Appendix F: Sound Survey and Analysis Report

Sound Survey and Analysis Report

Lordstown Energy Center
Lordstown, Ohio

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TETRA TECH

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
^{o}F	degrees Fahrenheit
µPa	microPascal
dB	decibel
dBA	A-weighted decibel
dBL	linear decibel
CTG	combustion turbine generator
HRSG	heat recovery steam generator
Hz	Hertz
I-80	Interstate 80
ISO	International Organization for Standardization
kHz	kilohertz
L_{eq}	equivalent sound level
L_{w}	sound power level
L_{P}	sound pressure level
$L_{i(c)}$	interior sound pressure level
m	meters
mi	miles
ML	monitoring location
mph	miles per hour
NIST	National Institute of Standards and Technology
OPSB	Ohio Power Siting Board
OSHA	Occupational Safety and Health Administration
the Project	Lordstown Energy Center
pW	picowatt
STC	Sound Transmission Class
STG	steam turbine generator
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WCT	wet mechanical draft cooling tower

1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) has prepared this noise impact assessment for the proposed Lordstown Energy Center (the Project) to support a regulatory application to the Ohio Siting Siting Board (OPSB). The Project has a nominal net capacity of 800 megawatts, with a maximum of 940 megawatts, utilizing two highly efficient Siemens SCC6-8000H combustion turbine generators (CTG) operating in a combined-cycle mode. As a combined-cycle power plant, the exhaust heat of the CTG is used in the heat recovery steam generator (HRSG) to produce steam to generate additional energy in a steam turbine generator (STG). The two CTGs and the STG are located in separate acoustically treated enclosures. A wet mechanical draft cooling tower (WCT) is located in the northeast section of the Project site. Other external equipment includes transformers, circulating water pumps, gas compressors, and lube oil packages.

The report provides background information on concepts related to environmental sound including: descriptions of the noise metrics used throughout the report; applicable noise standards and regulations; the results of the ambient sound measurement program; predicted noise levels from full-load operation of Project equipment; and an assessment of the potential noise impacts from operation of the proposed Project.

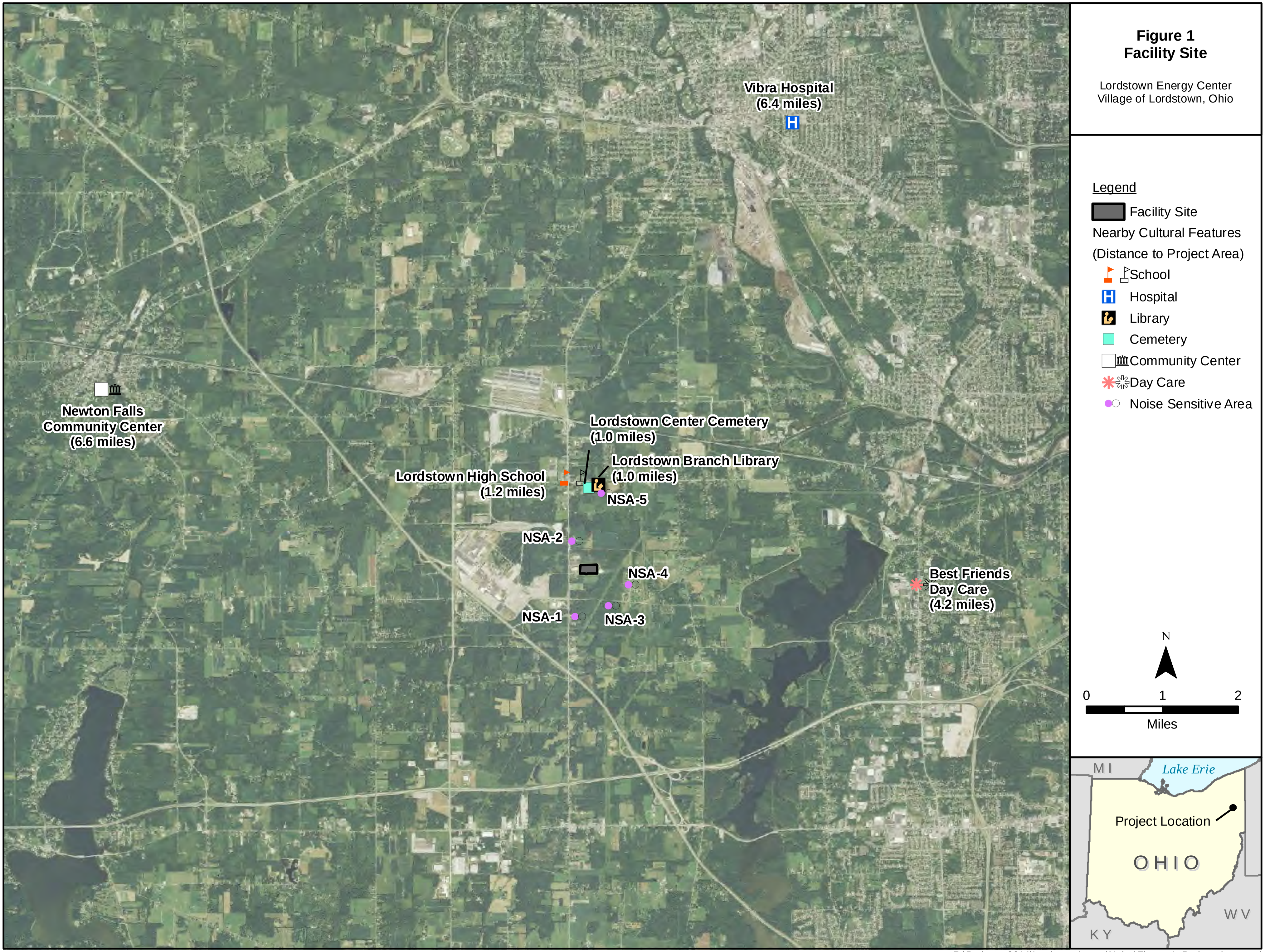
The objectives of this report are to:

- Identify noise-sensitive land uses in the area that may be affected by the proposed Project;
- Describe the standards to which the Project is held;
- Document existing ambient noise levels in the area;
- Identify the principal noise source levels associated with the Project;
- Assess the potential impact of the Project on noise levels through the use of a predictive acoustic modeling for both construction and operation analysis; and
- Propose practicable measures to minimize noise impacts associated with operation of the Project. These mitigation measures are presented to show the feasibility of the proposed Project to meet the specific noise requirements, but the final design may incorporate different mitigation measures in order to achieve the same objective as demonstrated in this assessment.

The Project site is located within the Village of Lordstown, Trumbull County, Ohio. The Project footprint is along the southern side of Henn Parkway, located east of and perpendicular to State Route 45 (Tod Avenue), and northeast of Interstate 80 (I-80). The Project site is zoned for industrial use and is located within the Lordstown Industrial Park, a designated Enterprise Zone with Foreign Trade Zone status. Area to the west is also zoned for industrial use, with the General Motors Lordstown Assembly Plant located on the opposite side of State Route 45. Areas to the north, east, and south, however, are predominantly zoned for residential use, with scattered commercial zones along the major roadways. In addition to the roadway corridors that extend through the area, several Norfolk Southern rail lines run east-west just north of the Project site. Several transmission and transportation corridors traverse the area, with three First Energy-owned 345-kilovolt transmission circuits extending in a general north-south direction just east of the Project site.

The Project site currently consists of agricultural land, with some scattered trees. Mud Creek, located southeast of the Project site, flows northeast and an unnamed tributary of Mud Creek flows east just north of the Project site before joining with Mud Creek. Construction laydown will occur on the southern portion of the Project site, while the facility's footprint will be located on the northern portion.

Baseline sound levels in the residential areas abutting the Project site were measured at five different locations: on Hallock Young Road, Goldner Lane, Woodridge Way, and two locations on State Route 45. The dominant sources of sound were high speed motor vehicles on I-80, local area businesses, periodic aircraft over flights, train movements, local traffic, and natural sounds. Acoustic modeling of Project equipment was performed using the Cadna-A® model to predicted maximum sound levels at residences and other noise sensitive areas including the closest school, day care center, library, hospital, community center, and cemetery. Figure 1 provides an overview of the Project site as well as these noise sensitive land uses.



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1.1 ACOUSTIC METRICS AND TERMINOLOGY

All sounds originate with a source, whether it is a human voice, motor vehicles on a roadway, or a combustion turbine. Energy is required to produce sound and this sound energy is transmitted through the air in the form of sound waves – tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear. A sound source is defined by a sound power level (abbreviated "L_W"), which is independent of any external factors. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts.

A source sound power level cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source outside the acoustic and geometric near-field. A sound pressure level (abbreviated "L_P") is a measure of the sound wave fluctuation at a given receiver location, and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. The sound pressure level in decibels (dB) is the logarithm of the ratio of the sound pressure of the source to the reference sound pressure of 20 microPascals (μPa), multiplied by 20.[1] The range of sound pressures that can be detected by a person with normal hearing is very wide, ranging from about 20 μPa for very faint sounds at the threshold of hearing, to nearly 10 million μPa for extremely loud sounds such as a jet during take-off at a distance of 300 feet.

Broadband sound includes sound energy summed across the entire audible frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum can be completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves. Typically the frequency analysis examines 11 octave bands ranging from 16 Hz (low) to 16,000 Hz (high). Since the human ear does not perceive every frequency with equal loudness, spectrally-varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system, and is represented in dBA.

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The equivalent sound level has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments in the State of Ohio. Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Table 1. Table 2 presents additional reference information on terminology used in the report.

Table 1. Sound Pressure Levels (L_P) and Relative Loudness of Typical Noise Sources and Acoustic Environments

Noise Source or Activity	Sound Level (dBA)	Subjective Impression
Vacuum cleaner (10 feet)	70	Moderate
Passenger car at 65 mph (25 feet)	65	
Large store air-conditioning unit (20 feet)	60	
Light auto traffic (100 feet)	50	Quiet
Quiet rural residential area with no activity	45	

[1] The sound pressure level (L_p) in decibels (dB) corresponding to a sound pressure (p) is given by the following equation:

$$Lp = 20 \log10 (p / pref);$$

Where:

p = the sound pressure in μPa; and
pref = the reference sound pressure of 20 μPa.

Noise Source or Activity	Sound Level (dBA)	Subjective Impression
Bedroom or quiet living room; Bird calls	40	Faint
Typical wilderness area	35	
Quiet library, soft whisper (15 feet)	30	Very quiet
Wilderness with no wind or animal activity	25	Extremely quiet
High-quality recording studio	20	
Acoustic test chamber	10	Just audible
	0	Threshold of hearing

Adapted from: Kurze and Beranek (1988) and United States Environmental Protection Agency (1971)

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in dB referenced to 20 microPascals, the approximate threshold of human perception to sound at 1,000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in dB referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report.
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz.
Broadband Noise	Noise which covers a wide range of frequencies within the audible spectrum, i.e., 200 to 2,000 Hz.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hz or kilohertz (kHz). One hundred Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.

2.0 NOISE LEVEL REQUIREMENTS AND GUIDELINES

Noise levels resulting from construction and operation of the Project were evaluated with respect to noise guidelines and policies as established by the OPSB. OPSB Rule §4906-13-07(A)(3) provides certification requirements for noise during both Project construction and operation, but does not set absolute limits necessary to provide a regulatory compliance determination. Although the OPSB approval subsumes local requirements, consideration of local standards is recommended. Part 11 of the Lordstown Planning and Zoning Code provides nuisance clauses as they pertain to noise, but no numerical limits are prescribed. The OPSB and Lordstown guidance is further discussed below. Also referenced is the Occupational Safety and Health Administration (OSHA) noise standard developed for worker safety.

2.1 OHIO POWER SITING BOARD NOISE REQUIREMENTS

OPSB §4906-13-07(A)(3)(a) through (d) define requirements for the assessment of noise that must be addressed during the permitting process for electric power generating facilities, including construction noise levels; operational noise levels; the location of noise-sensitive areas within one mile; and a description of equipment and procedures to mitigate the effects of noise emissions during both construction and operation. The OPSB rules do not define quantifiable sound limits; however, precedent for recent energy facilities undergoing permitting has shown that the OPSB has previously identified thresholds of significance including increases in sound level relative to ambient conditions and in the form of absolute sound level limits. The OPSB has typically required ambient measurements for comparative purposes. In recent cases, the OPSB has determined that a new noise source should not exceed ambient levels by more than 6 dBA L_{eq} at any given noise sensitive area.

2.2 VILLAGE OF LORDSTOWN NOISE ORDINANCE

The Village of Lordstown sets noise standards to prohibit any use which would cause objectionable noise as well as other potential nuisances such as dust, odor, and smoke. There is no numerical decibel limit associated with the nuisance clause and the Board of Zoning Appeals has the authority to determine what would constitute an objectionable condition. The Codified Ordinances of Lordstown, Part 11 of the Planning and Zoning Codes under Chapter 1161 Supplementary Regulations, Section 4 states:

> *1161.04 BUSINESS AND INDUSTRIAL USES IN B-1, B-2 AND I-1 DISTRICTS*
>
> *No land or building in any district shall be used or occupied in any manner creating dangerous, injurious, noxious, or otherwise objectionable conditions which could adversely affect the surrounding areas or adjoining premises, except that any use permitted by this Zoning Ordinance may be undertaken and maintained if acceptable measures and safeguards to reduce dangerous and objectionable conditions to acceptable limits as established by the performance requirements in the following subsections.*
>
>> *(h) Noise. Objectionable noise as determined by the Board of Zoning Appeals which is due to volume, frequency, or beat shall be muffled or otherwise controlled. Air-raid sirens and related apparatus used solely for public purposes are exempt from this requirement.*

2.3 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION NOISE SAFETY STANDARDS

The federal government has long recognized the potential hazards caused by noise associated with construction projects, as well as operating industrial facilities. OSHA's current noise standard stems from the occupational noise standard originally published in 1969 by the Bureau of Labor Standards under the authority of the Construction Safety Act (40 United States Code [U.S.C.] 333). OSHA adopted the construction noise standard in 1971 (36

Federal Register 7340, 4/27/71) and later recodified it as 29 Code of Federal Regulations (CFR) 1926.52. Another section of the construction standard (29 CFR 1926.101) contains a provision requiring employers to provide hearing protection devices when needed. Both sections 1926.52 and 1926.101 apply to employers engaged in construction where high noise levels are possible.

Paragraph CFR 1926.52(a) requires protection against the effects of both construction and operational noise exposure when 8-hour time-weighted average sound levels exceed a permissible exposure limit of 90 dBA, measured on the A-scale of a sound level meter set at slow response. The exposure level is raised 5 dB for every halving of exposure duration as shown in Table 3. Furthermore, exposure to impulsive or impact noise should not exceed a 140 dB peak sound pressure level.

Paragraph 29 CFR 1926.52(b) states that when employees are subjected to noise doses exceeding those shown in Table 3, feasible administrative or engineering controls will be identified and implemented to lower employee noise exposure. If controls fail to reduce sound to the PEL, personal protective equipment must be provided and used to reduce noise exposure. In compliance with OSHA, project contractors will be required to readily provide construction workers with OSHA approved hearing protection devices and to identify high noise areas and activities where hearing protection will be required.

Table 3. OSHA Permissible Daily Noise Exposure Limits

Duration of Exposure Per Day (Hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

3.0 EXISTING ENVIRONMENT

Tetra Tech conducted a series of ambient sound level measurements to characterize the existing acoustic environment in the vicinity of the proposed Project. This section summarizes the methodologies used by Tetra Tech to conduct the sound survey, describes the measurement locations, and presents the results of the ambient sound levels.

3.1 FIELD METHODOLOGY

Ambient sound measurements were performed on November 20 and 21, 2014. The measurements were conducted using a Larson Davis Model 831 precision integrating sound-level meter that meets the requirements of American National Standards Institute Standards for Type 1 instruments. This instrument has an operating range of 5 dB to 140 dB, and an overall frequency range of 8 to 20,000 Hz. During the measurements, the microphone was fitted with a windscreen and set upon a tripod at a height of approximately 5 feet above ground, and located out of the influence of any vertical reflecting surfaces. The sound level meter was calibrated at the beginning and end of the measurement period using a Larson Davis Model CAL200 acoustic calibrator following procedures that are traceable to the National Institute of Standards and Technology (NIST). Table 4 lists the measurement equipment employed during the survey; the NIST laboratory calibration certifications are provided in Appendix A. The sound level meters were programmed to sample and store A-weighted and octave band sound level data, including L_{eq} and the percentile sound levels.

Table 4. Measurement Equipment

Description	Manufacturer	Type
Signal Analyzer	Larson Davis	831
Preamplifier	Larson Davis	PRM902
Microphone	PCB	377B02
Windscreen	ACO Pacific	7-inch
Calibrator	Larson Davis	CAL200

During the survey there was no substantial precipitation, though brief snow flurries occurred during the nighttime noise measurements. Temperatures ranged from 39 to 42 degrees Fahrenheit (ºF) during the day, and 15 to 20ºF during the nighttime. Wind speeds were variable, averaging from 15 to 20 miles per hour (mph) during the daytime, and 9 to 13 mph during the nighttime, with occasional higher gusts during both time periods. Atmospheric conditions during the survey period were acceptable for the collection of accurate sound measurements. There was a coating of new snow on the ground, but roadways conditions were generally dry during the survey period.

3.2 MEASUREMENT LOCATIONS

Short-term, attended sound measurements were performed at five locations in adjoining residentially zoned areas, as shown on Figure 2. The monitoring locations (ML) were selected to be representative of the closest noise-sensitive land use in the vicinity of the Project site. Measurements of 30 minutes (minimum) in duration were made at each location for daytime (10:00 am to 4:00 pm) periods and nighttime periods (10:00 pm to 2:00 am) during a typical weekday. In addition, an extended duration measurement was made onsite to further document variation within the study area. The measurement locations are mapped on Figure 2. Additional descriptions of the monitoring locations and field observations are provided in Sections 3.2.1 to 3.2.4.

Figure 2
Sound Monitoring Locations

Lordstown Energy Center
Village of Lordstown, Ohio

3.2.1 Monitoring Location 1: State Route 45, South

Monitoring Location 1 (ML-1) is 0.65 mile (1,038 meters) south-southwest of the northern Project stack[2]. The measurement was taken in the parking lot behind Ross' Eatery and Pub. Daytime sound measurements were collected from 10:06 am to 10:38 am. Weather was partly sunny with light winds and a temperature of 21 degrees Fahrenheit (^{o}F). Field observations identified a dominant acoustic source of motor vehicle traffic on State Route 45, distant noise from I-80, aircraft flyovers possibly from the Youngstown-Warren Airport, and other natural sounds such as rustling branches. All of these sources are considered typical for this residential environment near a busy roadway.

