AECM206
headphone test fixture

User's Guide and Specifications

model AECM206

November, 2017

Audio precision

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Documentation and Support

This booklet contains a user's guide and full specifications for the Audio Precision AECM206 Headphone Test Fixture. The AECM206 is an acoustic accessory that requires ICP® powering for its internal microphones, and typically requires an audio analyzer such as an Audio Precision APx5 Series for signal measurement and analysis.

ap.com

Visit the Audio Precision web site at ap.com for APx support information and APx resources. You can also contact our Technical Support staff at techsupport@ap.com, or by telephoning 503-627-0832 ext. 4, or 800-231-7350 ext. 4 (toll free in the U.S.A.).

Serial Numbers

The internal microphones and preamplifiers are mated and calibrated as a pair, and must be maintained as a pair for the TEDS calibration to remain valid. Record your serial numbers here for reference.

AECM206 Headphone Test Fixture	sn _____
Left Ear Usage (blue cable marking)	
AECM304 Occluded Ear Simulator (with embedded microphone)	sn _____
426M15 preamplifier	sn _____
Right Ear Usage (red cable marking)	
AECM304 Occluded Ear Simulator (with embedded microphone)	sn _____
426M15 preamplifier	sn _____

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User's Guide

Overview

The AECM206 is a well-isolated headphone test fixture that supports standards-compliant headphone, earphone, earbud and hearing protection (ear muff) testing.

Symmetrical, anatomical pinnae are provided in two hardnesses, accommodating circum-aural, supra-aural, intra-concha, and insert earphone testing.

In the head of the fixture are two AECM304 ear simulators (acoustic couplers with built-in measurement microphones). Each AECM304 is fitted with an ear canal extension and connected to a 426M15 preamplifier and cable. The fixture is stabilized and mounted on a steel base that helps to isolate mechanical vibrations during testing.

The AECM206 complies with applicable portions of the International Standards ISO 4869-3 and IEC 60318-4.

What's in the box?

The AECM206 is delivered surrounded by protective contoured foam, shipped in either a cardboard carton or an optional hard travel case. The fixture is fully assembled and ready for immediate use.

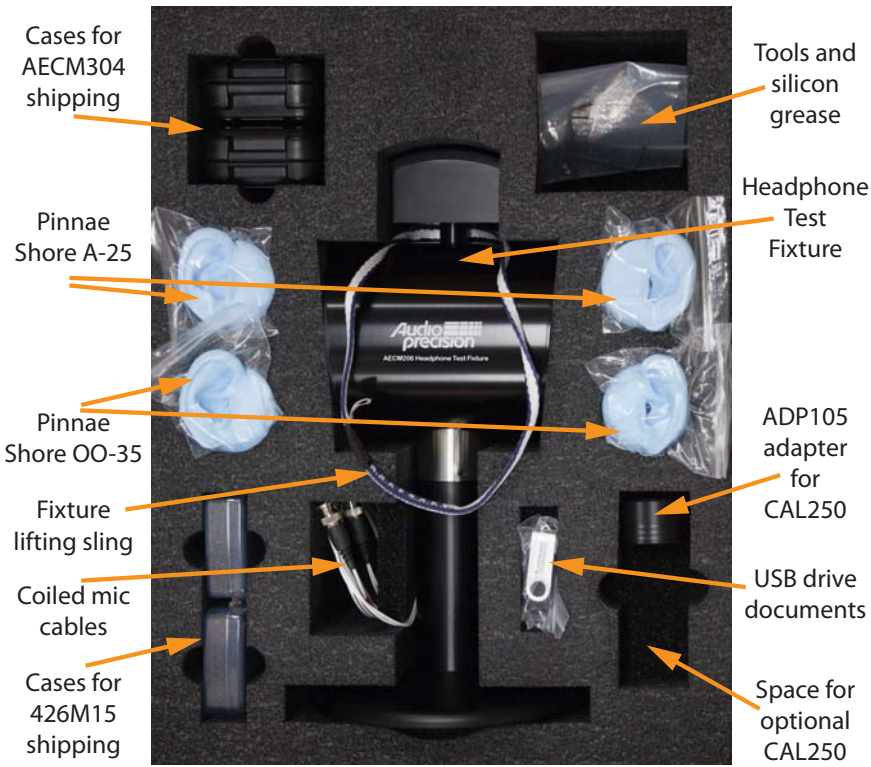

Figure 1. AECM206 as packaged for shipment

Inspection and preparation

Removal from the packaging

See Figure 1. The test fixture is protected for shipment by contoured foam in a strong carton or hard travel case. The fixture must be removed with care. For this purpose, a sling is provided. Pull the sling upwards with one hand while easing the base of the test fixture out of the case with the other hand.

Carefully remove the coiled audio cables from their cavity. Be sure to carefully coil the cables, and to encircle the test fixture with the sling when replacing it into the foam cutout.

To carry the AECM206, support both the neck and head simultaneously.

Components

The headphone test fixture consists of a massive tubular head, fitted on a neck, which is connected to a circular base. The head encloses an internal cavity where the ear simulator/preamplifier assemblies are mounted. The hat provides a support for the headband provided with most headphones.

