S-AES17 Low-Pass Filter Option User's Guide

Audio precision ®

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Contents

Safety Information

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

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

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

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

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

This product is for indoor use—pollution degree 2.

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.

Safety Symbols

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

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

ATTENTION!—This symbol alerts you to important operating considerations or a potential operating condition that could damage equipment. If you see this marked on equipment, consult 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.

Chapter 1
Introduction

Scope of This Manual

This manual supports the S-AES17 Low Pass Filter Option in several ways:

- If you are installing the S-AES17-KIT, it will guide you in the installation of both the hardware and software.

- It presents the specifications and characteristics of the S-AES17 Low Pass Filter Option.

- It discusses the configuration and use of the S-AES17 Low Pass Filter Option with APWIN.

The S-AES17 Low Pass Filter Option

The Audio Precision S-AES17 Low-Pass Filter Option is a hardware option which meets the requirements of AES17-1998 and can be added to System Two, System Two Cascade or System Two Cascade *Plus*. It is designed to enable the analog testing of signals which are combined with large amounts of out-of-band noise, using the technique recommended in the AES17 standard.

It is unlike other optional filters available from Audio Precision in that it uses a larger module (the SPLX), and also in that this module is inserted in a different location in the measurement circuit, just after the input conditioning amplifier and prior to any measurement circuits. The S-AES17 filter option also contains two post-analyzer modules, the FLP-B20K and the FLP-B40K option filters, which must be used in conjunction with the pre-analyzer low-pass module for proper operation.

The S-AES17 filter provides a sharp roll-off beyond 20 kHz early in the measurement path to insure that measurements accurately reflect the true

performance within the audio band. As an additional feature, the filter has a switchable mode which offers a broader passband, setting the sharp roll-off beyond 40 kHz.

The Audio Precision S-AES17 Low-Pass Filter Option improves upon the capabilities of the earlier S2-AES17LP filter, which is no longer available.

The S-AES17 Low Pass Filter Option can be ordered

- installed in a new System (S-AES17),

- as a factory-installed upgrade (S-AES17-UPG), or

- as a user-installed option kit (S-AES17-KIT).

The S-AES17 Low Pass Filter Option requires APWIN Version 2.2 or later. A CD-ROM with the latest version of APWIN is included with the kit. If this option is installed by the user in the field, a procedure file included on the CD-ROM must be also be run, as described on page 11 of this manual.

Skip the **Installation** chapter if your S-AES17 Low Pass Filter Option was fitted at the factory.

Overview

Digital-to-analog converters frequently use delta-sigma modulation and oversampling techniques to achieve high performance at an affordable cost. The noise inherent in this type of conversion is pushed up in frequency out of the audio band by means of high-order noise shaping. The resultant signal is quiet within the audio range but carries large amounts of out-of-band noise.

