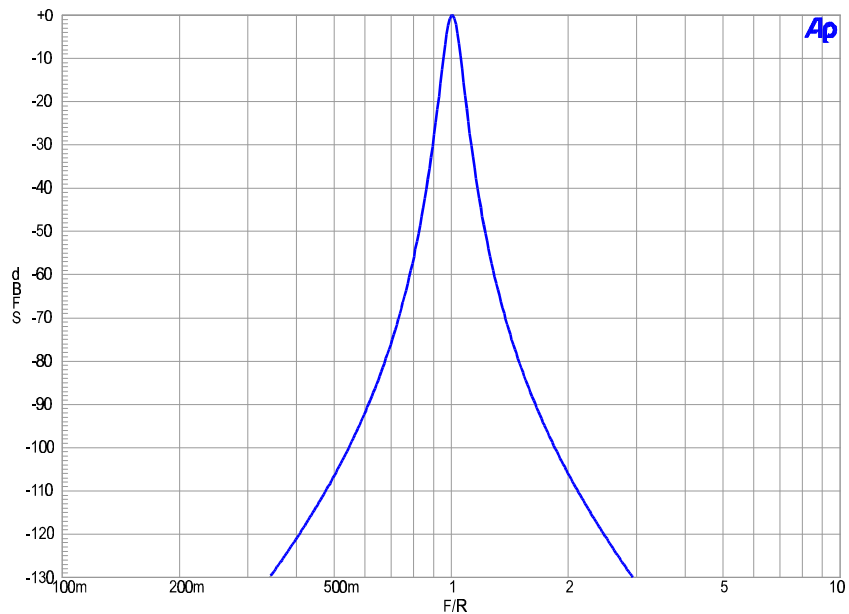


Figure 2-29. Digital Domain Band Pass filter response.

2.5.3.3 THD + N Measurements

Fundamental Range	0.02% to 45% of sample rate (10 Hz-22.0 kHz at 48.0 k samples/s)
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth
Low pass Filters	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass <i>both: 0.1dBpp ripple, ³110 dB stopband attenuation</i>
Weighting Filters	ANSI-IEC "A" weighting, per IEC Rec 179 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour (see Figure 2-28 on page 2-26)

2.5.3.4 Frequency Measurements

Range	5 Hz to 47% of sample rate (5 Hz-21.0 kHz at 44.1 k samples/s) (5 Hz-23.0 kHz at 48.0 k samples/s)
Accuracy	$\pm 0.01\%$ of reading or 0.0001% of sample rate, whichever is greater
Resolution	0.003% of reading or 0.0001% of sample rate, whichever is greater

2.5.4 Maximum Length Sequence Analyzer

(“MLS.AZ2”) Quasi-anechoic acoustic tester

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

2.5.5 Multitone Analyzer

(FASTTEST.AZ2)

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

2.6 Digital Signal Generator

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

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

2.6.1 Digital Output Characteristics

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

2.6.2 Digital Signal Generation

2.6.2.1 Sine Wave

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

2.6.2.2 Sine Burst

Sine burst with rectangular envelope

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

2.6.2.3 Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 k samples/s)
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 k samples/s)
Phase Range	± 180 deg.
Phase Resolution	0.01 deg.
Flatness	± 0.001 dB
Residual Distortion	$\leq 0.00001\%$ [-140 dB]

2.6.2.4 Stereo Sine Wave

Sine wave of independent frequency and amplitude on each channel

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

2.6.2.5 Dual Sine Wave

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

Frequency Range	10 Hz to 47% of sample rate (22.56 kHz at 48 k samples/s)
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 k samples/s)
Flatness	± 0.001 dB
Residual Distortion	$\leq 0.00001\%$ [-140 dB]
Amplitude ratio	0 dB to -120 dB

2.6.2.6 Sine + Offset

Sine wave plus a constant value

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

2.6.2.7 Shaped Sine Burst

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

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

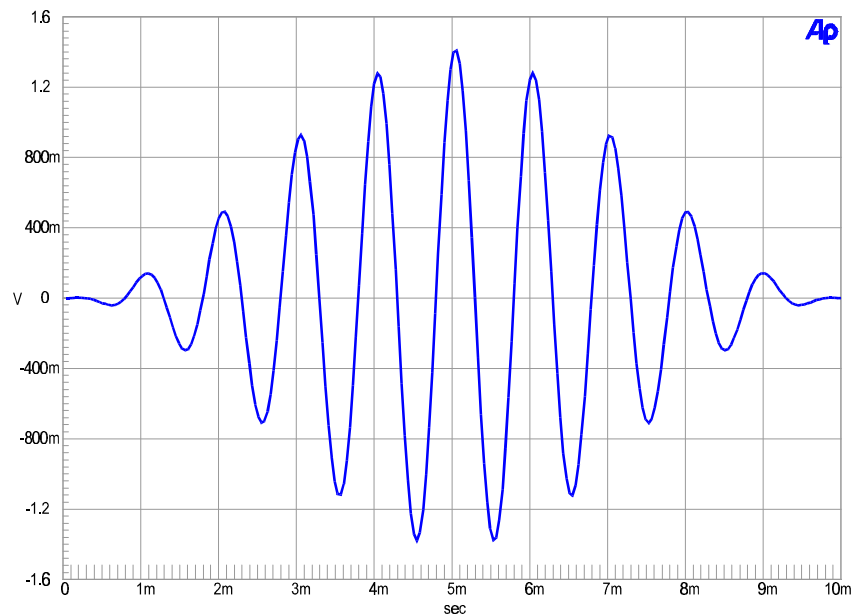


Figure 2-30. Shaped Sine Burst signal (1 kHz, 10 cycles)

2.6.2.8 Square Wave

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

2.6.2.9 SMPTE/DIN Waveform

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

2.6.2.10 CCIF and DFD IMD Waveforms

Center Frequency Range	3000 Hz to (47% of sample rate – $\frac{1}{2}$ IM frequency) (22.51 kHz at 48 k samples/s; 20.67 kHz at 44.1 k samples/s)
IM Frequency Range	80 Hz-2000 Hz
Frequency Resolution	Sample Rate $\div 2^{23}$ (typically 0.006 Hz at 48 k samples/s)
Flatness	± 0.001 dB
Residual Distortion	$\leq 0.00001\%$ [-140 dB]

2.6.2.11 DIM IMD Waveform

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

2.6.2.12 Noise

Types	Pink, White, Burst, USASI
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2.6.2.13 Special Signals

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

2.6.2.14 Maximum Length Sequence Signals

Pseudo random noise signal for speaker testing with MLS analyzer (Page 2-28)

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

2.6.2.15 Multitone Signals

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

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

2.6.2.16 Arbitrary Waveforms

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

2.6.2.17 Dither (all waveforms)

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

2.6.2.18 Pre-Emphasis Filters (all waveforms)

Filter Shape	50/15 μ s or J17
Response Accuracy	± 0.02 dB 10 Hz to 45% sample rate
Residual Distortion	$\leq 0.00003\%$ [-130 dB]

2.7 AES/EBU Interface Generation

2.7.1.1 Interface Signal

Amplitude Range	(Fixed RISE/FALL time)
Balanced (XLR)	0-10.24 Vpp, $\pm(10\% + 80$ mV) into 110 Ω in 40 mV steps
Unbalanced (BNC)	0 to 2.048 Vpp, $\pm(8\% + 16$ mV) into 75 Ω in 8 mV steps
Optical (Toslink [®])	0 to 256% of nominal intensity in 1% steps
Channel Status Bits	Full implementation, English language decoded, Pro or consumer or hex formats; independent in each channel
User Bits	set to 0
Validity Flag	selectable, set or cleared

2.7.1.2 AES/EBU Impairments

Variable rise/fall time	16 ns to 400 ns, $\pm 20\%$
Induced Jitter	Selectable sinewave, squarewave lowpass noise, or wideband noise
Jitter Freq Range	10 Hz-99.864 kHz
Jitter Freq Accuracy	$\pm 0.0002\%$ [± 2 PPM]
Jitter Amplitude	0-2.55 UI (pp), $\pm(10\% + 0.02$ UI) in 0.01 UI steps 2.6-25.5 UI, $\pm(10\%)$ in 0.1 UI steps ²¹
Jitter Flatness (500 Hz ref.)	± 1 dB, 50 Hz to 99 kHz
Residual Jitter, peak to peak calibrated	(total generator/analyzer)
Average response	≤ 0.035 UI (120 Hz-100 kHz BW), ≤ 0.007 UI (1.2 kHz-100 kHz BW)
Peak response:	≤ 0.09 UI (120 Hz-100 kHz BW), ≤ 0.03 UI (1.2 kHz-100 kHz BW)
Spurious Jitter Products	
Jitter & Ref Delay Off	≤ 0.001 UI
Jitter On	≤ -30 dB below jitter signal
Normal Mode Noise	
Balanced	0-2.55 Vpp, $\pm(10\% + 100$ mV), in 10 mV steps
Unbalanced	0-635 mVpp, $\pm(10\% + 25$ mV), in 2.5 mV steps
Common Mode Freq	20 Hz to 40 kHz in octave steps

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

Common Mode Ampl	0-20.48 Vpp, $\pm(10\% + 200 \text{ mV})$, in 80 mV steps
Cable Simulation	Multi-pole fit to AES 3-1992 filter to simulate the response degradation of a typical long cable
Offset from reference	-64 to +63.5 UI

2.7.2 Reference Input Characteristics

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

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

2.7.3 Reference Output Characteristics

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

Output Format	AES/EBU (per AES 11-1994)
Output Sample Rates	28.8 kHz-52.8 kHz AES/EBU; locked to front panel output
Status Bits	Format "Professional" Sample Rate indicates closest rate Type "Grade 2 reference" Origin "SYS2" Reliability flags implemented CRCC implemented Time of Day not implemented Sample Count not implemented
Output Delay from Reference	
Output	-64/+63.5 UI, $\pm(5\% + 0.5 \text{ UI})$, in 0.5 UI steps
Residual jitter	$\leq 0.01 \text{ UI p-p}$ (120Hz-100 kHz)

2.8 Digital Analyzer

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

2.8.1 Digital Input Characteristics

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

2.8.2 Embedded Audio Measurements

2.8.2.1 Wideband Level/Amplitude

(ANALYZER.AZ2)

Range	0 dBFS to -140 dBFS
Frequency Range	5 Hz-22.0 kHz at 48 k samples/s
Accuracy	± 0.01 dB, ≥ -90 dBFS
Flatness	± 0.01 dB, 15 Hz-22 kHz, with <10 Hz high-pass filter selection
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth 400 Hz, 10-pole elliptical <i>when not using notch filter or bandpass mode</i> (response is -120 dB for ≤ 220 Hz, ± 0.1 dB for ≥ 400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour (<i>see Figure 2-28 on page 2-26</i>)
Residual Noise	-140 dBFS unweighted -142 dBFS A-weighted -134 dBFS CCIR RMS -127 dBFS CCIR QPk -139 dBFS 20 kHz LP -140 dBFS 15 kHz LP -138 dBFS "F" weighting

2.8.2.2 Narrow Band Amplitude

(ANALYZER.AZ2)

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, $Q=19$ ($BW = 5.3\%$ of f_0) (<i>see Figure 2-29 on page 2-27</i>)
Residual Distortion	≤ -150 dBFS

2.8.2.3 THD + N Measurements

(ANALYZER.AZ2)

Fundamental Range	0.02% to 45% of sample rate (10 Hz-22.0 kHz at 48.0 k samples/s)
Residual THD+N	≤-130 dBFS (see Figure 2-31)
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth
Low pass Filters	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass <i>both: 0.1 dBpp ripple, ³110 dB stopband attenuation</i>
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour (see Figure 2-28 on page 2-26)
Residual Noise	Same as Wideband Level/Amplitude

2.8.2.4 Frequency Measurements

("ANALYZER.AZ2")

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

2.8.2.5 FFT Analyzer

("FFT.AZ2")

Acquisition Length	256-16384 samples in binary steps; or 24,576 samples
Transform Length	256-16384 samples in binary steps
Processing	48 bit
Windows (see Figure 2-27 on page 2-25)	Blackman-Harris (4 term with -92 dB sidelobe) Hann Flat-top (±0.02 dB) Equi-ripple (-145 dB sidelobes) None None, sync to sine
Amplitude Accuracy	±0.02 dB, 20 Hz to 20 kHz, using Flat-top window
Averaging	1-4096 in binary steps, averaging algorithm is power based or synchronous
Distortion	≤-140 dB
Waveform Display Modes	Normal, interpolate, peak, max

Frequency Display Modes	Peak pick, individual bin
Sync to Sine Window	
Frequency Range	7 th bin to 45% of sample rate (21.6 kHz at 48 k samples/s)
Amplitude Accuracy	±0.025 dB

2.8.2.6 Multitone Analyzer

(“FASTTEST.AZ2”)

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

2.8.2.7 Maximum Length Sequence Analyzer

(“MLS.AZ2”) *Quasi-anechoic acoustic tester*

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

2.8.3 Digital Interface Measurements

2.8.3.1 AES/EBU Impairments, real time displays

Input Sample Rate	$\pm 0.0003\%$ [± 3 PPM] internal ref, $\pm 0.0001\%$ [± 1 PPM] external ref
Output to Input Delay	Measures status propagation from the AES/EBU output to the input. Range is 0-192 samples (frames), resolution ± 60 ns.
AES/EBU Input Voltage	
Balanced	100 mV to 10.24 Vpp, $\pm(5\% + 50$ mV)
Unbalanced	25 mV to 2.048 Vpp, $\pm(5\% + 12$ mV)
Jitter Amplitude (500 Hz)	(peak-peak sinewave calibrated)
Average Mode	0-10 UI, $\pm(10\% + 0.03$ UI)
Peak Mode	0-6 UI, $\pm(10\% + 0.08$ UI)
Jitter Flatness	± 1.0 dB, 100 Hz-80 kHz (50 Hz – 100 kHz BW selection, average detection, 48 kHz sample rate)
Residual Jitter, peak to peak calibrated (analyzer only)	
Average response	≤ 0.03 UI (120 Hz – 100 kHz BW), ≤ 0.006 UI (1.2 kHz – 100 kHz BW)
Peak response	≤ 0.08 UI (120 Hz – 100 kHz BW), ≤ 0.018 UI (1.2 kHz – 100 kHz BW)
Spurious Jitter Products	≤ 0.002 UI (>1.2 kHz) or <-40 dB below jitter signal
Common Mode Amplitude	0-20.48 Vpp, $\pm(10\% + 300$ mV), 315 Hz-1 MHz, peak reading
Cable Equalization	Per AES 3-1992
Channel Status Bits	Full implementation, English language decoded (Professional or Consumer) or hex formats, independent in each channel
User Bits	Not displayed
Validity Flag	Displayed for each channel
Parity	Displayed for total signal (both channels combined)
Signal Confidence	Displayed for total signal (both channels combined)
Receiver Lock	Displayed for total signal (both channels combined)
Coding Error	Displayed for total signal (both channels combined)

2.8.4 AES/EBU Interface Analyzer

("INTERVU.AZZ")

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

as a probability graph. The jitter signal or the data on the interface may be reproduced through the monitor loudspeaker.