Nighttime sound measurements were collected from 11:01 pm to 11:33 pm. Temperature was 21^{o}F with winds of 13 mph. Field observations identified motor vehicle traffic on State Route 45, distant noise from I-80, aircraft flyovers, tree branches rustling, and other natural sounds. Nighttime levels were noticeably lower than daytime levels due to the lower contribution of nearby motor vehicle and aircraft over flights. Figure 3 presents a view of ML-1 to the north-northeast, toward the Project. Figure 4 presents a view of ML-1 to the south-southwest facing toward State Route 45 and a residence.

Figure 3: View north-northeast toward the Project

Figure 4: View south-southwest toward the residence

[2] Note that distance was measured from this particular location as it is centrally-located within the Project site.

3.2.2 Monitoring Location 2: State Route 45, North

Monitoring Location 2 (ML-2) is 0.61 mile (978 meters) north-northwest of the northern Project stack. The measurement was taken across from the residential address 7439 State Route 45, at the gated entrance near the water towers. Daytime sound measurements were collected from 11:07 am to 11:37 am. Field observations identified a dominant acoustic source of trucks and light vehicle traffic on State Route 45, distant noise from I-80, trains from a nearby rail yard, and birds chirping.

Nighttime sound measurements were collected from 11:40 am to 12:10 am. Field observations identified a dominant acoustic source of vehicle traffic on State Route 45, distant noise from I-80, trains from a nearby rail yard, and airplanes over flights. The vehicular traffic consisted of mostly cars. Figure 5 presents a view of ML-2 to the south-southeast facing toward the Project. Figure 6 presents a view of ML-2 to the southeast facing toward the residence located on State Route 45.

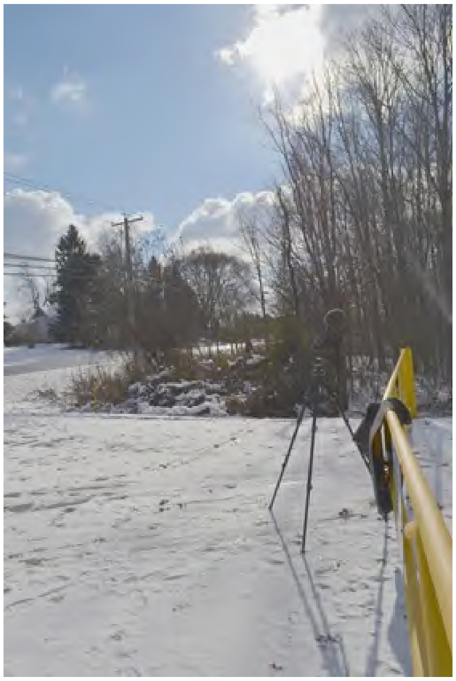


Figure 5: View to the south-southeast toward the Project

Figure 6: View to the southeast toward the residence

3.2.2 Monitoring Location 3: Hallock Young Road

Monitoring Location 3 (ML-3) is 0.45 mile (717 meters) south-southeast of the northern Project stack. The measurement was taken within an electrical transmission right-of-way and is representative of the residential address of 1277 Hallock Young Road. Daytime sound measurements were collected from 11:50 am to 12:20 pm. The temperature was 23^{o}F with winds up to 17 mph. Field observations identified noise from I-80 and State Route 45, light vehicle traffic on Hallock Young Road, natural sounds from rustling branches, and two four-propeller airplanes flying low above ML-3. The airplane noise was deemed extraneous and subsequently removed from the monitored data. Construction vehicles moved into the area after the measurement was completed.

Nighttime sound measurements were collected from 12:20 am to 12:50 am. Field observations identified vehicular noise from I-80 and State Route 45, light traffic of Hallock Young Road, train noise, and natural sounds. Figure 7 presents a view of ML-3 to the north, looking down the electrical transmission right-of-way, facing toward Hallock Young Road and the Project. Figure 8 presents a view of ML-3 to the east facing toward an electrical transmission tower and the residence located at 1277 Hallock Young Road.

Figure 7: View to the north toward the Project

Figure 8: View to the east toward the residence

3.2.3 Monitoring Location 4: Goldner Lane

Monitoring Location 4 (ML-4) is 0.56 mile (901 meters) east of the northern Project stack. The measurement was taken adjacent to the residential address of 3500 Goldner Lane, Lordstown. Measurements were stopped to avoid capturing noise from snow-plows and other heavy machinery. Daytime sound measurements were collected from 1:12 pm to 1:42 pm. Field observations identified a distant traffic noise, dogs, birds, and other natural sounds.

Nighttime sound measurements were collected from 1:02 am to 1:32 am. Field observations identified highway noise, train noise, some wind rustle noise, and natural sounds. Figure 9 presents a view of ML-4 to the west-northwest facing toward the Project. Figure 10 presents a view of ML-4 to the northwest facing toward residence.

Figure 9: View to the west-northwest toward the Project

Figure 10: View to the northwest toward the residence

3.2.4 Monitoring Location 5: Woodridge Way

Monitoring Location 5 (ML-5) is 1.0 mile (1,610 meters) northeast of the northern Project stack. The measurement was taken adjacent to the residential address of 6570 Woodridge Way, Lordstown. Woodridge Way is a dead end road with a wooded lot at the end. Daytime sound measurements were collected from 1:55 pm to 2:35 pm. Field observations identified traffic noise likely from State Route 45, periodic train movements, wind and rustling leaves, bird sounds, and other natural sound.

Nighttime sound measurements were collected from 1:48 am to 2:19 am. Field observations identified distant light traffic likely from State Route 45, periodic train movements, tree branch rustling, and other natural sounds. Figure 11 presents a view of ML-5 to the south-southwest facing toward the Project. Figure 12 presents a view of ML-5 to the northwest facing toward the residence.

Figure 11: View to the south-southwest toward the Project

Figure 12: View to the northwest toward the residence

3.3 MEASUREMENT RESULTS

Tables 5 and 6 provide a summary of the measured ambient sound levels on a weekday at the short-term locations and a one-week average at the long-term location. For each monitoring location table 5 provides the corresponding Universal Transverse Mercator (UTM) coordinates are given, the linear distance to the northern Project stack, and the average daytime and nighttime L_{eq}. Table 6 provides representative daytime and nighttime octave band sound pressure levels for the short term and long term measurements on a weekday at the short-term locations and an average over eight days at the long-term locations. In general, ambient sound levels were lowest during nighttime periods. Consequently, the nighttime ambient sound levels were used as the basis for assessing the potential noise impacts associated with normal Project operation.

Table 5. Sound Measurement Results – L_{eq} Sound Levels

Measurement Location				Time Period	L_{eq} Sound Level (dBA)
Map ID	Coordinates (UTM Zone 17N)		Distance and Direction from the Northern Stack		
	Easting (m)	Northing (m)			
ML-1	512074.48	4554350.81	0.65 mi (1,038 m) SSW	Day	53
				Night	52
ML-2	511950.86	4556134.91	0.61 mi (978 m) NW	Day	60
				Night	54
ML-3	512640.67	4554616.52	0.45 mi (717 m) SSW	Day	49
				Night	45
ML-4	513388.66	4555270.91	0.56 mi (901 m) E	Day	48
				Night	45
ML-5	512708.59	4556912.73	1.0 mi (1,610 m) NNE	Day	46
				Night	38
LT-1	512306.8	4555203.13	Located on Project site	Day	49
				Night	48

Table 6. Sound Measurement Results – Composite Octave Band Center Frequencies

Monitoring Location	Time Period	1/1 L_{eq} Octave Band Sound Pressure Levels (dB)										
		16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz
ML-1	Day	71	63	62	53	49	52	48	39	31	29	24
	Night	68	60	59	52	49	51	48	40	25	16	12
ML-2	Day	65	64	68	61	58	56	57	53	43	30	18
	Night	63	62	62	57	51	51	51	45	34	23	15
ML-3	Day	70	62	56	49	51	49	42	35	26	19	13
	Night	64	59	53	45	47	46	38	29	22	16	10
ML-4	Day	68	62	62	54	56	55	51	47	38	27	20
	Night	62	55	52	44	41	41	32	32	22	18	11
ML-5	Day	63	57	53	49	48	46	39	32	30	24	16
	Night	58	51	48	41	39	38	29	23	18	14	10

LT-1	Day	62	58	58	50	48	48	45	34	27	21	15
	Night	60	58	60	51	45	47	44	34	24	21	15

Results of the ambient sound survey show that sound levels surrounding the Project site are at moderate levels reflective of sound sources within their area-specific environment (i.e., near an industrial area, roadway, rail corridor, or local businesses). Ambient sound levels also exhibited typical diurnal patterns, with higher ambient sound levels during the day than at night, except at the onsite location which exhibited a more constant level. Daytime L_{eq} sound levels at the measurement locations ranged from low of 46 dBA at ML-5 to a high of 60 dBA at ML-2. Nighttime sound levels ranged from a low of 38 dBA at ML-5 to 54 dBA at ML-2. The high sound levels recorded at ML-2 and ML-1 are as expected given their proximity to local roadways and the I-80, which influenced both the daytime and nighttime measurement periods. The varied sound levels during daytime versus nighttime measurements at ML-3 and ML-4 are as expected, given that dominant daytime sources, which tend to fluctuate over time, contribute considerably less during the nighttime due to lower human activity levels. The sound levels presented for ML-5, situated north of the Project site, were the lowest due to minimal observed traffic within the residential area. The dominant sources within this area during the nighttime measurement period were natural sounds and distant high speed traffic. During the daytime and nighttime measurement periods, noise from train movements and occasional overhead aircraft also contributed to the measured ambient sound levels.

4.0 PROJECT CONSTRUCTION

Construction of the Project is expected to be typical of other power generating facilities in terms of schedule, equipment, and activity. Construction is anticipated to require approximately 32 months. Nighttime construction will be limited, but activities may occur 6 days per week, 10 hours per day. The last 4 to 6 months of construction would include commissioning and start-up, which would involve steam blows potentially occurring 24 hours a day, 7 days a week.

4.1 NOISE CALCULATION METHODOLOGY

Acoustic emission levels for activities associated with Project construction were based upon typical ranges of energy equivalent noise levels at construction sites, as documented by the United States Environmental Protection Agency (USEPA) (USEPA, Technical Document NTID300.1, December 1971) and the USEPA's "Construction Noise Control Technology Initiatives" (USEPA, Technical Report No. 1789, September 1980). The USEPA methodology distinguishes between type of construction and construction phase.

Using those energy equivalent noise levels as input to a basic propagation model, construction noise levels were calculated at the nearest property boundary and five MLs. The basic model assumed spherical wave divergence from a point source located at the acoustic center of the site. Furthermore, the model conservatively assumed that all pieces of construction equipment associated with an activity would operate simultaneously for the duration of that activity. An additional level of conservatism was built into the construction noise model by excluding potential shielding effects due to intervening structures and buildings along the propagation path from the site to receiver locations.

4.2 PROJECTED NOISE LEVELS DURING CONSTRUCTION

Table 7 summarizes the projected noise levels due to Project construction, organized into the following five broad work activities:

1. Site clearing and grading.
2. Placement of major structural concrete foundations.
3. Erection of building structural steel.
4. Installation of mechanical and electrical equipment.
5. Commissioning and testing of equipment.

Construction sound levels are predicted to range from 38 to 56 dBA at the MLs, which are representative of nearby noise sensitive areas, based on a simplified model. Periodically, some noises will be higher or lower than the levels presented here, but the overall sound levels should generally be lower because of excess attenuation and the trend toward quieter construction equipment in the intervening decades since these data were developed. As shown in Table 7, the highest projected noise level from construction-related activity is expected to occur at ML-3, during activities associated with excavation and project commissioning.

Reasonable efforts will be made to minimize the impact of noise resulting from construction activities at proximate noise sensitive areas through the use of noise mitigation. Because of the temporary nature of the construction noise, no adverse or long-term effects are expected. Compliance with OSHA standards will be achieved through equipment mitigation practices, use of personal protective equipment such as hearing protection devices, and limitations on duration of noise exposure in high noise areas.

Table 7. Projected Construction Noise Levels by Phase (dBA)

Construction Phase	USEPA Construction Noise Level 50 feet	Closest Property Line	ML-1	ML-2	ML-3	ML-4	ML-5
Phase 1: Site clearing and grading	86	69	49	50	53	51	46
Phase 2: Excavation and placement of major structural concrete foundations	89	72	52	53	56	54	49
Phase 3: Erection of building structural steel	78	61	41	42	45	43	38
Phase 4: Installation of mechanical and electrical equipment	83	66	46	47	50	48	43
Phase 5: Equipment installation, commissioning and testing of equipment	89	72	52	53	56	54	49

4.3 CONSTRUCTION NOISE MITIGATION

Since construction machines operate intermittently, and the types of machines in use at the site change with the phase of the Project, noise emitted during construction will be mobile and highly variable, making it challenging to control. The construction management protocols will include the following noise mitigation measures to minimize noise impacts using the following measures:

- Maintain all construction tools and equipment in good operating order according to manufacturers' specifications.
- Limit use of major excavating and earth moving machinery to daytime hours.
- To the extent practicable, schedule construction activity during normal working hours on weekdays when higher sound levels are typically present, and are found acceptable. Some limited activities, such as concrete pours, will be required to occur continuously until completion.
- Equip any internal combustion engine used for any purpose on the job or related to the job with a properly operating muffler that is free from rust, holes, and leaks.
- For construction devices that utilize internal combustion engines, ensure the engine's housing doors are kept closed, and install noise-insulating material mounted on the engine housing consistent with manufacturers' guidelines, if possible.
- Limiting possible evening shift work to low noise activities such as welding, wire pulling and other similar activities, together with appropriate material handling equipment.
- Prior to the start of construction, a procedure for addressing any noise complaints received from residents will be prepared.
- Commissioning activities could involve extended periods of activity that could be temporarily disruptive to the community. Before conducting specific loud noise activities, such as steam blows, communication will occur to plan ahead for such events.

5.0 OPERATIONAL NOISE

This section describes the methods and input assumptions used to calculate noise levels due to the Project's normal operation, a conceptual noise mitigation strategy, and the results of the noise impact analysis.

5.1 NOISE PREDICTION MODEL

The Cadna-A® computer noise model was used to calculate sound pressure levels from the operation of the Project equipment in the vicinity of the site. An industry standard, Cadna-A® was developed by DataKustik GmbH to provide an estimate of sound levels at distances from sources of known emission. It is used by acousticians and acoustic engineers due to the capability to accurately describe noise emission and propagation from complex facilities consisting of various equipment types like the Project and in most cases yields conservative results of operational noise levels in the surrounding community.

The current International Organization for Standardization (ISO) standard for outdoor sound propagation, ISO 9613 Part 2 – "Attenuation of sound during propagation outdoors," was used within Cadna-A.® The method described in this standard calculates sound attenuation under weather conditions that are favorable for sound propagation, such as for downwind propagation or atmospheric inversion, conditions which are typically considered worst-case. The calculation of sound propagation from source to receiver locations consists of full octave band sound frequency algorithms, which incorporate the following physical effects:

- Geometric spreading wave divergence;
- Reflection from surfaces;
- Atmospheric absorption at 10 degrees Celsius and 70 percent relative humidity;
- Screening by topography and obstacles;
- The effects of terrain features including relative elevations of noise sources;
- Sound power levels from stationary and mobile sources;
- The locations of noise-sensitive land use types;
- Intervening objects including buildings and barrier walls;
- Ground effects due to areas of pavement and unpaved ground;
- Sound power at multiple frequencies;
- Source directivity factors;
- Multiple noise sources and source type (point, area, and/or line); and
- Averaging predicted sound levels over a given time period.

Cadna-A® allows for three basic types of sound sources to be introduced into the model: point, line, and area sources. Each noise-radiating element was modeled based on its noise emission pattern. Point sources were programmed for concentrated small dimension sources such as building ventilation fans that radiate sound hemispherically. Line sources are used for linear-shaped sources such as ducts and pipelines. Larger dimensional sources such as the HRSGs and building walls were modeled as area sources. Noise walls, equipment enclosures, stacks and plant equipment were modeled as solid structures as diffracted paths around and over structures tend to reduce computed noise levels. The interaction between sound sources and structures was taken into account with reflection loss. The storage tanks were modeled as obstacles impeding noise propagation. The reflective characteristic of the structure is quantified by its reflection loss, which is typically defined as smooth façade from which the reflected sound energy is 2 dB less than the incident sound energy. Transformer fire walls and sound barriers were modeled as reflective or absorptive barriers.

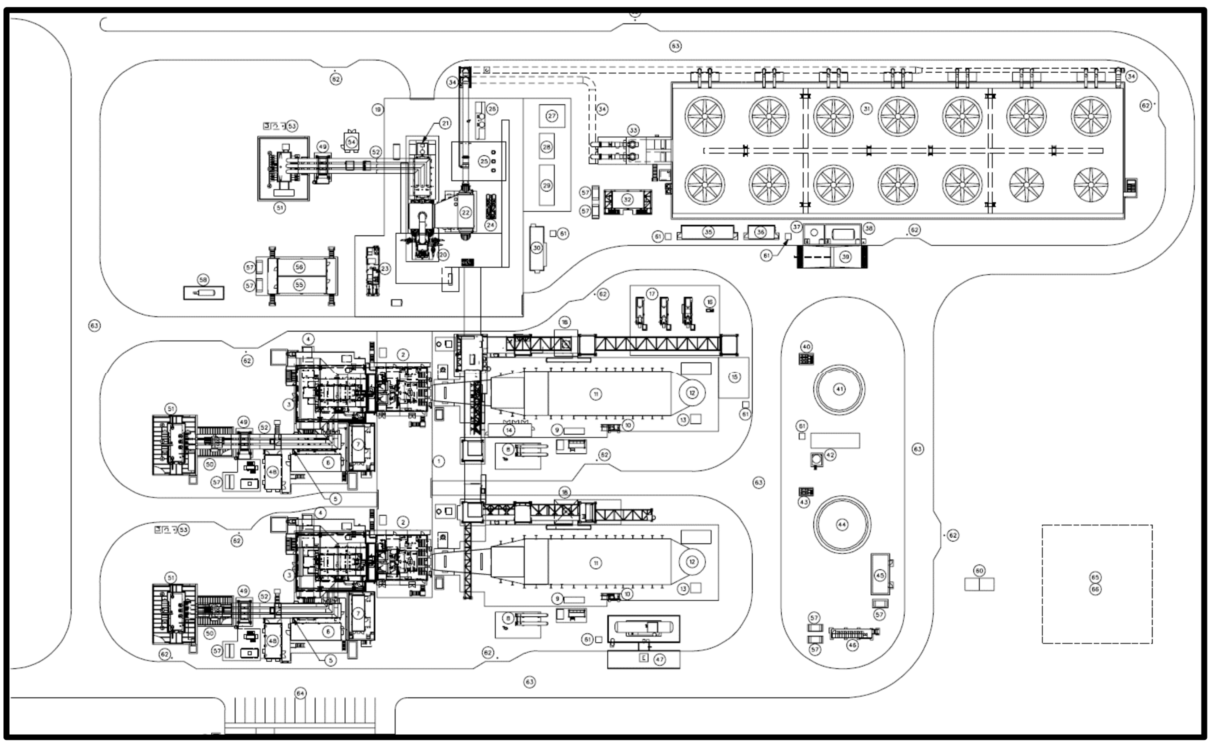
Offsite topography was obtained using the publically available United States Geological Survey digital elevation data. A default ground attenuation factor of 0.5 was assumed for offsite sound propagation over acoustically "mixed" ground. A ground attenuation factor of 0.0 for a reflective surface was assumed for paved onsite areas.