The AECM304 ear simulator is fitted with an internal measurement microphone and is threaded for attachment to the 426M15 preamplifier. Each AECM304/426M15 assembly is a mated pair, calibrated together. The components must not be interchanged between assemblies.

At the acoustic end, each AECM304 is fitted with an ear canal extension. The ear canal extensions project slightly from the right and left side ends of the head. An alignment ring plate is mounted on each end, to secure the pinnae and aid in alignment when mounting headphones. See Figures 2 through 6.

Figure 2. Headphone Test Fixture key components

Figure 3. AECM206-RING alignment ring plate and screws. Two such rings are mounted on the AECM206.

Figure 4. ADP105 Adapter for CAL250.

Figure 5. 2.5 mm, 2 mm and 1.5 mm hex drivers; silicon grease.

Figure 6. An AECM304, shown here fitted with an ear canal extension to the left in the photograph, and mated to an 426M15 preamplifier, shown to the right. Two such assemblies are mounted within the AECM206 head.

Ear Simulator and Preamplifier

As mentioned, the AECM304 ear simulator and the 426M15 preamplifier are a mated pair that must be used together for the calibration and TEDS data to be valid.

The small cases provided for these components carry the part number and serial number, and are also labeled with the part number and serial number of the paired component. See Figure 7. Do not interchange these components.

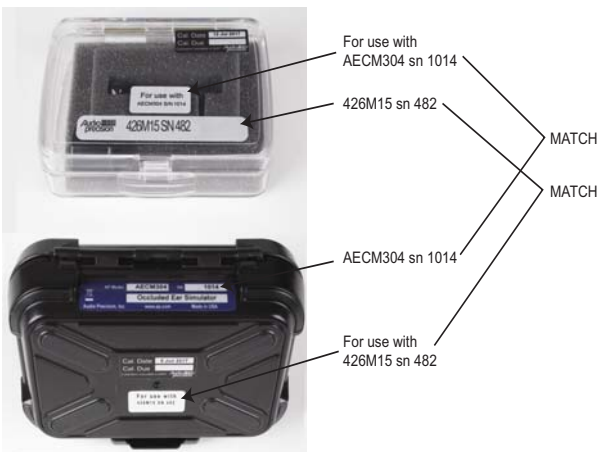

Figure 7. Example of serial number pairing labels.

Pinnae part numbers

Each pinna is labeled with a part number that designates left or right usage, and the hardness by the Shore rating scale.

Part Number	Usage	Hardness
AEC-LOO35	Left	Shore OO-35
AEC-ROO35	Right	Shore OO-35
AEC-LA25	Left	Shore A-25
AEC-RA25	Right	Shore A-25

Orientation

For orientation purposes, the face of the test fixture head is associated with the Audio Precision logo. Therefore, when the fixture is set with the logo facing you, the left pinna and internal ear simulator are to your right, and the right pinna and internal ear simulator are to your left.

The cable connected to the left ear simulator/preamplifier is indicated by a blue marker at the BNC connector, and the cable connected to the right ear simulator/preamplifier is indicated by a red marker.

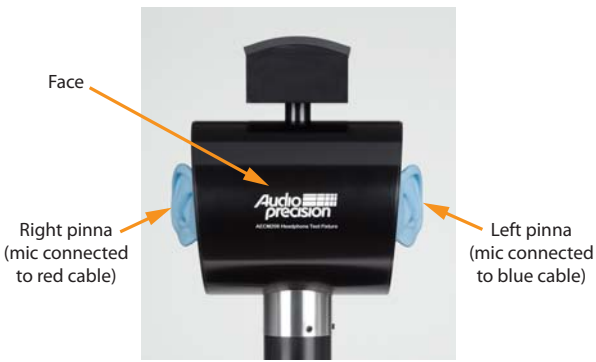

Figure 8. Headphone Test Fixture orientation

Attaching pinnae

You may remove the ring plate to fit the pinnae to the head and then replace the ring plate, or you can fit the pinnae without removing the ring plate by carefully pressing and tucking the base of each pinna into the shallow cavity behind the ring. In either case, be sure to line up the key slot at the bottom of each pinna to the alignment stud in the head, as shown in Figure 9.

Figure 9. Aligning the pinna.

To remove the pinnae, you can first remove the ring plates, or you can gently pull each pinna out from under the ring, being sure to grip the whole pinna so as not to damage it.

The Shore OO-35 pinnae are Type 3.3 pinna simulators, recommended for measurements on all types of devices.

The Shore A-25 pinnae are a Type 3.3 style with a Type 3.4 hardness. They are provided as a harder alternative, compressing to a lesser extent when using supra-aural or other compressing headphones.

Connection to an analyzer

Powering

Use the two BNC-terminated coaxial cables to connect to the unbalanced inputs of an audio analyzer (blue to left, red to right), via suitable microphone powering. The preamplifiers within the headphone test fixture require ICP® (IEPE) constant current power (CCP). This may be provided by using a suitable power supply, such as the Larson Davis 480B12, available from Audio Precision. Another excellent solution is the Audio Precision APx1701 Transducer Test Interface, which provides constant current power for the microphones and also a precision power amplifier to drive the headphone transducers.

