Larson Davis
AEC201 Ear Simulator
Technical Reference Manual

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Larson Davis

AEC201 Ear Simulator

Reference Manual

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CHAPTER

1 Introduction

This chapter describes the features of the AEC201 Ear Simulator.

The AEC201 Ear Simulator

FIGURE 1-1 AEC201 with earphone

The Larson Davis AEC201 Ear Simulator covers the frequency range from 20 to 10000 Hz, which has been designed for the calibration of supra-aural earphones used in audiometry and telephonometry. The AEC201 allows accurate and repeatable measurements within its frequency range.

This ear simulator is part of the Larson Davis family of products for audiometer calibration and electro-acoustic test. With the other components of LD audiometer calibration systems, it provides a durable means of calibrating and testing many types of electro-acoustic transducers. It may also be used for production testing where correlation between the ear simulator and real ear response is not a requisite.

Components and Construction

The AEC201 is composed of three cavities coupled by precise acoustical impedances. The main cavity houses a 1/2” 377B13 pressure microphone, which is connected to the preamplifier inserted in the base of the coupler. Major mechanical parts are made of non-magnetic stainless steel for hardness, finish and long lasting quality, see FIGURE 1-2. The base has a non-skid rubber bottom and a vibration isolation pad is provided with the system.

In use, a supra-aural earphone is securely contained by an earphone retainer ring made of durable black anodized aluminum. Clamping force is supplied by a stainless steel main weight (4.5 N) lowered into the retainer ring. This approach adapts to different earphones and avoids adjusting complex spring loaded mechanisms.

The AEC201 also includes one Type 1 adapter plate and a heftier weight bag (9.5 N) required for circumaural ear phone testing. An optional Type 2 Adaptor, AEC201-2, is also available.

AEC201-A

The AEC201-A consist of both an AEC201 Ear Simulator and a 377B13 12.5 mV/Pa, prepolarized, pressure microphone.

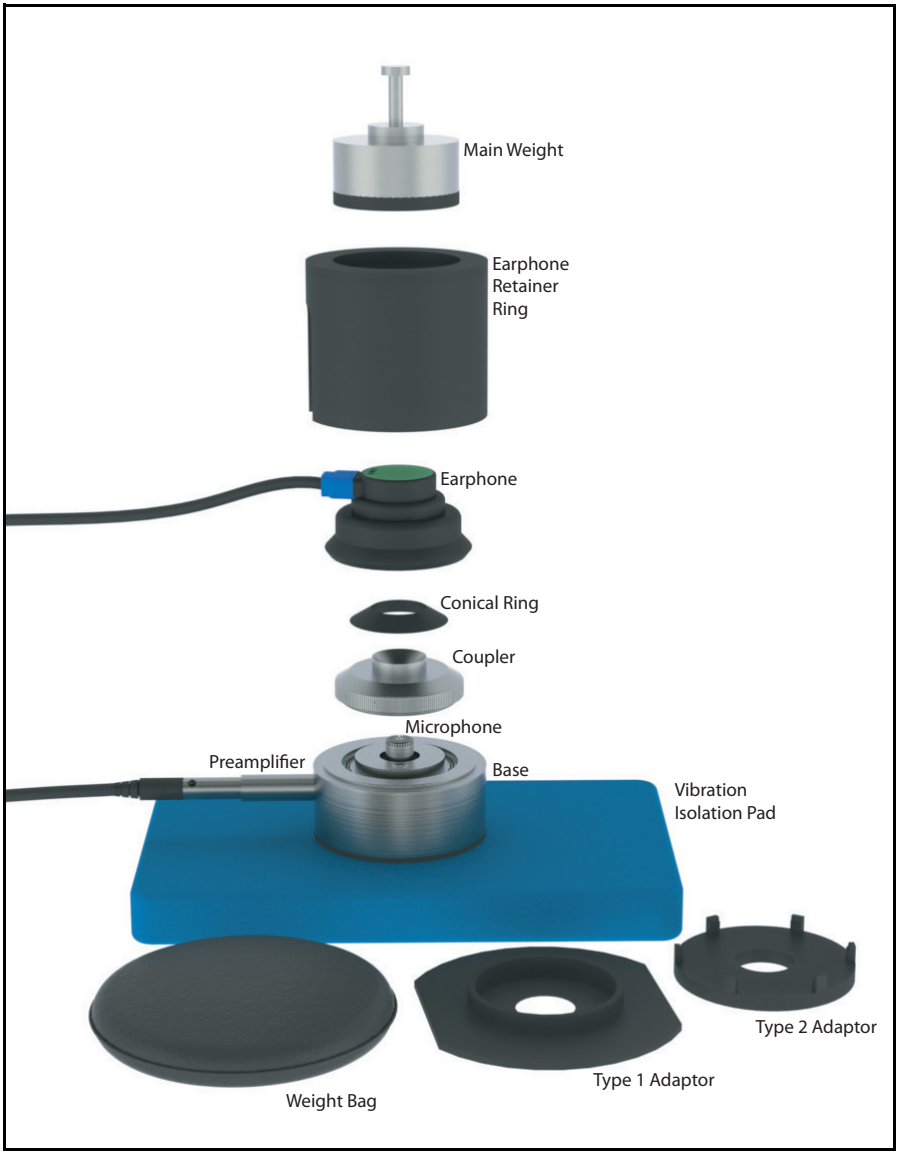


FIGURE 1-2 AEC201 Components

Earphone, microphone, preamplifier and Type 2 adaptor are optional components not supplied with the AEC201.

