Case No. 2020-00219
AEUG Madison Solar, LLC
Responses to Post-Hearing Data Requests

1. Provide a copy of the ambient noise study. To the extent the ambient noise study has not been completed by May 14, 2021, provide a draft copy of the ambient noise study and accompanying information on when the study will be completed.

RESPONSE: Please see attached.

WITNESS: Brad Sohm, SWCA Environmental Consultants

Madison Solar Facility Project: Baseline Sound Monitoring

MAY 2021

PREPARED FOR

AEUG Madison Solar, LLC

PREPARED BY

SWCA Environmental Consultants

MADISON SOLAR FACILITY PROJECT: BASELINE SOUND MONITORING

Prepared for
AEUG Madison Solar, LLC
50 E Monroe St
Chicago, IL 60603
Attn: Mark Randall

Prepared by
SWCA Environmental Consultants
201 Chatham Street, Suite 3
Sanford, North Carolina 27330
(919) 292-2200
www.swca.com

SWCA Project No. 63270

May 2021

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1 INTRODUCTION

At the request of AEUG Madison, LLC, SWCA Environmental Consultants (SWCA) conducted a sound monitoring survey on April 21 -23, 2021 to document the acoustic environment in the area surrounding the proposed Madison Solar Project (the Project) located in Madison County, Kentucky. The purpose of the sound monitoring survey was to determine the baseline or ambient sound levels experienced near the Project at the closest noise-sensitive areas (NSAs). This memorandum provides a summary of the baseline sound monitoring results for the area surrounding the Madison Solar Project.

These following sections describe the area monitored and provide a map showing the location of the proposed Project and locations of the sound monitors, a description of the sound level meter (SLM) used, a description of the metrics recorded, and a summary of sound level readings collected at the monitoring locations.

The memorandum contains the following sections detailing the results of the sound monitoring:

- Section 2.0 provides a general project area description.
- Section 3.0 provides a basic introduction to the sound fundamentals and descriptors of time averaged sound levels.
- Section 4.0 presents a brief summary of the local applicable noise regulations.
- Section 5.0 contains a brief description of the sound monitoring locations.
- Section 6.0 provides a description of the sound level meter used.
- Section 7.0 includes a description of the calibration sequences.
- Section 8.0 includes a discussion of the survey weather conditions.
- Section 9.0 includes a discussion on how the sound meters were setup, the parameters used, and data collected.
- Section 10.0 includes a discussion of how the measured ambient data affects the noise impacts previously reported in the Noise and Traffic Study.
- Section 11.0 provides a discussion of how the measured ambient data affects the noise impacts previously reported in the Noise and Traffic Study.
- Appendix A provides photographs of the sound equipment at the monitoring locations.
- Appendix B contains the laboratory calibration certificates for the sound level meters.
- Appendix C provides summaries of the sound data collected and weather conditions.
- Appendix D contains daily field data sheets.

2 AREA DESCRIPTION

AEUG Madison Solar, LLC (AEUG Madison Solar) proposes to develop the 100-megawatt (MW) photovoltaic (PV) Madison Solar Project in Madison County, Kentucky. The Project would be built on portions of approximately 1,770 acres (Project Area). The majority (81.01%) of the Project Area currently is in agricultural use.

The Project Area is located between the towns of Richmond and Ford in Madison County. It is roughly bounded by the intersection of State Highways 388 and 627 in the north, Dr. Robert R. Martin Bypass on the south, State Highway 388 on the east, and U.S. Highway 75 on the west. The topography in the area consists of a series of gently to moderately rolling hills and swales. Land use is primarily pasture and agricultural, with no large, forested areas except outside of the 2-mile buffer area in and around the state park. Tree lines typically occur at parcel boundaries, in riparian zones, and along roadways. Scattered rural residential development, commercial and retail businesses, communication facilities, and vehicular transportation networks are all present within the Project Area.

3 SOUND FUNDAMENTALS

Sound is defined as a form of energy that is transmitted by pressure variations, which the animal or human ear can detect. Noise can be defined as any unpleasant or unwanted sound that is unintentionally added to a desired sound or environment. The noise effects in humans include interference with communication, learning, rest or sleep and physiological health effects.

There are two main properties of sound - the amplitude and the frequency. Amplitude refers to the level of energy that reaches the ear (how loud we perceive the sound, while frequency is the number of cycles or oscillations per unit of time completed by the source. Frequency is normally expressed in hertz (Hz).

Sound power is defined as the measurement of the ability of a source to make sound. It is independent of the acoustic environment in which is located. The sound power level (Lpw) of a source is the amount of energy it produces relative to a reference value and is normally expressed in decibels (dB). The decibel is a logarithmic scale to describe the sound pressure ratio. For example, on the decibel scale, the smallest audible sound is 0 dB. A sound 10 times more powerful is 10 dB, while a sound 100 times more powerful is 20 dB.

Humans perceive a frequency range of about 20 Hz to about 20,000 Hz. A-weighting scale – an internationally standardized frequency weighting was designed to approximate the audible range of frequencies of a healthy human ear. A-weighted scale corresponds to the fact that the human ear is not as sensitive to sound of the lower frequencies as it is at the higher frequencies.

3.1 Sound Descriptors

A number of different descriptors of-time averaged sound levels are used to account for fluctuations of sound intensity over time. The sound descriptors calculated by the sound meters and used in this report to describe environmental sound are defined below:

- A-weighted Sound Level describes a receiver's sound at any moment in time. A-weighting is an internationally standardized frequency weighting used to account for the relative loudness as perceived by the human ear at different frequencies.

- Maximum Sound Level (L_{max}) describes the highest sound level occurring during a single sound event.
- Minimum Sound Level (L_{min}) describes the lowest sound level occurring during a single sound event.
- The Equivalent Sound Level (L_{eq}) describes the average sound exposure from all events over a specified period of time.
- The Day-Night Average Sound Level (L_{dn}) describes the cumulative sound exposure from all events over a full 24 hours, with events between 10 p.m. (22:00) and 7 a.m. (07:00) increased by 10 decibels to account for greater nighttime sensitivity to noise.
- Daytime Sound Level (L_d) is defined as the equivalent sound level for a 15-hour period between 7 a.m. (07:00) and 10 p.m. (22:00).
- Nighttime Sound Level (L_n) is defined as the equivalent sound level for a 9-hour period between 10 p.m. (22:00) and 7 a.m. (07:00).
- Residual sound level (L_{90}) is the level that is exceeded 90% of the time over a specified period. The residual sound level excludes intruding sound from sporadic anthropogenic noises, wildlife, and wind gusts that raise the average and maximum levels over a measurement period.

3.2 Sound Levels of Representative Sounds and Noises

The U.S. Environmental Protection Agency (EPA) has developed an index to assess noise impacts from a variety of sources using residential receptors. If L_{dn} values exceed 65 dBA, residential development is not recommended (EPA 1974). Sound levels in a quiet rural area at night are typically between 32 and 35 dBA. Quiet urban night-time sound levels range from 40 to 50 dBA.

Sound levels during the day in a noisy urban area are frequently as high as 70 to 80 dBA. Sound levels above 110 dBA become intolerable; levels higher than 80 dBA over continuous periods can result in hearing loss. Levels above 70 dBA tend to be associated with task interference. Levels between 50 and 55 dBA are associated with raised voices in a normal conversation. Constant sounds tend to be less noticeable than irregular or periodic sounds.

Table 1 provides criteria that have been used to estimate an individual's perception to increases in sound. In general, an average person perceives an increase of 3 dBA or less as barely perceptible. An increase of 10 dBA is perceived as a doubling of the sound.

Table 1. Average Human Ability to Perceive Changes in Sound Levels

Increase in Sound Level (dBA)	Human Perception of Sound
2–3	Barely perceptible
5	Readily noticeable
10	Doubling of the sound
20	Dramatic change

Source: Bolt, Beranek, and Newman, Inc. (1973)

Table 2 presents sound levels for some common sound sources and the human response to those decibel levels.

Table 2. Sound Levels of Representative Sounds and Noises

Source and Distance	Sound Level (dBA)	Human Response
Jet takeoff (nearby)	150	
Jet takeoff (15 m/50 feet)	140	
50-hp siren (30 m/100 feet)	130	
Loud rock concert (near stage)	120	Pain threshold
Construction noise (3 m/10 feet)	110	Intolerable
Jet takeoff (610 m/2,000 feet)	100	
Heavy truck (8 m/25 feet)	90	
Garbage disposal (0.6 m/2 feet)	80	Constant exposure endangers hearing
Busy traffic	70	
Normal conversation	60	
Light traffic (30 m/100 feet)	50	Quiet
Library	40	
Soft whisper (4.5 m/15 feet)	30	Very quiet
Rustling leaves	20	
Normal breathing	10	Barely audible
Threshold of hearing	0	

Source: Beranek (1988)

4 APPLICABLE NOISE REGULATIONS

In 1974 the U.S. EPA published "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin on Safety". In this publication, the U.S. EPA evaluated the effects of environmental noise with respect to health and safety and determined an L_{dn} of 55 dBA (equivalent to a continuous noise level of 48.6 dBA) to be the maximum sound level that will not adversely affect public health and welfare by interfering with speech or other activities in outdoor areas.

AEUG Madison obtained a conditional use permit ("CUP") from the Madison County Board of Adjustments on December 7, 2020. The CUP authorizes the solar facility to be constructed on properties in Madison County leased by AEUG Madison with numerous conditions ranging from minimum setbacks, landscape screening, and decommissioning. Condition #7 from Madison CUP indicates that "Noise levels, during operation, shall not exceed 50 decibels when measured at the property line of an adjacent nonparticipating properties." Measured L_{eq} ambient values at all the long-term monitoring sites were found to be below the 50 dBA threshold. Ambient sound levels at 9 out of 13 of the short-term monitoring sites were measured to be above the 50 dBA on a L_{eq} basis.

5 MEASUREMENT LOCATIONS

Two (2) long-term and thirteen (13) short-term sound monitoring locations were selected to provide the existing ambient (or background) sound level, that represents the existing reference sound level at the Project's site. The specific placement of the sound level meters was mainly determined by environmental and logistical constraints, and the location of the closest NSAs. The long-term sound monitors were placed at the closest Project property boundary to an NSA, and the Project property boundary nearest to the NSA with the greatest predicted operational noise impacts.

Short-term monitors were placed at the neighboring NSAs to provide good coverage of the area surrounding the project. Sound levels at the long-term and short-term monitoring sites are expressed as L_{90}, as use of the L_{90} level removes the influence of intruding sound from sporadic noises, as it is not a constant sound, thereby not considered part of the existing background sound level.

The following is a description of the sound measurement position near the NSAs:

- Long-term monitoring location 1 (LT-1): This monitor is located approximately 1,000 feet west of State Highway 388 (Red House Rd). Otter Creek Rd is roughly located 300 feet to the northeast of the monitor location. Bill Eads Roads runs along the north perimeter. This region is a rural and wooded landscape.

- Long-term monitoring location 2 (LT-2): This monitor is located 330 feet east of Red House Road, roughly 0.62 miles from a booster station. Highway 75 This region has a hilly and grassy landscape with scattered patches of trees.

- Short-term monitoring location 1 (NSA 1): The monitor is located at a large church on top of a hill (Red House Baptist Church). The monitor location was located 320 feet east from State Highway 388. The region is a hilly and grassy landscape with scattered patches of trees.

- Short-term monitoring location 2 (NSA 9): The monitor was located 15 feet west of Red House Road. A railroad passes across Red House Road approximately 120 feet from the monitor location. This region has a hilly and grassy terrain with scattered patches of trees.

- Short-term monitoring location 3 (NSA 16): The monitor is located 35 feet east of Three Forks Road. This area is a hilly grassland with scattered patches of trees.

- Short-term monitoring location 4 (NSA 18): The monitor is located 15 feet west of Three Forks Road. This area is rural farmland that is hilly and grassy with scattered patches of trees.

- Short-term monitoring location 5 (NSA 25/58): The monitor is located 20 feet east of Three Forks Road. The region is rural farmland located at the bottom of a hill with small, wooded area.

- Short-term monitoring location 6 (NSA 26): The monitor located 15 feet south of Crystal Creek Ln and approximately 1.6 miles east of highway 75. This is an open field with trees surrounding it.

- Short-term monitoring location 7 (NSA 37): The NSA is located on top of a hill 15 feet off State Highway 388 The area is hilly with patches of scattered trees.

- Short-term monitoring location 8 (NSA 41): This monitoring site is located in a residential area on Sycamore Drive, approximately 1 mile east of Highway 75.

- Short-term monitoring location 9 (NSA 43): The monitor location was on E Bill Eads Road. The is a closed wooded area.

- Short-term monitoring location 10 (NSA 45): This is a rural farmland close to a residential neighborhood. The monitoring site was 10 feet from Bill Eades Road.

- Short-term monitoring location 11 (NSA 47): This monitor location was located in a hilly and grassy landscape with scattered patches trees. The monitor was located on top of a hill in a rural neighborhood 20 feet southeast of Three Folks Road. A substation is location right across Three Forks Road.

- Short-term monitoring location 12 (NSA 54): This region is a hilly grassy area with scattered patches of trees. The NSA is located on top of a hill right 15 feet west off State Highway 388 in a small neighborhood.

- Short-term monitoring location 13 (NSA 61): Monitor was placed at the intersection of Otter Creek Rd and Parson Lane. A railroad runs perpendicular to Parson Lane. This monitor location is in a valley in a wooded area.

Monitoring locations are mapped on Figure 1 and described below in Table 3.

Table 3. Monitoring locations

Monitor	Monitor Location		Elevation	Dominant Background Noise Source
	Latitude	Longitude		
LT-1	37.824376	-84.275922	720 ft	Traffic, trains, birds, cattle
LT-2	37.814675	-84.268231	850 ft	Traffic, trains, birds, cattle
NSA 1	37.821721	-84.270658	848 ft	Traffic, airplanes
NSA 9	37.828872	-84.272713	711 ft	Traffic, trains, airplanes
NSA 16	37.808713	-84.289063	795 ft	Traffic, airplanes, birds
NSA 18	37.803315	-84.286318	799 ft	Traffic, airplanes, birds
NSA 25/58	37.798177	-84.280297	770 ft	Traffic, birds
NSA 26	37.795252	-84.294309	789 ft	Traffic, airplanes, birds
NSA 37	37.808758	-84.269097	865 ft	Traffic
NSA 41	37.819681	-84.30459	922 ft	Lawnmowers, dogs, children, birds
NSA 43	37.82624	-84.29857	899 ft	Traffic, dogs, birds
NSA 45	37.824584	-84.308497	884 ft	Traffic, airplanes, birds
NSA 47	37.814131	-84.297162	904 ft	Traffic, birds
NSA 54	37.796723	-84.270076	876 ft	Traffic, birds
NSA 61	38.443702	-83.821043	856 ft	Traffic, birds, dogs.

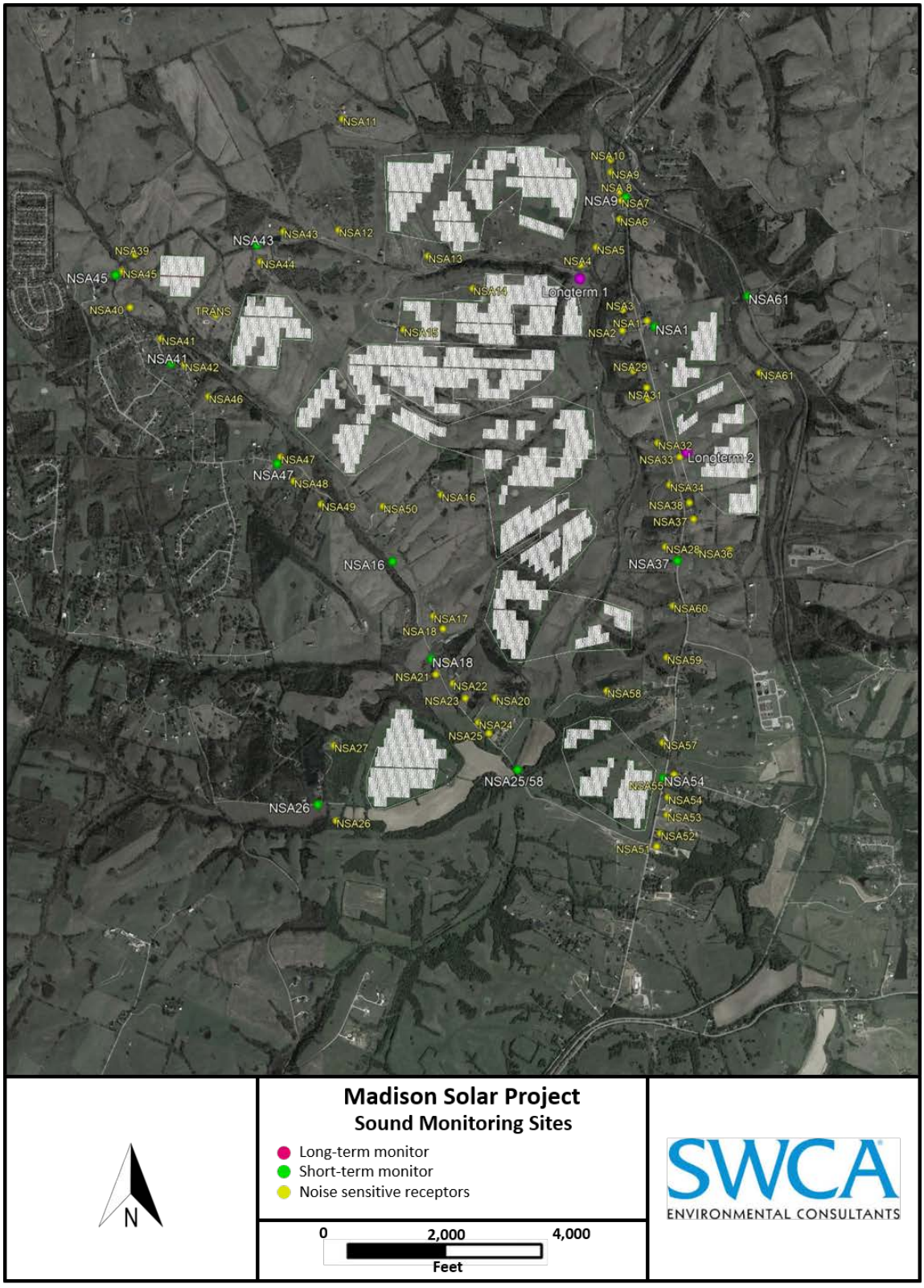

Figure 1. Monitoring Locations

6 INSTRUMENT DESCRIPTION

Sound measurements were collected using three (3) Larson Davis Precision Integrating Sound Level Meter Model 831C meeting the requirements of the American National Standards Institute (ANSI), one (1) PCB PRM831 preamplifier and one (1) PCB 377B02 free-field microphones as described in Table 4.

The microphone was fitted with an environmental windscreen and bird spikes and set upon a tripod at a height of 5 feet above ground and located as far from the influence of vertical reflective sources as possible. All cables were secured to prevent any sounds due to wiring hitting other objects. All clocks associated with the sound measurement were synchronized using the Larson Davis G4 LD Utility software.

Table 4. Instrumentation

Monitoring Location	Sound Level Meter	Preamplifier	1/2" free-field microphone
LT-1	Larson Davis 831C (S/N 0010739)	PRM831 (S/N 58504)	377B02 (S/N 311602)
LT-2	Larson Davis 831C (S/N 0010737)	PRM831 (S/N 58503)	377B02 (S/N 311601)
NSA 1 NSA 9 NSA 16 NSA 18 NSA 25/58 NSA 26 NSA 37 NSA 41 NSA 43 NSA 45 NSA 47 NSA 54 NSA 61	Larson Davis 831C (S/N 0011446)	PRM831 (S/N 29478)	377B02 (S/N 326325)

7 CALIBRATION CHECKS

The sound level meter was calibrated at the beginning and end of each measurement period using a Larson Davis Model CAL200 Precision Acoustic Calibrator. The Larson Davis CAL200 emits a 1 kHz tone at 114 dB against which the response can be checked. The calibrator has been designed for both field and laboratory use and the accuracy has been calibrated to a reference traceable to the National Institute of Standards and Technology (NIST).

Instrument calibration certificates for the 831C sound level meters, the microphone, and the Larson Davis CAL200 calibrator are included in Appendix B.

As recommended by Larson Davis, when using a free-field microphone, the pressure level at the microphone diaphragm will be slightly different. Thus, a free field correction of -0.12 dB was applied to the 114.0 dB tone. The LD 831C SLMs showed a response of less than the normal error of 0.50 dB. The results for the calibrations are shown in Table 5.

