System Two GPIB Option
Decription and Installation Manual

Audio precision

System Two – GPIB Option
Description and Installation Manual

Audio precision®

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

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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 4.2.3 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.

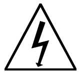
The International Electrotechnical Commission (IEC 1010-1) requires that measuring circuit terminals used for voltage or current measurement be marked to indicate their *Installation Category*. The Installation Category is defined by IEC 664 and is based on the amplitude of transient or impulse voltage 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.

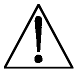
This product contains a lithium battery. Dispose only in accordance with all applicable regulations.

This product is for indoor use – pollution degree 2.

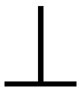
Safety Symbols



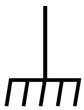
WARNING! – This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.



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 describes several basic hardware considerations for installing the components, such as power line voltage settings, fuse information, and GPIB control interface setup.
- It contains full specifications for the System Two, including its options and ancillary components (switchers, etc).

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

1.2 Related Documentation

- **System Two GPIB Programmer's Reference Manual**- contains detailed programming information about instrument control and acquisition via the IEEE-488 GPIB interface. This manual is provided only as part of the System Two GPIB Software Developer's Kits (S2G-DEV-ISA, S2G-DEV-PCM, and S2G-PROG), it is not a standard accessory with the System Two GPIB option.
- **APWIN version 1.52a User's Manuals** (User's Manual, Tutorial, Basic User's Manual and Programmer's Reference)
- **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 with the GPIB option is a 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 may be controlled through its GPIB interface port by user-defined software and GPIB controller interface, or 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).

GPIB interface setup and APIB cable connections are described in Section 2.

Specifications for the System Two and its accessories are found in Section 3.

1.3.2 System Two

System Two audio test equipment provides stimulus and measurement capability. System Two is 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.

These analog options may be installed in your System Two:

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

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

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

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

1.3.3 GPIB Option

System Two with GPIB option supports all of the System Two configurations as well as the SWR switchers and the DCX-127 Multi-function Interface. No accessories are provided with the instrument. A

GPIB Programmer's Reference manual is supplied with optional software development kits only.

1.3.4 Optional Software Development Kits

Three optional software development kits are available from Audio Precision to simplify the process of developing application software to control the instrument.

Two software development kits, S2G-DEV-ISA and S2G-DEV-PCM, are available from Audio Precision which provide APIB interfacing capability. Each kit provides one of two types of APIB interface cards for a PC compatible computer, APWIN software and documentation, GPIB Programmer's Reference Manual, and GPIB sample software. All of the software and PDF versions of the manuals are provided on a System Two GPIB CD ROM. The S2G-DEV-ISA provides an APIB interface card and cable for the ISA computer bus. The S2G-DEV-PCM provides a PCMCIA card with cable for computers with PCMCIA type II interfaces.

A third optional software development kit, S2G-PROG, provides only the System Two GPIB CD ROM and the GPIB Programmer's Reference Manual.

1.3.5 Switchers

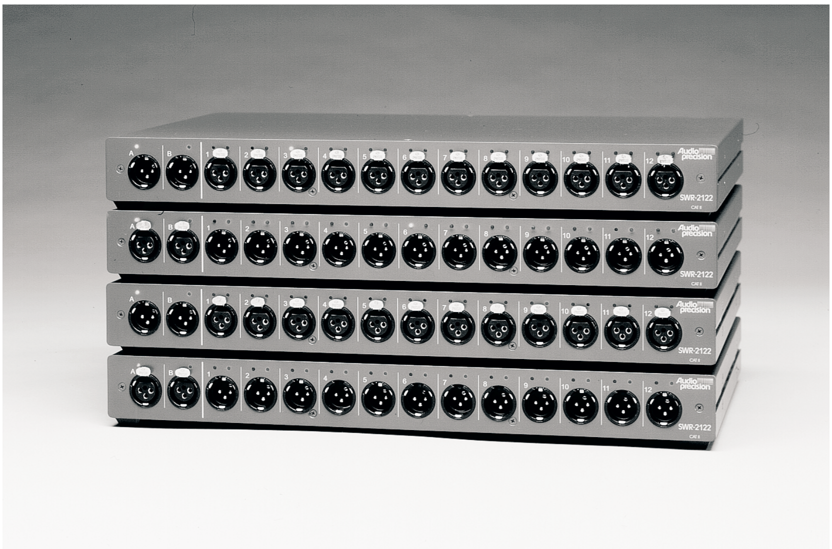


Figure 1-1. SWR-2122 Switchers

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.

- 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.

1.3.6 DCX-127 Multi-Function Module

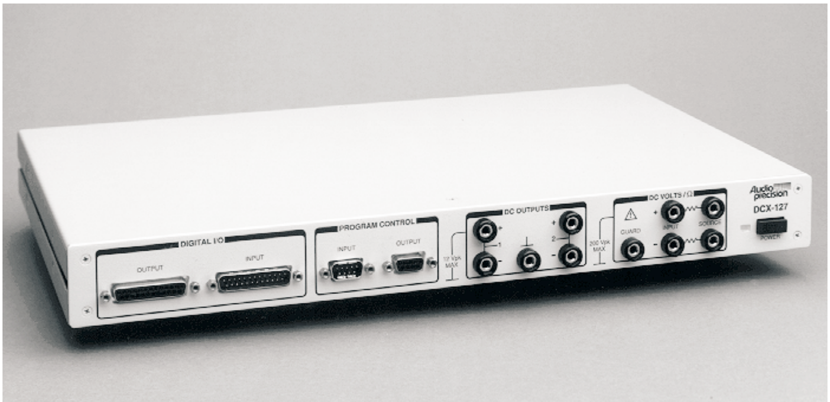


Figure 1-2. DCX-127 Multi-Function Module

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

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

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

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

Refer to Section 3.12 for DCX-127 specifications.

1.3.7 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 3.13 for SIA-2322 specifications.

2. The GPIB Software Development Process

A practical working knowledge of System Two is required in order to develop effective GPIB software for it. Figure 2-1 illustrates a typical software development scenario in which Audio Precision APWIN software is used to develop expertise with the System Two before attempting to integrate the instrument into a larger system with your GPIB interface software programs.

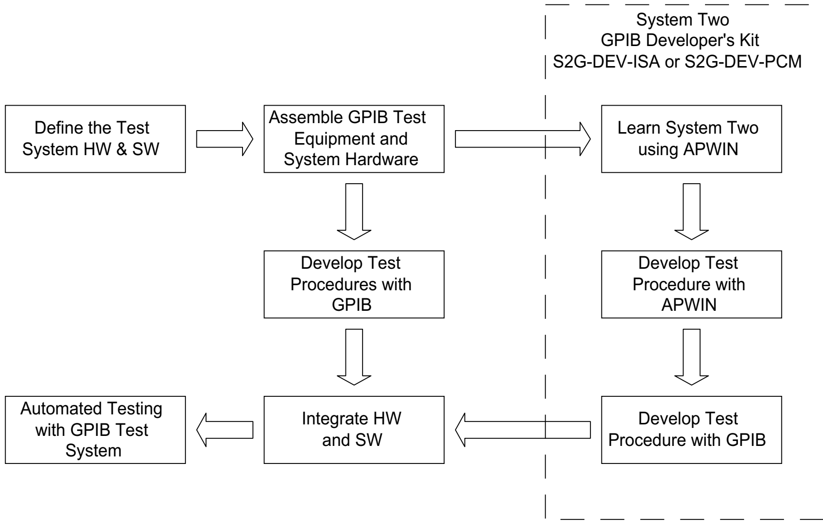


Figure 2-1. Recommended GPIB software development process using APWIN

Audio Precision provides two software developer's kits that provide everything you need to begin developing audio tests for the System Two: the S2G-DEV-ISA and the S2G-DEV-PCM. Both of these kits provide an APIB interface for your computer, the APWIN manuals and this manual, and a CD ROM with the APWIN software and GPIB Sample Software for the System Two. APWIN software provides the interactive "front panel" for System Two. APWIN is designed to run on WIN 95, WIN 98, or Win NT 4.0 with an interface card that interfaces to the APIB port connector of the System Two. The GPIB programming commands for System Two are modeled directly on the APWIN user interface, thus knowledge of the APWIN user interface is a prerequisite for efficient use of the GPIB commands.

The fastest development scenario for GPIB software involves using APWIN with SystemTwo. Use APWIN Basic and the Learn Mode button on the tool bar to develop APWIN Basic procedures that perform the tests you wish to develop for GPIB. If you use APWIN to develop your audio tests you will quickly learn how to take the best advantage of System Two. With the interactive environment of APWIN you will quickly develop test methods for your device under test and build confidence that your methods are correct. Once you have done this, the task of developing equivalent code for the GPIB port will be greatly simplified.

The command description sections of the GPIB Programmer's Reference manual show APWIN control panels for each of the major subsections of the instrument. Each panel is illustrated with GPIB command call-outs to help you convert your APWIN setup to GPIB commands. Figure 2-2 illustrates this for the Analog Analyzer panel.

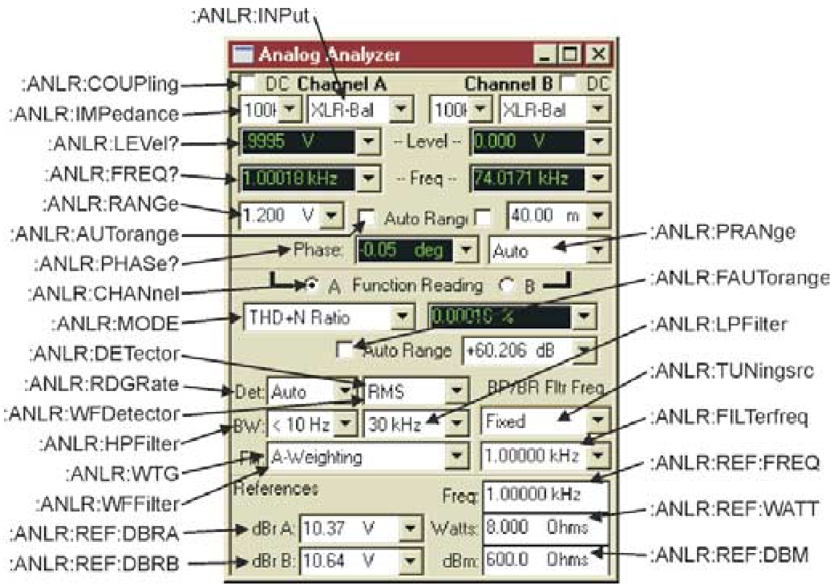


Figure 2-2. APWIN Analog Analyzer Panel with GPIB Command Call-outs

2.1 GPIB and APIB Control Modes for Software Development

Your SystemTwo with GPIB option installed has an APIB port and a GPIB port on the rear panel. The rear panel switches provide a means to configure either port to be used to control the instrument. During the software development process you may switch between the two modes in order to take advantage of the interactive development environment of APWIN.

Only one port may be used as the control port. The red LED on the rear panel labeled GPIB adjacent to the GPIB connector indicates which port is in control. If it is ON then it indicates that the GPIB port is in control and the APIB controller card in your computer must be disconnected from the APIB port on the instrument. Note that the instrument uses the APIB port to control other APIB products from Audio Precision. Figure 2-3 illustrates how to connect these products to the System Two when the GPIB port is the control port. Figure 2-4 illustrates ho to connect an APIB controller in a computer to this system when the GPIB port is disabled.

