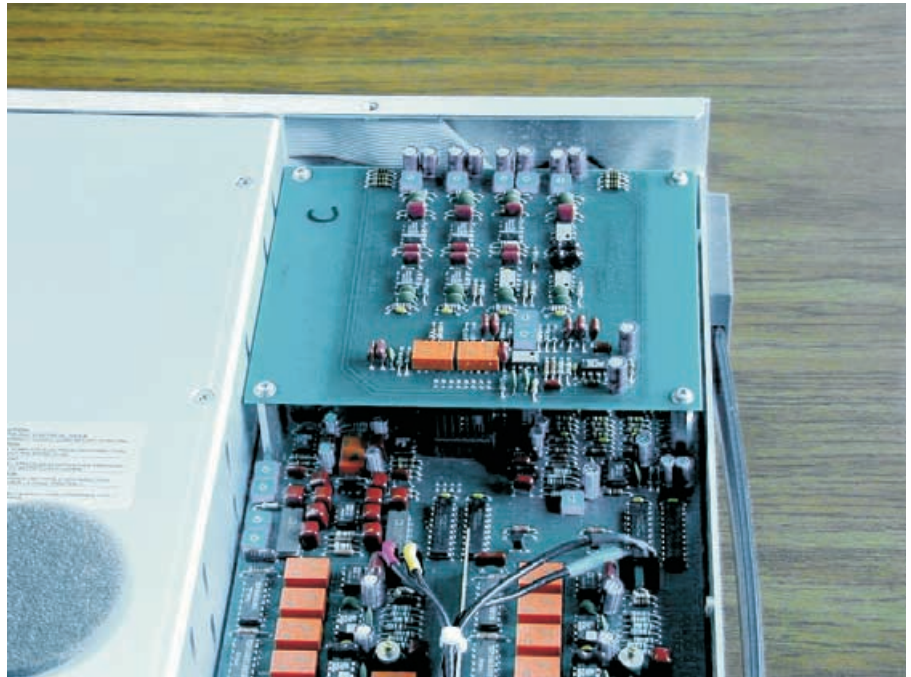


AES17 Low-Pass Filter for System Two and System Two Cascade

Description, Installation, and User's Guide



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Revision 0

June 2000

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Audio Precision, Inc.
PO Box 2209
Beaverton, Oregon 97075-2209
U.S. Toll Free: 1-800-231-7350
Tel: (503) 627-0832 Fax: (503) 641-8906
email: techsupport@audioprecision.com
Web: www.audioprecision.com

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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.

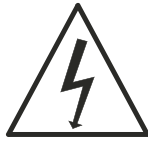
For continued fire hazard protection, fuses should be replaced ONLY with the exact value and type as indicated on the rear panel of the instrument. The AC voltage selector also must be set to the same voltage as the nominal power source voltage (100, 120, 230, or 240V rms) with the appropriate fuses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

Description

Scope of This Manual

This guide serves several purposes:

- It will help you install the hardware and software for the AES17 Low-Pass Filter.
- It describes several basic hardware considerations for using the filter.
- It presents characteristics and specifications of the AES17 filter.
- It contains some fundamental APWIN assistance relating to the use of the AES17 filter.

Overview

Introduction

This guide covers the installation and use of the AES17 Low-Pass Filter in System Two and System Two Cascade. For the filter to be functional, these conditions must be met:

- You must be running APWIN Version 2.10 or later software
Earlier versions of APWIN are not able to recognize the AES17 filter.
- You must have run the utility AES17.APB
This utility sets a bit in firmware to tell the system that the AES17 filter is present. Otherwise, the AES17 selection will not show up in the Analog Analyzer filter selection box.
- The filter must be installed and working properly
Without the filter present, the only noise improvement when AES17 is selected will be due to the 80 kHz low-pass filter.

Background

High performance converters using delta-sigma converters achieve improved noise performance by using a technique called “noise shaping.” Noise shaping causes a rise in the noise floor above the audio band (>20 kHz). Listeners cannot perceive this out-of-band noise, but they will perceive the improved in-band noise performance.

