Dundonnell Wind Farm

Noise Compliance Testing

S5345.1C12

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sonus.

Chris Turnbull
Principal
Phone: +61 (0) 417 845 720
Email: ct@sonus.com.au
www.sonus.com.au

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Author	Alexander Lee, MAAS
Reviewer	Chris Turnbull, MAAS

Contents

1 INTRODUCTION

In accordance with Condition 14 of Planning Permit No. 2015/23858 (the Planning Permit) for the Dundonnell Wind Farm (the Wind Farm), a Noise Compliance Test Plan (NCTP) was prepared by Sonus (with Sonus reference S5345C4, dated March 2018) and endorsed by the Minister for Planning on 16 October 2018. The NCTP provides the procedure for the post-construction noise assessment in accordance with the Planning Permit.

The Wind Farm is required to comply with the noise performance requirements as set out in Condition 11 of the Planning Permit.

Sonus has been engaged by Vestas Australia Wind Technology P/L to conduct the first round of post-construction testing in accordance with the NCTP.

This report summarises the assessment of operational noise levels at four residences selected in accordance with the NCTP. The assessment includes analysis of noise monitoring at the residential locations, intermediate locations between the residences and Wind Farm and nearfield locations around nominated turbines. The assessment also includes an assessment of the special audible characteristics of tonality and amplitude modulation in accordance with the NCTP.

In accordance with the NCTP, the testing will be repeated 12 months after the first round of post-construction testing (within 14 months of commissioning)

2 NCTP TEST METHOD

The NCTP establishes a methodology to determine compliance in accordance with the Planning Permit Conditions and New Zealand Standard 6808:2010, *Acoustics – Wind Farm Noise* (the **Standard**). The NCTP provides four residential logging locations where noise levels from operation of the Wind Farm are to be measured. Where the Wind Farm is shown to be compliant with the noise criteria at the test locations, the Wind Farm is compliant with the Planning Permit Conditions in accordance with the NCTP. The following table provides the four locations.

Table 1: Testing Locations

No	Testing Location	Coordinates (WGS 84 Zone 54)		Alternate Test Location
		Easting	Northing	
1	18	680221	5807762	17
2	46 (PN)	673610	5803201	47 (PN)
3	52 (PN)	671547	5811153	51 (PL)
4	62	675853	5812054	21

(PL) Participating Landholder
(PN) Participating Neighbour

There was one residential logging location where access was not granted (H52) and the noise monitoring was therefore conducted at the alternate location (H51) with approximate coordinates 671667E, 5811042N.

Sonus conducted a pre-construction noise assessment of the Wind Farm that included determining the criteria which apply at residences in the vicinity of the Wind Farm. Table 2 is from the pre-construction noise assessment and summarises the criteria for the compliance monitoring locations.

Table 2: Criteria

Residential Logging Location	Criteria dB(A), at Integer Hub Height Wind Speed, m/s									
	3	4	5	6	7	8	9	10	11	12
H18	40	40	40	40	40	40	41	43	45	47
H46	40	40	40	40	40	40	41	43	44	46
H52 / H51	40	40	40	40	40	40	40	40	41	43
H62	40	40	40	40	40	40	41	40	43	44

In accordance with the NCTP, nearfield and intermediate testing was conducted for the purpose of determining the character of noise (tonality and amplitude modulation) from the turbines and enabling noise from other sources to be excluded from the data analysis. The testing was conducted at locations where the noise from other sources in the environment is minimised (in comparison to the noise level from wind turbines) and therefore the results can assist in determining compliance at the residential logging locations, when the noise from turbines is masked by other sources.

3 NEARFIELD AND INTERMEDIATE MEASUREMENTS

3.1 NEARFIELD MEASUREMENTS

Nearfield measurements were conducted at two representative turbines (H09 and G06) in general accordance with IEC61400-11 Edition 3.0 (2012) (**IEC61400-11**) from 13 to 15 July 2021. The results of the measurements in the nearfield have been analysed to determine:

- the apparent sound power level (in accordance with IEC61400-11);
- if any special audible characteristics were present as follows:
    - Tonality: the K_t adjustment and frequency of any tones in accordance with ISO1996.2;
    - Excessive amplitude modulation: in accordance with the NZS6808 Interim Test Method.

The apparent sound power levels provide an indication of the wind speed at which the highest noise is emitted from the turbines. If the noise at residential logging locations continues to increase at wind speeds above the wind speed of highest noise emission, it indicates that the noise is from sources other than the turbines (most commonly wind in trees) for high wind speed conditions.

Where the special audible characteristics of tonality or excessive amplitude modulation are identified in the nearfield measurements, there is the potential for the characteristic to be present at residential locations and a further assessment is required.

3.1.1 Data Collection

Noise measurements were made using Class 1 Rion NL-52, NATA calibrated, sound level meters equipped with a one-third octave band analyser. The sound level meters were calibrated before and after the measurements using a Class 1 Rion NC-74 calibrator (serial number 35094478), with negligible drift observed.

The measurements were taken in the proximity of two representative turbines, H09 and G06. The measurement locations are provided in Table 3 with the serial number of the sound level meters. The calibration certificates are provided in Appendix A.

Table 3: Nearfield Measurement Locations

Turbine	Sound Level Meter Serial Number	Coordinates		Slant Distance (m)	Downwind Direction (˚)
		Easting	Northing		
H09	00320653	671772	5803371	206	350
G06	00320647	670022	5805695	203	7

A secondary wind shield was used for each sound level meter and was positioned over the microphone on the measurement board. The following figure shows an example of a nearfield monitoring setup used.

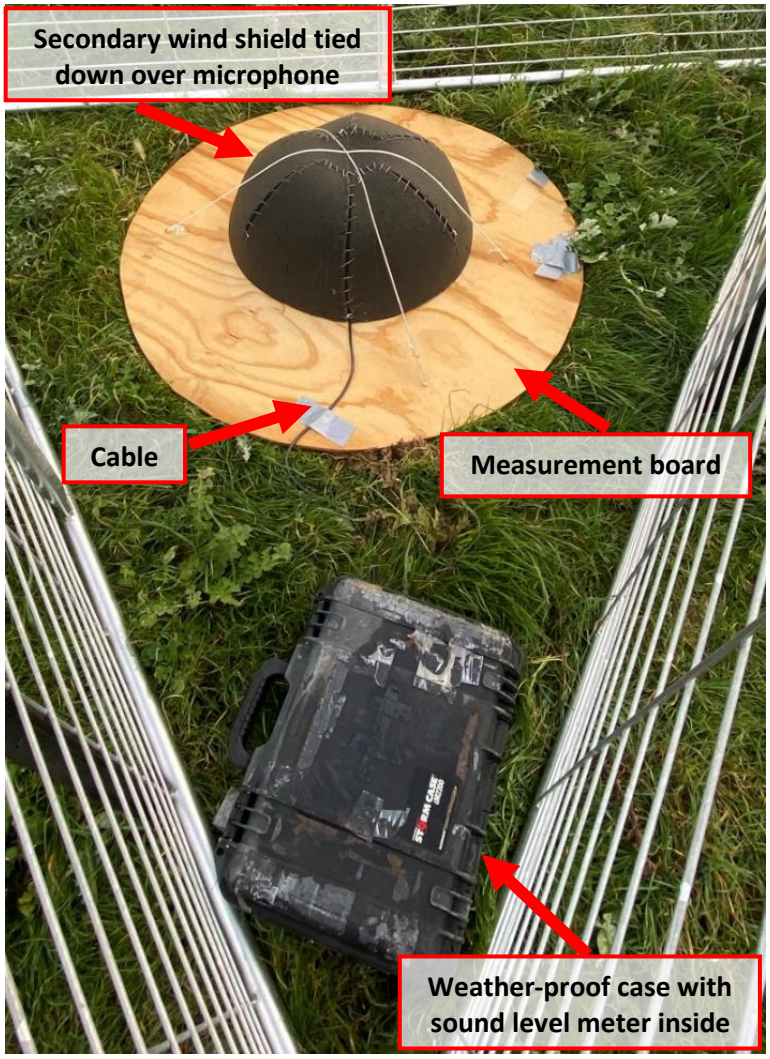

Figure 1: Example Nearfield Monitoring Set Up

The insertion loss of the secondary wind shield has been measured and is summarised in the following table.

Table 4: Secondary Wind Shield Insertion Loss

Frequency 1/3-octave band (Hz)	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Insertion loss (dB)	-0.2	-0.2	-0.2	-0.2	-0.2	-0.5	-0.3	-0.6	-0.2	-0.3
Frequency 1/3-octave band (Hz)	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**
Insertion loss (dB)	-0.3	0.1	0.3	1.2	2.0	2.7	1.9	0.9	1.1	2.1
Frequency 1/3-octave band (Hz)	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**		
Insertion loss (dB)	1.5	2.1	2.5	2.3	2.5	2.7	3.1	3.6		

3.1.2 Apparent Sound Power Level

The apparent sound power level at each integer wind speed has been derived using the general procedure outlined in Section 9 of the IEC 61400-11:2012. It is noted that the wind speed based on power output of the wind turbine was not available during the measurements and therefore the nacelle anemometer has been used for the analysis of hub height wind speed while operating[1]. At times when the turbine is paused to obtain background noise level measurements (in the absence of the test turbine noise level), the wind speed from the closest meteorological mast is used to remove the effect of the stationary blade on the nacelle anemometer measurements.

[1] It is noted that the use of anemometer wind speed instead of wind speed based on output power can result in inaccuracies at low wind speeds. The measurements of peak sound power level would not be affected.

3.1.2.1 Analysis Procedure

The steps taken to derive the apparent sound power level at each integer wind speed for turbines H09 and G06 are provided below:

1. Any data points which are outside of the downwind +/- 15 degrees range are excluded;
2. All measured equivalent sound pressure levels at each one-third octave band between 20 Hz to 10 kHz are normalised to the measured overall equivalent sound pressure level. The one-third octave band levels between 20Hz and 10kHz are logarithmically summed and its difference with the measured overall level is arithmetically added to each one-third octave band levels.
3. The one-third octave band equivalent sound pressure levels are corrected for the influence of the secondary wind shield. The secondary wind shield insertion losses provided in Table 4 are arithmetically added to the one-third octave band levels. The resultant overall sound pressure level is obtained by logarithmically summing the corrected one third octave sound pressure levels.
4. The one-third octave band equivalent sound pressure levels are sorted into wind speed bins, each ±0.25 m/s wide, centred at integer wind speeds. The turbine operational noise and background noise data are segregated into separate data sets.
5. The average one-third octave band equivalent sound pressure levels for each wind speed bin are determined logarithmically. The one-third octave band equivalent sound pressure levels at the bin centres are then calculated using linear interpolation between the bin average sound pressure level and wind speed values.
6. The background corrected wind turbine sound pressure levels are derived using the one-third octave band equivalent sound pressure levels (referenced to the bin centre) as follows:
    a. “turbine off” sound levels are logarithmically subtracted from the “turbine on” sound levels where the “turbine off” level is at least 3 dB(A) below the “turbine on” one-third octave band equivalent sound pressure level.
    b. In the case where the “turbine off” sound level is within 3 dB(A) of the one-third octave band “turbine on” sound pressure level, 3 dB(A) has been subtracted from the one-third octave band “turbine on” equivalent sound pressure level.
7. The background corrected wind turbine sound pressure levels at each one-third octave band are used to calculate the apparent sound power levels at each integer wind speed using Equation (26) in the IEC 61400-11:2012. The slant distance for each measurement location is presented in Table 3.
8. The overall apparent sound power level at each integer wind speed is determined by logarithmically summing the one-third octave band apparent sound power levels.

3.1.2.2 Analysis Results

The following graphs show the apparent sound power level for each of the test turbines at each integer wind speed after the data analysis.

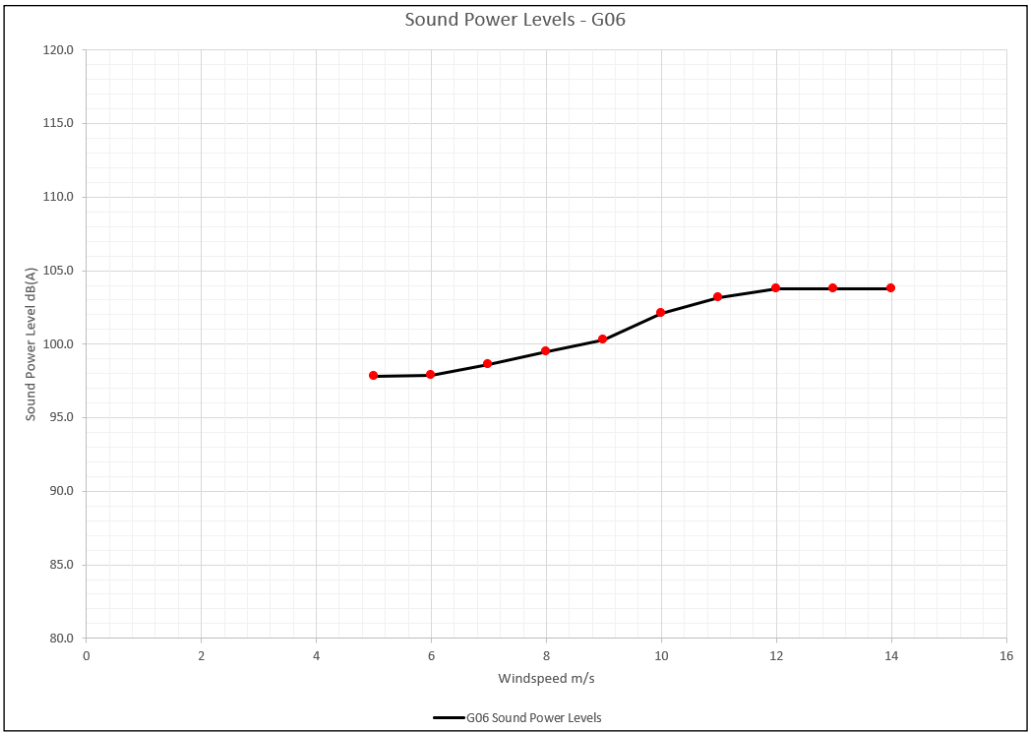

Figure 2: G06 Sound Power Levels

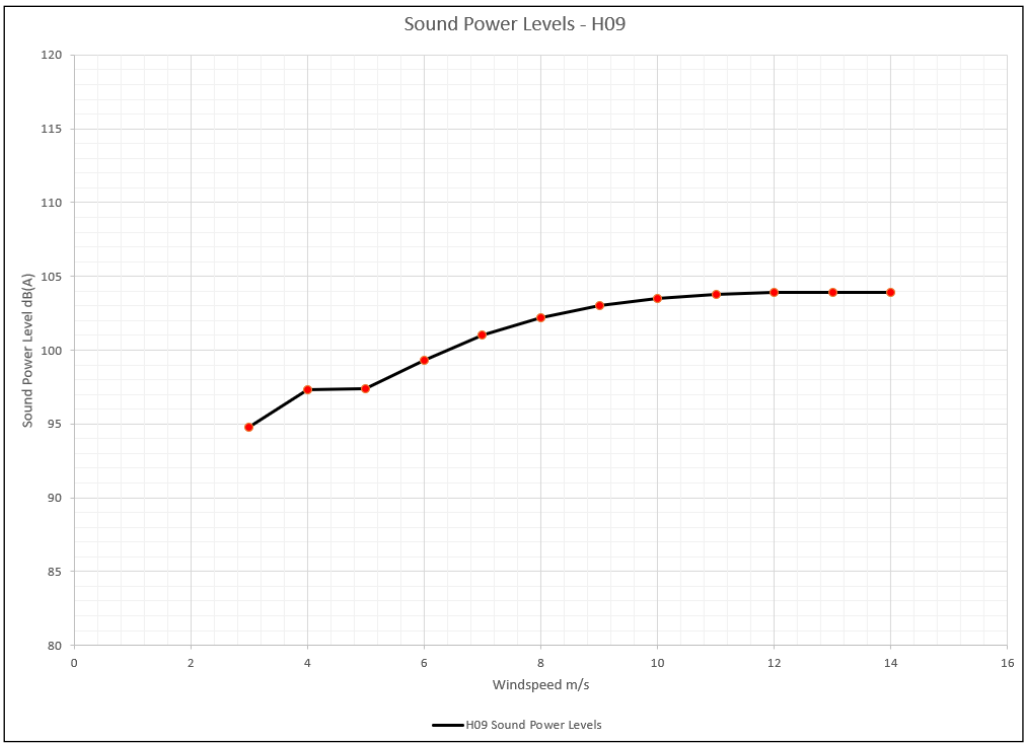

Figure 3: H09 Sound Power Levels

The results indicate that the noise level from the turbines does not increase any further for wind speeds above 12m/s. Based on the results, any increase in noise level at residential logging locations above that measured at 12m/s will be as a result of noise sources other than the Wind Farm. The assessment has therefore been restricted to wind speeds up to and including 12m/s.