TEDS

The preamplifiers are programmed with identification information and results of the latest factory calibration, encoded as TEDS (Transducer Electronic Data Sheet) data. The calibration information is specific to each ear simulator/preamplifier assembly. These comprise a mated pair and should not be interchanged with the components of another assembly.

Many devices (including the Audio Precision APx1701 Transducer Test Interface) can read embedded TEDS data.

Calibration

Factory Calibration

We recommend that the AECM206 be returned to the factory for calibration and certification as part of a regular service program.

Alternatively, the paired AECM304/426M15 assemblies can be removed from the head and returned to the factory together for calibration. Small cases are provided for this purpose. For information on removal, see "Removing Preamplifier and Ear Simulator" on page 10.

In either case, the TEDS for each AECM304/426M15 assembly will be updated using the latest factory calibration information.

Local Acoustic Level Calibration

In daily use, a local acoustic level calibration is typically performed frequently, perhaps at the beginning and end of each day, or even with each test. This ensures accurate testing levels in the local environment.

If local level calibration is not available, the TEDS data embedded in each AECM304/426M15 assembly can be used.

To calibrate the acoustic level for the Headphone Test Fixture, you must use a Larson Davis CAL250 calibrator. The CAL250 is an option you can purchase through Audio Precision. An ADP105 adapter is provided with the Headphone Test Fixture, and must be securely attached to the CAL250. The ADP105 is fitted with gaskets to assure a good acoustic seal with both the CAL250 and the Ear Canal Extension fitted to each AECM304.

Note: if the CAL250 has an ADP019 adapter already fitted, the ADP019 must be removed before attaching the ADP105.

Figure 10. CAL250 shown with ADP105 unattached, and with ADP105 attached for use.

Calibrate each side of the Headphone Test Fixture. Place the CAL250 with ADP105 on the ear canal extension of the internal ear simulator, and push it firmly into place to establish an acoustic seal, as shown in Figure 11. The coaxial output cable for that ear simulator/preamplifier assembly should be connected to a power supply and analyzer input. The CAL250 calibrator's acoustic output is 114 dBSPL (10 Pa) at 251.2 Hz.

Figure 11. CAL250 attached to the AECM206

Push the button on the calibrator to turn it on. The CAL250 will run for 60 seconds, which provides sufficient time for you to measure and set the calibration level in your analyzer. When calibration is complete, carefully remove the calibrator from the ear canal extension, pressing down to release the gasket seal before pulling the calibrator away, as shown in Figures 12 and 13.

Repeat this procedure to calibrate the opposite side of the Headphone Test Fixture.

Figure 12. Pressing down to release gasket seal.

Figure 13. Removing the calibrator.

Test Use Case

Figure 14 shows a block diagram of a basic headphone test, using the AECM206 Headphone Test Fixture, an Audio Precision analyzer and the Audio Precision APx1701 Transducer Test Interface.

This figure is representative: a different audio analyzer could be used, and the functions of the APx1701 could be replaced by an audio power amplifier and a two-channel ICP® microphone power supply.

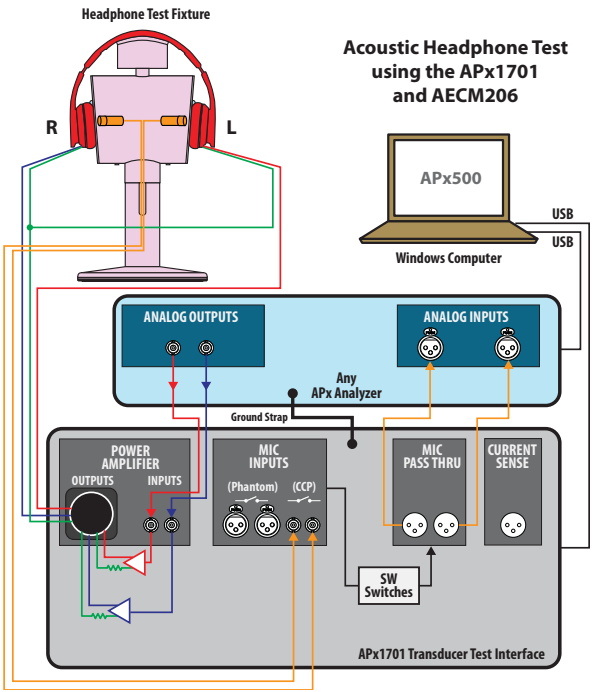

Figure 14. AECM206 test use case

Service

The AECM206 Headphone Test Fixture does not require regular maintenance. Keep the fixture clean and dust-free.

We recommend regular factory calibration for the left and right ear simulator/preamplifier assemblies. You can ship the entire Headphone Test Fixture to the factory; or, you may find it simpler to remove the two ear simulator/preamplifier assemblies (with attached cables) and return them for calibration using the small cases provided.