Only one APIB port is provided on the System Two when the GPIB option is installed. If additional instruments are required, such as the SWR switchers or the DCX-127, their APIB ports must be connected to the one APIB connector on the System Two by connecting each unit to the next in daisy-chain fashion. This will leave the last instrument in the chain with an unused APIB port. This port may be connected to the APIB interface card in the computer when it is desired to use the APWIN software to control the instrument system. The System Two must be placed in the APIB control mode when used in this configuration and must not be in the GPIB control mode or a bus conflict will result. APWIN will behave erratically if this occurs.

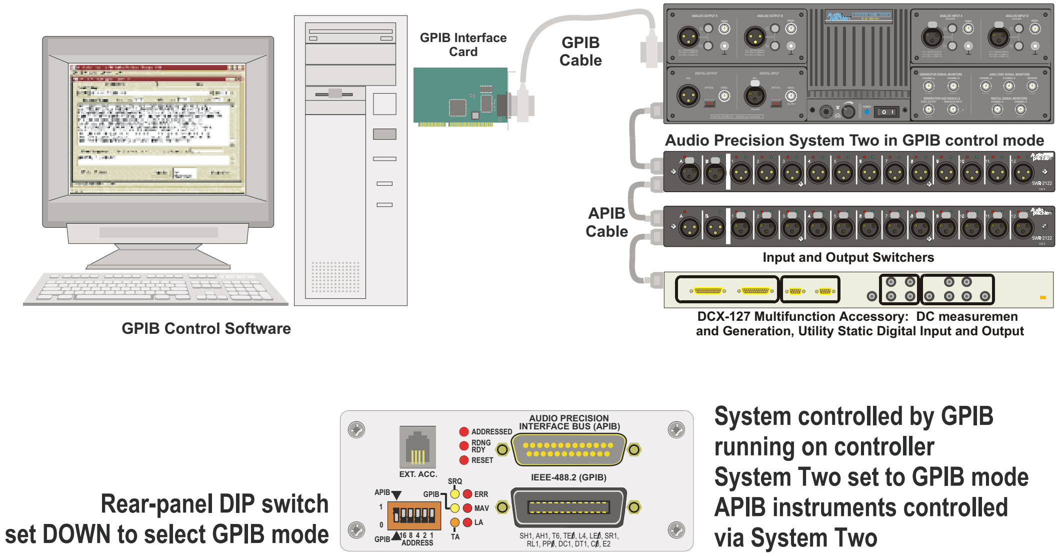
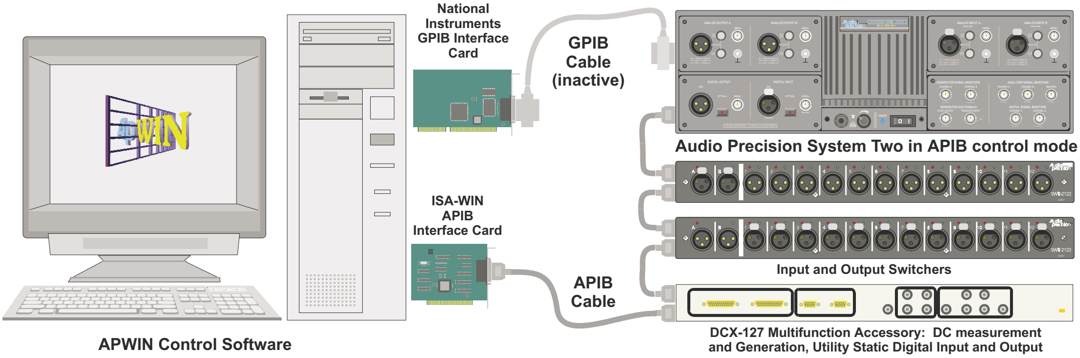


Figure 2-3. APIB connections to System Two with GPIB option in GPIB control mode. SWR-2122 Switcher and DCX-127 connected to the APIB connector of the System Two. Computer APIB cable not connected.



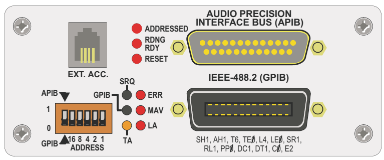


Figure 2-4. APIB controller connections, System Two with GPIB option in APIB control mode. Computer APIB cable connected to DCX-127, then to SWR-2122, then to System Two.

2.2 Establishing GPIB Communication

2.2.1 GPIB Connection

The System Two with GPIB option installed has a 24-pin GPIB-compatible connector on the rear panel. This D-shell connector conforms to the mechanical requirements of IEEE-488.1-1987. The instrument is connected to the instrument controller via a GPIB cable. The instrument controller (a computer) must have a corresponding GPIB interface port. The GPIB cables are designed so they can be stacked if needed to connect multiple instruments into your GPIB system.

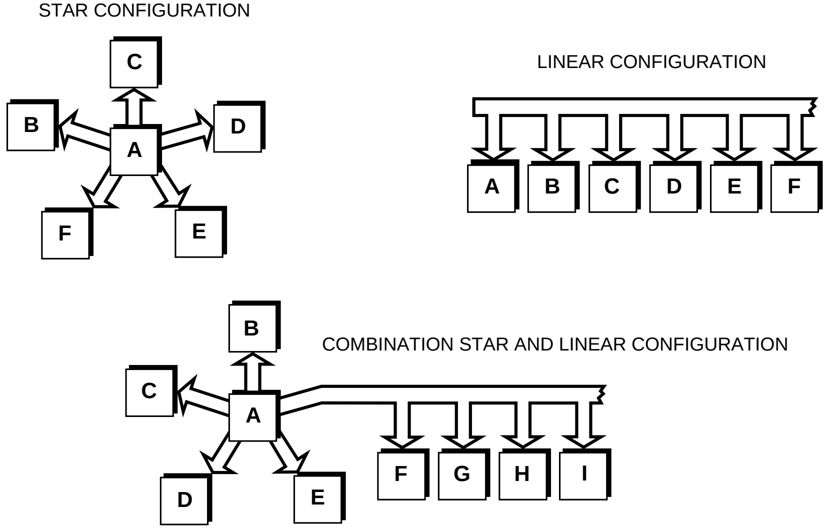


Figure 2-5. GPIB devices may be connected in star, linear, or combination star/linear configurations

When connecting instruments into a GPIB system, observe the following rules:

- Connect and disconnect instruments from the bus only when the power to all instruments in the system is off
- Assign a unique GPIB address to each instrument (device) on the bus
- Devices may be connected in a star or linear configuration (see Figure 1-5), or a combination of star and linear configuration
- Do not attach more than 15 devices (including the controller) to one bus
- One device must be attached to the bus for every two meters (6 feet) of cable

- Total cable length must not exceed 20 meters (66 feet)
- At least two-thirds of the devices on the bus must be powered up for operation

2.2.2 GPIB Address and I/O Mode Switch

The instrument must be set to a unique GPIB address, one that is not used by any other device on the bus.

An address select switch with six slide switches sets the GPIB address and the I/O Mode. The switch is shown below in Figure 2-6. The five switches on the right labeled 1 to 16 comprise the 5-bit binary primary address of the instrument. Legal addresses are 0 through 30. Set each switch up for a binary 1 or down for a binary 0.

The left bit of the select switch sets the I/O mode independent of the GPIB address switch settings. Set the switch to 0 (down) to set the I/O mode to GPIB. The APIB port must not be connected to an Audio Precision APIB interface card when the GPIB mode is selected. Set the switch to 1 (up) to set the I/O mode to APIB. The APIB mode disables the GPIB interface (high-impedance state) and permits an Audio Precision APIB interface card in a computer to control the System Two.

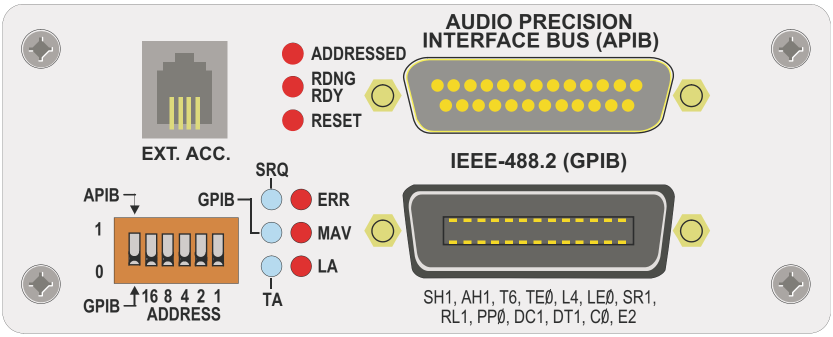


Figure 2-6. System Two Rear Panel Connector – Address Switch, Status LEDs, GPIB Port, and APIB Port

2.2.3 GPIB Status LEDs

The GPIB Status LEDs, indicate the current status of the GPIB bus. See Figure 2-6 above. Status indication is as follows when the LED is illuminated:

- SRQ The instrument has asserted the SRQ line in order to request service from the GPIB controller (SRQ interrupt).
- GPIB The instrument is under the control of the GPIB interface according to the setting of the I/O Mode switch. The APIB bus connector will be driven internally by the instrument GPIB interface board.
- TA Talk Addressed – The instrument is talk addressed by the GPIB controller.
- LA Listen Addressed – The instrument is listen addressed by the GPIB controller.
- MAV The instrument has one or more bytes in the output queue and has asserted the MAV bit in the Status Byte Register.
- ERR The instrument has detected an error condition that has not been reported to the system controller. This LED goes off when the error condition has been reported in response to the :ERRM? or :ERRS? error queries.

2.2.4 GPIB Program Message Terminators <PMT>

Two program message terminators are supported when the instrument is addressed as a listener: EOI line asserted with the NL character (ASCII 10, the linefeed character), or EOI line asserted with the last byte of a message. The NL character alone without EOI is not supported.

The program message terminator when the instrument is addressed as a talker is the NL character sent with the EOI line asserted.

3. System Two Specifications

3.1 Analog Signal Outputs

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

3.1.1 Analog Signal Generator

3.1.1.1 Low Distortion Sine Wave

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

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

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

3.1.2 Intermodulation Distortion Related Signals

with option "IMD"

3.1.2.1 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

3.1.2.2 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).

3.1.2.3 DIM (or TIM) Test Signals

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

3.1.3 Special Purpose Signals

with option "BUR"

3.1.3.1 Sine Burst

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

3.1.3.2 Square Wave

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

3.1.3.3 Noise Signals

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

3.1.4 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.

3.1.4.1 D/A Converter

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

3.1.4.2 Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

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

3.1.4.3 Stereo Sine Wave

Sine waves of independent frequency and amplitude on each channel

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

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

3.1.4.4 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

3.1.4.5 Shaped Sine Burst

Sine burst with raised cosine envelope (see graph in Section 3.5)

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

3.1.4.6 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)

3.1.4.7 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.

3.1.4.8 Maximum Length Sequence Signals

Pseudo-random noise signal for speaker testing with MLS analyzer

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

3.1.4.9 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)

3.1.5 "IMD" Related Signals

Digitally generated

3.1.5.1 SMPTE (or DIN) Test Signal

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

3.1.5.2 CCIF and DFD Test Signals

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

[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).