AES/EBU Input Voltage	
Balanced	0 – 20.48 Vpp, $\pm(10\% + 50 \text{ mV})$
Unbalanced	0 – 4.096 Vpp, $\pm(8\% + 12 \text{ mV})$
Jitter Amplitude	0 – 10 UIpp, $\pm(5\% + 0.03 \text{ UI})$
Residual Jitter	$\leq 0.02 \text{ UI}$ (250 Hz – 1 MHz BW)
Spurious Jitter Products	$\leq 0.001 \text{ UI}$, or $\leq -60 \text{ dB}$ below jitter signal
Common Mode Amplitude	0 – 20.48 Vpp, $\pm(30\% + 50 \text{ mV})$, 20 kHz – 1 MHz
Jitter Probability Display	256 bins, autoranging
Input Probability Display	256 bins, autoranging
Bit Width Probability Display	8192 bins
Risetime	$\leq 20 \text{ ns}$
Acquisition time/memory	3.9 ms / 256k

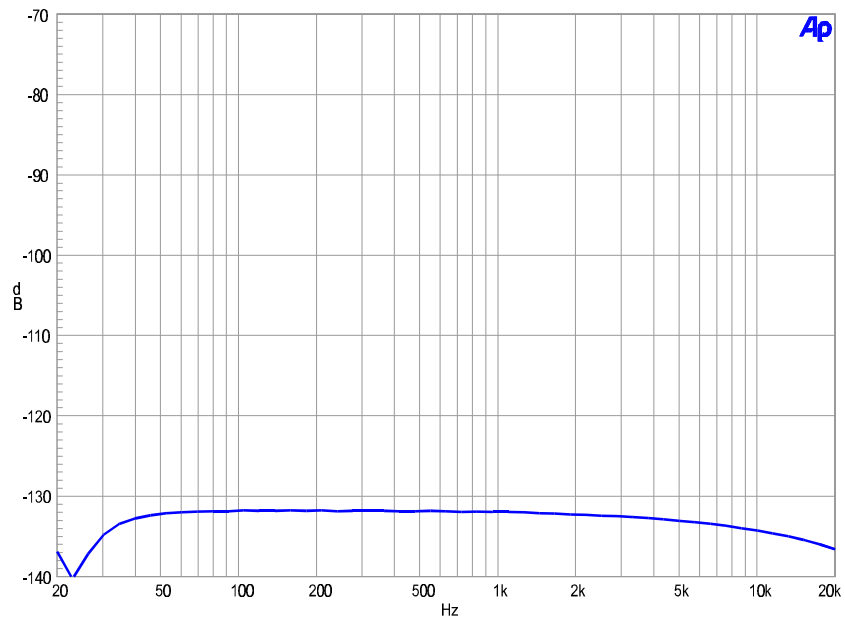


Figure 2-31. Typical Digital Domain system residual THD+N

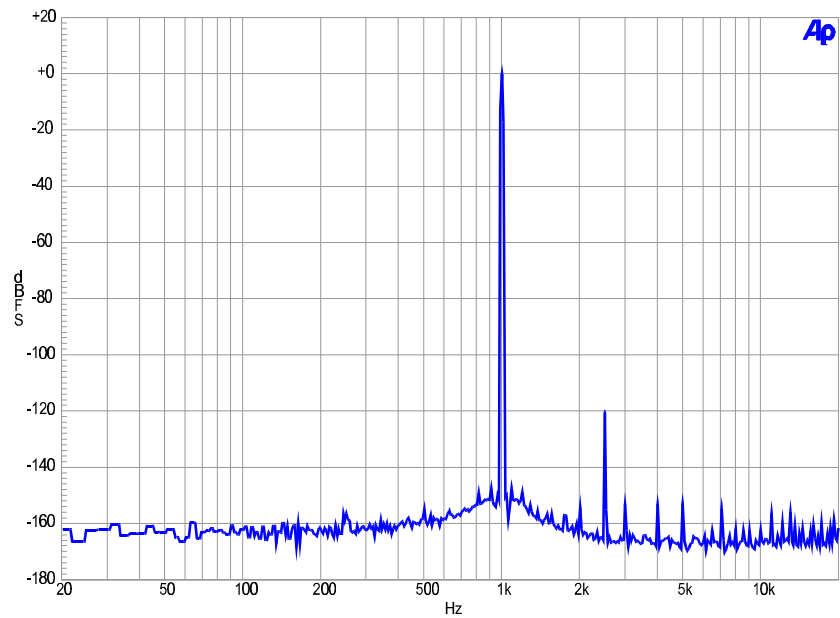


Figure 2-32. Illustration of typical Digital Domain FFT dynamic range. Signal is 0 dB 1 kHz with a secondary signal at -120 dB and 2.5 kHz. Harmonics of 1 kHz signal are visible at about -150 dB, consistent with 24-bit audio.

2.9 Auxiliary Signals

2.9.1 Generator Signal Monitors

(all units except SYS-2300)

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

2.9.1.1 Generator Auxiliary Signals

(all units except SYS-2300)

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

2.9.1.2 Analyzer Signal Monitors

(all units except SYS-2300)

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

2.9.1.3 Digital Signal Monitors

(SYS-2222 & SYS-2322 only)

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

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

2.9.1.4 Digital Interface Monitors

(SYS-2322 & SYS-2300 only)

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

2.9.1.5 Miscellaneous Digital I/O

(SYS-2322 & SYS-2300 only)

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

2.10 Audio Monitor

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

Power Output	Typically 1 Watt
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END OF SYSTEM TWO SPECIFICATIONS.

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

2.11 Switchers Specifications

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

2.12 DCX-127 Multi-Function Module Specifications

2.12.1 DC Volts Measurements

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

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

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

2.12.2 Resistance Measurements

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

2.12.3 DC Outputs

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

2.12.4 Digital Input/Output

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

2.12.5 Auxiliary Output Ports

Configuration	Three independent 8-bit parallel ports, LSTTL-CMOS compatible
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2.13 SIA-2322 Serial Interface Adapter Specifications

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

2.14 Primary Power and Fuse Information (all components)

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

Primary Voltage Ranges, all components	100, 120, 230, or 240 V ac (-10%/+6%), 50 - 60 Hz	
Power Ratings		
System Two	240 VA max	
Switcher (each unit)	20 VA max	
DCX	20 VA max	
SIA-2322	none (powered from the System Two)	
Fuse Requirements	100 or 120 V	230 or 240 V
System Two	2 A	1 A
Switchers	200 mA	100 mA
DCX	200 mA	100 mA

2.15 Environmental (all components)

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

2.16 Physical Dimensions and Weights

2.16.1 System Two

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

2.16.2 Switchers, DCX-127, and SIA-2322

Dimensions	
Width	17.2 in. (43.7 cm)
Height	1.75 in. (4.4 cm)
Depth	10.625 in. (27 cm)
Weight	
Switchers	9.2 lbs (4.2 kg)
DC-127	9.5 lbs (4.3 kg)
SIA-2322	6.9 lbs (3.1 kg)

2.17 Regulatory Compliances (all components)

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

2.18 Software and Control

2.18.1 Computer Requirements

APWIN is a Microsoft Windows-based program. As such, it requires that Windows 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, practical considerations will suggest a configuration exceeding this to achieve acceptable speed with most applications, including APWIN. If the computer used to run APWIN will also be required to run other Windows applications such as word processors, spread sheets, or data bases we suggest a computer configuration better than the minimum requirement. The following table lists the minimum and recommended requirements.

	Minimum Requirement	Recommended Configuration
Windows 3.1, 3.11		
Computer CPU:	386SX, 20 MHz	486DX2, 66MHz
Memory:	8 MB	16 MB
Hard drive:	100 MB	500 MB
Free hard drive space:	20 MB	100 MB
Video:	VGA (640 x 480)	SVGA (1024 x 768)
Windows 95, NT 4.0		
Computer CPU:	486DX2, 66MHz	Pentium or better
Memory:	16 MB	32 MB or more
Hard drive:	500 MB	500 MB or more
Free hard drive space:	100 MB	100 MB
Video:	VGA (640 x 480)	SVGA (1024 x 768)

²⁴ Emission and Immunity levels are influenced by the shielding performance of the connecting cables. The shielding performance of the cable will depend on the internal design of the cable, connector quality, and the assembly methods used. EMC compliance was evaluated using Audio Precision XLR type cables, part number 4155.0117.

Note regarding Windows 3.11, Windows 95, and Windows NT

APWIN will operate under either Windows 3.11, Windows for WorkGroups, Windows 95, or Windows NT 4.0. We have experienced some minor incompatibilities in some Windows 3.1 installations and therefore recommend upgrading to Windows 3.11 or Windows 95 if problems occur. Windows 95 or Windows NT 4.0 will provide the best performance for APWIN.

2.18.2 ISA-WIN APIB Card

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

2.18.3 PCM-WIN Card

The PCM-WIN Card interfaces between a portable computer and the APIB. The computer must have a Type II PCMCIA slot and, if running Windows 3.11, be version 2 or greater software compliant and have Card and Socket Services release 2.1 or later software installed. Refer to Section 3.4 for further information.

2.18.4 Cables and Adapters

2.18.4.1 Analog Audio Cables

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

- CAB-XLR consists of a set of four XLR male to XLR female cables.
- CAB-XBR consists of a set of four cables with XLR male connectors to RCA/PHONO male 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.

2.18.4.2 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.
- CAB-AES2: Set of two AES/EBU cables, 6.5 ft (2 m) long.
- CAB-AES4: Set of two AES/EBU cables, 13 ft (4 m) long.
- CAB-DIO: Set of two interface cables, 4.25 ft (1.3 m) long, to connect between the SYS-2322 rear panel 50-pin ribbon input/output connectors and a DUT fixture with 0.1-in. spaced 2 x 25-pin headers.

2.18.4.3 Cable Adapters

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

2.18.4.4 Digital Control (APIB) Cables

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

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

3. Hardware Installation

Hardware setup involves installing an interface card in the computer and connecting a cable from this interface card to 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 table top use, the System two can be stacked with switchers or other instruments.

3.1 Rack Mounting

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

3.1.1 Fixed Rack-Mounting Brackets

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

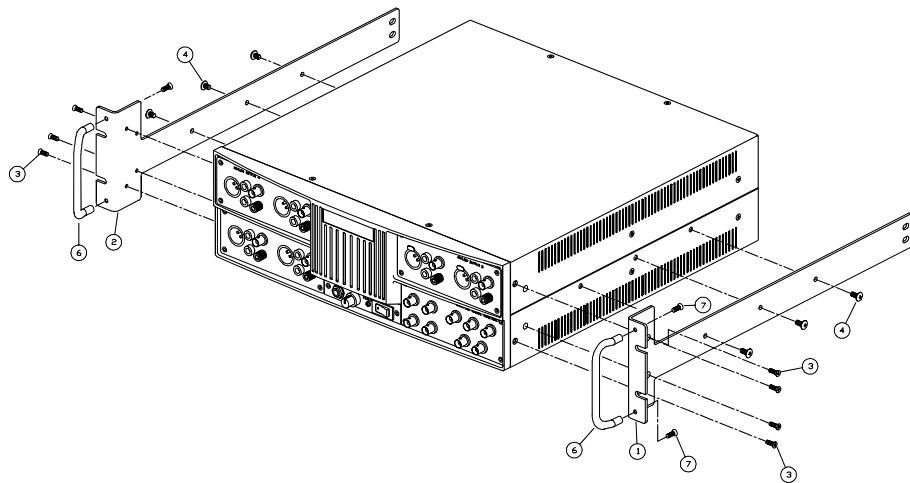


Figure 3-1. Fixed installation rackmounting kit

Table 3-1. Parts list for fixed installation rackmounting

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

3.1.2 Sliding Rack-Mounting Brackets

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

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

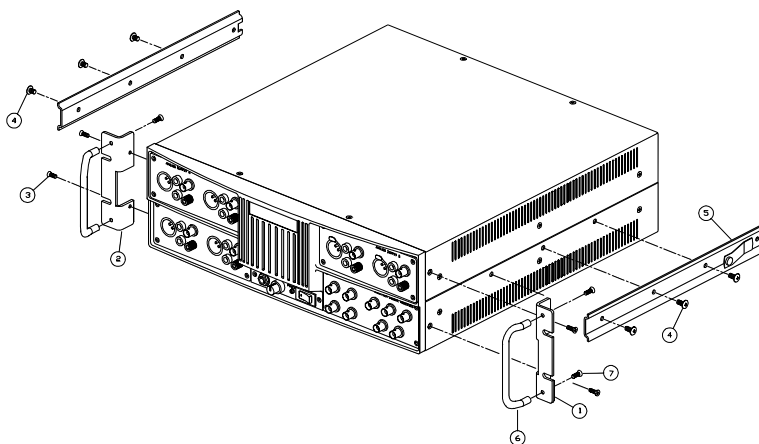


Figure 3-2. Sliding rack mount installation kit

Table 3-2. Parts list for sliding installation rackmounting

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

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

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

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

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

3.2 Primary Power Considerations

Refer to fuse specifications in Section 2.14 or on the rear-panel label for all power line-powered instruments. Unplug the power cord from the instrument before changing fuses or performing any other operations described in this section.