Standards

The AEC201 is designed to achieve the characteristics defined in International Electrotechnical Commission IEC 60318-1:2009 *Simulators of Human Head and Ear - Part 1: Ear Simulator for the calibration of supra-aural and circumaural earphones*. The AEC201 also meets the requirements of the American National Standard ANSI S3.7-1995 (R2008) *Method for Coupler Calibration of Earphones (Section 5.4)*. It is used with the PCB 377B13 precision 1/2" pressure microphone.

With the help of a circumaural adapter plate as described in IEC60318-1:2009 Annex B and ANSI S3.6-2004 Annex C, the AEC201 may also serve to calibrate specific high acoustic damping earphones. See Type 1 and Type 2 Adaptors in FIGURE 1-2.

Applications

The Larson Davis AEC201 Ear Simulator may be used for a number of precision electro-acoustic test applications, such as audiometer calibration and earphone frequency response production testing.

Audiometer Calibration

The accuracy of an individual's hearing evaluation is extremely important for clinical, legal, as well as personal reasons. The audiometers used to quantify hearing loss are complex instruments. They include signal generation, presentation and electro-acoustic components which must be verified periodically to ensure accuracy and repeatability.

Audiometers are often located in test areas which must also be tested for ambient noise and it is preferable not to remove them from their installation. Therefore, portable calibration systems are advantageous.

The Larson Davis AEC201 Ear Simulator is ideal for a lightweight portable calibration system. It is included in the LD SYS012 and SYS013 audiometer calibration systems, to perform exhaustive calibration for Audiometers.

Earphone Frequency Response Production Testing

As is the case with other Ear Simulators, the AEC201 approximates the average human ear only for a limited frequency range and with certain earphones. The measured responses may be significantly different from one earphone type to another. However, an exact correlation is not always required for production testing. It is possible to use the AEC201 as part of an accurate system for production testing of earphones or other electro-acoustic transducers. Such a system may consist of the following components:

- Test earphone and adapter for AEC201
- Larson Davis AEC201 Ear Simulator
- Cable from earphone connector to output of source
- Precision amplifier (if required)
- Precision sound level meter such as Larson Davis Model 831 with frequency analysis capability, OBA. See FIGURE 1-3.

Frequency response, level linearity and harmonic distortion can be measured using a signal generator, the ear simulator and a precision sound level meter.

FIGURE 1-3 Model 831

CHAPTER

2 Inspection and Assembly

This chapter describes the components and assembly of the AEC201 Ear Simulator.

The AEC201 is available in a variety of configurations. You may have purchased the ear simulator alone, with various accessories, or within a complete audiometer test system. In this chapter, the initial inspection of the AEC201 will be covered. You will also assemble an AEC201 and connect it to a measurement system, in this case the Model 831 sound level meter. For this you will need:

Part Number	Description
CBL138	USB Cable
Model 831	Model 831 precision sound level meter (SLM)
EXC010	10 foot extension cable with 5 pin connectors
PRM831	1/2”diameter low noise microphone preamplifier
CAL200	Precision SPL calibrator with 114 dB SPL output at 1k Hz
AEC201	Ear Simulator including base, contacts, insulator, vibration isolation pad, coupler, conical ring, earphone retainer ring, 377B13 microphone, Type 1 adaptor, main weight and weight bag
AEC201-2	Circumaural Type 2 Earphone Adaptor (optional)
377B13	Prepolarized pressure microphone

WARNING! *Before continuing, ensure that the SLM is turned off. Sensitive circuitry may be adversely affected during assembly if the SLM is on. The SLM should remain off until the system is fully assembled.*

The AEC201 Ear Simulator is a versatile coupler and allows measurement of a variety of earphones with its provided accessories. Read the following instructions to inspect and assemble the coupler for the first time.

Step 1 Place the cushioned vibration isolation pad on a table or other stable surfaces near the audiometer system.

Step 2 Visually inspect the coupler for gouges, scratches and dents which may affect the measurement especially around the lip which will be in contact with the test earphone. Verify that the small tube in the capillary leak hole is present with no obstructions FIGURE 2-1.

Note: The AEC201 comes assembled with microphone. Once assembled Steps 2-3 can be skipped.

FIGURE 2-1 AEC201 with coupler, leak hole

Note: When it is necessary to remove the microphone be careful to remove the entire microphone and not just the grid cap. If the grid cap comes off without the mic body attached it could be damaged. If this happens, reattach the grid cap, remove the two Phillips screws and top ring shown in FIGURE 2-2. The microphone body is now more accessible for easy removal.