Measuring the audio performance of such converters can be a challenge for most contemporary wide-band audio distortion and noise analyzers. These instruments are designed to characterize classic analog audio devices, which typically exhibit a noise floor spread evenly over the full spectrum of the analyzer, usually diminishing with increased frequency. Out-of-band noise and interference are expected to be low in amplitude in relation to the signal, so band-limiting or noise-weighting filters, if needed, are inserted at the end of the measurement path, following several gain stages. When measuring classic analog audio devices, this approach yields accurate and repeatable THD+N results.
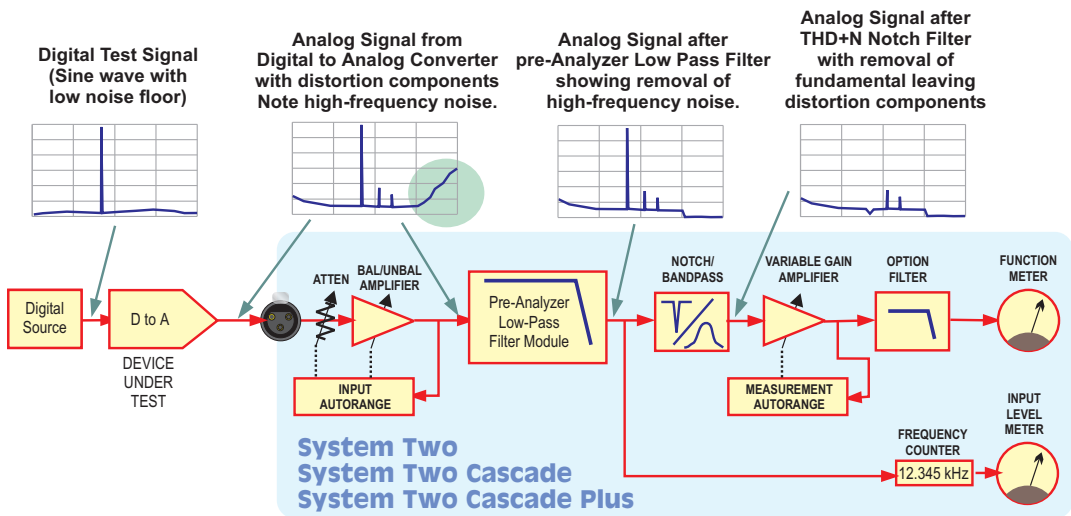
Figure 1. Conceptual signal path diagram showing how the AES17 Low-Pass Filter attenuates out-of-band noise and allows accurate measurement of audio-band distortion.

The spectrum of the noise floor of a noise-shaped delta-sigma D-to-A converter, however, shows a steeply rising energy characteristic beyond the 20 kHz upper limit of the audio band. When measuring low-level signals, the energy contribution of this ultrasonic noise can be substantial. In many situations it can overload instrument gain stages or throw off ranging circuits and cause grossly inaccurate measurements. Conventional band-limiting and noise-weighting filters cannot solve the problem because they are located too late in the measurement chain—the damage has already been done.

The AES17 "Standard Low-Pass Filter"

The Audio Engineering Society has defined the techniques for measuring digital audio equipment—that is, systems that contain digital-to-analog converters—in its standard, AES17. In section 4.2.1 AES17-1998 specifies the use of a "standard low-pass filter" that has a sharp roll-off above the audio band to attenuate out-of-band noise.

The AES17 standard specifies a stop-band attenuation of 60 dB or better above 24 kHz, quite a steep slope. The filter must be inserted early in the measurement path in order to remove the out-of-band noise before the measurement notch filter and its subsequent gain. This will insure that the "+N" part of THD+N contains only the in-band noise and distortion. Without the filter, the automatic gain ranging that normally follows the THD+N notch filter can behave incorrectly and the resulting measurement will be in error.

Chapter 2
Specifications

The S-AES17 Low-Pass Filter Option is intended for measuring the THD+N of D-to-A converters in accordance with AES17-1998 (section 4.2.1.1). It replaces the earlier Audio Precision S2-AES17LP filter.

The filter option consists of a dual-frequency pre-analyzer low-pass module, the SLPX; and two additional analyzer option filters, FLP-B20K and FLP-B40K.

An essential feature of the pre-analyzer low-pass module is its location *previous* to the Analog Analyzer, where it attenuates the out-of-band noise components before they can overload the circuitry and make distortion and other low-level measurements difficult. The additional option filters complete the job to satisfy the AES17 recommendation.

For specified performance, the S-AES17 option must be used with both the pre-analyzer low-pass module and the option filter FLP-B20K when set for 20 kHz, and with option filter FLP-B40K when set for 40 kHz.