Measuring the audio performance of such converters can be a challenge for most contemporary audio analyzers. Classic analog audio devices typically exhibit a noise floor evenly spread over the full spectrum, frequently diminishing with increased frequency. Since all analog-based analyzers are wide-band measuring devices, the character of the noise floor can contribute significantly to signal-to-noise and total harmonic distortion plus noise (THD+N) measurements. The performance of a device where the spectrum of the noise floor is somewhat constant or diminishes at higher frequencies can be easily characterized with this classic wide-band measurement technique. Band-limiting or noise-weighting filters, inserted at the end of the measurement path and following several gain stages, yield repeatable and accurate results.

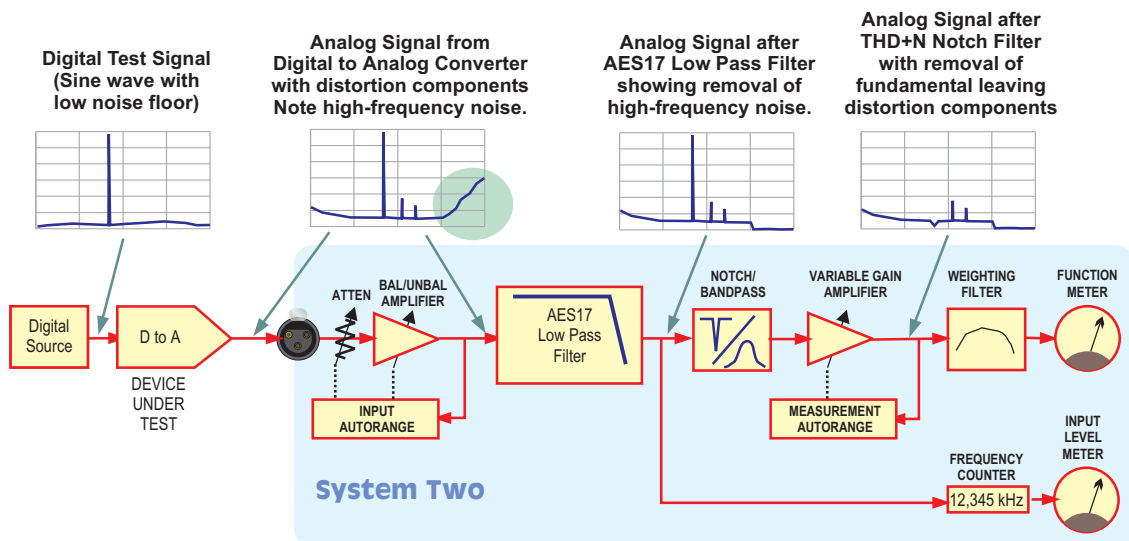


Figure 1-1. Conceptual signal path diagram showing how the AES17 Low-Pass Filter attenuates out-of-band noise and allows accurate measurement of audio-band distortion.

The spectrum of the noise floor of a noise-shaped delta-sigma converter shows a steeply rising energy characteristic beyond the 20 kHz upper limit of the audio band (see Figure 1-1). When measuring low-level signals, the energy contribution of this above-20 kHz noise can be significant. In fact, in many situations, it can cause grossly inaccurate reading results. Conventional band-limiting and noise-weighting filters cannot solve the problem because they are located too late in the measurement chain—the damage is already done.

The Audio Engineering Society has defined the techniques for measuring digital audio equipment that contain digital-to-analog converters. AES17-1998 (section 4.2.1) specifies the use of a “Standard low-pass filter” that has a sharp roll-off above the audio upper band, 20 kHz.