Step 3 Working over the vibration isolation pad (ACC001), install the microphone 377B13 on the center of the base. The microphone should install easily: screw it finger tight. See FIGURE 2-2.

FIGURE 2-2 Microphone installed on AEC201 Base

Step 4 Insert the 1/2” microphone preamplifier (LD Model PRM831 or equivalent) gently in the side port until its threads contact those of the base. The preamplifier should install easily; screw it finger tight. See FIGURE 2-3.

Note: When removing the preamplifier, unscrew it by holding on its body, not the connector sleeve

FIGURE 2-3 Preamp ready to be installed in the AEC201

Step 5 Connect the EXC010 instrument cable to the preamplifier.

Step 6 Connect the EXC010 cable to the Model 831 Sound Level Meter. The coupler is now ready for level calibration.

AEC201 Ear Simulator SPL Calibration

Level calibration is performed using a Larson Davis CAL200 precision calibrator. It offers a level of 114 dB with an accuracy of +/-0.2 dB at 1 kHz. To calibrate the measurement system and artificial ear, follow the procedure below:

Step 1 If attached, remove the coupler from the base by gently unscrewing counter clock-wise. One finger can be placed on the microphone grid cap to prevent it from turning. See FIGURE 2-1.

Step 2 The coupler base should rest on the vibration isolation pad so that effects of ambient vibration will be minimized.

Note: Do not remove the microphone grid cap.

Step 3 Place the calibrator opening on the microphone and gently seat it fully. See FIGURE 2-4.

FIGURE 2-4 Installing the CAL200 on AEC201

Do not hold the calibrator during calibration.

FIGURE 2-5 CAL200 being activated on AEC201

Step 4 Activate the calibrator and verify the stability of the indication on the measurement system. See FIGURE 2-5.

Step 5 Follow the instructions for calibration of the Model 831 Sound Level Meter found in it's Technical Reference manual.

Step 6 If a different Sound Level Meter is used make sure the microphone bias is set to prepolarized (zero volts).

CHAPTER

3 Testing Transducers

This chapter describes the testing of audiometer transducers using the AEC201.

Audiometer Transducer Test Configurations

Please contact Larson Davis if you have any system assembly questions not covered in this manual.

The table below lists some typical audiometer transducers, many of which are covered in specifications such as American National Standards Institute Specifications for Audiometers, S3.6-2004, and International Electrotechnical Commission 60645. These test setups are covered in greater detail in subsequent sections.

Transducer Type	Example	Suggested Setup
Supra-aural earphone	Telephonics TDH-39, 49, 50	AEC100 NBS 9-A coupler or AEC201 ear simulator. *'Testing Supra-Aural Earphones using AEC201" on page 3-2*
Circumaural earphone	Sennheiser HDA200	AEC201 ear simulator with Type 1 adaptor plate. *See Step 1 on page 3-5*
Circumaural earphone	Koss HV/1A	AEC201 ear simulator with Type 2 adaptor plate. *See Step 5 on page 3-6*

Table 3-1 Typical Audiometer Transducers

Testing Supra-Aural Earphones using AEC201

The following steps are suggested for audiometer calibration using AEC201.

Step 1 Assemble the coupler as described in Chapter 2 "Assembly" on page 2-2. The base should rest on the vibration isolation pad so that ambient noise and vibration will be minimized.

Step 2 Perform a calibration of the system as described in Chapter 2 "AEC201 Ear Simulator SPL Calibration" on page 2-4.

Step 3 Screw the coupler over the base until finger tight. See FIGURE 3-1.

FIGURE 3-1 Coupler being installed on AEC201

Step 4 Place the black conical ring on the top of the coupler. See FIGURE 3-2.

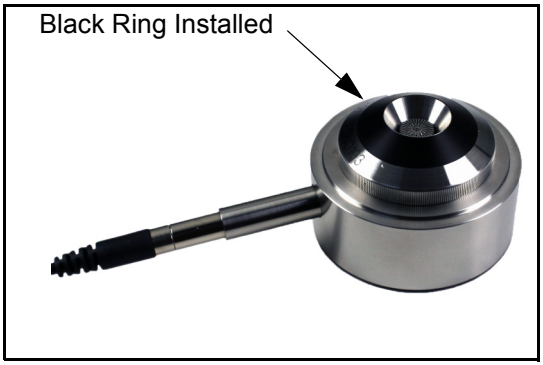


FIGURE 3-2 Black Conical ring installed on AEC201

Step 5 For earphones with a very stiff ear cap, use a thin, soft ring of rubber sheet on the contact area between coupler and earphone.

Step 6 Center the test earphone on the coupler. Lower the black earphone retainer ring over the earphone, holding the earphone cable in line with the notch. See FIGURE 3-3.

FIGURE 3-3 Earphone and retainer ring being installed on AEC201

Step 7 Lower the main weight on top of the earphone. See FIGURE 3-4.