S-AES17 Specifications	
Passband Response, 20 kHz setting:	± 0.10 dB, 10 Hz–20.0 kHz
Passband Response, 40 kHz setting:	± 0.10 dB, 10 Hz–40.0 kHz
Stopband Attenuation, 20 kHz setting:	≥ 60 dB, 24.0 kHz–200 kHz
Stopband Attenuation, 40 kHz setting:	≥ 60 dB, 48.0 kHz–200 kHz
Residual THD+N (1 kHz), 20 kHz AES mode: Residual THD+N (1 kHz), 40 kHz AES mode:	≤ (0.0003% [–110.5 dB] +1.0 μV) ≤ (0.0004% [–108 dB] +1.4 μV)

Figure graphs the performance of the Audio Precision S-AES17 Low-Pass Filter Option at the **20 kHz** setting, used with the option filter FLP-B20K. This filter option satisfies the AES17 standard.
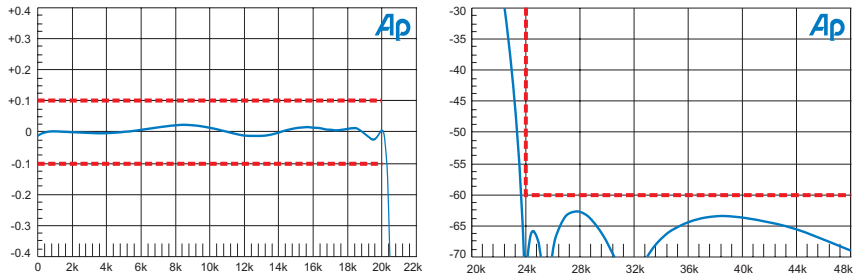
Figure . S-AES17 Low Pass Filter Option passband and stopband response with 20 kHz setting, used with FLP-B20K option filter.

The S-AES17 Low-Pass Filter Option will cause a slight (about 1 dB) degradation in system residual THD+N compared to the performance with the option disabled.

Chapter 3
Installation

Summary

These instructions cover the field installation of the Audio Precision S-AES17-KIT Low-Pass Filter Option in System Two, System Two Cascade and System Two Cascade *Plus*. Skip this chapter if your S-AES17 filter was factory-installed.

> *Filter operation requires the use of APWIN version 2.2 or later software.*

These instructions assume you are a qualified electronics technician, working on an approved static-protected workstation, and observing proper handling and safety precautions. You should wear a grounded wrist strap; the workstation should be grounded, and should be free of all static-generating materials.

S-AES17-KIT Parts List

Qty	AP Part No.	Description
1	SLPX	Circuit board assembly, S-AES17 Low-Pass Filter pre-analyzer module
1	4221.0024.2	Interconnect, 16-pin (24-pin interconnect, modified)
4	5532.1240	Standoff, hex 1-1/4 in. M-F
1		APWIN Version 2.2 (or later) CD-ROM
1	FLP-B20K	20 kHz "Brick Wall" Option Filter
1	FLP-B40K	40 kHz "Brick Wall" Option Filter