3.1.6 Output Characteristics

Source Configuration	Selectable balanced, unbalanced, or CMTST (common mode test)
Source Impedances	
Balanced or CMTST	40 Ω (±1 Ω), 150 Ω (±1.5 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

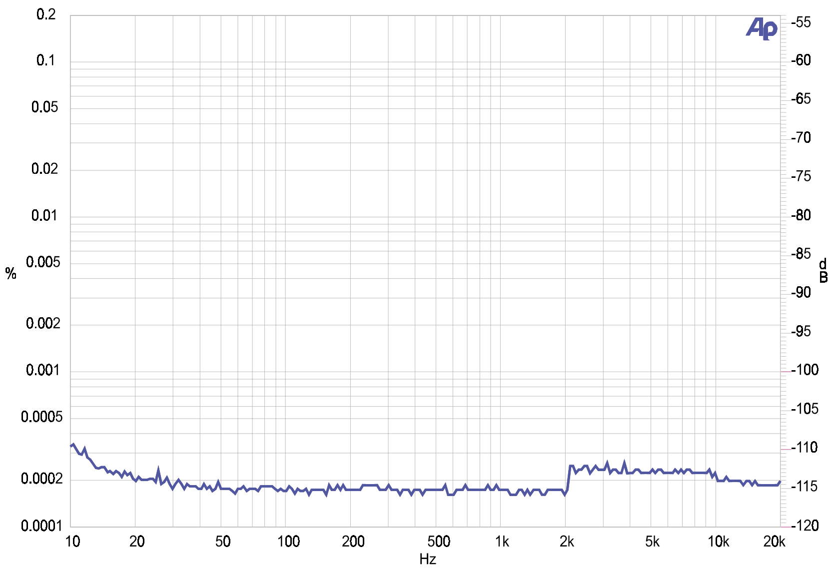


Figure 3-1. Typical total system THD+N versus frequency using analog sinewave at 2 Vrms

8 200Ω with option "EURZ"

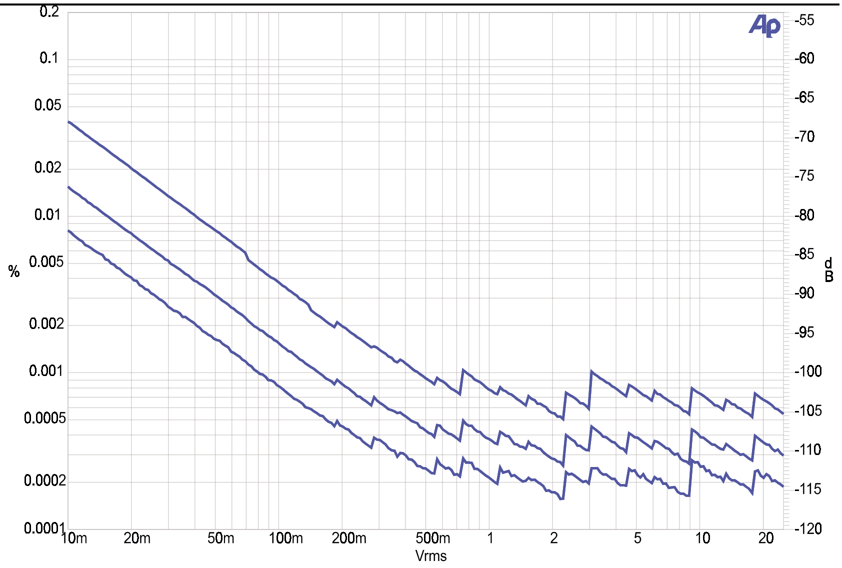


Figure 3-2. Typical THD+N versus Amplitude at 1 kHz for three different analog analyzer measurement bandwidths. Lower curve is with 22 kHz bandwidth limiting. Middle curve is with 80 kHz. Upper curve is with 500 kHz.

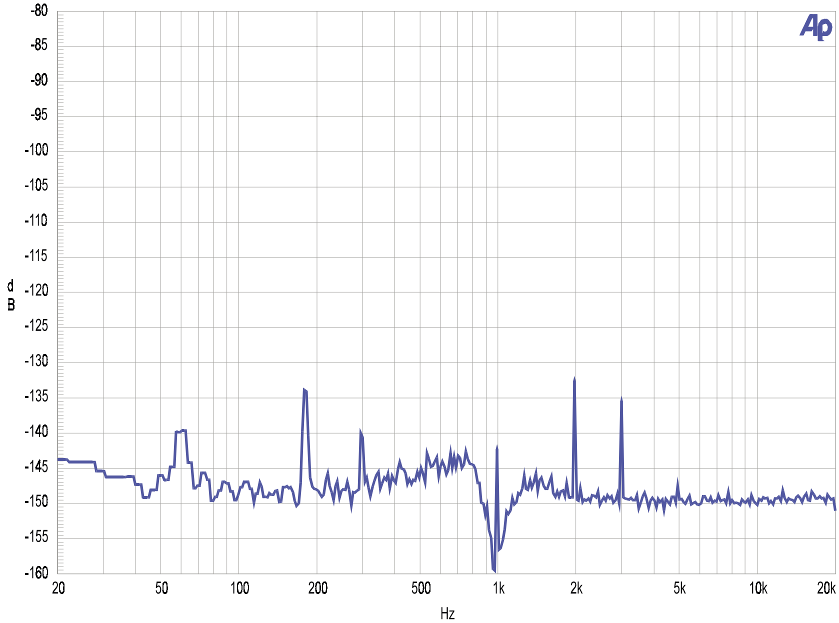


Figure 3-3. Typical analog generator residual THD+N spectrum at 1 kHz, 2 Vrms (16384 point FFT of notch filter output, Fs = 48 kHz, 16 averages)

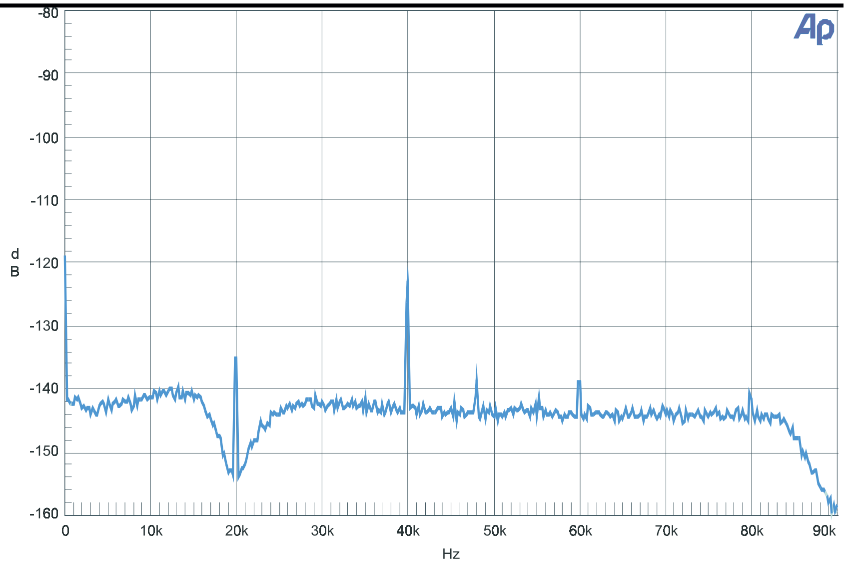


Figure 3-4. Typical analog generator residual THD+N spectrum at 20 kHz, 2 Vrms (16384 point FFT of notch filter output, Fs = 192 kHz, 16 averages)

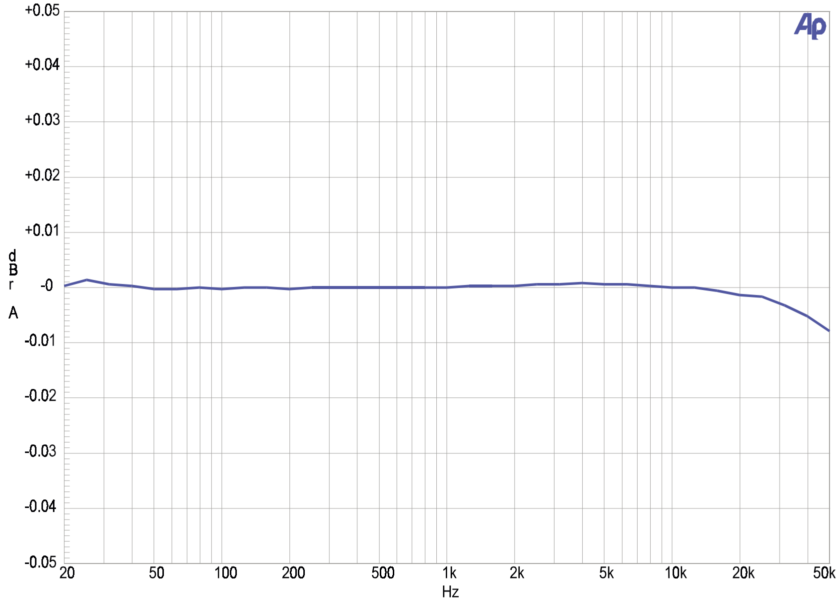


Figure 3-5. Typical analog System flatness at 2 V rms signal level

3.2 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.

3.2.1 Analog Input Characteristics

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

[9] Not valid below 50 Hz with ac coupling.

3.2.1.1 Level Meter Related

(both channels)

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

3.2.1.2 Frequency Meter Related

(both channels)

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

3.2.1.3 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 μV, using the 32/s reading rate). Numerical displays using a dB unit are rounded to the nearest 0.001 dB.

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

[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.

3.2.2 Wideband Amplitude/Noise Function

Measurement Range	<1 μV to 160 V rms
Accuracy (1 kHz)	±1.0% [±0.09 dB]
Flatness (1 kHz ref)[13]	
20 Hz–20 kHz	±0.02 dB
15 Hz–50 kHz	±0.05 dB
50 kHz–120 kHz	±0.15 dB
120 kHz–200 kHz	+0.2 dB/-0.3 dB (typically < -3 dB at 500 kHz)
Bandwidth Limiting Filters	
LF -3 dB	<10 Hz, 22 Hz per CCIR Rec 468, 100 Hz ±5% (3-pole), or 400 Hz ±5% (3-pole)
HF -3 dB	22 kHz per CCIR Rec 468, 30 kHz ±5% (3-pole), 80 kHz ±5% (3-pole), or >500 kHz
Optional Filters	up to 7 (see Section 3.3)
Detection	RMS (τ = 25 ms or 50 ms), AVG, QPk per CCIR Rec 468, Pk (pseudo-peak), or S-Pk (0.7071 x Pk reading)
Residual Noise	
22 Hz-22 kHz BW	≤1.0 μV [-118 dBu]
80 kHz BW	≤2.0 μV [-112 dBu]
500 kHz BW	≤6.0 μV [-102 dBu]
A-weighted	≤0.5 μV [-124 dBu]
CCIR-QPk	≤2.5 μV [-110 dBu]

3.2.2.1 Bandpass Amplitude Function

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

[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.

3.2.2.2 Bandreject Amplitude Function

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

3.2.2.3 THD+N Function

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

3.2.2.4 Crosstalk Function

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

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.

3.2.3 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.