FIGURE 3-4 Main Weight on headphone

The AEC201 ear simulator and earphone are now ready for measurement.

Testing Circumaural Earphones using AEC201

Circumaural earphones are available for audiometers using extended high-frequencies from 8000 Hz to 16000 Hz. These earphones typically rest against the head with little or no contact with the pinna (external ear). Their speaker or driver is coupled to the ear with a relatively large volume of air under the ear cap.

Interim RETSPLs for two circumaural earphones are listed in Annex C of ANSI S3.6-2004, the Sennheiser HDA200 and Koss HV/1A.

Environmental conditions

It is recommended in various standards that the extended high-frequency calibration of circumaural earphones be

performed when the following environmental conditions are met.

Condition	ANSI S3.6-2004 (Annex C)	IEC 60318-1:2009 Clause 6 Calibration
Ambient Pressure	98 to 104 kPa	98.3 to 104.3 kPa
Temperature	18 to 26 degrees C	20 to 26 degrees C
Relative Humidity	30 to 80% RH	30 to 70% RH
Any conditions not met	Calibration is not allowed	State actual values

Table 3-2 Environmental Conditions

Test Configurations

The following steps are suggested for circumaural earphone audiometer calibration using AEC201:

Step 1 Assemble the ear simulator as described in Chapter 2 "Assembly" on page 2-2. The base should rest on the vibration isolation pad so that ambient noise and vibration will be minimized.

Step 2 Perform a calibration of the system as described in Chapter 2 "AEC201 Ear Simulator SPL Calibration" on page 2-4.

Step 3 Screw the coupler over the base until finger tight. See FIGURE 3-1.

Step 4 For earphones designed to be calibrated with a Type 1 adapter, such as the Sennheiser HDA200, install the Type 1 adapter on the coupler, with the cylindrical rim facing down. Place the black conical ring on top of the coupler and plate, with its flat base on the bottom. See FIGURE 3-5.

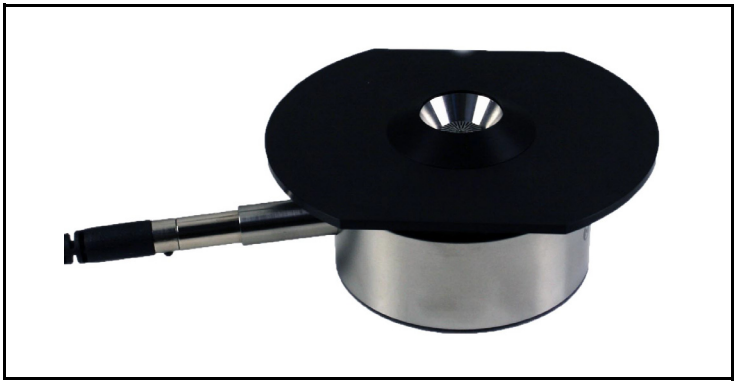


FIGURE 3-5 AEC201 with Type 1 adapter installed

Step 5 For earphones designed to be calibrated with a Type 2 adapter such as the KOSS HV/1A, use the optional AEC201-2 Type 2 adapter. Do not use the black conical ring. See FIGURE 3-6.

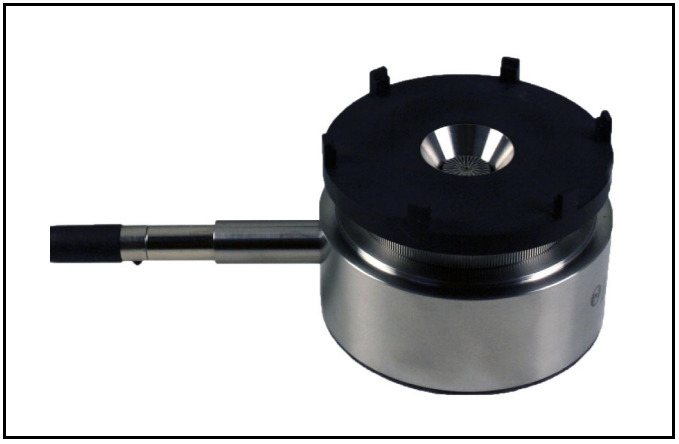


FIGURE 3-6 Type 2 adapter installed on AEC201

Step 6 Center the earphone on the coupler or place it as recommended by the earphone manufacturer if the cushion is asymmetrical.

Step 7 ANSI S3.6-2004 requires a static force of 9 to 10 N on the earphone during calibration. Use the weight bag. See FIGURE 3-7.

FIGURE 3-7 Sennheiser earphone and weight being installed on AEC201

The coupler and earphone are now ready for measurement.

APPENDIX

A Specifications

Standards

Fulfills the requirements of:

- International Standard IEC 60318-1:2009, *Simulators of human head and ear - Part 1 ear simulator for the measurement of supra-aural and circumaural earphones* when used with Model PCB 377B13 1/2" pressure microphone.
- American National Standards Institute ANSI S3.7-1995 (R2008) *Method for Coupler Calibration of Earphones*:

  Section 5.4: *IEC coupler for supra-aural earphones* described in Annex C (normative) Calibration of circumaural earphones for extended high frequency testing.