3.1.3 Tonality

An assessment has been made of the special audible characteristic of tonality at the nearfield locations in accordance with Annex C of ISO1996.2 (2007), based on the data measured in general accordance with IEC61400-11.

The level of tonality for each integer wind speed has been determined based on the tonality for 2-minute periods at each integer wind speed. The 2-minute periods analysed were those where the average wind speed was close to each integer as practical. Where a 2-minute period was not found close to the integer wind speed, a 1-minute period has been used as a replacement. A total of 85 periods (40 for H09, 45 for G06) have been analysed for wind speeds ranging between 3m/s and 12m/s including each integer wind speed, as well as wind speeds between integers. Where the tonality adjustment K_t was greater than 0 dB for any of the assessed periods, an assessment was conducted at the residential logging locations. The nearfield tonality assessment identified the following periods where tones were present:

Table 5: Tonal Adjustments K_t

Location	Windspeed	Frequency	K_t
H09	3m/s	76.2Hz	3.86
	4m/s	76.2Hz	3.25
		76.2Hz	2.71
		76.2Hz	4.87
	5m/s	79.1Hz	4.49
G06	3m/s	96.7Hz	2.19
		82.0Hz	0.33
	4m/s	82.0Hz	1.09
		79.1Hz	2.05
	6m/s	102.5Hz	3.18
		87.9Hz	1.75

In accordance with the NCTP and based on the above, tonality has been considered at the residential logging locations for wind speeds of 3m/s, 4m/s, 5m/s and 6m/s. Although the tonality detected was only in the one-third octave bands with centre frequencies of 80Hz and 100Hz, the assessment at residences was conservatively extended to include the 63Hz and 125Hz one-third octave bands. The assessment is detailed in Section 4.

3.1.4 Amplitude Modulation

The NCTP references the "interim test method" provided in Section 3.2 of NZS6808:2010 to test for excessive amplitude modulation. Audio files from the two nearfield measurement locations have been used to determine if amplitude modulation was excessive, which is defined in the NCTP to occur when the measured A-weighted peak through trough levels exceed 5 dB(A) at the blade pass frequency on a regular basis.

Samples have been analysed for each integer wind speed and show amplitude modulation at approximately 1 Hz (the approximate blade pass frequency). Typical peak to trough values were in the order of 2 to 4 dB, which is below the 5 dB criterion. The following figure shows an example time series showing the amplitude modulation and further graphs of all wind speeds are shown in Appendix B.

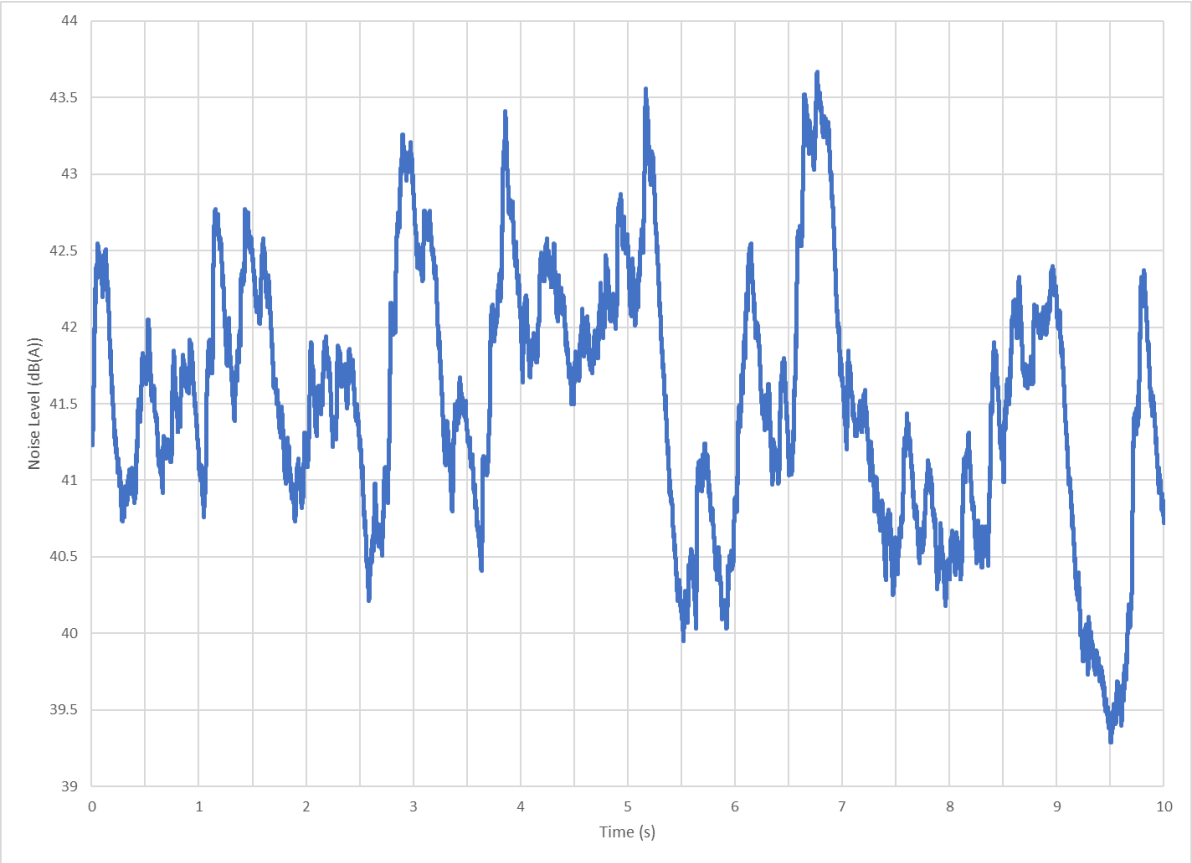

Figure 4: Amplitude modulation assessment example

Given that there is no indication of excessive amplitude modulation in the nearfield, the procedures outlined in the NCTP do not require further consideration at the residential logging locations and no adjustments or penalties are made to the measurements for the character of amplitude modulation.

3.2 INTERMEDIATE MEASUREMENTS

The NCTP recommends that the noise level from the Wind Farm be measured simultaneously at the residential logging locations as well as intermediate locations, which:

- are between the Wind Farm and residence being assessed; and,
- have a higher Wind Farm noise level to background noise level ratio (the noise level from the Wind Farm is more likely to be measurable above the level of background noise).

Data filtering may remove time periods where noise data collected at an intermediate position confirms that the source of the noise at a residential logging location is not the wind turbines. For example, noise data collected in a particular 10 minute interval at a residential logging location may be removed:

- if the noise measured in the same period at the intermediate position (closer to the turbines) is at a lower level; or
- if the frequency content of the noise at the receptor is not consistent with the frequency content at the Intermediate Position.

The locations of the intermediate measurements were a combination of residences associated with the Wind Farm (beneficiaries), which are between the residential logging locations and the Wind Farm, and two locations which were in paddocks between residence H18 and the closest turbine and residence H51 and the closest turbine.

The noise level was measured at the intermediate locations using a combination of Rion NL-52, NL-42 and NL-21 Class 1 and 2, NATA calibrated, sound level meters. The coordinates of the intermediate locations and the serial numbers of the sound level meters used are provided in the following table and the calibration certificates are attached in Appendix A.

Table 6: Intermediate Logging Locations

Intermediate Logging Location	***Coordinates***		***Sound Level Meter Serial Number***
	Easting	**Northing**	
H18 Intermediate	678542	5807808	01298933
H51 Intermediate	671682	5810935	00683866/01298933
H62 Intermediate (H49)	673610	5803201	00320649
H46 Intermediate (H2)	672687	5804696	00320657

An aerial photograph showing the residential logging locations, the turbine layout and the intermediate locations is provided below:

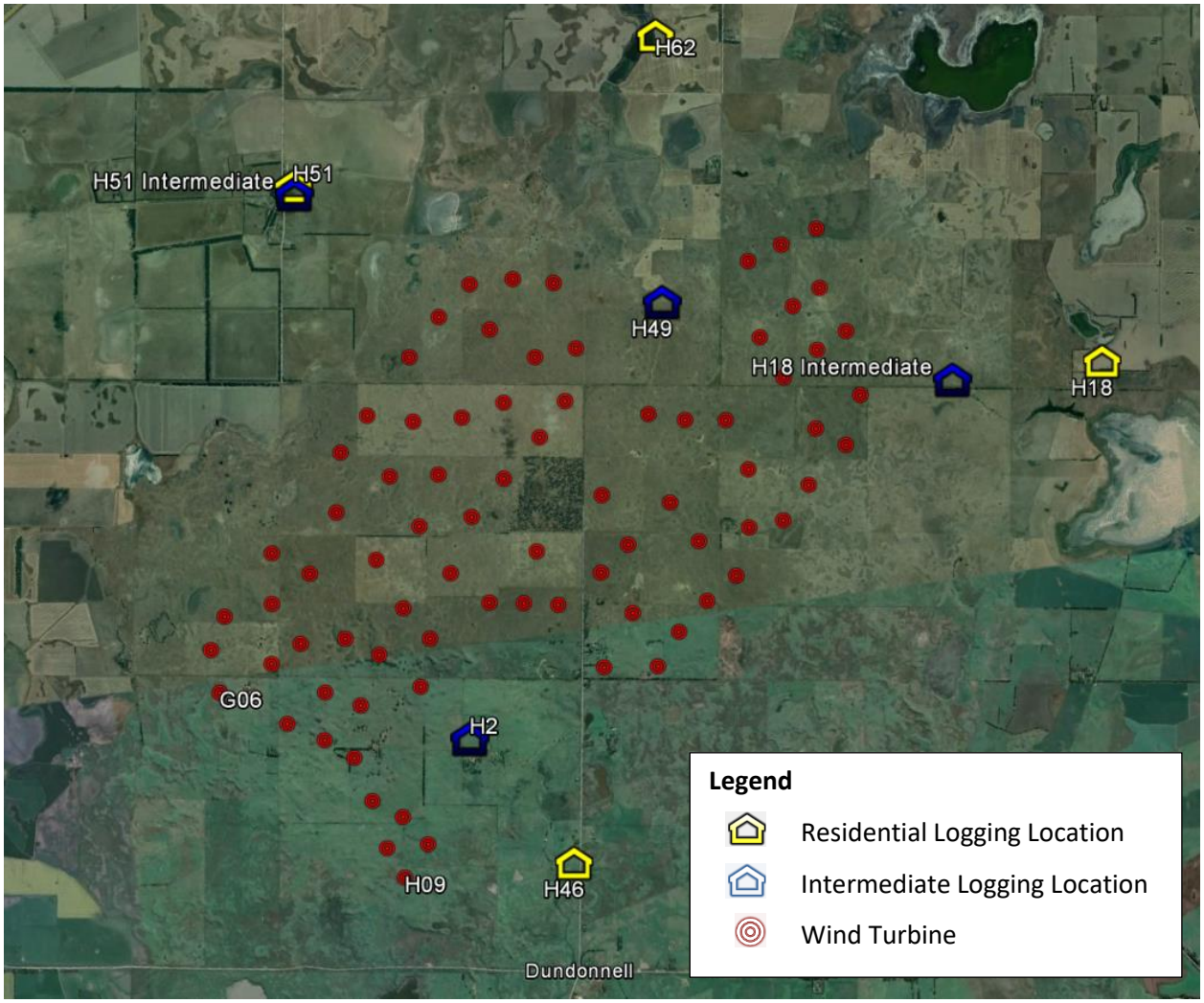

Figure 5: Aerial View of the Site

The use of the intermediate location measurements are discussed further in Section 4.

4 RESIDENTIAL LOGGING

The noise levels (L_{A90}) at each of the residential logging locations were measured continuously in 10 minute intervals over a number of periods between 14 July 2021 and 19 January 2022, which resulted in at least 6 weeks of data, not affected by operational constraints on the Wind Farm. It is noted that the extended measurement period was as a result of a shutdown period for the Wind Farm (approximately 2 weeks) as well as travel restrictions, which did not allow noise loggers to be downloaded or collected at all times.

At each of the residential logging locations, noise monitoring equipment was placed at the equivalent position to the background noise logging location prior to construction of the Wind Farm with the exception of:

- H51, where background noise levels have not been measured; and,
- H62, where the logger was placed approximately 15m further south to ensure line of sight to the closest turbines (not obstructed by buildings) and such that the location was on the Wind Farm side of the residence.

The position of noise loggers, in all instances, was on the Wind Farm side of the dwelling and at least 5m from the building facade, to remove the effects of large reflecting surfaces. A photograph of the noise logging equipment at each residential logging location is provided in Appendix C.

In addition to the noise logging, local wind speed logging was conducted at 3 locations (H2, H49 and H51), with rainfall data collected at 2 locations (H2 and H51). The rainfall data and the measured wind speed at the microphone height were used to identify periods when data might have been adversely affected by weather. For locations where the local weather logging equipment was not deployed, data from the closest weather logger has been used in the analysis.

At each of the monitoring locations, Rion NL-52 or NL-42, NATA calibrated, Class 1 or 2 sound level meters with a noise floor of less than 20 dB(A) were deployed. The serial numbers of the sound level meters are provided in the following table and the calibration certificates are in Appendix A.

Table 7: Sound Level Meter Serial Numbers

Residential Logging Location	***Sound Level Meter Serial Number***
H18	00220543
H46	00320652
H51	00598175
H62	01000229

The sound level meters were calibrated before and after the background noise monitoring regime with a Class 1 Rion NC-74 calibrator (with serial number 35094478) and the microphones were fitted with Rion WS-15 all-weather wind shields.