3.2.3.1 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 to 750 Hz
Measurement Range	0-20%
Accuracy	±0.5 dB
Residual IMD[16]	≤0.0015%, 60 + 7 kHz or 250 + 8 kHz

3.2.3.2 CCIF and DFD IMD Functions

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

3.2.3.3 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.

3.2.4 Wow & Flutter Measurements

with option "W&F"

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

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

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

3.3 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.

3.3.1 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

3.3.2 Precision De-emphasis Family

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

3.3.3 Precision Sharp Cutoff Low-Pass Family

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

See also FLP-A20K under Miscellaneous

3.3.4 Bandwidth Limiting, Low-Pass

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

3.3.5 Bandwidth Limiting, High-Pass

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

3.3.6 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

3.3.7 Receiver Testing

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

3.3.8 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 3-6.

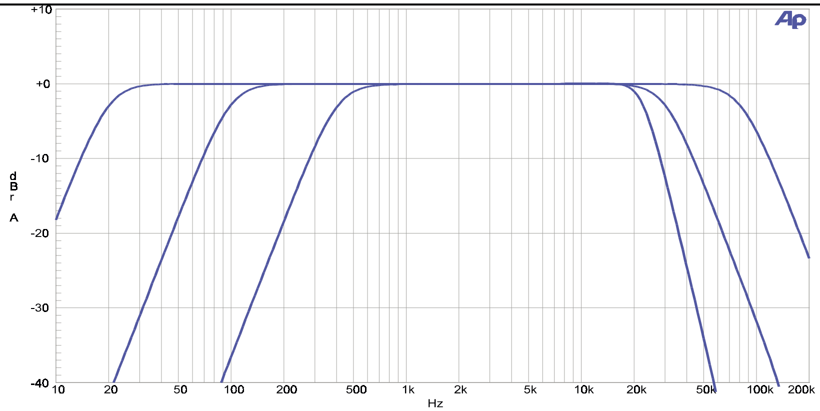


Figure 3-6. Standard Band-limiting filters included with every System Two. High pass selectable 22Hz, 100 Hz, 400 Hz; Low pass selectable 22 kHz, 30 kHz, 80 kHz.

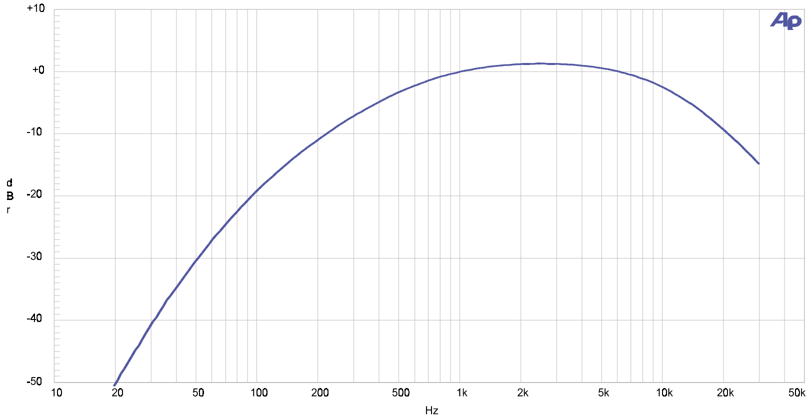


Figure 3-7. FIL-AWT ANSI-IEC "A" Weighting Filter

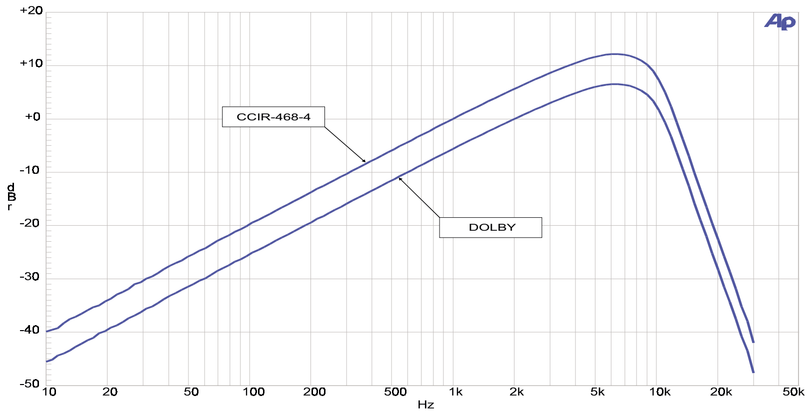


Figure 3-8. FIL-CCR CCIR-468 / DIN 45404 Noise Weighting Filter

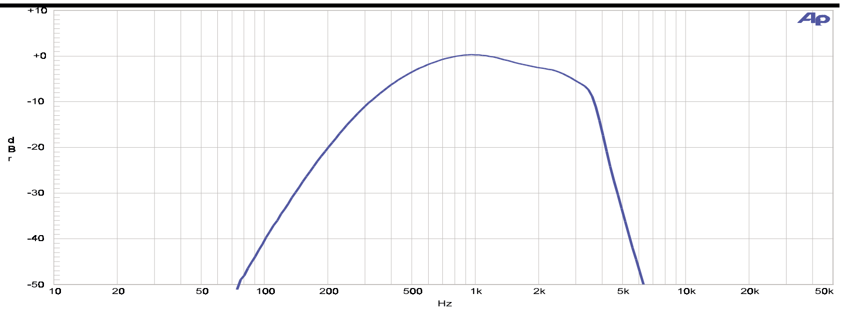


Figure 3-9. FIL-CIT CCITT P53 Noise Weighting Filter

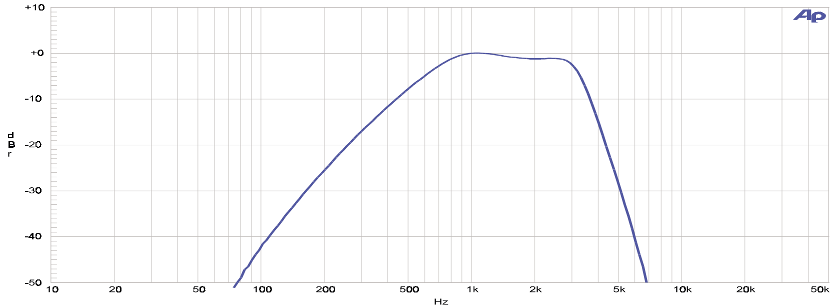


Figure 3-10. FIL-CMS C-Message Weighting Filter (ANSI/IEEE 743-1984)

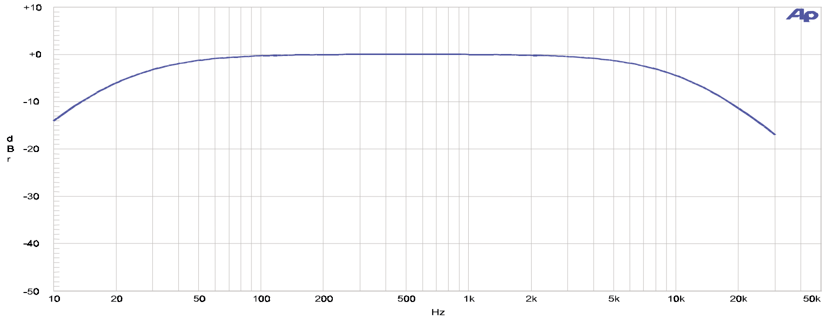


Figure 3-11. FIL-CWT "C" Weighting (IEC-179)