Note: IEC 60318-1:2009 replaced both IEC 60318-1:1998-07 and IEC 60318-2:1998-08.

- International Standard IEC 60318-2:1998-08, *Electroacoustics - Simulators of human head and ear - Part 2 An interim acoustic coupler for the calibration of audiometric earphones in the extended high-frequency range* when used with the PCB Model 377B13 1/2" pressure microphone and Type 1 or Type 2 adapter plate.
- Application of Council Directives: 2004 /108/EC EMC Directive.
- IEC 61326-1: 2005 Electrical equipment for measurement, control and laboratory use - EMC requirements.
- CE-Mark indicates compliance with EMC directive 2004 /108/EC
- CISPR 11:ed 5.0.2009: Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement. Class B, group 1.

Physical

AEC201 Coupler and Base	
Nominal acoustic volumes	2487 mm^3, 1819 mm^3, 7438 mm^3
Microphone mounting thread	11.7 mm - 60 UNS (0.4606-60 UNS-2A)
Preamplifier mounting thread	11.7 mm - 60 UNS (0.4606.60 UNS-2B)
Maximum diameter	82 mm (3.2 in)
Height	50.9 mm (2.0 in) without mass and earphone retainer, 119 mm (4.7 in) with earphone retainer ring
Weight	1.4 kg (3.2 lb)

Type 1 Adaptor	
Maximum diameter	120 mm (4.72 in)
Height	10.8 mm (.42 in)
Weight	260 g (.57 lb)
Typical earphone	Sennheiser HDA200

Type 2 Adaptor LD AEC201-2	
Maximum diameter	78.5 mm (3.1 in)
Height	10.8 mm (0.5 in)
Weight	247 g (.54 lb)
Typical earphone	Koss HV/1A

Weights	
Main Weight with handle	470 g (1.0 lb)
Weight bag	970 g (2.1 lb)

Calibration Environmental Conditions	
Reference ambient pressure	101.3 kPa ± 3.0 kPa
Reference temperature	23 °C ± 3 °C (73.4 °F ± 5.4 °F)
Reference relative humidity	50% RH ± 20% RH
Transfer Impedance Temperature sensitivity	+0.04 dB/°C typical (18 °C to 28 °C)
Transfer Impedance Static pressure sensitivity	+0.10 dB/kPa at 400 Hz typical +0.07 dB/kPa at 1 kHz typical +0.11 dB/kPa at 3 kHz typical (86 kPa to 102 kPa)

Compatibility	
Microphone	PCB Model 377B13 1/2 in. prepolarized pressure microphone of Type WS2P per IEC 61094-4
Preamplifier	Larson Davis Model PRM831, PRM902 or PRMLxT1/1L
Circumaural Earphones	Type 1 Adaptor or Type 2 Adaptor AEC201-2
Artificial Mastoid	Larson Davis Model AMC493
Please contact Larson Davis for compatibility with other accessories.	

User Replaceable Parts

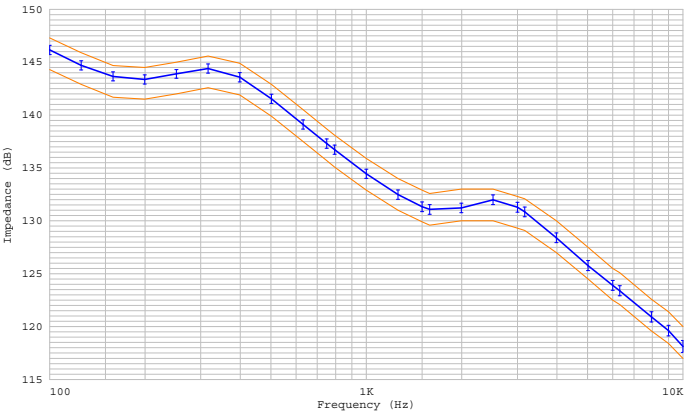
Component (see FIGURE 1-2)	
Coupler	S201.11
Base	S201.12
Conical Ring	MAEC101.08
Earphone Retainer Ring	MAE100.6
Main Weight	S201.13
Preamplifier	PRM831, PRMLxT1 or PRM902
Microphone	377B13
Vibration Isolation Pad	ACC001
Type 1 Adaptor	MAEC101.06
Weight Bag	AMAEC101.10
Optional Type 2 Adaptor	AEC201-2

Replacement of parts within these components may affect the acoustic performance and can only be repaired or replaced at the factory.

Frequency Response

Typical Transfer impedance and Sensitivity of the AEC201 are presented as a function of frequency on the following pages.