During the noise monitoring regime, wind speed and direction was monitored at three meteorological masts located around the Wind Farm (Operational Masts). The three locations have been used to provide a hub height (114m) data set, free of wake effects. The wind speed data were then referenced back to the two locations where masts were located during the pre-construction noise monitoring (Development Masts). This was conducted based on correlations between the wind masts when all masts were operating, prior to the operation of the Wind Farm and the process has been reviewed by DNV GL. The review is summarised in report "10359504-AUME-T-02". The locations of the meteorological masts are provided below:

Table 8: Mast Locations

Mast Location	Coordinates (WGS 84 Zone 54)	
	Easting	Northing
Development Mast 1 (Dev 1)	671503	5806243
Development Mast 2 (Dev 2)	673295	5808362
Operational Mast 1	672712	5808278
Operational Mast 2	669927	5806734
Operational Mast 3	672116	5803360

4.1 DATA ANALYSIS

The NCTP allows noise from other sources to be removed as follows:

- By filtering out time periods:
    - affected by rain, hail or wind based on a weather logger placed at an equivalent location to one of the noise loggers. Data is adversely affected where precipitation occurs in a 10 minute period or where a wind speed greater than 5 m/s is exceeded for 90% of a 10 minute period;
    - when sufficient WTGs have not been connected to the grid to influence the measured level during the current 10 minute period; and
    - considered abnormal, such as during local construction or maintenance activities.
- By filtering out time periods or frequency content where noise data collected at an Intermediate Position confirms that the source of the noise at a receptor is not the wind turbines.
- The subtraction of the background noise levels from the compliance noise measurements.

It is noted that:

- For a large wind farm, it is typical that at any time, one or more turbines may not be operating, for maintenance or other reasons. As this is a typical scenario, it is inevitable that during the noise monitoring regime, some turbines will not be operating. The operator has reviewed shutdown activity and turbine operation and considers that 90% active turbines represents typical operation. For an operating scenario with up to 10% of (randomly dispersed) turbines not operating, the overall noise level would be reduced by less than 0.5 dB(A) compared with all turbines operating. Overall noise levels therefore are unlikely to be affected by including points where up to 10% of turbines were inactive. Data periods were therefore filtered when less than 90% of the wind turbines were active.
- Local weather data was not recorded for some time periods during the noise monitoring campaign. During these periods, a conservative approach has been taken to not filter the data points for adverse weather and therefore some higher noise levels may have been included in the assessment where rain or high wind speeds occurred.
- Although the NCTP allows for additional data filtering based on the results at the intermediate location, this was not conducted. This is a conservative approach as noise from other sources is included in the measured noise levels.
- Although the NCTP notes that the background noise level will be subtracted from the residential logging results where intermediate data is not used, the subtraction was not conducted. This is a conservative approach as noise from other sources is included in the measured noise levels. That is, the Wind Farm noise level is less than the measured noise levels which have been used to demonstrate compliance with the noise criteria in this report.

Following removal, the remaining noise data were correlated with the hub height wind speed data for each testing location. The hub height wind speed used for the correlation was taken from the same Development Mast location as the pre-construction background noise assessments. The following table provides the number of valid data points following removal of adverse data and identifies the wind mast which has been used for the correlations at each testing location.

Table 9: Number of valid data pairs and relevant wind mast

Testing Location	Valid Data Points	Relevant Mast
H18	7210	Development Mast 2
H46	7097	Development Mast 1
H51^	6619	Development Mast 1
	6889	Development Mast 2
H62	7192	Development Mast 2

^ For completeness, both masts have been used where it is unclear which mast was used for pre-construction background noise monitoring.

A third order regression analysis was performed on the correlations to determine the noise levels to be compared with the criteria.

4.2 RESIDENTIAL LOGGING RESULTS

The correlation graphs with the regression curve and criteria are provided in Figure 6 to Figure 10 inclusive. The measured noise levels and criteria for each integer hub height wind speed from 3m/s to 12m/s have also been tabulated below. It is noted that the analysis is limited to an upper wind speed of 12m/s based on the nearfield measurements showing this as the wind speed where the highest sound power level was measured.

The results indicate that the measured noise levels are less than the project criteria at wind speeds from cut-in to 12m/s, without the filtering of data points based on the intermediate noise measurements and without subtracting the pre-construction background noise level. The Wind Farm is therefore compliant with the noise criteria subject to the assessment of special audible characteristics.

Table 10: Resultant Wind Farm Noise Levels (dB(A))

Testing Location	3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s	
	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion	Measured	Criterion
H18	31	40	32	40	33	40	34	40	35	40	36	40	38	41	39	43	41	45	43	47
H46	34	40	34	40	34	40	35	40	35	40	36	40	38	41	39	43	41	44	43	46
H51 Dev 1	34	40	34	40	34	40	34	40	35	40	35	40	36	40	37	40	38	41	38	43
H51 Dev 2	34	40	34	40	34	40	34	40	35	40	35	40	36	40	37	40	38	41	38	43
H62	33	40	33	40	34	40	34	40	35	40	35	40	36	41	37	40	39	43	41	44

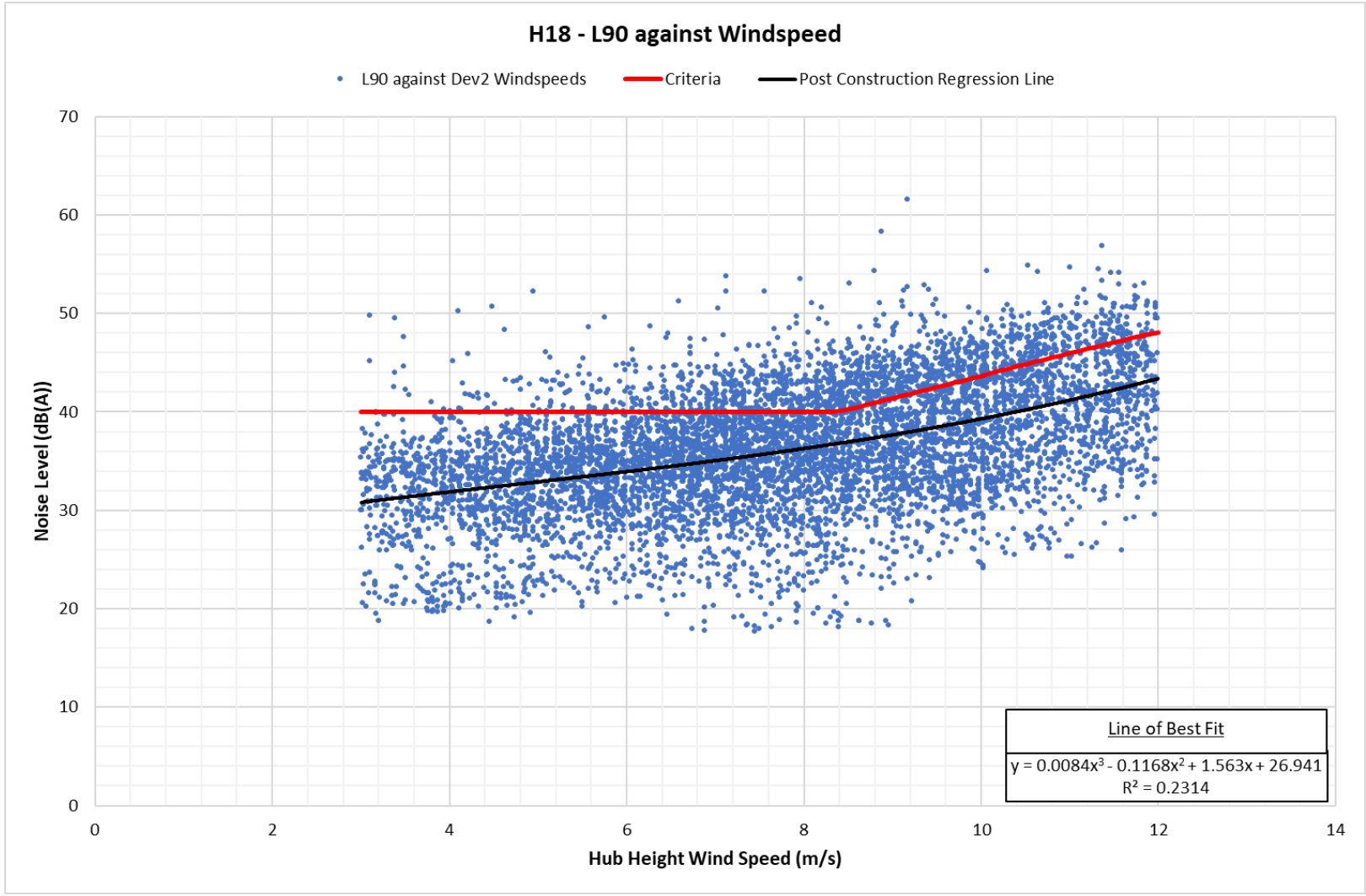

Figure 6: H18 - Filtered L90 Noise Level Correlations to Development Mast 2 Windspeeds

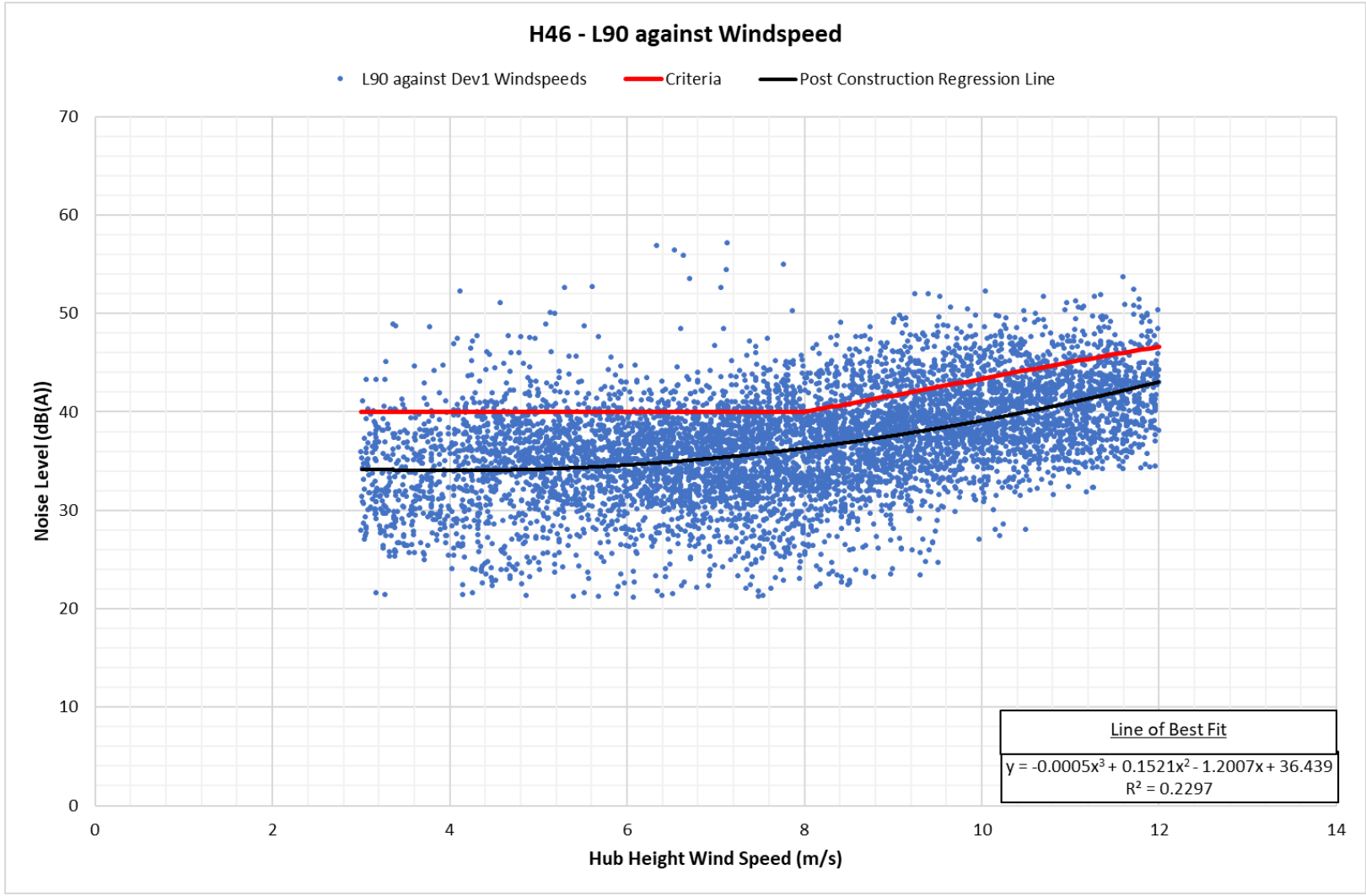

Figure 7: H46 - Filtered L90 Noise Level Correlations to Development Mast 1 Windspeeds