Installation Procedure

SLPX Pre-Analyzer Module

1. Disconnect the instrument from the ac mains supply and place it on your workstation surface.

2. Using a Philips screwdriver, remove the top cover from the instrument (12 screws).

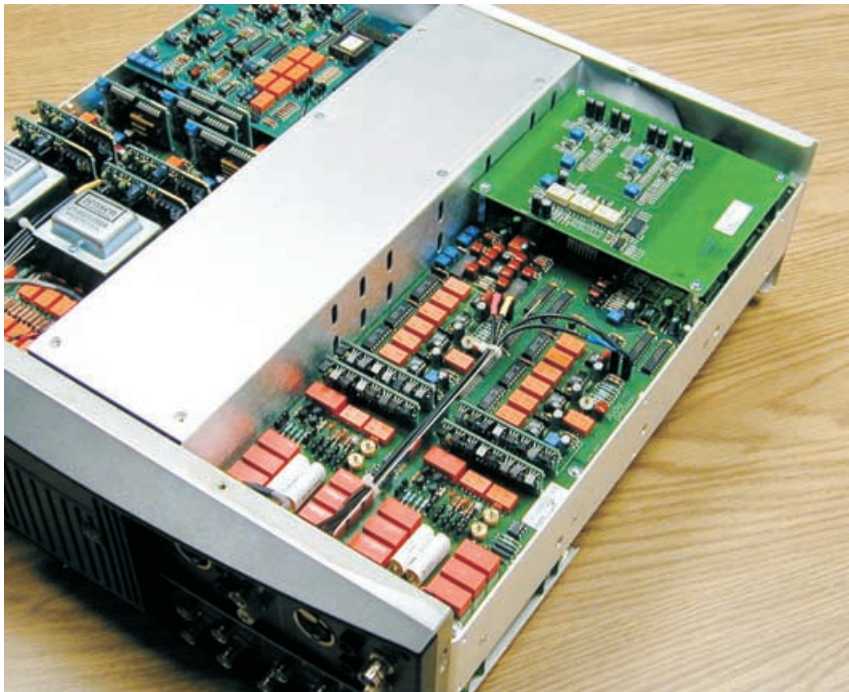3. Locate the top right-hand compartment, shown in Figure .

Figure 2. System Two Cascade (top view) with covers removed and SLPX module installed.

4. Locate the four rear mounting screws for the INP Module (marked "A" in Figure).

5. Remove these four screws (save for re-use), and replace them with the four standoff posts from the kit. USE CAUTION not to overtighten the standoffs, since they break easily.

6. Install the 16-pin interconnect assembly into J570 on the INP Module (marked "B" in Figure).

7.

Install the SLPX board assembly by carefully aligning its header with the 16-pin interconnect, and pressing it into place.
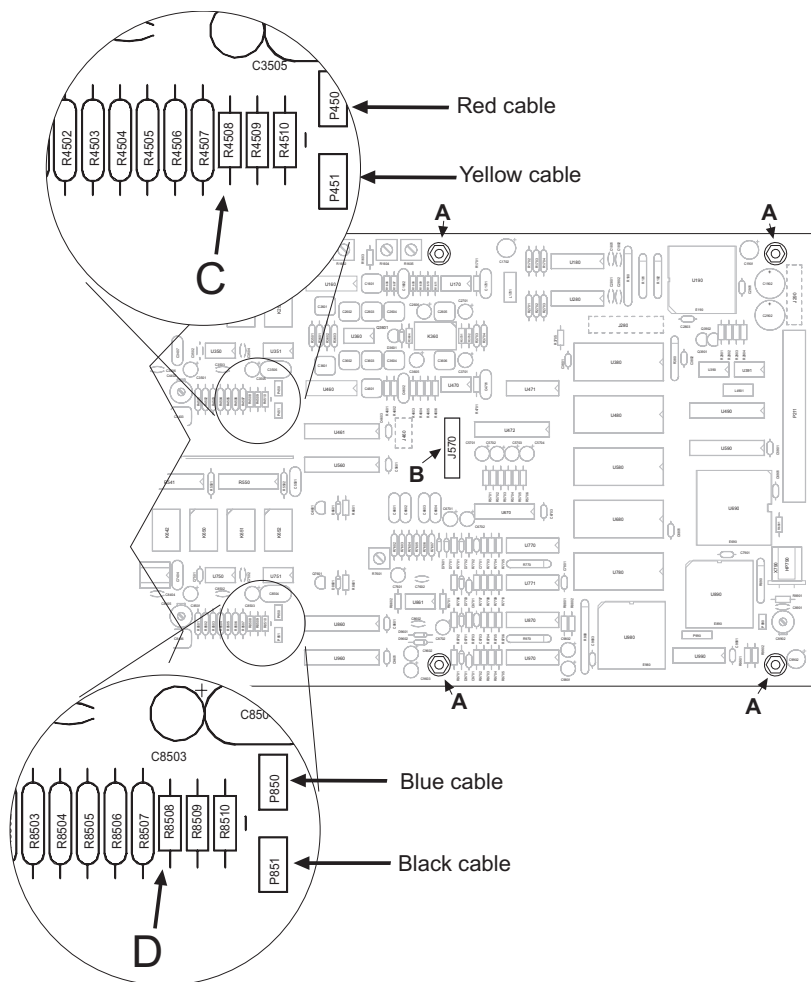

Figure 3. INP module (partial).