Table 5. Pre- and Post-Instrument Response Checks

Monitoring Location	Test	Sound Level	Response	Error [1]
LT-1	Pre-Test (4-21-2021)	114 dB (113.88 dB)	113.9 dB	0.02 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.93 dB	0.05 dB
LT-2	Pre-Test (4-21-2021)	114 dB (113.88 dB)	113.92 dB	0.04 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.94 dB	0.06 dB
NSA 1	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.99 dB	0.11 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.82 dB	-0.06 dB
NSA 9	Pre-Test (4-22-2021)	114 dB (113.88 dB)	113.90 dB	0.02 dB
	Post-Test (4-22-2021)	114 dB (113.88 dB)	113.80 dB	-0.08 dB
NSA 16	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.94 dB	0.06 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.92 dB	0.04 dB
NSA 18	Pre-Test (4-22-2021)	114 dB (113.88 dB)	113.91 dB	0.03 dB
	Post-Test (4-22-2021)	114 dB (113.88 dB)	113.85 dB	-0.03 dB
NSA 25/58	Pre-Test (4-20-2021)	114 dB (113.88 dB)	113.91 dB	0.03 dB
	Post-Test (4-20-2021)	114 dB (113.88 dB)	113.90 dB	0.02 dB
NSA 26	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.88 dB	0.00 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.86 dB	-0.02 dB
NSA 37	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.88 dB	0.00 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.89 dB	0.01 dB
NSA 41	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.79 dB	-0.09 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.87 dB	-0.01 dB
NSA 43	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.92 dB	0.04 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.94 dB	0.06 dB
NSA 45	Pre-Test (4-22-2021)	114 dB (113.88 dB)	113.96 dB	0.08 dB
	Post-Test (4-22-2021)	114 dB (113.88 dB)	113.94 dB	0.04 dB
NSA 47	Pre-Test (4-23-2021)	114 dB (113.88 dB)	113.89 dB	0.01 dB
	Post-Test (4-23-2021)	114 dB (113.88 dB)	113.85 dB	-0.03 dB
NSA 54	Pre-Test (4-22-2021)	114 dB (113.88 dB)	113.87 dB	-0.01 dB
	Post-Test (4-22-2021)	114 dB (113.88 dB)	113.84 dB	-0.04 dB
NSA 61	Pre-Test (4-22-2021)	114 dB (113.88 dB)	113.88 dB	0.00 dB
	Post-Test (4-22-2021)	114 dB (113.88 dB)	113.97 dB	0.09 dB

[1] Calibration error indicates the difference between the values measured by the instrument and the tone emitted by the acoustic calibrator.

8 METEOROLOGICAL DATA

Meteorological data was not measured at the monitoring sites during the measurement period. Instead, sound data collected during the survey were validated against weather data from the Richmond Station (KKYRICHM59) located approximately 3.6 miles south of the Project in the city of Richmond, Kentucky. Hourly weather information is presented in Appendix C. A summary of the survey weather conditions are listed in Table 6.

Table 6. Weather conditions for April 21 through April 23, 2021

Weather Station	Start	End	Wind Speed (mph)		Temperature (F)		Humidity (% relative humidity)	
			Range	Average	Range	Average	Range	Average
Richmond Station (KKYRICHM59)	4/212021 00:00	4/23/2021 17:00	0.0-7.0	2.85	30.0-59.0	41.1	37-98	66

The ASTM Standard Guide for Measurement of Outdoor A-Weighted Noise levels (ASTM E1014-12) specifies that data should not be used when steady wind speeds exceed 20 kilometers per hour (km/hr) (12.4 mph). Because wind speeds above 12.4 mph were identified, no hourly data points were removed from any of the sound data sets.

9 READINGS

Long-term monitoring was conducted from April 21 to April 23, 2021. Sound meter LD 831C – 0010739 was placed at the monitoring location LT-1 from 8:04 PM (EDT) on April 21 to 8:40 PM (EDT) on April 23. Data were collected for approximately 49 hours; sound levels were recorded over each 1-minute and 1- hour intervals. Sound meter LD 831C – 0010737 was placed at the monitoring location LT-2 from 7:22 PM (EDT) on April 21 to 8:13 PM (EDT) on April 23. Data were collected for approximately 49 hours; sound levels were recorded over each 1-minute and 1- hour intervals.

Short-term monitoring was conducted at thirteen (13) NSAs. Start and stop times for the thirteen (13) short-term monitoring sites are presented in Table 7 of the results section. Short-term sound levels were recorded for a single 15-minute interval.

The sound level meters were programmed to sample and store A-weighted sound level data including L_{eq}, percentile levels and community sound parameters. The following gives a brief description of the methodology used for the sound data collection:

- A-weighted sound level was selected.
- Sound meter was set on “slow” response.
- During sound measurements any dominant background noise source was noted.
- Weather conditions were observed and documented.

Field data sheets were completed during each visit and are provided in Appendix D of this report.

The ambient sound level at a receptor location in a given environment is the all-inclusive sound associated with that environment and is due to the combination of sound sources from many directions, near and far. Observed sources of background noise that contributed to the existing sound level at the monitoring locations included road traffic, trains, birds, insects, and cattle.

Existing conditions at the long-term and short-term sound monitoring sites are better represented by the L_{90} parameter. As defined above, the 90th percentile-exceeded sound level, L_{90}, is a metric that indicates the single sound level that is exceeded during 90 percent of a measurement period although the actual instantaneous sound levels fluctuate continuously. The L_{90} sound level is typically considered the ambient sound level as it quantifies the acoustical character of an environment and represents the residual (i.e., ambient) sound level between discrete sound events of short duration, such as bird chirps, dog barks, car horns, etc. The measured L_{90} time-intervals are arithmetically averaged to present the background levels of the environment for day and night.

10 RESULTS

Data collection began on April 21, 2021 and continued through April 23, 2021. Table 7 summarizes the measured A-weighted L_{eq}, L_{90}, L_{dn} (calculated from the measured L_{eq}) for each of the monitoring locations.

Table 7. Summary of Ambient Sound Measurements

Monitoring Location	Monitoring Start	Monitoring End	Elapsed Time	Measured Sound Levels				
				L_{eq}	L_{90}	L_{dn}	L_d	L_n
LT-1 [(a)]	4/21/2021 20:03	4/23/2021 20:40	48:36	44.9	**35.3**	50.5	45.4	43.8
LT-2 [(a)]	4/21/2021 19:22	4/23/2021 20:12	48:50	48.6	**32.0**	52.4	49.9	44.8
NSA 1	4/23/2021 13:22	4/23/2021 13:51	0:17	42.6	33.5	-	42.6	-
NSA 9	4/22/2021 9:19	4/22/2021 9:42	0:23	66.3	41.8	-	66.3	-
NSA 16	4/23/2021 10:20	4/23/2021 10:41	0:20	51.5	30.9	-	51.5	-
NSA 18	4/22/2021 16:44	4/22/2021 17:01	0:17	56.5	37.6	-	56.5	-
NSA 25/58	4/22/2021 13:19	4/22/2021 13:39	0:20	57.6	34.5	-	57.6	-
NSA 26	4/23/2021 9:35	4/23/2021 9:52	0:17	49.6	45.7	-	49.6	-
NSA 37	4/23/2021 14:15	4/23/2021 14:30	0:15	63.9	41.2	-	63.9	-
NSA 41	4/23/2021 15:25	4/23/2021 15:41	0:15	51.6	44.7	-	51.6	-
NSA 43	4/23/2021 8:31	4/23/2021 8:47	0:15	46.9	43.3	-	46.9	-
NSA 45	4/22/2021 15:02	4/22/2021 15:20	0:18	50.4	43.6	-	50.4	-
NSA 47	4/23/2021 12:17	4/23/2021 12:37	0:20	57.9	37	-	57.9	-
NSA 54	4/22/2021 12:36	4/22/2021 12:58	0:22	68.8	38.4	-	68.8	-
NSA 61	4/22/2021 10:45	4/22/2021 11:01	0:16	42.1	33.9	-	42.1	-

a) Data derived from the average 1-hour L_{eq} calculated by logarithmic averaging the number of sound measurements taken at each specific hour.

11 NOISE IMPACTS

The Noise and Traffic Study presented in the Madison Solar Project: Site Assessment Report (SAR) dated December 2020, presented estimated noise impacts at neighboring NSAs from the operation of the proposed Project. Standard acoustical engineering methods were used and were based on vendor-supplied equipment sound levels. The estimated sound levels were based on inverters, trackers, and transformers specified in the preliminary design. Predicted levels at the closest sensitive receptor were calculated based on geometric spreading attenuation using International Organization for Standardization (ISO) 9613-2, Acoustics – Sound Attenuation during Propagation Outdoors (ISO 1996).

Existing ambient sound levels at these NSAs were based on general ambient sound levels (L_{eq} and L_{dn}) based on land use categories published by The American National Standards Institute (ANSI 2013). The areas surrounding the Project were defined as a sparse suburban or rural area with very few (if any) near sources of sound; therefore, background sound levels were conservatively represented by those of *Category 6: Very quiet suburban and rural residential* of the ANSI Publication. Thus, the majority of the analysis area was expected to have background L_{dn} of about 42 dBA or less.

As shown in Table 7, measured L_{90} values in the vicinity of the Project range between 32.0 and 35.3 dBA. Table 8 provides a comparison between the present values in the SAR and the estimated noise impacts after updating the ambient sound levels based on the monitored values for the "as proposed" scenario at the nearest NSA. Daytime and nighttime L_{90} sound levels were calculated from recorded 1-minute L_{eq} values to determine an overall baseline L_{eq} and L_{dn} sound levels to estimate total sound levels at the nearest NSA.

Table 8. Calculated Sound Levels at Nearest NSA Due to Operation

Parameter	Calculated L_{eq} Total (dBA)	Community Sound Level (dBA)		
		L_{day}	L_{night}	L_{dn}
Project Sound Contribution – As Proposed [a]	46.7	46.7	46.6	53.1
SAR Estimated Ambient Sound Level [b]	38.6	40.0	34.0	42.0
Total Sound Level at Nearest NSA (Project plus Ambient)	47.3	47.6	46.9	53.4
Estimated Increase due to the Project	8.7	7.6	12.9	11.4
Measured Ambient Sound Level (April 21-23, 2021 Survey) [c,d]	36.7	38.2	31.4	39.7
Total Sound Level at Nearest NSA (Project plus ambient)	47.1	47.3	46.8	52.3
Estimated Increase due to the Project	10.4	9.1	15.4	12.6

[a] Sound levels were estimated assuming the equipment locations as proposed in the Project layout. Presented values correspond to the maximum cumulative sound levels for all the evaluated NSAs. The nearest non-participating residential sensitive receptor is located approximately 160 feet from the property boundary and approximately 660 feet from the nearest inverter.

[b] ANSI S12.9-2013/Part 3

[c] L_{day} and L_{night} sound levels were derived from the average 1-min L_{eq} measurements and presented as the 90th percentile-exceeded sound level L_{90} for the daytime and nighttime hours.

[d] Representative L_{eq} and L_{dn} values were estimated from L_{day} and L_{night} values.

As presented above, the estimated sound contribution from the "as proposed" scenario L_{dn} at the nearest sensitive receptor, a residence on the east side of the Project, 660 feet from the nearest inverter, has not changed (53.1 dBA L_{dn}).

As shown in Table 8, the L_{dn} value at the closest NSA when the monitored levels are used to represent the existing ambient conditions (39.7 dBA L_{dn}) was estimated as 52.3 dBA; hence, below the EPA's recommended 24-hour average day and night value of 55 dBA L_{dn} (EPA 1974). Additionally, the estimated L_{eq} (47.1 dBA), L_{day} (47.3 dBA) and L_{night} (46.8 dBA) are expected to remain below 50 dBA as required by Condition #7 from Madison CUP.

12 LITERATURE CITED

American National Standards Institute, Inc (ANSI). 2013. Quantities and Procedures for Description and Measurements with an Observer Present – Part 3: Short-term Measurements with an Observer Present, ANSI/ASA S12.9-2013/Part 3.[2] ANSI S12.9-2013/Part 3, 2013.

Beranek, L.L. (ed.). 1988. *Noise and Vibration Control*. Washington, D.C.: Institute of Noise Control Engineering.

Bolt, Beranek and Newman, Inc. 1973. *Fundamentals and Abatement of Highway Traffic Noise*. Report Number PB-222-703. U.S. Department of Transportation, Federal Highway Administration.

U.S. Environmental Protection Agency (EPA). 1974. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. Available at: http://www.nonoise.org/library/levels/levels.htm#levelsof. Accessed April 16, 2021.

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APPENDIX A

Monitoring Site Photographs

Figure A1. Long-term monitoring site LT-1

Figure A2. Long-term monitoring site LT-2

Figure A3. Short-term monitoring site NSA 1

Figure A4. Short-term monitoring site NSA 9

Figure A5. Short-term monitoring site NSA 16

Figure A6. Short-term monitoring site NSA 18

Figure A7. Short-term monitoring site NSA 25/58

Figure A8. Short-term monitoring site NSA 26

Figure A9. Short-term monitoring site NSA 37

Figure A10. Short-term monitoring site NSA 41

Figure A11. Short-term monitoring site NSA 43

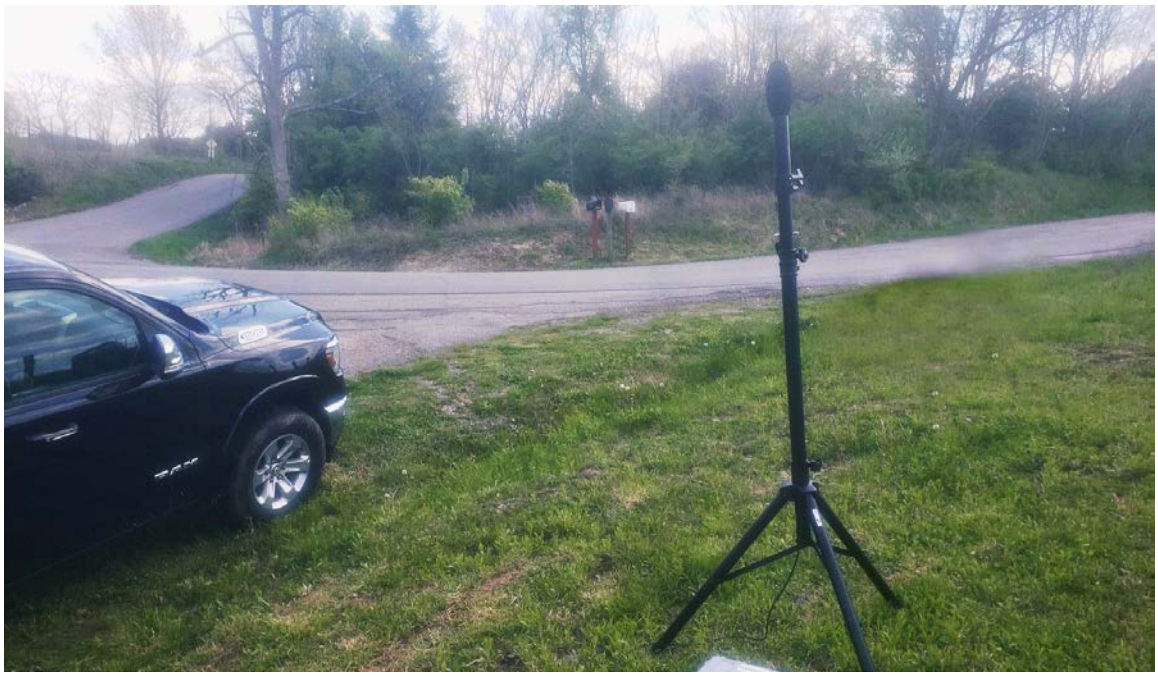

Figure A12. Short-term monitoring site NSA 45

Figure A13. Short-term monitoring site NSA 47

Figure A14. Short-term monitoring site NSA 54

Figure A15. Short-term monitoring site NSA 61

APPENDIX B
Equipment Calibration Certificates

Calibration Certificate

Certificate Number 2021001372

Customer:
The Modal Shop
10310 AeroHub Boulevard
Cincinnati, OH 45215, United States

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	18566	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	4 Feb 2021		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	31	%RH	± 3 %RH
		Static Pressure	101.1	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	08/04/2020	08/04/2021	001021
Larson Davis Model 2900 Real Time Analyzer	04/02/2020	04/02/2021	001051
Microphone Calibration System	03/03/2020	03/03/2021	005446
1/2" Preamplifier	08/27/2020	08/27/2021	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/06/2020	08/06/2021	006507
1/2 inch Microphone - RI - 200V	06/04/2020	06/04/2021	006510
Pressure Transducer	07/17/2020	07/17/2021	007368

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
114	101.0	114.01	113.80	114.20	0.14	Pass
94	101.1	94.01	93.80	94.20	0.15	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
114	101.0	1,000.03	990.00	1,010.00	0.20	Pass
94	101.1	1,000.04	990.00	1,010.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
114	101.0	0.34	0.00	2.00	0.25 ‡	Pass
94	101.1	0.38	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 25 °C, 27 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
108.0	107.9	-0.03	-0.30	0.30	0.04 ‡	Pass
101.3	101.3	0.00	-0.30	0.30	0.04 ‡	Pass
92.0	92.0	0.04	-0.30	0.30	0.04 ‡	Pass
83.0	82.8	0.05	-0.30	0.30	0.04 ‡	Pass
74.0	74.1	0.02	-0.30	0.30	0.04 ‡	Pass
65.0	65.1	-0.06	-0.30	0.30	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 25 °C, 27 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	107.9	0.00	-10.00	10.00	0.20 ‡	Pass
101.3	101.3	0.00	-10.00	10.00	0.20 ‡	Pass
92.0	92.0	0.00	-10.00	10.00	0.20 ‡	Pass
83.0	82.8	-0.01	-10.00	10.00	0.20 ‡	Pass
74.0	74.1	-0.01	-10.00	10.00	0.20 ‡	Pass
65.0	65.1	-0.01	-10.00	10.00	0.20 ‡	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 25 °C, 27 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
108.0	107.9	0.33	0.00	2.00	0.25 ‡	Pass
101.3	101.3	0.33	0.00	2.00	0.25 ‡	Pass
92.0	92.0	0.34	0.00	2.00	0.25 ‡	Pass
83.0	82.8	0.34	0.00	2.00	0.25 ‡	Pass
74.0	74.1	0.36	0.00	2.00	0.25 ‡	Pass
65.0	65.1	0.38	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: Scott Montgomery

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Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Cert. #3622.01

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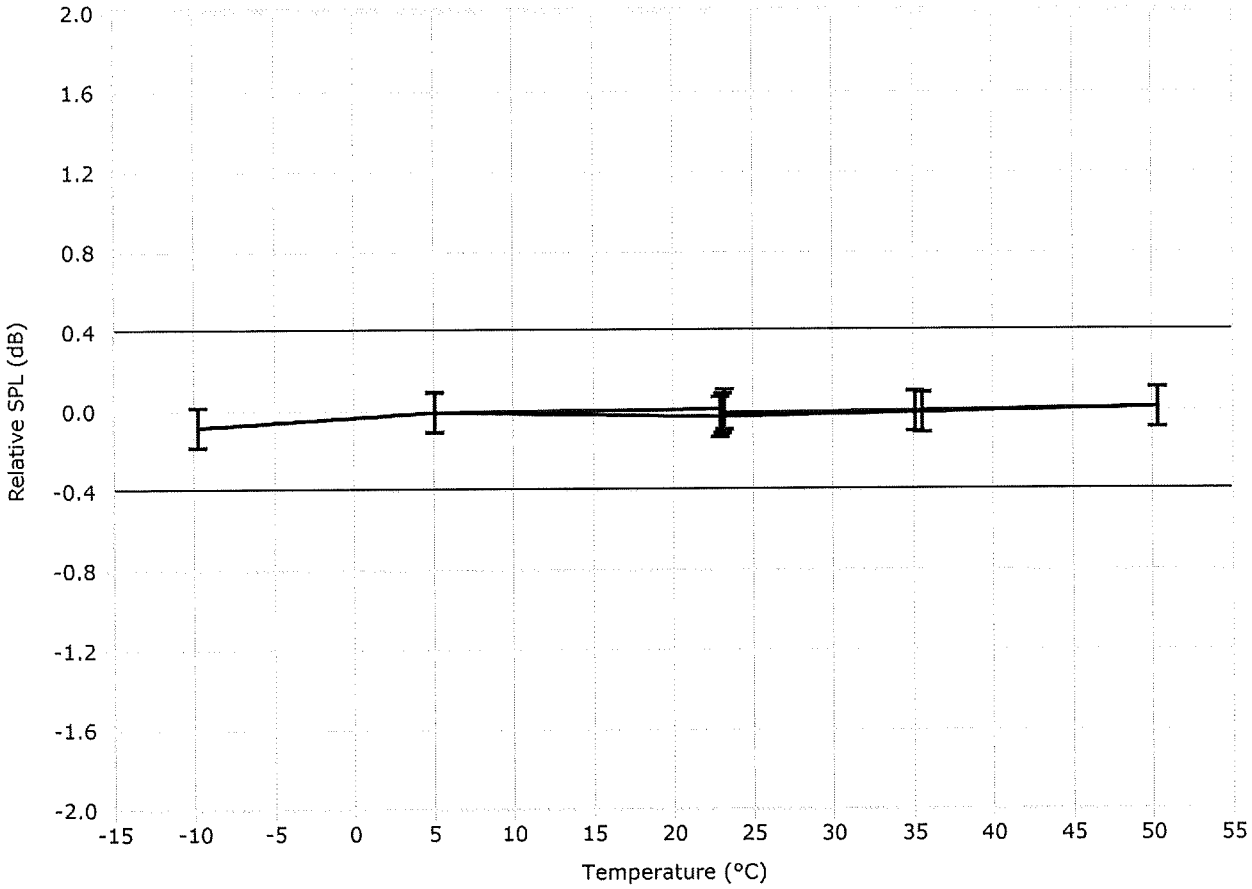
A PCB PIEZOTRONICS DIV.