3.2.1 AC Mains Switch Required

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

3.2.2 Checking or Changing Power Line Voltage

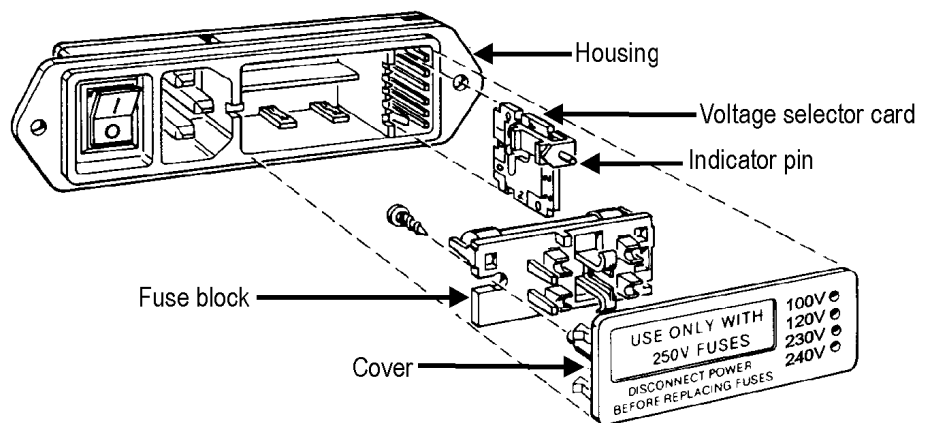


Figure 3-3. Changing power line voltage

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

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

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

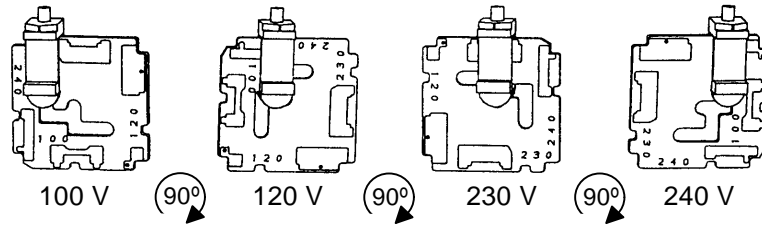


Figure 3-4. Voltage selector card positions

4. Orient the selector card so that the desired input voltage is readable at the bottom (see Figure 3-4). Then orient the indicator pin to point up when the desired voltage is readable at the bottom, with the indicator pin assembly seated in the notch on the board edge.
5. Insert the voltage selector card into the housing with the printed side of the card facing toward the connector, and the edge indicating the desired voltage first.
6. Confirm that the correct fuse is installed for the intended input voltage (refer to fuse ratings in Section 2.14 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 3-5), and European (see Figure 3-6). The North American fusing arrangement uses a single type 3AG (0.25 x 1.25 in.) SB (“slow blow”) fuse; the European fusing arrangement uses two 5 x 20 mm IEC-approved type T fuses. Refer to Section 2.14 or to the label on the rear panel for fuse current ratings.

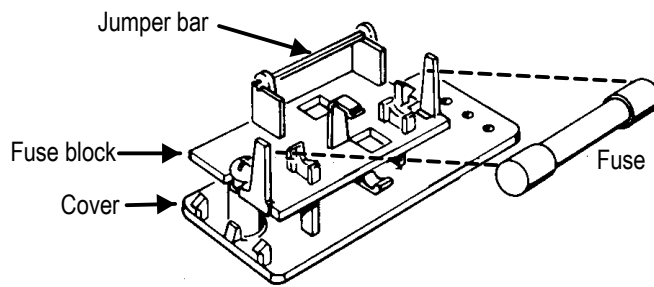


Figure 3-5. North American fusing arrangement

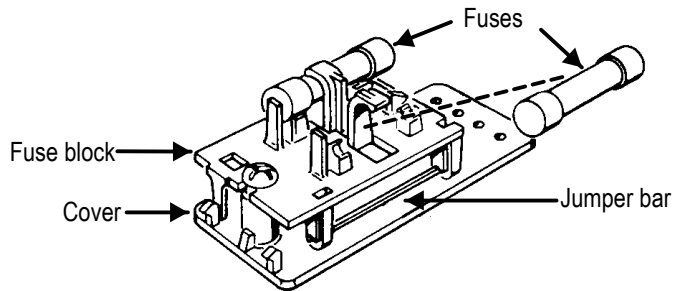


Figure 3-6. European fusing arrangement

3.2.4 Changing Fusing Arrangement

To change from one fusing arrangement to the other:

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

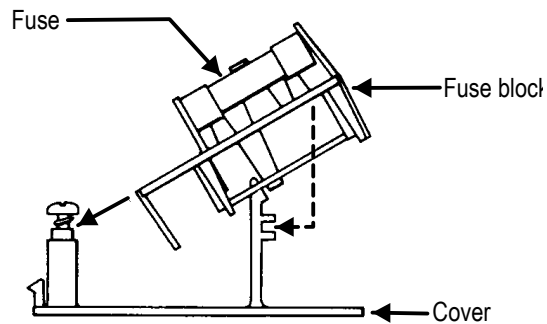


Figure 3-7. Changing fuse types

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

3.2.5 Proper Environment

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

3.3 Installing ISA-WIN APIB Card

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

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

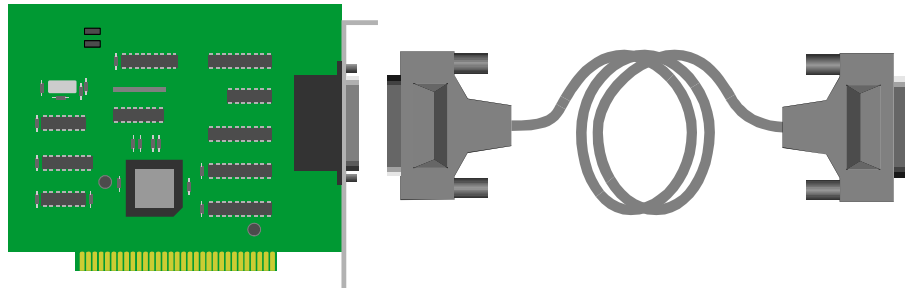


Figure 3-8. ISA-WIN Interface Card and cable

TIP:

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

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

3.3.1 Address Jumper Settings

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

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

(Memory space required: eight address locations.)

NOTE

When APWIN starts, it will automatically look through the possible address locations to find an ISA-WIN or PCM-WIN card. In the unlikely event that this auto-detect does not function correctly you can force the software to utilize a specific address location using command line start-up switches. To do this, see Section 6.1.1.3.

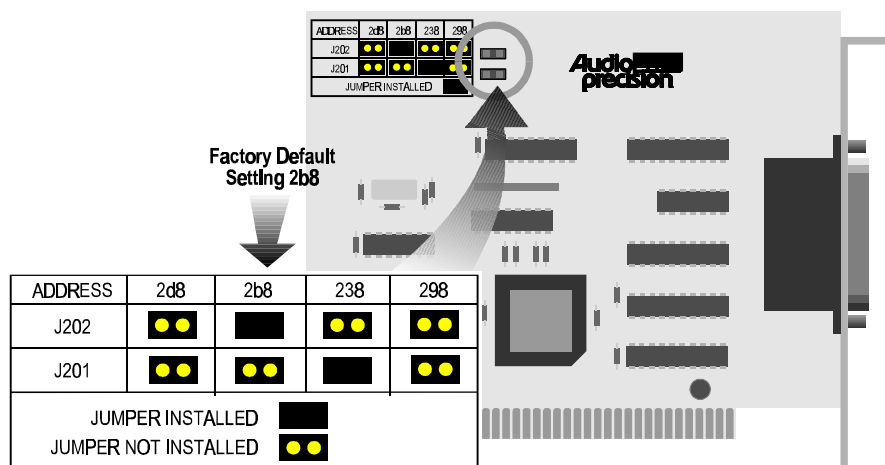


Figure 3-9. ISA-WIN APIB Card with address jumper selections shown

3.4 Installing PCM-WIN PCMCIA Interface Card

The Audio Precision PCM-WIN card is a PCMCIA to APIB interface adapter. It can be used to connect a PC or notebook computer equipped with a PCMCIA type II slot 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.

Note:

If you are using the PCM-WIN card, do NOT install it until after the APWIN software is installed, per Section 4 (Windows 95) or Section 5 (Windows 3.11).

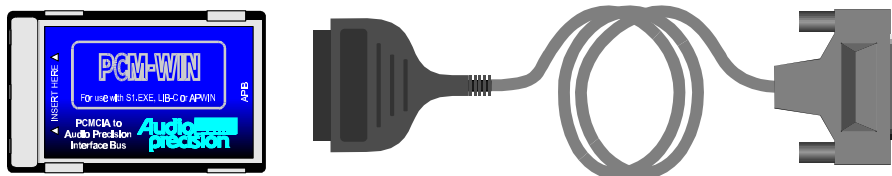


Figure 3-10. PCMCIA to APIB interface card and cable

Refer to Section 4.1 to install the associated PCMCIA drivers for Windows 95, or Section 5.3 to install the PCMCIA drivers for Windows 3.11.

3.5 Connecting the APIB Interface

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

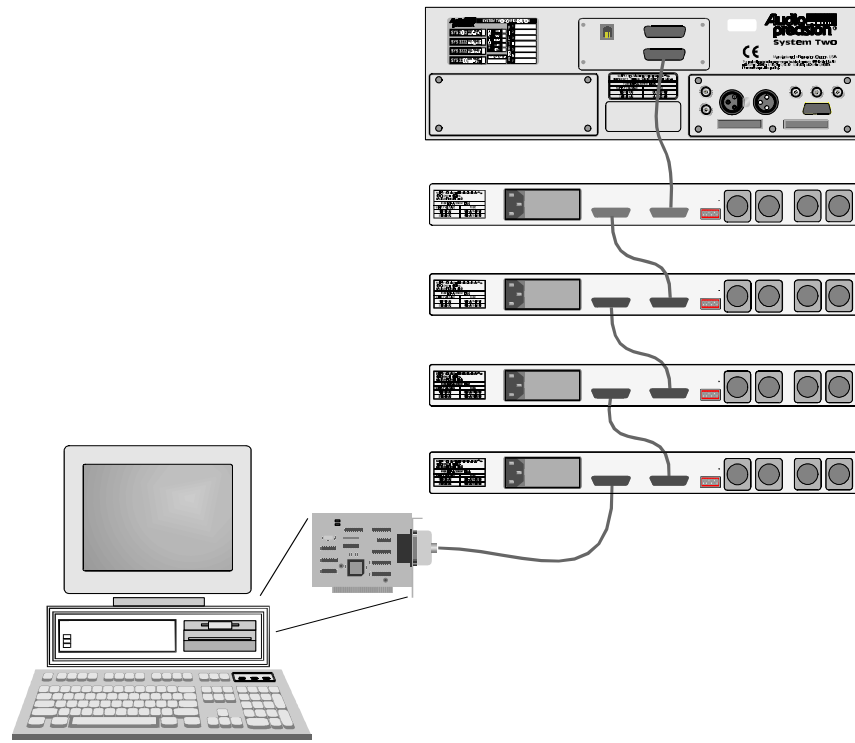


Figure 3-11. APIB connections block diagram (typical)

3.6 Setting Switcher Addresses and Modes

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

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

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

3.6.1 Switcher Address Settings

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

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

Table 3-3. APIB Address switch settings

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

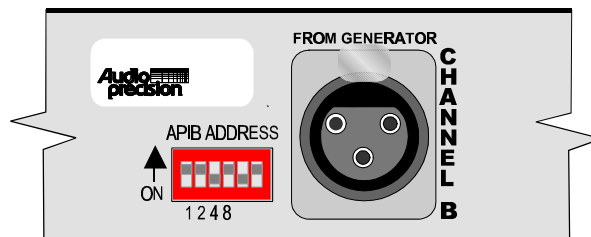


Figure 3-12. Rear panel DIP switch (typical)

3.6.2 Input, Output, and Patch Point Switcher Mode Switches

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

Table 3-4. Patch point switcher mode settings

Patch Point Mode	Rear Switch	
	Switch 5	Switch 6
Either A or B	Up	Up
Channel A	Up	Down
Channel B	Down	Up
Off	Down	Down

Either A or B: The switcher's channel A responds to the A channel addresses, and channel B responds to B channel addresses. This is the normal mode.

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

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

Off: Neither channel responds to any address.

3.6.3 Unbalanced Switcher Mode Switch

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

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

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

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

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

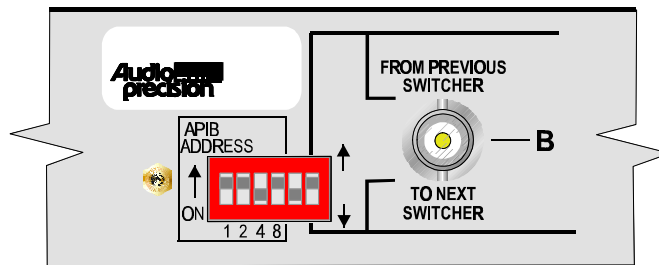


Figure 3-13. Unbalanced switcher address/mode switch

3.6.4 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 3-14. The jumper positions are shown for reference only and will normally not need to be changed.