8. Install the four screws (removed in step 5) into the four mounting holes of the filter board. Again, do not overtighten the screws.

9. Locate the zero-ohm resistors R4508 and R8508 (marked "C" and "D" in Figure).

10. Remove these resistors from the circuit. We suggest unsoldering and lifting only one end, in order to facilitate restoring the circuit if the filter board is removed.

11. Replace the cover on your instrument.

   This completes the installation of the SLPX pre-analyzer module. The two option filters, FLP-B20K and FLP-B40K, must be installed as well.

FLP-B20K and FLP-B40K Option Filters

12. Remove the handle or the rackmounting brackets (if present) from the sides of the instrument.

13. Turn the instrument upside down. Using a Philips screwdriver, remove the ten screws in the bottom cover and lift off the cover.
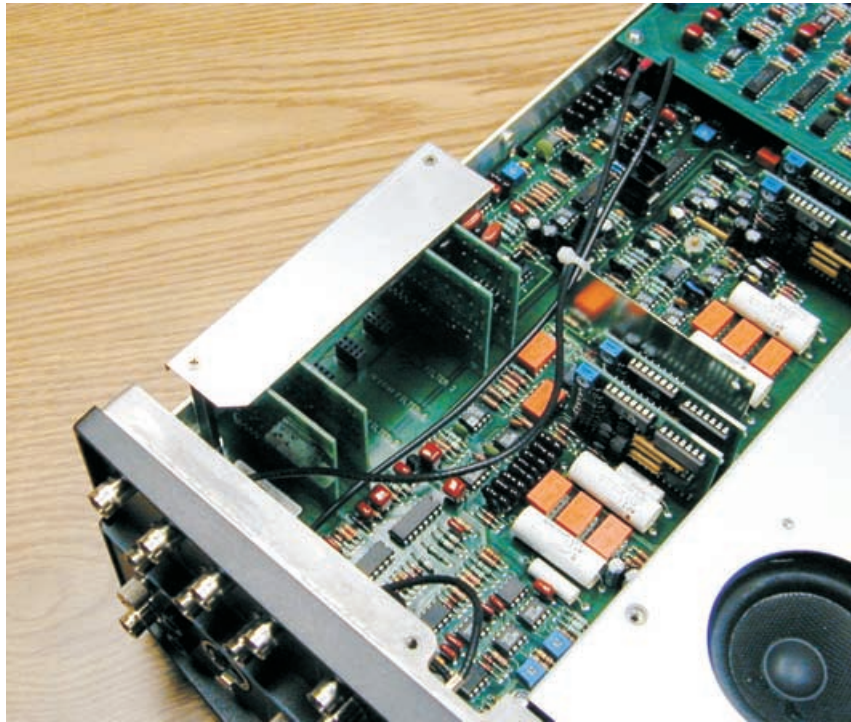

Figure 4. System Two Cascade (tbottom view) with covers removed. Note the four filter cards installed under the filter hold-down bracket.

14. Refer to Figure to locate the option filters area. Filter slots are numbered 1–7, with #7 closest to the System front panel.

15. Remove the two screws securing the filter hold-down bracket.

16. Install the FLP-B20K and FLP-B40K option filter boards in any two filter positions. Make sure that all eight pins engage the socket properly.

