

AESQbox

AES Signal Tester



The Whirlwind AESQbox is a multipurpose testing device for troubleshooting AES-3 and S/PDIF digital audio signals. The AESQbox is composed of two sections; Input and Output. The Input section consists of the LED sample rate indicator, the Fault LED and the decoder that converts the digital signal into analog for the Speaker and the Line/Phones Out. The Output section converts a choice of analog input signals into AES-3 professional and S/PDIF digital format and delivers them to the output connectors through Output Level and Sample Rate controls. Clip LEDs light when output levels reach digital zero and the Locked to Input LED indicates that the output sample rate is matched to an input signal sample rate.

The AESQbox has three operating modes; Cable Test, In/Out and Pass Thru. Cable Test provides a method of testing the integrity of digital cables, In/Out links the sample rate of the input to the output and Pass Thru allows bridging onto a digital signal and monitoring it both visually and aurally. Both professional and consumer versions of AES-3 can be decoded by the AESQbox.

Theory of Operation

The AESQbox is designed to provide a portable means of testing various aspects of AES-3 and S/PDIF digital audio systems. It is able to generate AES-3 or S/PDIF output signals over a sample frequency range from 32kHz to 192kHz. Audio sources for the Output or transmitter function include a built-in microphone, a pair of tone generators (440 Hz for the left channel, 880 Hz for the right), and an external line-level stereo input, for an MP3 or CD player, computer sound card, etc. An Output Level control adjusts the selected source level into the digital encoder and Clip LEDs illuminate when the level reaches digital zero.

AES-3 or S/PDIF digital signals, both professional and consumer, can be monitored and decoded by the Input or receiver section. The AESQbox is capable of receiving and displaying sample frequencies from 32kHz to 192kHz, and monitoring the audio content via the built-in speaker or line/headphone output jack.

There are three operating modes available in the AESQbox: In/Out mode, Pass-Thru mode, and Cable Test mode. Each of these modes is described in detail in the following paragraphs.

When using In/Out mode, the internal digital receiver will lock to any useable AES-3 or S/PDIF signals applied to the input connectors. The detected sample rate will be displayed and the Lock To Input indicator will also illuminate. The digital audio is decoded and presented to both the speaker and the Line Out jack. At the same time, the selected test signal (mic, aux or tone) will be converted to digital format and output from the digital output jacks. If a digital input signal is present and locked, the digital output sample rate will mimic the sample rate of the digital input and the output sample rate switch has no effect. This feature allows a greater number of possible sample rates to be output while using a single crystal-controlled frequency source. If there is no digital input present, the output sample rate will be that selected by the sample rate switch. In this mode, if an AES-3 or S/PDIF input signal is present but its sample rate cannot be determined, the Fault indicator will flash on and off at a slow rate (about once every 1/2 second).

Pass-Thru mode is used to monitor a digital audio signal without interrupting its destination, essentially acting as a wiretap. The digital audio input signal is decoded and the serial data stream is fed to the digital-to-analog converter for analog monitoring and to the digital output encoder for re-transmission without passing through the analog domain. To use this mode, the signal source cable is connected to one of the digital input connectors, and the signal destination cable is connected to one of the digital output connectors. When the input signal is present, the appropriate sample rate indicator will illuminate as well as the Lock indicator, and the input signal will be present on the digital output connector. The input signal in analog format is available at the speaker and the headphone/line output jack. Any analog input sources are ignored, as well as the output sample rate switch.

Cable Test mode is similar to In/Out except the digital output sample rate is independent of the digital input. The selected test signal is driven out of the digital output at the sample rate selected by the sample rate switch. If a good cable is connected between the input and output, the Sample Rate indicators will display the detected sample rate, the Locked to Input LED will light and the selected test signal will be heard over the speaker and the line output. In this mode, the digital input will be locked and presented as audio, but if the input and output sample rates do not match, the Fault indicator will flash on and off at a rate of about once every 1/4 second.