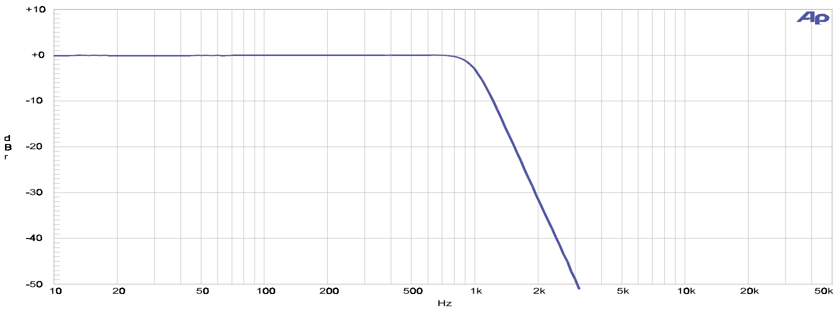


Figure 3-12. FLP-1K 1 kHz Low Pass 5-pole Butterworth Filter

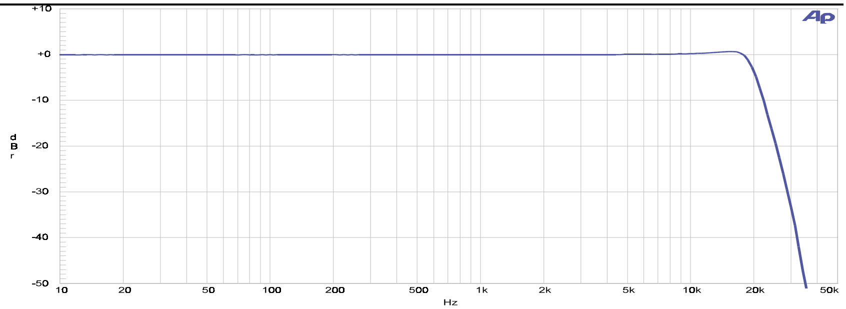


Figure 3-13. FLP-20K 20.0 kHz Quasi-elliptic sharp cutoff Low Pass Filter

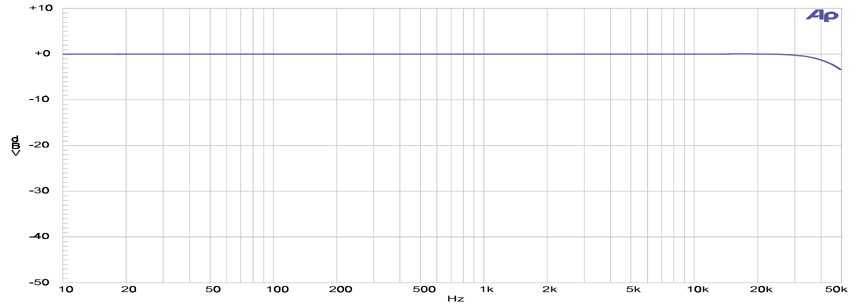


Figure 3-14. FLP-50K 50 kHz 3-pole Butterworth Low Pass Filter

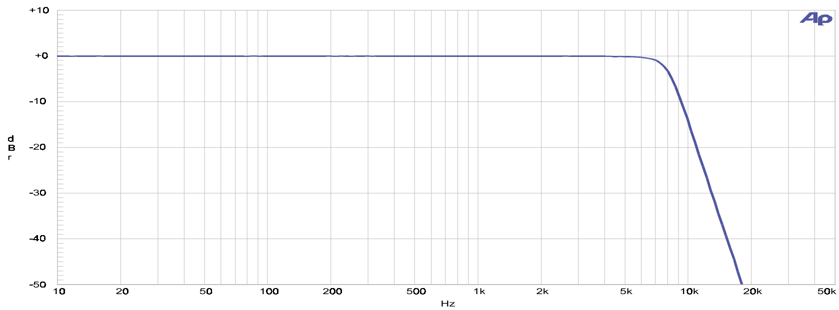


Figure 3-15. FLP-8K 8 kHz 7-pole Butterworth Low Pass Filter

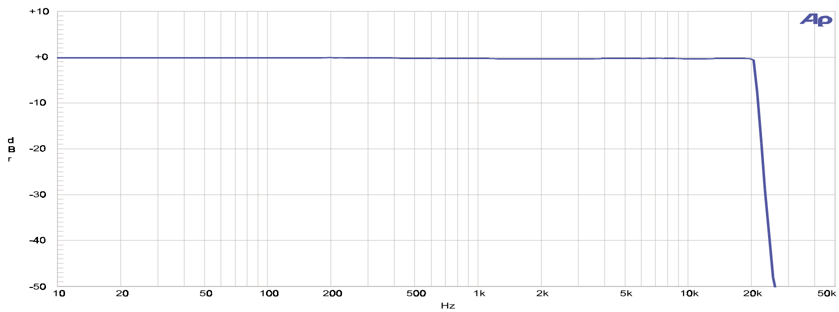


Figure 3-16. FLP-A20K Apogee "Brick-Wall" 20 kHz Low Pass Filter

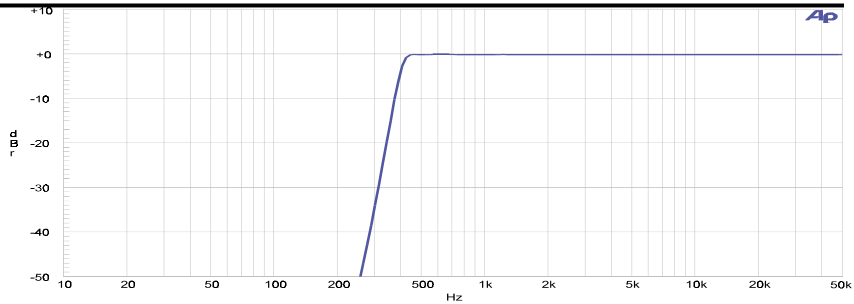


Figure 3-17. FHP-400 400 Hz 9-pole High Pass Filter

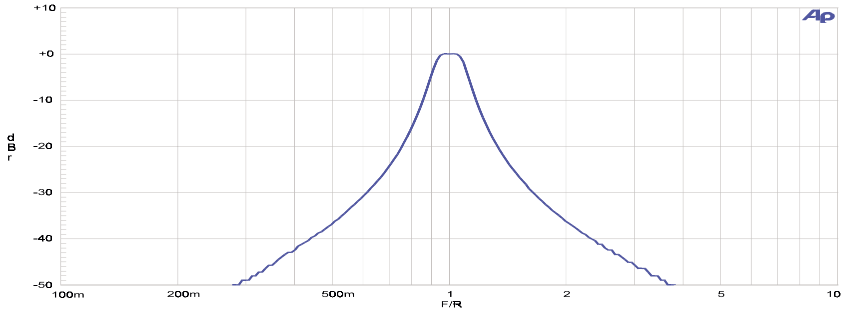


Figure 3-18. FBP-XXXX Fixed 1/3 Octave Band Pass Filter

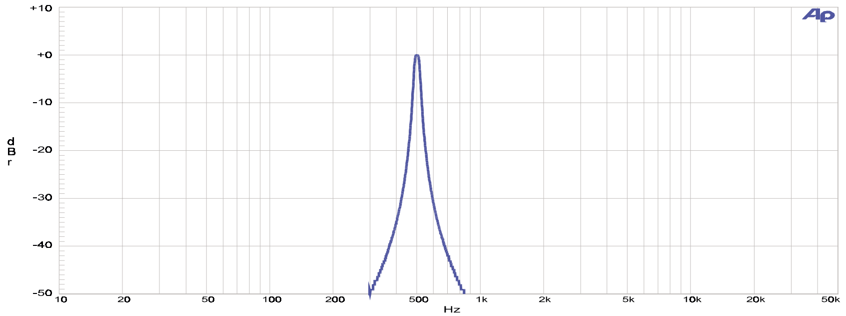


Figure 3-19. FBP-500X High-Q 500 Hz Band Pass Filter (for CD linearity testing)

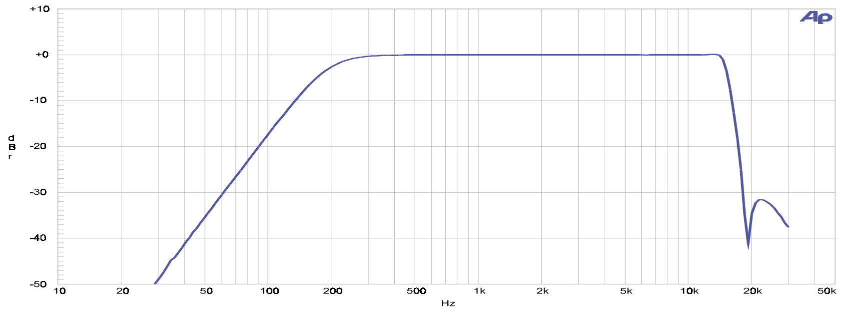


Figure 3-20. FIL-RCR 200 Hz to 15 kHz with 19 kHz (FM) notch Receiver Testing Filter

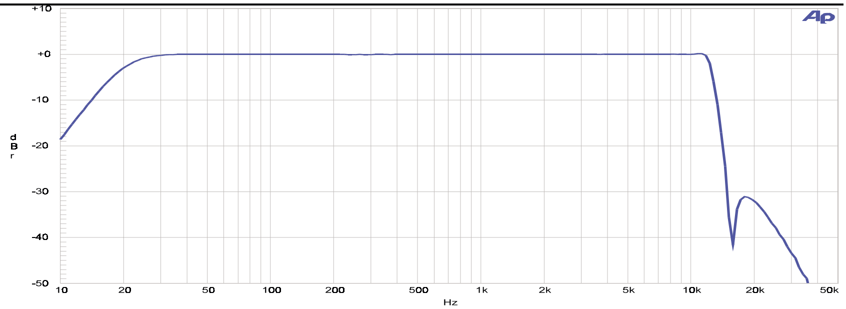


Figure 3-21. FIL-IECR 20 Hz to 15 kHz with 15.625 kHz (PAL) notch Receiver Testing Filter

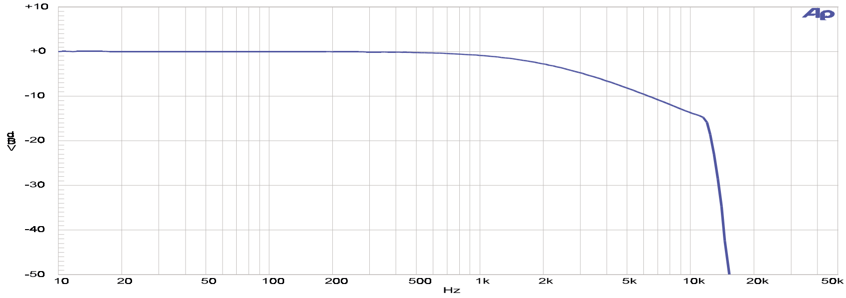


Figure 3-22. FIL-D75B 75 μs with 15.734 kHz (NTSC) notch De-emphasis Filter

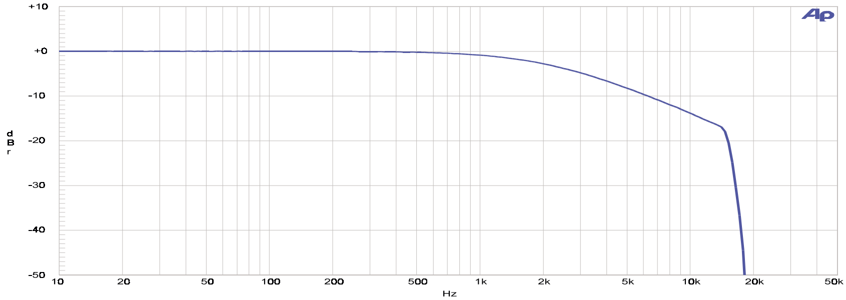


Figure 3-23. FIL-D75F 75 μs with 19 kHz (FM) notch De-emphasis Filter

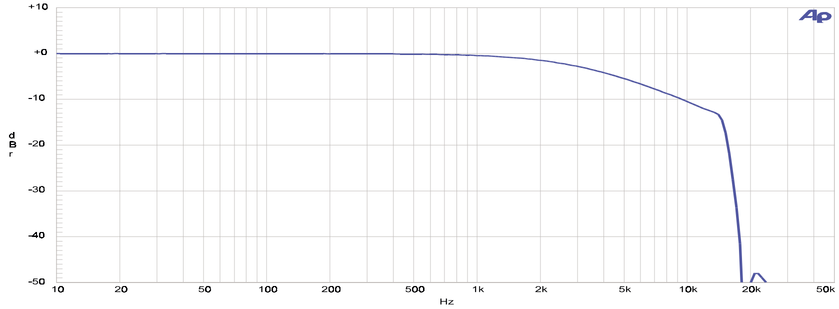


Figure 3-24. FIL-D50F 50 μs with 19 kHz (FM) notch De-emphasis Filter

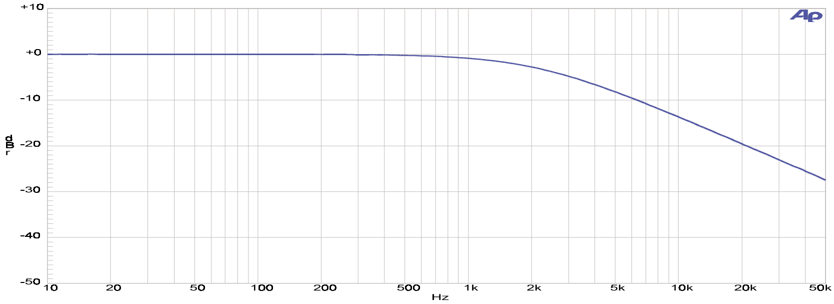


Figure 3-25. FIL-D75 75 μs De-emphasis Filter

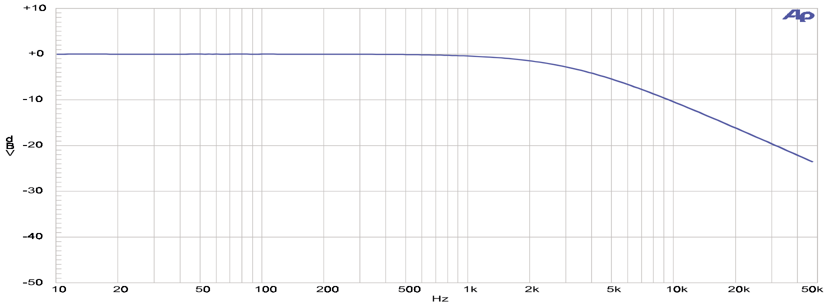


Figure 3-26. FIL-D50 50 μs De-emphasis Filter

3.4 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.

3.4.1 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)

3.4.2 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)

3.4.3 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 3-27)*	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.