17. Replace the filter hold-down bracket.

18. Replace the bottom cover on your instrument and turn it over.

19. Edit the tag on the rear of the instrument to reflect the new filter installation.

20. Connect the instrument to the APIB cable and the power mains, and turn on the system.

21. Open APWIN. From within APWIN, run the procedure C:\Program Files\Audio Precision\APWIN 200\S-AES17 Set Bit.apb. This procedure sets a bit in the System firmware that informs APWIN of the presence of the AES17 option. The following dialog box will open:

Figure 5. S-AES17 Set Bit.apb dialog box.
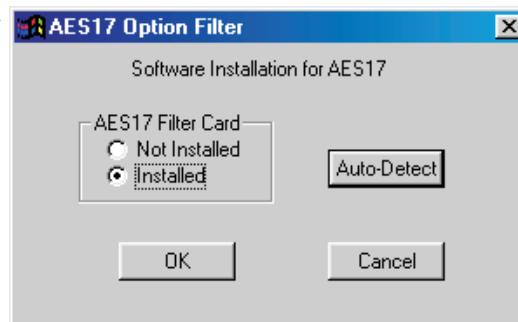
22. Select **Installed**, then click **OK**. If you click **Auto-Detect**, APWIN will detect whether the filter is installed and working, and set the **Not Installed** or **Installed** button accordingly. This can be a useful troubleshooting tool if you experience difficulty.

23. Close and then re-open APWIN. This causes the software setting made in the previous step to become effective.

   THIS COMPLETES THE INSTALLATION. No adjustments are necessary.

Removing the SLPX

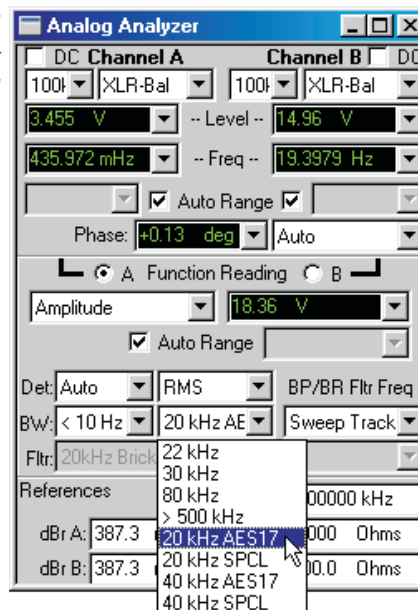   Reverse steps 1–11 and restore the jumper (zero ohm) connections.

   Run the procedure S-AES17 Set Bit.apb, select **Not Installed** in the dialog box, then click **OK**.

Chapter 4

## APWIN Software Operation

Analog Analyzer: AES17 Low-Pass Filter

Figure 6. AES17 Low-Pass Filter Selection and Channel A routing.

When installed, the AES17 filter is enabled by choosing one of the four new choices available on the low-pass **BW** (bandwidth) filter list.

*The four AES17 filter selections will not appear on the **BW** list until the filter installation software (which is provided with the filter kit) is run.*
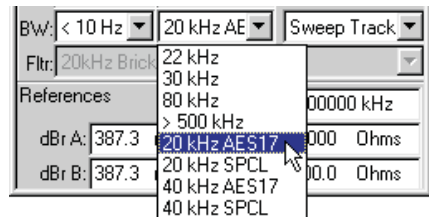
The new selections are:

- **20 kHz AES17**
  This choice selects both the 20 kHz pre-analyzer filter and the 20 kHz brick-wall option filter. Selection of other option filters is disabled. If the required option filter is not installed, a warning will appear and the selection will default to **20 kHz SPCL**.

- **20 kHz SPCL**
  This choice selects only the 20 kHz pre-analyzer filter. You may choose any option filter, or **None**.

- **40 kHz AES17**
  This choice selects both the 40 kHz pre-analyzer filter and the 40 kHz brick-wall option filter. Selection of other option filters is disabled. If the required option filter is not installed, a warning will appear and the selection will default to **40 kHz SPCL**.

- **40 kHz SPCL**
  This choice selects only the 40 kHz pre-analyzer filter. You may choose any option filter, or **None**.