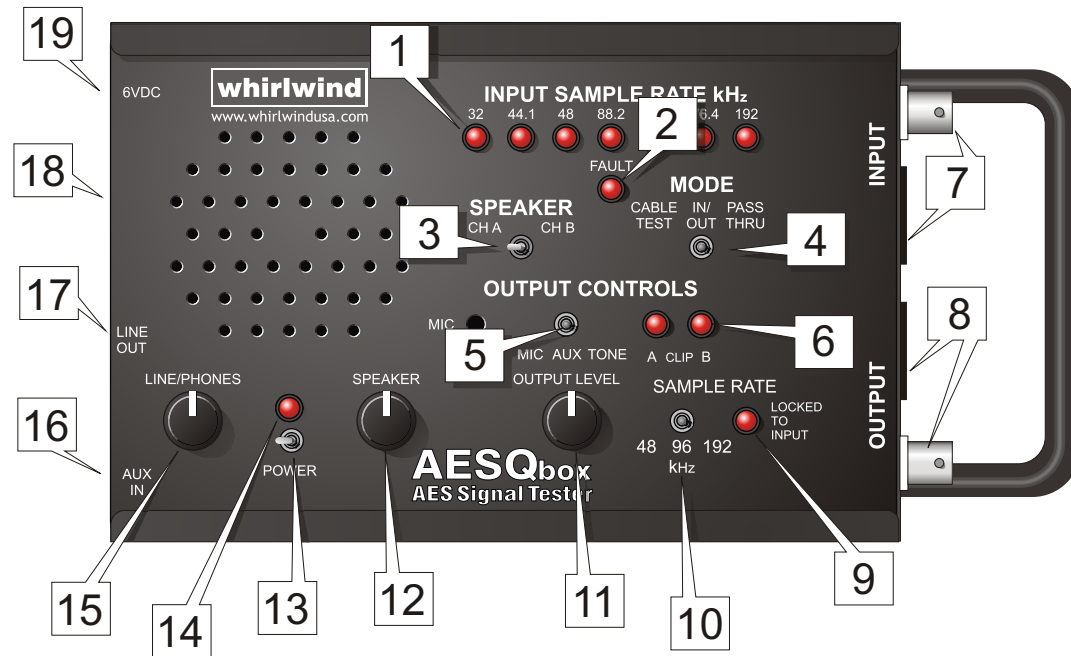
When testing a cable to determine if the cable has high-frequency problems, select the highest sample rate. If the digital receiver is able to lock to the signal, chances are that the cable is good. If the cable has integrity problems, it may not lock at a rate of 192kHz, but may lock at a lower sample rate.

Cable test also provides an excellent means of performing an end-to-end test of the AESQbox itself. Connecting a short cable between the input and output allows the operator to test the functionality of all the internal components. Cable test mode can also allow the unit to serve as an analog audio amplifier for a weak line input signal.

The Input Sample Rate LEDs indicate the detected sample rate when they are locked to the digital input. If the input can't lock to determine the sample rate, the Fault LED will flash slowly. Only one LED will be illuminated at a time, except during the Power-On Self-Test. Displayed sample rates are 32kHz, 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, and 192kHz. The AESQbox can detect both versions of the AES-3 bitstream; professional and consumer. If the digital input is the professional version, the Sample Rate LEDs will glow continuously. The consumer bitstream is identified by the Sample Rate LEDs flashing at a fast (about once every 1/4 second) rate as they indicate the detected sample rate. The Fault LED displays three types of fault annunciations. A steadily illuminated Fault LED indicates a malfunction in the microcontroller. Cycling the Power switch may reset the unit. If the Fault LED flashes slowly (about once every 1/2 second rate), it means the input sample rate cannot be determined (In/Out or Pass-Thru modes), or that the digital input sample rate does not match the output sample rate (Cable Test mode). If the Fault LED flashes quickly (about a 1/4 second rate), it means the input is locked to a signal that is not a PCM (pulse-code modulation, or audio bit stream) signal. This signal could be a data stream or a DTS-CD stream.

The AESQbox runs through an initialization and diagnostic sequence at power up. During this sequence, all the indicators under digital control (the Sample Rate, Fault and Lock LEDs) will flash on one at a time, then all will flash on and off twice. Upon completion, the unit is ready to operate, unless the Fault LED is steadily illuminated.

Analog monitoring of the digital input signal is done through the internal speaker or externally by connecting an amplifier or headphones to the Line Out jack. It provides a high-quality analog version of any AES-3 or S/PDIF signal that is received by the AESQbox. Peak output level is +4dB, and the output is capable of driving headphones from 32 to 100 Ohms impedance. This output is controlled by the Line/Phones level control. The Speaker has a volume control and a three-position switch that selects the Channel A (left) or the Channel B (right) signal from the digital stream to be monitored. In the center position, the A and B signals are both fed to the audio amplifier simultaneously.