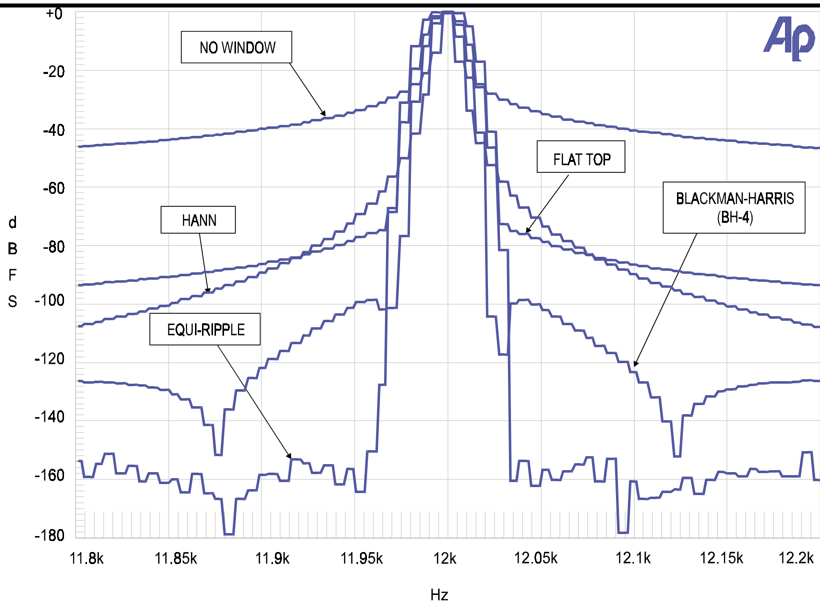


Figure 3-27. Windows available with FFT function

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

3.4.4 DSP Audio Analyzer

(“ANALYZER.AZ2”)

3.4.4.1 Wideband Level/Amplitude

Frequency Range	5 Hz–22.0 kHz at 48 k samples/s
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth 400 Hz, 10-pole elliptical *when not using notch filter or bandpass mode* (response is -120 dB for ≤220 Hz, ±0.1 dB for ≥400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass *both: 0.1dBpp ripple, ≥110 dB stopband attenuation*

Weighting Filters	ANSI-IEC “A” weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 “F” weighting corresponding to 15 phon loudness contour *(see Figure 3-28)*

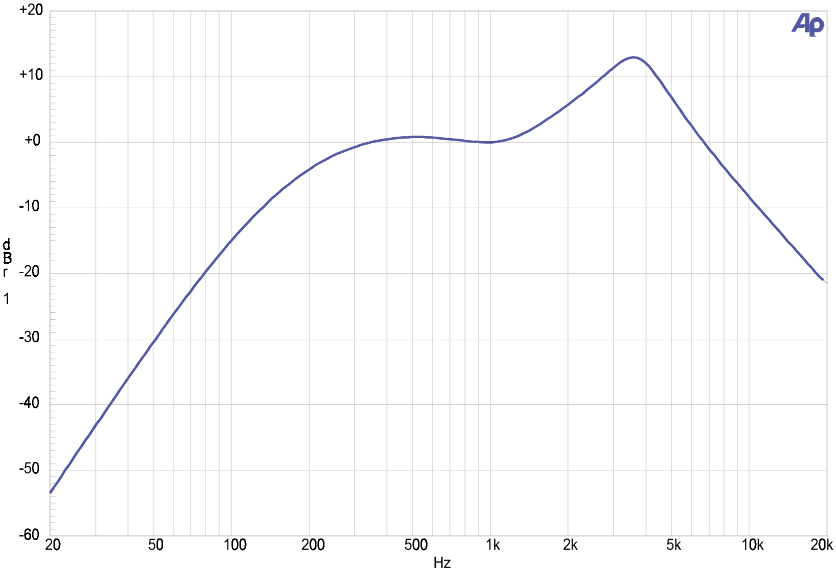


Figure 3-28. Digital Analyzer F-weighting curve

3.4.4.2 Narrow Band Amplitude

Frequency Range	0.02% to 40% of sample rate (10 Hz-19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see Figure 3-29)*

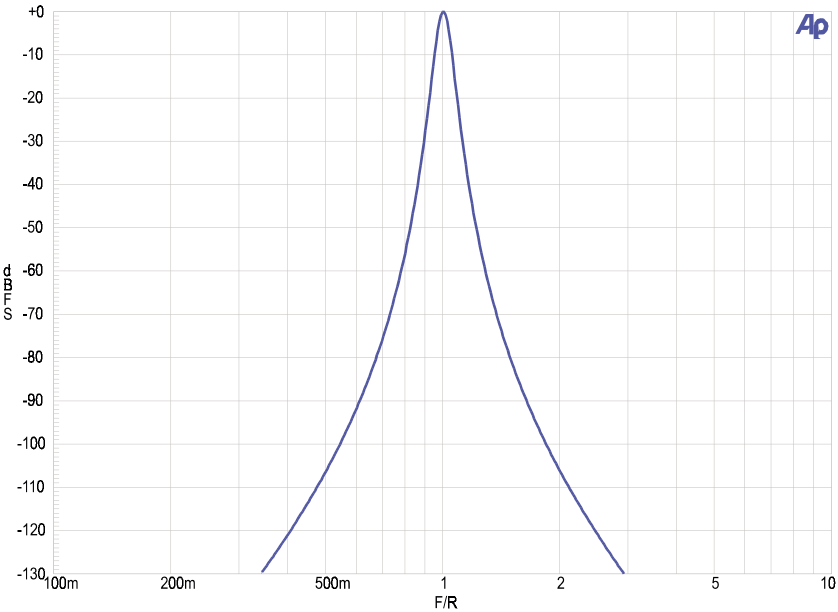


Figure 3-29. Digital Domain Band Pass filter response.

3.4.4.3 THD+N Measurements

Fundamental Range	0.02% to 45% of sample rate (10 Hz–22.0 kHz at 48.0 k samples/s
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth
Low pass Filters	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass *both: 0.1dBpp ripple, ≥110 dB stopband attenuation*
Weighting Filters	ANSI-IEC “A” weighting, per IEC Rec 179 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 “F” weighting corresponding to 15 phon loudness contour *(see Figure 3-28 on page 3-26)*

3.4.4.4 Frequency Measurements

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

3.4.5 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%

3.4.6 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

3.5 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.

3.5.1 Digital Output Characteristics

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

3.5.2 Digital Signal Generation

3.5.2.1 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]

3.5.2.2 Sine Burst

Sine burst with rectangular envelope

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

3.5.2.3 Variable Phase Sine Wave

Two sine waves, same frequency, independently settable phase

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

3.5.2.4 Stereo Sine Wave

Sine wave of independent frequency and amplitude on each channel

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

3.5.2.5 Dual Sine Wave

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

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

3.5.2.6 Sine + Offset

Sine wave plus a constant value

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

3.5.2.7 Shaped Sine Burst

Sine burst with raised cosine envelope (see Figure 3-30)

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

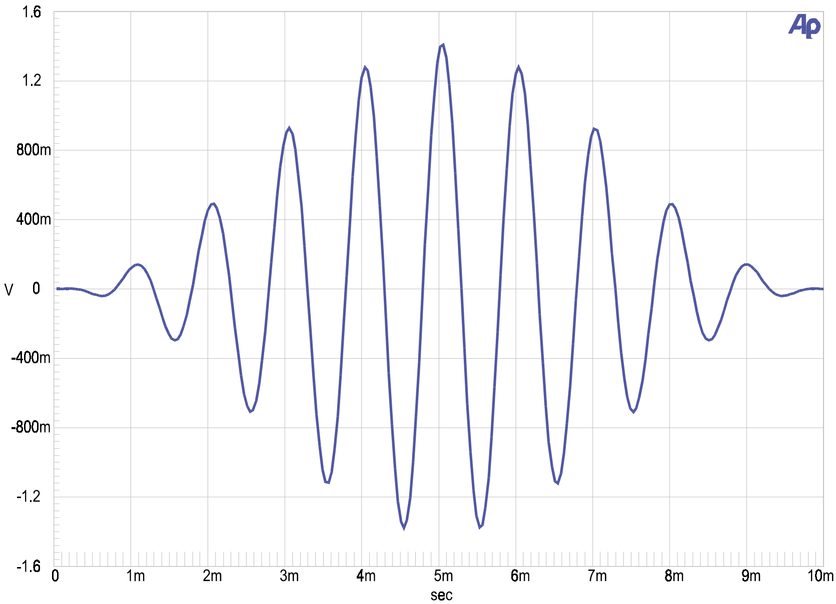


Figure 3-30. Shaped Sine Burst signal (1 kHz, 10 cycles)

3.5.2.8 Square Wave

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

3.5.2.9 SMPTE/DIN Waveform

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

3.5.2.10 CCIF and DFD IMD Waveforms

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

3.5.2.11 DIM IMD Waveform

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

3.5.2.12 Noise

Types	Pink, White, Burst, USASI

3.5.2.13 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

3.5.2.14 Maximum Length Sequence Signals

Pseudo random noise signal for speaker testing with MLS analyzer (Page 3-28)

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

3.5.2.15 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	≤0.00001% [-140 dB]

3.5.2.16 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.

3.5.2.17 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

3.5.2.18 Pre-Emphasis Filters (all waveforms)

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

3.6 AES/EBU Interface Generation

3.6.1 Interface Signal

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

3.6.2 AES/EBU Impairments

Variable rise/fall time	16 ns to 400 ns, ±20%
Induced Jitter	Selectable sinewave, squarewave lowpass noise, or wideband noise
Jitter Freq Range	10 Hz–99.864 kHz
Jitter Freq Accuracy	±0.0002% [±2 PPM]
Jitter Amplitude	0 – 1.27 UI (pk), ±(10% + 0.01 UI) in 0.005 UI steps 1.3 – 12.7 UI, ±(10%) in 0.05 UI steps[21]
Jitter Flatness (500 Hz ref.)	±1 dB, 50 Hz to 20 kHz
Residual Jitter, peak calibrated	(total generator/analyzer)
Average response	≤0.0175 UI (120 Hz-100 kHz BW), ≤0.0035 UI (1.2 kHz-100 kHz BW)
Peak response:	≤0.045 UI (120 Hz-100 kHz BW), ≤0.015 UI (1.2 kHz-100 kHz BW)

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

Spurious Jitter Products	
Jitter & Ref Delay Off	≤0.001 UI
Jitter On	≤-30 dB below jitter signal
Normal Mode Noise	
Balanced	0-2.55 Vpp, ±(10% + 100 mV), in 10 mV steps
Unbalanced	0-635 mVpp, ±(10% + 25 mV), in 2.5 mV steps
Common Mode Freq	20 Hz to 40 kHz in octave steps
Common Mode Ampl	0-20.48 Vpp, ±(10% + 200 mV), in 80 mV steps
Cable Simulation	Multi-pole fit to AES 3-1992 filter to simulate the response degradation of a typical long cable
Offset from reference	-64 to +63.5 UI

3.6.3 Reference Input Characteristics

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

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

3.6.4 Reference Output Characteristics

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

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

3.7 Digital Analyzer

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

3.7.1 Digital Input Characteristics

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

3.7.2 Embedded Audio Measurements

3.7.2.1 Wideband Level/Amplitude

("ANALYZER.AZ2")