Model CAL200 Relative SPL vs. Temperature

Larson Davis Model CAL200 Serial Number: 18566

Model CAL200 Relative SPL vs. Temperature at 50% RH.
A 2559 Mic (SN: 2915) with a PRM901 Preamp (SN: 0186), station 8 was used to check the levels.

Test Date: 08 Jan 2021 12:02:42 PM



0.1dB expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL250w200.SEQ

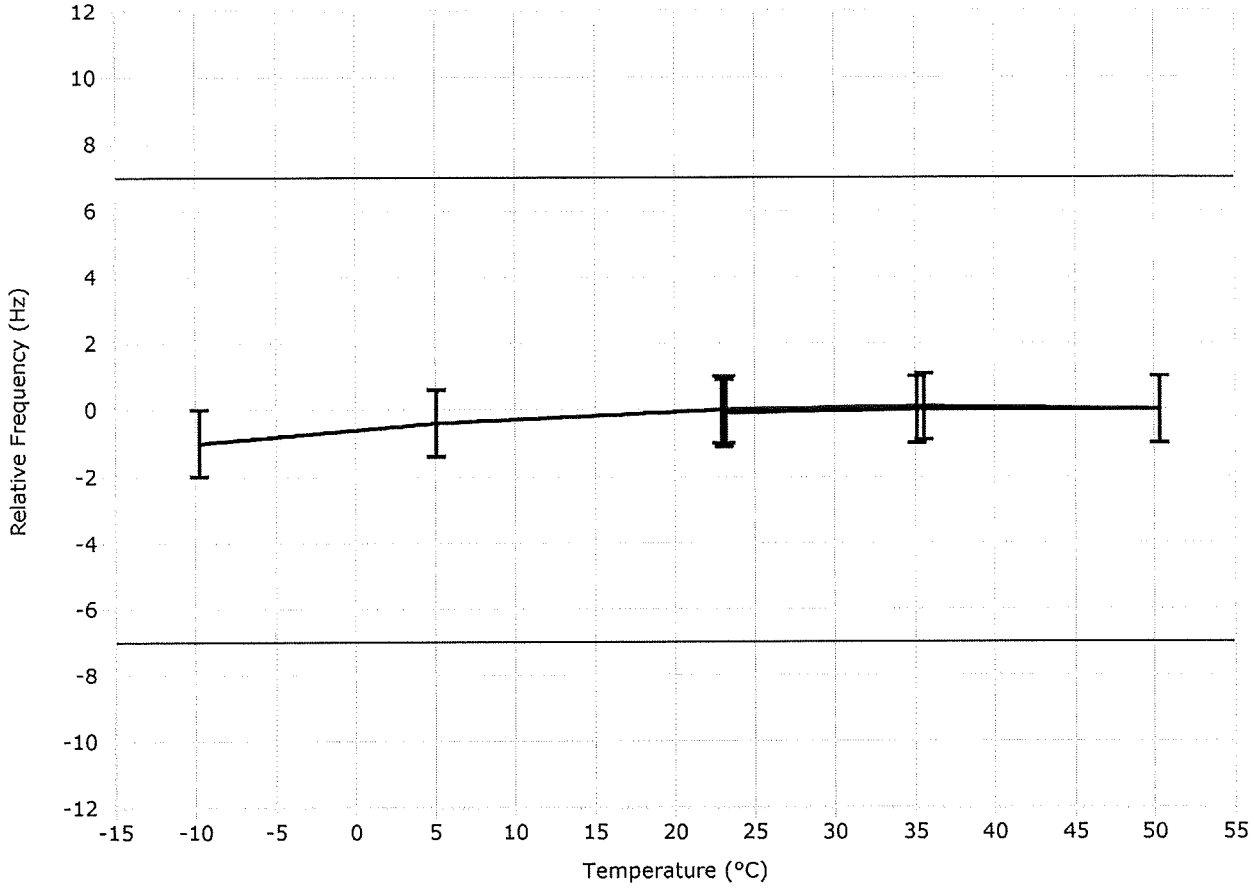
Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Model CAL200 Relative Frequency vs. Temperature

Larson Davis Model CAL200 Serial Number: 18566

Model CAL200 Relative Frequency vs. Temperature at 50% RH.
A 2559 Mic (SN: 2915) with a PRM901 Preamp (SN: 0186), station 8 was used to check the levels.

Test Date: 08 Jan 2021 12:02:42 PM



1.0 Hz expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL250w200.SEQ

Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Calibration Certificate

Certificate Number 2021002515

Customer:
The Modal Shop
10310 AeroHub Boulevard
Cincinnati, OH 45215, United States

Model Number	377B02	***Procedure Number***	D0001.8387		
Serial Number	326325	***Technician***	Abraham Ortega		
Test Results	**Pass**	***Calibration Date***	8 Mar 2021		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	25.2	°C	± 0.01 °C
Description	1/2 inch Microphone - FF - 0V	***Humidity***	25.6	%RH	± 0.5 %RH
		Static Pressure	101.43	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an electrostatic actuator.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis Model 2900 Real Time Analyzer	07/01/2020	07/01/2021	001230
Microphone Calibration System	08/25/2020	08/25/2021	001233
1/2" Preamplifier	12/18/2020	12/18/2021	001274
Agilent 34401A DMM	12/08/2020	12/08/2021	001329
Larson Davis CAL250 Acoustic Calibrator	09/01/2020	09/01/2021	003030
1/2" Preamplifier	04/13/2020	04/13/2021	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	07/09/2020	07/09/2021	006507
1/2 inch Microphone - RI - 200V	06/04/2020	06/04/2021	006510
1/2 inch Microphone - RI - 200V	07/31/2020	07/31/2021	006519
Larson Davis 1/2" Preamplifier 7-pin LEMO	07/09/2020	07/09/2021	006530
Larson Davis 1/2" Preamplifier 7-pin LEMO	07/24/2020	07/24/2021	006531

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Frequency [Hz]	Actuator [dB]	Free Field [dB]	Lower limit [dB]	Upper limit [dB]	Result
251.19	0.00	0.00	-0.50	0.50	Pass ‡
316.23	-0.01	0.00	-0.50	0.50	Pass ‡
398.11	-0.02	-0.02	-0.50	0.50	Pass ‡
501.19	-0.03	0.01	-0.50	0.50	Pass ‡
630.96	-0.04	0.00	-0.50	0.50	Pass ‡
794.33	-0.06	0.03	-0.50	0.50	Pass ‡
1,000.00	-0.09	0.03	-0.50	0.50	Pass ‡
1,059.25	-0.10	0.03	-0.50	0.50	Pass ‡
1,122.02	-0.11	0.03	-0.50	0.50	Pass ‡
1,188.50	-0.12	0.03	-0.50	0.50	Pass ‡
1,258.93	-0.13	0.03	-0.50	0.50	Pass ‡
1,333.52	-0.14	0.04	-0.50	0.50	Pass ‡
1,412.54	-0.16	0.03	-0.50	0.50	Pass ‡
1,496.24	-0.18	0.02	-0.50	0.50	Pass ‡
1,584.89	-0.19	0.02	-0.50	0.50	Pass ‡
1,678.80	-0.21	0.02	-0.50	0.50	Pass ‡
1,778.28	-0.24	0.01	-0.50	0.50	Pass ‡
1,883.65	-0.26	0.02	-0.50	0.50	Pass ‡
1,995.26	-0.29	0.02	-0.50	0.50	Pass ‡
2,113.49	-0.32	0.02	-0.50	0.50	Pass ‡
2,238.72	-0.35	0.02	-0.50	0.50	Pass ‡
2,371.37	-0.39	0.02	-0.50	0.50	Pass ‡
2,511.89	-0.43	0.03	-0.50	0.50	Pass ‡
2,660.73	-0.47	0.04	-0.50	0.50	Pass ‡
2,818.38	-0.53	0.03	-0.50	0.50	Pass ‡
2,985.38	-0.58	0.04	-0.50	0.50	Pass ‡
3,162.28	-0.65	0.03	-0.50	0.50	Pass ‡
3,349.65	-0.72	0.02	-0.50	0.50	Pass ‡
3,548.13	-0.80	0.02	-0.50	0.50	Pass ‡
3,758.37	-0.88	0.02	-0.50	0.50	Pass ‡
3,981.07	-0.98	0.02	-0.50	0.50	Pass ‡
4,216.97	-1.08	0.03	-0.56	0.56	Pass ‡
4,466.84	-1.20	0.03	-0.63	0.63	Pass ‡
4,731.51	-1.33	0.04	-0.69	0.69	Pass ‡
5,011.87	-1.48	0.05	-0.75	0.75	Pass ‡
5,308.84	-1.63	0.07	-0.81	0.81	Pass ‡
5,623.41	-1.81	0.07	-0.88	0.88	Pass ‡
5,956.62	-2.00	0.07	-0.94	0.94	Pass ‡
6,309.57	-2.21	0.08	-1.00	1.00	Pass ‡
6,683.44	-2.44	0.08	-1.00	1.00	Pass ‡
7,079.46	-2.68	0.10	-1.00	1.00	Pass ‡
7,498.94	-2.96	0.11	-1.00	1.00	Pass ‡
7,943.28	-3.26	0.13	-1.00	1.00	Pass ‡
8,413.95	-3.59	0.14	-1.00	1.00	Pass ‡
8,912.51	-3.99	0.12	-1.00	1.00	Pass ‡
9,440.61	-4.43	0.09	-1.00	1.00	Pass ‡
10,000.00	-4.89	0.06	-1.00	1.00	Pass ‡
10,592.54	-5.51	-0.11	-1.13	1.13	Pass ‡
11,220.19	-5.98	-0.12	-1.25	1.25	Pass ‡
11,885.02	-6.40	-0.08	-1.38	1.38	Pass ‡
12,589.25	-6.78	-0.01	-1.50	1.50	Pass ‡
13,335.21	-6.99	0.20	-1.63	1.63	Pass ‡
14,125.38	-7.16	0.43	-1.75	1.75	Pass ‡

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Calibration Certificate

Certificate Number 2021003381
Customer:
The Modal Shop
10310 AeroHub Boulevard
Cincinnati, OH 45215, United States

Model Number	831C	***Procedure Number***	D0001.8378		
Serial Number	11446	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	26 Mar 2021		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.47	°C	± 0.25 °C
Description	Larson Davis Model 831C	***Humidity***	52.3	%RH	± 2.0 %RH
	Class 1 Sound Level Meter	***Static Pressure***	85.18	kPa	± 0.13 kPa
	Firmware Revision: 04.6.0R0				

Evaluation Method Tested electrically using Larson Davis PRM831 S/N 071089 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

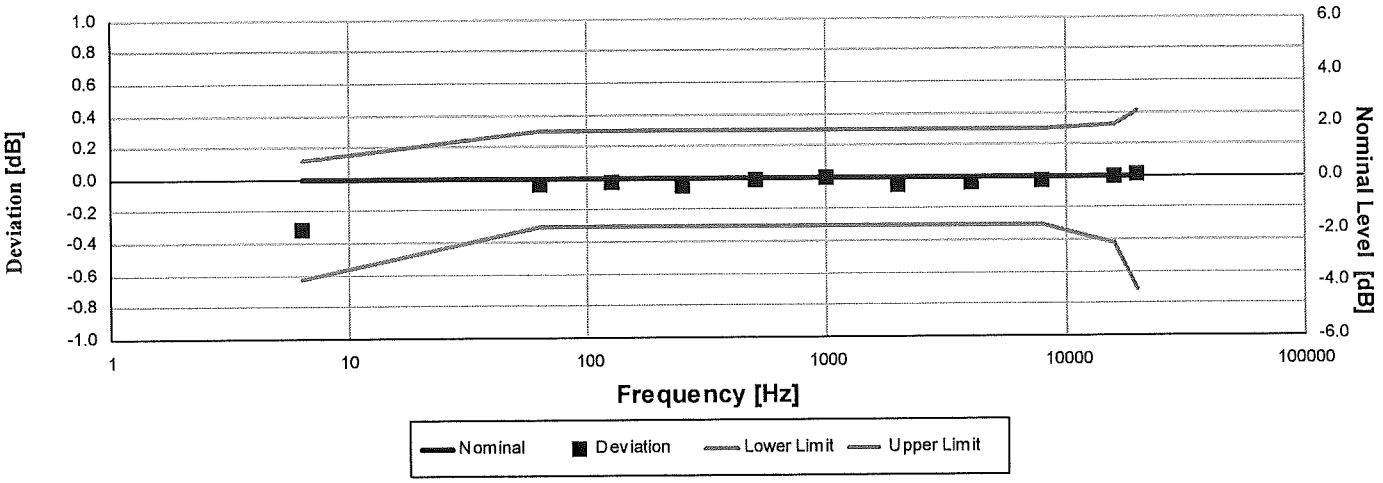
The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev M, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa; Reference Range: 0 dB gain

Standards Used			
Description	**Cal Date**	**Cal Due**	**Cal Standard**
Hart Scientific 2626-S Humidity/Temperature Sensor	2020-05-12	2021-05-12	006943
SRS DS360 Ultra Low Distortion Generator	2020-04-14	2021-04-14	007635

Z-weight Filter Response

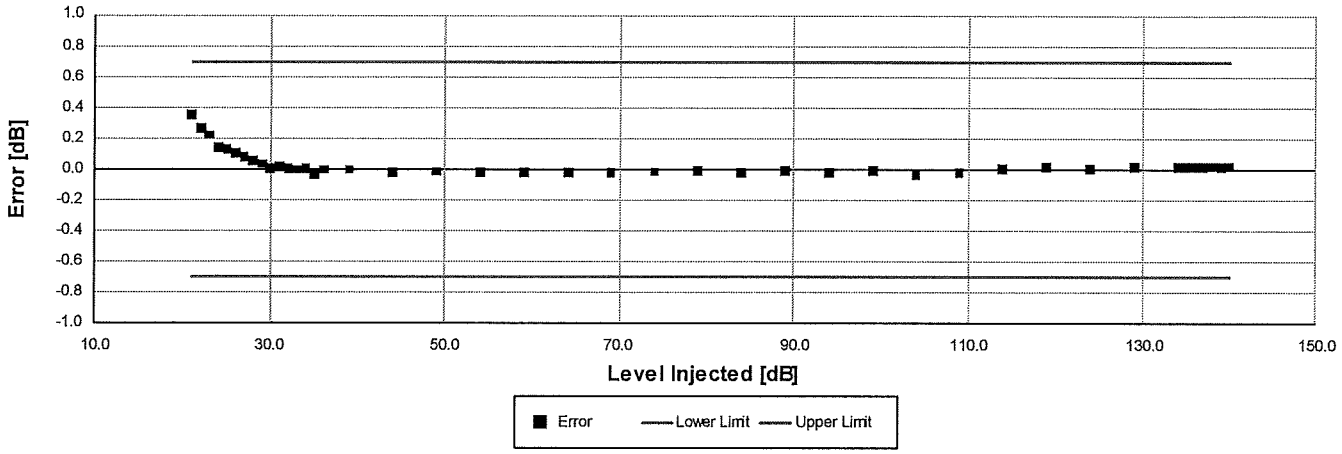


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.31	-0.31	-0.63	0.12	0.15	Pass
63.10	-0.03	-0.03	-0.30	0.30	0.15	Pass
125.89	-0.03	-0.03	-0.30	0.30	0.15	Pass
251.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
501.19	-0.01	-0.01	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.04	-0.04	-0.30	0.30	0.15	Pass
3,981.07	-0.04	-0.04	-0.30	0.30	0.15	Pass
7,943.28	-0.03	-0.03	-0.30	0.30	0.15	Pass
15,848.93	0.00	0.00	-0.42	0.32	0.15	Pass
19,952.62	0.01	0.01	-0.71	0.41	0.15	Pass

-- End of measurement results--

A-weighted 0 dB Gain Broadband Log Linearity: 8,000.00 Hz



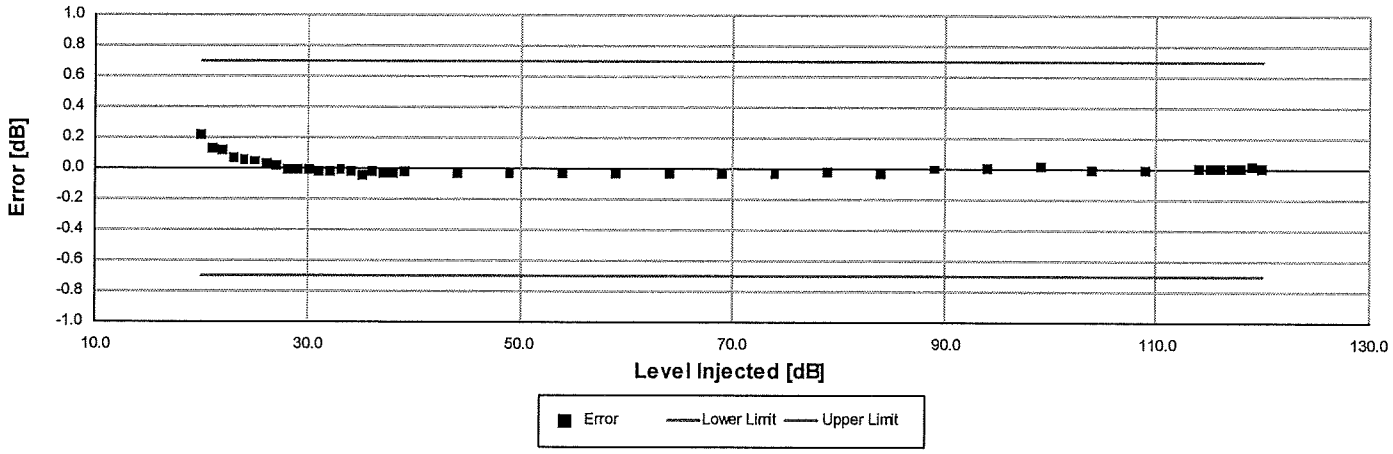
Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
21.00	0.36	-0.70	0.70	0.16	Pass
22.00	0.27	-0.70	0.70	0.16	Pass
23.00	0.22	-0.70	0.70	0.16	Pass
24.00	0.15	-0.70	0.70	0.16	Pass
25.00	0.13	-0.70	0.70	0.16	Pass
26.00	0.10	-0.70	0.70	0.16	Pass
27.00	0.08	-0.70	0.70	0.16	Pass
28.00	0.06	-0.70	0.70	0.16	Pass
29.00	0.04	-0.70	0.70	0.18	Pass
30.00	0.00	-0.70	0.70	0.17	Pass
31.00	0.01	-0.70	0.70	0.17	Pass
32.00	0.00	-0.70	0.70	0.17	Pass
33.00	0.00	-0.70	0.70	0.16	Pass
34.00	0.01	-0.70	0.70	0.16	Pass
35.00	-0.03	-0.70	0.70	0.16	Pass
36.00	0.00	-0.70	0.70	0.16	Pass
39.00	0.00	-0.70	0.70	0.16	Pass
44.00	-0.02	-0.70	0.70	0.16	Pass
49.00	-0.01	-0.70	0.70	0.16	Pass
54.00	-0.02	-0.70	0.70	0.16	Pass
59.00	-0.02	-0.70	0.70	0.16	Pass
64.00	-0.02	-0.70	0.70	0.16	Pass
69.00	-0.02	-0.70	0.70	0.16	Pass
74.00	-0.01	-0.70	0.70	0.16	Pass
79.00	-0.01	-0.70	0.70	0.16	Pass
84.00	-0.02	-0.70	0.70	0.16	Pass
89.00	-0.01	-0.70	0.70	0.16	Pass
94.00	-0.02	-0.70	0.70	0.16	Pass
99.00	-0.01	-0.70	0.70	0.16	Pass
104.00	-0.03	-0.70	0.70	0.15	Pass
109.00	-0.02	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.02	-0.70	0.70	0.15	Pass
124.00	0.00	-0.70	0.70	0.15	Pass
129.00	0.02	-0.70	0.70	0.15	Pass
134.00	0.01	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
135.00	0.02	-0.70	0.70	0.15	Pass
136.00	0.02	-0.70	0.70	0.15	Pass
137.00	0.02	-0.70	0.70	0.15	Pass
138.00	0.02	-0.70	0.70	0.15	Pass
139.00	0.02	-0.70	0.70	0.15	Pass
140.00	0.02	-0.70	0.70	0.15	Pass