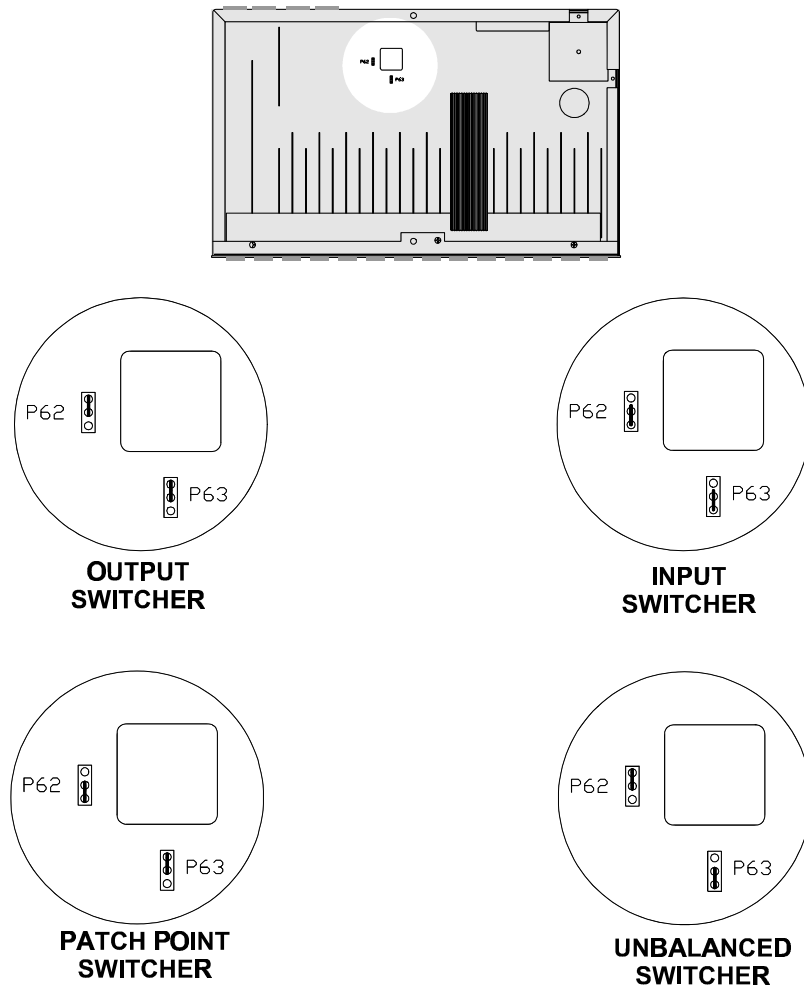


Figure 3-14. Switcher mode jumper positions

4. Software Installation- Windows 95 and NT

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

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

Note:

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

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

Note:

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

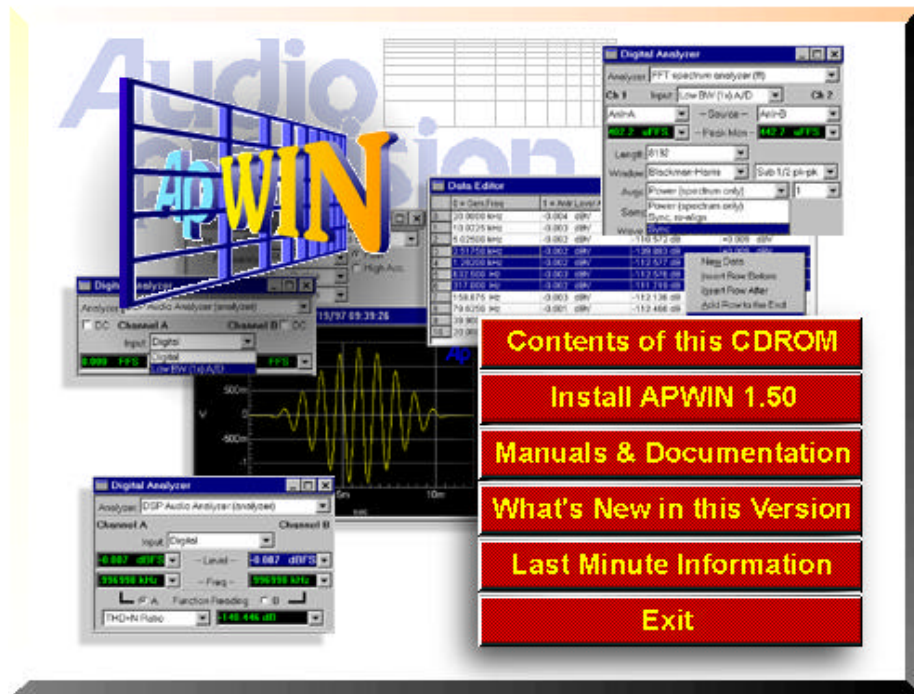


Figure 4-1. APWIN installation Setup screen

Click on the **Install APWIN 1.50** button. If you are installing under Windows NT 4.0, your account must have Administrator rights. Otherwise, you will get the following screen (Figure 4-2) when you try to install:

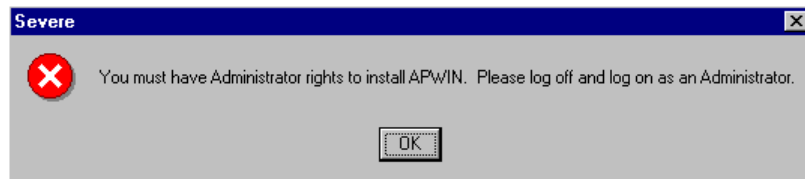


Figure 4-2. Windows NT Administrator rights warning screen

The following screen appears (Figure 4-3):

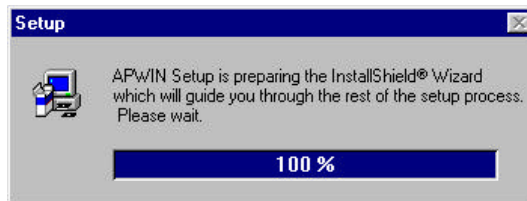


Figure 4-3. Setup progression screen

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

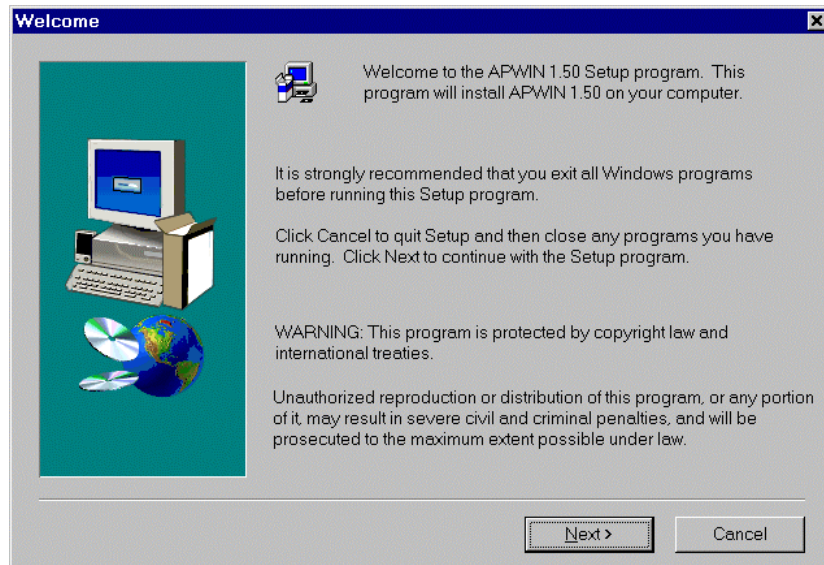



Figure 4-4. Welcome screen

Click the  button. The following dialog box appears:

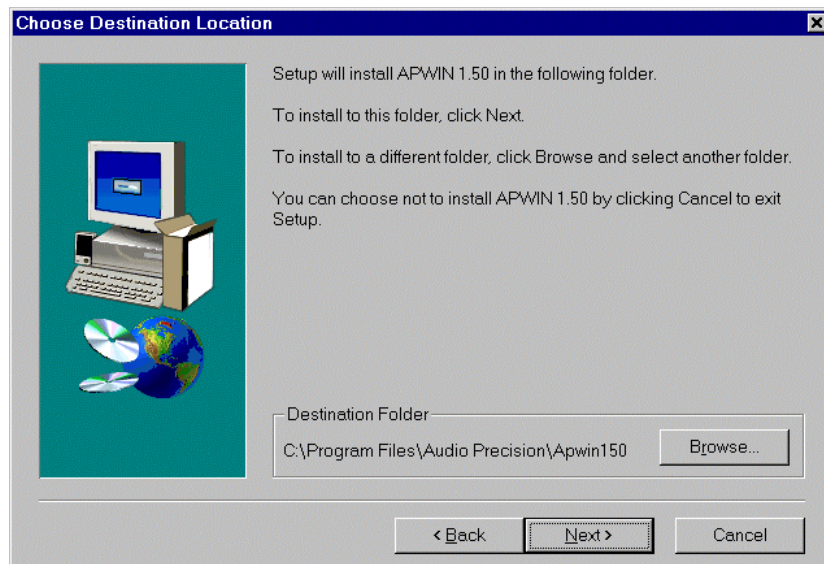




Figure 4-5. Choose Destination Location for APWIN dialog box

This screen (Figure 4-5) will suggest location for the APWIN program files. If you wish to choose an alternate location, click on the 

button. When you click the  button, the dialog shown in Figure 4-6 will appear.

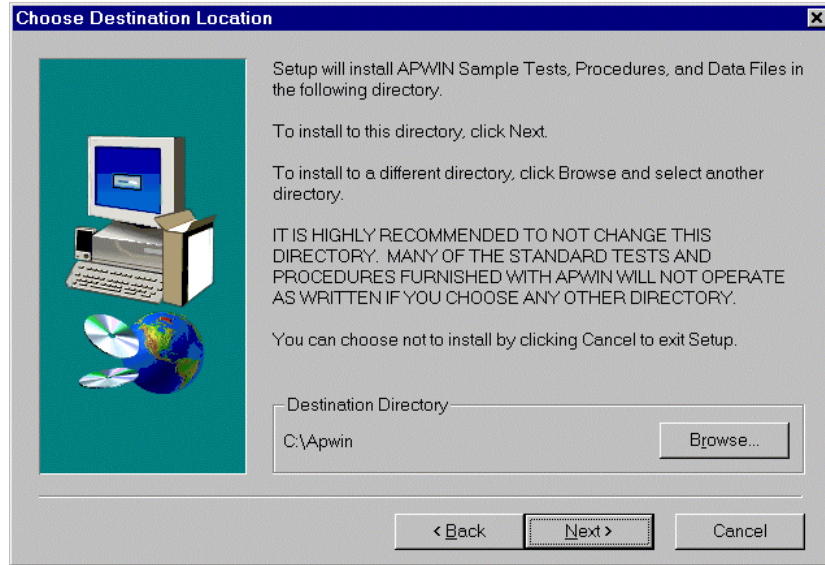




Figure 4-6. Choose Destination Location for sample tests, procedures, and data files dialog box

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

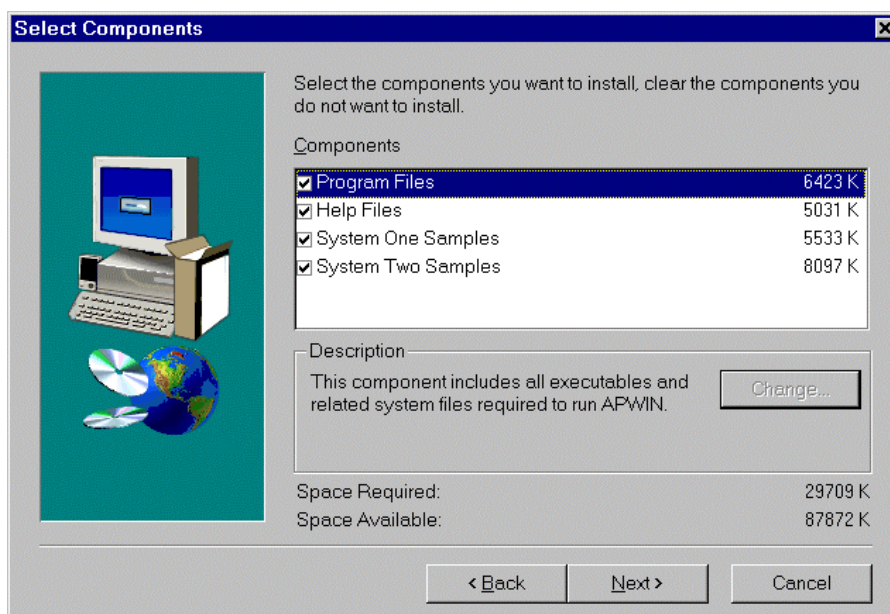


Figure 4-7. Choose Components to Install dialog box

Here you have a choice of what to install and how much space will be required. If you are tight on space or you are re-installing part of the software, you can selectively turn off any of the items shown by clicking on the check boxes (an **X** 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 1.50. If you choose one of the existing Program Groups, the new icons will be added to that group rather than put in a new group.

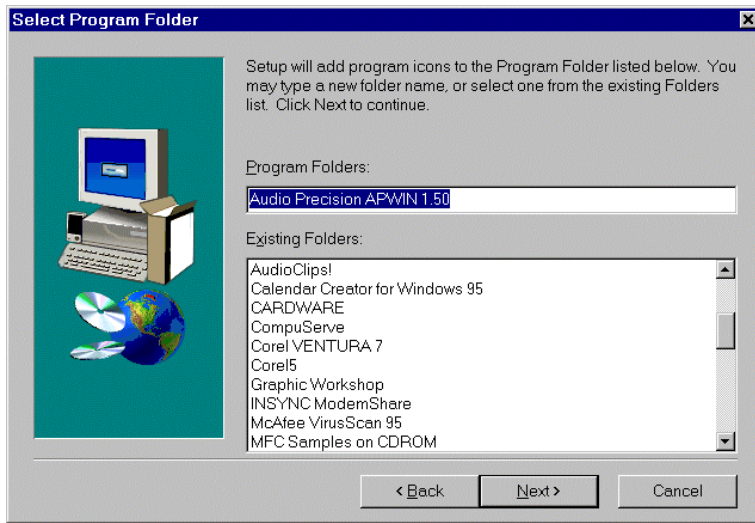


Figure 4-8. Select Program Manager Group dialog box

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

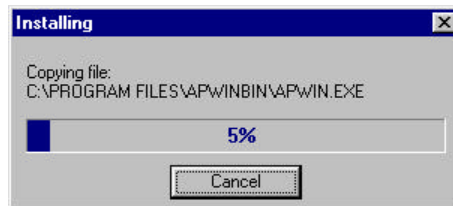


Figure 4-9. Installing progress screen

If you are installing APWIN from diskettes, the following screen will appear after all of the files from each disk are loaded. At each screen, insert the next disk in the series as instructed.