Range	0 dBFS to -140 dBFS
Frequency Range	5 Hz–22.0 kHz at 48 k samples/s
Accuracy	±0.01 dB, ≥-90 dBFS
Flatness	±0.01 dB, 15 Hz-22 kHz, with <10 Hz high-pass filter selection
High pass Filters	<10 Hz, 4-pole Butterworth 22 Hz, 4-pole Butterworth 100 Hz, 4-pole Butterworth 400 Hz, 4-pole Butterworth 400 Hz, 10-pole elliptical *when not using notch filter or bandpass mode* (response is -120 dB for ≤220 Hz, ±0.1 dB for ≥400 Hz)
Low pass Filters	20 kHz 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see Figure 3-28 on page 3-26)*
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

3.7.2.2 Narrow Band Amplitude

("ANALYZER.AZ2")

Frequency Range	0.02% to 40% of sample rate (10 Hz–19.2 kHz at 48.0 k samples/s)
Filter Shape	10-pole, Q=19 (BW = 5.3% of f_o) *(see Figure 3-29 on page 3-27)*
Residual Distortion	≤-150 dBFS

3.7.2.3 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 3-31)*
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 *both: 0.1 dBpp ripple, ≥110 dB stopband attenuation*	20 kHz, 6-pole elliptic low-pass 15 kHz, 6-pole elliptic low-pass
Weighting Filters	ANSI-IEC "A" weighting, Type 0 CCIR QPk per CCIR Rec 468 CCIR RMS per AES 17 C-message per IEEE Std 743-1978 CCITT per CCITT Rec. P.53 "F" weighting corresponding to 15 phon loudness contour *(see Figure 3-28 on page 3-26)*
Residual Noise	Same as Wideband Level/Amplitude

3.7.2.4 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

3.7.2.5 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 3-27on page 3-25)*	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

3.7.2.6 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

3.7.2.7 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%

3.8 Digital Interface Measurements

3.8.1 AES/EBU Impairments, real time displays

Input Sample Rate	±0.0003% [±3 PPM] internal ref, ±0.0001% [±1 PPM] external ref
Output to Input Delay	Measures status propagation from the AES/EBU output to the input. Range is 0 – 192 samples (frames), resolution ±60 ns.
AES/EBU Input Voltage Balanced Unbalanced	 100 mV to 10.16 Vpp, ±(5% + 50 mV) 25 mV to 2.54 Vpp, ±(5% + 12 mV)
Jitter Amplitude (500 Hz) Average Mode Peak Mode	(peak sinewave calibrated) 0 – 5 UI, ±(10% + 0.015 UI) 0 – 3 UI, ±(10% + 0.040 UI)
Jitter Flatness	±1.0 dB, 100 Hz – 20 kHz (50 Hz – 100 kHz BW selection, average detection, 48 kHz sample rate)
Residual Jitter, peak calibrated (analyzer only) Average response Peak response	 ≤0.015 UI (120 Hz – 100 kHz BW), ≤0.003 UI (1.2 kHz – 100 kHz BW) ≤0.040 UI (120 Hz – 100 kHz BW), ≤0.009 UI (1.2 kHz – 100 kHz BW)
Spurious Jitter Products	≤0.002 UI (>1.2 kHz) or <-40 dB below jitter signal
Common Mode Amplitude	0-20.48 Vpp, ±(10% + 300 mV), 315 Hz-1 MHz, peak reading
Cable Equalization	Per AES 3-1992
Channel Status Bits	Full implementation, English language decoded (Professional or Consumer) or hex formats, independent in each channel
User Bits	Not displayed
Validity Flag	Displayed for each channel
Parity	Displayed for total signal (both channels combined)
Signal Confidence	Displayed for total signal (both channels combined)
Receiver Lock	Displayed for total signal (both channels combined)
Coding Error	Displayed for total signal (both channels combined)

3.8.2 AES/EBU Interface Analyzer

("INTERVU.AZ2")

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

AES/EBU Input Voltage	
Balanced	0 – 20.48 Vpp, ±(10% + 50 mV)
Unbalanced	0 – 4.096 Vpp, ±(8% + 12 mV)
Jitter Amplitude	0 – 5 UI pk, ±(5% + 0.015 UI)
Residual Jitter	≤0.01 UI (250 Hz – 1 MHz BW)
Spurious Jitter Products	≤0.001 UI, or ≤-60 dB below jitter signal
Common Mode Amplitude	0 – 20.48 Vpp, ±(30% + 50 mV), 20 kHz – 1 MHz
Jitter Probability Display	256 bins, autoranging
Input Probability Display	256 bins, autoranging
Bit Width Probability Display	8192 bins
Risetime	≤20 ns
Acquisition time/memory	3.9 ms / 256k

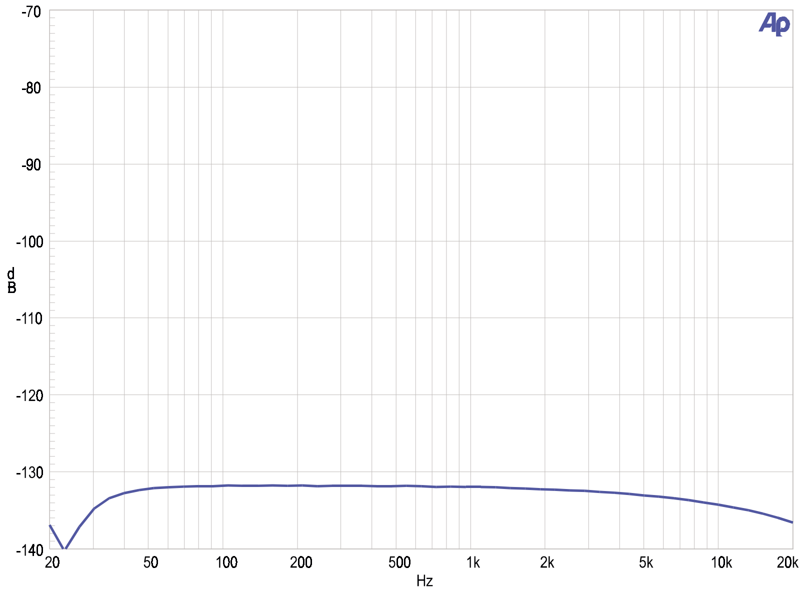


Figure 3-31. Typical Digital Domain system residual THD+N

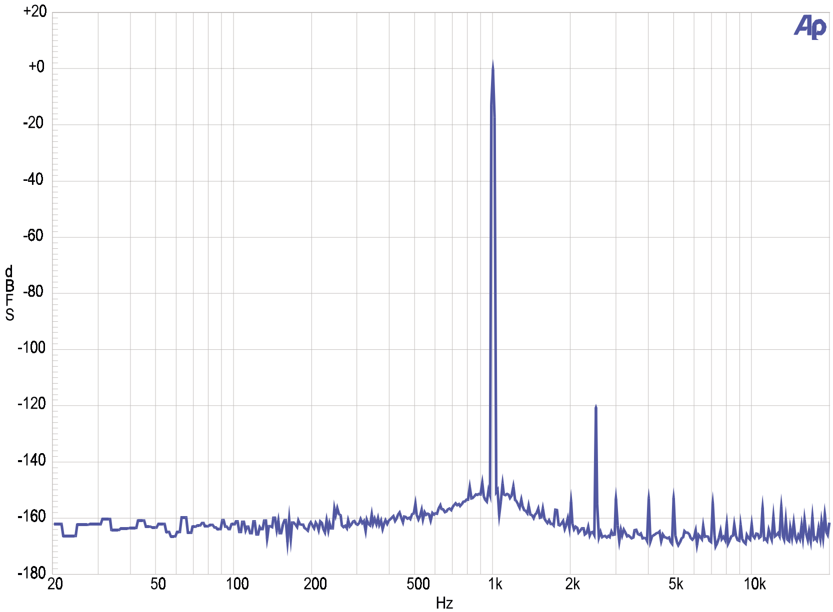


Figure 3-32. Illustration of typical Digital Domain FFT dynamic range. Signal is 0 dB 1 kHz with a secondary signal at –120 dB and 2.5 kHz. Harmonics of 1 kHz signal are visible at about –150 dB, consistent with 24-bit audio.

3.9 Auxiliary Signals

3.9.1 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.

3.9.2 Generator Auxiliary Signals

(all units except SYS-2300)

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

3.9.3 Analyzer Signal Monitors

(all units except SYS-2300)

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

3.9.4 Digital Signal Monitors

(SYS-2222 & SYS-2322 only)

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

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

3.9.5 Digital Interface Monitors

(SYS-2322 & SYS-2300 only)

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

3.9.6 Miscellaneous Digital I/O

(SYS-2322 & SYS-2300 only)

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

3.10 Audio Monitor

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

Power Output	Typically 1 Watt

END OF SYSTEM TWO SPECIFICATIONS.

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

3.11 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

3.12 DCX-127 Multi-Function Module Specifications

3.12.1 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

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.

Input Resistance	10 MΩ ±1% (all ranges)
Common Mode Rejection	>120 dB at dc and 50 Hz – 20 kHz

3.12.2 Resistance Measurements

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

3.12.3 DC Outputs

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

3.12.4 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

3.12.5 Auxiliary Output Ports

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

3.13 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.

3.14 Primary Power and Fuse Information (all components)

Refer to Section 4.2 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

3.15 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

3.16 Physical Dimensions and Weights

3.16.1 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

3.16.2 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)

3.17 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

3.18 Cables and Adapters

3.18.1 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.

[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.

3.18.2 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.

3.18.3 Cable Adapters

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

3.18.4 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).

4. Hardware Installation

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

4.1 Rack Mounting

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

4.1.1 Fixed Rack-Mounting Brackets

Install the fixed installation rackmounting kit as shown in Figure 4-1. The parts required are identified in Table 4-1.

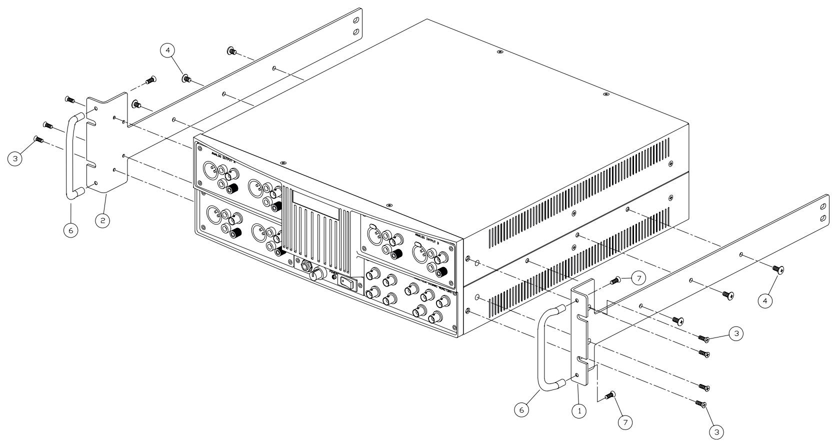


Figure 4-1. Fixed installation rackmounting kit

Table 4-1. 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

4.1.2 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 4-1. The parts required are identified in Table 4-1.