-- End of measurement results--

A-weighted 20 dB Gain Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
20.00	0.21	-0.70	0.70	0.17	Pass
21.00	0.13	-0.70	0.70	0.16	Pass
22.00	0.12	-0.70	0.70	0.16	Pass
23.00	0.07	-0.70	0.70	0.16	Pass
24.00	0.05	-0.70	0.70	0.16	Pass
25.00	0.05	-0.70	0.70	0.16	Pass
26.00	0.03	-0.70	0.70	0.19	Pass
27.00	0.02	-0.70	0.70	0.18	Pass
28.00	-0.01	-0.70	0.70	0.19	Pass
29.00	-0.01	-0.70	0.70	0.18	Pass
30.00	-0.01	-0.70	0.70	0.17	Pass
31.00	-0.02	-0.70	0.70	0.17	Pass
32.00	-0.02	-0.70	0.70	0.17	Pass
33.00	-0.01	-0.70	0.70	0.16	Pass
34.00	-0.02	-0.70	0.70	0.16	Pass
35.00	-0.05	-0.70	0.70	0.16	Pass
36.00	-0.02	-0.70	0.70	0.16	Pass
37.00	-0.03	-0.70	0.70	0.16	Pass
38.00	-0.03	-0.70	0.70	0.16	Pass
39.00	-0.02	-0.70	0.70	0.16	Pass
44.00	-0.03	-0.70	0.70	0.16	Pass
49.00	-0.03	-0.70	0.70	0.16	Pass
54.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.03	-0.70	0.70	0.16	Pass
69.00	-0.03	-0.70	0.70	0.16	Pass
74.00	-0.03	-0.70	0.70	0.16	Pass
79.00	-0.02	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
89.00	0.00	-0.70	0.70	0.16	Pass
94.00	0.00	-0.70	0.70	0.16	Pass
99.00	0.01	-0.70	0.70	0.16	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	-0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
115.00	0.00	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
116.00	0.00	-0.70	0.70	0.15	Pass
117.00	0.01	-0.70	0.70	0.15	Pass
118.00	0.01	-0.70	0.70	0.15	Pass
119.00	0.02	-0.70	0.70	0.15	Pass
120.00	0.01	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
139.00	40	Negative Pulse	135.89	134.64	136.64	0.15	Pass
		Positive Pulse	135.85	134.63	136.63	0.15	Pass
	30	Negative Pulse	135.10	134.64	136.64	0.15	Pass
		Positive Pulse	135.08	134.63	136.63	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.10	± 0.50	0.15 ‡	Pass
	5	-0.09	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	-0.17	± 1.50	0.15 ‡	Pass
108.00	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	-0.14	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.08	± 0.50	0.15 ‡	Pass
	5	-0.09	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.10	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	-0.25	± 1.50	0.15 ‡	Pass
108.00	3	-0.10	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	0.04	± 1.50	0.16 ‡	Pass

-- End of measurement results--

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	94.01	93.91	94.11	0.15	Pass
0 dB Gain, Linearity	28.08	27.31	28.71	0.16	Pass
20 dB Gain	94.02	93.91	94.11	0.15	Pass
20 dB Gain, Linearity	23.09	22.31	23.71	0.16	Pass
OBA High Range	94.01	93.20	94.80	0.15	Pass
OBA Normal Range	94.01	93.91	94.11	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	6.10	9.00	Pass
C-weight Noise Floor	11.90	15.00	Pass
Z-weight Noise Floor	21.68	25.00	Pass

-- End of measurement results--

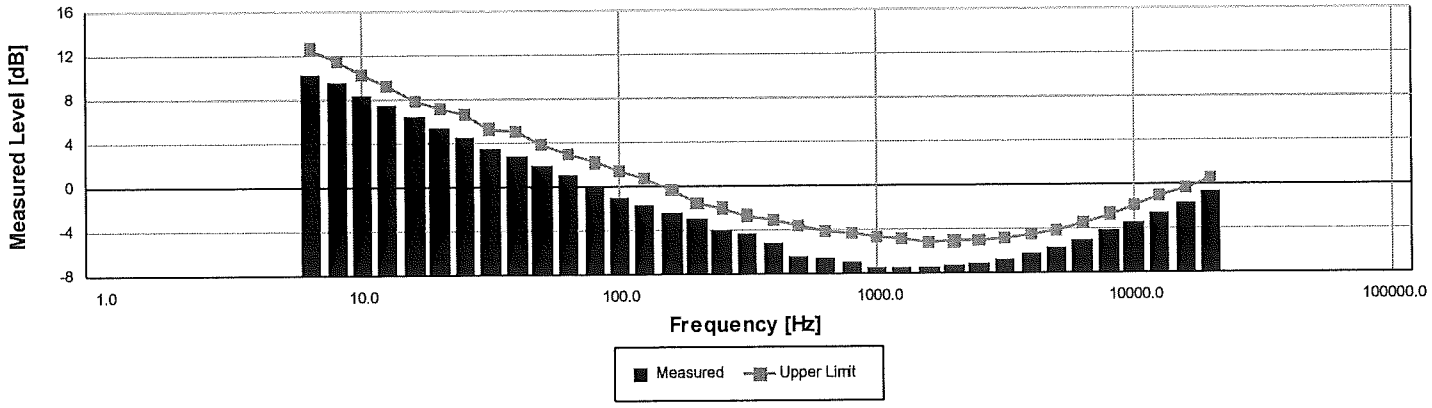
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	137.53	137.20	138.80	0.15	Pass
THD	-82.10		-60.00	1.30 ‡	Pass
THD+N	-80.31		-60.00	1.30 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to normal range and 20 dB gain.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	10.31	12.60	Pass
8.00	9.58	11.50	Pass
10.00	8.36	10.20	Pass
12.50	7.55	9.20	Pass
16.00	6.36	7.90	Pass
20.00	5.42	7.20	Pass
25.00	4.48	6.60	Pass
31.50	3.48	5.30	Pass
40.00	2.87	5.00	Pass
50.00	1.85	3.80	Pass
63.00	1.00	3.00	Pass
80.00	-0.06	2.20	Pass
100.00	-1.00	1.40	Pass
125.00	-1.71	0.70	Pass
160.00	-2.36	-0.40	Pass
200.00	-2.94	-1.50	Pass
250.00	-4.06	-2.00	Pass
315.00	-4.36	-2.70	Pass
400.00	-5.28	-3.10	Pass
500.00	-6.37	-3.70	Pass
630.00	-6.63	-4.10	Pass
800.00	-6.94	-4.30	Pass
1,000.00	-7.39	-4.70	Pass
1,250.00	-7.41	-4.80	Pass
1,600.00	-7.49	-5.20	Pass
2,000.00	-7.37	-5.10	Pass
2,500.00	-7.16	-5.00	Pass
3,150.00	-6.72	-4.80	Pass
4,000.00	-6.22	-4.50	Pass
5,000.00	-5.66	-4.10	Pass
6,300.00	-4.96	-3.40	Pass
8,000.00	-4.13	-2.70	Pass
10,000.00	-3.41	-1.90	Pass
12,500.00	-2.56	-1.10	Pass
16,000.00	-1.67	-0.30	Pass
20,000.00	-0.70	0.60	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ACCREDITED
Cert. #3822.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Calibration Certificate

Certificate Number 2019003913

Customer:

SWCA
Suite 1700
20 East Thomas Road
Phoenix, AZ 85012, United States

Model Number	831C	***Procedure Number***	D0001.8378		
Serial Number	10739	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	29 Mar 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.4	°C	± 0.25 °C
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Humidity***	49.7	%RH	± 2.0 %RH
		Static Pressure	86.16	kPa	± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRM831 S/N 058504 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

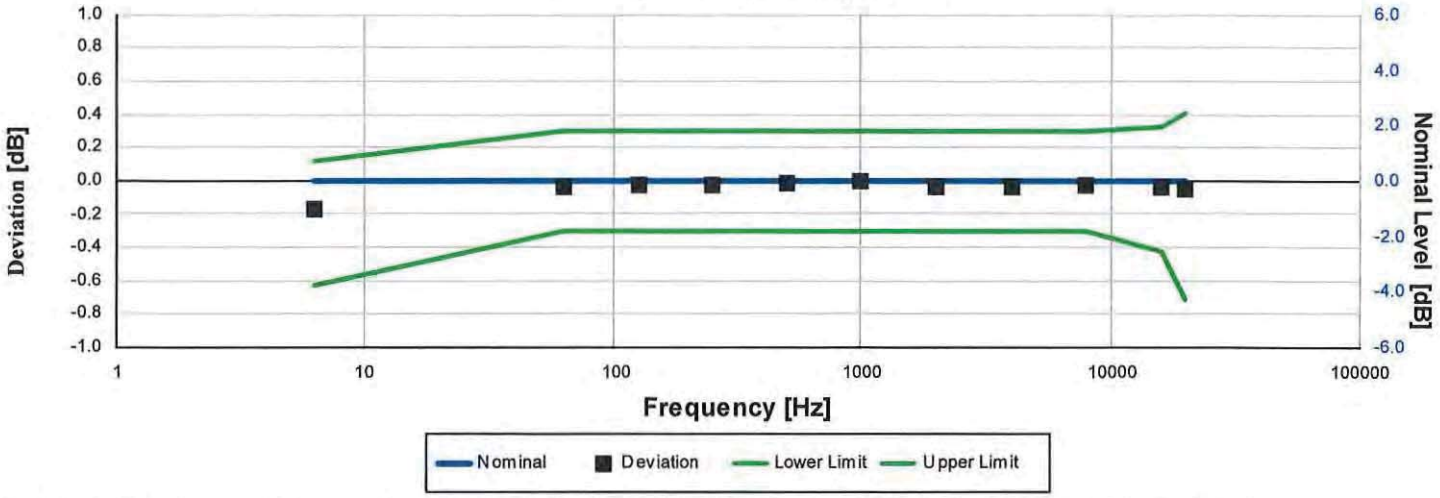
The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa; Reference Range: 0 dB gain

Standards Used			
Description	**Cal Date**	**Cal Due**	**Cal Standard**
Hart Scientific 2626-H Temperature Probe	2018-08-19	2019-08-19	006798
SRS DS360 Ultra Low Distortion Generator	2018-10-04	2019-10-04	007167

Z-weight Filter Response

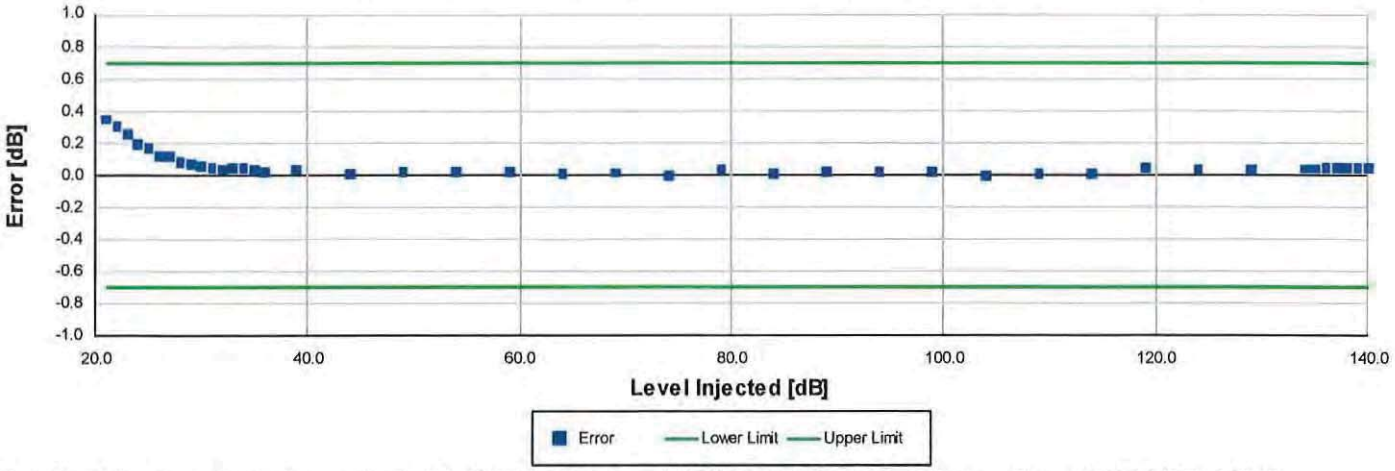


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.17	-0.17	-0.63	0.12	0.15	Pass
63.10	-0.04	-0.04	-0.30	0.30	0.15	Pass
125.89	-0.02	-0.02	-0.30	0.30	0.15	Pass
251.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
501.19	-0.01	-0.01	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.04	-0.04	-0.30	0.30	0.15	Pass
3,981.07	-0.04	-0.04	-0.30	0.30	0.15	Pass
7,943.28	-0.03	-0.03	-0.30	0.30	0.15	Pass
15,848.93	-0.03	-0.03	-0.42	0.32	0.15	Pass
19,952.62	-0.05	-0.05	-0.71	0.41	0.15	Pass

-- End of measurement results--

A-weighted 0 dB Gain Broadband Log Linearity: 8,000.00 Hz



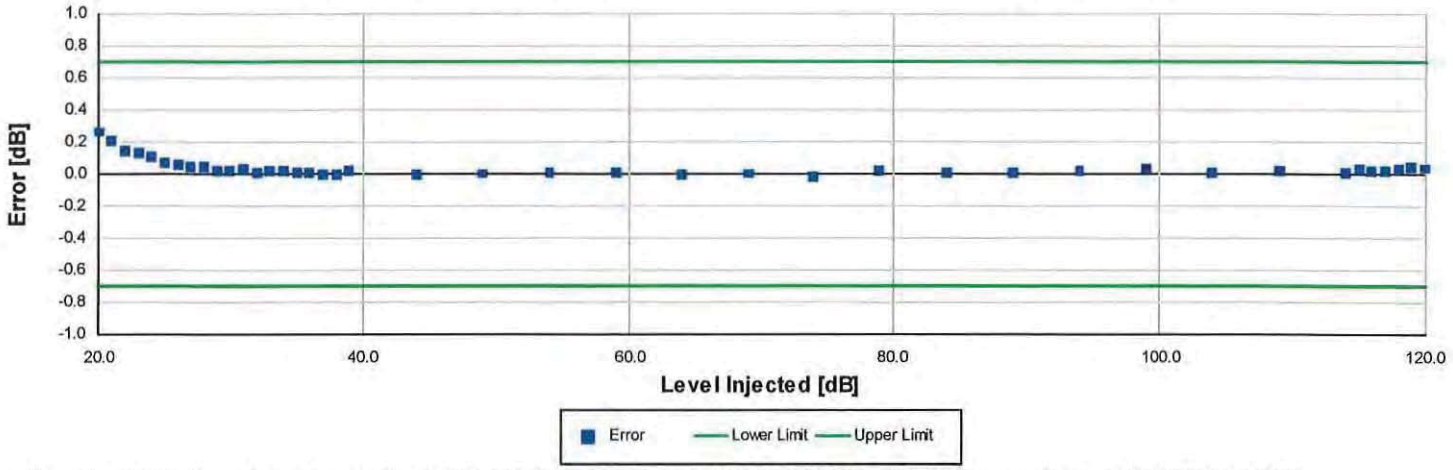
Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
21.00	0.35	-0.70	0.70	0.16	Pass
22.00	0.30	-0.70	0.70	0.16	Pass
23.00	0.25	-0.70	0.70	0.16	Pass
24.00	0.20	-0.70	0.70	0.16	Pass
25.00	0.16	-0.70	0.70	0.16	Pass
26.00	0.12	-0.70	0.70	0.16	Pass
27.00	0.11	-0.70	0.70	0.16	Pass
28.00	0.08	-0.70	0.70	0.16	Pass
29.00	0.07	-0.70	0.70	0.18	Pass
30.00	0.05	-0.70	0.70	0.17	Pass
31.00	0.04	-0.70	0.70	0.17	Pass
32.00	0.03	-0.70	0.70	0.17	Pass
33.00	0.05	-0.70	0.70	0.16	Pass
34.00	0.04	-0.70	0.70	0.16	Pass
35.00	0.03	-0.70	0.70	0.16	Pass
36.00	0.02	-0.70	0.70	0.16	Pass
39.00	0.03	-0.70	0.70	0.16	Pass
44.00	0.01	-0.70	0.70	0.16	Pass
49.00	0.01	-0.70	0.70	0.16	Pass
54.00	0.01	-0.70	0.70	0.16	Pass
59.00	0.01	-0.70	0.70	0.16	Pass
64.00	0.00	-0.70	0.70	0.16	Pass
69.00	0.01	-0.70	0.70	0.16	Pass
74.00	-0.01	-0.70	0.70	0.16	Pass
79.00	0.03	-0.70	0.70	0.16	Pass
84.00	0.01	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.01	-0.70	0.70	0.16	Pass
99.00	0.01	-0.70	0.70	0.16	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.04	-0.70	0.70	0.15	Pass
124.00	0.03	-0.70	0.70	0.15	Pass
129.00	0.03	-0.70	0.70	0.15	Pass
134.00	0.04	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
135.00	0.04	-0.70	0.70	0.15	Pass
136.00	0.04	-0.70	0.70	0.15	Pass
137.00	0.04	-0.70	0.70	0.15	Pass
138.00	0.04	-0.70	0.70	0.15	Pass
139.00	0.04	-0.70	0.70	0.15	Pass
140.00	0.04	-0.70	0.70	0.15	Pass

-- End of measurement results--

A-weighted 20 dB Gain Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
20.00	0.26	-0.70	0.70	0.17	Pass
21.00	0.20	-0.70	0.70	0.16	Pass
22.00	0.14	-0.70	0.70	0.16	Pass
23.00	0.12	-0.70	0.70	0.16	Pass
24.00	0.10	-0.70	0.70	0.16	Pass
25.00	0.07	-0.70	0.70	0.16	Pass
26.00	0.05	-0.70	0.70	0.19	Pass
27.00	0.04	-0.70	0.70	0.18	Pass
28.00	0.04	-0.70	0.70	0.19	Pass
29.00	0.02	-0.70	0.70	0.18	Pass
30.00	0.02	-0.70	0.70	0.17	Pass
31.00	0.03	-0.70	0.70	0.17	Pass
32.00	0.01	-0.70	0.70	0.17	Pass
33.00	0.01	-0.70	0.70	0.16	Pass
34.00	0.02	-0.70	0.70	0.16	Pass
35.00	0.00	-0.70	0.70	0.16	Pass
36.00	0.00	-0.70	0.70	0.16	Pass
37.00	-0.01	-0.70	0.70	0.16	Pass
38.00	-0.01	-0.70	0.70	0.16	Pass
39.00	0.01	-0.70	0.70	0.16	Pass
44.00	0.00	-0.70	0.70	0.16	Pass
49.00	0.00	-0.70	0.70	0.16	Pass
54.00	0.00	-0.70	0.70	0.16	Pass
59.00	0.00	-0.70	0.70	0.16	Pass
64.00	-0.01	-0.70	0.70	0.16	Pass
69.00	0.00	-0.70	0.70	0.16	Pass
74.00	-0.02	-0.70	0.70	0.16	Pass
79.00	0.01	-0.70	0.70	0.16	Pass
84.00	0.00	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.02	-0.70	0.70	0.16	Pass
99.00	0.03	-0.70	0.70	0.16	Pass
104.00	0.01	-0.70	0.70	0.15	Pass
109.00	0.02	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
115.00	0.03	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
116.00	0.02	-0.70	0.70	0.15	Pass
117.00	0.02	-0.70	0.70	0.15	Pass
118.00	0.02	-0.70	0.70	0.15	Pass
119.00	0.04	-0.70	0.70	0.15	Pass
120.00	0.03	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
139.00	40	Negative Pulse	138.32	137.00	139.00	0.15	Pass
		Positive Pulse	138.26	137.00	139.00	0.15	Pass
	30	Negative Pulse	137.50	137.00	139.00	0.15	Pass
		Positive Pulse	137.49	137.00	139.00	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass
108.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	-0.25	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.14	± 0.50	0.15 ‡	Pass
	5	-0.15	± 1.00	0.15 ‡	Pass
	10	-0.09	± 1.50	0.15 ‡	Pass
108.00	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	-0.08	± 1.50	0.16 ‡	Pass