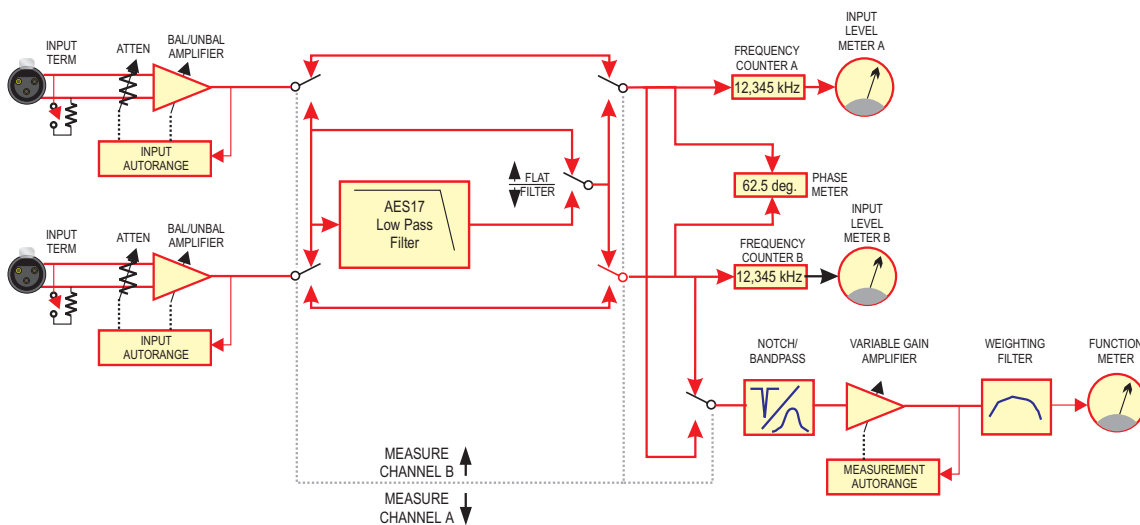


Figure 1-2. Block diagram showing the AES17 Low-Pass Filter enabled. Note that the single AES17 Low-Pass Filter is shared between input channels A and B dependent on the setting of the “Function Reading” control (shown in Figure 1-3).

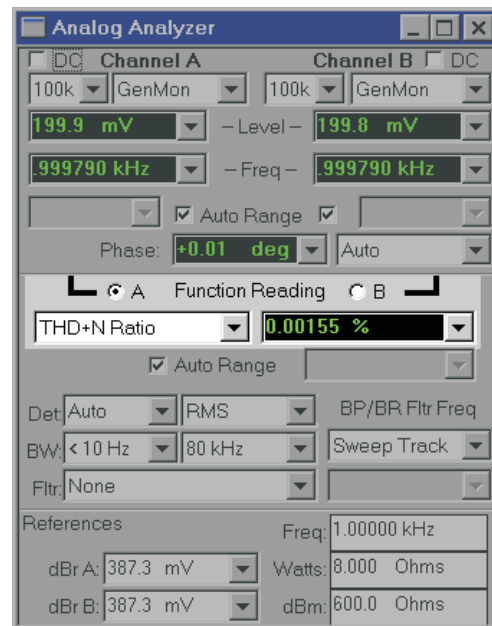
Audio Precision AES17 Low-Pass Filter

The Audio Precision AES17 Low-Pass Filter provides a sharp roll-off beyond 20 kHz. This filter can be added to a System Two or System Two Cascade. The filter has a stop-band attenuation of 60 dB or better above 24 kHz, an aggressive slope. See Figures 2-1 and 2-2.

The AES17 filter is unlike other optional filters available from Audio Precision in that it is a larger module. In addition, it is inserted in a different location in the measurement circuit: just after the input conditioning amplifier and prior to any measurement circuits. Installation early in the measurement path is necessary to remove the out-of-band noise before the measurement notch filter and its subsequent gain. This insures 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 would behave incorrectly, resulting in measurement errors.

The AES17 filter is a single-channel device that tracks the channel radio buttons in the Function meter (that is, it filters the signal channel, A or B, that has been selected on the Analyzer panel). See Figures 1-2 and 1-3. The filter requires APWIN Version 2.10 or later.

Figure 1-3. Analog Analyzer dialog box showing “Function Reading” control



Specifications

The S2-AES17 lowpass filter allows measuring the THD+N of D/As in accordance with AES17-1998 (section 4.2.1.1). It is a very sharp roll-off filter whose primary function is to remove out-of-band noise and spurious artifacts that influence a THD+N measurement. It is compatible with the Audio Precision System Two and System Two Cascade instrument families only.

- Passband Response: ± 0.10 dB, 10 Hz to 20.0 kHz
- Stopband Attenuation: ≥ 60 dB, 24.0 kHz to 200 kHz
- Residual THD+N (1 kHz): $\leq (0.0004\% [-108 \text{ dB}] + 1.0 \mu\text{V})$

Figures 2-1 and 2-2 show the curve of the Audio Precision AES17 Low-Pass filter. The dashed lines indicate the AES17-1998 specification.