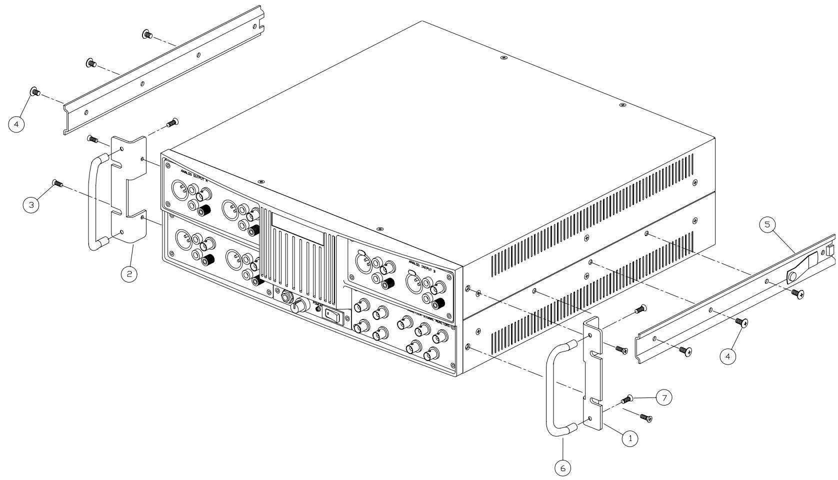


Figure 4-2. Sliding rack mount installation kit

Table 4-2. 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

4.1.3 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 4.2.1 when rackmounting.

4.2 Primary Power Considerations

Refer to fuse specifications in Section 3.14 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.

4.2.1 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.

4.2.2 Checking or Changing Power Line Voltage

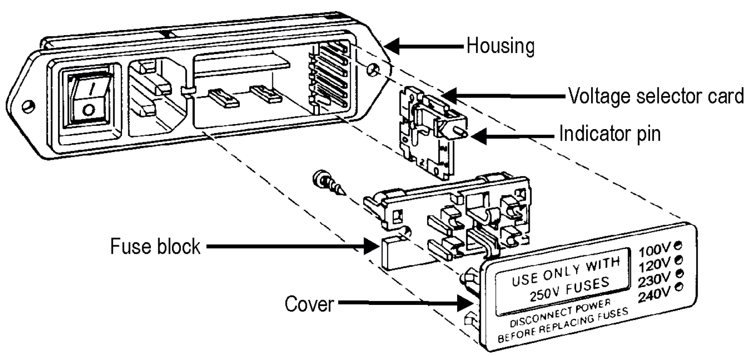


Figure 4-3. Changing power line voltage

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 4-3).

To change the input voltage, refer to Figure 4-3 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.

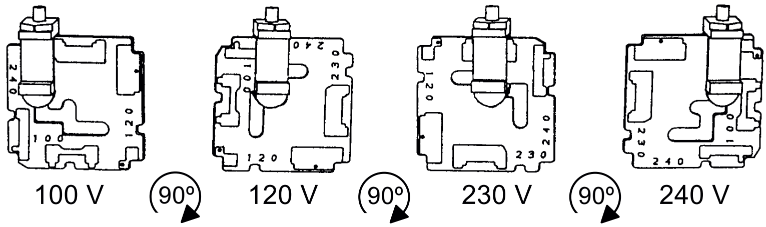


Figure 4-4. Voltage selector card positions

4. Orient the selector card so that the desired input voltage is readable at the bottom (see Figure 4-4). 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 3.14 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.

4.2.3 Fuse Information

The connector/fuse block/voltage selector assembly allows two fusing arrangements: North American (see Figure 4-5), and European (seeFigure 4-6). 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 3.14 or to the label on the rear panel for fuse current ratings.

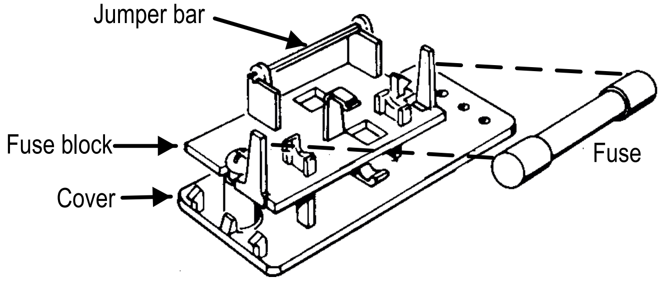


Figure 4-5. North American fusing arrangement

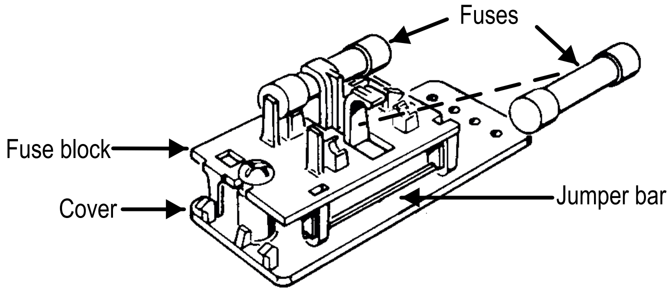


Figure 4-6. European fusing arrangement

4.2.4 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 4-7).

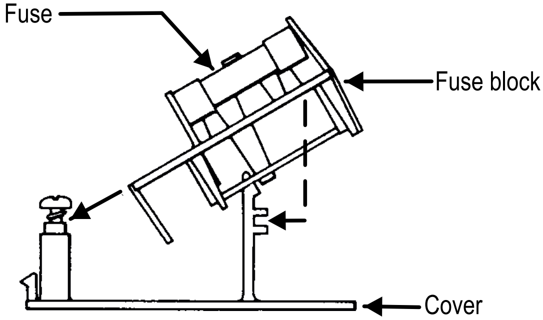


Figure 4-7. Changing fuse types

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.

4.2.5 Proper Environment

All Audio Precision System Two products are intended for use indoors, in a normal environment. Refer to Section 3.15 for temperature range and humidity specifications.

4.3 Connecting the APIB Interface

Refer to Section 2 for a description of how to connect the System Two APIB bus to the computer or to the SWR switchers and the DCX-127 when the System Two GPIB option is installed.

4.4 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 4-3. 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 4.4.2).

4.4.1 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 4-8 shows a typical rear-panel APIB Address switch. Table 4-3 shows relationships among APIB Address switch positions, binary codes, and channel numbers of the GPIB commands or APWIN software “panels.”

Table 4-3. 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	Down	Up	Up	Up	0001
25 – 36	Up	Down	Up	Up	0010
37 - 48	Down	Down	Up	Up	0011
49 - 60	Up	Up	Down	Up	0100
61 - 72	Down	Up	Down	Up	0101
73 - 84	Up	Down	Down	Up	0110
85 - 96	Down	Down	Down	Up	0111
97 - 108	Up	Up	Up	Down	1000
109 - 120	Down	Up	Up	Down	1001
121 - 132	Up	Down	Up	Down	1010
133 - 144	Down	Down	Up	Down	1011
145 - 156	Up	Up	Down	Down	1100
157 - 168	Down	Up	Down	Down	1101
169 - 180	Up	Down	Down	Down	1110
181 - 192	Down	Down	Down	Down	1111

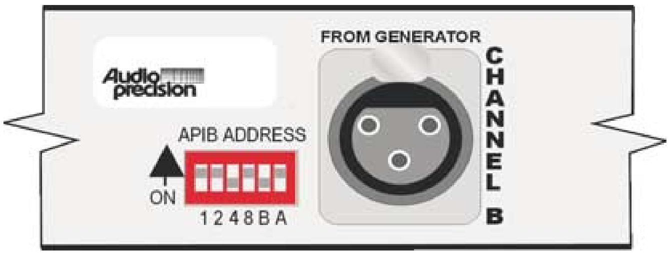


Figure 4-8. Rear panel DIP switch (typical)

4.4.2 Input, Output, and Patch Point Switcher Mode Switches

Switches 5 and 6 of the switch bank set the switcher mode as described in

Table 4-4. The modes are defined below.

Table 4-4. Patch point switcher mode settings

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

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

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

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

Off: Neither channel responds to any address.

4.4.3 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 4-9.

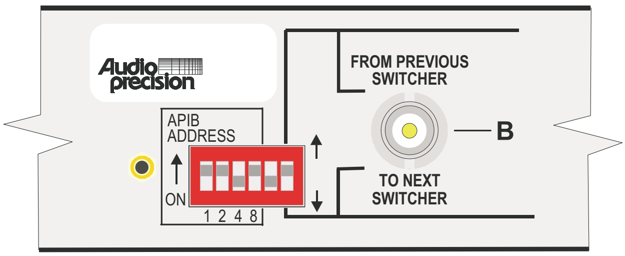


Figure 4-9. Unbalanced switcher address/mode switch

4.4.4 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 4-10. The jumper positions are shown for reference only and will normally not need to be changed.

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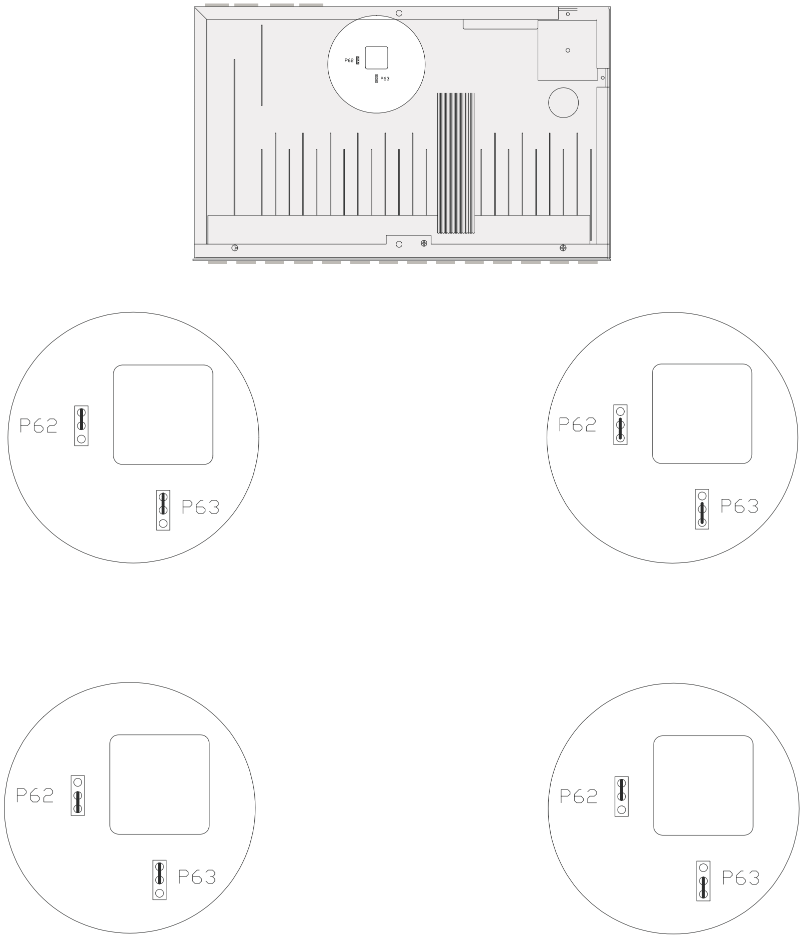

Figure 4-10. Switcher mode jumper positions

5. Maintenance and Troubleshooting

5.1 Technical Support

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:

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

APIB instruments attached to the APIB ports (SWR-2122 and DXC-127)

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

For APWIN, the amount of RAM installed (typically 8, 12, 16 or 32Meg)

For GPIB, the type of GPIB controller interface in your computer

For GPIB, the System Two GPIB firmware version number (response to *IDN? query)

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.