The output from Cadna-A® includes tabular sound level results at selected receiver locations and colored noise contour maps (isopleths) that show areas of equal and similar sound levels.

5.2 INPUT TO THE NOISE PREDICTION MODEL

The Project general arrangement was reviewed and directly imported into the acoustic model so that on-site equipment could be easily identified, buildings and structures could be added, and sound emission data could be assigned to sources as appropriate. Figure 13 shows the Project equipment layout based on Siemens Drawing No. GH45130101 dated December 11, 2014.

Figure 13: Project Equipment Layout



The primary noise sources during base load operation have been identified as the WCT, STG, CTG, main step-up transformers, combustion inlet face and filter house, HRSG, and HRSG exhaust stack exit at 160 feet above finished grade. Reference sound power levels used as input to Cadna-A® were provided by equipment manufacturers, based on information contained in reference documents, or developed using empirical methods. The source levels used in the predictive modeling are based on estimated sound power levels that are generally deemed to be conservative. The projected operational noise levels are based on vendor-supplied estimated sound power level data for the major sources of equipment, including the Siemens power generation package. The sound power level (abbreviated "L_W") is defined as ten times the logarithm (to the base 10) of the ratio of a given sound power to the reference sound power of 1 picowatt (1 pW = 10^{-12} watts). Sound power levels are expressed in terms of dB. Sound power is defined as the rate per unit time at which sound energy is radiated from a source and is expressed in terms of watts. Table 8 summarizes the equipment sound power level data used as inputs to the modeling analysis.

Table 8. Modeled Octave Band Sound Power Level (L_P) for Major Pieces of Project Equipment

Sound Source	Type[1]	Sound Power Level (L_P) by Octave Band Frequency dBL									Broadband Level
		31.5	63	125	250	500	1k	2k	4k	8k	dBA
GT Inlet Filter House & Evaporative Cooler	L_W	118	109	104	94	79	88	71	88	95	97
GT Inlet Duct Wall Radiated – Lagged	L_W	109	104	103	92	86	100	85	86	91	101
GT Enclosure Walls[2]	L_W	98	101	86	81	77	82	83	86	82	91
GT Enclosure Air Inlet Vents	L_W	94	101	89	91	90	90	93	93	93	99
GT Enclosure Air Discharge Vents	L_W	95	102	90	88	85	92	94	95	95	101
GT Exhaust Diffuser & Expansion Joint	L_W	129	126	111	109	106	104	102	96	73	110
HRSG Inlet Transition Duct Radiated	L_W	120	125	109	105	101	99	99	95	74	106
HRSG Wall Radiated	L_W	115	119	102	98	93	89	86	82	61	98
HRSG Exhaust Stack Wall Radiated	L_W	110	106	92	83	78	77	61	53	27	84
HRSG Exhaust Stack Exit – w/o Directivity	L_W	120	116	115	113	114	108	90	89	68	114
HRSG Duct Burner Gas Piping	L_W	102	108	110	102	92	95	99	100	97	105
SCR Ammonia Skid	L_W	96	103	99	96	97	97	95	92	87	101
GT Fuel Gas Systems	L_W	104	100	89	81	80	86	88	91	89	96
GT Generator	L_W	110	115	110	93	82	77	78	75	72	96
Unenclosed Lube Oil Package	L_W	96	100	98	105	102	97	97	92	83	104
Steam Turbine – Total – partly weather enclosed / insulated[2]	L_W	112	114	115	111	109	103	103	102	89	111
Condenser during Base Load	L_W	118	117	116	112	111	106	106	102	95	113
Hydrogen-cooled Generator for Steam Turbine	L_W	117	123	120	112	113	109	113	111	108	118
Enclosed Lube Oil Package – Steam Turbine[2]	L_W	94	94	100	95	97	92	89	85	80	98
Steam Turbine Control Oil Supply Skid	L_W	110	109	103	105	104	105	100	99	96	109
Boiler Feed Water Pumps In Building	L_W	104	110	108	102	103	112	110	106	96	116

Main GSU Transformer	L_W	106	106	110	110	110	94	89	82	77	108
Auxiliary Transformer	L_W	87	87	91	88	94	86	76	71	65	93
Circulating Water Pump	L_W	102	102	99	97	98	102	93	90	81	104
Service Water Pump Skid	L_W	74	81	82	89	94	91	89	91	88	98
Cooling Tower – Total	L_W	70	74	81	86	101	103	103	105	101	110
Demin Water Forwarding Pump	L_W	88	82	82	85	92	95	96	92	84	101
Raw Water Forwarding Pump	L_W	71	78	79	86	91	88	86	88	85	95
Cooling Water Heat Exchangers and Pump Skid	L_W	117	112	113	109	107	99	93	101	103	109
Gas Compressor – Enclosed[2]	L_W	112	107	108	104	102	94	88	96	98	104
Steam Turbine Building	$L_{i(c)}$	89	87	94	84	81	80	75	65	56	85

[1] "L_W" is the sound power level in dBL, and dBA broadband, (re: 1 pW). "$L_{i(c)}$" is the calculated average interior sound pressure in dBL, and dBA broadband, (re: 20µPa), within a building or enclosure, based on the sound power levels of noise sources located within that building or structure. Data presented may contain project proprietary information and should be considered privileged and confidential to the client and is not intended for use for any other purposes.

[2] Sound levels presented are equipment housed in acoustical package enclosures.

The Project has been designed such that several large components, such as the combustion and steam turbines and the steam generators, are housed in acoustical package enclosures specifically designed for the attenuation of noise. As specified by Siemens, silencers were applied to the combustion turbine air inlets and transmission loss ratings were incorporated into the wall and roof assemblies of the steam turbine and generator buildings based on the projected Sound Transmission Class (STC) rating of 35, a typical design choice for combined-cycle plants. These pre-packaged mitigation measures for which data were available from the equipment manufacturers are summarized in Table 9, which also includes the expected insertion loss associated with the installation of lagging and the net reduction resulting from the combined HRSG and silencer at the exhaust stack. Note that the selected mitigation is intended to reflect the feasibility of achieving the resulting level of impact; final design is may incorporate different mitigation in order to achieve the same objective.

Table 9. Noise Level Reductions for Different Types of Construction and Acoustical Treatments

Type of Construction or Acoustical Treatment	Modeled Noise Level Reductions by Octave Band Center Frequency (dBL)								
	31.5	63	125	250	500	1k	2k	4k	8k
Standard Equipment Enclosure	5	9	14	19	29	38	46	52	58
Wall Panel STC 35	10	16	17	29	32	41	49	52	57
Acoustical Building Roof	12	18	23	28	38	43	50	52	51
Building Acoustical Louver	1	1	2	3	3	4	5	5	3

Building Fan Attenuators	3	3	8	10	13	16	8	5	4
HRSG + Stack Silencer Attenuation	13	10	24	29	36	45	36	42	41
Acoustical Lagging Insertion Loss	-	3	8	14	18	23	25	27	28

5.3 NOISE PREDICTION MODEL RESULTS

Broadband (dBA) sound pressure levels were calculated for expected normal Project operation assuming that all components identified previously are operating continuously and concurrently at the representative manufacturer-rated sound levels. The sound energy was then summed to determine the equivalent continuous A-weighted downwind sound pressure level at a point of reception. Sound contour plots displaying broadband (dBA) sound levels presented as color-coded isopleths are provided in Figure 14. The noise contours are graphical representations of the cumulative noise associated with full operation of the equipment and show how operational noise would be distributed over the surrounding area within a 1-mile radius of the Project site. The contour lines shown are analogous to elevation contours on a topographic map, i.e., the noise contours are continuous lines of equal noise level around some source, or sources, of noise. Figure 14 also shows the monitoring locations, representative of proximate noise sensitive, that were used to assess potential noise impacts on a cumulative basis.

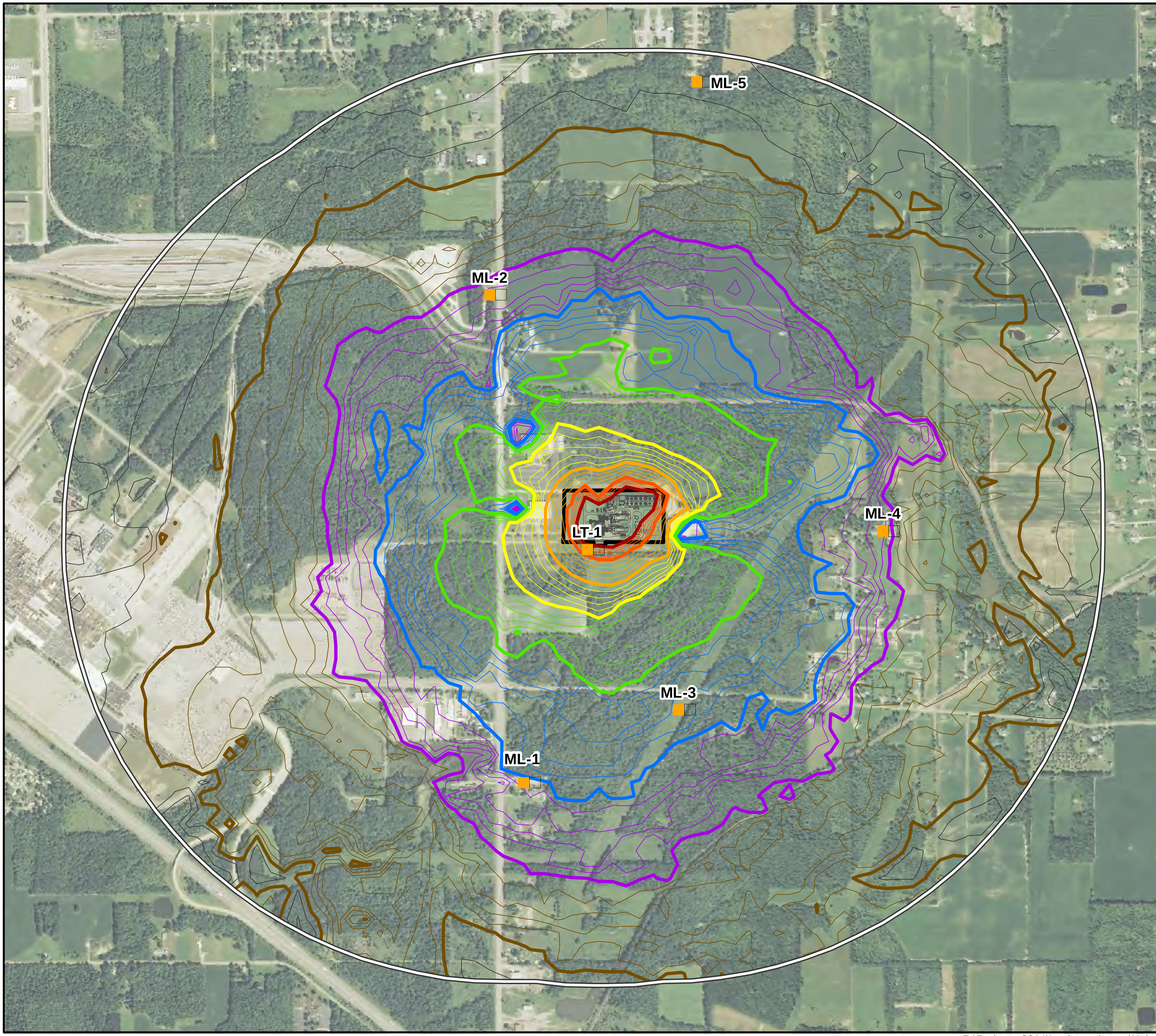


Figure 14
Received Sound Levels: Normal Operation

Lordstown Energy Center
Village of Lordstown, Ohio

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Table 10 shows the projected exterior sound levels resulting from full, normal operation of the Project at the MLs under the mitigated design. The table also provides the total predicted net increase in sound energy at each of the five MLs, which are representative of proximate noise sensitive areas in each of the principal geographical directions relative to the Project site.

Table 10. Acoustic Modeling Results Summary – Mitigated Design

Monitoring Location	Nighttime Ambient L_{eq}, dBA	Project Sound Level, dBA	Total Sound Level (Ambient + Project), dBA	Net Increase in Sound Level, dBA
ML-1	52	44	53	+1
ML-2	54	42	54	<1
ML-3	45	46	49	+4
ML-4	45	41	46	+1
ML-5	38	34	39	+1

Table 11 shows the projected exterior sound levels resulting from full, normal operation of the Project at the closest culturally significant locations. The resulting sound levels are lower due to the greater separation distance between the Project site and these specific receiver locations.

Table 11. Received Sound Levels at Culturally Acoustic Modeling Results Summary – Mitigated Design

Noise Sensitive Cultural Location			Distance (miles)[2]	Direction	Project Sound Level, dBA
Location	Coordinates NAD UTM 16				
Lion's Club[1]	512134.3	4555179.8	0.06	SW	59
Lordstown Center Cemetery	512413.96	4557058.82	1.5	N	33
Lordstown High School	511900.99	4557274.97	1.6	N	31
Lordstown Branch Library	512610.17	4557106.79	1.8	N	33
Newton Falls Community Center	502075.82	4559141.92	2.0	W	N/A
Best Friends Day Care	519358.57	4555000.96	2.3	SE	N/A
Warren General Hospital	518663.58	4564410.97	6.8	NE	N/A

*N/A: outside calculation area
[1] CEF-L is working to relocate the Lion's Club to a property further away from the proposed Project.
[2] Distance measured from the northern stack as it is centrally-located within the Project site.

6.0 NOISE CONTROL MEASURES

The Project will incorporate design features to minimize potential noise impacts on the surrounding community. Sound resulting from Project operation will be minimized through design measures both inherent in the equipment and added for additional attenuation. Through the modeling process, alternative noise control mitigation measures underwent two evaluations before they were incorporated in the final noise mitigation design. First, all major potential noise sources were entered into the software model. Next, candidate mitigation strategies were tested and applied or discarded until the design was optimized. Specific measures may be refined through final design details, but will be required to be fully compliant with the applicable standards. The following mitigation measures have been included in this analysis to demonstrate that compliant sound levels can be achieved by the Project:

- Project siting to achieve an adequate distance buffer between noise sensitive areas and noise-producing equipment;
- Combustion and steam turbines and the steam turbine generators will be housed in acoustical enclosures equipped with acoustic silencers and attenuators as required to reduce noise emissions from ventilation openings, fans, and make-up air units.
- Safety and relief valves that release high pressure steam will be equipped with silencing, to the extent permitted by the American Society for Mechanical Engineers code;
- A combustion turbine inlet silencing package designed to reduce air inlet sound power levels below the base design inlet silencer;
- Acoustical lagging of the CTG exhaust diffuser as it exits the turbine compartment and enters the HRSG;
- On-site gas compressors (if required) will be located within a self-contained building with sound insulation.
- A stack silencing package inclusive of the HRSG will be designed to achieve a total sound power level of 114 dBA to reduce sound pressure levels leaving the flue in the stack structure, which is consistent with Siemens plan to install HRSG exhaust silencing;
- National Electrical Manufacturers Association low-noise-rated step-up transformers associated with the CTG and the STG, combined with the use of fire walls and acoustical barriers will further serve to reduce offsite transformer noise levels;
- A low-noise design WCT is specified in the design. Use of splash attenuators or other acoustical treatments will be applied as necessary to achieve far-field acoustic design targets; and
- For balance of plant components, no additional mitigation is required beyond what is typically provided by the manufacturers as part of their standard design. This may include the use of low-noise gas heaters and housing large pumps and air compressors associated with the HRSG and power train (i.e. boiler feed water pumps, vacuum pumps, and fuel oil forwarding pumps) in buildings or acoustical enclosures.

In addition, all equipment will include sound attenuation to meet OSHA nearfield sound levels whenever practical. Hearing protection will be mandatory in any areas where this is not practical. The treatments with the acoustic performance as outlined above relate to the dominant noise sources. Table 8 includes the noise level reduction values associated with the installation mitigation where noted, as assumed in the acoustic modeling analyses. Table 9 presents further sound reduction indices as incorporated in the modeling calculations. These mitigation measures were incorporated into this screening level assessment to demonstrate the feasibility of the proposed Project to meet the specific noise requirements, but the final design may incorporate different mitigation measures in order to achieve the same objective as demonstrated in this assessment.

7.0 CONCLUSIONS

The operation of the Project will fully comply with all of the applicable noise standards and guidance pursuant to the OPSB, OSHA, and local requirements.

During the construction period, as outlined in Table 7, sound levels will increase during certain phases, and will vary over time. However, the construction period will be limited in duration, and most construction activities will occur during daytime hours. Reasonable efforts will be made to minimize the impact of noise resulting from construction activities at proximate noise sensitive areas. No adverse or long-term effects are expected. Compliance with OSHA standards will be achieved through equipment mitigation practices, use of personal protective equipment such as hearing protection devices, and limitations on exposure.

During operation, noise levels from the Project will range from 34 to 46 dBA L_{eq} at nearby noise sensitive areas, as represented by the five MLs. Since ambient nighttime noise levels range from 38 to 54 dBA L_{eq}, the Project is expected to have a minimal effect on ambient sound levels in the adjacent community. With the basic noise control features described in Sections 5 and 6, the projected increase in the nighttime L_{eq} at the MLs is expected to range from less than 1 to 4 dBA. Although the specific mitigation assumptions incorporated in this modeling effort may be refined in final design, the level of impact reflected in the analysis can be readily achieved by the Project. OSHA standards will apply to on-site operational workers, and will be met through equipment mitigation, use of personal protective equipment such as hearing protection devices, and limitations on exposure.

8.0 REFERENCES

ANSI S1.4-1983 American National Standard Specification for Sound Level Meters, (R 2006), 1819 L Street, N.W., Sixth Floor, Washington, D.C. 20036

Barron, R. 2003. Industrial Noise Control and Acoustics. Marcel Dekker Inc., New York.

Bies D. and Hansen C. 2003. “Engineering Noise Control: Theory and Practice”, Published by Taylor & Francis, 2003.

Bolt, Beranek and Newman, Inc. 1977. Power Plant Construction Noise Guide, prepared for the Empire State Electric Energy Research Corporation, Report No. 3321, 1977.

Edison Electric Institute, Electric Power Plant Environmental Noise Guide, 1985.