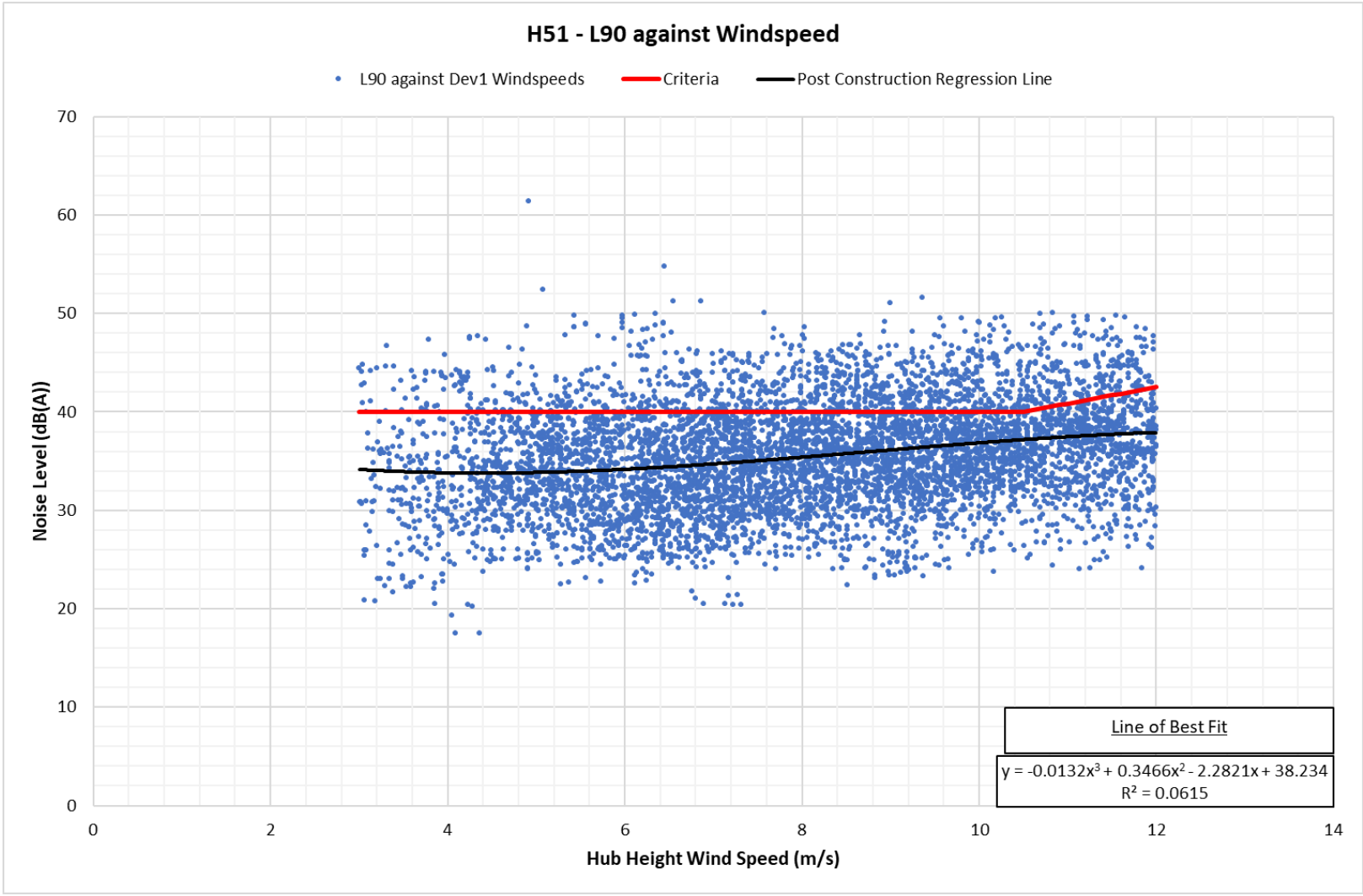

Figure 8: H51 - Filtered L90 Noise Level Correlations to Mast 1 Windspeeds

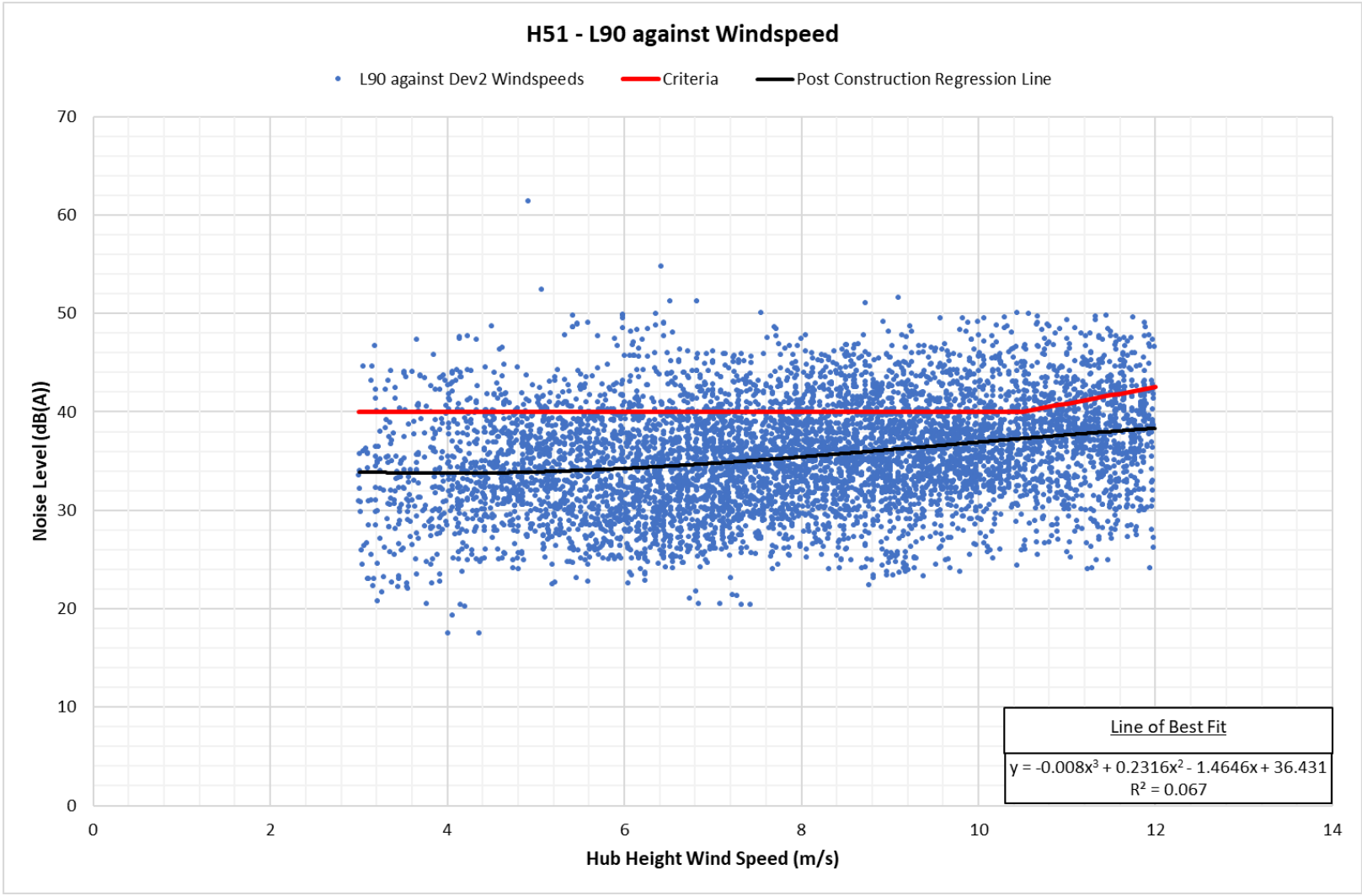

Figure 9: H51 - Filtered L90 Noise Level Correlations to Mast 2 Windspeeds

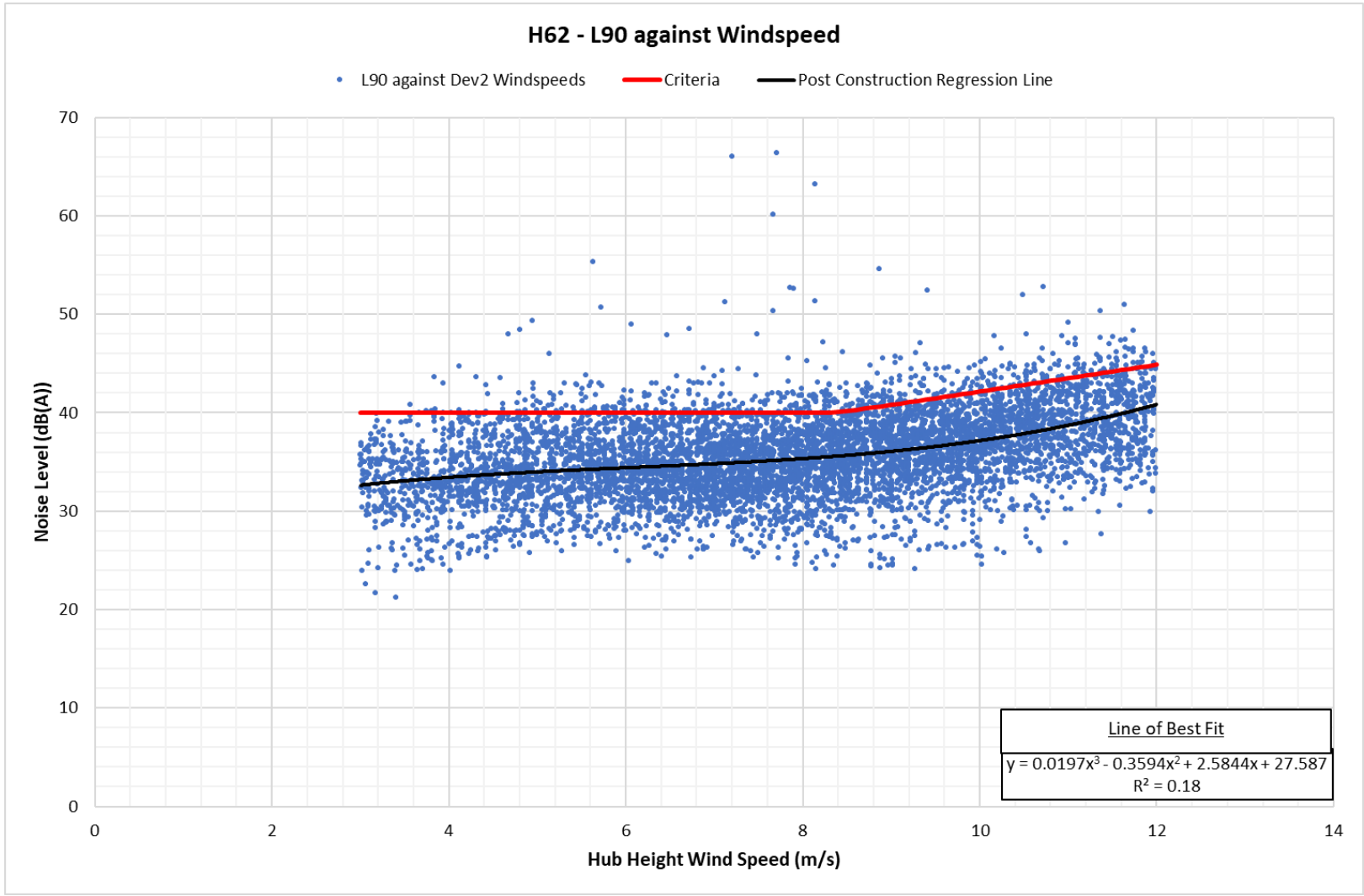

Figure 10: H62 - Filtered L90 Noise Level Correlations to Development Mast 2 Windspeeds

4.3 SPECIAL AUDIBLE CHARACTERISTICS

4.3.1 Tonality Adjustments

There were eleven instances when tonality was identified in the nearfield measurements, ranging between 76.2Hz and 102.5Hz, on windspeeds between 3m/s and 6m/s.

The NCTP therefore requires an assessment at the residential logging locations for these wind speeds and frequencies of tone. It is noted that as a conservative approach, the tonal range was extended to the one-third octave bands with centre frequencies between 63Hz and 125Hz. The following summarises the assessment in accordance with the NCTP:

- For every 10 minute period, the equivalent sound pressure level in each unweighted one third octave band was compared against the equivalent sound pressure levels in the neighbouring one third octave bands.
- Where the sound pressure level exceeded the average level of adjacent bands by more than the values in the table below, a potential tone was identified.

Table 11: Tonal Level Difference

One Third Octave Band	Level Difference
25-125 Hz	15 dB
160-400 Hz	8 dB
500-4000Hz	5 dB

- For each of these potential tones, the digital audio was reviewed to determine if the tone was associated with the Wind Farm.

There were five instances where the 10 minute samples exhibited tonality within the one-third octave bands between 63Hz and 125Hz. These are shown in the table below:

Table 12: Tones at Residences

Location	Tones detected
H18	4
H46	1
H51	0
H62	0

The digital audio identified that in all cases, the tonality was from sources other than the Wind Farm. These other sources were mostly local sources in the vicinity of the noise loggers, as well as distant vehicles. Based on the assessment, no adjustments have been applied to the noise levels for tonality at the residences.

4.3.2 Modulation Adjustments

As noted in the nearfield measurement section, no excessive amplitude modulation was identified and therefore the NCTP does not require further assessment at residential logging locations. No adjustments are therefore made for the character of amplitude modulation.

5 CONCLUSION

The first round of noise compliance testing has been conducted for the Dundonnell Wind Farm in accordance with the NCTP.

The testing included noise measurements at four residential logging locations in the vicinity of the Wind Farm, intermediate locations between these locations and the Wind Farm and in the nearfield of example turbines. The results of these measurements have been used to confirm that the noise from operation of the Wind Farm is less than the established noise criteria at all surrounding dwellings and that no penalties are warranted for the special audible characteristics of tonality or amplitude modulation.

The Project therefore complies with the noise performance requirements as set out in Condition 11 of the Planning Permit. In accordance with the NCTP, a second round of testing will be repeated 12 months after the first round of post-construction testing (within 14 months of commissioning).

6 APPENDIX A: CALIBRATION CERTIFICATES

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013

Calibration Certificate
Calibration Number C20320

Client Details	Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320647
Microphone Serial Number :	03401
Pre-amplifier Serial Number :	54465

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.8°C	**Ambient Temperature :**	24.7°C
Relative Humidity :	46.3%	**Relative Humidity :**	49%
Barometric Pressure :	101.64kPa	**Barometric Pressure :**	101.56kPa

Calibration Technician :	Jeff Yu	**Secondary Check:**	Max Moore
Calibration Date :	29 May 2020	**Report Issue Date :**	1 Jun 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.2°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
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www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20540

Client Details	Sonus Pty Ltd 17 Ruthven Avenue Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320653
Microphone Serial Number :	03402
Pre-amplifier Serial Number :	10661

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23.4°C	**Ambient Temperature :**	21.9°C
Relative Humidity :	41.7%	**Relative Humidity :**	42.3%
Barometric Pressure :	100.32kPa	**Barometric Pressure :**	100.2kPa

Calibration Technician : Jeff Yu
Calibration Date : 24 Sep 2020
Secondary Check: Max Moore
Report Issue Date : 6 Oct 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20538

Client Details	Sonus Pty Ltd 17 Ruthven Avenue Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320657
Microphone Serial Number :	03435
Pre-amplifier Serial Number :	10665

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	21.5°C	**Ambient Temperature :**	21.4°C
Relative Humidity :	49.4%	**Relative Humidity :**	47.4%
Barometric Pressure :	99.92kPa	**Barometric Pressure :**	99.96kPa

Calibration Technician :	Jeff Yu	**Secondary Check:**	Max Moore
Calibration Date :	23 Sep 2020	**Report Issue Date :**	6 Oct 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM 29615

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion		
Type No:	NL-25	**Serial No:**	00598175
Mic. Type:	UC-59	**Serial No:**	15519
Pre-Amp. Type:	NH-25	**Serial No:**	98387

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1011	hPa ±1 hPa	**Date of Receipt :**	24/05/2021
Temperature	23	°C ±1° C	**Date of Calibration :**	25/05/2021
Relative Humidity	55	% ±5%	**Date of Issue :**	25/05/2021

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Jack Kidd

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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WORLD RECOGNISED ACCREDITATION
Accredited Lab No. 9262
Acoustic and Vibration Measurements

Acu-Vib Electronics
CALIBRATIONS SALES RENTALS REPAIRS

Head Office & Calibration Laboratory
Unit 14, 22 Hudson Ave, Castle Hill NSW 2154
(02) 9680 8133
www.acu-vib.com.au

Page 1 of 2 Calibration Certificate
AVCERT10.1 Rev.2.0 14/04/2021

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM 29997

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion		
Type No:	NL-21	**Serial No:**	01298933
Mic. Type:	UC-52	**Serial No:**	127252
Pre-Amp. Type:	NH-21	**Serial No:**	31528

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 2. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1006	hPa ±1 hPa	**Date of Receipt :**	07/07/2021
Temperature	25	°C ±1° C	**Date of Calibration :**	08/07/2021
Relative Humidity	36	% ±5%	**Date of Issue :**	08/07/2021

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Note See

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Acoustic and Vibration Measurements