Artificial Ear Transfer Impedance
Larson Davis Model: AEC201 S/N: 0101



Transfer Impedance (reference: 1 Pa·s/m^3)

Frequency (Hz)	Impedance (dB)	Error (dB)	Lower Limit (dB)	Upper Limit (dB)	Uncertainty (dB)
100	146.165	0.365	144.30	147.30	0.44
126	144.701	0.301	142.90	145.90	0.43
158	143.663	0.463	141.70	144.70	0.43
200	143.370	0.370	141.50	144.50	0.43
251	143.909	0.409	142.00	145.00	0.41
316	144.405	0.305	142.60	145.60	0.43
398	143.589	0.189	141.90	144.90	0.44
501	141.542	0.142	139.90	142.90	0.43
631	139.118	0.118	137.50	140.50	0.44
750	137.313	0.113	135.70	138.70	0.44
794	136.735	0.135	135.10	138.10	0.44
1000	134.453	0.053	132.90	135.90	0.44
1259	132.486	-0.014	131.00	134.00	0.44
1500	131.333	-0.067	129.90	132.90	0.45
1585	131.086	-0.014	129.60	132.60	0.45
1995	131.229	-0.271	130.00	133.00	0.45
2512	131.992	0.492	130.00	133.00	0.46
3000	131.299	0.499	129.30	132.30	0.46
3162	130.850	0.250	129.10	132.10	0.46
3981	128.404	-0.096	127.00	130.00	0.46
5012	125.779	-0.221	124.50	127.50	0.47
6000	123.908	-0.092	122.50	125.50	0.47
6310	123.395	-0.205	122.10	125.10	0.47
7943	120.923	-0.177	119.60	122.60	0.48
9000	119.629	-0.271	118.40	121.40	0.50
10000	118.127	-0.373	117.00	120.00	0.57

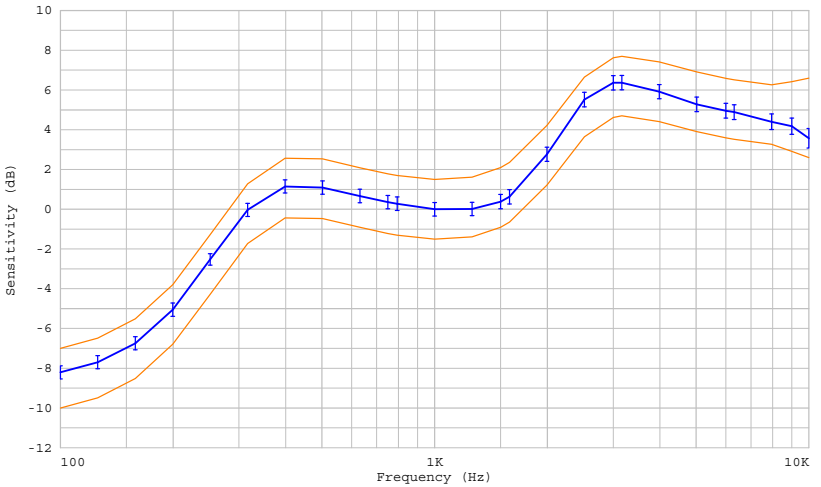
Temperature (°C): 23 ± 3 Relative Humdity (%): 27 ± 5 Static Pressure (kPa): 101.2 ± 2.0

Uncertainty at ~95% confidence level (k=2)

Tested by A. Tester on 22NOV2010 at 2:09 PM

FIGURE A-8 Typical Ear Simulator Test Data

Artificial Ear Sensitivity
Larson Davis Model: AEC201 S/N: 0101



Frequency Response (reference to 1 kHz)

Frequency (Hz)	Sensitivity (dB)	Error (dB)	Lower Limit (dB)	Upper Limit (dB)	Uncertainty (dB)
100	-8.205	0.294	-10.00	-7.00	0.33
126	-7.695	0.293	-9.49	-6.49	0.33
158	-6.744	0.267	-8.51	-5.51	0.33
200	-5.049	0.238	-6.79	-3.79	0.33
251	-2.521	0.253	-4.27	-1.27	0.29
316	-0.030	0.191	-1.72	1.28	0.33
398	1.149	0.079	-0.43	2.57	0.33
501	1.096	0.056	-0.46	2.54	0.33
631	0.670	0.077	-0.91	2.09	0.34
750	0.362	0.077	-1.22	1.78	0.34
794	0.281	0.079	-1.30	1.70	0.34
1000	0.000	0.000	-1.50	1.50	0.34
1259	0.017	-0.096	-1.39	1.61	0.34
1500	0.387	-0.211	-0.90	2.10	0.36
1585	0.630	-0.233	-0.64	2.36	0.36
1995	2.769	0.046	1.22	4.22	0.36
2512	5.522	0.369	3.65	6.65	0.36
3000	6.366	0.239	4.63	7.63	0.36
3162	6.371	0.171	4.70	7.70	0.36
3981	5.921	0.007	4.41	7.41	0.36
5012	5.283	-0.123	3.91	6.91	0.37
6000	4.961	-0.131	3.59	6.59	0.37
6310	4.890	-0.130	3.52	6.52	0.37
7943	4.407	-0.358	3.26	6.26	0.39
9000	4.182	-0.486	2.92	6.42	0.41
10000	3.574	-1.029	2.60	6.60	0.49

Temperature (°C): 23 ± 3 Relative Humdity (%): 27 ± 5 Static Pressure (kPa): 101.2 ± 2.0

Uncertainty at ~95% confidence level (k=2)

Tested by A. Tester on 22NOV2010 at 2:09 PM

FIGURE A-9 Typical Ear Simulator Test Data

Static Pressure Response

Typical Transfer Impedance and Sensitivity of the AEC201 are presented as a function of static pressure in the following figures.