-- End of measurement results--

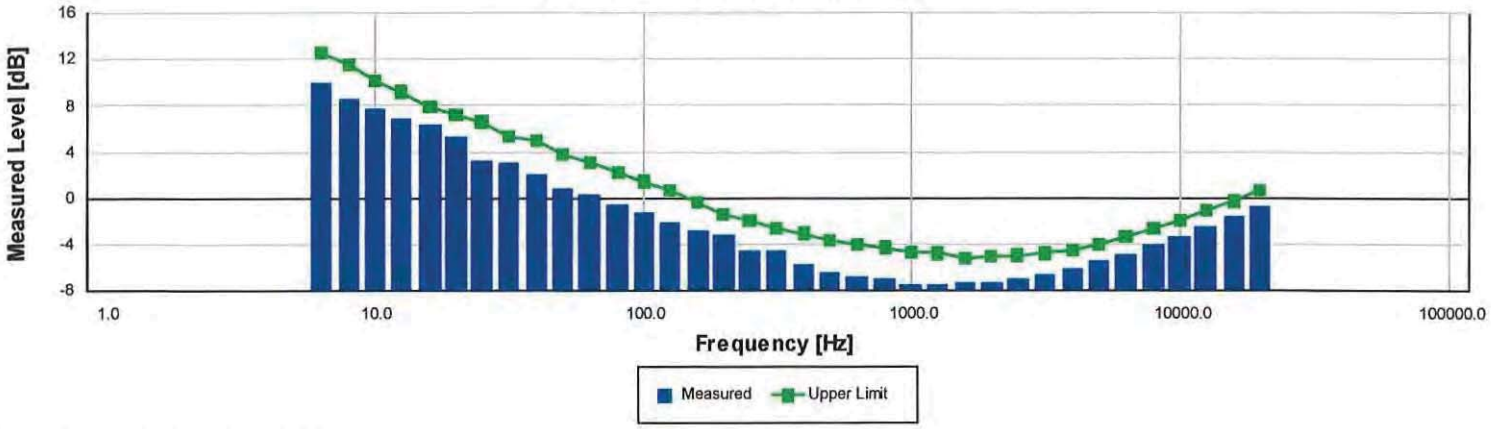
Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	94.00	93.89	94.09	0.15	Pass
0 dB Gain, Linearity	28.08	27.29	28.69	0.16	Pass
20 dB Gain	94.01	93.89	94.09	0.15	Pass
20 dB Gain, Linearity	23.13	22.29	23.69	0.16	Pass
OBA High Range	93.99	93.20	94.80	0.15	Pass
OBA Normal Range	93.95	93.89	94.09	0.15	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to normal range and 20 dB gain.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	10.07	12.60	Pass
8.00	8.56	11.50	Pass
10.00	7.65	10.20	Pass
12.50	6.92	9.20	Pass
16.00	6.37	7.90	Pass
20.00	5.23	7.20	Pass
25.00	3.27	6.60	Pass
31.50	3.12	5.30	Pass
40.00	2.11	5.00	Pass
50.00	0.90	3.80	Pass
63.00	0.30	3.00	Pass
80.00	-0.62	2.20	Pass
100.00	-1.34	1.40	Pass
125.00	-2.17	0.70	Pass
160.00	-2.89	-0.40	Pass
200.00	-3.15	-1.50	Pass
250.00	-4.64	-2.00	Pass
315.00	-4.57	-2.70	Pass
400.00	-5.79	-3.10	Pass
500.00	-6.53	-3.70	Pass
630.00	-6.79	-4.10	Pass
800.00	-6.96	-4.30	Pass
1,000.00	-7.46	-4.70	Pass
1,250.00	-7.45	-4.80	Pass
1,600.00	-7.40	-5.20	Pass
2,000.00	-7.30	-5.10	Pass
2,500.00	-6.99	-5.00	Pass
3,150.00	-6.58	-4.80	Pass
4,000.00	-6.10	-4.50	Pass
5,000.00	-5.50	-4.10	Pass
6,300.00	-4.89	-3.40	Pass
8,000.00	-4.12	-2.70	Pass
10,000.00	-3.32	-1.90	Pass
12,500.00	-2.52	-1.10	Pass
16,000.00	-1.63	-0.30	Pass
20,000.00	-0.70	0.60	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	6.20	9.00	Pass
C-weight Noise Floor	11.65	15.00	Pass
Z-weight Noise Floor	21.50	25.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	137.56	137.20	138.80	0.15	Pass
THD	-81.11		-60.00	1.30 ‡	Pass
THD+N	-79.51		-60.00	1.30 ‡	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ACCREDITED Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Calibration Certificate

Certificate Number 2019003906

Customer:

SWCA
Suite 1700
20 East Thomas Road
Phoenix, AZ 85012, United States

Model Number	831C	***Procedure Number***	D0001.8378		
Serial Number	10737	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	29 Mar 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.48	°C	± 0.25 °C
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Humidity***	49.6	%RH	± 2.0 %RH
		Static Pressure	86.08	kPa	± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRM831 S/N 058503 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

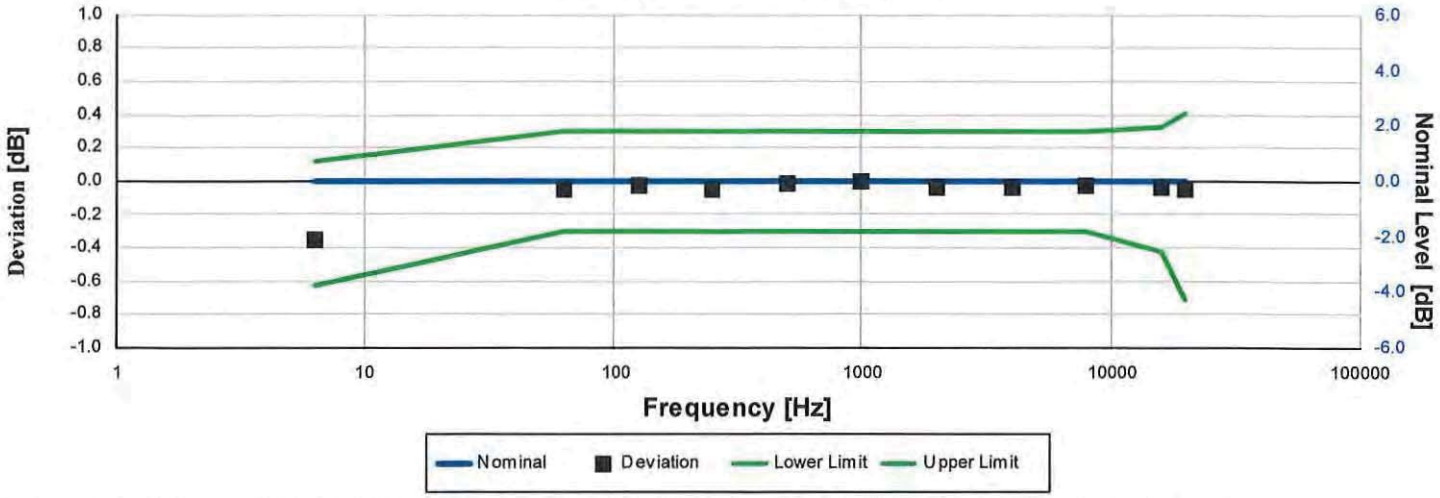
The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa; Reference Range: 0 dB gain

Standards Used			
Description	**Cal Date**	**Cal Due**	**Cal Standard**
Hart Scientific 2626-H Temperature Probe	2018-08-19	2019-08-19	006798
SRS DS360 Ultra Low Distortion Generator	2018-10-04	2019-10-04	007167

Z-weight Filter Response

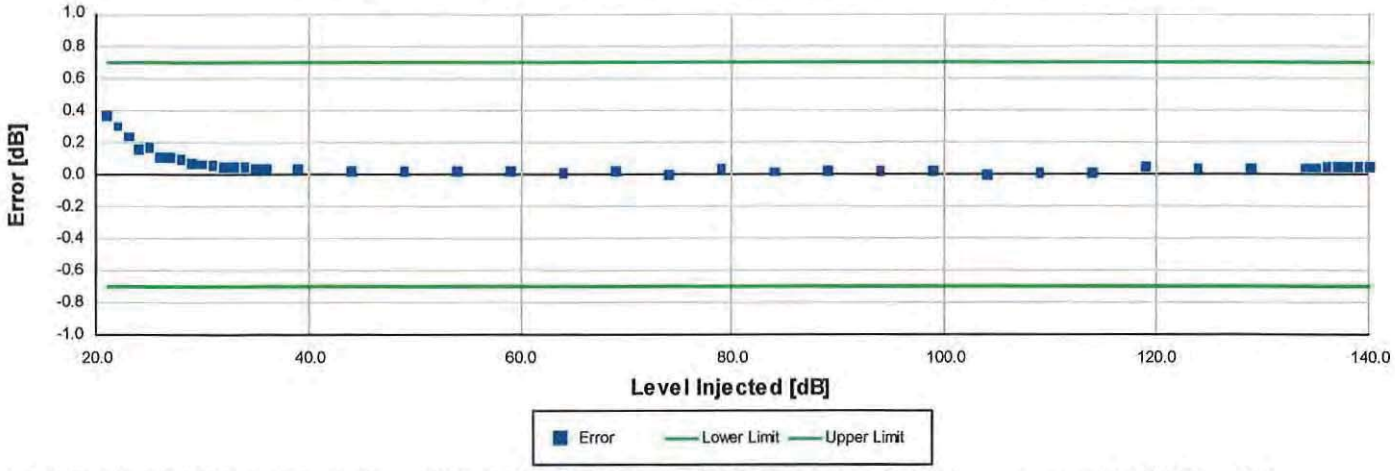


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.34	-0.34	-0.63	0.12	0.15	Pass
63.10	-0.05	-0.05	-0.30	0.30	0.15	Pass
125.89	-0.03	-0.03	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.01	-0.01	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.04	-0.04	-0.30	0.30	0.15	Pass
3,981.07	-0.04	-0.04	-0.30	0.30	0.15	Pass
7,943.28	-0.03	-0.03	-0.30	0.30	0.15	Pass
15,848.93	-0.03	-0.03	-0.42	0.32	0.15	Pass
19,952.62	-0.05	-0.05	-0.71	0.41	0.15	Pass

-- End of measurement results--

A-weighted 0 dB Gain Broadband Log Linearity: 8,000.00 Hz



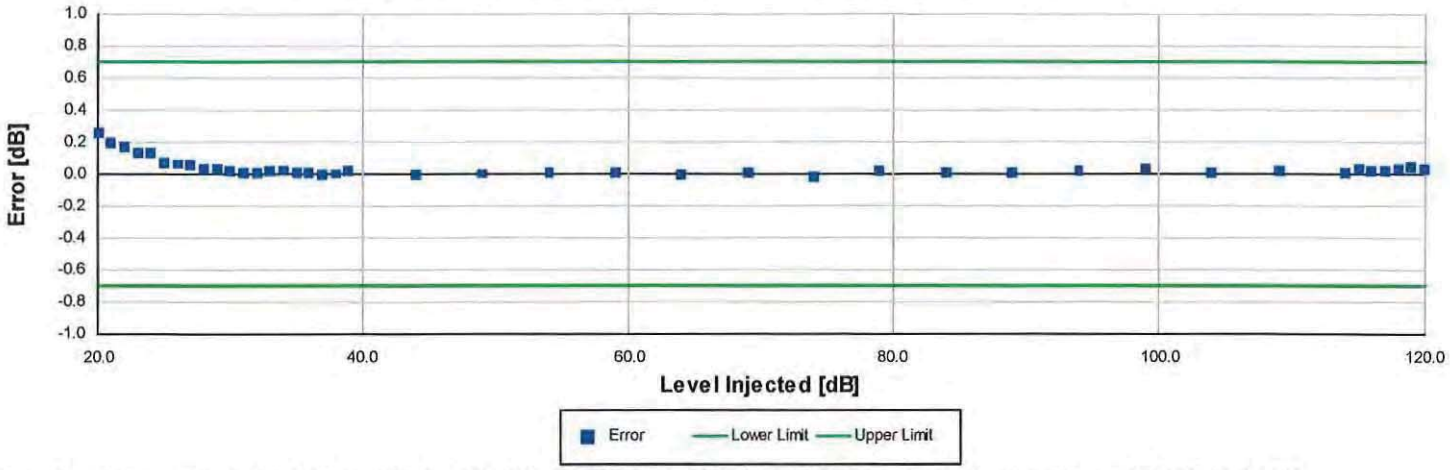
Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
21.00	0.36	-0.70	0.70	0.16	Pass
22.00	0.30	-0.70	0.70	0.16	Pass
23.00	0.24	-0.70	0.70	0.16	Pass
24.00	0.16	-0.70	0.70	0.16	Pass
25.00	0.16	-0.70	0.70	0.16	Pass
26.00	0.10	-0.70	0.70	0.16	Pass
27.00	0.10	-0.70	0.70	0.16	Pass
28.00	0.09	-0.70	0.70	0.16	Pass
29.00	0.07	-0.70	0.70	0.18	Pass
30.00	0.06	-0.70	0.70	0.17	Pass
31.00	0.05	-0.70	0.70	0.17	Pass
32.00	0.05	-0.70	0.70	0.17	Pass
33.00	0.05	-0.70	0.70	0.16	Pass
34.00	0.04	-0.70	0.70	0.16	Pass
35.00	0.03	-0.70	0.70	0.16	Pass
36.00	0.03	-0.70	0.70	0.16	Pass
39.00	0.03	-0.70	0.70	0.16	Pass
44.00	0.01	-0.70	0.70	0.16	Pass
49.00	0.01	-0.70	0.70	0.16	Pass
54.00	0.02	-0.70	0.70	0.16	Pass
59.00	0.02	-0.70	0.70	0.16	Pass
64.00	0.01	-0.70	0.70	0.16	Pass
69.00	0.01	-0.70	0.70	0.16	Pass
74.00	-0.01	-0.70	0.70	0.16	Pass
79.00	0.03	-0.70	0.70	0.16	Pass
84.00	0.01	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.01	-0.70	0.70	0.16	Pass
99.00	0.02	-0.70	0.70	0.16	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.04	-0.70	0.70	0.15	Pass
124.00	0.03	-0.70	0.70	0.15	Pass
129.00	0.03	-0.70	0.70	0.15	Pass
134.00	0.04	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
135.00	0.04	-0.70	0.70	0.15	Pass
136.00	0.04	-0.70	0.70	0.15	Pass
137.00	0.04	-0.70	0.70	0.15	Pass
138.00	0.04	-0.70	0.70	0.15	Pass
139.00	0.04	-0.70	0.70	0.15	Pass
140.00	0.04	-0.70	0.70	0.15	Pass

-- End of measurement results--

A-weighted 20 dB Gain Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
20.00	0.25	-0.70	0.70	0.17	Pass
21.00	0.19	-0.70	0.70	0.16	Pass
22.00	0.16	-0.70	0.70	0.16	Pass
23.00	0.13	-0.70	0.70	0.16	Pass
24.00	0.12	-0.70	0.70	0.16	Pass
25.00	0.07	-0.70	0.70	0.16	Pass
26.00	0.06	-0.70	0.70	0.19	Pass
27.00	0.05	-0.70	0.70	0.18	Pass
28.00	0.02	-0.70	0.70	0.19	Pass
29.00	0.03	-0.70	0.70	0.18	Pass
30.00	0.01	-0.70	0.70	0.17	Pass
31.00	0.01	-0.70	0.70	0.17	Pass
32.00	0.01	-0.70	0.70	0.17	Pass
33.00	0.02	-0.70	0.70	0.16	Pass
34.00	0.02	-0.70	0.70	0.16	Pass
35.00	0.01	-0.70	0.70	0.16	Pass
36.00	0.00	-0.70	0.70	0.16	Pass
37.00	-0.01	-0.70	0.70	0.16	Pass
38.00	0.00	-0.70	0.70	0.16	Pass
39.00	0.01	-0.70	0.70	0.16	Pass
44.00	0.00	-0.70	0.70	0.16	Pass
49.00	0.00	-0.70	0.70	0.16	Pass
54.00	0.00	-0.70	0.70	0.16	Pass
59.00	0.00	-0.70	0.70	0.16	Pass
64.00	-0.01	-0.70	0.70	0.16	Pass
69.00	0.00	-0.70	0.70	0.16	Pass
74.00	-0.02	-0.70	0.70	0.16	Pass
79.00	0.01	-0.70	0.70	0.16	Pass
84.00	0.00	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.02	-0.70	0.70	0.16	Pass
99.00	0.03	-0.70	0.70	0.16	Pass
104.00	0.01	-0.70	0.70	0.15	Pass
109.00	0.02	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
115.00	0.03	-0.70	0.70	0.15	Pass

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
116.00	0.02	-0.70	0.70	0.15	Pass
117.00	0.02	-0.70	0.70	0.15	Pass
118.00	0.02	-0.70	0.70	0.15	Pass
119.00	0.04	-0.70	0.70	0.15	Pass
120.00	0.03	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
139.00	40	Negative Pulse	138.33	137.00	139.00	0.15	Pass
		Positive Pulse	138.33	137.00	139.00	0.15	Pass
	30	Negative Pulse	137.50	137.00	139.00	0.15	Pass
		Positive Pulse	137.50	137.00	139.00	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.14	± 1.00	0.15 ‡	Pass
	10	-0.18	± 1.50	0.15 ‡	Pass
108.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	0.01	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
138.00	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
128.00	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
118.00	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.18	± 1.50	0.15 ‡	Pass
108.00	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	-0.08	± 1.50	0.16 ‡	Pass

-- End of measurement results--

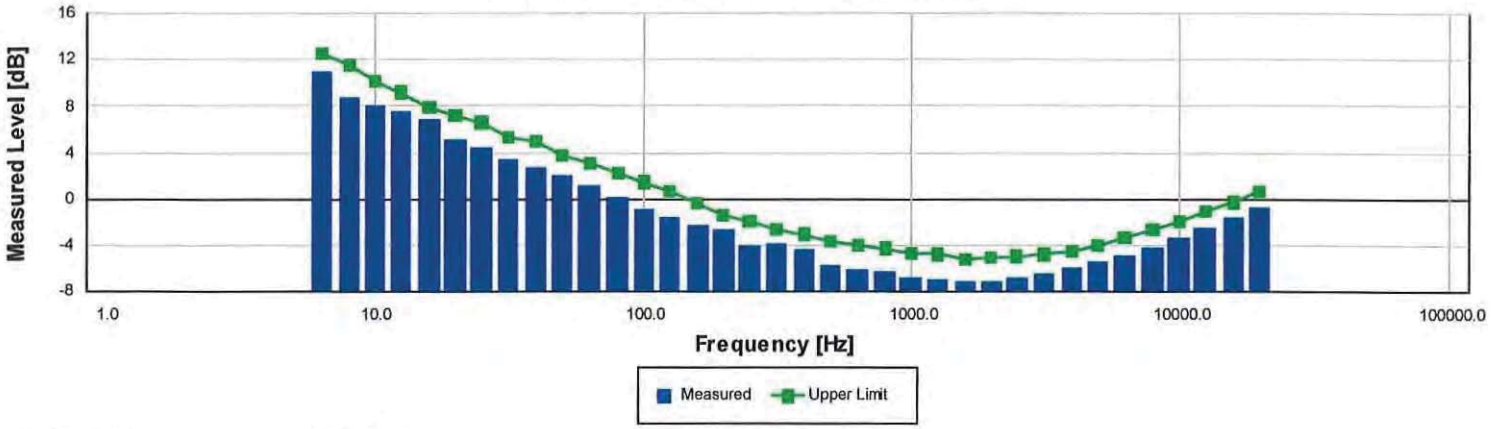
Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	94.00	93.89	94.09	0.15	Pass
0 dB Gain, Linearity	28.11	27.29	28.69	0.16	Pass
20 dB Gain	94.00	93.89	94.09	0.15	Pass
20 dB Gain, Linearity	23.09	22.29	23.69	0.16	Pass
OBA High Range	93.99	93.20	94.80	0.15	Pass
OBA Normal Range	93.99	93.89	94.09	0.15	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to normal range and 20 dB gain.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	11.01	12.60	Pass
8.00	8.70	11.50	Pass
10.00	8.12	10.20	Pass
12.50	7.62	9.20	Pass
16.00	6.93	7.90	Pass
20.00	5.16	7.20	Pass
25.00	4.50	6.60	Pass
31.50	3.50	5.30	Pass
40.00	2.80	5.00	Pass
50.00	1.98	3.80	Pass
63.00	1.14	3.00	Pass
80.00	0.10	2.20	Pass
100.00	-0.84	1.40	Pass
125.00	-1.63	0.70	Pass
160.00	-2.30	-0.40	Pass
200.00	-2.62	-1.50	Pass
250.00	-4.12	-2.00	Pass
315.00	-3.88	-2.70	Pass
400.00	-4.46	-3.10	Pass
500.00	-5.68	-3.70	Pass
630.00	-6.15	-4.10	Pass
800.00	-6.23	-4.30	Pass
1,000.00	-6.76	-4.70	Pass
1,250.00	-6.92	-4.80	Pass
1,600.00	-7.10	-5.20	Pass
2,000.00	-7.08	-5.10	Pass
2,500.00	-6.83	-5.00	Pass
3,150.00	-6.51	-4.80	Pass
4,000.00	-5.86	-4.50	Pass
5,000.00	-5.44	-4.10	Pass
6,300.00	-4.90	-3.40	Pass
8,000.00	-4.13	-2.70	Pass
10,000.00	-3.37	-1.90	Pass
12,500.00	-2.54	-1.10	Pass
16,000.00	-1.70	-0.30	Pass
20,000.00	-0.70	0.60	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	6.40	9.00	Pass
C-weight Noise Floor	12.00	15.00	Pass
Z-weight Noise Floor	22.14	25.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	137.55	137.20	138.80	0.15	Pass
THD	-77.70		-60.00	1.30 ‡	Pass
THD+N	-76.55		-60.00	1.30 ‡	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

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1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA A2LA ACCREDITED Cert. #3622.01

LARSON DAVIS A PCB PIEZOTRONICS DIV.