If a preamplifier/ear simulator assembly, cable, or other component is lost or damaged, contact our service department at service@ap.com for parts or service.

Disassembly

Removing the alignment ring plate

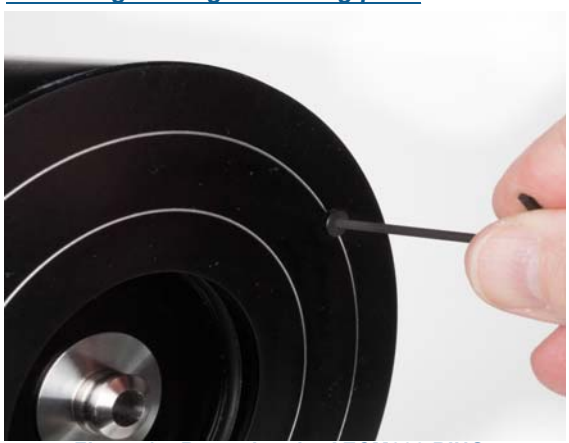

Figure 15. Removing the AECM206-RING.

The AECM206-RING alignment ring plate is attached to the fixture by four 2.5 mm screws. It is easily removed by removing the screws using the provided 2 mm hex wrench.

When re-attaching, secure the ring using the four screws. Do not over-tighten.

Removing the preamplifier/ear simulator system from the head

Each mated AECM304/426M15 assembly is clamped into the fixture, secured by a recessed set screw available on the rear of the fixture. Using the 2.5 mm hex wrench, back the set screw partially out by turning it counter-clockwise until two or three threads are visible, as shown in Figure 16.

Figure 16. Location of clamp set screws.

Gently pull the AECM304/426M15 assembly out of the fixture, as shown in Figure 17. If a tool is required, use pliers with non-marring (plastic or rubber) jaws. Be sure that the attached cable glides freely through the head. If the cables

cannot be pulled easily, remove the head from the neck as described on page 12.

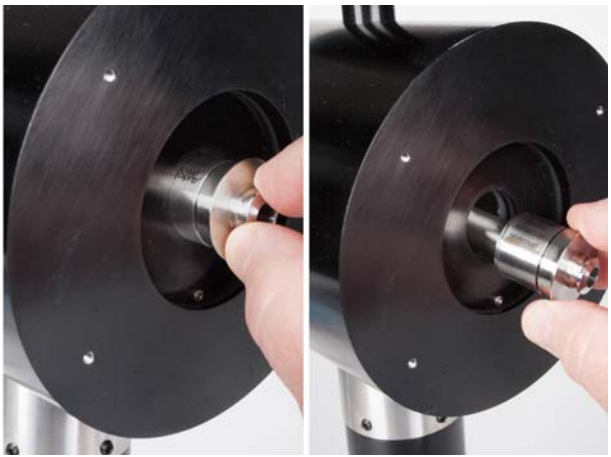

Figure 17. Removing the ear simulator/ preamplifier assembly.

Removing the ear simulator/preamplifier assembly for shipping

To completely remove the preamplifier/ear simulator assembly and cable for shipping, you must first separate the 426M15 preamplifier from the AECM304, and then remove the fixture head from the neck to free the cables from the acoustic isolation material.

Separating the preamplifier from the ear simulator

Once the clamp has been loosened (Figure 16) and the AECM304/426M15 assembly has been pulled out of the head (Figure 17), gently unscrew the AECM304 from the 426M15 as shown in Figure 18. To protect the threads on the 426M15, you may place a rubber boot (found in the preamplifier plastic case) over the threads, as shown in Figure 19.

Figure 18. Separating the preamplifier and ear simulator

Figure 19. Protective rubber boot on preamplifier threads

Removing the head from the neck

Two set screws in the stainless steel collar of the head secure the head to the neck, as shown in Figure 20. Use the 2.5 mm hex wrench to remove the two set screws.

Figure 20. Set screws securing the head to the neck.

Since both the head and the stand (the neck/base assembly) are heavy and unwieldy, care must be taken that the audio cables are not pulled or crimped.

Hold the base down with one hand and pull from the hat to separate the head and the neck, as shown in Figure 21. There is a tight acoustic seal between the head and the neck, requiring considerable force to separate the two. Avoid twisting, which may cause the cables to break.

Carefully remove the head from the neck and set it along side the stand. If there is not enough slack in the cables to allow you to set the head next to the stand, lay the stand on its side until you can release the cables.

Lay the head and neck/base assembly on a table as shown in Figure 22, pulling sufficient cable through the acoustic isolation material so that there will not be a strain on the cables.

Figure 21. Separating the head from the neck.

Figure 22. If necessary, lay the stand and head down together until you can loosen the cables.

In the neck, the audio cables are tucked into a crevice in the rubber barrier and acoustic isolation material, as can be seen in Figure 23. Gently pull the wires from the gasket by pulling away from the stand. If they don't come loose easily, use a hex driver to remove the washer and gasket, then gently pull the cables out of the gasket.

If you have already separated the AECM304 from the 426M15 as discussed on page 11, you will now be able to pull the cable and the attached 426M15 down through the head and neck collar and remove it.