LD AEC201 Ear Simulator
Transfer Impedance Change with static Pressure

	Static Pressure (kPa)			
Freq	101.3	96.4	91.3	86.3
(Hz)	(dB)	(dB)	(dB)	(dB)
100	145.94	145.68	145.37	145.05
126	144.42	144.15	143.95	143.71
158	143.33	143.18	143.00	142.85
200	143.01	142.83	142.66	142.52
251	143.49	143.24	142.94	142.67
316	144.04	143.59	143.13	142.69
398	143.34	142.84	142.30	141.80
501	141.40	140.94	140.44	139.97
631	138.99	138.58	138.14	137.72
750	137.19	136.81	136.41	136.02
794	136.59	136.23	135.83	135.46
1000	134.33	134.01	133.67	133.33
1259	132.34	132.08	131.82	131.53
1500	131.20	131.00	130.78	130.54
1585	130.96	130.78	130.56	130.33
1995	131.08	130.82	130.55	130.22
2512	131.92	131.44	130.93	130.40
3000	131.25	130.73	130.17	129.60
3162	130.81	130.30	129.76	129.19
3981	128.43	127.98	127.48	126.98
5012	125.94	125.51	125.03	124.55
6000	124.12	123.68	123.21	122.71
6310	123.61	123.17	122.69	122.19
7943	121.39	120.93	120.43	119.91
9000	120.03	119.55	119.05	118.53
10000	119.52	119.02	118.51	117.97