Elliott, T. et al. Standard Handbook of Powerplant Engineering. McGraw-Hill: 1998, New York.

Empire State Electric Energy Research Corporation, Power Plant Construction Noise Guide, Bolt, Beranek and Newman, Inc., Report No. 3321 (1977).

Kurze, U. and L. Beranek. 1988. Noise and Vibration Control. Institute of Noise Control Engineering, Washington, DC.

NEMA (National Electrical Manufacturers Association). 2000. NEMA Standards Publication No. TR 1-1993 (R2000) Transformers, Regulators and Reactors.

ISO. 1996. Acoustics – Attenuation of Sound during Propagation Outdoors. Part 2: General Method of Calculation. ISO Standard 9613-2. Geneva, Switzerland.

USEPA (U.S. Environmental Protection Agency). 1971. Noise from Construction Equipment and Operations, US Building Equipment, and Home Appliances. Prepared by Bolt Beranek and Newman for USEPA Office of Noise Abatement and Control, Washington, DC.

APPENDIX A: CALIBRATION CERTIFICATION DOCUMENTATION

Certificate of Calibration and Conformance

This document certifies that the instrument referenced below meets published specifications per Procedure PRD-P263; ANSI S1.4-1983 (R 2006) Type 1; S1.4A-1985; S1.43-1997 Type 1; S1.11-2004 Octave Band Class 0; S1.25-1991; IEC 61672-2002 Class 1; 60651-2001 Type 1; 60804-2000 Type 1; 61260-2001 Class 0; 61252-2002.

Manufacturer:	Larson Davis	Temperature:	70.8	°F
Model Number:	831		21.56	°C
Serial Number:	3326	Rel. Humidity:	51.4	%
Customer:	TMS Rental	Pressure:	996.8	mbars
Description:	Sound Level Meter		996.8	hPa

Note: As Found / As Left: In Tolerance

Upon receipt for testing, this instrument was found to be:

Within the Stated tolerance of the manufacturer's specification

Calibration Date: 14-May-14 Calibration Due:

Calibration Standards Used:

Manufacturer	Model	Serial Number	Cal Due	Traceability No.
Larson Davis	LDSigGen/2239	0760/0109	4/14/2015	2013-176324

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at The Modal Shop and/or Larson Davis Corporate Headquarters. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of The Modal Shop.

Technician: Wayne Underwood Signature:

THE MODAL SHOP INC.
A PCB GROUP CO.

The Modal Shop, Inc.
3149 East Kemper Road
Cincinnati, OH 45241
Phone: (513) 351-9919
(800) 860-4867
www.modalshop.com

~ Certificate of Calibration and Compliance ~

Microphone Model: 377B02 Serial Number: 141566 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
Hewlett Packard	34401A	MY41045214	LD-001	3/6/13	3/6/14
Bruel & Kjaer	4192	2657834	CA1270	11/26/13	11/26/14
Newport	BTH-W/N	8410668	CA1187	not required	not required
Larson Davis	PRM915	122	CA-865	9/17/13	9/17/14
Larson Davis	PRM902	4701	CA1450	10/21/13	10/21/14
Larson Davis	2559LF	3216	CA-883	not required	not required
Larson Davis	ADP005	1	LD-017	not required	not required
Larson Davis	PRM916	127	CA924	4/15/13	4/15/14
Larson Davis	CAL250	5025	CA1277	7/25/13	7/25/14
Larson Davis	2201	140	CA-1409	3/22/13	3/21/14
Larson Davis	2900	1079	CA-521A	6/4/13	6/4/14
Larson Davis	PRA951-4	234	CA1154	9/17/13	9/17/14
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 microphone is traceable through PTB.
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 9001, 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: Milton Munger MM 3646 Date: January 20, 2014

ilac-MRA ACCREDITED CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

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

ID:CAL60-3473116907.287

~ Calibration Report ~

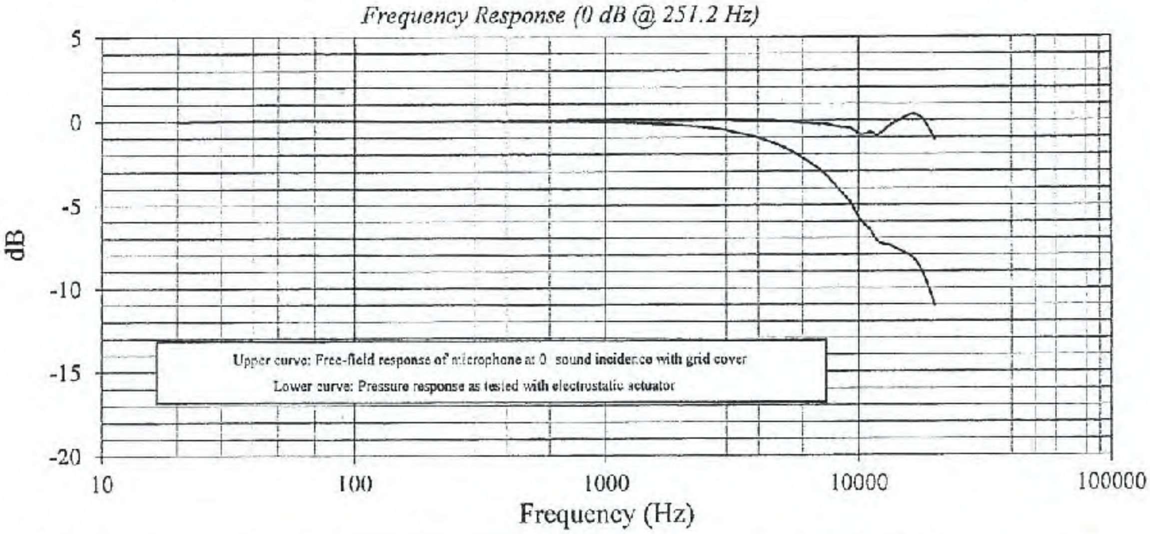
Microphone Model: 377B02 Serial Number: 141566 Description: 1/2" Free-Field Microphone

Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 50.25 mV/Pa
-25.98 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 11.1 pF

Temperature: 69 °F (21°C) Ambient Pressure: 983 mbar Relative Humidity: 26 %



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	0.00	0.00	1584.9	-0.17	0.04	6683.4	-2.69	-0.17	-	-	-
25.1	0.02	0.02	1678.8	-0.19	0.04	7079.5	-2.96	-0.18	-	-	-
31.6	0.03	0.03	1778.3	-0.21	0.04	7498.9	-3.29	-0.22	-	-	-
39.8	0.03	0.03	1883.7	-0.23	0.05	7943.3	-3.71	-0.32	-	-	-
50.1	0.03	0.03	1995.3	-0.26	0.05	8414.0	-4.10	-0.37	-	-	-
63.1	0.03	0.03	2113.5	-0.29	0.05	8912.5	-4.51	-0.40	-	-	-
79.4	0.02	0.02	2238.7	-0.32	0.05	9440.6	-5.01	-0.49	-	-	-
100.0	0.02	0.02	2371.4	-0.36	0.05	10000.0	-5.73	-0.78	-	-	-
125.9	0.01	0.01	2511.9	-0.40	0.06	10592.5	-6.22	-0.82	-	-	-
158.5	0.01	0.01	2660.7	-0.45	0.06	11220.2	-6.58	-0.72	-	-	-
199.5	0.01	0.01	2818.4	-0.50	0.06	11885.0	-7.19	-0.87	-	-	-
251.2	0.00	0.00	2985.4	-0.55	0.07	12589.3	-7.39	-0.62	-	-	-
316.2	0.00	0.01	3162.3	-0.66	0.02	13335.2	-7.46	-0.27	-	-	-
398.1	-0.01	-0.01	3349.7	-0.73	0.01	14125.4	-7.66	-0.07	-	-	-
501.2	-0.02	0.02	3548.1	-0.81	0.01	14962.4	-7.85	0.12	-	-	-
631.0	-0.03	0.01	3758.4	-0.90	0.00	15848.9	-8.04	0.31	-	-	-
794.3	-0.05	0.04	3981.1	-1.01	-0.01	16788.0	-8.38	0.34	-	-	-
1000.0	-0.08	0.04	4217.0	-1.12	-0.01	17782.8	-8.99	0.12	-	-	-
1059.3	-0.08	0.05	4466.8	-1.25	-0.02	18836.5	-9.92	-0.41	-	-	-
1122.0	-0.09	0.05	4731.5	-1.40	-0.03	19952.6	-11.03	-1.10	-	-	-
1188.5	-0.10	0.05	5011.9	-1.56	-0.03	-	-	-	-	-	-
1258.9	-0.11	0.05	5308.8	-1.76	-0.06	-	-	-	-	-	-
1333.5	-0.12	0.06	5623.4	-1.95	-0.07	-	-	-	-	-	-
1412.5	-0.14	0.05	5956.6	-2.20	-0.13	-	-	-	-	-	-
1496.2	-0.15	0.05	6309.6	-2.44	-0.15	-	-	-	-	-	-

Technician: Milton Munger MM 3040 Date: January 20, 2014

ilac-MRA A2LA ACCREDITED
CALIBRATION CERT #1862.01

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

ID.CAL60-3473.1:0907.207

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2014-187372

Instrument Model CAL200, Serial Number 11080, was calibrated on 7 Mar 2014. The instrument meets factory specifications per Procedure D0001.8190, IEC 60942:2003.

New Instrument
Date Calibrated: 7 Mar 2014
Calibration due:

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2900	0661	12 Months	8 Apr 2014	2013-172252
Larson Davis	2559	2506	12 Months	13 Jun 2014	29027
Larson Davis	MTS1000/2201	0111	12 Months	22 Aug 2014	SM082213
Larson Davis	PRM902	0480	12 Months	23 Aug 2014	2013-178669
Hewlett Packard	34401A	3146A10352	12 Months	3 Sep 2014	6214490
PCB	1502C02FJ15PSIA	1429	12 Months	2 Oct 2014	3463562806
Larson Davis	PRM915	0112	12 Months	9 Oct 2014	2013-180644

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as shown on calibration report.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

Signed: Scott Montgomery
Technician: Scott Montgomery

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2013-175241

Microphone Model 377B02, Serial Number 109271, was calibrated on 06JUN2013. The microphone meets factory specifications per Test Procedure D0001.8167.

Instrument found to be in calibration as received: YES
Date Calibrated: 06JUN2013
Calibration due: 06JUN2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2900	0575	12 Months	26JUL2013	2012-162047
Larson Davis	PRM902	0206	12 Months	14AUG2013	2012-162575
Larson Davis	2559	3034LF	12 Months	14AUG2013	2012-162596
Larson Davis	MTS1000 / 2201	1000 / 0100	12 Months	07SEP2013	SM070912-2
Larson Davis	PRM902	0529	12 Months	07SEP2013	2012-163529
Larson Davis	PRM902	0528	12 Months	10SEP2013	2012-163530
Hewlett Packard	34401A	3146A62099	12 Months	26NOV2013	5884920
Larson Davis	PRM915	0102	12 Months	04DEC2013	2012-167168
Larson Davis	PRM916	0102	12 Months	13DEC2013	2012-167454
Larson Davis	2559	2504	12 Months	03JAN2014	19648-1
Larson Davis	CAL250	42630	12 Months	04JAN2014	2013-168402

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data is the same as shipped data.

Signed: Abraham Ortega
Technician: Abraham Ortega

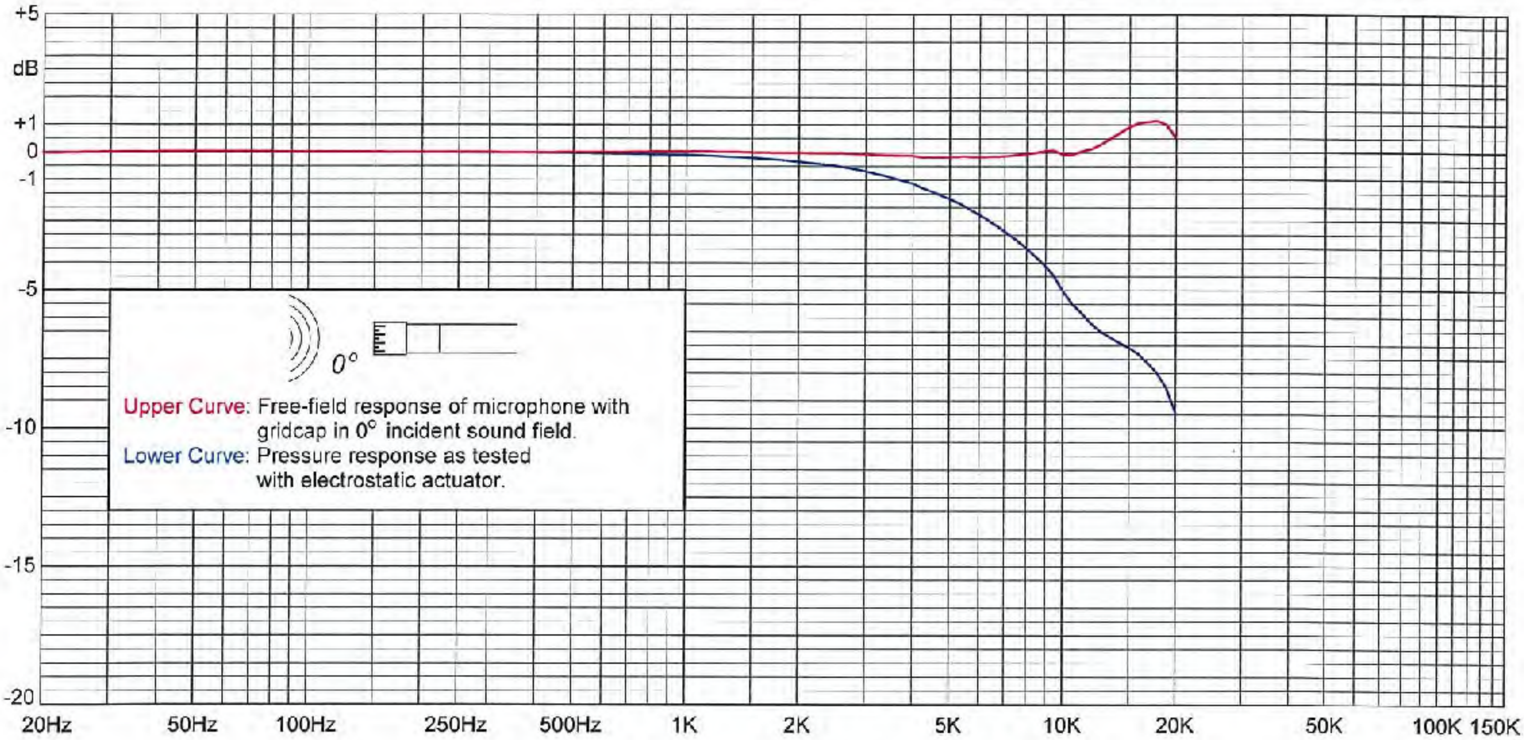
Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Larson Davis

PCB 1/2" Microphone Calibration Chart
Model: 377B02 Serial Number: 109271

Open Circuit Sensitivity @ 1013.7 mbar & 251.19 Hz
-26.09 dB re 1V/Pascal
49.59 mV/Pascal
+0.07 K_0(-dB re 50 mV/Pascal)
Expanded Uncertainty @ ~95% confidence level
0.2 dB

Capacitance @ 251.2 Hz
12.1 pF
Lower Limiting Frequency
-3 dB @ **1.17** Hz
Test Conditions:
Polarization Voltage **0** V
Ambient Pressure **1013.7** mbar
Temperature **23.8** °C
Relative Humidity **33.4** %



Frequency Response (0 dB @ 251.19 Hz)
Free-field and actuator response with reference to level at 251.19 Hz

Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)	Freq (Hz)	Upper (dB)	Lower (dB)
19.95	-0.04	-0.04	501.19	0.01	-0.03	1883.65	-0.02	-0.30	4216.97	-0.17	-1.28	9440.61	0.08	-4.44
25.12	-0.01	-0.01	630.96	0.00	-0.04	1995.26	-0.02	-0.33	4466.84	-0.17	-1.40	10000.00	-0.07	-5.02
31.62	0.01	0.01	794.33	0.02	-0.07	2113.49	-0.03	-0.37	4731.51	-0.17	-1.54	10592.54	-0.07	-5.47
39.81	0.02	0.02	1000.00	0.02	-0.10	2238.72	-0.04	-0.41	5011.87	-0.16	-1.69	11220.19	0.04	-5.82
50.12	0.02	0.02	1059.25	0.02	-0.11	2371.37	-0.04	-0.45	5308.84	-0.15	-1.85	11885.02	0.12	-6.20
63.10	0.02	0.02	1122.02	0.02	-0.12	2511.89	-0.03	-0.49	5623.41	-0.15	-2.03	12589.25	0.29	-6.48
79.43	0.02	0.02	1188.50	0.02	-0.13	2660.73	-0.04	-0.55	5956.62	-0.16	-2.23	13335.21	0.50	-6.69
100.00	0.02	0.02	1258.93	0.01	-0.15	2818.38	-0.05	-0.61	6309.57	-0.15	-2.44	14125.38	0.70	-6.89
125.89	0.01	0.01	1333.52	0.02	-0.16	2985.38	-0.06	-0.68	6683.44	-0.15	-2.67	14962.36	0.92	-7.05
158.49	0.01	0.01	1412.54	0.01	-0.18	3162.28	-0.08	-0.76	7079.46	-0.12	-2.90	15848.93	1.07	-7.28
199.53	0.01	0.01	1496.24	0.00	-0.20	3349.65	-0.10	-0.84	7498.94	-0.09	-3.16	16788.04	1.11	-7.61
251.19	0.00	0.00	1584.89	-0.01	-0.22	3548.13	-0.11	-0.93	7943.28	-0.04	-3.43	17782.80	1.16	-7.95
316.23	0.00	-0.01	1678.80	-0.01	-0.24	3758.37	-0.12	-1.02	8413.95	-0.01	-3.74	18836.49	1.01	-8.50
398.11	-0.02	-0.02	1778.28	-0.02	-0.27	3981.07	-0.12	-1.12	8912.51	0.05	-4.06	19952.62	0.55	-9.38

Abraham Ortega 06JUN2013
Larson-Davis Model 9700 ES Microphone Calibration System

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2013-175217

Instrument Model PRM831, Serial Number 010875, was calibrated on 10JUN2013. The instrument meets factory specifications per Procedure D0001.8167.