Calibration Certificate

Certificate Number 2019003919

Customer:
SWCA
Suite 1700
20 East Thomas Road
Phoenix, AZ 85012, United States

Model Number	831C	***Procedure Number***	D0001.8384		
Serial Number	10739	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	29 Mar 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.5	°C	± 0.25 °C
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Humidity***	49.3	%RH	± 2.0 %RH
		Static Pressure	86.26	kPa	± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 µPa.***

Larson Davis PRM831. S/N 058504
PCB 377B02. S/N 311602
Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa; Reference Range: 0 dB gain

Periodic tests were performed in accordance with precedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2018-09-19	2019-09-19	001250
SRS DS360 Ultra Low Distortion Generator	2018-06-21	2019-06-21	006311
Hart Scientific 2626-H Temperature Probe	2018-08-19	2019-08-19	006798
Larson Davis CAL200 Acoustic Calibrator	2018-07-24	2019-07-24	007027
Larson Davis Model 831	2019-02-22	2020-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2019-03-06	2020-03-06	007185

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.18	-0.20	-1.20	0.80	0.23	Pass
1000	0.12	0.00	-0.70	0.70	0.23	Pass
8000	-3.20	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted, 20 dB gain	46.33

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

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Calibration Certificate

Certificate Number 2019001804

Customer:

SWCA
Suite 1700
20 East Thomas Road
Phoenix,AZ 85012,United States

Model Number	PRM831	***Procedure Number***	D0001.8383		
Serial Number	058504	***Technician***	Malinda Madsen		
Test Results	**Pass**	***Calibration Date***	12 Feb 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.25	°C	± 0.01 °C
Description	Larson Davis 1/2" Preamplifier for Model 831 Type 1	***Humidity***	49.3	%RH	± 0.5 %RH
		Static Pressure	86.16	kPa	± 0.03 kPa

Evaluation Method Tested electrically using a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

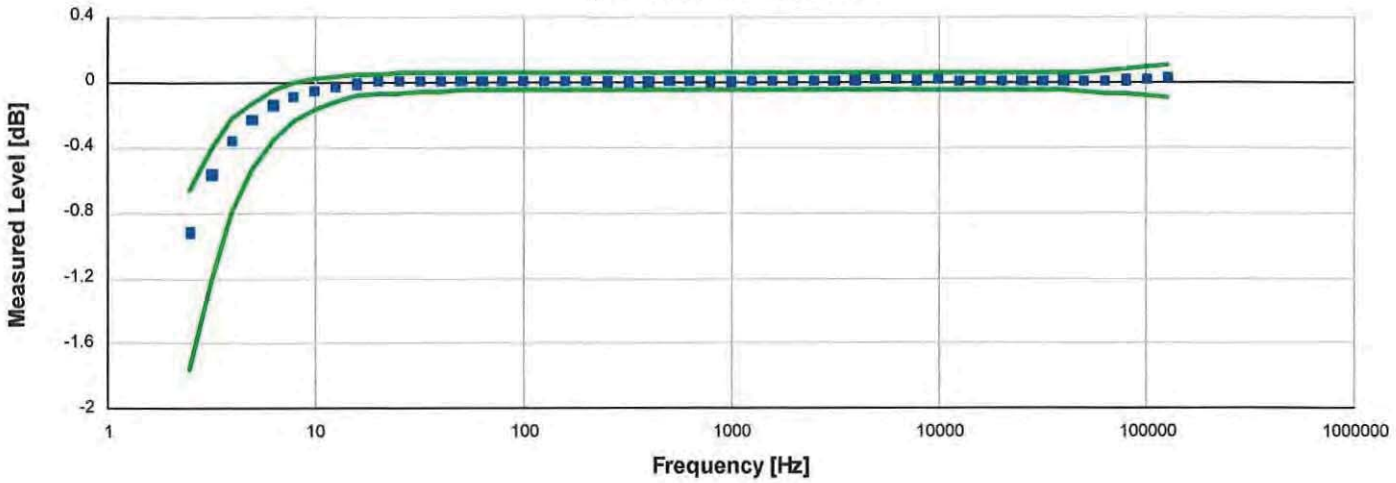
This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis Model 2900 Real Time Analyzer	02/16/2018	02/16/2019	001447
Hart Scientific 2626-H Temperature Probe	08/19/2018	08/19/2019	006798
Agilent 34401A DMM	07/11/2018	07/11/2019	007116
SRS DS360 Ultra Low Distortion Generator	03/16/2018	03/16/2019	007174

Frequency Response



Frequency response electrically tested at 120.0 dB re 1 µV

Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
2.50	-0.92	-1.76	-0.66	0.12	Pass
3.20	-0.57	-1.20	-0.40	0.12	Pass
4.00	-0.36	-0.81	-0.23	0.12	Pass
5.00	-0.23	-0.53	-0.13	0.12	Pass
6.30	-0.14	-0.36	-0.05	0.12	Pass
7.90	-0.09	-0.24	-0.01	0.12	Pass
10.00	-0.05	-0.17	0.03	0.12	Pass
12.60	-0.03	-0.13	0.04	0.12	Pass
15.80	-0.01	-0.09	0.04	0.12	Pass
20.00	0.00	-0.08	0.05	0.12	Pass
25.10	0.00	-0.07	0.05	0.12	Pass
31.60	0.00	-0.07	0.05	0.12	Pass
39.80	0.01	-0.06	0.05	0.12	Pass
50.10	0.01	-0.06	0.05	0.12	Pass
63.10	0.01	-0.05	0.05	0.12	Pass
79.40	0.01	-0.05	0.05	0.12	Pass
100.00	0.01	-0.05	0.05	0.12	Pass
125.90	0.00	-0.05	0.05	0.12	Pass
158.50	0.00	-0.05	0.05	0.12	Pass
199.50	0.00	-0.05	0.05	0.12	Pass
251.20	0.00	-0.05	0.05	0.12	Pass
316.20	0.00	-0.05	0.05	0.12	Pass
398.10	0.00	-0.05	0.05	0.12	Pass
501.20	0.00	-0.05	0.05	0.12	Pass
631.00	0.00	-0.05	0.05	0.12	Pass
794.30	0.00	-0.05	0.05	0.12	Pass
1,000.00	0.00	-0.05	0.05	0.12	Pass
1,258.90	0.00	-0.05	0.05	0.12	Pass
1,584.90	0.00	-0.05	0.05	0.12	Pass
1,995.30	0.01	-0.05	0.05	0.12	Pass
2,511.90	0.01	-0.05	0.05	0.12	Pass
3,162.30	0.01	-0.05	0.05	0.12	Pass

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Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
3,981.10	0.01	-0.05	0.05	0.12	Pass
5,011.90	0.01	-0.05	0.05	0.12	Pass
6,309.60	0.01	-0.05	0.05	0.12	Pass
7,943.30	0.01	-0.05	0.05	0.12	Pass
10,000.00	0.01	-0.05	0.05	0.12	Pass
12,589.30	0.00	-0.05	0.05	0.12	Pass
15,848.90	0.00	-0.05	0.05	0.12	Pass
19,952.60	0.00	-0.05	0.05	0.12	Pass
25,118.90	0.01	-0.05	0.05	0.12	Pass
31,622.80	0.00	-0.05	0.05	0.12	Pass
39,810.70	0.01	-0.05	0.05	0.12	Pass
50,118.70	0.00	-0.06	0.06	0.12	Pass
63,095.70	0.01	-0.07	0.07	0.12	Pass
79,432.80	0.01	-0.08	0.08	0.12	Pass
100,000.00	0.02	-0.09	0.09	0.12	Pass
125,892.50	0.03	-0.10	0.10	0.26	Pass

Gain Measurement

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
Output Gain @ 1 kHz	-0.14	-0.45	-0.03	0.12	Pass

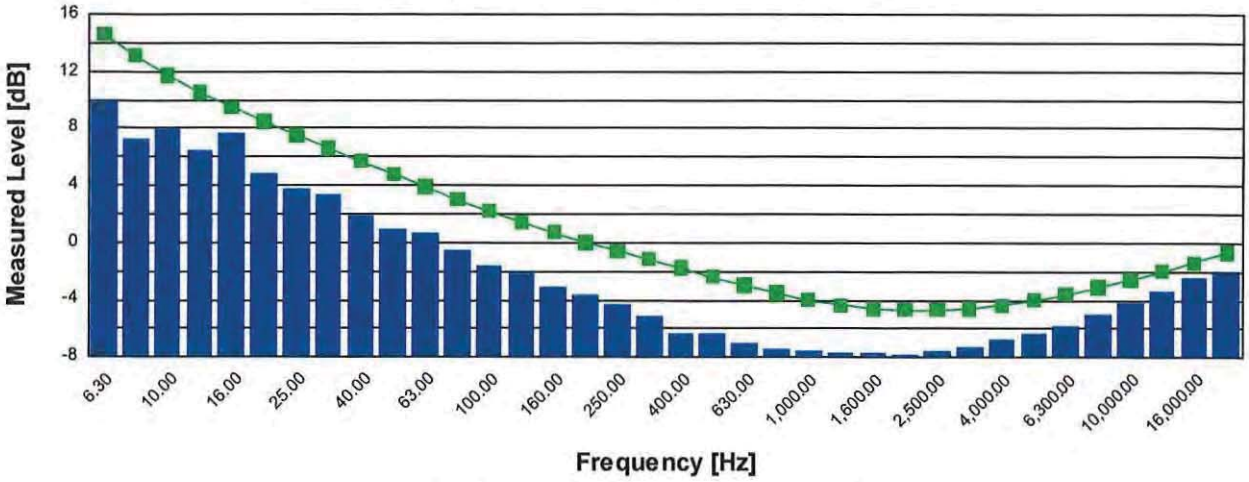
-- End of measurement results--

DC Bias Measurement

Measurement	Test Result [V]	Lower limit [V]	Upper limit [V]	Expanded Uncertainty [V]	Result
DC Voltage	18.67	15.50	19.50	0.04 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



Frequency [Hz]	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
6.30	9.80	14.60	Pass
8.00	7.20	13.10	Pass
10.00	7.90	11.70	Pass
12.50	6.50	10.50	Pass
16.00	7.70	9.50	Pass
20.00	4.80	8.50	Pass
25.00	3.70	7.50	Pass
31.50	3.30	6.60	Pass
40.00	1.80	5.70	Pass
50.00	0.90	4.80	Pass
63.00	0.70	3.90	Pass
80.00	-0.60	3.00	Pass
100.00	-1.60	2.20	Pass
125.00	-2.20	1.40	Pass
160.00	-3.10	0.70	Pass
200.00	-3.70	0.00	Pass
250.00	-4.30	-0.60	Pass
315.00	-5.20	-1.20	Pass
400.00	-6.30	-1.80	Pass
500.00	-6.40	-2.40	Pass
630.00	-7.00	-3.00	Pass
800.00	-7.40	-3.50	Pass
1,000.00	-7.60	-4.00	Pass
1,250.00	-7.70	-4.40	Pass
1,600.00	-7.70	-4.60	Pass
2,000.00	-7.80	-4.70	Pass
2,500.00	-7.60	-4.70	Pass
3,150.00	-7.30	-4.60	Pass
4,000.00	-6.70	-4.40	Pass
5,000.00	-6.30	-4.00	Pass
6,300.00	-5.80	-3.60	Pass
8,000.00	-5.00	-3.10	Pass
10,000.00	-4.20	-2.60	Pass
12,500.00	-3.40	-2.00	Pass
16,000.00	-2.50	-1.40	Pass
20,000.00	-2.00	-0.70	Pass

-- End of measurement results--

Self-generated Noise

Bandwidth	Test Result [µV]	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
A-weighted (1 Hz - 20 kHz)	1.88	5.50	8.00	Pass
Broadband (1 Hz - 20 kHz)	4.12	12.30	15.50	Pass

-- End of measurement results--

Signatory: *Malinda Madsen*

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Provo,UT 84601,United States
716-684-0001

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LARSON DAVIS A PCB PIEZOTRONICS DIV.

Calibration Certificate

Certificate Number 2019003678

Customer:
SWCA
Suite 1700
20 East Thomas Road
Phoenix,AZ 85012,United States

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	16651	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	25 Mar 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	24	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	33	%RH	± 3 %RH
		Static Pressure	101.1	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/06/2018	09/06/2019	001021
Larson Davis Model 2900 Real Time Analyzer	04/10/2018	04/10/2019	001051
Microphone Calibration System	03/04/2019	03/04/2020	005446
1/2" Preamplifier	09/20/2018	09/20/2019	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/07/2018	08/07/2019	006507
1/2 inch Microphone - RI - 200V	05/10/2018	05/10/2019	006510
Pressure Transducer	07/18/2018	07/18/2019	007368

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
114	101.3	114.01	113.80	114.20	0.14	Pass
94	101.1	94.03	93.80	94.20	0.15	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
114	101.3	1,000.19	990.00	1,010.00	0.20	Pass
94	101.1	1,000.20	990.00	1,010.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
114	101.3	0.37	0.00	2.00	0.25 ‡	Pass
94	101.1	0.43	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 24 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
108.0	108.0	-0.01	-0.30	0.30	0.04 ‡	Pass
101.3	101.6	0.00	-0.30	0.30	0.04 ‡	Pass
92.0	91.9	0.02	-0.30	0.30	0.04 ‡	Pass
83.0	82.9	0.02	-0.30	0.30	0.04 ‡	Pass
74.0	73.9	-0.01	-0.30	0.30	0.04 ‡	Pass
65.0	65.0	-0.08	-0.30	0.30	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 24 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	108.0	0.00	-10.00	10.00	0.20 ‡	Pass
101.3	101.6	0.00	-10.00	10.00	0.20 ‡	Pass
92.0	91.9	0.00	-10.00	10.00	0.20 ‡	Pass
83.0	82.9	0.00	-10.00	10.00	0.20 ‡	Pass
74.0	73.9	-0.01	-10.00	10.00	0.20 ‡	Pass
65.0	65.0	-0.01	-10.00	10.00	0.20 ‡	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 24 °C, 29 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
108.0	108.0	0.37	0.00	2.00	0.25 ‡	Pass
101.3	101.6	0.36	0.00	2.00	0.25 ‡	Pass
92.0	91.9	0.35	0.00	2.00	0.25 ‡	Pass
83.0	82.9	0.35	0.00	2.00	0.25 ‡	Pass
74.0	73.9	0.35	0.00	2.00	0.25 ‡	Pass
65.0	65.0	0.36	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: *Scott Montgomery*

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Provo,UT 84601,United States
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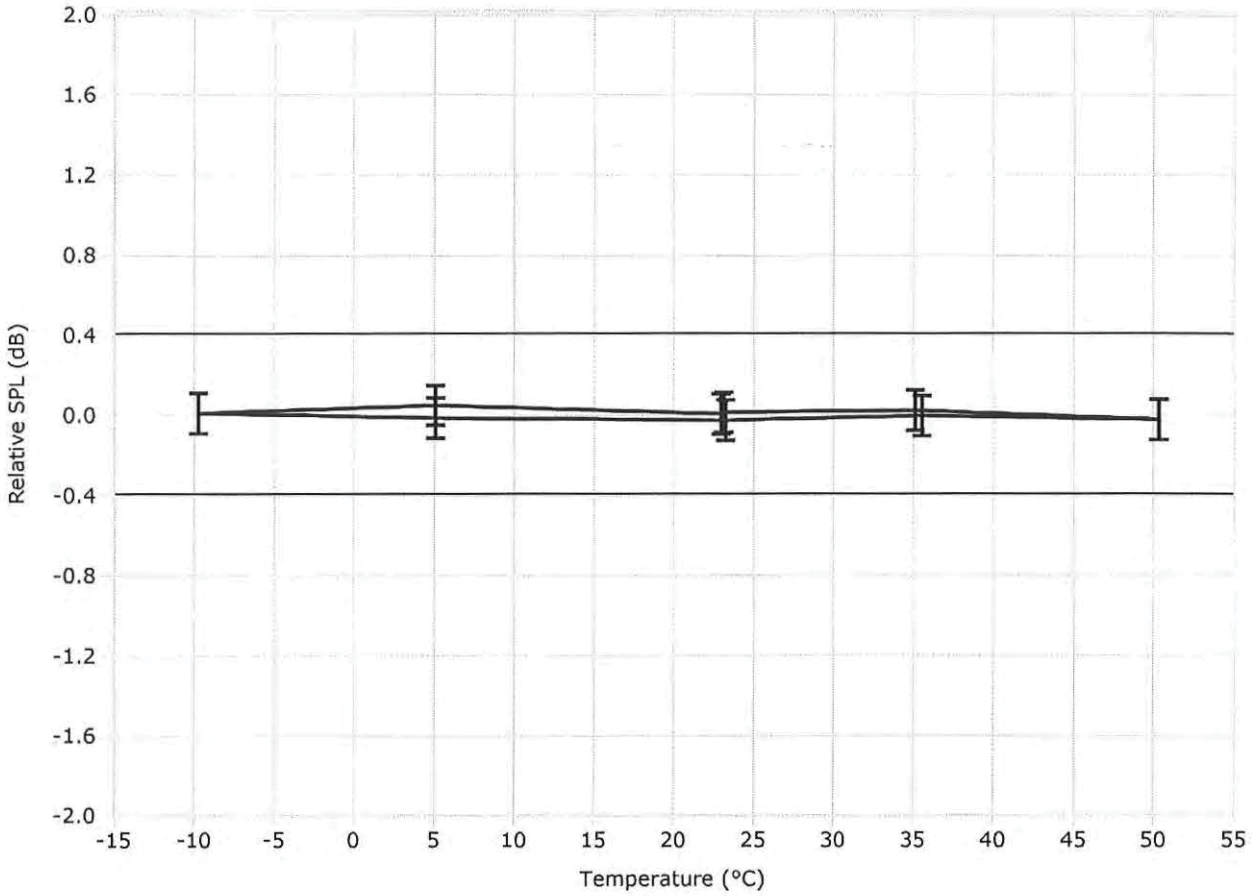
LARSON DAVIS A PCB PIEZOTRONICS DIV.

Model CAL200 Relative SPL vs. Temperature

Larson Davis Model CAL200 Serial Number: 16651

Model CAL200 Relative SPL vs. Temperature at 50% RH.
A 2559 Mic (SN: 2989) with a PRM901 Preamp (SN: 0167), station 14 was used to check the levels.

Test Date: 12 Feb 2019 4:21:02 PM



0.1dB expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL200.SEQ

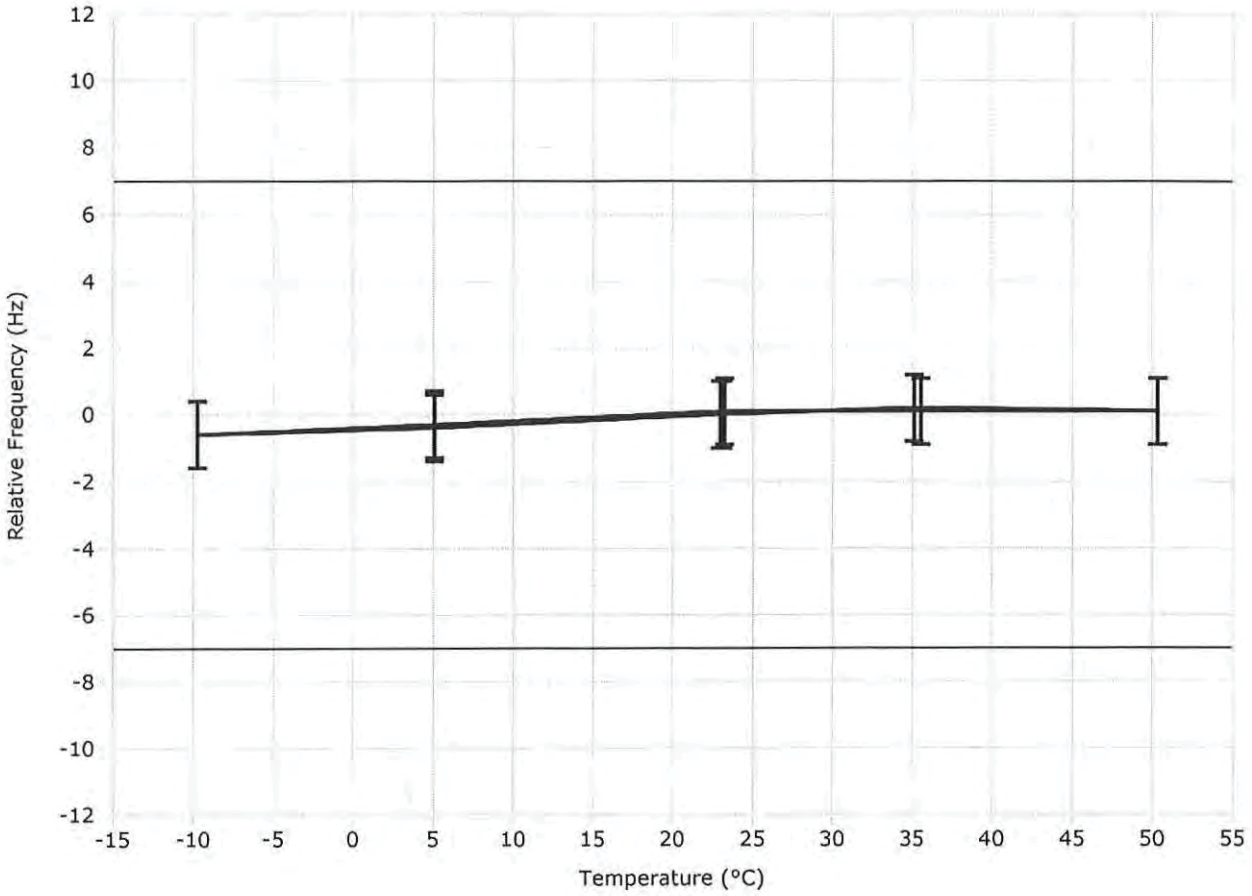
Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Model CAL200 Relative Frequency vs. Temperature

Larson Davis Model CAL200 Serial Number: 16651

Model CAL200 Relative Frequency vs. Temperature at 50% RH.
A 2559 Mic (SN: 2989) with a PRM901 Preamp (SN: 0167), station 14 was used to check the levels.