FIGURE A-10 Transfer Impedance change with Static Pressure Table

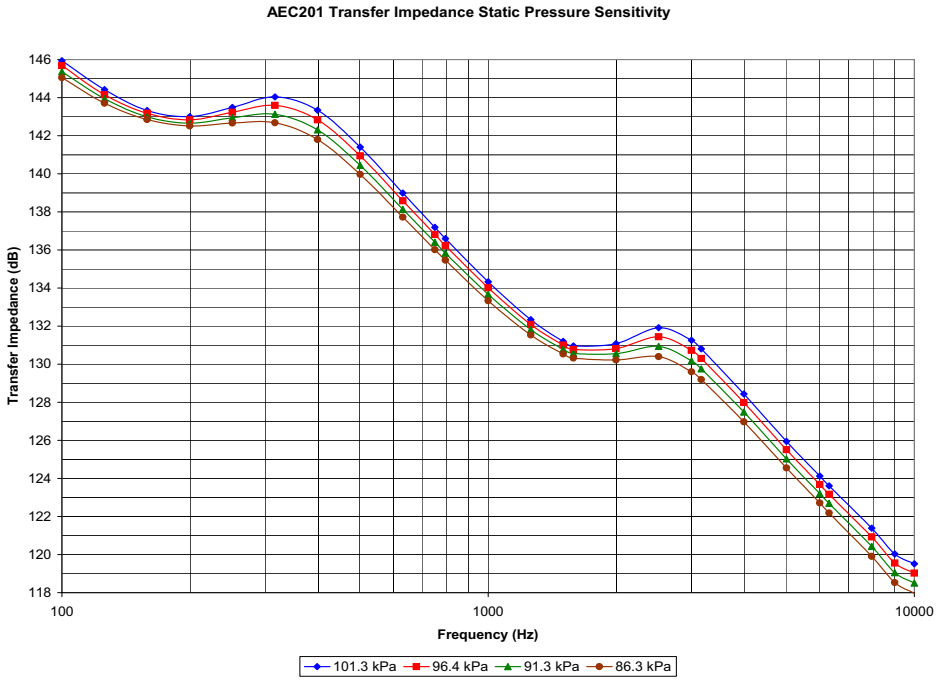


FIGURE A-11 Transfer Impedance change with Static Pressure Graph

LD AEC201 Ear Simulator
Sensitivity Change with static Pressure

	Static Pressure (kPa)			
Freq (Hz)	101.3 (dB)	96.4 (dB)	91.3 (dB)	86.3 (dB)
100	-8.40	-8.34	-8.32	-8.29
126	-7.92	-7.87	-7.73	-7.64
158	-7.01	-6.84	-6.69	-6.49
200	-5.32	-5.18	-5.02	-4.82
251	-2.84	-2.78	-2.73	-2.67
316	-0.30	-0.42	-0.55	-0.66
398	1.01	0.82	0.63	0.47
501	1.06	0.92	0.76	0.63
631	0.66	0.57	0.47	0.39
750	0.36	0.30	0.24	0.19
794	0.26	0.22	0.17	0.13
1000	0.00	0.00	0.00	0.00
1259	0.01	0.07	0.15	0.20
1500	0.39	0.51	0.63	0.72
1585	0.63	0.77	0.90	0.99
1995	2.74	2.80	2.86	2.87
2512	5.58	5.42	5.25	5.05
3000	6.45	6.25	6.03	5.79
3162	6.46	6.27	6.07	5.84
3981	6.08	5.95	5.79	5.62
5012	5.58	5.46	5.33	5.19
6000	5.31	5.19	5.05	4.90
6310	5.24	5.11	4.97	4.80
7943	5.01	4.87	4.70	4.52
9000	4.72	4.57	4.40	4.22
10000	5.11	4.94	4.76	4.56

FIGURE A-12 Sensitivity change with Static Pressure Table

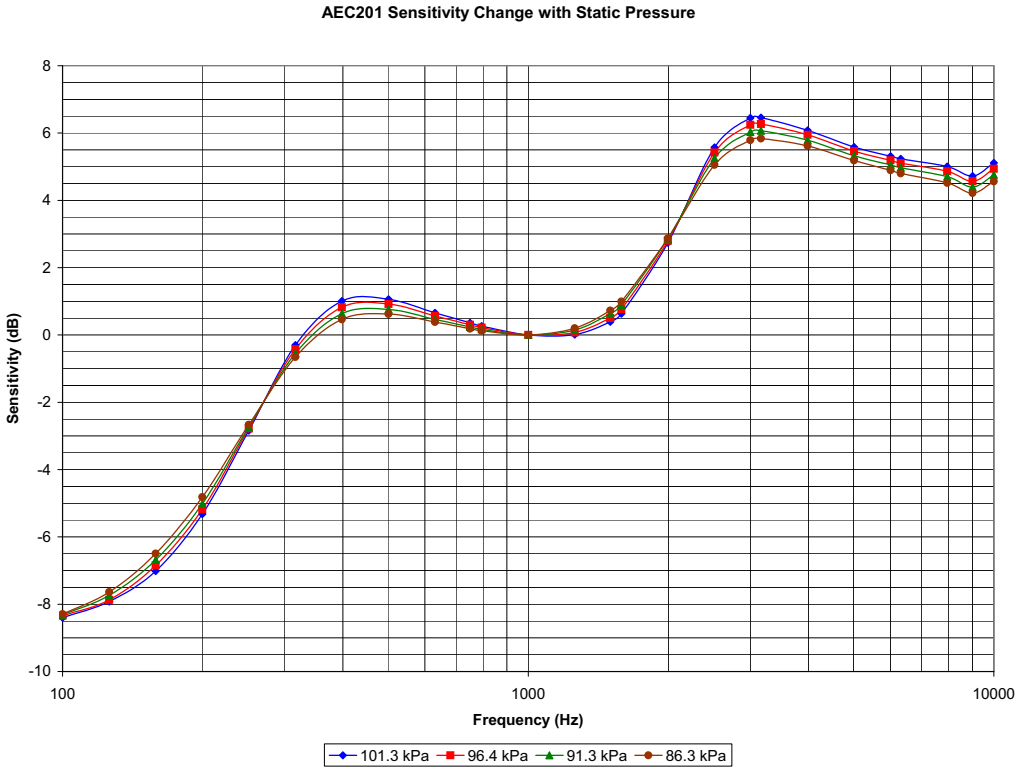


FIGURE A-13 Sensitivity change with Static Pressure Graph

APPENDIX

B Calibration of the Ear Simulator

Larson Davis provides calibration services, which is what we recommend. The procedure below is documented here as required by IEC 603181-1:2009 clause 6.2.

This appendix describes a method used to calibrate the ear simulator. A ½" pressure microphone type of WS2P having a nominal pressure sensitivity of 12 mV/Pa is used without a grid cap as the transmitter to produce an acoustic signal within the coupler. The pressure sensitivity M_1 of this microphone must be known. It is mounted in a flat plate as shown in IEC 60318-1:2009 Annex C with the microphone diaphragm centered above and flush with the top of the ear simulator. The current passing through the driver microphone is measured by putting a known capacitor in series with the microphone and measuring the Voltage across it. The current is given by:

$$i = V_d * j * 2\pi * f * C$$

Where Vd is the measured Voltage, f is the frequency of the signal and C is the capacitance of the series capacitor.

Calibrate the receiver microphone and sound level meter in decibels re 20μPa. The transmitter microphone is driven at a fixed frequency and the level L on the meter is noted along with the Voltage across the series capacitor. L is converted from dB re 20μPa to Pascals P. The signal is stepped or swept over the range of 100 Hz to 10 kHz. At each frequency the transfer impedance is calculated in dB.

$$Z_a = 20 * Log_{10}\left(\frac{P}{M_1 * i}\right)$$

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