Instrument found to be in calibration as received: YES
Date Calibrated: 10JUN2013
Calibration due: 10JUN2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Agilent Technologies	34401A	MY41044529	12 Months	25JAN2014	5954339
Larson Davis	LDSigGn/2209	0277 / 0109	12 Months	08MAR2014	2013-171090

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 32 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

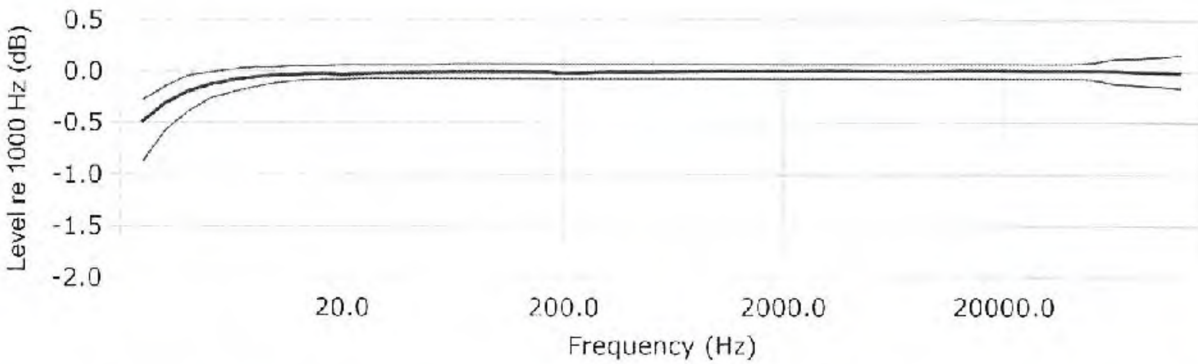
"AS RECEIVED" data same as shipped data.

Signed: Ron Harris
Technician: Ron Harris

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Preamplifier Model: PRM831 Serial Number: 010875
Frequency Response Test Report

Frequency response electrically tested at 120.0 dBµV using a 18 pF capacitor to simulate microphone capacitance.



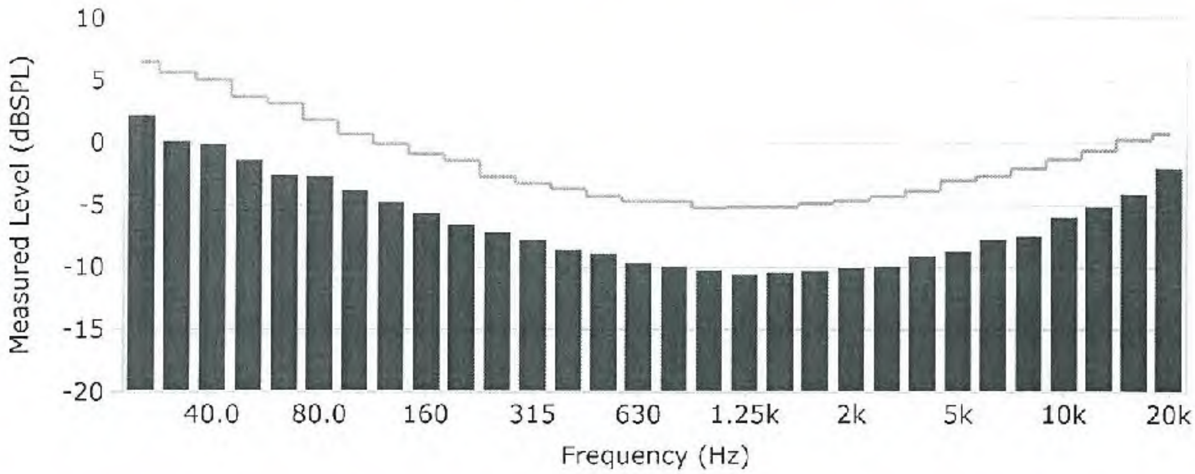
Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Relative Level (dB)	Uncertainty (dB)	Limits (dB)
2.5	-0.48	0.08	-0.27,-0.87	631.0	-0.00	0.02	0.07,-0.07
3.2	-0.30	0.06	-0.14,-0.57	794.3	-0.00	0.02	0.07,-0.07
4.0	-0.19	0.06	-0.04,-0.39	1000.0	0.00	0.02	0.07,-0.07
5.0	-0.12	0.04	-0.01,-0.26	1258.9	0.00	0.02	0.07,-0.07
6.3	-0.08	0.04	0.02,-0.20	1584.9	0.00	0.02	0.07,-0.07
7.9	-0.05	0.04	0.04,-0.15	1995.3	0.00	0.02	0.07,-0.07
10.0	-0.04	0.02	0.04,-0.11	2511.9	0.00	0.02	0.07,-0.07
12.6	-0.03	0.02	0.05,-0.09	3162.3	0.00	0.02	0.07,-0.07
15.8	-0.02	0.02	0.05,-0.08	3981.1	0.00	0.02	0.07,-0.07
20.0	-0.03	0.02	0.06,-0.08	5011.9	0.00	0.02	0.07,-0.07
25.1	-0.02	0.02	0.06,-0.07	6309.6	0.00	0.02	0.07,-0.07
31.6	-0.02	0.02	0.06,-0.07	7943.3	-0.00	0.02	0.07,-0.07
39.8	-0.01	0.02	0.06,-0.07	10000.0	0.00	0.02	0.07,-0.07
50.1	-0.01	0.02	0.06,-0.07	12589.3	0.00	0.02	0.07,-0.07
63.1	-0.01	0.02	0.07,-0.07	15848.9	0.00	0.02	0.07,-0.07
79.4	-0.01	0.02	0.07,-0.07	19952.6	0.00	0.02	0.07,-0.07
100.0	-0.01	0.02	0.07,-0.07	25118.9	0.00	0.02	0.07,-0.07
125.9	-0.01	0.02	0.07,-0.07	31622.8	0.00	0.02	0.07,-0.07
158.5	-0.01	0.02	0.07,-0.07	39810.7	0.00	0.02	0.07,-0.07
199.5	-0.02	0.02	0.07,-0.07	50118.7	0.00	0.02	0.08,-0.08
251.2	-0.01	0.02	0.07,-0.07	63095.7	-0.00	0.05	0.12,-0.12
316.2	-0.01	0.02	0.07,-0.07	79432.8	-0.00	0.05	0.13,-0.13
398.1	-0.01	0.02	0.07,-0.07	100000.0	-0.01	0.05	0.14,-0.14
501.2	-0.00	0.02	0.07,-0.07	125892.5	-0.01	0.06	0.16,-0.16

1000 Hz measured level: 119.881 dBµV, -0.119 dB re input (0.035 dB uncertainty; -0.490 dB to 0.010 dB limit)
Environmental conditions: 23.7 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainties are given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: PRM831.xml
This frequency response is in compliance with manufacturers specification for the item tested.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:18:36

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

Preamplifier Model: PRM831 Serial Number: 010875
1/3 Octave Noise Floor Test Report



Frequency (Hz)	Measured (dBµV)	Uncertainty (dB)	Limits (dBµV)	Frequency (Hz)	Measured (dBµV)	Uncertainty (dB)	Limits (dBµV)
25.0	2.2	2.0	6.5	800.0	-9.9	0.6	-4.7
31.5	0.1	1.9	5.7	1000.0	-10.2	0.5	-5.2
40.0	-0.1	1.8	5.1	1250.0	-10.6	0.5	-5.1
50.0	-1.4	1.7	3.7	1600.0	-10.4	0.5	-5.1
63.0	-2.6	1.6	3.2	2000.0	-10.3	0.5	-4.8
80.0	-2.7	1.5	1.8	2500.0	-10.1	0.5	-4.6
100.0	-3.8	1.4	0.7	3150.0	-9.9	0.5	-4.3
125.0	-4.8	1.3	-0.1	4000.0	-9.1	0.5	-3.8
160.0	-5.7	1.2	-0.9	5000.0	-8.7	0.5	-3.0
200.0	-6.6	1.1	-1.4	6300.0	-7.8	0.5	-2.6
250.0	-7.2	1.0	-2.7	8000.0	-7.5	0.5	-2.0
315.0	-7.8	0.9	-3.2	10000.0	-6.0	0.5	-1.3
400.0	-8.6	0.8	-3.7	12500.0	-5.1	0.5	-0.6
500.0	-8.9	0.7	-4.3	16000.0	-4.1	0.5	0.3
630.0	-9.7	0.6	-4.7	20000.0	-2.0	0.5	0.8

A-weighted Sum: 1.4 µV, 3.2 dBµV (0.5 dB uncertainty; 7.0 dBµV limit)
Environmental conditions: 23.8 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainties are given as expanded uncertainty at ~95 percent confidence level ($k = 2$).
Test Procedure: PRM831.xml
This noise floor is in compliance with manufacturers specification for the item tested.

Technician: Ron Harris Test Date: 10 Jun 2013 07:18:36

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

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2013-175223

Instrument Model 831, Serial Number 0001350, was calibrated on 10JUN2013. The instrument meets factory specifications per Procedure D0001.8310, ANSI S1.4-1983 (R 2006) Type 1; S1.4A-1985 ; S1.43-1997 Type 1; S1.11-2004 Octave Band Class 1; S1.25-1991; IEC 61672-2002 Class 1; 60651-2001 Type 1; 60804-2000 Type 1; 61260-2001 Class 1; 61252-2002.

Instrument found to be in calibration as received: YES
Date Calibrated: 10JUN2013
Calibration due: 10JUN2015

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Stanford Research Systems	DS360	61746	12 Months	06JUL2013	61746-070612

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 32 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

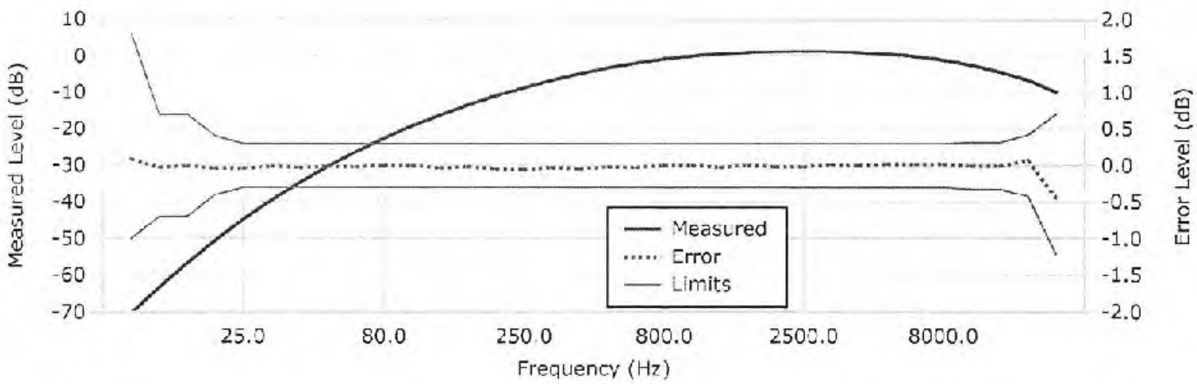
"AS RECEIVED" data same as shipped data.
Tested with PRM831-010875

Signed: Ron Harris
Technician: Ron Harris

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
A-Weight Electrical Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 137.0dBµV. The instrument's A-weighted response was then electrically tested using a sinewave at exact frequencies as specified in IEC 61672-1:2002 Table 2 note b. Instrument has 0dB gain.



Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)	Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)
10.00	-70.35	-70.43	0.08	0.13	1.80,-1.00	501.19	-3.25	-3.23	-0.02	0.13	0.30,-0.30
12.59	-63.40	-63.37	-0.03	0.13	0.70,-0.70	630.96	-1.93	-1.90	-0.03	0.13	0.30,-0.30
15.85	-56.70	-56.69	-0.01	0.13	0.70,-0.70	794.33	-0.82	-0.82	0.00	0.13	0.30,-0.30
19.95	-50.49	-50.45	-0.04	0.13	0.40,-0.40	1000.00	0.00	0.00	0.00	0.13	0.30,-0.30
25.12	-44.75	-44.70	-0.04	0.13	0.30,-0.30	1258.93	0.56	0.59	-0.03	0.13	0.30,-0.30
31.62	-39.46	-39.44	-0.02	0.13	0.30,-0.30	1584.89	0.98	0.98	0.00	0.13	0.30,-0.30
39.81	-34.66	-34.63	-0.03	0.13	0.30,-0.30	1995.26	1.18	1.20	-0.02	0.13	0.30,-0.30
50.12	-30.25	-30.23	-0.02	0.13	0.30,-0.30	2511.89	1.25	1.27	-0.02	0.13	0.30,-0.30
63.10	-26.22	-26.19	-0.02	0.13	0.30,-0.30	3162.28	1.21	1.20	0.01	0.13	0.30,-0.30
79.43	-22.50	-22.50	0.00	0.13	0.30,-0.30	3981.07	0.97	0.97	0.00	0.13	0.30,-0.30
100.00	-19.15	-19.14	-0.00	0.13	0.30,-0.30	5011.87	0.57	0.55	0.02	0.13	0.30,-0.30
125.89	-16.14	-16.10	-0.04	0.13	0.30,-0.30	6309.57	-0.11	-0.12	0.02	0.13	0.30,-0.30
158.49	-13.37	-13.35	-0.02	0.13	0.30,-0.30	7943.28	-1.09	-1.11	0.02	0.13	0.30,-0.30
199.53	-10.92	-10.87	-0.05	0.13	0.30,-0.30	10000.00	-2.50	-2.49	-0.01	0.13	0.32,-0.32
251.19	-8.69	-8.63	-0.06	0.13	0.30,-0.30	12589.25	-4.33	-4.32	-0.01	0.13	0.32,-0.32
316.23	-6.64	-6.61	-0.03	0.13	0.30,-0.30	15848.93	-6.53	-6.60	0.08	0.13	0.42,-0.42
398.11	-4.85	-4.81	-0.04	0.13	0.30,-0.30	19952.62	-9.76	-9.32	-0.44	0.13	0.71,-1.21

Environmental conditions: 24.2 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

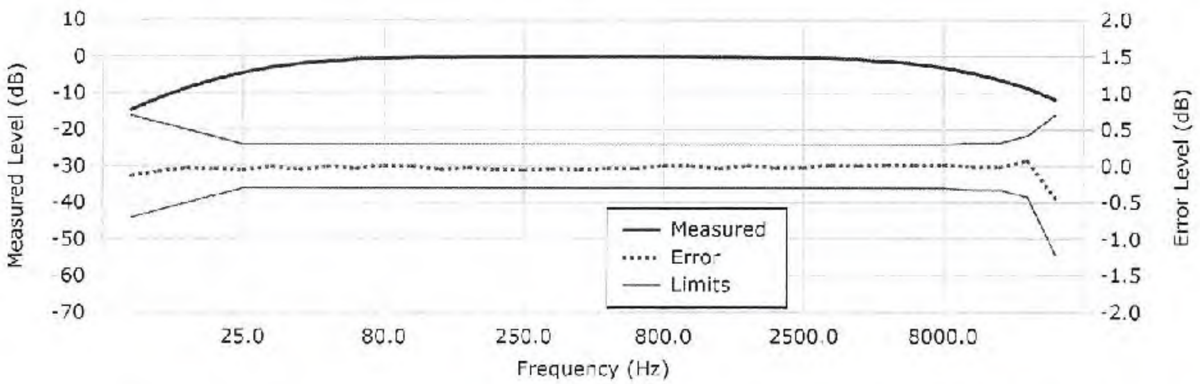
This A-Weight frequency response is in compliance with IEC 61672-1:2002 5.4 Class 1, IEC 60651-2001 6.1 and 9.2.2, ANSI S1.4-1983 (R2006) 5.1 and 8.2.1, and IEC 60804-2000 5.1 for Type 1 sound level meters when used with a PCB precision microphone.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
C-Weight Electrical Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 137.0dBµV. The instrument's C-weighted response was then electrically tested using a sinewave at exact frequencies as specified in IEC 61672-1:2002 Table 2 note b. Instrument has 0dB gain.



Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)
10.00	-14.46	-14.33	-0.13	0.12	0.70,-0.70
12.59	-11.32	-11.25	-0.07	0.12	0.60,-0.60
15.85	-8.55	-8.53	-0.02	0.12	0.50,-0.50
19.95	-6.28	-6.24	-0.04	0.12	0.40,-0.40
25.12	-4.45	-4.41	-0.05	0.12	0.30,-0.30
31.62	-3.02	-3.01	-0.01	0.12	0.30,-0.30
39.81	-2.04	-2.00	-0.04	0.12	0.30,-0.30
50.12	-1.30	-1.29	-0.01	0.12	0.30,-0.30
63.10	-0.85	-0.82	-0.03	0.12	0.30,-0.30
79.43	-0.50	-0.50	0.00	0.12	0.30,-0.30
100.00	-0.30	-0.30	-0.00	0.12	0.30,-0.30
125.89	-0.21	-0.17	-0.04	0.12	0.30,-0.30
158.49	-0.11	-0.09	-0.02	0.12	0.30,-0.30
199.53	-0.08	-0.03	-0.05	0.12	0.30,-0.30
251.19	-0.05	-0.00	-0.05	0.12	0.30,-0.30
316.23	-0.01	0.02	-0.03	0.12	0.30,-0.30
398.11	-0.02	0.03	-0.05	0.12	0.30,-0.30

Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)
501.19	0.01	0.03	-0.02	0.12	0.30,-0.30
630.96	0.00	0.03	-0.03	0.12	0.30,-0.30
794.33	0.02	0.02	0.00	0.12	0.30,-0.30
1000.00	0.00	0.00	0.00	0.12	0.30,-0.30
1258.93	-0.06	-0.03	-0.03	0.12	0.30,-0.30
1584.89	-0.08	-0.09	0.00	0.12	0.30,-0.30
1995.26	-0.19	-0.17	-0.02	0.12	0.30,-0.30
2511.89	-0.32	-0.30	-0.02	0.12	0.30,-0.30
3162.28	-0.49	-0.50	0.01	0.12	0.30,-0.30
3981.07	-0.82	-0.82	0.00	0.12	0.30,-0.30
5011.87	-1.27	-1.29	0.02	0.12	0.30,-0.30
6309.57	-1.98	-2.00	0.02	0.12	0.30,-0.30
7943.28	-2.99	-3.01	0.02	0.12	0.30,-0.30
10000.00	-4.41	-4.41	-0.00	0.12	0.32,-0.32
12589.25	-6.25	-6.24	-0.01	0.12	0.32,-0.32
15848.93	-8.45	-8.53	0.08	0.12	0.42,-0.42
19952.62	-11.69	-11.25	-0.44	0.12	0.71,-1.21

Environmental conditions: 24.1 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

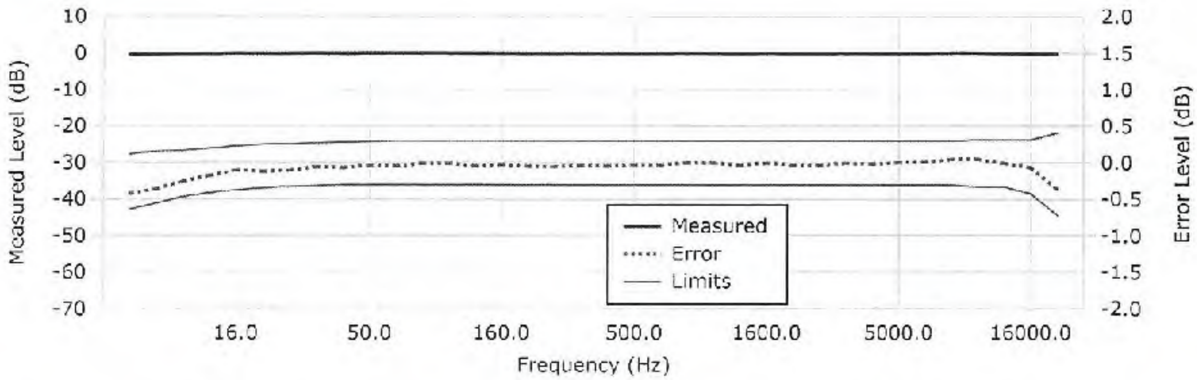
This C-Weight frequency response is in compliance with IEC 61672-1:2002 5.4 Class 1, IEC 60651-2001 6.1 and 9.2.2, ANSI S1.4-1983 (R2006) 5.1 and 8.2.1, and IEC 60804-2000 5.1 for Type 1 sound level meters when used with a PCB precision microphone.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Z-Weight Electrical Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 137.0dBµV. The instrument's Z-weighted response was then electrically tested using a sinewave at exact frequencies as specified in IEC 61672-1:2002 Table 2 note b. Instrument has 0dB gain.



Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)	Freq. (Hz)	Meas. (dB)	Theor. (dB)	Error (dB)	Uncert. (dB)	Limits (dB)
6.31	-0.42	0.00	-0.42	0.13	0.12,-0.63	398.11	-0.04	0.00	-0.04	0.13	0.30,-0.30
7.94	-0.35	0.00	-0.35	0.13	0.16,-0.55	501.19	-0.02	0.00	-0.02	0.13	0.30,-0.30
10.00	-0.25	0.00	-0.25	0.13	0.17,-0.46	630.96	-0.03	0.00	-0.03	0.13	0.30,-0.30
12.59	-0.17	0.00	-0.17	0.13	0.20,-0.41	794.33	0.00	0.00	0.00	0.13	0.30,-0.30
15.85	-0.10	0.00	-0.10	0.13	0.23,-0.37	1000.00	0.00	0.00	0.00	0.13	0.30,-0.30
19.95	-0.12	0.00	-0.12	0.13	0.25,-0.34	1258.93	-0.03	0.00	-0.03	0.13	0.30,-0.30
25.12	-0.10	0.00	-0.10	0.13	0.26,-0.32	1584.89	-0.00	0.00	-0.00	0.13	0.30,-0.30
31.62	-0.05	0.00	-0.05	0.13	0.27,-0.31	1995.26	-0.03	0.00	-0.03	0.13	0.30,-0.30
39.81	-0.07	0.00	-0.07	0.13	0.28,-0.30	2511.89	-0.03	0.00	-0.03	0.13	0.30,-0.30
50.12	-0.03	0.00	-0.03	0.13	0.29,-0.30	3162.28	-0.00	0.00	-0.00	0.13	0.30,-0.30
63.10	-0.05	0.00	-0.05	0.13	0.30,-0.30	3981.07	-0.01	0.00	-0.01	0.13	0.30,-0.30
79.43	-0.01	0.00	-0.01	0.13	0.30,-0.30	5011.87	0.01	0.00	0.01	0.13	0.30,-0.30
100.00	-0.01	0.00	-0.01	0.13	0.30,-0.30	6309.57	0.02	0.00	0.02	0.13	0.30,-0.30
125.89	-0.04	0.00	-0.04	0.13	0.30,-0.30	7943.28	0.05	0.00	0.05	0.13	0.30,-0.30
158.49	-0.02	0.00	-0.02	0.13	0.30,-0.30	10000.00	0.05	0.00	0.05	0.13	0.32,-0.32
199.53	-0.05	0.00	-0.05	0.13	0.30,-0.30	12589.25	-0.00	0.00	-0.00	0.13	0.32,-0.32
251.19	-0.05	0.00	-0.05	0.13	0.30,-0.30	15848.93	-0.06	0.00	-0.06	0.13	0.32,-0.42
316.23	-0.03	0.00	-0.03	0.13	0.30,-0.30	19952.62	-0.35	0.00	-0.35	0.13	0.41,-0.71

Environmental conditions: 24.1 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

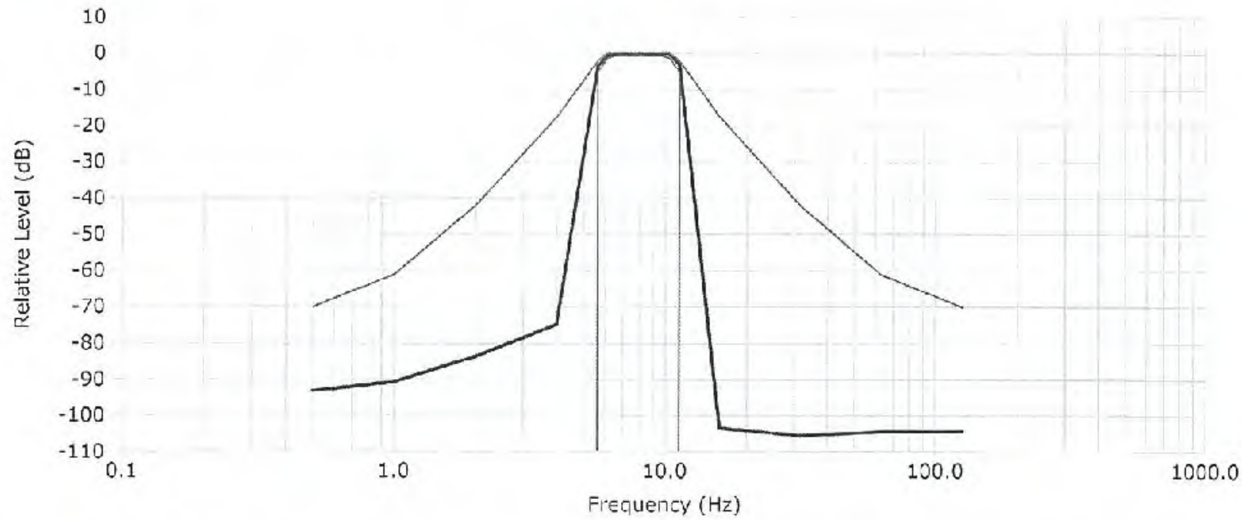
This Z-Weight frequency response is in compliance with IEC 61672-1:2002 5.4 Class 1, IEC 60651-2001 6.1 and 9.2.2, ANSI S1.4-1983 (R2006) 5.1 and 8.2.1, and IEC 60804-2000 5.1 for Type 1 sound level meters when used with a PCB precision microphone.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
8.0Hz Full Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 8.0Hz filter response was then electrically tested using a 138.0dBµV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
0.50	-93.15	1.34	-70.00, -inf	8.66	-0.07	0.12	+0.30, -0.40
1.00	-90.66	2.51	-61.00, -inf	9.44	-0.02	0.12	+0.30, -0.60
2.00	-83.65	0.90	-42.00, -inf	10.29	0.02	0.12	+0.30, -1.30
3.98	-74.85	0.13	-17.50, -inf	11.22	-3.06	0.12	-2.00, -5.00
5.62	-3.37	0.12	-2.00, -5.00	15.85	-103.35	1.46	-17.50, -inf
6.13	-0.40	0.12	+0.30, -1.30	31.62	-105.51	1.23	-42.00, -inf
6.68	-0.15	0.12	+0.30, -0.60	63.10	-104.40	1.27	-61.00, -inf
7.29	-0.12	0.12	+0.30, -0.40	125.89	-104.22	1.61	-70.00, -inf
7.94	-0.10	0.12	+0.30, -0.30				

Environmental conditions: 24.2 °C, 32.8 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

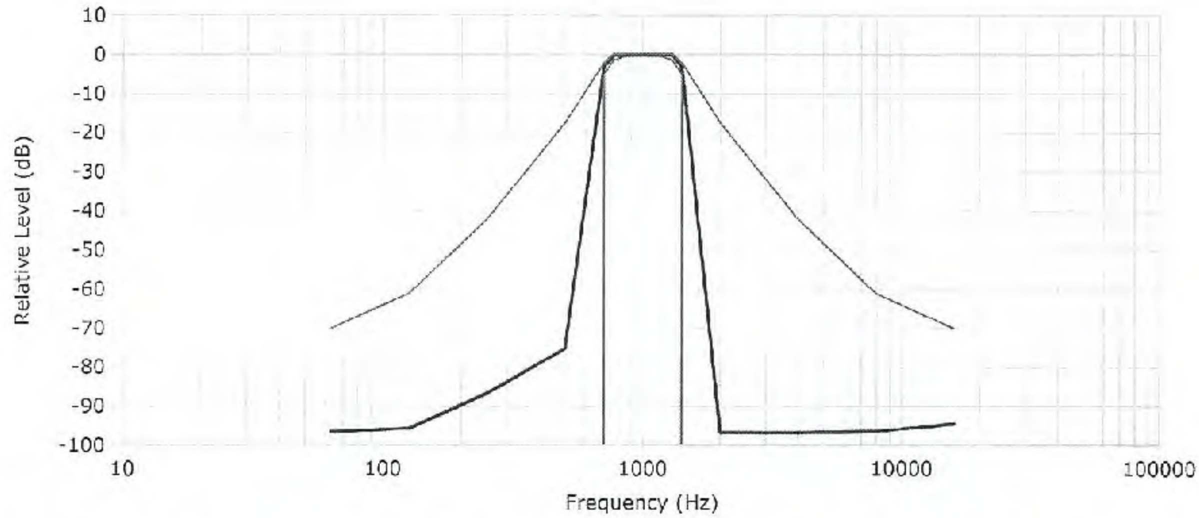
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
1000.0Hz Full Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 1000.0Hz filter response was then electrically tested using a 138.0dBμV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
63.10	-96.60	1.15	-70.00, -inf	1090.18	-0.04	0.12	+0.30, -0.40
125.89	-95.62	1.62	-61.00, -inf	1188.50	-0.02	0.12	+0.30, -0.60
251.19	-86.68	0.82	-42.00, -inf	1295.69	0.00	0.12	+0.30, -1.30
501.19	-75.19	0.13	-17.50, -inf	1412.54	-3.15	0.12	-2.00, -5.00
707.95	-3.16	0.12	-2.00, -5.00	1995.26	-96.72	0.60	-17.50, -inf
771.79	-0.23	0.12	+0.30, -1.30	3981.07	-96.77	0.66	-42.00, -inf
841.40	-0.03	0.12	+0.30, -0.60	7943.28	-96.38	0.64	-61.00, -inf
917.28	-0.02	0.12	+0.30, -0.40	15848.93	-94.41	0.49	-70.00, -inf
1000.00	-0.00	0.12	+0.30, -0.30				

Environmental conditions: 24.2 °C, 32.8 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

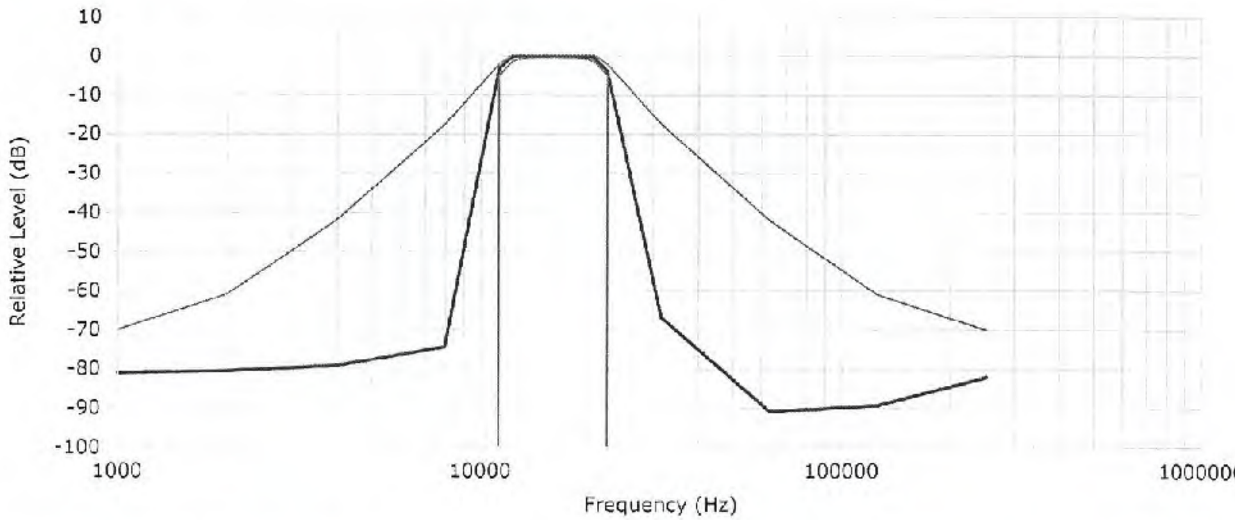
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
16000.0Hz Full Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 16000.0Hz filter response was then electrically tested using a 138.0dBµV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
1000.00	-80.98	0.28	-70.00, -inf	17278.26	-0.06	0.12	+0.30, -0.40
1995.26	-80.57	0.31	-61.00, -inf	18836.49	-0.18	0.13	+0.30, -0.60
3981.07	-79.21	0.53	-42.00, -inf	20535.25	-0.31	0.13	+0.30, -1.30
7943.28	-74.35	0.16	-17.50, -inf	22387.21	-3.82	0.13	-2.00, -5.00
11220.18	-3.06	0.12	-2.00, -5.00	31622.78	-66.91	0.18	-17.50, -inf
12232.07	-0.14	0.12	+0.30, -1.30	63095.73	-90.84	1.85	-42.00, -inf
13335.21	0.07	0.12	+0.30, -0.60	125892.54	-89.28	1.68	-61.00, -inf
14537.84	0.03	0.12	+0.30, -0.40	251188.64	-82.04	7.11	-70.00, -inf
15848.93	-0.01	0.12	+0.30, -0.30				

Environmental conditions: 24.2 °C, 32.8 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

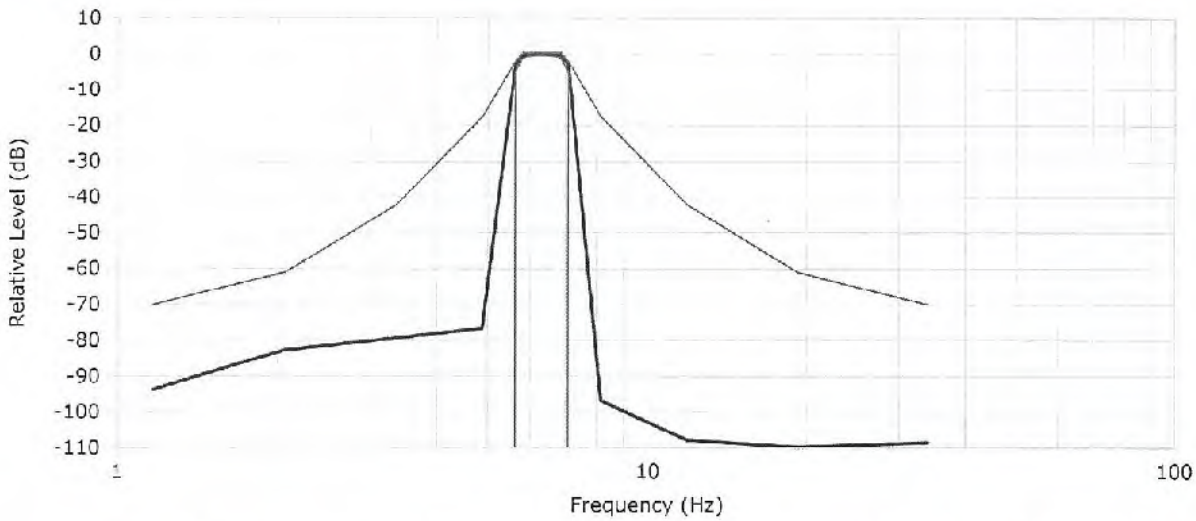
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
6.3Hz Third Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 6.3Hz filter response was then electrically tested using a 138.0dBµV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
1.17	-93.66	1.19	-70.00, -inf	6.48	-0.10	0.12	+0.30, -0.40
2.07	-82.66	0.66	-61.00, -inf	6.66	-0.09	0.12	+0.30, -0.60
3.35	-79.33	5.32	-42.00, -inf	6.86	-0.27	0.12	+0.30, -1.30
4.87	-76.71	0.12	-17.50, -inf	7.08	-2.93	0.12	-2.00, -5.00
5.62	-3.18	0.12	-2.00, -5.00	8.17	-96.78	0.18	-17.50, -inf
5.80	-0.53	0.12	+0.30, -1.30	11.87	-107.80	2.13	-42.00, -inf
5.98	-0.12	0.12	+0.30, -0.60	19.27	-109.86	2.08	-61.00, -inf
6.15	-0.12	0.12	+0.30, -0.40	34.02	-108.52	1.33	-70.00, -inf
6.31	-0.11	0.12	+0.30, -0.30				

Environmental conditions: 24.1 °C, 32.3 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

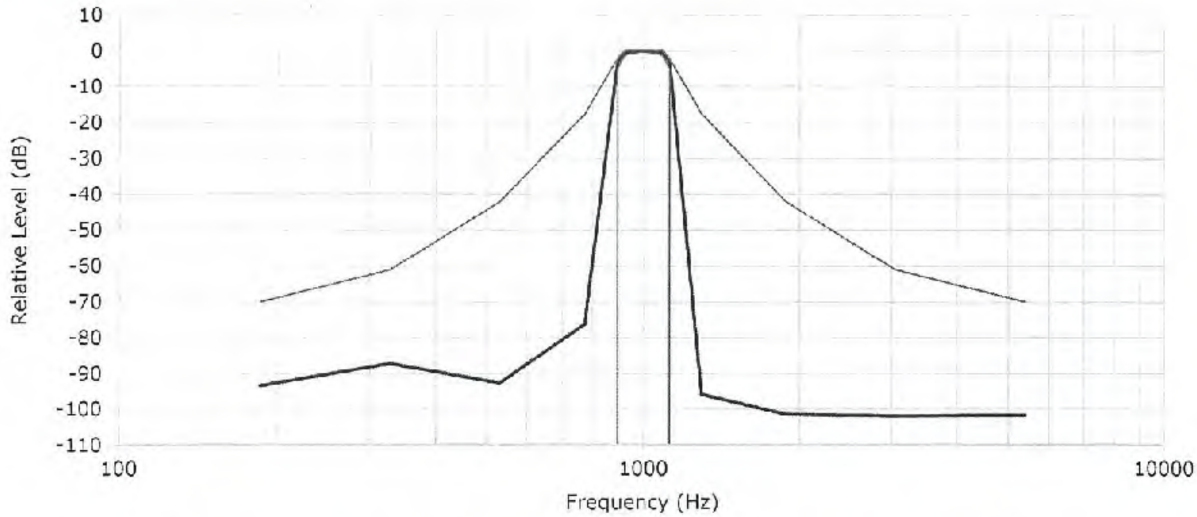
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
1000.0Hz Third Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 1000.0Hz filter response was then electrically tested using a 138.0dBµV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
185.46	-93.35	1.70	-70.00, -inf	1026.67	0.00	0.12	+0.30, -0.40
327.48	-87.21	1.04	-61.00, -inf	1055.75	-0.01	0.12	+0.30, -0.60
531.43	-92.60	1.82	-42.00, -inf	1087.46	-0.24	0.12	+0.30, -1.30
772.57	-76.20	0.13	-17.50, -inf	1122.02	-2.97	0.12	-2.00, -5.00
891.25	-3.01	0.12	-2.00, -5.00	1294.37	-95.87	0.38	-17.50, -inf
919.58	-0.41	0.12	+0.30, -1.30	1881.73	-101.38	0.61	-42.00, -inf
947.19	-0.01	0.12	+0.30, -0.60	3053.65	-101.84	0.62	-61.00, -inf
974.02	-0.04	0.12	+0.30, -0.40	5391.95	-101.65	0.66	-70.00, -inf
1000.00	-0.00	0.12	+0.30, -0.30				