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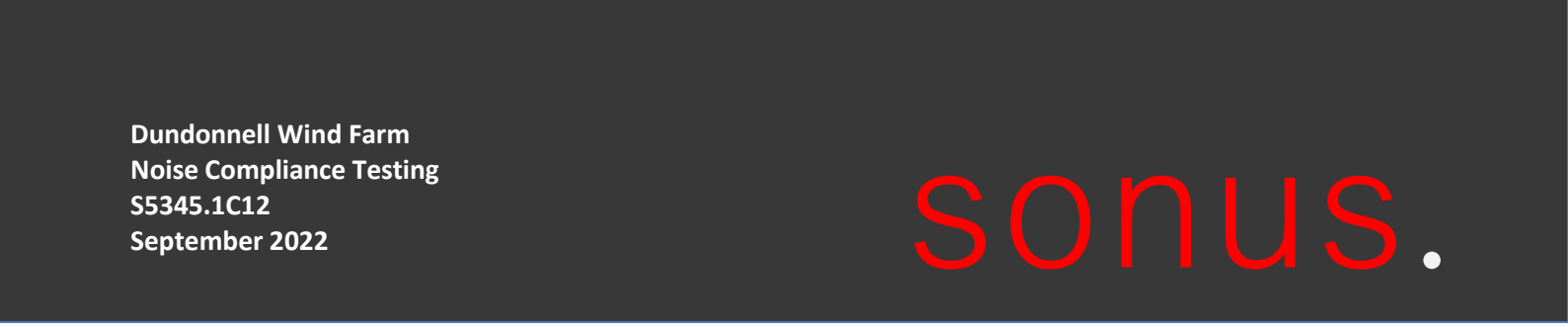
AVCERT10.3 Rev.2.0 14/04/2021



RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Level Meter, Class 2**

Model : **NL-42** **S/No.** : **01000229**

Date of Calibration : **January, 12, 2021**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.
K. Ikeda
Manager, Quality Control Department

NATacoustic
Acoustic Calibration & Testing Laboratory
Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Calibrator

Calibration Date 12/02/2021 **Job No** RB856 **Operator** AH
Client Name SONUS PTY LTD
Client Address 17 RUTHVEN AVE, ADELAIDE, SA, 5000

Test Item

Calibrator Make RION **Model** NC-74 **Serial No** #35094478
Accessories N/A

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	23.6	23.6
Rel. Humidity (%)	58.4	58.4
Air Pressure (kPa)	100.3	100.28

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Audio Tester AUDT30 v3.0 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
This document shall not be reproduced, except in full.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.
See "Sound Level Calibrator Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:

Calibration Statement:
The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 15/02/2021

Template Document Name: RQT-03 (rev 62) Calibrator Verification

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20318

Client Details	Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-22
Instrument Serial Number :	00683866
Microphone Serial Number :	120591
Pre-amplifier Serial Number :	27972

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	20.6°C	**Ambient Temperature :**	23.5°C
Relative Humidity :	54%	**Relative Humidity :**	48.2%
Barometric Pressure :	101.71kPa	**Barometric Pressure :**	101.68kPa

Calibration Technician :	Jeff Yu	**Secondary Check:**	Max Moore
Calibration Date :	29 May 2020	**Report Issue Date :**	1 Jun 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.2°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20535

Client Details	Sonus Pty Ltd 17 Ruthven Avenue Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00220543
Microphone Serial Number :	03377
Pre-amplifier Serial Number :	10543

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	22.4°C	**Ambient Temperature :**	22.1°C
Relative Humidity :	50.1%	**Relative Humidity :**	47%
Barometric Pressure :	99.81kPa	**Barometric Pressure :**	99.87kPa

Calibration Technician : Jeff Yu
Calibration Date : 22 Sep 2020
Secondary Check: Max Moore
Report Issue Date : 6 Oct 2020
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

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Unit 36/14 Loyalty Rd
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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20320

Client Details	Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320647
Microphone Serial Number :	03401
Pre-amplifier Serial Number :	54465

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.8°C	**Ambient Temperature :**	24.7°C
Relative Humidity :	46.3%	**Relative Humidity :**	49%
Barometric Pressure :	101.64kPa	**Barometric Pressure :**	101.56kPa

Calibration Technician : Jeff Yu
Calibration Date : 29 May 2020
Secondary Check: Max Moore
Report Issue Date : 1 Jun 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.2°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
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Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
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A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Meter

Calibration Date	11/02/2021	Job No	RB856	Operator	AM
Client Name	SONUS PTY LTD				
Client Address	17 RUTHVEN AVE, ADELAIDE SA 5000				

Test Item

Instrument Make	RION	Model	NL-52	Serial No	#00320649
Microphone Make	RION	Model	UC-59	Serial No	#03398
Preamplifier Make	RION	Model	NH-25	Serial No	#20834
Ext'n Cable Make	Nil	Model	N/A	Serial No	N/A
Accessories	Nil			Firmware	2.0

SLM Type	1
Filters Class	N/A

Environmental Conditions	Measured	
	Start	End
Air Temp. (°C)	23.7	23.6
Rel. Humidity (%)	58.7	59.1
Air Pressure (kPa)	100.6	100.5

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3 :2013 and IEC 61260-3 :2016

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Function Generator Model 33220A SN MY43004013
Agilent Digital Multimeter Model 34401A SN MY41004386

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
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Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.
See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
The uncertainty is stated at a confidence level of 95% using a k factor of 2.

Calibration Statement:
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013 and IEC 61260-3:2016, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 and IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 and IEC 61260-1:2014 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 and IEC 61260-3:2016 cover only a limited subset of the specifications in IEC 61672-1:2013 and IEC 61260-1:2014.

NATA
WORLD RECOGNISED ACCREDITATION

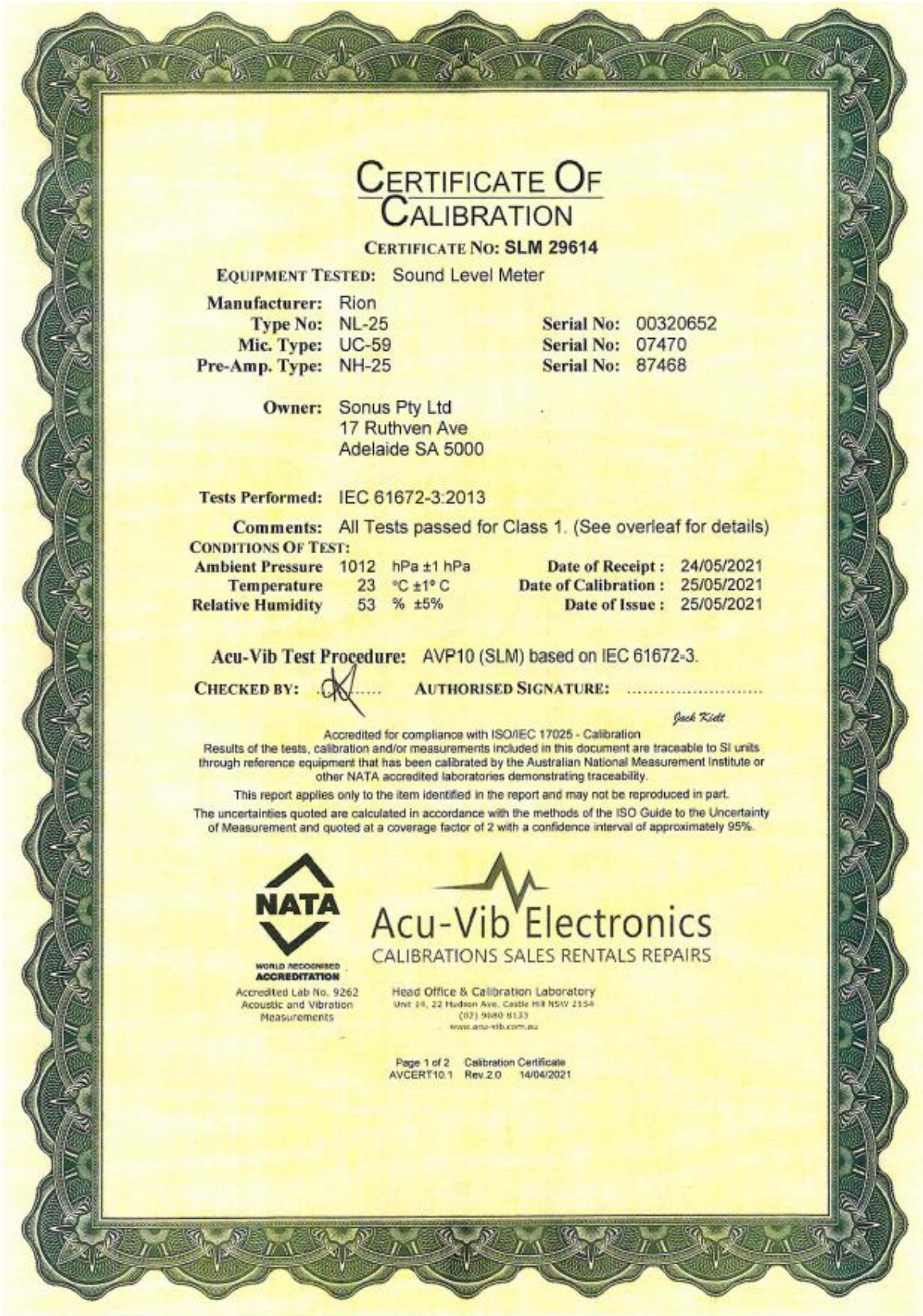
NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 15/02/2021

Template Document Name: RQT-05 (rev 72) SLM ISO Verification



CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM 29614

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Rion		
Type No:	NL-25	**Serial No:**	00320652
Mic. Type:	UC-59	**Serial No:**	07470
Pre-Amp. Type:	NH-25	**Serial No:**	87468

Owner: Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000

Tests Performed: IEC 61672-3:2013

Comments: All Tests passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1012	hPa ±1 hPa	**Date of Receipt :**	24/05/2021
Temperature	23	°C ±1° C	**Date of Calibration :**	25/05/2021
Relative Humidity	53	% ±5%	**Date of Issue :**	25/05/2021

Acu-Vib Test Procedure: AVP10 (SLM) based on IEC 61672-3.

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Jack Kidd

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Acoustic and Vibration Measurements

Acu-Vib Electronics
CALIBRATIONS SALES RENTALS REPAIRS

Head Office & Calibration Laboratory
Unit 14, 22 Hudson Ave, Castle Hill NSW 2154
(02) 9680 8133
www.acu-vib.com.au

Page 1 of 2 Calibration Certificate
AVCERT10.1 Rev.2.0 14/04/2021

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C20540

Client Details	Sonus Pty Ltd 17 Ruthven Avenue Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320653
Microphone Serial Number :	03402
Pre-amplifier Serial Number :	10661

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23.4°C	**Ambient Temperature :**	21.9°C
Relative Humidity :	41.7%	**Relative Humidity :**	42.3%
Barometric Pressure :	100.32kPa	**Barometric Pressure :**	100.2kPa

Calibration Technician : Jeff Yu
Calibration Date : 24 Sep 2020
Secondary Check: Max Moore
Report Issue Date : 6 Oct 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