Alternatively, if the AECM304/426M15 assembly is still mounted in the head, you can gently pull the assembly completely out of the head, as shown in Figure 17. Feed the cable and BNC connector up through the head and out the side.

Separate the 426M15 from the AECM304 by unscrewing the two devices, as shown in Figure 18. Do not remove the ear canal extension.

Figure 23. Slip the cables through the slot in the gasket and then pull the cables up through the opening in the neck.

Reassembly

Reinstalling the preamplifier/ear simulator system and cable

Ensure the correct AECM304 and mated 426M15 are to be installed on the correct side. See Orientation on page 5.

NOTE: It is important to follow these steps exactly to ensure the quality of the acoustic testing.

Connect AECM304 to 426M15 preamplifier by pushing together and screwing hand tight.

With head disconnected from the neck, feed the cable/BNC connector through the head cavity down out the neck collar, pulling all the cable through and finally inserting the attached AECM304/426M15 assembly into the head. Push the AECM304 in until set.

Figure 24. Removing the neck washer and gasket.

Using the 2.5 mm hex driver, unscrew the washer/gasket screw completely. Pull off assembly, and then separate the washer from the gasket, as shown in Figures 24 and 25. Place the head next to the stand.

Figure 25. Separating the washer from the gasket.

Measure approximately six inches of cable starting from the neck insert and running down, and at that spot gently push the cables into the gasket as shown in Figure 26. The length of cable between the gasket and neck insert should be approximately 6 inches.

Figure 26. Inserting the cables into the gasket.

Align the gasket slit with the center of the opening in the neck, so that the cables run down into the neck.

Place gasket on the neck with cables running down into the neck opening. Place washer on top and screw together with a torque of 20 ounce inches to provide an optimal seal. While turning the screw, squeeze the slit of the gasket together as shown in Figure 27. The slit in the gasket should be fully closed.

Figure 27. Tightening the neck washer and gasket.

Liberally grease the edges of the gasket as shown in Figures 28 and 29.

Feed the cable slack into the head. Ensure all cables are completely tucked in before moving on to the next step, so that you do not risk cutting the cables. See Figure 30.

With the head vertically aligned with the neck, mount the head onto the neck. You will feel resistance and a pressure build up in the head; this is normal. Screw in the neck screws until set, hand tight.

Ensure the AECM304/426M15 assembly is completely pushed into the head. Using a torque screwdriver set to 40 ounce inches, tighten the set screws on the back of the head until the assembly is clamped in place. See Figure 31.

Figure 28. Applying silicon grease to the neck gasket (1).

Figure 29. Applying silicon grease to the neck gasket (2).

Figure 30. Feeding cable slack into the head cavity.

Figure 31. Tightening the ear simulator clamp set screws.

Specifications

AECM206

Standards Met

AECM206

IEC 61010-1 (2010-06) Edition 3

ISO 4869-3:2007

Acoustics -- Hearing protectors -- Part 5

- Measurement of insertion loss of ear-muff type protectors using an acoustic test fixture

AECM304

IEC 60318-4:2010 occluded-ear simulators

ITU-T P.57 Type 3.3 compliant pinnae simulator

(AEC-LOO35 & AEC-ROO35)

Safety Marks

CE	CE mark indicates compliance with the EMC and Low Voltage Directives
	WEEE mark indicates compliance with the EU WEEE Directive

Physical Characteristics

Weight (case and all components): 18.3 kg (41 lbs)

Weight (test fixture only): 9.46 kg (21 lbs)

Size (height x width): 37.8 cm x 20 cm (7.9 in x 14.9 in). See Figure 32, Dimensions.

Cable Length: 5 ft (1.5 m)

Electrical Connector: BNC

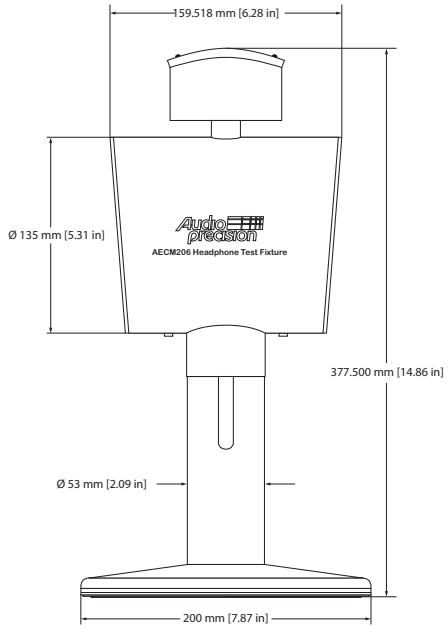

Figure 32.

Microphone

Information for the 377C13 microphone included in the AECM304 included ear simulator can be found at pcb.com

Options

CAL250 Class 1 acoustic calibrator with 1 inch opening and output of 114 dB re 20 µPa at 251.2 Hz.