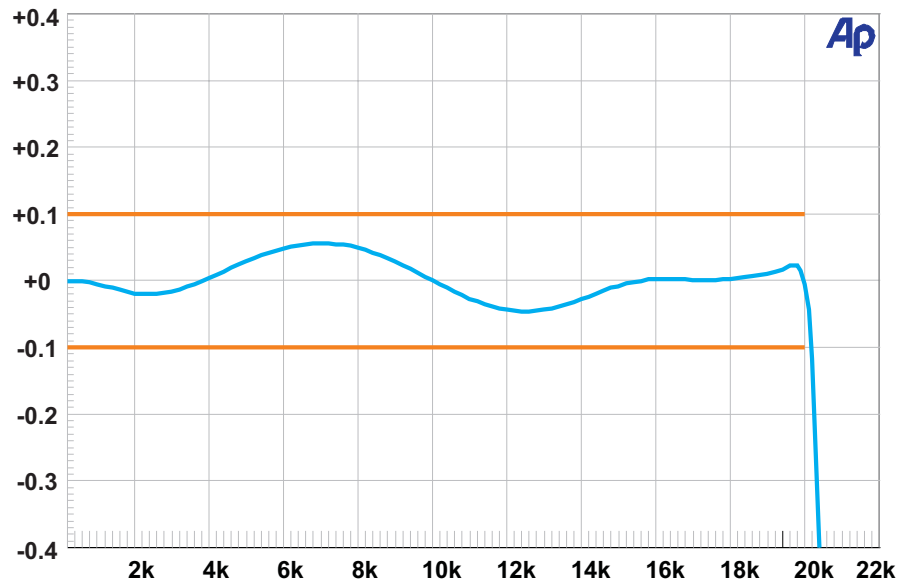


Figure 2-1. AES17 Low-pass filter in-band response

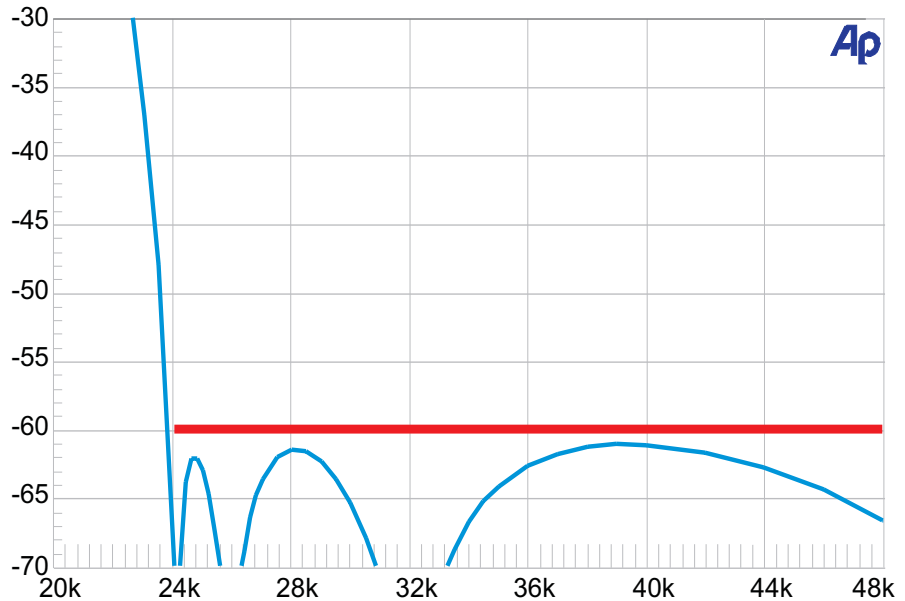


Figure 2-2. AES17 Low-pass filter out-of-band response

Caveats

- The AES17 filter affects phase measurements, since one channel is filtered, and the other is not. Do not perform phase measurements when this filter is enabled.
- Level and Frequency meters become unusable above about 22 kHz.
- RATIO units are not valid with the filter active, since the filter is located before the Level meter.
- Residual distortion of the filter will degrade the internal System Two Cascade residual distortion starting at levels above approximately -20 dBV.