PAGE 1 OF 1

7 APPENDIX B: AMPLITUDE MODULATION GRAPHS

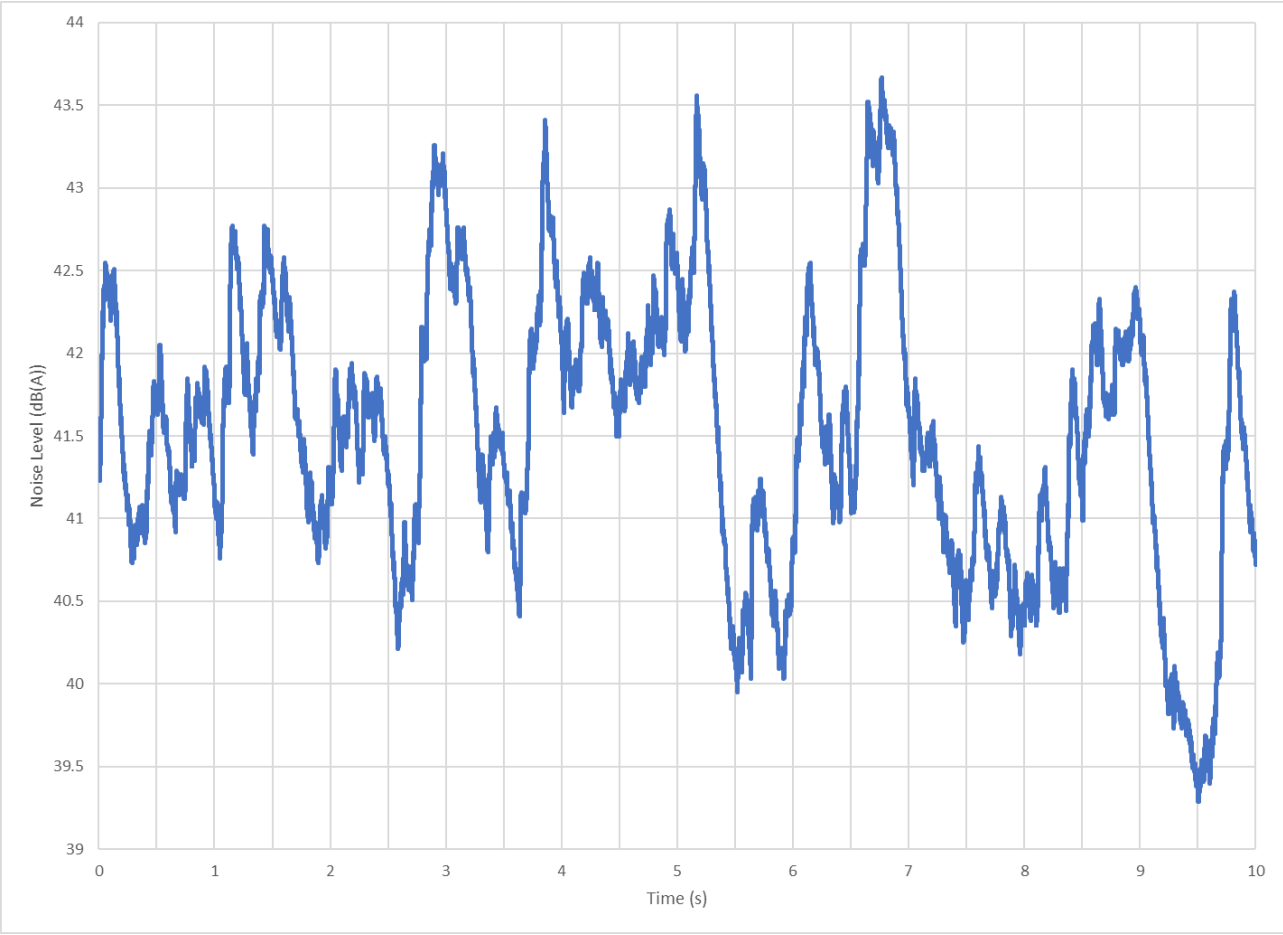

Figure 11: Amplitude Modulation - H09 - 3m/s

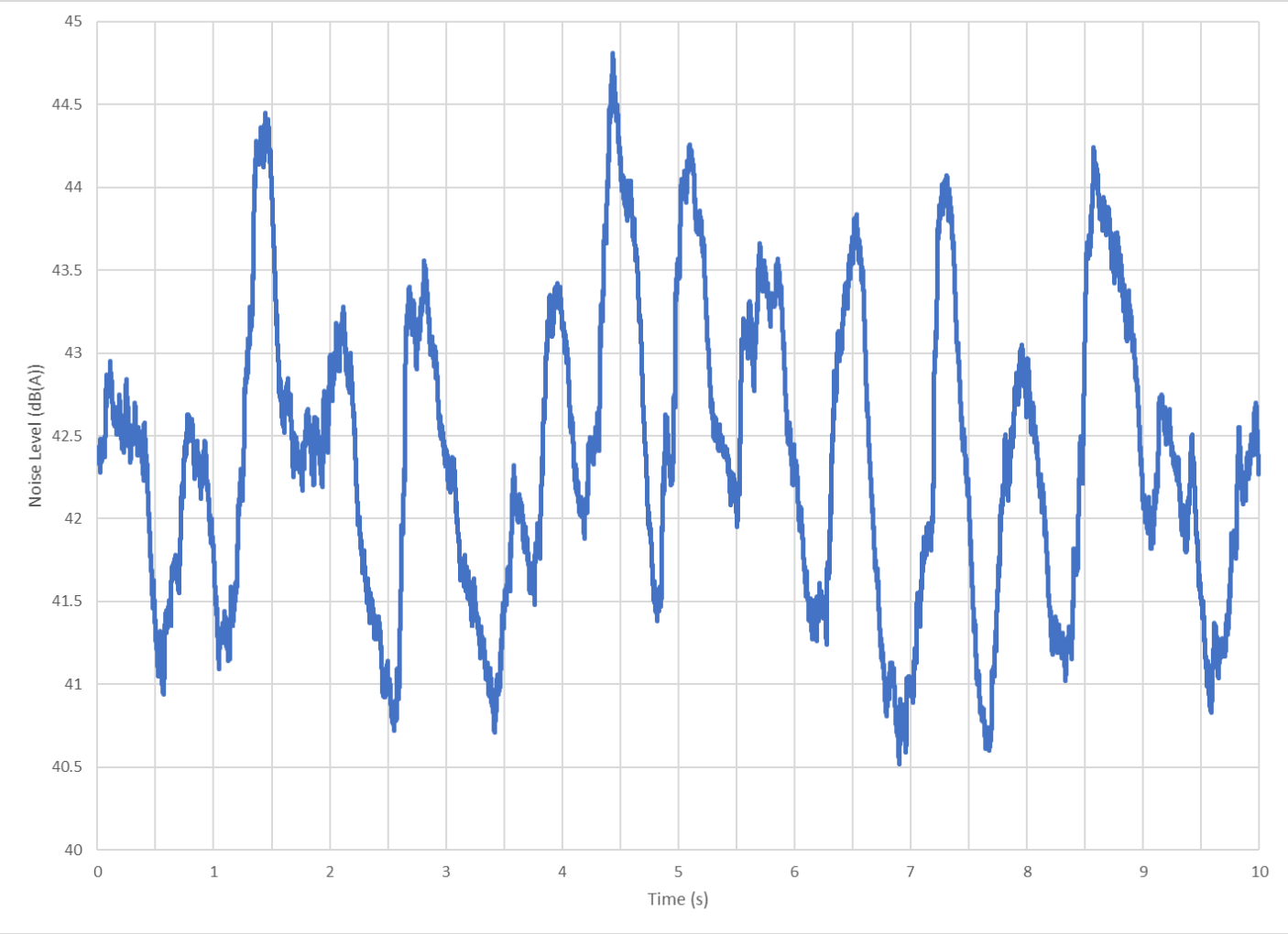

Figure 12: Amplitude Modulation - H09 - 4m/s

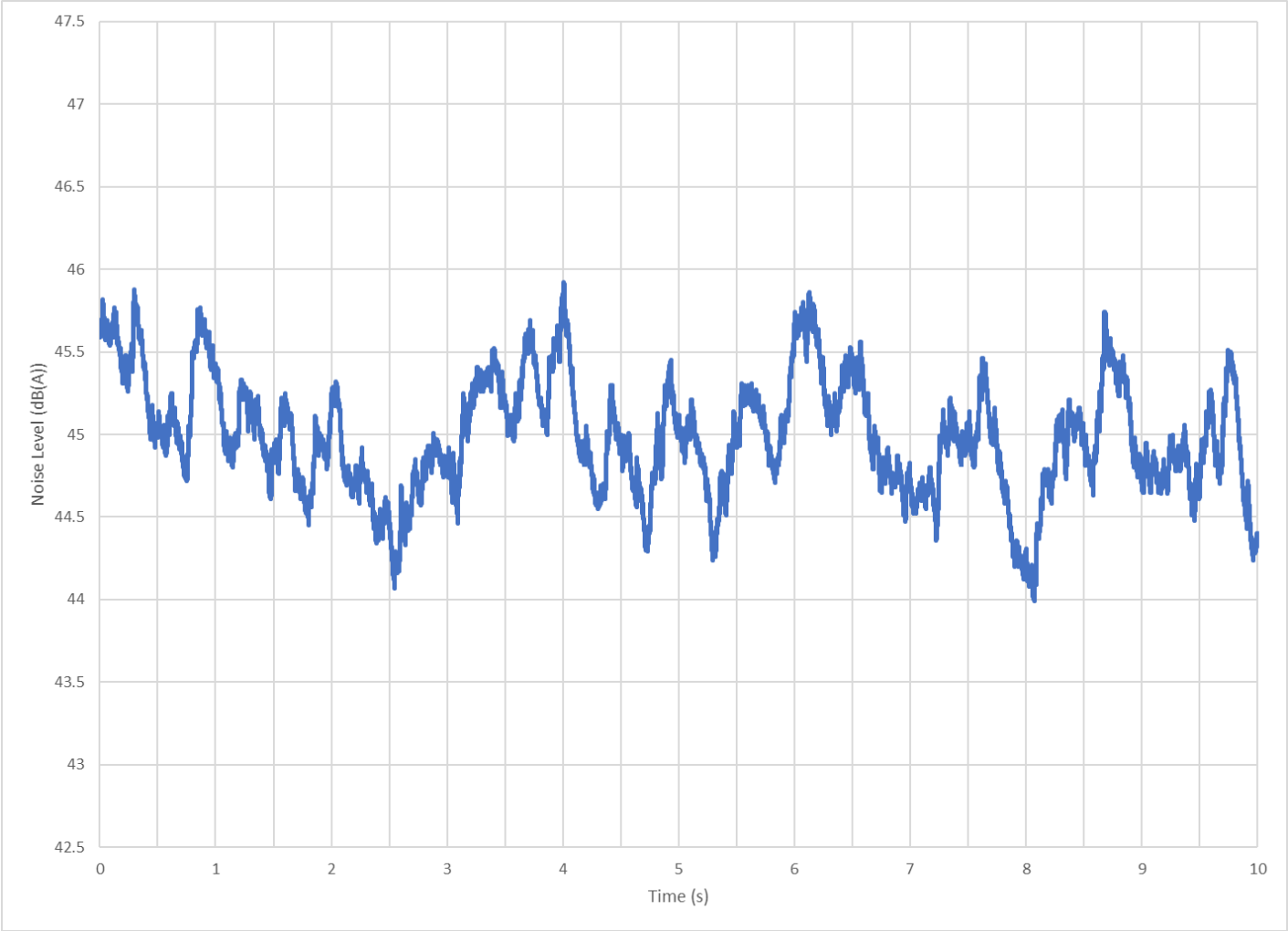

Figure 13: Amplitude Modulation - H09 - 5m/s

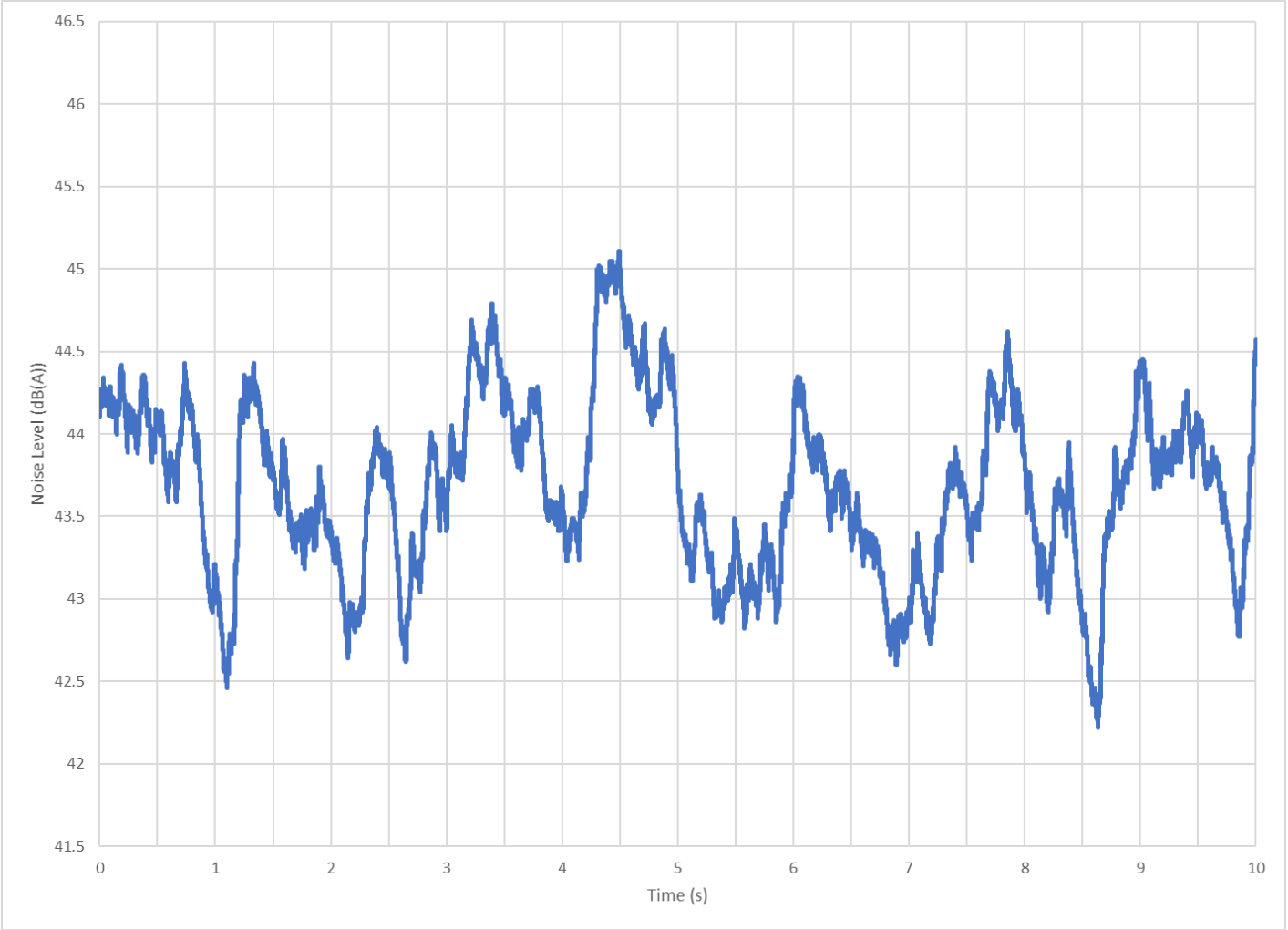

Figure 14: Amplitude Modulation - H09 - 6m/s