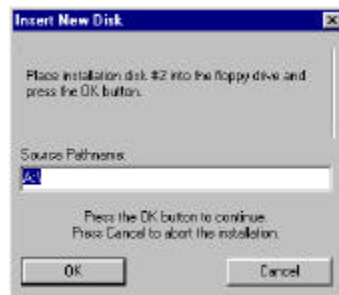


Figure 4-10. Insert New Disk dialog box

After APWIN is successfully installed, the following message window (Figure 4-11) 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, you can now insert the PCM-WIN card and Windows 95 will install the card using the Audio Precision driver.

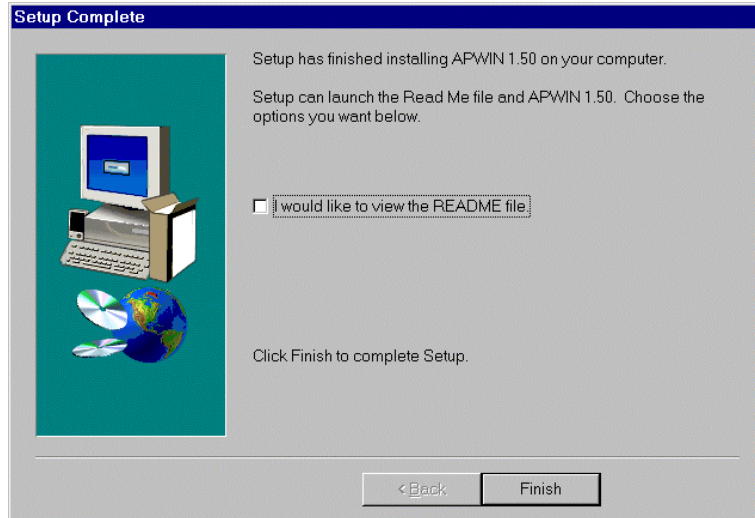


Figure 4-11. Setup Complete message window

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**, You may now insert the PCM-WIN APIB card in its slot, and connect its cable as described in Section 3.4. **If you are running Windows NT 4.0**, the computer should be switched off before removing or inserting a PCMCIA card (the Windows NT 4.0 system does not support hot swapping).

5. Software Installation- Windows 3.11

5.1 Installing APWIN

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

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

Note:

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

There are two ways to install APWIN. The installation program SETUP.EXE is in the root directory of the CD-ROM, or on diskette 1. You can either use FILE MANAGER to find the SETUP.EXE program on your floppy drive and then double click on it, or from PROGRAM MANAGER select RUN in the FILE menu. This opens the dialog box shown in Figure 5-1.

Note:

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

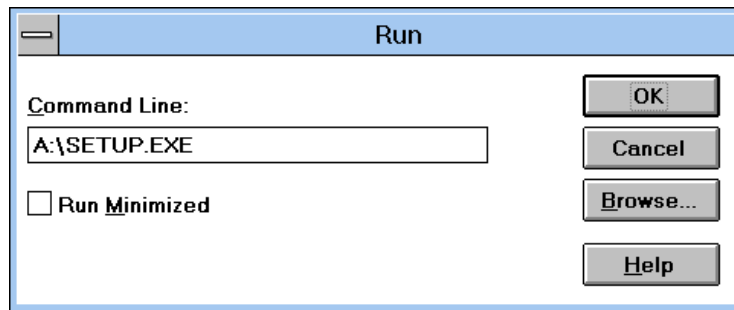



Figure 5-1. RUN dialog box

At this point, you can either type in your CD-ROM or diskette drive letter (the one that has the APWIN installation disk 1) and type SETUP as shown and then press the  button.

Alternately, you can use the  button to "find" this file. This is what the Browse... dialog box should look like:

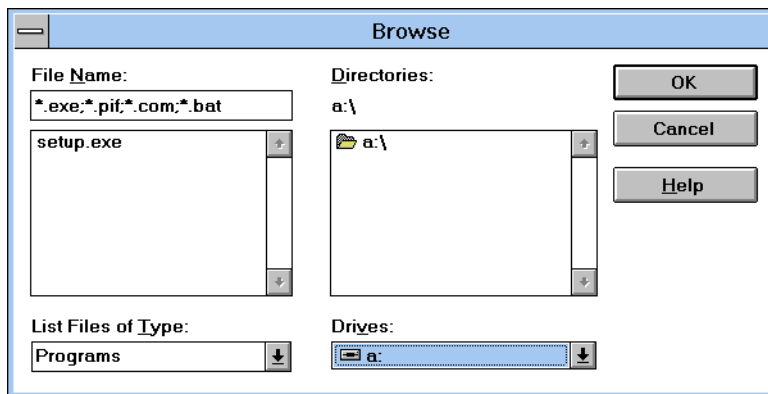




Figure 5-2. Browse dialog box

Now you can click on the setup.exe file name and click  (or just double click on the setup.exe file name) to return to the File Run dialog box.

When you click  in the Run dialog box, the installation process begins. You should then see the initial opening screen shown in Figure 5-4.

Note:

If you do not see the Welcome opening screen shown in Figure 5-4, and you are installing APWIN under Windows 3.11, it is possible that your system does not have the Windows 32-bit extensions required to run APWIN.

If the Win32s extension to Windows 3.11 has not been previously installed*, you will see the following screen:




Figure 5-3. Install Win32s message screen

If your screen displays the message shown in Figure 5-3, perform the procedure described in Section 5.2 now. Otherwise, your screen should look like Figure 5-4.



Figure 5-4. APWIN Installation Welcome screen

* Several 32-bit applications require Win32s to run on Windows 3.11. It is possible that some other application you have previously installed has already installed Win32s.

Click on the  button to proceed.

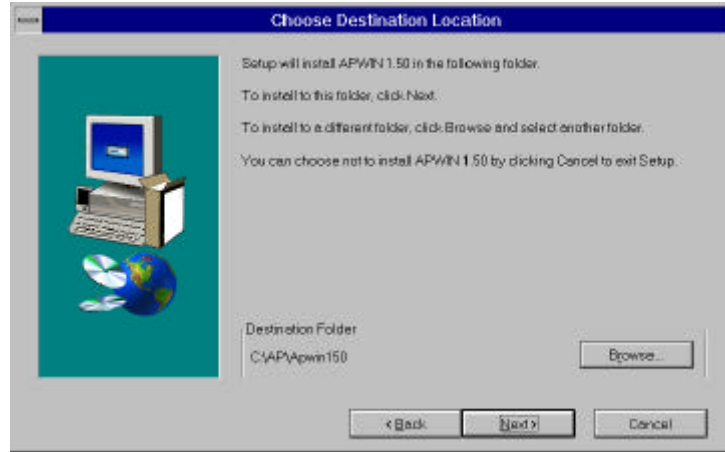




Figure 5-5. Choose Destination dialog box, program files

This screen will suggest locations for the APWIN program files. If you wish to choose an alternate location, click on the  button. Note that the sample procedures that come with APWIN expect the default locations specified here and will not run if you change directory locations. (Of course, you could edit the procedures to reflect your alternate choices). When you click on , the dialog box of Figure 5-6 will appear.

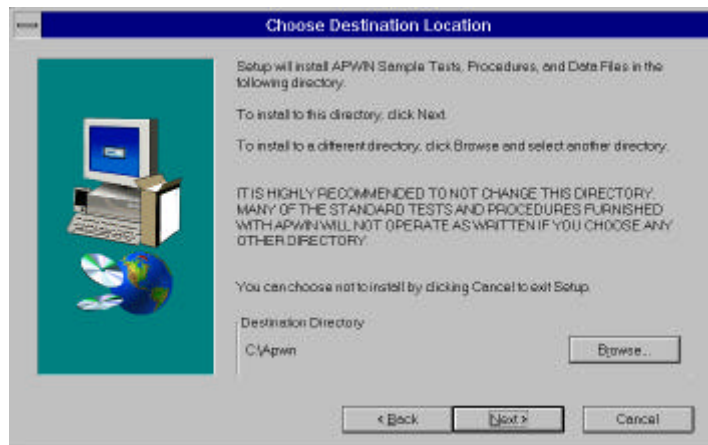


Figure 5-6. Choose Destination dialog box, tests and procedures

As it did with program files, this screen will suggest locations for all the tests, procedures, and data. If you wish to choose alternate locations,



click on the  button. When you click on , the dialog box of Figure 5-7 will appear.



Figure 5-7. Choose Components to Install dialog box

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

The next screen asks if you want the Audio Precision PCMCIA driver installed in your CONFIG.SYS file. If you intend to use APWIN with the PCM-WIN card interface, you will need Card and Socket Services and the Audio Precision PCMCIA driver for this interface to function. Click the Install APS1DRV.SYS driver selection on the screen.

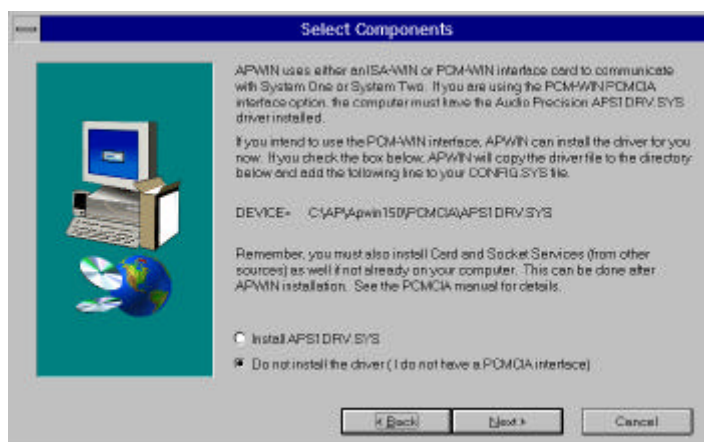


Figure 5-8. PCMCIA Driver Installation selection screen

Click to proceed with the installation. This dialog box 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 APWIN1.50." 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.

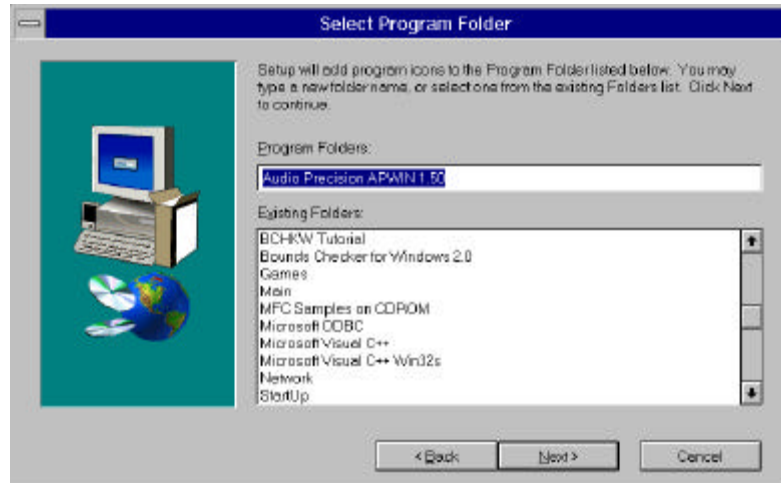


Figure 5-9. PCMCIA Driver Installation selection screen

Click to proceed with the installation. You should see a screen similar to Figure 5-10.

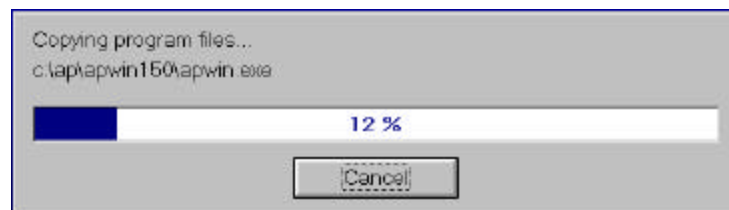


Figure 5-10. Installing progression screen

If you are installing APWIN from diskettes, the following screen (Figure 5-11) will appear after all of the files from each disk are loaded. At each screen insert the next disk in the series.

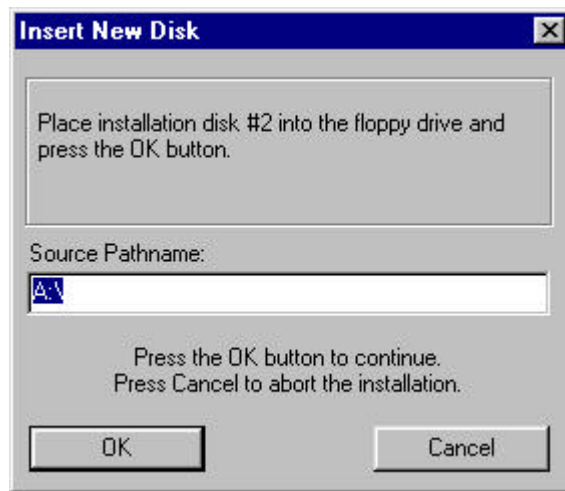


Figure 5-11. Insert New Disk dialog box

After APWIN is successfully installed, and if you are not using the PCM-WIN card, the following message window (Figure 5-12) will appear. This completes the installation and you should now be able to start APWIN.

If you are using the PCM-WIN PCMCIA interface, you should see the message window of Figure 5-13. You must insert the PCMCIA card in its slot and reboot your computer.