Test Date: 12 Feb 2019 4:21:02 PM



1.0 Hz expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL200.SEQ

Test Location: Larson Davis, a division of PCB Piezotronics, Inc.
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Calibration Certificate

Certificate Number 2019001803

Customer:

SWCA
Suite 1700
20 East Thomas Road
Phoenix,AZ 85012,United States

Model Number	PRM831	***Procedure Number***	D0001.8383		
Serial Number	058503	***Technician***	Malinda Madsen		
Test Results	**Pass**	***Calibration Date***	12 Feb 2019		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.29	°C	± 0.01 °C
Description	Larson Davis 1/2" Preamplifier for Model 831 Type 1	***Humidity***	50.7	%RH	± 0.5 %RH
		Static Pressure	86.17	kPa	± 0.03 kPa

Evaluation Method Tested electrically using a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

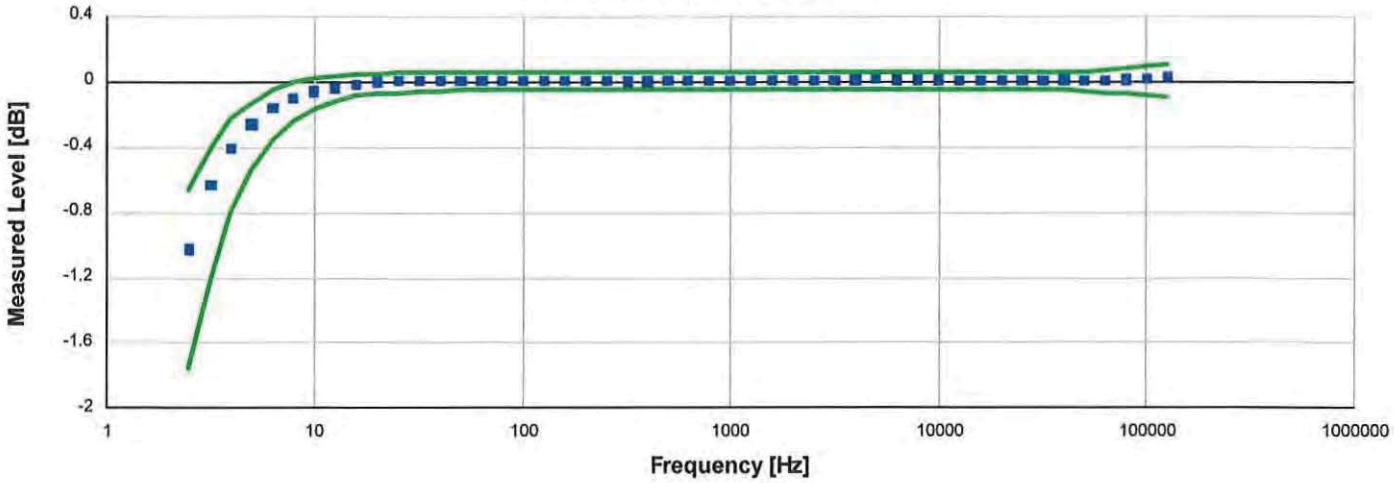
This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis Model 2900 Real Time Analyzer	02/16/2018	02/16/2019	001447
Hart Scientific 2626-H Temperature Probe	08/19/2018	08/19/2019	006798
Agilent 34401A DMM	07/11/2018	07/11/2019	007116
SRS DS360 Ultra Low Distortion Generator	03/16/2018	03/16/2019	007174

Frequency Response



Frequency response electrically tested at 120.0 dB re 1 µV

Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
2.50	-1.03	-1.76	-0.66	0.12	Pass
3.20	-0.64	-1.20	-0.40	0.12	Pass
4.00	-0.41	-0.81	-0.23	0.12	Pass
5.00	-0.26	-0.53	-0.13	0.12	Pass
6.30	-0.16	-0.36	-0.05	0.12	Pass
7.90	-0.10	-0.24	-0.01	0.12	Pass
10.00	-0.06	-0.17	0.03	0.12	Pass
12.60	-0.04	-0.13	0.04	0.12	Pass
15.80	-0.02	-0.09	0.04	0.12	Pass
20.00	0.00	-0.08	0.05	0.12	Pass
25.10	0.00	-0.07	0.05	0.12	Pass
31.60	0.00	-0.07	0.05	0.12	Pass
39.80	0.00	-0.06	0.05	0.12	Pass
50.10	0.01	-0.06	0.05	0.12	Pass
63.10	0.01	-0.05	0.05	0.12	Pass
79.40	0.01	-0.05	0.05	0.12	Pass
100.00	0.01	-0.05	0.05	0.12	Pass
125.90	0.00	-0.05	0.05	0.12	Pass
158.50	0.00	-0.05	0.05	0.12	Pass
199.50	0.00	-0.05	0.05	0.12	Pass
251.20	0.00	-0.05	0.05	0.12	Pass
316.20	0.00	-0.05	0.05	0.12	Pass
398.10	0.00	-0.05	0.05	0.12	Pass
501.20	0.00	-0.05	0.05	0.12	Pass
631.00	0.00	-0.05	0.05	0.12	Pass
794.30	0.00	-0.05	0.05	0.12	Pass
1,000.00	0.00	-0.05	0.05	0.12	Pass
1,258.90	0.00	-0.05	0.05	0.12	Pass
1,584.90	0.01	-0.05	0.05	0.12	Pass
1,995.30	0.01	-0.05	0.05	0.12	Pass
2,511.90	0.01	-0.05	0.05	0.12	Pass
3,162.30	0.01	-0.05	0.05	0.12	Pass

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Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
3,981.10	0.01	-0.05	0.05	0.12	Pass
5,011.90	0.01	-0.05	0.05	0.12	Pass
6,309.60	0.01	-0.05	0.05	0.12	Pass
7,943.30	0.01	-0.05	0.05	0.12	Pass
10,000.00	0.01	-0.05	0.05	0.12	Pass
12,589.30	0.00	-0.05	0.05	0.12	Pass
15,848.90	0.00	-0.05	0.05	0.12	Pass
19,952.60	0.00	-0.05	0.05	0.12	Pass
25,118.90	0.01	-0.05	0.05	0.12	Pass
31,622.80	0.01	-0.05	0.05	0.12	Pass
39,810.70	0.01	-0.05	0.05	0.12	Pass
50,118.70	0.00	-0.06	0.06	0.12	Pass
63,095.70	0.01	-0.07	0.07	0.12	Pass
79,432.80	0.01	-0.08	0.08	0.12	Pass
100,000.00	0.02	-0.09	0.09	0.12	Pass
125,892.50	0.03	-0.10	0.10	0.26	Pass

Gain Measurement

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
Output Gain @ 1 kHz	-0.14	-0.45	-0.03	0.12	Pass

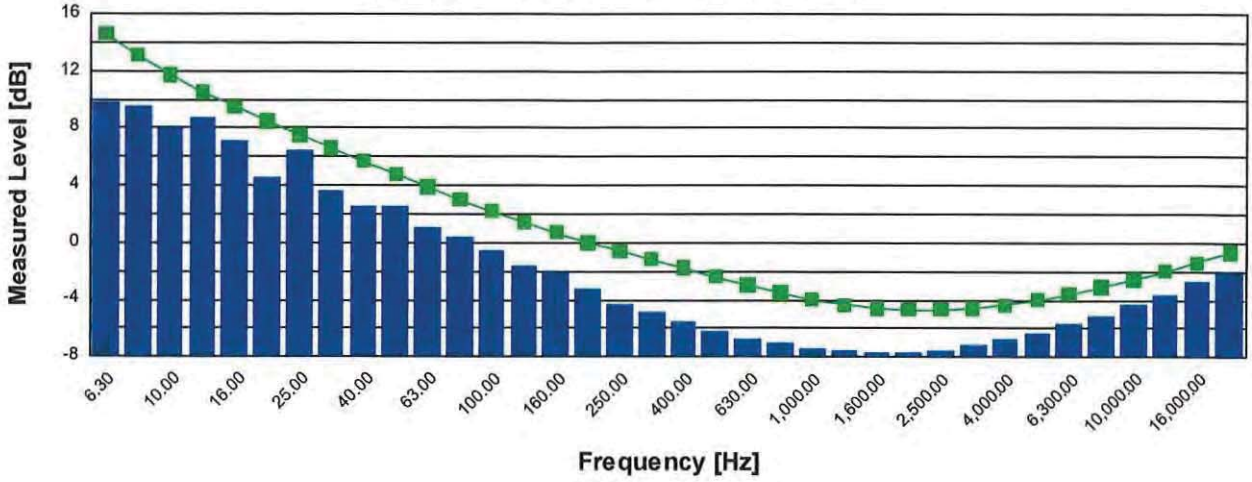
-- End of measurement results--

DC Bias Measurement

Measurement	Test Result [V]	Lower limit [V]	Upper limit [V]	Expanded Uncertainty [V]	Result
DC Voltage	18.61	15.50	19.50	0.04 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



Frequency [Hz]	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
6.30	9.80	14.60	Pass
8.00	9.50	13.10	Pass
10.00	8.10	11.70	Pass
12.50	8.70	10.50	Pass
16.00	7.10	9.50	Pass
20.00	4.60	8.50	Pass
25.00	6.50	7.50	Pass
31.50	3.60	6.60	Pass
40.00	2.50	5.70	Pass
50.00	2.50	4.80	Pass
63.00	1.00	3.90	Pass
80.00	0.40	3.00	Pass
100.00	-0.60	2.20	Pass
125.00	-1.70	1.40	Pass
160.00	-2.10	0.70	Pass
200.00	-3.20	0.00	Pass
250.00	-4.40	-0.60	Pass
315.00	-4.90	-1.20	Pass
400.00	-5.60	-1.80	Pass
500.00	-6.20	-2.40	Pass
630.00	-6.70	-3.00	Pass
800.00	-7.00	-3.50	Pass
1,000.00	-7.40	-4.00	Pass
1,250.00	-7.60	-4.40	Pass
1,600.00	-7.70	-4.60	Pass
2,000.00	-7.70	-4.70	Pass
2,500.00	-7.60	-4.70	Pass
3,150.00	-7.20	-4.60	Pass
4,000.00	-6.80	-4.40	Pass
5,000.00	-6.30	-4.00	Pass
6,300.00	-5.70	-3.60	Pass
8,000.00	-5.10	-3.10	Pass
10,000.00	-4.40	-2.60	Pass
12,500.00	-3.60	-2.00	Pass
16,000.00	-2.70	-1.40	Pass
20,000.00	-2.10	-0.70	Pass

-- End of measurement results--

Self-generated Noise

Bandwidth	Test Result [µV]	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
A-weighted (1 Hz - 20 kHz)	1.91	5.60	8.00	Pass
Broadband (1 Hz - 20 kHz)	4.57	13.20	15.50	Pass

-- End of measurement results--

Signatory: *Malinda Madsen*

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Provo,UT 84601,United States
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Calibration Certificate

Certificate Number 2019003911

Customer:

SWCA
Suite 1700
20 East Thomas Road
Phoenix, AZ 85012, United States

Model Number	831C	***Procedure Number***	D0001.8384
Serial Number	10737	***Technician***	Ron Harris
Test Results	**Pass**	***Calibration Date***	29 Mar 2019
Initial Condition	As Manufactured	***Calibration Due***	
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Temperature***	23.58 °C ± 0.25 °C
		Humidity	49.7 %RH ± 2.0 %RH
		Static Pressure	86.15 kPa ± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 µPa.***

Larson Davis PRM831. S/N 058503
PCB 377B02. S/N 311601
Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa; Reference Range: 0 dB gain

Periodic tests were performed in accordance with precedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2018-09-19	2019-09-19	001250
SRS DS360 Ultra Low Distortion Generator	2018-06-21	2019-06-21	006311
Hart Scientific 2626-H Temperature Probe	2018-08-19	2019-08-19	006798
Larson Davis CAL200 Acoustic Calibrator	2018-07-24	2019-07-24	007027
Larson Davis Model 831	2019-02-22	2020-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2019-03-06	2020-03-06	007185

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.21	-0.20	-1.20	0.80	0.23	Pass
1000	0.14	0.00	-0.70	0.70	0.23	Pass
8000	-2.64	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted, 20 dB gain	45.90

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

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716-684-0001

ACCREDITED Cert. #3622.01

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~ Certificate of Calibration and Compliance ~

Microphone Model: 377B02 Serial Number: 311602 Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	10/19/18	10/18/19
Larson Davis	PRM915	132	CA1552	11/29/18	11/29/19
Larson Davis	PRM902	4407	CA1248	5/23/18	5/23/19
Larson Davis	PRM916	125	TA469	6/26/18	6/26/19
Larson Davis	CAL250	5026	CA1278	9/19/18	9/19/19
Larson Davis	2201	115	TA472	4/12/18	4/12/19
Bruel & Kjaer	4192	2764626	CA1636	8/15/18	8/15/19
Larson Davis	GPRM902	4163	CA1089	6/12/18	6/12/19
Newport	iTHX-SD/N	1080002	CA1511	2/8/19	2/7/20
Larson Davis	PRA951-4	234	CA1154	10/24/18	10/24/19
Larson Davis	PRM915	147	CA2179	6/8/18	6/7/19
PCB	68510-02	N/A	CA2672	12/21/18	12/20/19
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Open Circuit Sensitivity is measured using the insertion voltage method following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-20.

Technician: Leonard Lukasik Date: February 13, 2019

ilac-MRA ACCREDITED

CALIBRATION CERT #1662.01

PCB PIEZOTRONICS VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-363926196.063+0

~ Calibration Report ~

Microphone Model: 377B02 Serial Number: 311602 Description: 1/2" Free-Field Microphone

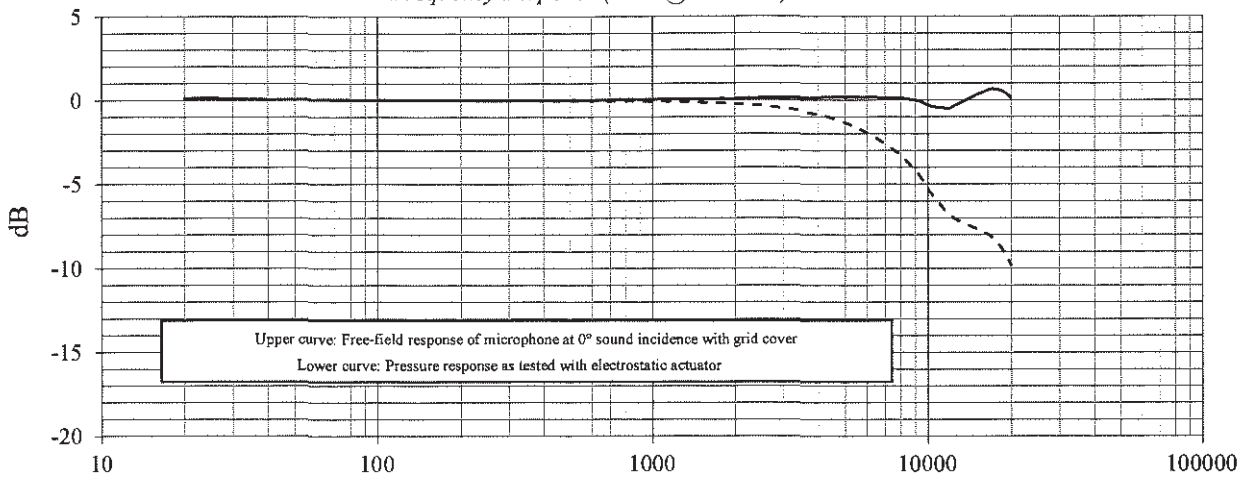
Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 53.17 mV/Pa
-25.49 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 12.7 pF

Temperature: 69 °F (21°C) Ambient Pressure: 977 mbar Relative Humidity: 31 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.10	0.10	1679	-0.16	0.07	7499	-2.95	0.12	-	-	-
25.1	0.12	0.12	1778	-0.17	0.08	7943	-3.26	0.13	-	-	-
31.6	0.07	0.07	1884	-0.21	0.07	8414	-3.68	0.05	-	-	-
39.8	0.06	0.06	1995	-0.24	0.07	8913	-4.11	0.01	-	-	-
50.1	0.06	0.06	2114	-0.25	0.09	9441	-4.62	-0.10	-	-	-
63.1	0.05	0.05	2239	-0.27	0.11	10000	-5.26	-0.31	-	-	-
79.4	0.04	0.04	2371	-0.32	0.09	10593	-5.82	-0.42	-	-	-
100.0	0.03	0.03	2512	-0.33	0.13	11220	-6.31	-0.45	-	-	-
125.9	0.02	0.02	2661	-0.39	0.12	11885	-6.82	-0.50	-	-	-
158.5	0.01	0.01	2818	-0.43	0.13	12589	-7.08	-0.31	-	-	-
199.5	0.01	0.01	2985	-0.50	0.12	13335	-7.29	-0.10	-	-	-
251.2	0.00	0.00	3162	-0.54	0.14	14125	-7.48	0.11	-	-	-
316.2	-0.01	0.00	3350	-0.60	0.14	14962	-7.64	0.33	-	-	-
398.1	-0.02	-0.02	3548	-0.69	0.13	15849	-7.87	0.48	-	-	-
501.2	-0.02	0.02	3758	-0.79	0.12	16788	-8.08	0.64	-	-	-
631.0	-0.04	0.00	3981	-0.86	0.14	17783	-8.49	0.62	-	-	-
794.3	-0.05	0.04	4217	-0.95	0.16	18837	-9.03	0.48	-	-	-
1000.0	-0.08	0.05	4467	-1.07	0.17	19953	-9.81	0.12	-	-	-
1059.3	-0.07	0.06	4732	-1.19	0.18	-	-	-	-	-	-
1122.0	-0.08	0.07	5012	-1.36	0.17	-	-	-	-	-	-
1188.5	-0.09	0.06	5309	-1.52	0.18	-	-	-	-	-	-
1258.9	-0.09	0.07	5623	-1.72	0.16	-	-	-	-	-	-
1333.5	-0.13	0.06	5957	-1.91	0.16	-	-	-	-	-	-
1412.5	-0.12	0.07	6310	-2.11	0.18	-	-	-	-	-	-
1496.2	-0.15	0.05	6683	-2.39	0.13	-	-	-	-	-	-
1584.9	-0.16	0.05	7080	-2.66	0.12	-	-	-	-	-	-

Technician: Leonard Lukasik Date: February 13, 2019

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CALIBRATION CERT #1862.01

PCB PIEZOTRONICS INC.
VIBRATION DIVISION

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TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-383928186_083+0

~ *Certificate of Calibration and Compliance* ~

Microphone Model: 377B02 Serial Number: 311601 Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	10/19/18	10/18/19
Larson Davis	PRM915	132	CA1552	11/29/18	11/29/19
Larson Davis	PRM902	4407	CA1248	5/23/18	5/23/19
Larson Davis	PRM916	125	TA469	6/26/18	6/26/19
Larson Davis	CAL250	5026	CA1278	9/19/18	9/19/19
Larson Davis	2201	115	TA472	4/12/18	4/12/19
Bruel & Kjaer	4192	2764626	CA1636	8/15/18	8/15/19
Larson Davis	GPRM902	4163	CA1089	6/12/18	6/12/19
Newport	iTHX-SD/N	1080002	CA1511	2/8/19	2/7/20
Larson Davis	PRA951-4	234	CA1154	10/24/18	10/24/19
Larson Davis	PRM915	147	CA2179	6/8/18	6/7/19
PCB	68510-02	N/A	CA2672	12/21/18	12/20/19
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Open Circuit Sensitivity is measured using the insertion voltage method following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-20.