Environmental conditions: 24.1 °C, 32.3 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

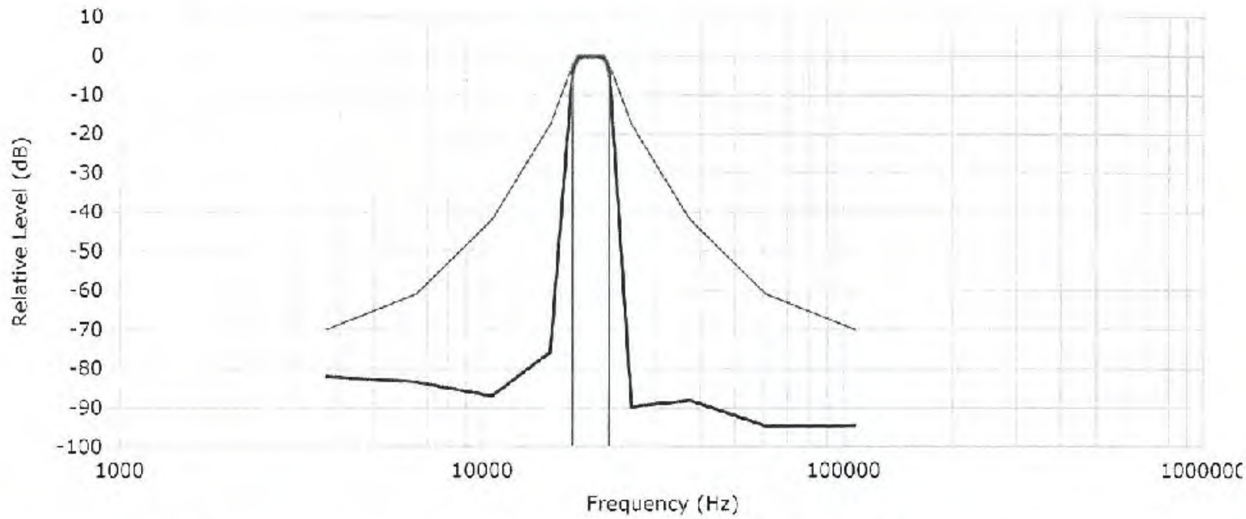
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
20000.0Hz Third Octave Filter Shape Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave. The instrument's 20000.0Hz filter response was then electrically tested using a 138.0dBµV sinewave at selected frequencies as specified in IEC 61260-2001. Instrument is in normal OBA range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)	Frequency (Hz)	Measured (dB)	Uncertainty (dB)	Limits (dB)
3700.45	-82.08	0.78	-70.00, -inf	20484.85	-0.10	0.13	+0.30, -0.40
6534.02	-83.35	0.88	-61.00, -inf	21065.07	-0.16	0.13	+0.30, -0.60
10603.35	-87.00	0.70	-42.00, -inf	21697.62	-0.47	0.13	+0.30, -1.30
15414.88	-75.72	0.13	-17.50, -inf	22387.21	-3.42	0.13	-2.00, -5.00
17782.79	-2.88	0.12	-2.00, -5.00	25826.16	-89.70	0.89	-17.50, -inf
18347.97	-0.35	0.13	+0.30, -1.30	37545.40	-88.10	0.82	-42.00, -inf
18898.93	0.03	0.13	+0.30, -0.60	60928.37	-94.62	1.78	-61.00, -inf
19434.23	-0.03	0.13	+0.30, -0.40	107583.52	-94.38	1.95	-70.00, -inf
19952.62	-0.08	0.13	+0.30, -0.30				

Environmental conditions: 24.1 °C, 32.3 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Test Procedure: 831 Cert OBA (ADP090).xml

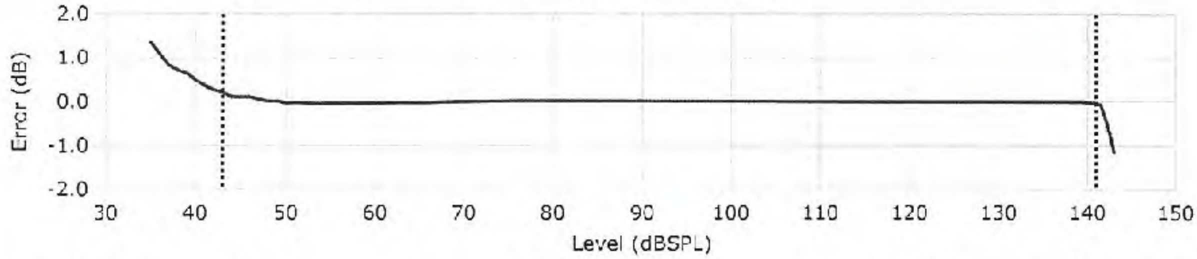
This filter is in compliance with IEC 61260-2001 Class 1 and ANSI S1.11-2004 Class 1.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202 1000.0Hz 1/1 Octave Log Linearity, Differential Linearity and Range Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1000.0Hz sine wave at a level of 117.5dBSPL. The instrument's 1/1 Octave, slow, Log Linearity response was then electrically tested using a 1000.0Hz sine wave with an equivalent voltage from 35.0dBSPL to 143.0dBSPL. Instrument is in normal OBA range. Instrument has 0dB gain.



Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)
35.0	**36.35**	**0.15**	**1.35**	47.0	47.05	0.11	0.05	117.5	117.50	0.11	0.00
36.0	**37.09**	**0.15**	**1.09**	48.0	48.01	0.11	0.01	138.0	138.00	0.11	-0.00
37.0	**37.83**	**0.15**	**0.83**	49.0	49.01	0.11	0.01	138.5	138.50	0.11	-0.00
38.0	**38.73**	**0.15**	**0.73**	50.0	49.97	0.11	-0.03	139.0	139.00	0.11	-0.00
39.0	**39.66**	**0.15**	**0.66**	51.0	50.98	0.11	-0.02	139.5	139.50	0.11	-0.00
40.0	**40.50**	**0.15**	**0.50**	52.0	51.97	0.11	-0.03	140.0	139.98	0.11	-0.02
41.0	**41.37**	**0.15**	**0.37**	53.0	52.95	0.11	-0.05	140.5	140.48	0.11	-0.02
42.0	**42.28**	**0.11**	**0.28**	54.0	53.95	0.11	-0.05	**141.0**	**140.97**	**0.11**	**-0.03**
43.0	43.21	0.11	0.21	55.0	54.96	0.11	-0.04	**141.5**	**141.42**	**0.11**	**-0.08**
44.0	44.11	0.12	0.11	56.0	55.95	0.11	-0.05	**142.0**	**141.63**	**0.11**	**-0.37**
45.0	45.10	0.12	0.10	76.5	76.52	0.11	0.02	**142.5**	**141.77**	**0.11**	**-0.73**
46.0	46.11	0.11	0.11	97.0	97.01	0.11	0.01	**143.0**	**141.86**	**0.11**	**-1.14**

Overload occurs at 140.9dBSPL (Limit: 140.2dBSPL).
Linear operating range: 97.9dB (Limit: 95.0dB), 43.0dBSPL to 140.9dBSPL.
Dynamic range: 110.0dB (Limit: 107.0dB), 30.9dBSPL to 140.9dBSPL.

Environmental conditions: 24.0 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

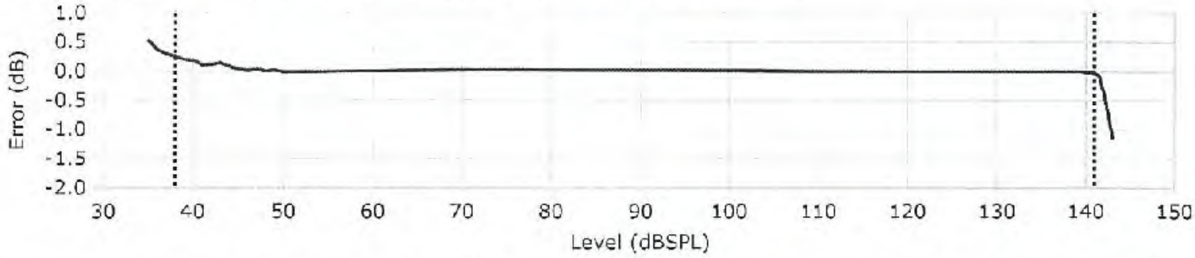
This log linearity is in compliance with IEC 61672-1:2002 5.5.5 and 5.6 Class 1, IEC 60651-2001 7.9 and 7.10, ANSI S1.4-1983 (R2006) 3.2 and IEC 60804-2000 9.2.1 for Class 1 sound level meters when used with a Larson Davis Class 1 microphone.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202 1000.0Hz 1/3 Octave Log Linearity, Differential Linearity and Range Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1000.0Hz sine wave at a level of 116.0dBSPL. The instrument's 1/3 Octave, slow, Log Linearity response was then electrically tested using a 1000.0Hz sine wave with an equivalent voltage from 35.0dBSPL to 143.0dBSPL. Instrument is in normal OBA range. Instrument has 0dB gain.



Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Level (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)
35.0	**35.53**	**0.15**	**0.53**	45.0	45.03	0.12	0.03	138.5	138.50	0.11	-0.00
36.0	**36.36**	**0.15**	**0.36**	46.0	46.01	0.11	0.01	139.0	139.00	0.11	-0.00
37.0	**37.29**	**0.15**	**0.29**	47.0	47.03	0.11	0.03	139.5	139.50	0.11	-0.00
38.0	38.25	0.15	0.25	48.0	48.00	0.11	0.00	140.0	139.99	0.11	-0.01
39.0	39.20	0.15	0.20	49.0	49.02	0.11	0.02	140.5	140.48	0.11	-0.02
40.0	40.19	0.15	0.19	50.0	49.99	0.11	-0.01	**141.0**	**140.97**	**0.11**	**-0.03**
41.0	41.10	0.15	0.10	72.0	72.02	0.11	0.02	**141.5**	**141.42**	**0.11**	**-0.08**
42.0	42.12	0.1[illegible]	0.12	94.0	94.02	0.11	0.02	**142.0**	**141.63**	**0.11**	**-0.37**
43.0	43.14	0.1[illegible]	0.14	116.0	116.00	0.11	0.00	**142.5**	**141.78**	**0.11**	**-0.72**
44.0	44.08	0.12	0.08	138.0	138.00	0.11	0.00	**143.0**	**141.86**	**0.11**	**-1.14**

Overload occurs at 140.9dBSPL (Limit: 140.2dBSPL).
Linear operating range: 102.9dB (Limit: 97.0dB), 38.0dBSPL to 140.9dBSPL.
Dynamic range: 114.7dB (Limit: 111.0dB), 26.2dBSPL to 140.9dBSPL.

Environmental conditions: 24.1 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 μPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

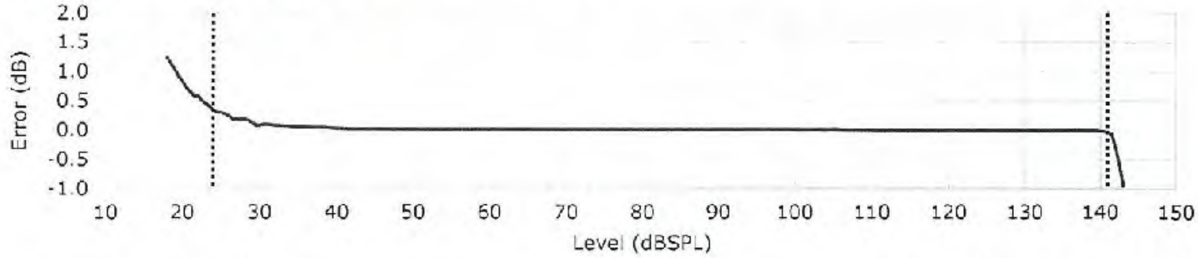
This log linearity is in compliance with IEC 61672-1:2002 5.5.5 and 5.6 Class 1, IEC 60651-2001 7.9 and 7.10, ANSI S1.4-1983 (R2006) 3.2 and IEC 60804-2000 9.2.1 for Class 1 sound level meters when used with a Larson Davis Class 1 microphone.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
1000.0Hz Broadband Log Linearity, Differential Linearity and Range Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1000.0Hz sine wave at a level of 112.0dBSPL. The instrument's A-Weighted, slow, Log Linearity response was then electrically tested using a 1000.0Hz sine wave with an equivalent voltage from 18.0dBSPL to 143.0dBSPL. Instrument has 0dB gain.



Theor. (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Theor. (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)	Theor. (dBSPL)	Meas. (dBSPL)	Uncert. (dB)	Error (dB)
18.0	**19.24**	**0.27**	**1.24**	26.5	26.69	0.16	0.19	92.0	92.01	0.11	0.01
18.5	**19.63**	**0.27**	**1.13**	27.0	27.20	0.16	0.20	102.0	102.01	0.11	0.01
19.0	**20.04**	**0.27**	**1.04**	27.5	27.69	0.16	0.19	112.0	112.00	0.11	0.00
19.5	**20.41**	**0.26**	**0.91**	28.0	28.19	0.16	0.19	122.0	122.00	0.11	-0.00
20.0	**20.83**	**0.26**	**0.83**	28.5	28.66	0.16	0.16	132.0	132.00	0.11	-0.00
20.5	**21.23**	**0.26**	**0.73**	29.0	29.12	0.16	0.12	138.0	138.00	0.11	-0.00
21.0	**21.65**	**0.26**	**0.65**	29.5	29.58	0.15	0.08	138.5	138.50	0.11	-0.00
21.5	**22.08**	**0.26**	**0.58**	30.0	30.08	0.15	0.08	139.0	139.00	0.11	-0.00
22.0	**22.58**	**0.26**	**0.58**	30.5	30.60	0.15	0.10	139.5	139.50	0.11	-0.00
22.5	**23.00**	**0.26**	**0.50**	31.0	31.10	0.15	0.10	140.0	139.99	0.11	-0.01
23.0	**23.45**	**0.26**	**0.45**	31.5	31.59	0.15	0.09	140.5	140.48	0.11	-0.02
23.5	**23.90**	**0.26**	**0.40**	32.0	32.08	0.15	0.08	**141.0**	**140.97**	**0.11**	**-0.03**
24.0	24.34	0.26	0.34	42.0	42.02	0.11	0.02	**141.5**	**141.43**	**0.11**	**-0.07**
24.5	24.80	0.26	0.30	52.0	52.02	0.11	0.02	**142.0**	**141.70**	**0.11**	**-0.30**
25.0	25.30	0.26	0.30	62.0	62.02	0.11	0.02	**142.5**	**141.91**	**0.11**	**-0.59**
25.5	25.78	0.16	0.28	72.0	72.02	0.11	0.02	**143.0**	**142.05**	**0.11**	**-0.95**
26.0	26.25	0.16	0.25	82.0	82.02	0.12	0.02				

Overload occurs at 140.9dBSPL (Limit: 140.2dBSPL).
Primary indicator range: 116.9dB (Limit: 115.0dB), 24.0dBSPL to 140.9dBSPL.
Dynamic range: 127.8dB (Limit: 126.0dB), 13.1dBSPL to 140.9dBSPL.
Noise Floors: A-Wt 13.1dBSPL (Limit: 15.0dBSPL), C-Wt 14.7dBSPL (Limit: 17.3dBSPL), Z-Wt 22.3dBSPL (Limit: 24.5dBSPL)

Environmental conditions: 23.8 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This log linearity is in compliance with IEC 61672-1:2002 5.5.5 and 5.6 Class 1, IEC 60651-2001 7.9 and 7.10, ANSI S1.4-1983 (R2006) 3.2 and IEC 60804-2000 9.2.1 for Class 1 sound level meters when used with a Larson Davis Class 1 microphone.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Crest Factor Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted response to specific crest factors was then electrically tested. Instrument has 0dB gain.

******* 200µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below upper limit of 140.9dBSPL *******

Crest Factor	Test Level (dBSPL)	Pulse OFF Time (ms)	Positive Pulse Error (dB)	Negative Pulse Error (dB)	Limits (dB)	Uncertainty (dB)
3	138.9	1.6	OVLD	OVLD	±0.7	0.15
5	138.9	4.8	OVLD	OVLD	±1.2	0.15
10	138.9	19.8	OVLD	OVLD	±1.7	0.15
3	128.9	1.6	0.10	0.08	±0.7	0.15
5	128.9	4.8	-0.15	-0.16	±1.2	0.15
10	128.9	19.8	OVLD	OVLD	±1.7	0.15
3	118.9	1.6	0.11	0.09	±0.7	0.15
5	118.9	4.8	-0.11	-0.14	±1.2	0.15
10	118.9	19.8	-0.33	-0.32	±1.7	0.15
3	108.9	1.6	0.13	0.11	±0.7	0.15
5	108.9	4.8	-0.12	-0.15	±1.2	0.15
10	108.9	19.8	-0.32	-0.32	±1.7	0.15

Environmental conditions: 23.9 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This crest factor response is in compliance with IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Burst Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted response to specific bursts was then electrically tested. Instrument has 0dB gain.