ADP019 adapter for 1/2 inch microphones and calibration certificate

AEC206-CUP AEC206 acoustic isolation test cup

Replacement pinnae

- AEC-LOO35 Left pinna with hardness Shore OO-35
- AEC-ROO35 Right pinna with hardness Shore OO-35
- AEC-LA25 Left pinna with hardness Shore A-25
- AEC-RA25 Right pinna with hardness Shore A-25

426M15 Microphone Preamplifier

Performance

Nominal Microphone Diameter 1/2 inch

Gain: –0.20 dB

Frequency Response (± 0.2 dB) (re 1 kHz): 10 to 126,000 Hz

Frequency Response (–3 dB) (re 1 kHz): <0.6 Hz

Phase Linearity (<1 °): 63 to 20,000 Hz

Distortion (3 Vrms input at 1 kHz): <–70 dB

Output Slew Rate: 2 V/µs

TEDS Compliant: Yes

Environmental

Temperature Range (Operating): –40 to 70 °C (–40 to 158 °F)

Temperature Range (Storage): –40 to 85 °C (–40 to 185 °F)

Temperature Response: <0.03 dB

Humidity Range (Non-Condensing): 0 to 95% RH

Humidity Sensitivity: <0.03 dB

Electrical

Excitation Voltage: 20 to 32 Vdc

Constant Current Excitation: 2 to 20 mA

Impedance (Input): 20 GΩ

Capacitance (Input): 0.2 pF

Output Bias Voltage: 10 to 14 Vdc

Impedance (Output): <50 Ω

Output Voltage: ± 8 V

TEDS Compliant: Yes

Physical

Housing Material: Stainless Steel

Size (Diameter x Length): 12.7 mm x 35.7 mm (0.5 in x 1.4 in)

Weight: 3.6 gm (0.13 oz)

Electrical Connector: BNC Plug

Cable Length: 1.5 m (5 ft)

Mounting Thread (Microphone to Preamplifier): 11.7 mm - 60 UNS

Isolation Testing

Tested at Larson Davis in Provo, Utah. Method in accordance with ISO 4869-3.

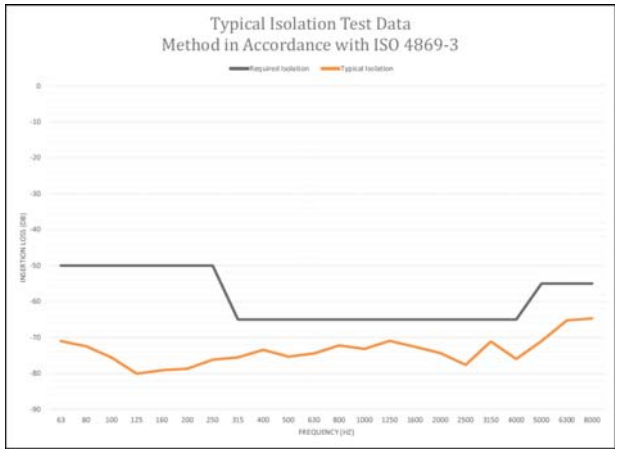

Figure 33.

Transfer Functions

The AECM206 is designed for headphone and earbud testing, where the sound is closely coupled to the ear. For free field and diffuse field head related transfer functions, it is assumed that a head and torso would be present rather than the actual geometry of the AECM206. The following transfer functions are in accordance with ANSI S3.36 (2012).

Free Field Response

Frequency (Hz)	*Response (dB)*	*Tolerance (dB)*
100	0.0	±1
125	0.0	±1
160	0.0	±1
200	0.0	±1
250	0.0	±1.3
315	1.0	±1.3
400	1.7	±1.5
500	2.5	±1.5
630	2.7	±1.8
800	4.0	±1.8
1000	3.5	±1.8

Frequency (Hz)	*Response (dB)*	*Tolerance (dB)*
1250	3.5	±2
1600	4.8	±2.5
2000	11.8	±2.5
2500	17.5	±2.5
3150	16.8	±2.5
4000	13.8	±2.5
5000	11.9	±3
6300	7.1	±6
8000	2.0	±8
10000	4.3	±8