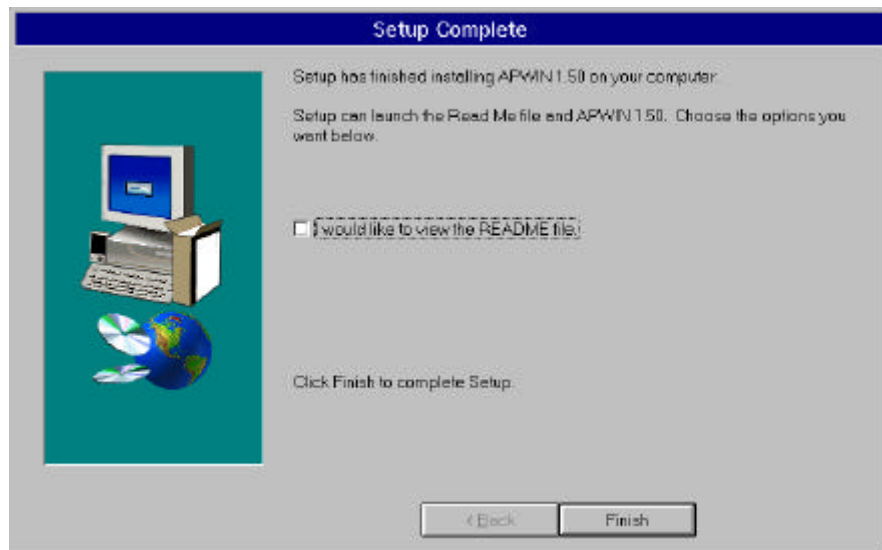


Figure 5-12. Setup Complete message window (using ISA-WIN APIB card)

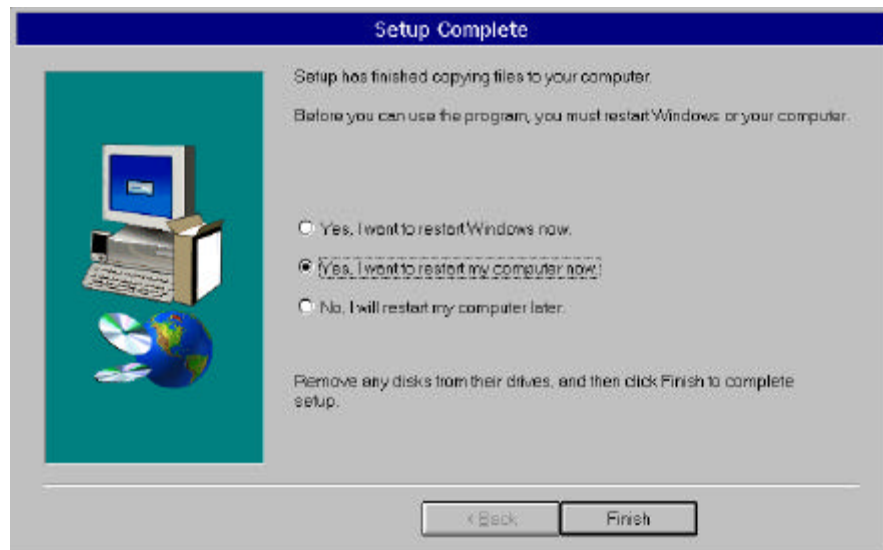


Figure 5-13. Setup Complete message window (using PCM-WIN APIB card)

5.2 Installing WIN32S

Note:

APWIN was designed as a 32-bit application to be able to take advantage of Windows 95 in a future release. Windows 3.11 is a 16-bit operating system but is able to run more advanced 32-bit applications by adding extensions to its basic capability. This extension is called WIN32S and is a Microsoft program. A copy of WIN32S version 1.30 is included with APWIN (under license from Microsoft). At the start of the APWIN installation, the setup program "looks for" the presence of WIN32S (that may have been already installed by another program). If it finds WIN32S, the APWIN installation continues. If it does not find WIN32S, the installation will inform you that the Microsoft WIN32S installation procedure must be done. You will be prompted to abort the APWIN installation and install WIN32S. After WIN32S is successfully installed you can again run the APWIN installation. If WIN32S has been successfully installed, you will then see the Welcome screen shown in Figure 5-4. Note that APWIN version 1.3 (and previous version 1.2) requires version 1.30 of WIN32S. Earlier versions of APWIN (prior to 1.2) installed an earlier version of WIN32S. The APWIN installation will automatically detect this and require the new version to be installed.

To install WIN32S, abort the APWIN installation and insert Disk 1 of the WIN32S installation disks included with this APWIN package. From the Windows PROGRAM MANAGER, select RUN and use the button to find the SETUP.EXE file on the floppy drive that contains disk 1. You should see the following dialog box:

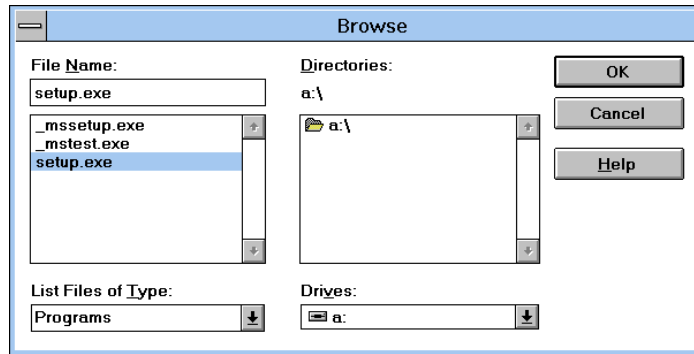


Figure 5-14. Win32s installation startup

Double click on SETUP.EXE and the installation will proceed. The next dialog you will see will be the following (Figure 5-15):

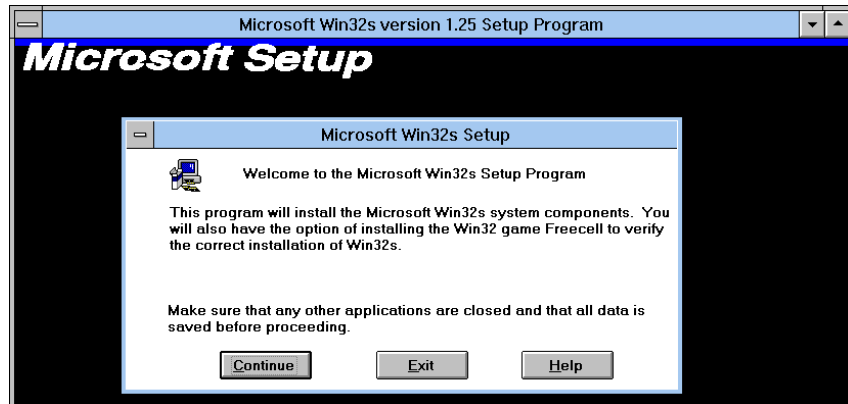


Figure 5-15. Win32s Welcome window

Click on Continue and the following screen (Figure 5-16) will appear:

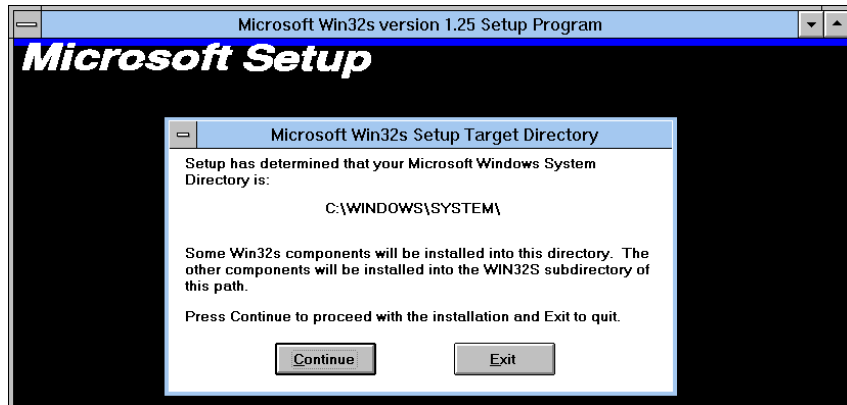


Figure 5-16. Win32s setup target directory window

At the end of the installation you should see the screen shown in Figure 5-17:



Figure 5-17. Win32s installation completion message window

Windows will restart to enable the new 32-bit extension. At this point you can again run the APWIN installation. Insert disk 1 of the APWIN installation disks and follow the instructions given in Section 5.1. This time you should see the Welcome screen shown in Figure 5-4.

5.3 Using PCM-WIN with Windows 3.11

Note:

For Windows 95, refer to Section 4.1 for PCMCIA card installation instructions.

The Audio Precision PCM-WIN interface adapter 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. To use this PCM-WIN interface, the driver supplied with this kit must be installed. This document explains how to install this driver. Card and Socket services, normally supplied with the notebook computer running Windows 3.11, must also be resident on the target notebook computer.

5.3.1 Installing APS1DRV.SYS

This driver enables the operation of the PCM-WIN PCMCIA interface card. It presumes the prior installation of Card and Socket Services in the user's computer. This would normally have been done to activate the PCMCIA card slots.

Since it is a device driver, APS1DRV.SYS must be specified in CONFIG.SYS. Assuming the driver is placed in the user's default directory on a standard system, the line added to CONFIG.SYS should read:

```
DEVICEHIGH=C:\AP\APWIN150\PCMCIA\APS1DRV.SYS
```

This command assumes MS-DOS version 5.0 or higher is used. The DEVICEHIGH command asks MS-DOS to load the driver in high memory maximizing the base memory for applications. If no high memory is available, the driver will be loaded at the lowest possible memory location.

If the driver is to be used with earlier versions of MS-DOS, high memory isn't available, the command should be:

```
DEVICE=C:\AP\APWIN150\PCMCIA\APS1DRV.SYS
```

Note:

This driver must be loaded in the CONFIG.SYS file after the Card and Socket Services drivers.

To install completely, the driver must complete four steps. The steps are: load (and start running), locate the Card Services device driver, identify an unused advanced multiplexed interrupt service number (AMIS), and “hook” into the system. If all of these steps succeed, the driver will display the following:

```
APS1DRV.SYS: Audio Precision Card Intercept Driver
version 1.0
```

```
Copyright (c) 1994,1995 Audio Precision Inc. All
rights reserved.
```

```
Card Services driver located.
```

```
PCMCIA Client has been installed properly.
```

```
Intercept Driver installed successfully.
```

The troubleshooting section of this document describes what messages appear if the driver fails during the installation.

5.3.2 What APS1DRV.SYS Does

APS1DRV acts like a centurion— always watching the PCMCIA slots for PCM-WIN and PCM-WIN cards. Like any other device driver (such as RAMDRIVE.SYS), APS1DRV links into MS-DOS as it starts, and supports a fixed set of well defined operations. The device created by loading APS1DRV.SYS is called “APS1_DRV”. This name must be different from the name of the file that loaded the driver (APS1DRV doesn’t contain an underscore). While the device name is much longer than MS-DOS users are used to, it acts just like ‘COM1’ or ‘LPT3’. This leads to an important point. **Just like COMx, LPTx, CON, AUX, and the like, APS1_DRV cannot be used as a disk file name— it is reserved.**

The experience we have had installing this and other PCMCIA devices on various notebook computers suggests that the “plug-and-play” attribute claimed for PCMCIA devices is an intention but not always the reality. The problems we experienced in trying to install the Audio Precision PCM -WIN interface were always traced to incompatible Card and Socket Services drivers supplied with the notebook computer. These drivers have been going through evolution over the past few years as the PCMCIA standard has evolved. In virtually all cases of incompatibility, we were able to solve the problem by installing a more recent version of the Card and Socket Services driver. In some cases, we changed vendors of the driver if the manufacturer of the driver supplied with the notebook could not supply an updated version. We found the driver from Award Software was able to resolve virtually all conflicts and

had the easiest installation. We recommend that anyone experiencing difficulties installing this PCM-WIN interface obtain the current Card and Socket Services package called "CardWare™" available from:

Award Software International Inc.
777 East Middlefield Road
Mountain View, CA 94043-4023
Tel: (415) 968-4433
Fax: (415) 968-0274

5.3.3 Configuring Card Services for use with APS1DRV

Card Services assigns I/O and Memory card addresses when the card is inserted. To do that, it must have a "pool" of free memory and I/O addresses to choose from. Each vendor uses a different method of generating and keeping the "pool".

APWIN requires that one of the four PCM-WIN addresses be available. The "pool" of I/O addresses needs to include one of these. Since some vendors don't include these addresses in their standard "pool", the user must manually change it. This section describes the changes (if any) that are needed on a vendor by vendor basis.

To make it easier to identify the software vendor, their standard installation directory is included with the vendor's name.

5.3.3.1 System Soft Corporation Installed in CARDSOFT directory

More than half of the PCMCIA systems shipped use System Soft's Card and Socket Services. We have found APS1DRV to be very compatible with their Card Services Release 2.1, Version 2.06. The Socket Services file name is dependent on the interface chip manufacturer. The Card Services file name is always CS.EXE.

We have successfully tested the following Socket Services device drivers: SCCIRRUS.EXE (Cirrus interface chip), SS365SL.EXE (Intel interface chip), and SSVLSI.EXE (VLSI Technologies interface chip).

We have observed problems with SSDBOOK.EXE (Data Book interface chip). See the section on Award Software for more information. This is likely to be fixed in later versions of Socket Services.

CARDSOFT software is installed using a floppy disk and MS-DOS. The installation process automatically detects the interface chip, and

installs the appropriate Socket Services driver. The installation changes CONFIG.SYS, but leaves AUTOEXEC.BAT alone.

As part of the installation process, the PC user is asked to manually change CONFIG.SYS to exclude memory from EMM386. If users are having problems with CARDSOFT software, they should make sure that their EMM386 installation line (if they use it) includes the following string:

X=D000-DFFF

CARDSOFT software uses a utility to determine what I/O and memory addresses are free for the "pool". The utility is called CSALLOC.EXE, and it is automatically run as part of the installation process. The "pool" is kept as a text file in the CARDSOFT directory. This file is called CSALLOC.INI, and can be changed by CSALLOC.EXE, or using any text editor (such as NOTEPAD, or EDIT).

The four addresses recognized by APWIN are rarely used by other hardware, so at least one of the I/O addresses is available in the "pool". This means that for most users, once APS1DRV is placed in the CONFIG.SYS file, and the machine has been restarted, APWIN is ready to run.