Technician: Leonard Lukasik Date: February 13, 2019

ilac-MRA ACCREDITED

CALIBRATION CERT #1862.01

PCB PIEZOTRONICS INC
VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-363292S15.644+0

~ Calibration Report ~

Microphone Model: 377B02 Serial Number: 311601 Description: 1/2" Free-Field Microphone

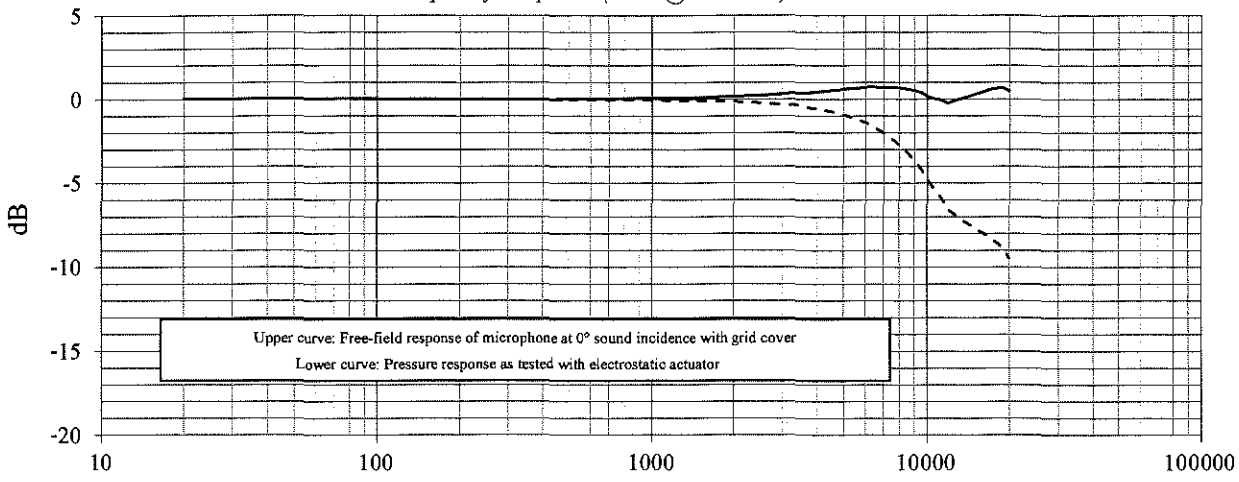
Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 44.87 mV/Pa
-26.96 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 12.3 pF

Temperature: 69 °F (21°C) Ambient Pressure: 977 mbar Relative Humidity: 31 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.04	0.04	1679	-0.12	0.12	7499	-2.38	0.69	-	-	-
25.1	0.03	0.03	1778	-0.11	0.14	7943	-2.72	0.67	-	-	-
31.6	0.04	0.04	1884	-0.14	0.14	8414	-3.12	0.61	-	-	-
39.8	0.03	0.03	1995	-0.13	0.18	8913	-3.58	0.53	-	-	-
50.1	0.03	0.03	2114	-0.17	0.17	9441	-4.11	0.41	-	-	-
63.1	0.03	0.03	2239	-0.17	0.20	10000	-4.78	0.17	-	-	-
79.4	0.02	0.02	2371	-0.20	0.21	10593	-5.38	0.02	-	-	-
100.0	0.01	0.01	2512	-0.22	0.24	11220	-5.92	-0.06	-	-	-
125.9	0.01	0.01	2661	-0.26	0.25	11885	-6.54	-0.22	-	-	-
158.5	0.00	0.00	2818	-0.29	0.28	12589	-6.85	-0.08	-	-	-
199.5	0.01	0.01	2985	-0.32	0.30	13335	-7.16	0.04	-	-	-
251.2	0.00	0.00	3162	-0.34	0.34	14125	-7.43	0.17	-	-	-
316.2	-0.02	-0.01	3350	-0.37	0.37	14962	-7.68	0.29	-	-	-
398.1	-0.02	-0.02	3548	-0.44	0.38	15849	-7.94	0.41	-	-	-
501.2	-0.03	0.01	3758	-0.52	0.38	16788	-8.17	0.55	-	-	-
631.0	-0.03	0.01	3981	-0.57	0.43	17783	-8.48	0.63	-	-	-
794.3	-0.05	0.05	4217	-0.65	0.46	18837	-8.85	0.66	-	-	-
1000.0	-0.05	0.07	4467	-0.72	0.51	19953	-9.47	0.46	-	-	-
1059.3	-0.07	0.06	4732	-0.83	0.54	-	-	-	-	-	-
1122.0	-0.06	0.08	5012	-0.93	0.61	-	-	-	-	-	-
1188.5	-0.06	0.09	5309	-1.08	0.63	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.22	0.66	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.37	0.70	-	-	-	-	-	-
1412.5	-0.10	0.09	6310	-1.56	0.73	-	-	-	-	-	-
1496.2	-0.10	0.10	6683	-1.82	0.70	-	-	-	-	-	-
1584.9	-0.10	0.11	7080	-2.08	0.70	-	-	-	-	-	-

Technician: Leonard Lukasik Date: February 13, 2019

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CALIBRATION CERT #1862.01

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ID:CAL112-363925915,644+0

APPENDIX C
Weather Data

Madison Solar Project
Baseline Noise Survey
Weather Data

ID: KKYRICHM59

Start date: 4/21/2021 **End date:** 4/23/2021

Day	Time	Temperature		Hourly Wind	Max Gust	Precipitation	Humidity	Daily max	Daily min
		F	C	mph	mph	in	%	F	F
4/21/2021	0:00	46.00	7.78	7.00	12.00	0.00	69	46.00	32.00
	1:00	42.00	5.56	7.00	12.00	0.00	78		
	2:00	39.00	3.89	5.00	10.00	0.00	87		
	3:00	34.00	1.11	4.00	7.00	0.00	94		
	4:00	32.00	0.00	1.00	3.00	0.00	97		
	5:00	32.00	0.00	2.00	3.00	0.00	98		
	6:00	32.00	0.00	3.00	5.00	0.00	98		
	7:00	33.00	0.56	2.00	5.00	0.00	96		
	8:00	33.00	0.56	3.00	6.00	0.00	93		
	9:00	34.00	1.11	4.00	7.00	0.00	91		
	10:00	34.00	1.11	4.00	8.00	0.00	90		
	11:00	37.00	2.78	5.00	9.00	0.00	80		
	12:00	38.00	3.33	5.00	10.00	0.00	72		
	13:00	40.00	4.44	5.00	9.00	0.00	65		
	14:00	41.00	5.00	4.00	8.00	0.00	60		
	15:00	42.00	5.56	5.00	10.00	0.00	54		
	16:00	43.00	6.11	4.00	8.00	0.00	54		
	17:00	42.00	5.56	5.00	8.00	0.00	56		
	18:00	42.00	5.56	3.00	6.00	0.00	61		
	19:00	42.00	5.56	2.00	3.00	0.00	63		
	20:00	38.00	3.33	1.00	2.00	0.00	71		
	21:00	36.00	2.22	0.00	1.00	0.00	77		
	22:00	34.00	1.11	0.00	1.00	0.00	85		
	23:00	35.00	1.67	2.00	3.00	0.00	83		

Madison Solar Project
Baseline Noise Survey
Weather Data

ID: KKYRICHM59

Start date: 4/21/2021 **End date:** 4/23/2021

Day	Time	Temperature		Hourly Wind	Max Gust	Precipitation	Humidity	Daily max	Daily min
		F	C	mph	mph	in	%	F	F
4/22/2021	0:00	33.00	0.56	2.00	2.00	0.00	86	53.00	31.00
	1:00	33.00	0.56	2.00	3.00	0.00	85		
	2:00	32.00	0.00	2.00	2.00	0.00	85		
	3:00	31.00	-0.56	2.00	4.00	0.00	87		
	4:00	32.00	0.00	2.00	4.00	0.00	87		
	5:00	33.00	0.56	2.00	4.00	0.00	86		
	6:00	34.00	1.11	2.00	3.00	0.00	83		
	7:00	35.00	1.67	2.00	3.00	0.00	80		
	8:00	38.00	3.33	2.00	4.00	0.00	74		
	9:00	43.00	6.11	5.00	9.00	0.00	64		
	10:00	46.00	7.78	5.00	9.00	0.00	61		
	11:00	48.00	8.89	6.00	10.00	0.00	54		
	12:00	48.00	8.89	6.00	11.00	0.00	51		
	13:00	48.00	8.89	6.00	10.00	0.00	48		
	14:00	50.00	10.00	6.00	11.00	0.00	43		
	15:00	52.00	11.11	6.00	11.00	0.00	40		
	16:00	53.00	11.67	6.00	10.00	0.00	40		
	17:00	53.00	11.67	4.00	7.00	0.00	39		
	18:00	53.00	11.67	4.00	8.00	0.00	37		
	19:00	52.00	11.11	3.00	5.00	0.00	39		
	20:00	48.00	8.89	0.00	1.00	0.00	43		
	21:00	44.00	6.67	0.00	1.00	0.00	52		
	22:00	42.00	5.56	0.00	1.00	0.00	60		
	23:00	40.00	4.44	0.00	1.00	0.00	62		

Madison Solar Project
Baseline Noise Survey
Weather Data

ID: KKYRICHM59

Start date: 4/21/2021 **End date:** 4/23/2021

Day	Time	Temperature		Hourly Wind	Max Gust	Precipitation	Humidity	Daily max	Daily min
		F	C	mph	mph	in	%	F	F
4/23/2021	0:00	37.00	2.78	0.00	1.00	0.00	72	59.00	30.00
	1:00	33.00	0.56	1.00	1.00	0.00	81		
	2:00	32.00	0.00	1.00	1.00	0.00	85		
	3:00	32.00	0.00	0.00	1.00	0.00	86		
	4:00	30.00	-1.11	0.00	1.00	0.00	91		
	5:00	31.00	-0.56	0.00	1.00	0.00	91		
	6:00	31.00	-0.56	0.00	0.00	0.00	92		
	7:00	33.00	0.56	0.00	0.00	0.00	93		
	8:00	39.00	3.89	0.00	1.00	0.00	81		
	9:00	46.00	7.78	1.00	2.00	0.00	68		
	10:00	50.00	10.00	3.00	6.00	0.00	57		
	11:00	52.00	11.11	3.00	5.00	0.00	59		
	12:00	55.00	12.78	2.00	5.00	0.00	51		
	13:00	57.00	13.89	3.00	6.00	0.00	43		
	14:00	59.00	15.00	4.00	7.00	0.00	45		
	15:00	59.00	15.00	3.00	7.00	0.00	47		
	16:00	58.00	14.44	4.00	8.00	0.00	49		
	17:00	58.00	14.44	5.00	9.00	0.00	50		
	18:00								
	19:00								
	20:00								
	21:00								
	22:00								
	23:00								

APPENDIX D
Field Logs

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: Longterm 1

Coordinates	Lat:	37.824376	**Calibrator**	Model :	CAL200
	Lon:	-84.275922		S/N:	16651
	Elevation (ft):	720			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0010739		S/N:	058504
Microphone	Model :	377B02			
	S/N:	311602			
Monitoring	Start Time:	4/21/2021 8:04PM	**Calibrations**	Pre-Test:	0.02
	End Time:	4/23/2021 8:40PM		Post-Test:	0.05

Location Description
This region is a rural and wooded landscape. Otter creek is roughly located 300 feet to the northeast of the monitor location. Birds and cows could were in the area. Bill Eads Roads runs along the north perimeter of the property and has light traffic. Train horns could be heard in the distance.

Parameter	21-Apr		23-Apr								
	20:04			20:40							
Duration hh:mm	0:00			48:36:49							
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq				44.90							
LDN				50.50							
Day				45.40							
Night				43.80							

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
			Peaks in the data may be from the train and cars.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: Longterm 2

Coordinates	Lat:	37°48'53.13"N	**Calibrator**	Model :	CAL200
	Lon:	84°16'6.24"W		S/N:	16651
	Elevation (ft):	850			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0010737		S/N:	058503
Microphone	Model :	377B02			
	S/N:	311601			
Monitoring	Start Time:	4/21/2021 7:22PM	**Calibrations**	Pre-Test:	0.04
	End Time:	4/23/2021 8:13PM		Post-Test:	0.06

Location Description
This region has a hilly and grassy landscape with scattered patches of trees. Cows and birds can be heard within the area. The NSA is on Red House Road with medium traffic. The NSA is located roughly 0.62 miles from a booster station. Train horns can be heard in the distance that can be heard at the NSA. Highway 75 can be heard from the monitor location.

Parameter	21-Apr		23-Apr								
	19:22			8:13PM							
Duration hh:mm	0:00			48:50:19							
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq				48.60							
LDN				52.40							
Day				49.90							
Night				44.80							

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
			Peaks in the data may be from the train and cars.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 1

Coordinates	Lat:	37.821721	**Calibrator**	Model :	CAL200
	Lon:	-84.270658		S/N:	16651
	Elevation (ft):	848			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 1:22PM	**Calibrations**	Pre-Test:	0.11
	End Time:	4/23/2021 1:51PM		Post-Test:	-0.06

Location Description
The region is a hilly and grasst landscape with scattered patches of trees. The NSA is a large church on top of a hill. The monitor location was located 320 feet from State Highway 388 which has medium traffic. Non-commercial airplanes fly in the region.

Parameter	23-Apr										
	13:22	13:51									
Duration hh:mm	0:00	28:22									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		49.70									
LDN		49.70									
Day		49.70									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
1	23-Apr	1:29-1:34	Airplane overhead.
2		1:41-1:46	Airplane overhead.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 9

Coordinates	Lat:	37.828872	**Calibrator**	Model :	CAL200
	Lon:	-84.272713		S/N:	16651
	Elevation (ft):	711			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 9:19AM	**Calibrations**	Pre-Test:	0.02
	End Time:	4/22/2021 9:44AM		Post-Test:	-0.08

Location Description
This region has a hilly and grassy terrain with scattered patches of trees. The monitor location was located right next to Red House Road with medium traffic. A railroad passes acros Red House Road approximately 120 feet from the monitor location. Various birds, roosters, and owls were located in the area.

Parameter	22-Apr										
	9:19	9:44									
Duration hh:mm	0:00	23:03									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		66.30									
LDN		66.30									
Day		66.30									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
	20-Apr	9:32	Airplane flew overhead.
			Airplane flew overhead.
			Airplane flew overhead.
			Airplane flew overhead.
			Airplane flew overhead.
			Airplane flew overhead.
			Airplane flew overhead.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 16

Coordinates	Lat:	37.808713	**Calibrator**	Model :	CAL200
	Lon:	-84.289063		S/N:	16651
	Elevation (ft):	795			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 10:20AM	**Calibrations**	Pre-Test:	0.06
	End Time:	4/23/2021 10:41AM		Post-Test:	0.04

Location Description
This area is a hilly grassland with scattered patches of trees. Highway 75 could be heard from the monitor location. Birds are located in the area. The monitor is located right off Three Forks Road with light traffic.

Parameter	23-Apr										
	10:20	10:41									
Duration hh:mm	0:00	20:18									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		51.50									
LDN		51.50									
Day		51.50									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
1	23-Apr	10:22-10:26	Can hear an airplane flying overhead.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 18

Coordinates	Lat:	37.803315	**Calibrator**	Model :	CAL200
	Lon:	-84.286318		S/N:	16651
	Elevation (ft):	799			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 4:44PM	**Calibrations**	Pre-Test:	0.03
	End Time:	4/22/2021 5:01PM		Post-Test:	-0.03

Location Description
This is a rural farmland that is hilly and grassy with scattered patches of trees. The NSA is located on Three Forks Road which has light traffic. Highway 75 can be heard from the monitor location. Birds were located in the area.

Parameter	22-Apr										
	16:44	17:01									
Duration hh:mm	0:00	17:22									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		56.50									
LDN		56.50									
Day		56.50									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
1	22-Apr	16:48	Airplane and Cars

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 25/58

Coordinates	Lat:	37.797177	**Calibrator**	Model :	CAL200
	Lon:	-84.280297		S/N:	16651
	Elevation (ft):	770			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 1:19PM	**Calibrations**	Pre-Test:	0.03
	End Time:	4/22/2021 1:39PM		Post-Test:	0.02

Location Description
The region is rural farmland located at the bottom of a hill with small wooded area. The monitor location is located on Three Forks Road with light traffic. Birds were located in the area.

Parameter	22-Apr										
	13:19	13:39									
Duration hh:mm	0:00	20:38									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		57.60									
LDN		57.60									
Day		57.60									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 26

Coordinates	Lat:	37.795252	**Calibrator**	Model :	CAL200
	Lon:	-84.294309		S/N:	16651
	Elevation (ft):	789			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 9:35AM	**Calibrations**	Pre-Test:	0
	End Time:	4/23/2021 9:52AM		Post-Test:	-0.02

Location Description
This is an open field with trees surrounding it. There are birds in the area and highway 75 is audible form this location. Commercial airplanes fly overhead.

Parameter	23-Apr										
	9:35	9:52									
Duration hh:mm	0:00	17:00									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		49.60									
LDN		49.60									
Day		49.60									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
1	23-Apr	First Minute	Airplane overhead.

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 37

Coordinates	Lat:	37.808758	**Calibrator**	Model :	CAL200
	Lon:	-84.269097		S/N:	16651
	Elevation (ft):	865			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 2:15PM	**Calibrations**	Pre-Test:	0
	End Time:	4/23/2021 2:30PM		Post-Test:	0.01

Location Description
This region is a hilly grassy area with scattered patches of trees. The NSA is located on top of a hill right off State Highway 388. The highway has medium traffic. Birds were located in the area.

Parameter	23-Apr										
	14:15	14:30									
Duration hh:mm	0:00	15:31									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		63.90									
LDN		63.90									
Day		63.90									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 41

Coordinates	Lat:	37.819681	**Calibrator**	Model :	CAL200
	Lon:	-84.30459		S/N:	16651
	Elevation (ft):	922			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 3:25PM	**Calibrations**	Pre-Test:	-0.09
	End Time:	4/23/2021 3:41PM		Post-Test:	-0.01

Location Description
This NSA is located in a residential area on Sycamore Drive. The area was active with lawnmowers, dogs, and children playing. Roosters, owl, and other birds could be heard in the area.

Parameter	23-Apr										
	15:25	15:41									
Duration hh:mm	0:00	15:23									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		51.60									
LDN		51.60									
Day		51.60									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 43

Coordinates	Lat:	37.82624	**Calibrator**	Model :	CAL200
	Lon:	-84.29857		S/N:	16651
	Elevation (ft):	899			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 8:31AM	**Calibrations**	Pre-Test:	0.04
	End Time:	4/23/2021 847AM		Post-Test:	0.06

Location Description
The is a closed wooded area. Birds are highly active and dogs can be heard in the distance. Highway 75 can be heard from this location. The monitor location was on E Bill Eads Road.

Parameter	23-Apr										
	8:31	8:47									
Duration hh:mm	0:00	15:29									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		46.90									
LDN		46.90									
Day		46.90									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 45

Coordinates	Lat:	37.824584	**Calibrator**	Model :	CAL200
	Lon:	-84.308497		S/N:	16651
	Elevation (ft):	884			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 3:02PM	**Calibrations**	Pre-Test:	0.08
	End Time:	4/22/2021 3:20PM		Post-Test:	0.04

Location Description
This is a rural farmland close to a residential neghborhood. The NSA is located on Bill Eades Road which has light traffic. Highway 75 can be heard from the monitor location. Commercial airplanes could be heard flying overhead. Birds were located in the area.

Parameter	22-Apr										
	15:02	15:20									
Duration hh:mm	0:00	18:08									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		50.40									
LDN		50.40									
Day		50.40									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 47

Coordinates	Lat:	37.814131	**Calibrator**	Model :	CAL200
	Lon:	-84.297162		S/N:	16651
	Elevation (ft):	904			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/23/2021 12:17PM	**Calibrations**	Pre-Test:	0.01
	End Time:	4/23/2021 12:37PM		Post-Test:	-0.03

Location Description
This monitor location is located in a hilly and grassy landscape with scattered patches trees. The NSA is located on top of a hill in a rural neighborhood. A substation is location right across Three Forks Road. Three Forks Road has light traffic. Birds could be heard in the area.

Parameter	23-Apr										
	12:17	12:37									
Duration hh:mm	0:00	20:28									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		57.90									
LDN		57.90									
Day		57.90									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 54

Coordinates	Lat:	37.796723	**Calibrator**	Model :	CAL200
	Lon:	-84.270076		S/N:	16651
	Elevation (ft):	876			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 12:34PM	**Calibrations**	Pre-Test:	-0.01
	End Time:	4/22/2021 12:59PM		Post-Test:	-0.04

Location Description
This region is a hilly grassy area with scattered patches of trees. The NSA is located on top of a hill right off State Highway 388in a small neighborhood. The highway has medium traffic. Birds were located in the area.

Parameter	22-Apr										
	12:34	12:59									
Duration hh:mm	0:00	22:31									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		68.80									
LDN		68.80									
Day		68.80									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)

Acciona Energy
Baseline Noise Survey
Madison Monitoring Locations

Location: NSA 61

Coordinates	Lat:	37.823415	**Calibrator**	Model :	CAL200
	Lon:	-84.264134		S/N:	16651
	Elevation (ft):	732			
Sound Meter	Model :	LD 831C	**Preamplifier**	Model :	PRM831
	S/N:	0011446		S/N:	29478
Microphone	Model :	377B02			
	S/N:	326325			
Monitoring	Start Time:	4/22/2021 10:45AM	**Calibrations**	Pre-Test:	0
	End Time:	4/22/2021 11:01AM		Post-Test:	0.09

Location Description
This monitor location is in a valley in a wooded area. A railroad runs perpindicular to Parson Lane. Birds and rustling trees could be heard while performing the survey. Highway 388 was audible during the survey.

Parameter	22-Apr										
	10:45	11:01									
Duration hh:mm	0:00	16:45									
Memory											
Battery											
Exceedance Events											
Overall Peak											
Overall Laeq		74.40									
LDN		74.40									
Day		74.40									
Night											

Log:

Event	Day	Time	Comment (Dominant Background Noise Source)
1	22-Apr	10:53	Large moving truck drove past the meter.

2. Provide a copy of the landscaping screen plan that is required to be submitted to Madison County. To the extent the landscaping screen plan has not been completed by May 14, 2021, provide a draft copy of the landscaping screen plan and accompanying information on when the plan will be completed.

RESPONSE: A draft landscaping screen plan is being filed in conjunction with a Petition for Confidential Treatment. A final plan is not anticipated to be completed until fourth quarter 2021.

WITNESS: Adam Stratton