Free Field Response

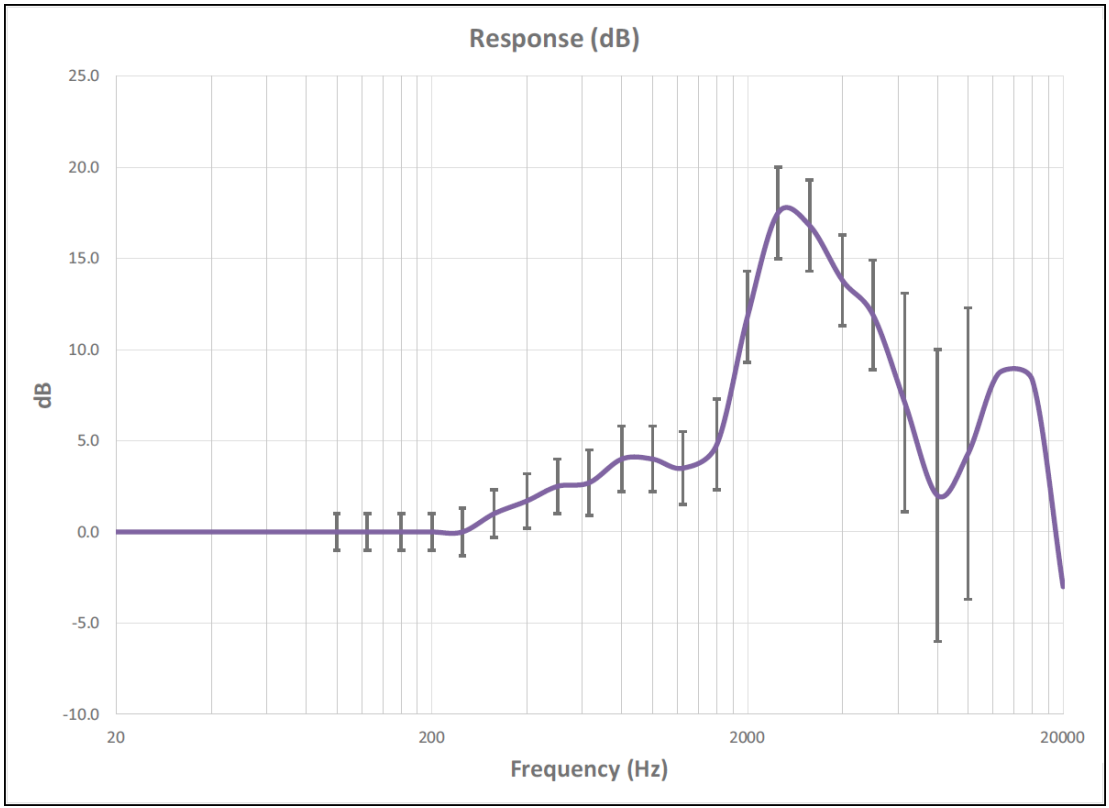

Figure 34.

Diffused Field Response

Frequency (Hz)	*Response (dB)*	*Tolerance (dB)*
100	0.0	±1
125	0.0	±1
160	0.3	±1
200	0.3	±1
250	0.3	±1.3
315	1.0	±1.3
400	1.7	±1.5
500	2.2	±1.5
630	2.9	±1.5
800	3.7	±1.5
1000	4.3	±1.5

Frequency (Hz)	*Response (dB)*	*Tolerance (dB)*
1250	5.8	±1.5
1600	8.0	±1.5
2000	11.3	±2
2500	14.4	±3
3150	14.8	±3
4000	13.4	±3
5000	11.1	±3
6300	9.6	±4
8000	10.0	±5
10000	7.7	±6

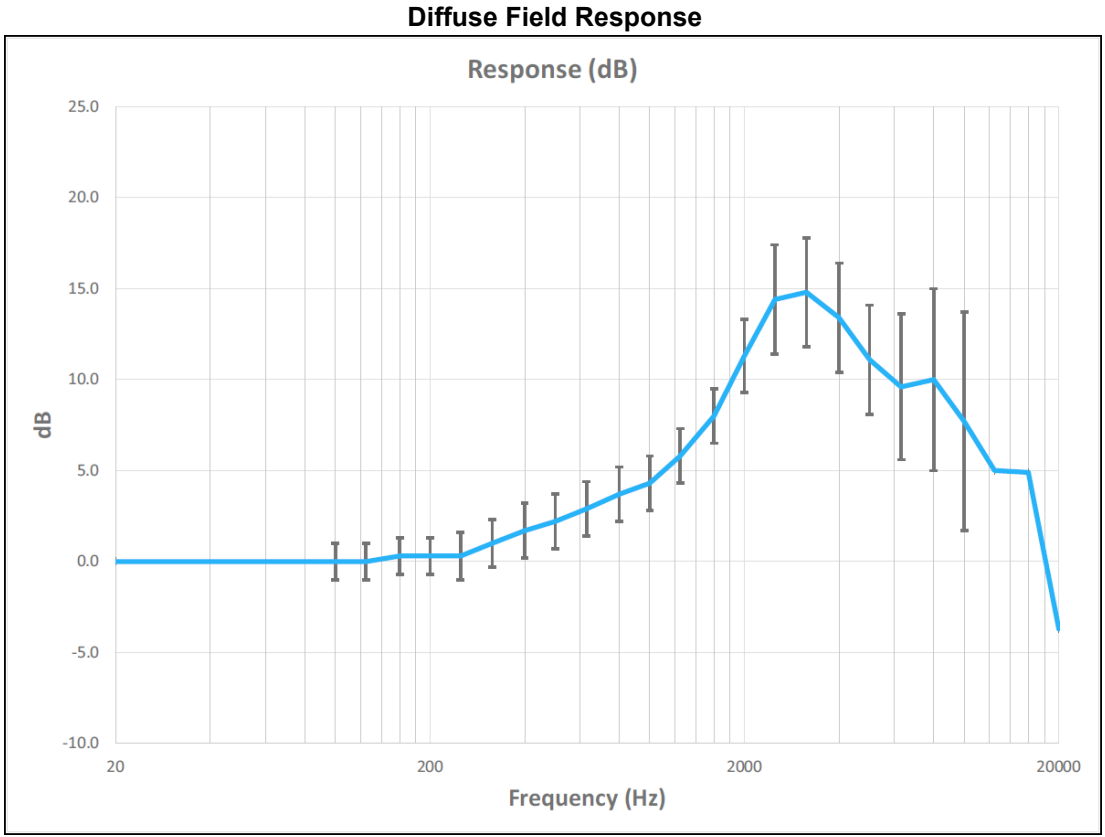
Diffuse Field Response
Response (dB)
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
dB
20
200
2000
20000
Frequency (Hz)

Figure 35.