Filter Installation

Summary

These instructions cover the field installation of the Audio Precision AES17 Low-Pass Filter in System Two and System Two Cascade. If the AES17 filter was factory-installed, the steps in this section have been performed for you.

NOTE: Filter operation requires the use of APWIN version 2.1 or later software. Earlier software can be used to operate your instrument normally, but the AES17 filter will not be enabled. A software utility is included that modifies the firmware in the system to enable the filter.

This procedure assumes version 2.1 software has been previously installed.

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, including this manual.)

Parts List

Qty	AP Part No.	Description
1	S2-AES17LP	Circuit board assembly, AES17 Low-Pass Filter
1	4221.0024.2	Interconnect, 16-pin (24-pin interconnect modified)
4	5532.1240	Standoff, hex 1-1/4 in. M-F
1		CD-ROM, including APWIN Version 2.10 (or later)

Procedure

1. Disconnect the instrument from the ac mains supply and place it on your workstation surface.
2. Using a Philips head screwdriver, remove the top cover from the instrument (12 screws).
3. Locate the top right-hand compartment, shown in Figure 3-1.



Figure 3-1. System Two Cascade with covers removed (shown with filter installed). System Two is mechanically similar.

4. Locate the four rear mounting screws for the INP Module (marked “A” in Figure 3-2).
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 3-2).
7. Install the AES17 Filter board assembly by carefully aligning its header with the 16-pin interconnect, and pressing it into place.

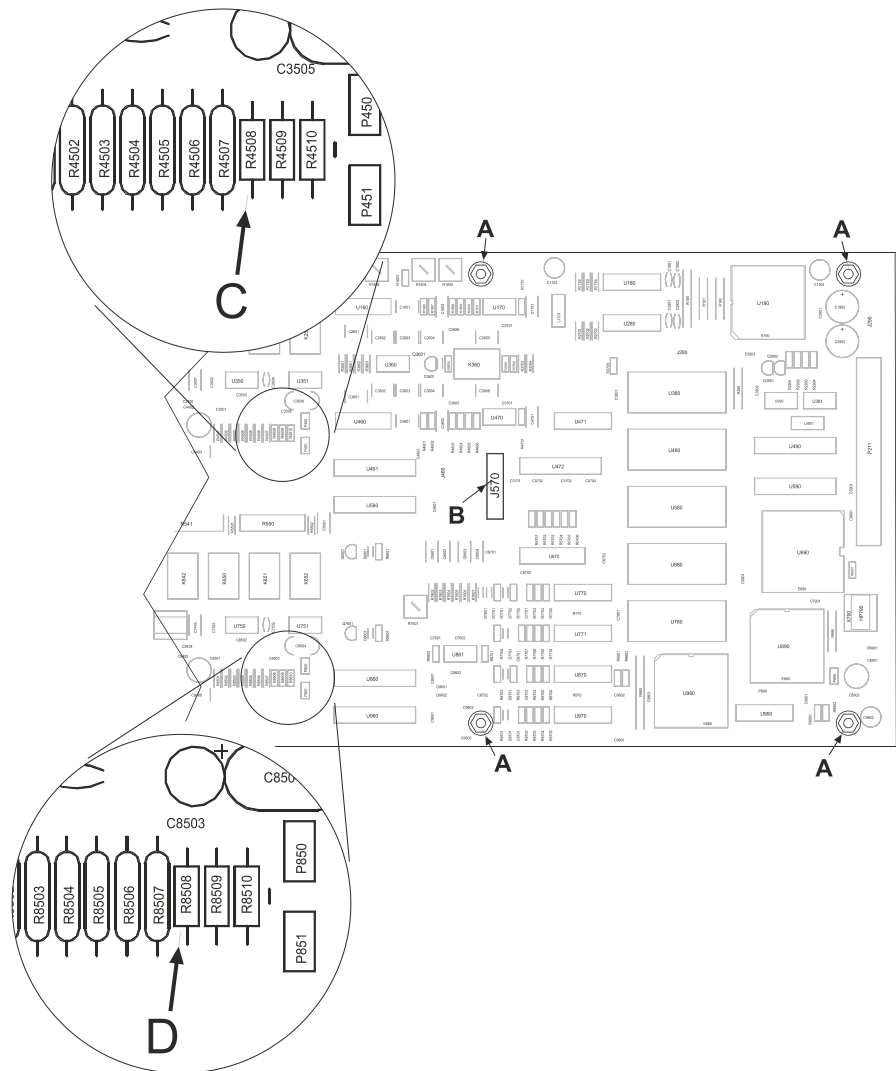
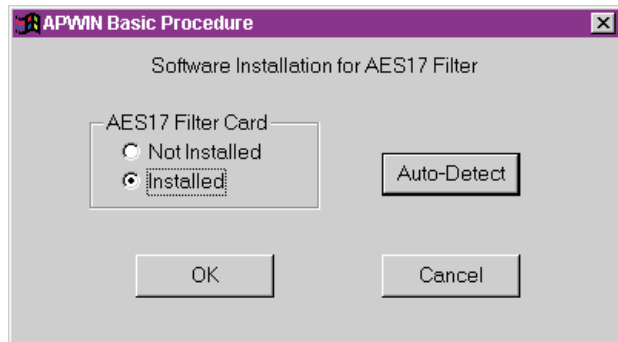