Note:

While CSALLOC.INI is a text file that can be changed, the Card Services program only reads it once (at boot time). If the file is changed, make sure the computer is restarted (CTRL-ALT-DEL) so the changes can take effect.

5.3.3.2 Award Software Inc. Installed in CARDWARE directory

Award is a recent entry into Card and Socket Services. We have found APS1DRV to be very compatible with their Card Services Level 2.1, Release 2.00 and later. The Socket Services file name is dependent on the interface chip used. The Card Services file name is always PCCS.EXE.

We have successfully tested the following Socket Services device drivers: SSPCIC.EXE (Cirrus interface chip), SSPCIC.EXE (Intel interface chip), and SSPCIC.EXE (VLSI Technologies interface chip). It appears this is a somewhat generic driver that can handle many different interface chips.

We have observed problems with SSTCIC.EXE (Data Book interface chip). Award has indicated that the Data Book chip contains byte

registers that must be accessed using word operations. This undocumented Data Book requirement was added to Award's 2.05 release of Card and Socket Services.

CARDWARE software is installed using a floppy disk and Windows. The installation process can be told (by user selection) to automatically detect the interface chip, and install the appropriate Socket Services driver. During installation, both the CONFIG.SYS and AUTOEXEC.BAT files are changed. If the user is running EMM386, the installer will add the following string to the EMM386 command line.

X=CF00-CFFF X=D000-D7FF

If the user has hardware at these locations, or later changes EMM386 in CONFIG.SYS, he/she must also change the CARDWARE.INI file (discussed below). See the notes at the end of this section for how to match CONFIG.SYS and CARDWARE.INI.

CARDWARE software uses a generic text file to set the I/O and memory addresses in the free "pool". The text file is in the CARDWARE directory, and is called CARDWARE.INI. It can be changed manually by using any text editor (such as EDIT or NOTEPAD).

The four addresses recognized by APWIN are not included in the generic "pool". This means that CARDWARE.INI must be changed before APWIN can run. Our experience with desk top PCs indicates that no hardware ever resides at the I/O address range 2B8-2BF. The user should therefore place the following line in the CARDWARE.INI file (just below the existing lines that start with 'I/O=').

I/O=0x2B8,0x08,E,10

Once CARDWARE.INI has been changed, the computer must be restarted (CTRL-ALT-DEL). This is because Card Services reads CARDWARE.INI only once at boot time. If you need to change the file, make sure you restart the computer so the changes can take effect.

Note:

As discussed earlier, the generic Award installation program assumes 4K bytes of memory at segment CF00, and 32K bytes of memory at segment D000 are available for Card Service's free "pool". On some notebook computers this may not be the case. For some advanced users, they may wish to use some of that for RAM (at the expense of not being able to use PCMCIA ATA disks, or RAM cards).

When the user changes CONFIG.SYS to include one of these memory ranges, CARDWARE.INI must be told to exclude them. The lines in CARDWARE.INI are as follows.

```
MEM=0xCF000,0x1000,E  
MEM=0xD0000,0x8000,E
```

Change these lines to reflect the excluded memory areas from EMM386.

Note:

Award installs their PCCARD program so that it automatically starts when Windows starts. It doesn't place its icon in the Startup folder, so the user can't easily remove the program from the Windows start process. This gets annoying for anyone who wishes to automatically start any other program, or just come up to Program Manager.

If you wish to remove PCCARD from the automatic startup process, you must edit the SYSTEM.INI file in the WINDOWS directory. In the file, there is a line that appears as follows:

```
run=C:\CARDWARE\PCCARD.EXE
```

The line should be deleted to keep PCCARD from executing.

5.3.3.3 Data Book Inc. Installed in CARDTALK directory

Data Book was the first vendor of PCMCIA interface hardware. Their software will only run on computers that use their interface chip. We have found APS1DRV to be somewhat compatible with their Card Services Version 3.02, Release 2.10. The problems observed seem to be related to interface hardware and not software.

The Socket Services file name is always SNOTESS2.EXE. The Card Services file name is always CTALKCS.EXE.

Note:

Many older PCMCIA notebook computers were built with Data Book interface chips, but did not contain Card Talk software (Data Book just supplied a few specific drivers for memory and ATA disk cards). These users must contact their manufacturer or Data Book to receive the Card Talk software (usually at no charge).

CARDTALK software is installed using a floppy disk and MS-DOS. The installation changes CONFIG.SYS and AUTOEXEC.BAT.

As part of the installation process, the user is asked to manually change CONFIG.SYS to exclude memory from EMM386. If users are having problems with CARDTALK software, make sure that their EMM386 installation line (if they use it) includes the following string:

```
X=D000-D7FF
```

Unlike the System Soft and Award drivers, CARDTALK uses the entries in CONFIG.SYS to set up the free "pool" of I/O and memory. A driver program called CARDTALK.SYS is loaded immediately after Card Services. On its command line, are switches that set the memory and I/O resources. On a generic configuration, the command line appears as follows.

```
DEVICE=C:\CARDTALK\CARDTALK.SYS /A /IOW=300-31F  
/MEMW=D000-D7FF
```

As you can see, none of the four addresses recognized by S1.EXE are included in the generic "pool". This means that CONFIG.SYS must be changed before APWIN can run. Our experience with desk top PCs indicates that standard PC hardware is never in the I/O address range 280-2BF. The user should therefore change the CONFIG.SYS entry to the following.

```
DEVICE=C:\CARDTALK\CARDTALK.SYS /A /IOW=280-2BF  
/MEMW=D000-D7FF
```

(This will actually be all on one line)

When the system is restarted, APWIN should work properly.

5.3.3.4 Phoenix Technologies Inc. Installed in the PCPLUS directory

If a system isn't shipped with System Soft's Card and Socket Services, it is likely to use Phoenix Technologies' software. We have had only a limited time to use their software, but found APS1DRV compatible with a release 2.00 of their Card and Socket Services. We expect release 2.10 to remain compatible.

5.3.3.5 Freeing up Conventional Memory

APWIN needs as much conventional memory as possible. While MS-DOS 5.0 (and later) moved DOS to upper memory, the standard PCMCIA installations swallow from 32 to 100K. This leaves a standard configuration with about 500K of conventional memory free. This section is designed to keep track of how to free more conventional memory— by moving drivers to high memory, or removing them entirely.

No matter which vendor supplies the software, a minimal installation for APS1DRV involves loading the Socket Services driver, the Card Services driver, and the card allocation driver (always installed as the line immediately following the Card Services installation line). Any other devices (such as RAM card drivers, ATA disk drivers, and Flash memory drivers), are installed after these three are installed. If you need to free up conventional memory, and have no plans to use any card but the PCM-WIN, you should comment out any other drivers.

Some of the Card and Socket Services installation programs attempt to load their drivers in high memory. Some installation programs don't try to install anything in high memory. If you need more conventional memory, try moving device drivers to high memory. This is a dangerous game, as drivers that aren't compatible with high memory will tend to crash the system. As long as you have MS-DOS 6, or a floppy disk that can boot your version of MS-DOS, much of conventional memory can be reclaimed by setting the Card and Socket services device lines to devicehigh.

All drivers from System Soft, Award, Data Book, and Phoenix can be placed in high memory.

6. Getting Started with APWIN

6.1 Starting APWIN

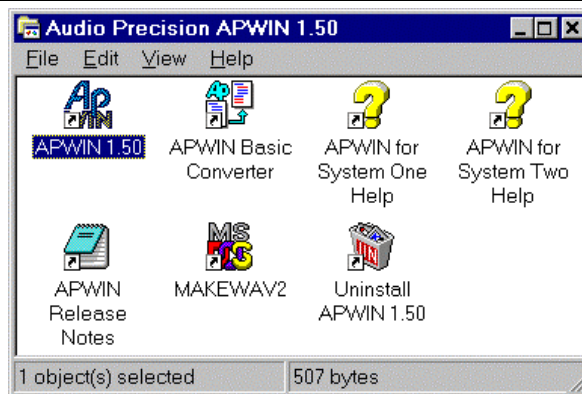


Figure 6-1. APWIN directory window

To start APWIN, simply double click on the APWIN 1.5 icon shown in Figure 6-1. 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 One or System Two. It is able to automatically identify System One or System Two and may, dependent on the configuration, ask you to choose which System to set up for.

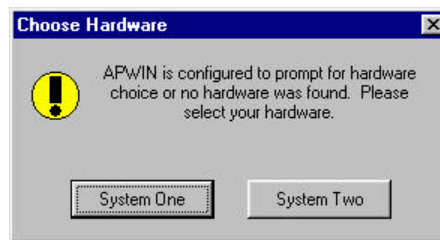


Figure 6-2. Choose Hardware window

(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

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 6-3):

Navigate to the S2 directory (folder) using the normal Windows method. If you installed APWIN with the default file locations, you should find it under the APWIN directory. Double click on the System2.apb procedure. This will then open the Procedure window. At the top of this window will be the Procedure tool bar shown in Figure 6-4 (which may also be at the top or side of the APWIN desktop if you have this tool bar turned on).

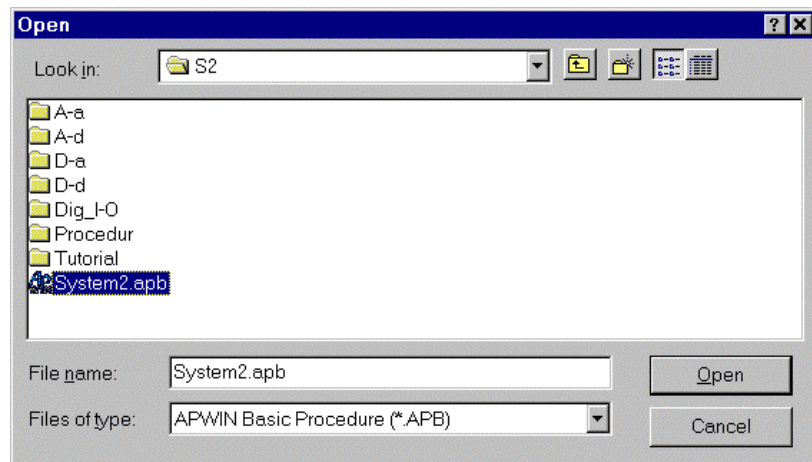


Figure 6-3. Windows 95 File Open dialog box



Figure 6-4. 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:

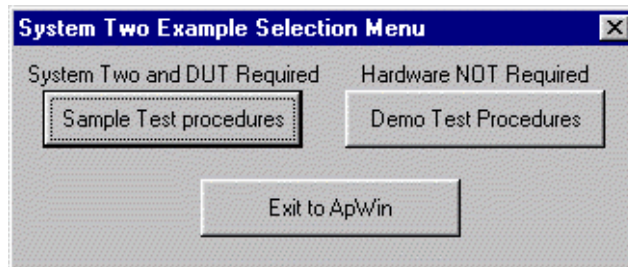


Figure 6-5. System Two Example Selection Menu window

You can now select from two groups of procedures: Demo Test Procedures includes stored sample data and can be used without a device under test connected (and even without a System 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 following menu box should appear.

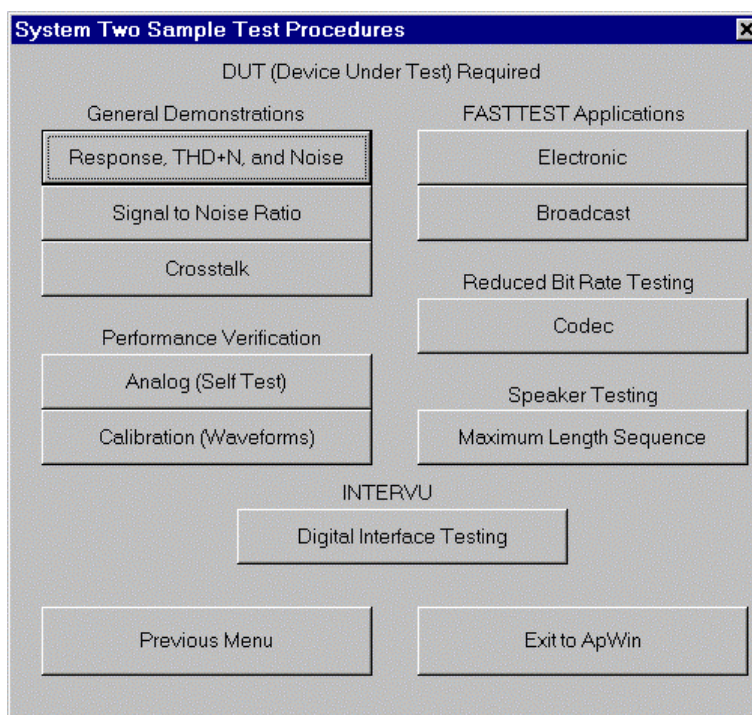


Figure 6-6. System Two Sample Test Procedures window

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

6.1.1 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.

6.1.1.1 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:

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

(this will actually be all on one line)

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

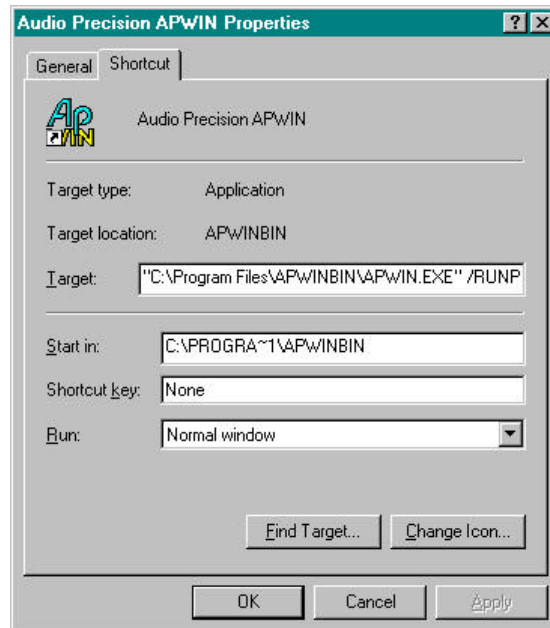


Figure 6-7. APWIN Properties dialog box

The above examples illustrate the use of command line parameters and switches to automate or control the starting of APWIN. Section 6.1.1.3 lists and describes all of the available command line options and switches.