Controls and Functions

1. Input Sample Rate LEDs indicate the detected sample rate when locked to a digital audio input. Only one will be illuminated at a time, either full on or flashing, except during the Power-On Self-Test. Steady state on indicates professional AES-3 data and flashing denotes consumer AES-3 digital signal.

2. The Fault LED has three on states. Fully on means that a microcontroller fault has been detected. Flashing slowly indicates the unit is locked to a signal but can't determine the sample rate, or in Cable Test mode that the input sample rate does not match the output sample rate. Flashing rapidly means that the digital input signal is a non-PCM format, and cannot be decoded as audio.

3. The Speaker Monitor A/B Switch controls which of the two available audio channels is presented to the speaker for monitoring. In the center position, the A and B signals are both on.

4. The Operating Mode Select Switch selects the desired operating mode.

5. The Analog Input Source Select Switch controls which of the three possible analog input sources will be transmitted as digital AES-3 and S/PDIF.

6. The Clip LEDs monitor the analog input level to the A/D converters and will start flashing dimly when the signal is about 4dB below digital full-scale, and will illuminate steadily at about 1dB below digital full-scale.

7. The AES Digital Input XLR accepts standard AES-3 digital audio signals over 110 Ohm balanced shielded cable, and the S/PDIF Digital Input BNC accepts standard S/PDIF digital audio signals over 75 Ohm coaxial cable. Input levels may be as high as 5V p-p and as low as 250mV p-p. Input sample rates may range from 32kHz to 192kHz. The two jacks are transformer isolated and may be used as a loop thru balun for converting from 110 Ohm to 75 Ohm transmission lines.

8. The AES Digital Output XLR outputs standard AES-3 digital audio signals over 110 Ohm balanced shielded cable at 5V p-p. The S/PDIF Digital Output BNC outputs standard S/PDIF digital audio signals over 75 Ohm coaxial cable at 5V p-p. With the unit off, the XLR and BNC can also be used as a loop thru balun.

9. The Locked to Input LED will illuminate whenever an AES-3 or S/PDIF digital input signal is recognized by the digital receiver. In Pass Thru or In/Out modes, this indicates that the sample rate of the digital output signal matches that of the input. In Cable Test mode it comes on to indicate a good test cable; the output sample rate is dictated by the Sample Rate switch.

10. The Output Sample Rate Switch controls, under some conditions, the sample rate of the digital audio transmission. If there is no digital input present, or in Cable Test mode, the output sample rate is determined by the sample rate switch. If a digital input signal is present and locked in Pass Thru or In/Out modes, the digital output sample rate will mimic the sample rate of the digital input and this switch has no effect.

11. Output Level controls the analog level presented to the A/D Converter input. The mic, tone oscillators, and aux input are affected by this control, typically adjusted to a level where the Clip LEDs occasionally flash on.

12. Speaker Level adjusts the volume of the built-in speaker.

13. The Power Switch applies power from the external supply or the batteries.

14. The Power LED is illuminated when the Power switch is ON. It will dim as the batteries lose power, thus giving an indication of remaining battery life.

15. Line/Phones Level controls the analog audio level present on the Line Out 3.5mm TRS jack.

16. The Aux In Jack allows the operator to connect any analog source to the AESQbox. The maximum input level is +4dB. This is an unbalanced 3.5mm TRS jack with the left channel connected to the tip, the right to the ring, and the sleeve to common.

17. The Line Out Jack provides a high-quality analog version of any digital audio source received by the AESQbox. Peak output level is +4dB, and the output is capable of driving headphones from 32 to 100 Ohms impedance. The left channel is connected to the tip, the right to the ring, and the sleeve to common of the unbalanced 3.5mm TRS jack.

18. The Battery Compartment is a slide out drawer that accepts four "AA" alkaline cells.

19. The 6VDC external power jack is a 5.5mm x 2.1mm size with the center contact wired positive and the barrel contact negative. A 6VDC 1000mA plug-in power supply with the correct mating connector is supplied with the unit.

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