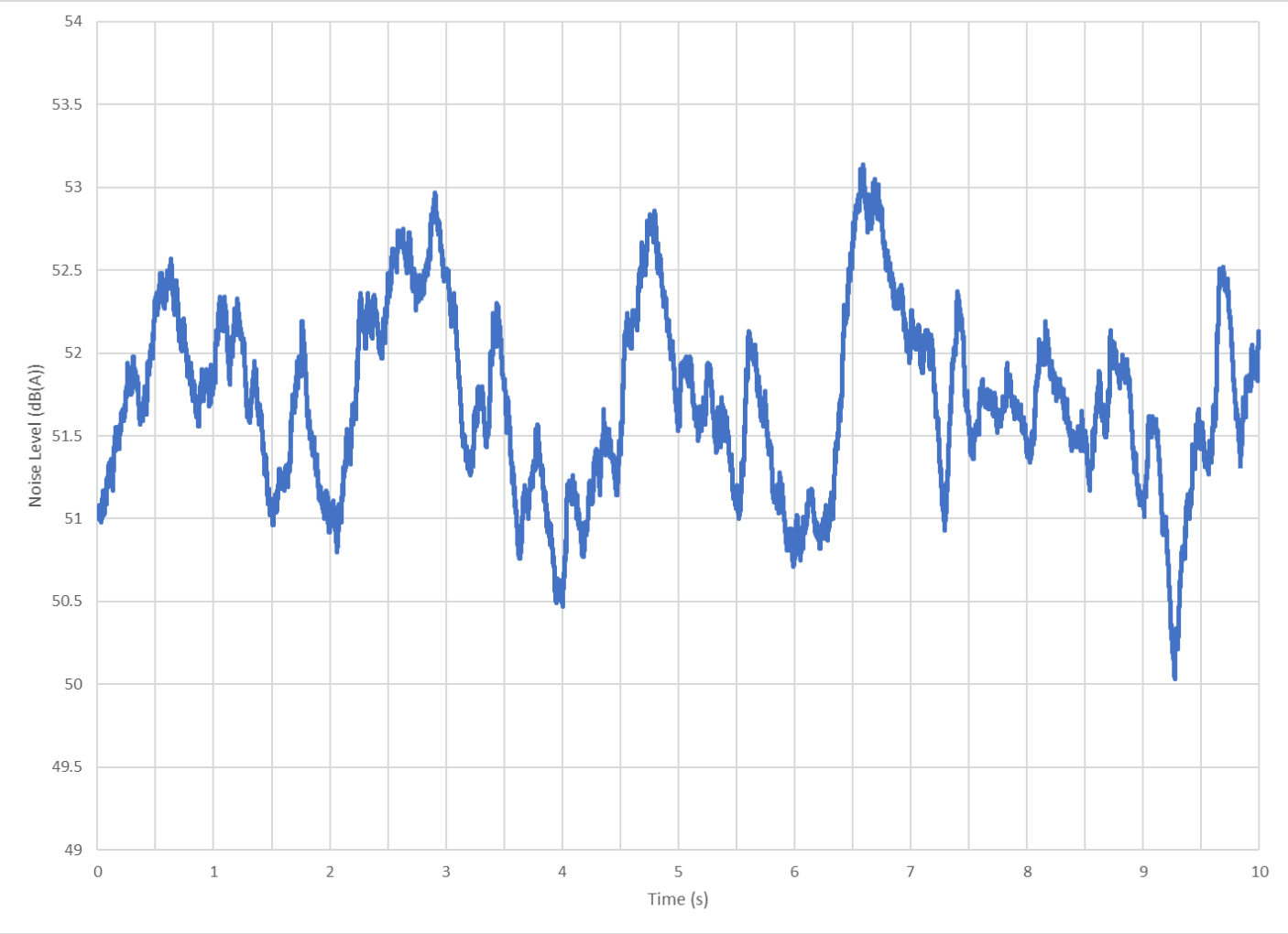

Figure 15: Amplitude Modulation - H09 - 7m/s

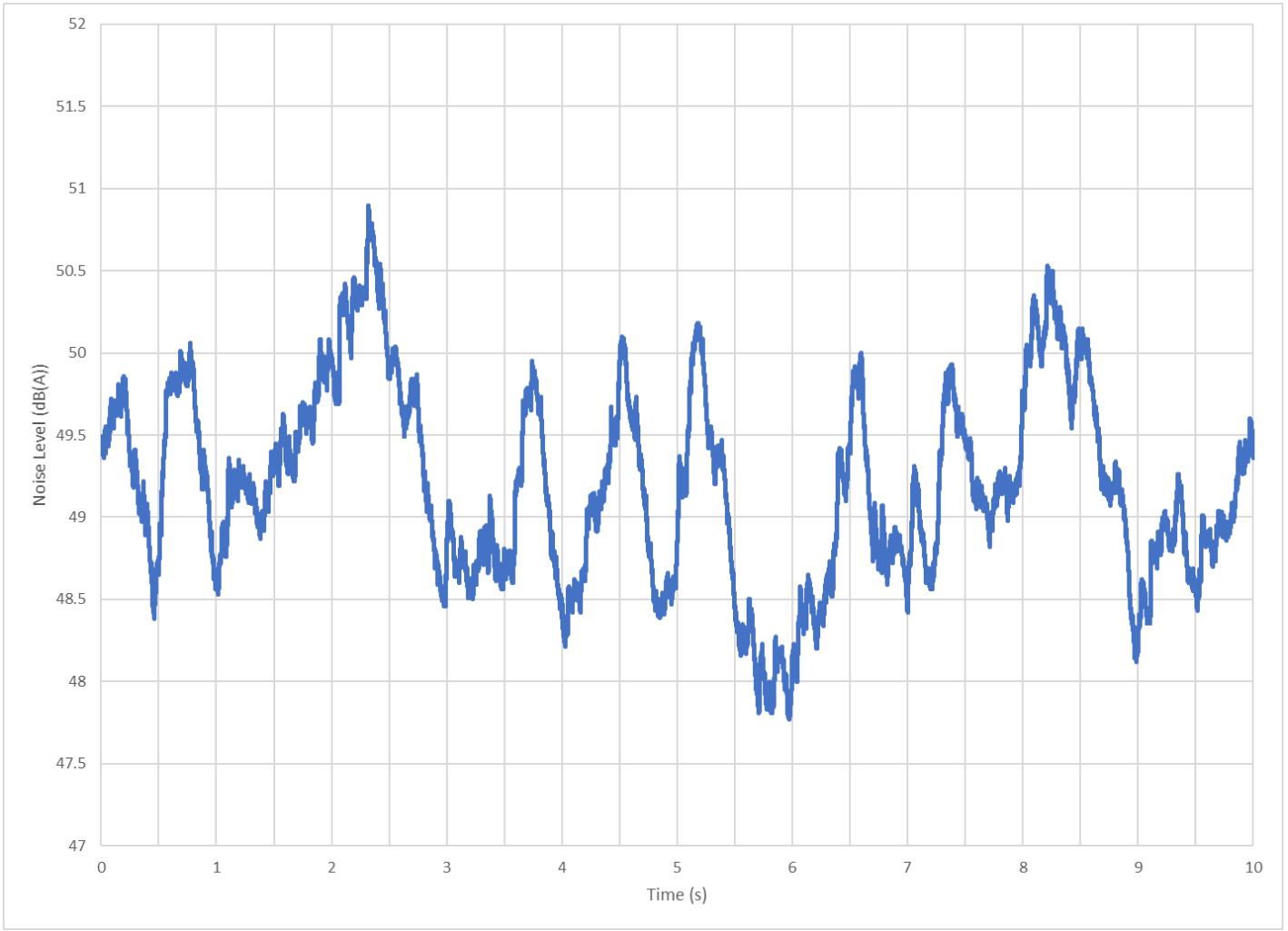

Figure 16: Amplitude Modulation - H09 - 8m/s

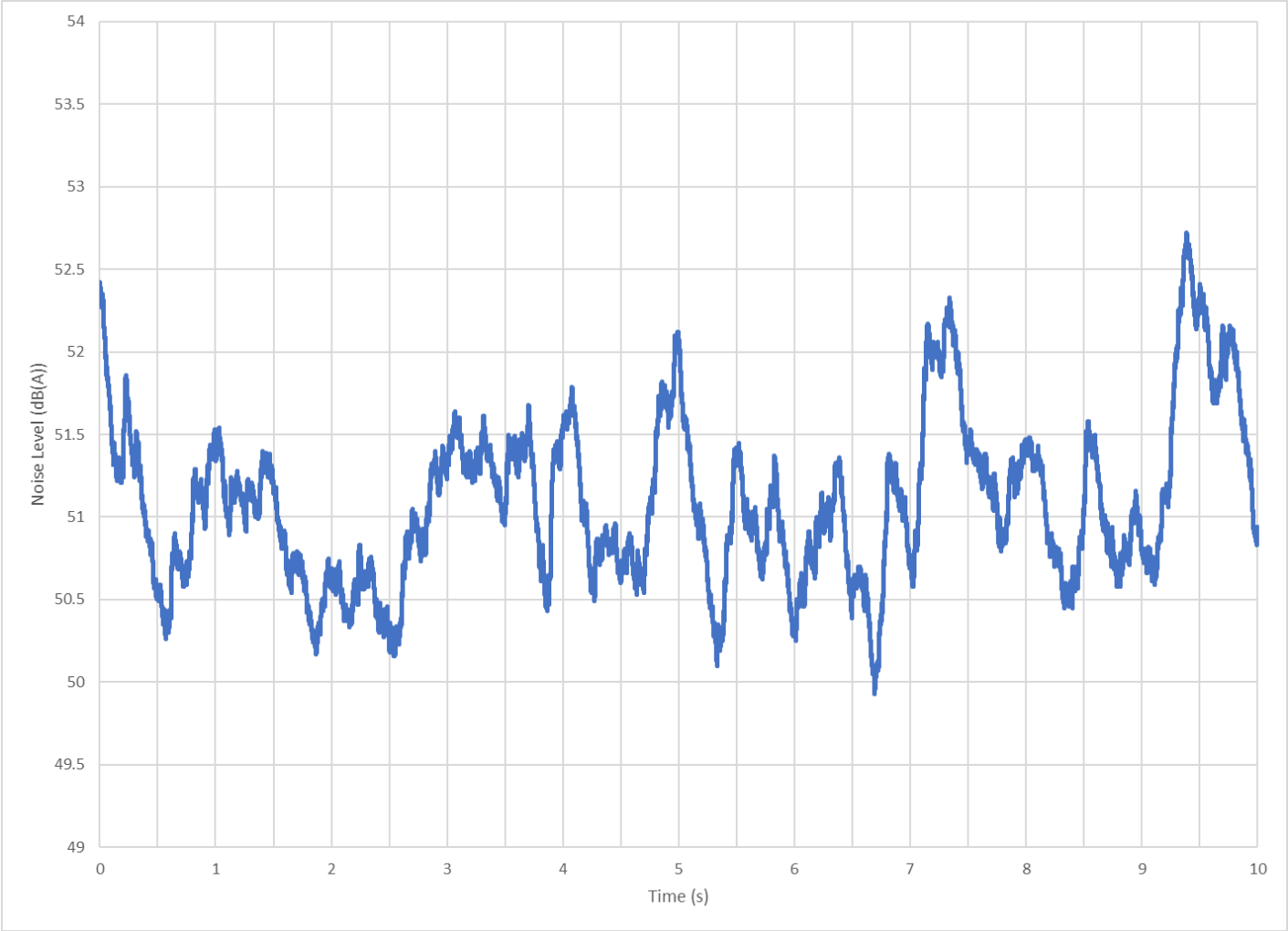

Figure 17: Amplitude Modulation - H09 - 9m/s

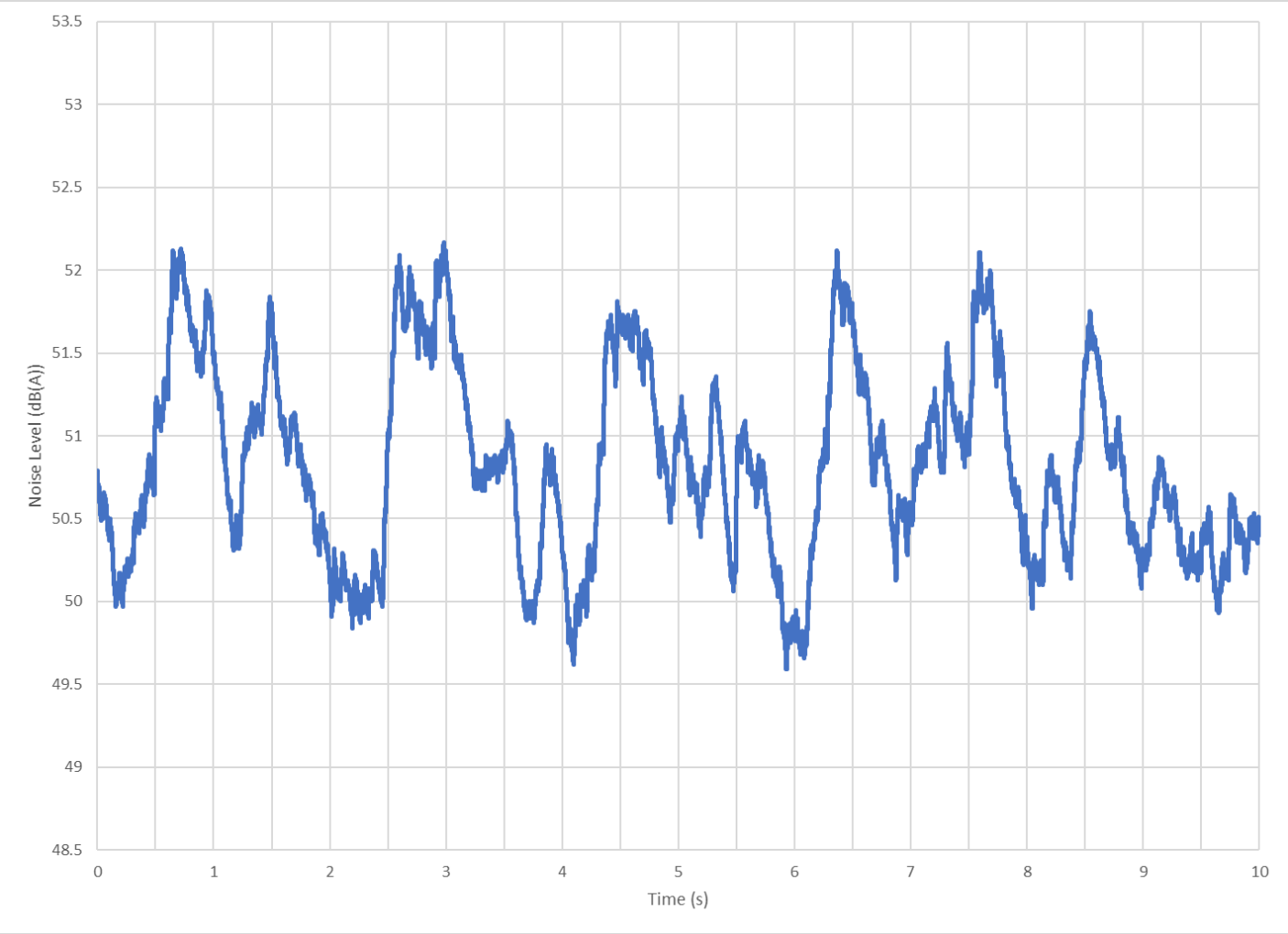

Figure 18: Amplitude Modulation - H09 - 10m/s

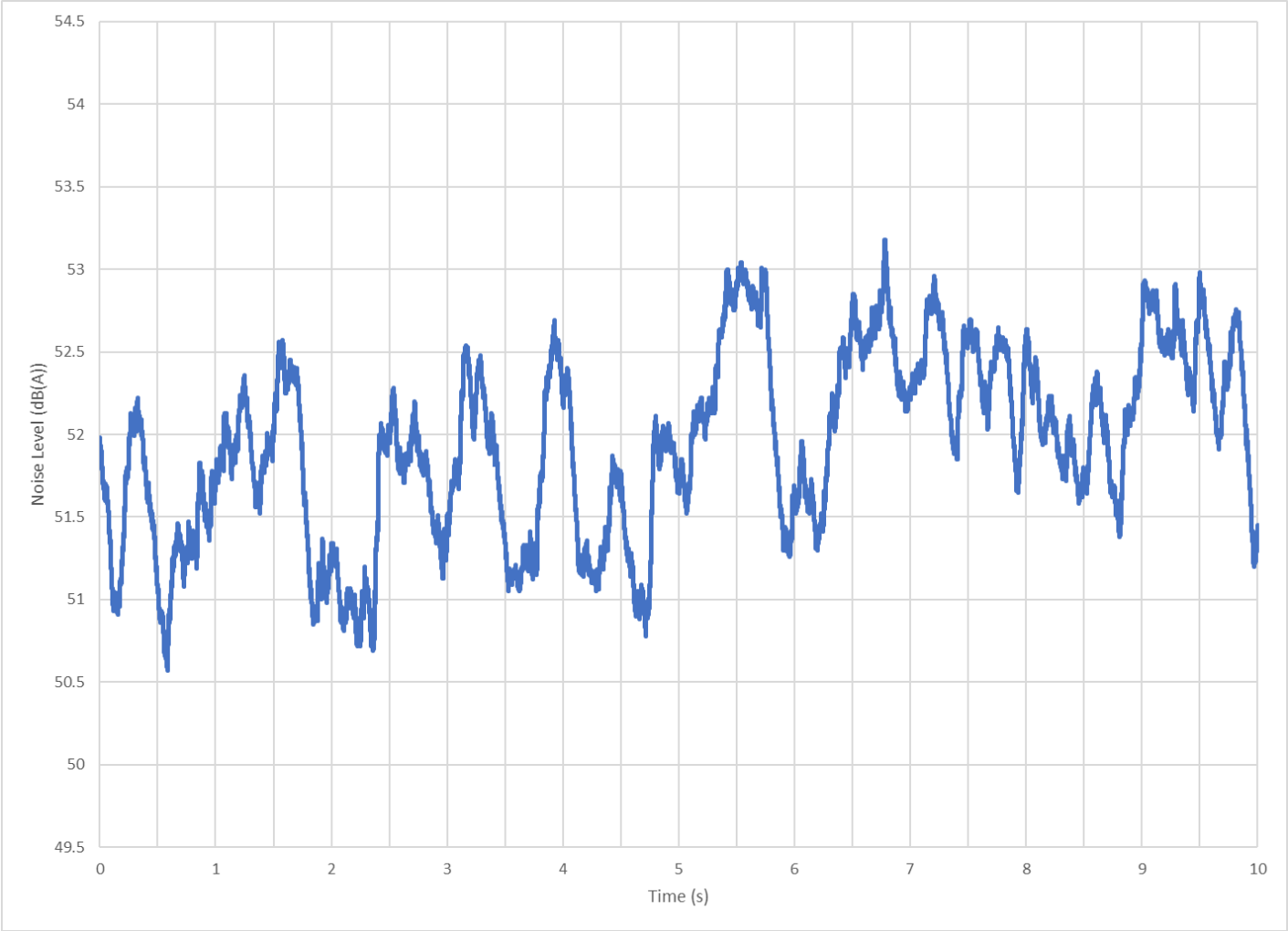