Figure 3-2. INP Module (partial)

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 3-2).

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 covers on your instrument.
12. Connect the instrument to the APIB cable and the power mains, and turn on the system.
13. In APWIN, run the procedure AES17.apb. This procedure sets a firmware bit to tell the software that the AES17 filter is present. The following dialog box appears:

Figure 3-3. AES17 setup dialog box



14. 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.

As usual, the **Cancel** button aborts the procedure and exits.

THIS COMPLETES THE INSTALLATION. No adjustments are necessary.

To remove the filter

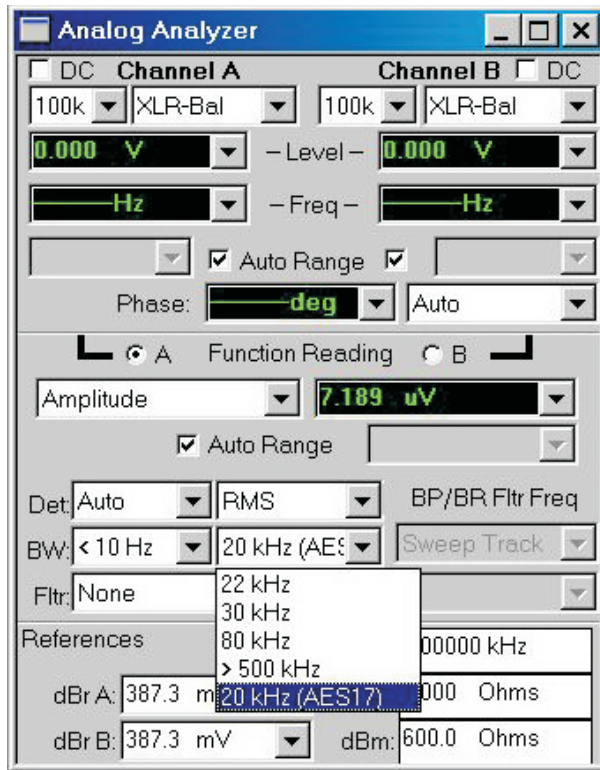
1. Generally reverse the steps of the previous section and restore the jumper (zero ohm) connections.
2. Run the procedure AES17.apb, select **Not Installed** in the dialog box, then click **OK**.

APWIN Software Operation

Filter Operation

To activate the filter, select the 20 kHz (AES17) choice from the Analog Analyzer dialog box (see Figure 5-1).

Figure 4-1. Analog Analyzer dialog box showing 20 kHz (AES17) filter selection



Although APWIN versions prior to 2.1 may look the same as Figure 5-1, there is no support for the AES17 filter.

If the AES17 filter selection does not appear in the drop-down list as shown above, first run the procedure AES17.apb, and select **Auto Detect**. This should set the radio button to **Installed**. Click OK. If the **NOT INSTALLED** radio button is selected, the system is not recognizing the filter. Contact Technical Support.

Technical Support

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

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

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

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

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

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

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

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

Figure 5-1. About APWIN window (typical— your version and build numbers will be different)