6.1.1.2 Windows 3.11

To start any Windows 3.11 program from the DOS prompt, type WIN followed by the Windows file name. This will automatically start Windows and launch the specified program. If this line is the final one in the AUTOEXEC.BAT file, the complete start up will be automated. As an alternative, the program to be launched can be put in the STARTUP group. Then every time Windows is started, the specified program will launch.

Here is a syntax example. Put the following lines at the end of your AUTOEXEC.BAT file:

```
CD\APWINBIN
WIN APWIN.EXE /RUNPRO C:\APWIN\S2\SAMPLES\SYSTEM2.APB
```

These commands will launch Windows, launch APWIN, load the procedure SYSTEM2.APB and run this procedure. The sample procedure used in this example presents the user with a series of buttons forming menu choices. Replace the path and filename reference in the example above with your particular procedure name. Section 6.1.1.3 lists and describes all of the available command line options and switches.

6.1.1.3 Command Line Options and Switches

Syntax:

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

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

Where

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

TESTNAME.AT2 is any valid System Two test file. When specified on the command line, this test file will be loaded with APWIN.

PROCEDUR.APB is any valid procedure file. When specified on the command line, this procedure file will be loaded with APWIN.

DATAFILE.ADA is any valid APWIN data file. When specified on the command line, this data file will be loaded with APWIN.

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

OPTIONS are any of the following:

s1 forces APWIN to be configured for System One

s2 forces APWIN to be configured for System Two

no logo 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
```

6.2 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 following dialog box:

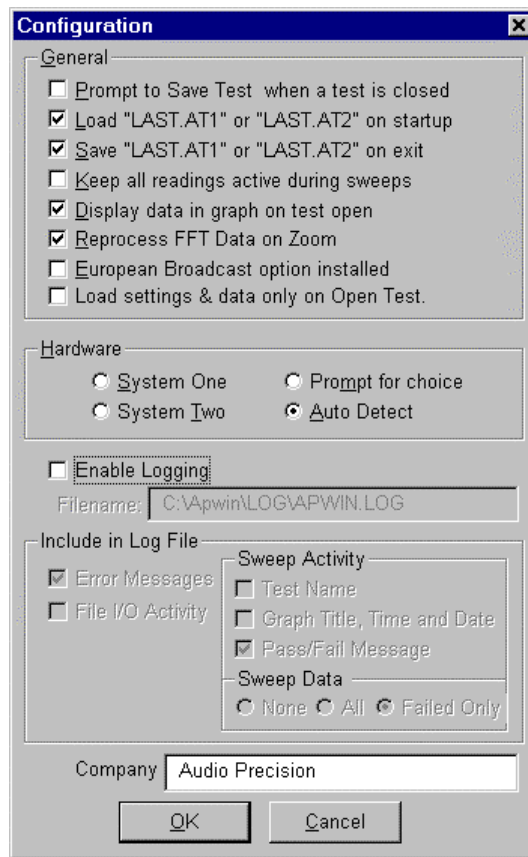


Figure 6-8. Configuration dialog box

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

If the System One or System Two 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 of System One and System Two should have a CONFIGURATION label that will identify the presence of the EURZ option.

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

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

6.3 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.

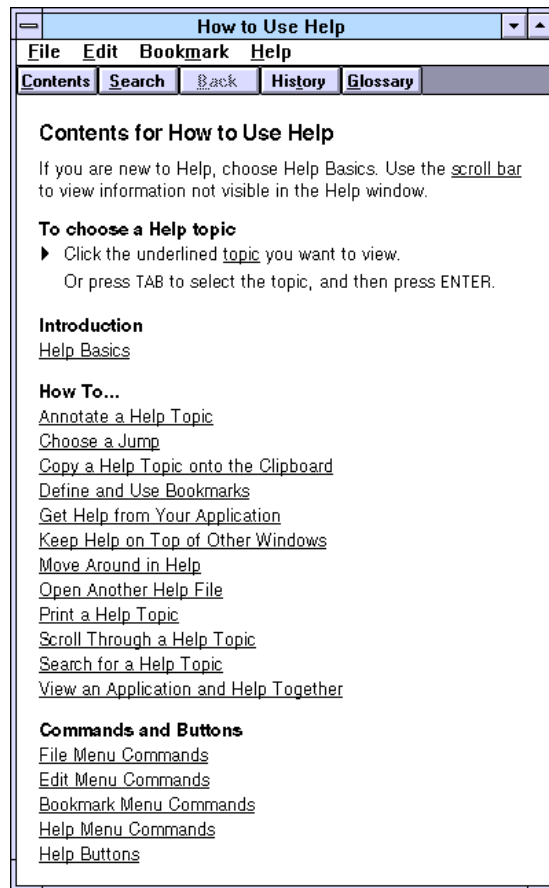


Figure 6-9. Windows 3.11 How to Use Help screen

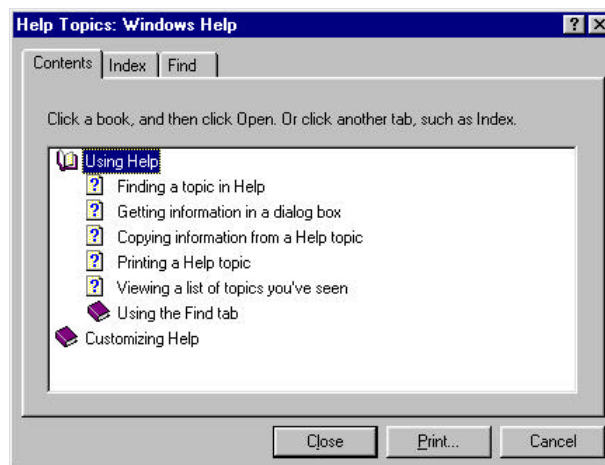


Figure 6-10. Windows 95 Windows Help screen

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

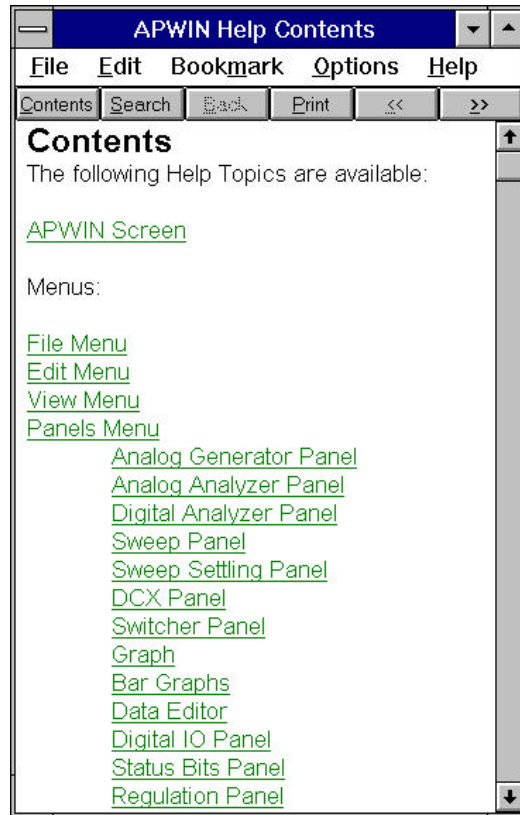


Figure 6-11. APWIN Help Contents screen

6.4 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.

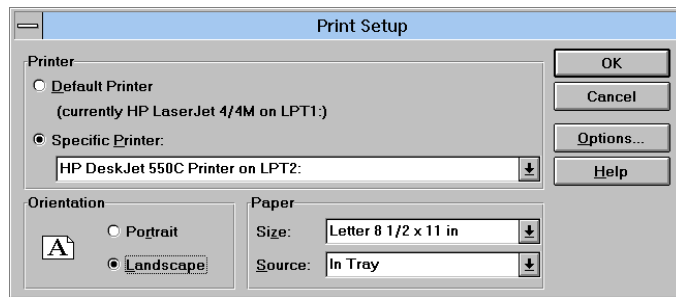


Figure 6-12. Printer Setup dialog box

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 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.*

6.5 Compatibility with S1.EXE

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

APWIN uses a scripting language based on Visual Basic that 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.

Coupling this capability with Learn Mode provides a fast and error-free method to create or augment a procedure. The user only needs to enable Learn Mode via the Procedure menu or tool bar selections, and manually go through the test scenario to create a test procedure.

6.5.1 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.

6.5.2 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.

6.5.3 S1.EXE Utility Programs

The MAKEWAVE utility has been modified into MAKEWAV2 for use with APWIN. This continues to be a DOS program but can be run under Windows and shows up as an icon in the APWIN program group. This program and its icon are automatically installed by the APWIN installation utility.

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.

6.6 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. (This feature is not available in Windows 3.11.)

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.

7. Maintenance and Troubleshooting

7.1 Error Messages Displayed when Loading APWIN

Cannot find WW_OA232.DLL

APWIN is a 32-bit application. Microsoft Windows 3.11 is a 16-bit operating system. By adding an extension called WIN 32S to the Windows 3.11, it is able to run 32-bit applications. The APWIN installation program automatically checks to see if WIN 32S version 1.30 is present on the machine and, if not, requests that it be installed. For WIN 32S to take effect after this installation, the computer must be restarted. The setup program will automatically do this but gives the user the option of not restarting. If APWIN is started with first restarting the computer (after just completing the installation) this message will appear.

If a version of WIN32S lower than 1.30 is present or if WIN 32S is inadvertently removed at some future time or some other change is made to the Windows installation that causes WIN 32S to not be present, this message will appear. Reinstall WIN32S by using the WIN32S installation disks supplied with APWIN.

Could not find an ISA-WIN or PCM-WIN APIB Interface Card. Will run in DEMO mode

APWIN requires an Audio Precision Windows-type interface card to communicate with System One or System Two. An ISA card for a desktop computer or a PCMCIA interface card for a notebook computer is shipped with every copy of APWIN. This card needs to be installed in the computer. APWIN can be run without such a card but all functions requiring the hardware will not function. That is, it will not be possible to receive live readings from the system or to set the generator. However, it is possible to load previously stored data, modify graph appearances, print graphs, and other activities not requiring hardware.

Found a non-WIN APIB card. This program requires an ISA-WIN or PCM-WIN card to function. Will run in DEMO mode.

The following Audio Precision interface cards will generate this message:

PCI-1, PCI-2, PCI-3, ISA-DOS, and PCM-DOS.

These cards do not have support for APWIN and are designed for DOS software such as S1.EXE and LIB-C.

**System One not properly installed or not powered on.
Will run in DEMO mode.**

This message will appear if a correct interface APIB card is present and if any of the following conditions are true: System One not connected, System One not powered on, System One internal interface defective, APIB interface cable defective.

**System Two not properly installed or not powered on.
Will run in DEMO mode.**

This message will appear if a correct interface APIB card is present and if any of the following conditions are true: System Two not connected, System Two not powered on, System Two internal interface defective, APIB interface cable defective.

**Win32s - Error
Unhandled Exception detected
Application will be terminated**

This message can be caused by not loading the Share program in Windows 3.1 or the Vshare program in Windows 3.11. If you are running Windows 3.1, use an ASCII editor to look at your AUTOEXEC.BAT. You should find a line: share. (There may be a path reference before share). This will run the share.exe program at boot time. If this line is missing, look to see if the share.exe program is on your computer. It will most likely be in DOS subdirectory. Add the following line to your AUTOEXEC.BAT to run this program. For example, if share.exe is in the dos directory, the line would look this:

C:\dos\share

If you are running Windows 3.11, vshare should have been automatically installed with Windows. Look in your SYSTEM.INI file under the heading [386Enh] for the line: device = vshare.386. If the line is missing, add it and be sure that the file vshare.386 is in your WINDOWS/SYSTEM subdirectory.

7.2 PCMCIA difficulties

See Appendix B and C for descriptions on how to install and troubleshoot PCMCIA installations in Windows 3.11 and Windows 95. If the PCMCIA installation seems to be operating correctly but the software is not communicating with System One or Two you may have an address space conflict. You can determine if the PCMCIA installation is functioning correctly by noting the messages during boot time to verify that Card and Socket Services has loaded correctly. Then when the PCM-WIN card is inserted, Windows should indicate this with a series of beeps. Finally, when APWIN is started, it will look like some communication has been established with System One or Two but control and readings will be erratic and unstable. Most likely Card and Socket Services has put the PCM-WIN card at an address location that is shared by some other device. To prevent this from happening, reserve the four addresses that the PCM-WIN interface could take to prevent anything else overlapping this area. If you are using the Award CardWare Card and Socket Services (as described in Appendix B and C), locate the CARDWARE.INI file. Using an ASCII editor locate the [Resources] section and add the following lines:

```
; The following four lines reserve four base  
; address (238, 298, 2B8, 2D8) plus an  
; additional seven consecutive address for  
; each base address that the Audio Precision  
; PCMCIA card can use to communicate with  
; System One or System Two related hardware.  
I/O=0x238,0x8,E,8  
I/O=0x298,0x8,E,8  
I/O=0x2b8,0x8,E,8  
I/O=0x2d8,0x8,E,8  
; End of Audio Precision changes.
```

This will reserve all possible address locations for the PCM-WIN card to prevent possible conflicts.

7.3 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: 1-800-231-7350
- 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:

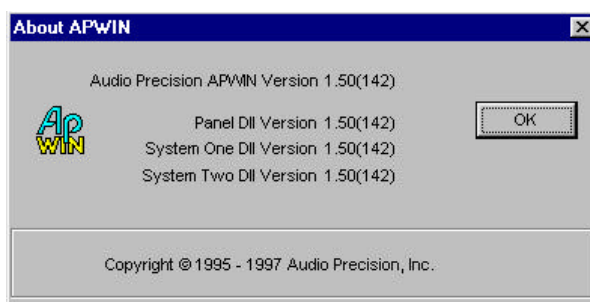


Figure 7-1. About APWIN window