***** 2kHz tone burst (rep rate 40Hz) at 2.0, 12.0, 22.0, 32.0 dB below upper limit of 140.9dBSPL *****

Crest Factor	Test Level (dBSPL)	Burst ON Time (ms)	Burst OFF Time (ms)	Error (db)	Limits (dB)	Uncertainty (dB)
3	138.9	5.5	19.5	OVLD	±0.7	0.12
5	138.9	2.0	23.0	OVLD	±1.2	0.12
3	128.9	5.5	19.5	-0.06	±0.7	0.12
5	128.9	2.0	23.0	-0.05	±1.2	0.12
3	118.9	5.5	19.5	-0.06	±0.7	0.12
5	118.9	2.0	23.0	-0.04	±1.2	0.12
3	108.9	5.5	19.5	-0.09	±0.7	0.12
5	108.9	2.0	23.0	-0.04	±1.2	0.12

Environmental conditions: 24.0 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This burst response is in compliance with IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Gain Stage Test Report

A 1kHz sine wave was fed into the Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter). For the normal range, the reading is compared to the input level of 94.0dBμV. At the low range the input signal is dropped 30dB and compared to the normal range reading. For the 20dB gain the unit is the normal range and the input signal is dropped 20dB and compared to the 0dB reading. Error shown is the difference between the output level read and the expected level.

Range	Error (dB)	Limits (dB)	Uncertainty (dB)
Normal	-0.382	±0.80	0.02
Low	-0.003	±0.10	0.02
20dB Gain	-0.002	±0.10	0.02

Environmental conditions: 23.8 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level ($k = 2$).
Test Procedure: 831 Cert OBA (ADP090).xml

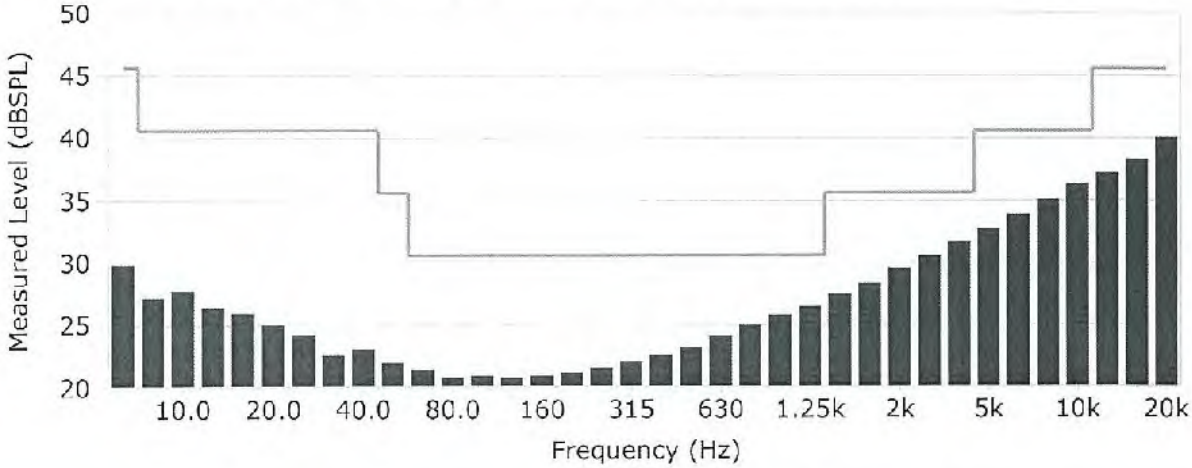
This gain result is in compliance with manufacturer established limits.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

1/3 Octave Noise Floor Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave at a level of 114.0dBµV. The instrument's 1/3 Octave Leq response was then electrically tested with the instrument set to normal range. Instrument has 0dB gain.



Frequency (Hz)	Measured (dBSPL)	Uncertainty (dB)	Limits (dBSPL)	Frequency (Hz)	Measured (dBSPL)	Uncertainty (dB)	Limits (dBSPL)
6.3	29.9	0.6	45.6	400.0	22.6	0.4	30.6
8.0	27.2	1.9	40.6	500.0	23.2	0.2	30.6
10.0	27.8	1.2	40.6	630.0	24.1	0.3	30.6
12.5	26.4	0.9	40.6	800.0	25.0	0.3	30.6
16.0	26.0	1.3	40.6	1000.0	25.8	0.3	30.6
20.0	25.0	0.7	40.6	1250.0	26.5	0.2	30.6
25.0	24.2	0.8	40.6	1600.0	27.5	0.2	35.6
31.5	22.6	0.7	40.6	2000.0	28.3	0.1	35.6
40.0	23.1	0.7	40.6	2500.0	29.5	0.2	35.6
50.0	22.0	0.6	35.6	3150.0	30.6	0.1	35.6
63.0	21.4	0.6	30.6	4000.0	31.7	0.2	35.6
80.0	20.8	0.4	30.6	5000.0	32.7	0.1	40.6
100.0	20.9	0.5	30.6	6300.0	33.9	0.1	40.6
125.0	20.8	0.4	30.6	8000.0	35.1	0.1	40.6
160.0	20.9	0.3	30.6	10000.0	36.3	0.4	40.6
200.0	21.2	0.4	30.6	12500.0	37.2	0.2	45.6
250.0	21.6	0.3	30.6	16000.0	38.3	0.1	45.6
315.0	22.1	0.3	30.6	20000.0	40.1	0.1	45.6

Environmental conditions: 24.1 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainties are given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml
This noise floor is in compliance with factory specification for the item tested.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
1/3 Octave Total Harmonic Distortion Test Report

A sine wave was fed into the Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter). Instrument is in normal OBA range. Instrument has 0dB gain.

Input Amplitude (dB re 20 µPa)	Frequency (Hz)	THD (%)	THD Limit (%)	THD+N (%)	THD+N Limit (%)	Uncertainty (%)
137.0	10.0	0.003	0.150	0.011	0.180	0.001

Environmental conditions: 23.8 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dB re 20 µPa assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml
This distortion is in compliance with manufacturers specification for the item tested.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Fast Detector Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 4kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted Detector Burst response was then electrically tested. Instrument has 0dB gain.

***** Fast detector tests at 3.0, 13.0, 23.0, 33.0 dB below upper limit of 140.9dBSPL *****

Test Level (dBSPL)	Burst Duration (ms)	Error (dB)	Limits (dB)	Uncertainty (dB)	Test Level (dBSPL)	Burst Duration (ms)	Error (dB)	Limits (dB)	Uncertainty (dB)
137.9	1000	-0.03	-0.8, 0.8	0.29	127.9	1000	-0.04	-0.8, 0.8	0.29
137.9	500	-0.04	-0.8, 0.8	0.29	127.9	500	-0.05	-0.8, 0.8	0.29
137.9	200	-0.13	-0.8, 0.8	0.29	127.9	200	-0.07	-0.8, 0.8	0.29
137.9	100	-0.18	-1.3, 1.3	0.29	127.9	100	-0.16	-1.3, 1.3	0.29
137.9	50	-0.19	-1.3, 1.3	0.29	127.9	50	-0.29	-1.3, 1.3	0.29
137.9	20	-0.14	-1.3, 1.3	0.29	127.9	20	-0.28	-1.3, 1.3	0.29
137.9	10	-0.30	-1.3, 1.3	0.29	127.9	10	-0.20	-1.3, 1.3	0.29
137.9	5	-0.14	-1.3, 1.3	0.29	127.9	5	-0.26	-1.3, 1.3	0.29
137.9	2	-0.17	-1.8, 1.3	0.29	127.9	2	-0.14	-1.8, 1.3	0.29
137.9	1	-0.17	-2.3, 1.3	0.29	127.9	1	-0.18	-2.3, 1.3	0.29
137.9	0.5	-0.47	-2.8, 1.3	0.29	127.9	0.5	-0.39	-2.8, 1.3	0.29
137.9	0.25	-0.41	-3.3, 1.3	0.29	127.9	0.25	-0.50	-3.3, 1.3	0.29
117.9	1000	-0.06	-0.8, 0.8	0.29	107.9	1000	-0.04	-0.8, 0.8	0.29
117.9	500	-0.07	-0.8, 0.8	0.29	107.9	500	-0.06	-0.8, 0.8	0.29
117.9	200	-0.12	-0.8, 0.8	0.29	107.9	200	-0.11	-0.8, 0.8	0.29
117.9	100	-0.24	-1.3, 1.3	0.29	107.9	100	-0.16	-1.3, 1.3	0.29
117.9	50	-0.15	-1.3, 1.3	0.29	107.9	50	-0.25	-1.3, 1.3	0.29
117.9	20	-0.23	-1.3, 1.3	0.29	107.9	20	-0.24	-1.3, 1.3	0.29
117.9	10	-0.19	-1.3, 1.3	0.29	107.9	10	-0.23	-1.3, 1.3	0.29
117.9	5	-0.33	-1.3, 1.3	0.29	107.9	5	-0.13	-1.3, 1.3	0.29
117.9	2	-0.36	-1.8, 1.3	0.29	107.9	2	-0.31	-1.8, 1.3	0.29
117.9	1	-0.37	-2.3, 1.3	0.29	107.9	1	-0.30	-2.3, 1.3	0.29
117.9	0.5	-0.31	-2.8, 1.3	0.29	107.9	0.5	-0.22	-2.8, 1.3	0.29
117.9	0.25	-0.52	-3.3, 1.3	0.29	107.9	0.25	-0.25	-3.3, 1.3	0.29

Environmental conditions: 24.0 °C, 32.7 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This detector is in compliance with IEC 61672-1:2002 5.8, IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Slow Detector Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 4kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted Detector Burst response was then electrically tested. Instrument has 0dB gain.

***** Slow detector tests at 3.0, 13.0, 23.0, 33.0 dB below upper limit of 140.9dBSPL *****

Test Level (dBSPL)	Burst Duration (ms)	Error (dB)	Limits (dB)	Uncertainty (dB)	Test Level (dBSPL)	Burst Duration (ms)	Error (dB)	Limits (dB)	Uncertainty (dB)
137.9	1000	-0.09	-0.8, 0.8	0.13	127.9	1000	-0.14	-0.8, 0.8	0.13
137.9	500	-0.13	-0.8, 0.8	0.13	127.9	500	-0.17	-0.8, 0.8	0.13
137.9	200	-0.15	-0.8, 0.8	0.13	127.9	200	-0.18	-0.8, 0.8	0.13
137.9	100	-0.13	-1.3, 1.3	0.13	127.9	100	-0.17	-1.3, 1.3	0.13
137.9	50	-0.14	-1.3, 1.3	0.13	127.9	50	-0.18	-1.3, 1.3	0.13
137.9	20	-0.15	-1.8, 1.3	0.13	127.9	20	-0.18	-1.8, 1.3	0.13
137.9	10	-0.16	-2.3, 1.3	0.13	127.9	10	-0.18	-2.3, 1.3	0.13
137.9	5	-0.17	-2.8, 1.3	0.13	127.9	5	-0.20	-2.8, 1.3	0.13
137.9	2	-0.16	-3.3, 1.3	0.13	127.9	2	-0.20	-3.3, 1.3	0.13
117.9	1000	-0.12	-0.8, 0.8	0.13	107.9	1000	-0.14	-0.8, 0.8	0.13
117.9	500	-0.13	-0.8, 0.8	0.13	107.9	500	-0.16	-0.8, 0.8	0.13
117.9	200	-0.18	-0.8, 0.8	0.13	107.9	200	-0.17	-0.8, 0.8	0.13
117.9	100	-0.19	-1.3, 1.3	0.13	107.9	100	-0.18	-1.3, 1.3	0.13
117.9	50	-0.16	-1.3, 1.3	0.13	107.9	50	-0.17	-1.3, 1.3	0.13
117.9	20	-0.17	-1.8, 1.3	0.13	107.9	20	-0.16	-1.8, 1.3	0.13
117.9	10	-0.18	-2.3, 1.3	0.13	107.9	10	-0.19	-2.3, 1.3	0.13
117.9	5	-0.17	-2.8, 1.3	0.13	107.9	5	-0.18	-2.8, 1.3	0.13
117.9	2	-0.20	-3.3, 1.3	0.13	107.9	2	-0.21	-3.3, 1.3	0.13

Environmental conditions: 23.9 °C, 32.5 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This detector is in compliance with IEC 61672-1:2002 5.8, IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris

Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Impulse Detector Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was referenced to a 2kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted Detector Burst response was then electrically tested. Instrument has 0dB gain.

***** Impulse detector tests at 4.0, 14.0, 24.0, 34.0 dB below upper limit of 143.9dBSPL *****
Single Burst Tests

Test Level (dBSPL)	Burst Duration (ms)	Error (dB)	Limits (dB)	Uncertainty (dB)
139.9	20.0	-0.03	±1.8	0.25
139.9	5.0	-0.09	±2.3	0.25
139.9	2.0	-0.02	±2.3	0.25
129.9	20.0	-0.07	±1.8	0.25
129.9	5.0	-0.04	±2.3	0.25
129.9	2.0	-0.02	±2.3	0.25
119.9	20.0	-0.02	±1.8	0.25
119.9	5.0	-0.07	±2.3	0.25
119.9	2.0	-0.26	±2.3	0.25
109.9	20.0	0.00	±1.8	0.25
109.9	5.0	-0.24	±2.3	0.25
109.9	2.0	-0.02	±2.3	0.25

***** Impulse detector tests at 4.0, 14.0, 24.0, 34.0 dB below upper limit of 143.9dBSPL *****
Repetitive Burst Tests

Test Level (dBSPL)	Repeat Frequency (Hz)	Error (dB)	Limits (dB)	Uncertainty (dB)
139.9	100.0	-0.16	±1.3	0.25
139.9	20.0	-0.24	±2.3	0.25
139.9	2.0	-0.14	±2.3	0.25
129.9	100.0	-0.07	±1.3	0.25
129.9	20.0	-0.24	±2.3	0.25
129.9	2.0	-0.08	±2.3	0.25
119.9	100.0	-0.14	±1.3	0.25
119.9	20.0	-0.06	±2.3	0.25
119.9	2.0	-0.17	±2.3	0.25
109.9	100.0	-0.07	±1.3	0.25
109.9	20.0	-0.09	±2.3	0.25
109.9	2.0	-0.18	±2.3	0.25

Environmental conditions: 24.1 °C, 32.8 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This impulse detector is in compliance with IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was subjected to the following peak detector tests:

Z-Weight Tests

The instrument's Peak Detector response was electrically tested with reference to a 10ms pulse.
***** Peak detector tests at 4.0, 14.0, 24.0, 34.0 dB below upper limit of 140.9dBSPL *****

Test Level (dBSPL)	Duration (ms)	Positive Pulse (dB)	Negative Pulse (dB)	Limits (dB)	Uncertainty (dB)
136.9	0.1	0.20	0.32	±2.2	0.31
126.9	0.1	-0.02	0.25	±2.2	0.31
116.9	0.1	0.31	0.08	±2.2	0.31
106.9	0.1	0.14	0.33	±2.2	0.31

C-Weight one-cycle Tests

The instrument's Peak Detector response was electrically tested with reference to a continuous sine wave.
***** Peak detector tests at 4.0, 14.0, 24.0, 34.0 dB below upper limit of 140.9 dBSPL *****

Test Level (dBSPL)	Frequency (Hz)	Error (dB)	Limits (dB)	Uncertainty (dB)
136.9	31.5	0.69	±2.4	0.22
136.9	500.0	0.07	±1.4	0.22
136.9	8000.0	-0.68	±2.4	0.22
126.9	31.5	0.69	±2.4	0.22
126.9	500.0	0.01	±1.4	0.22
126.9	8000.0	-0.66	±2.4	0.22
116.9	31.5	0.69	±2.4	0.22
116.9	500.0	0.07	±1.4	0.22
116.9	8000.0	-0.70	±2.4	0.22
106.9	31.5	0.69	±2.4	0.22
106.9	500.0	0.06	±1.4	0.22
106.9	8000.0	-0.73	±2.4	0.22

Environmental conditions: 24.2 °C, 32.5 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 µPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This peak detector is in compliance with IEC 61672-1:2002 5.12, IEC 60651-2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2.

Technician: Ron Harris   Test Date: 10 Jun 2013 07:33:26

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

Sound Level Meter Model: 831 Serial Number: 0001350 Firmware: 2.202
Peak Rise Time Test Report

This Sound Level Meter (including attached PRM831 preamplifier and ADP090 12 pF input adapter) was calibrated with a reference 1kHz sine wave using a voltage equivalent to 114.0dBSPL. The instrument's Flat-weighted response to pulse widths was then electrically tested to a 10ms pulse. Instrument has 0dB gain.

Test Level (dBSPL)	Pulse Width (μs)	Positive Pulse Error (dB)	Negative Pulse Error (dB)	Limits (dB)	Uncertainty (dB)
137.0	40.0	-0.55	-0.55	-2.2	0.2
137.0	30.0	-1.48	-1.51	-2.2	0.2

Environmental conditions: 24.2 °C, 32.6 %RH (0.3 °C, 3 %RH uncertainty)
Uncertainty is given as expanded uncertainty at ~95 percent confidence level (k = 2).
Data reported in dBSPL (dB re 20 μPa) assumes a microphone sensitivity of 50 mV/Pa.
Test Procedure: 831 Cert OBA (ADP090).xml

This peak detector is in compliance with IEC 60651 (2001-10) 9.4.4 and ANSI S1.4-1983 (R2006) 8.4.4.

Technician: Ron Harris Test Date: 10 Jun 2013 07:33:26

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

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Dear Larson Davis Customer,

Below you will find a check list for the following item(s) received on order: **283285**
Model / Serial Number(s): **831/0001350 PRM831/010875**
Please verify all certificates and data upon arrival as per the checked boxes below.
The following actions have taken place with your order:

FACTORY CERTIFICATION

- ☒ Certified and recalibrated the above listed item(s).
  - ☒ With a calibration cycle of 2yr
  - ☐ Without due date; recalibration period was not provided.
  - ☒ Test results included.
- ☒ Firmware upgraded to 2.202
  - ☒ New version of software CD included. ☒ Upgrade instructions included.
- ☐ Accessories (i.e. cables, adaptors, power supplies, etc.) were inspected:
- ☒ Settings were restored to same as upon arrival.
- ☐ Data was downloaded and saved as

SERVICE AND REPAIRS

- ☐ No faults were found with item(s).
  - ☐ No certification was issued.
  - ☐ Test results included.
- ☐ Repairs were performed.
  - ☐ No certification was issued.
  - ☐ Test results included.
- ☐ Neither repair nor certification occurred due to the following:
  - ☐ Larson Davis no longer supports repairs on item(s).
  - ☐ Item(s) damaged beyond reasonable means of repair.
  - ☐ Larson Davis did not manufacture the item(s) and we are unable to perform calibration, certification or repairs.
  - ☐ Repair costs exceed the price of a replacement.
- ☐ Damaged or unwanted item(s) disposed of at Larson Davis.
- ☐ Item(s) replaced with new product.
- ☐ Item(s) returned "AS IS".

We appreciate your business and would hope that in the future we will be able to continue to provide you with the service that you require.

Sincerely,
Larson Davis Service Team

R&D AND MANUFACTURING CENTER
1681 West 820 North, Provo, Utah 84601 USA
Phone: 801-375-0177 Fax: 801-375-8864

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