Eardrum (DRP) to ERP Transfer Function

Frequency (Hz)	Response (dB)
100	0.0
106	0.0
112	0.0
118	0.0
125	0.0
132	0.0
140	0.0
150	0.0
160	0.0
170	-0.1
180	-0.1
190	0.0
200	0.1
212	0.0
224	-0.1
236	-0.1
250	-0.2
265	-0.3
280	-0.3
300	-0.2
315	-0.2
335	-0.2
355	-0.3
375	-0.4
400	-0.4
425	-0.5

Frequency (Hz)	Response (dB)
450	-0.4
475	-0.5
500	-0.7
530	-0.6
560	-0.6
600	-0.6
630	-0.7
670	-0.8
710	-0.9
750	-1.1
800	-1.1
850	-1.2
900	-1.3
950	-1.4
1000	-1.6
1060	-1.9
1120	-2.1
1180	-2.3
1250	-2.5
1320	-2.8
1400	-3.2
1500	-3.6
1600	-4.2
1700	-4.7
1800	-5.2
1900	-5.8

Frequency (Hz)	Response (dB)
2000	-6.5
2120	-7.2
2240	-7.8
2360	-8.5
2500	-9.3
2650	-9.9
2800	-10.6
3000	-10.7
3150	-10.4
3350	-9.6
3550	-8.5
3750	-7.5
4000	-6.3
4250	-5.3
4500	-4.5
4750	-3.7
5000	-3.0
5300	-2.6
5600	-2.4
6000	-2.5
6300	-2.9
6700	-4.0
7100	-5.3
7500	-7.5
8000	-12.2
8500	-18.6

DRP to ERP Transfer Function

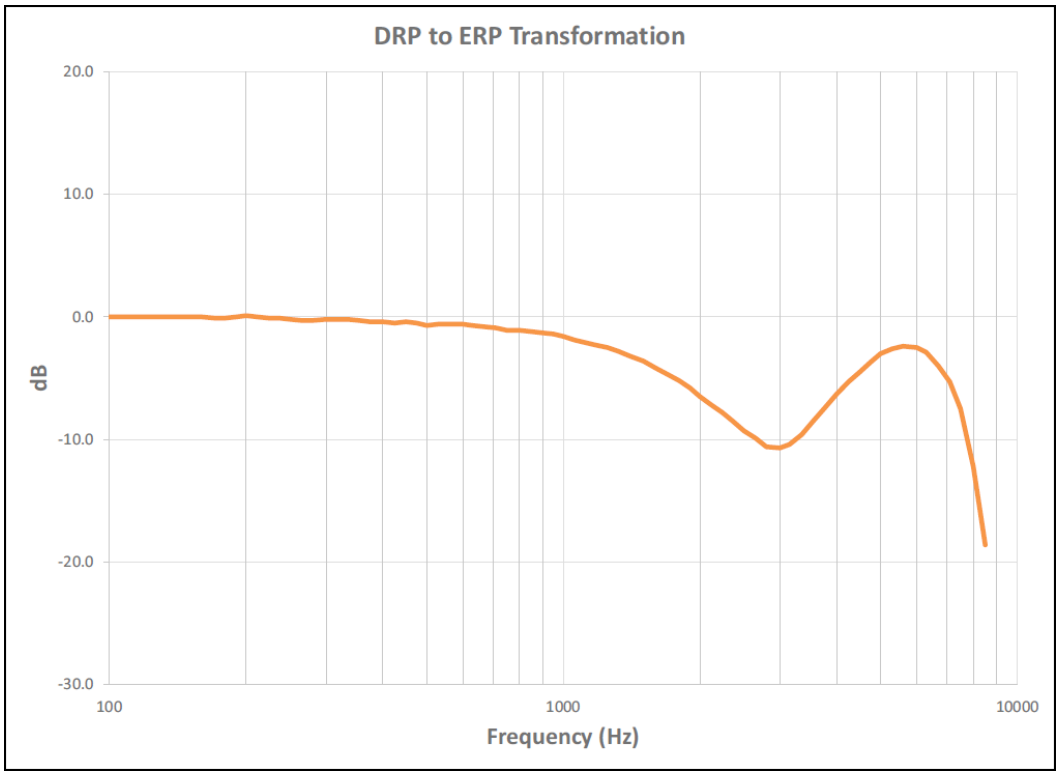

Figure 36.