The pre-analyzer section of the filter operates on only one channel at a time and follows the **A** or **B** channel selection made when setting **Function Reading**, as shown in Figures and 7.
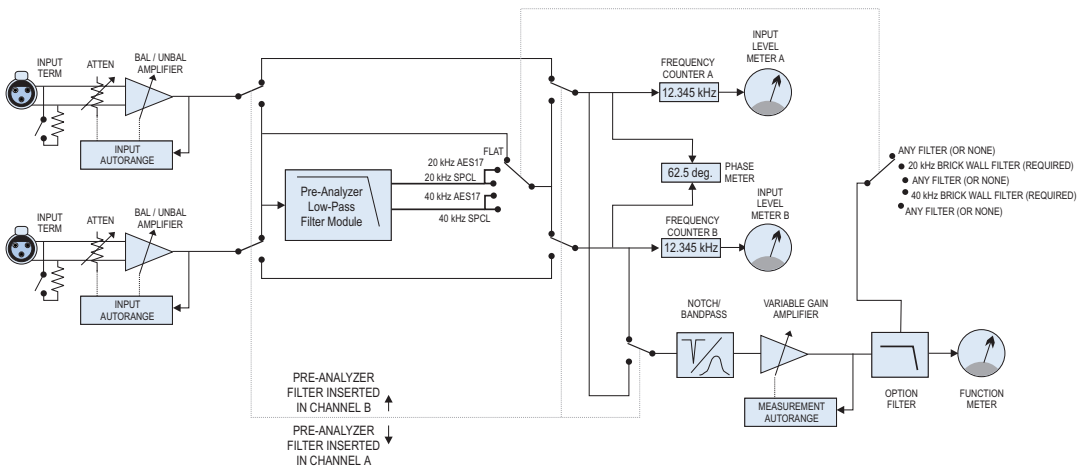
Figure 7. Block Diagram of AES17 Low-Pass Filter implementation in System Two, System Two Cascade or System Two Cascade Plus. Note the location of the pre-analyzer section of the filter, and the linked implementation of the post-analyzer option filters.

In the 20 kHz AES17 mode, the combination of pre-analyzer filter and the option filter is designed to provide a flat passband ($\pm$0.1 dB) through 20 kHz with a stopband attenuation of 60 dB or better above 24 kHz, satisfying the AES17-1998 Section 4.2.1 specification for a "standard low-pass filter."

In the 40 kHz AES17 mode, the combination of pre-analyzer filter and the option filter is designed to provide a flat passband ($\pm$0.1 dB) through 40 kHz with a stopband attenuation of 60 dB or better above 48 kHz.

> *This higher-bandwidth mode can be used with the high-bandwidth DACs typically used to convert direct streaming digital (DSD) audio analog audio. DSD is the key audio format used in making super audio compact discs (SACD).*

In either case, this filter will attenuate out-of-band noise typically created by oversampled converters and provide meaningful THD+N measurements of audio signals accompanied by high out-of-band noise.

Cautions

- The AES17 Option affects phase measurements, since one channel is filtered, and the other is not. Do not perform phase measurements when the AES17 Option is enabled.

- Level and Frequency meters become unusable above about 22 kHz (20 kHz mode) or 44 kHz (40 kHz mode).

- Ratio units are not valid when the filter is enabled, since the pre-analyzer module is located before the Level meter.

Chapter 5

Technical Support

If you have problems installing or running APWIN, call our technical support team for assistance. We are in during the following hours Monday through Friday except holidays: 8:00 am to 5:00 pm 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: audioprecision.com

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

- Your computer: CPU type and speed (*e.g.*: 486, Pentium, 66 MHz, 350 MHz, *etc.*)
- Amount of RAM installed (typically 64 or 128 Meg)
- System configuration and model number, options such as DSP, Dual Domain, BUR-GEN, IMD), *etc.*

If you call, we recommend that you have the computer keyboard and monitor at the same location as the telephone as we will likely ask you to try several things to assess the situation. If you need to determine which version of APWIN is loaded, on the Main menu choose **Help > About APWIN.**

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