Figure 19: Amplitude Modulation - H09 - 11m/s

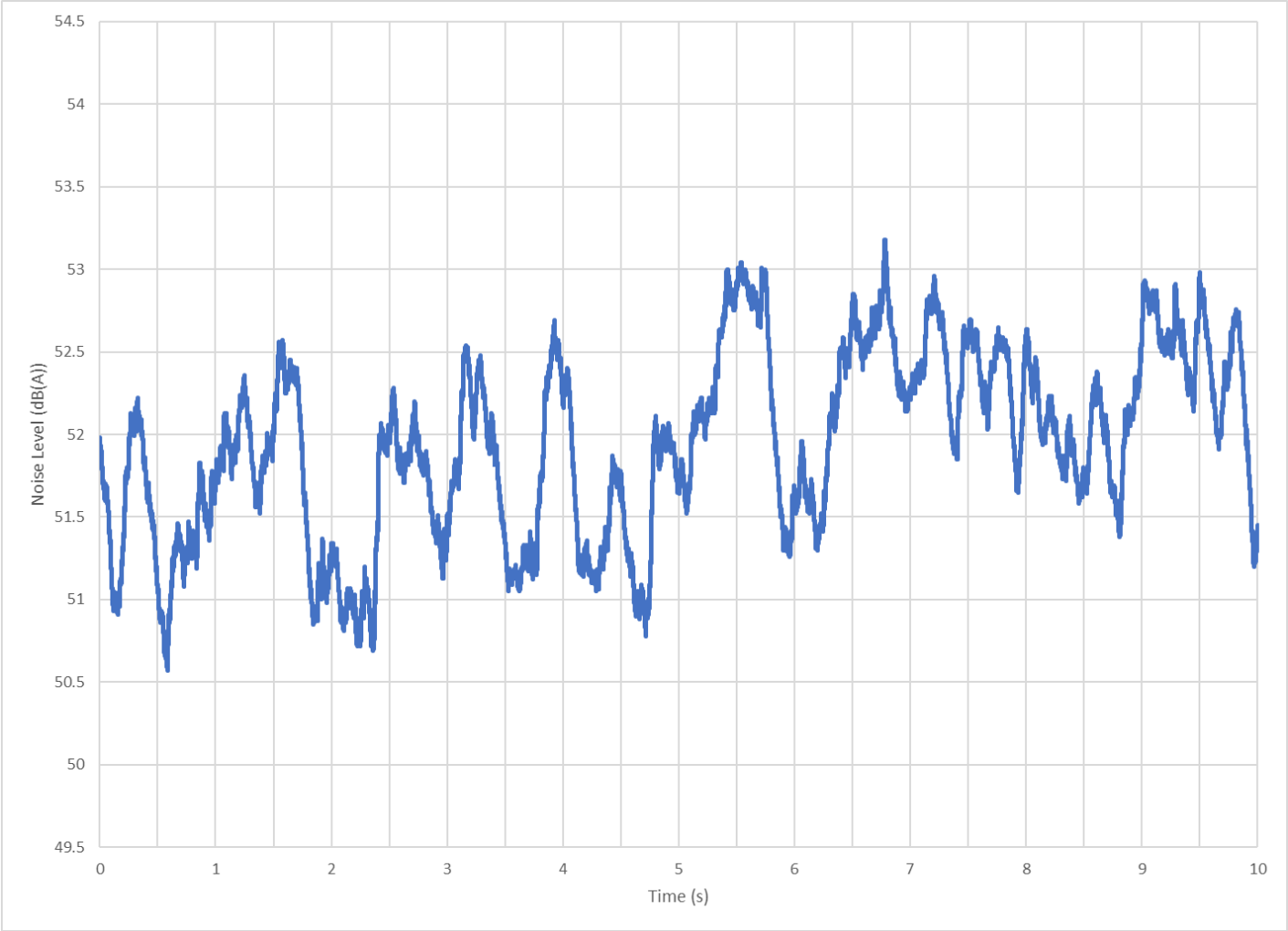

Figure 20: Amplitude Modulation - H09 - 12m/s

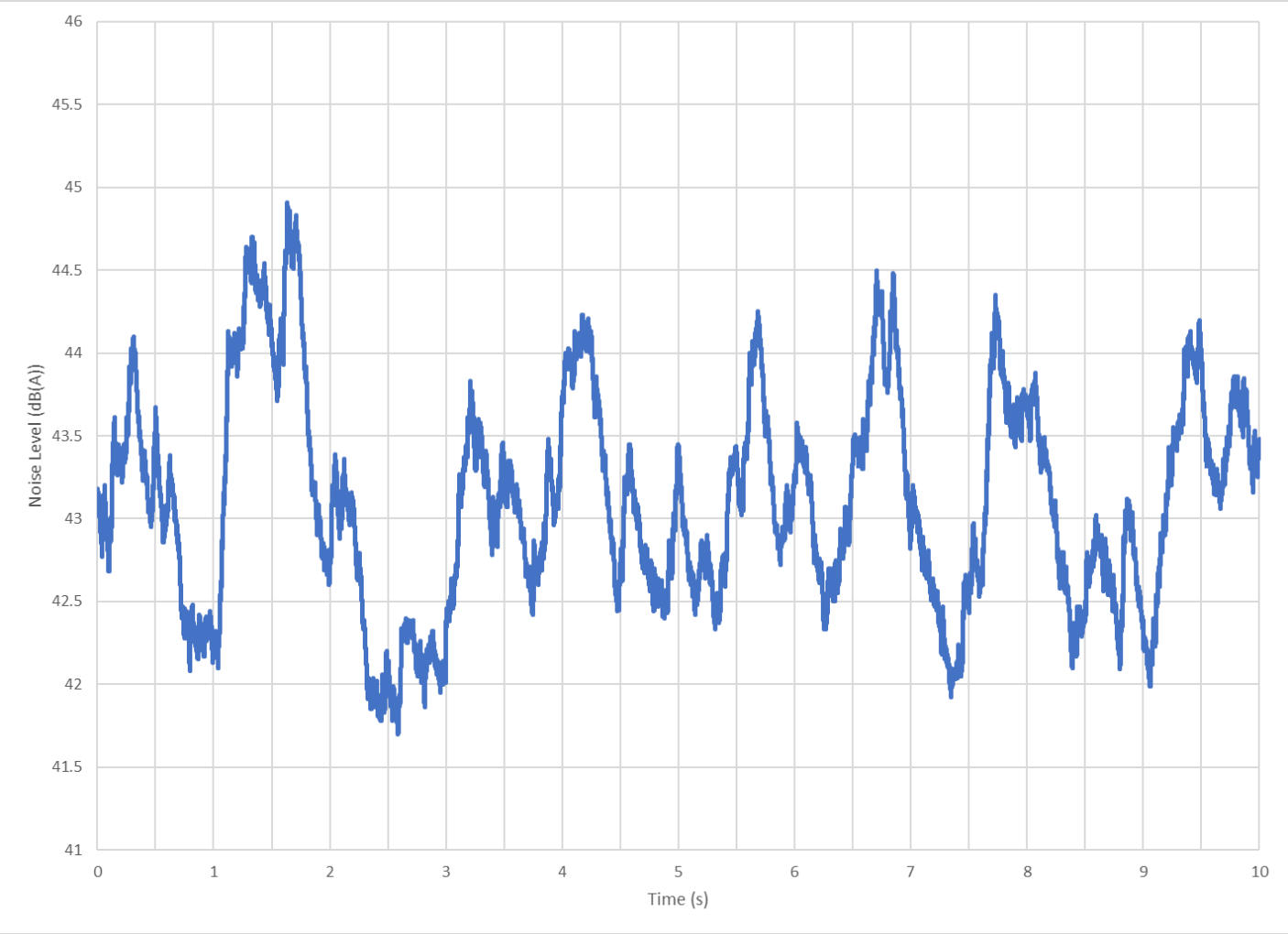

Figure 21: Amplitude Modulation – G06 - 3m/s

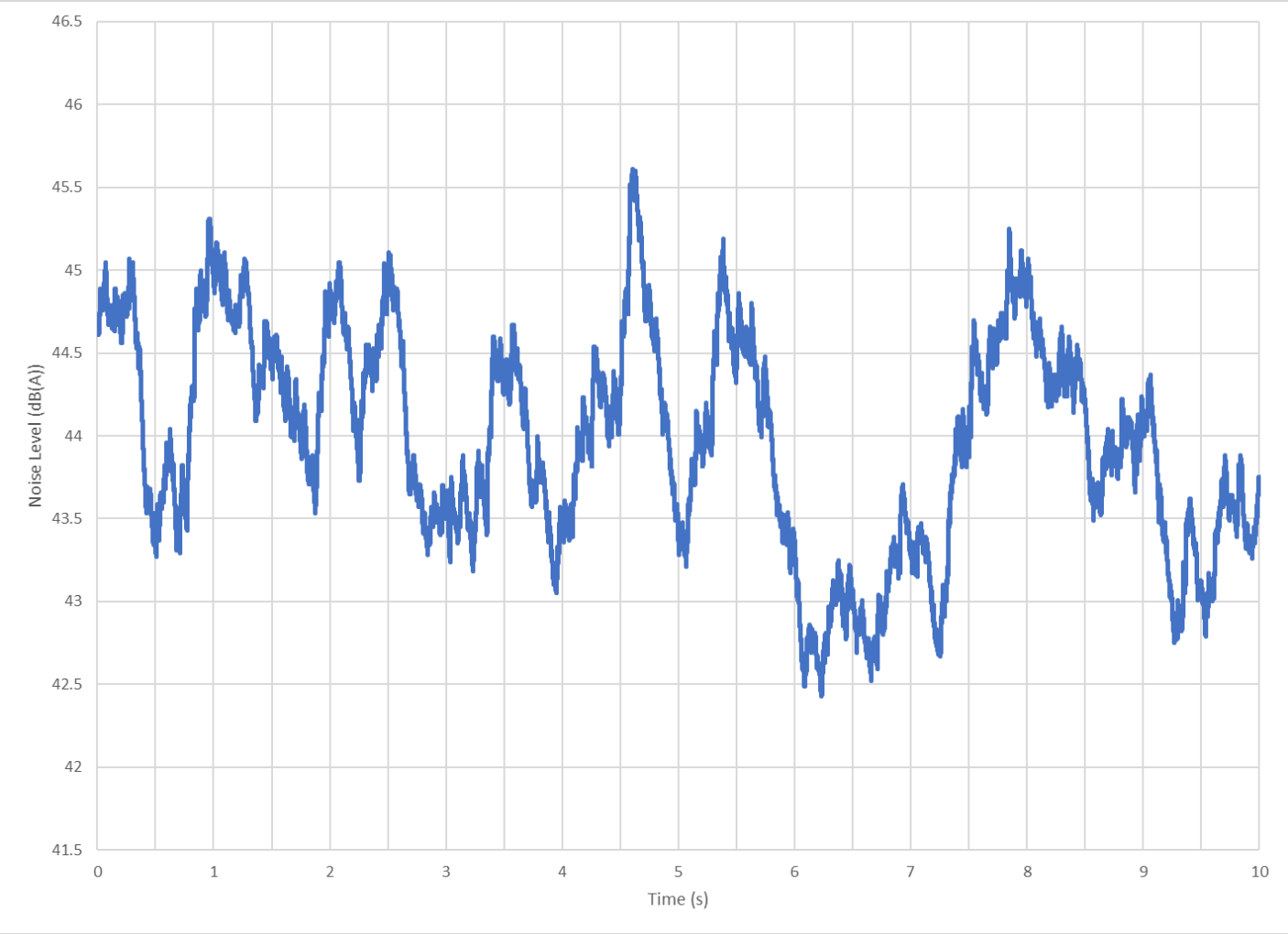

Figure 22: Amplitude Modulation – G06 - 4m/s

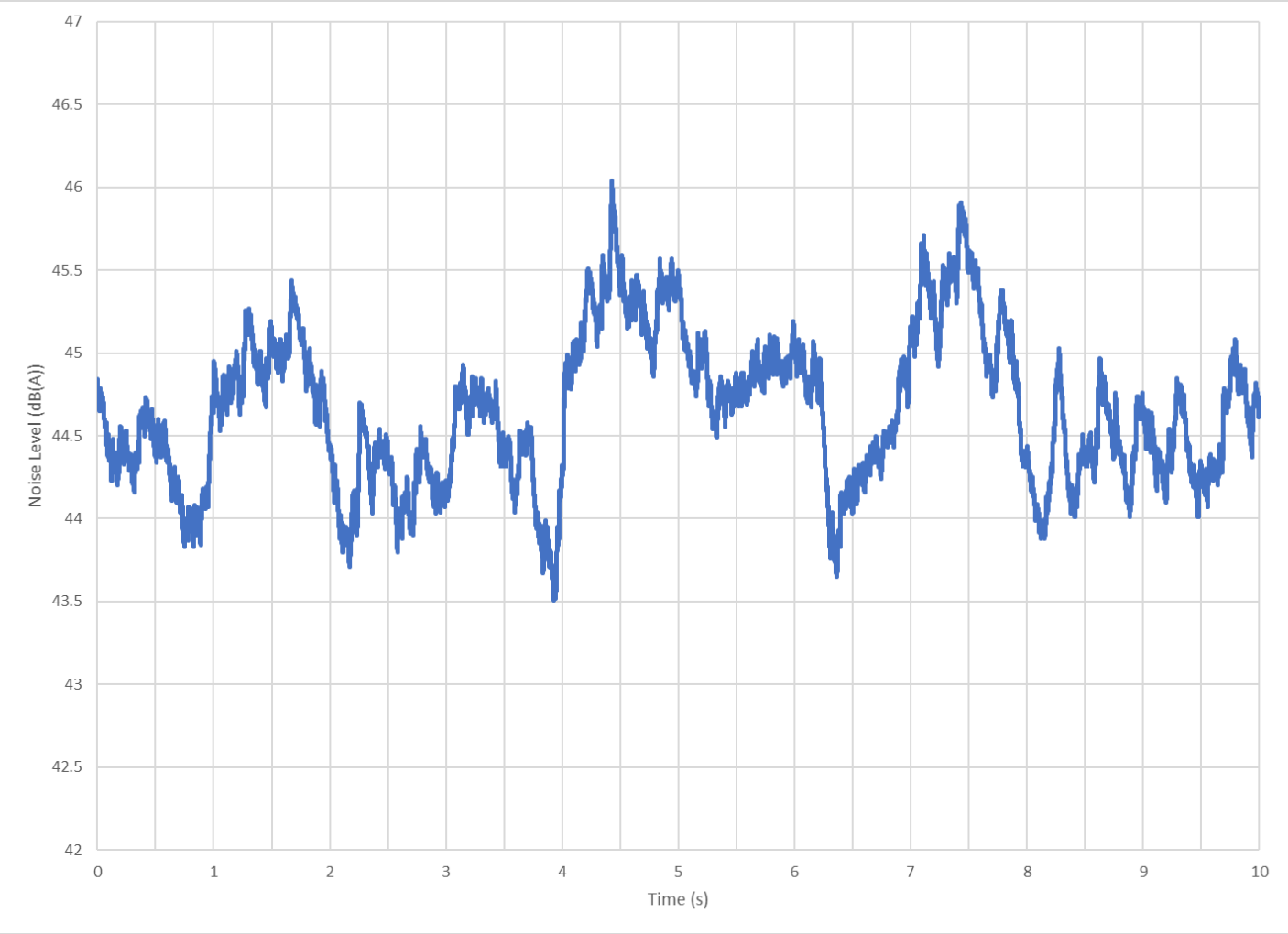

Figure 23: Amplitude Modulation – G06 - 5m/s

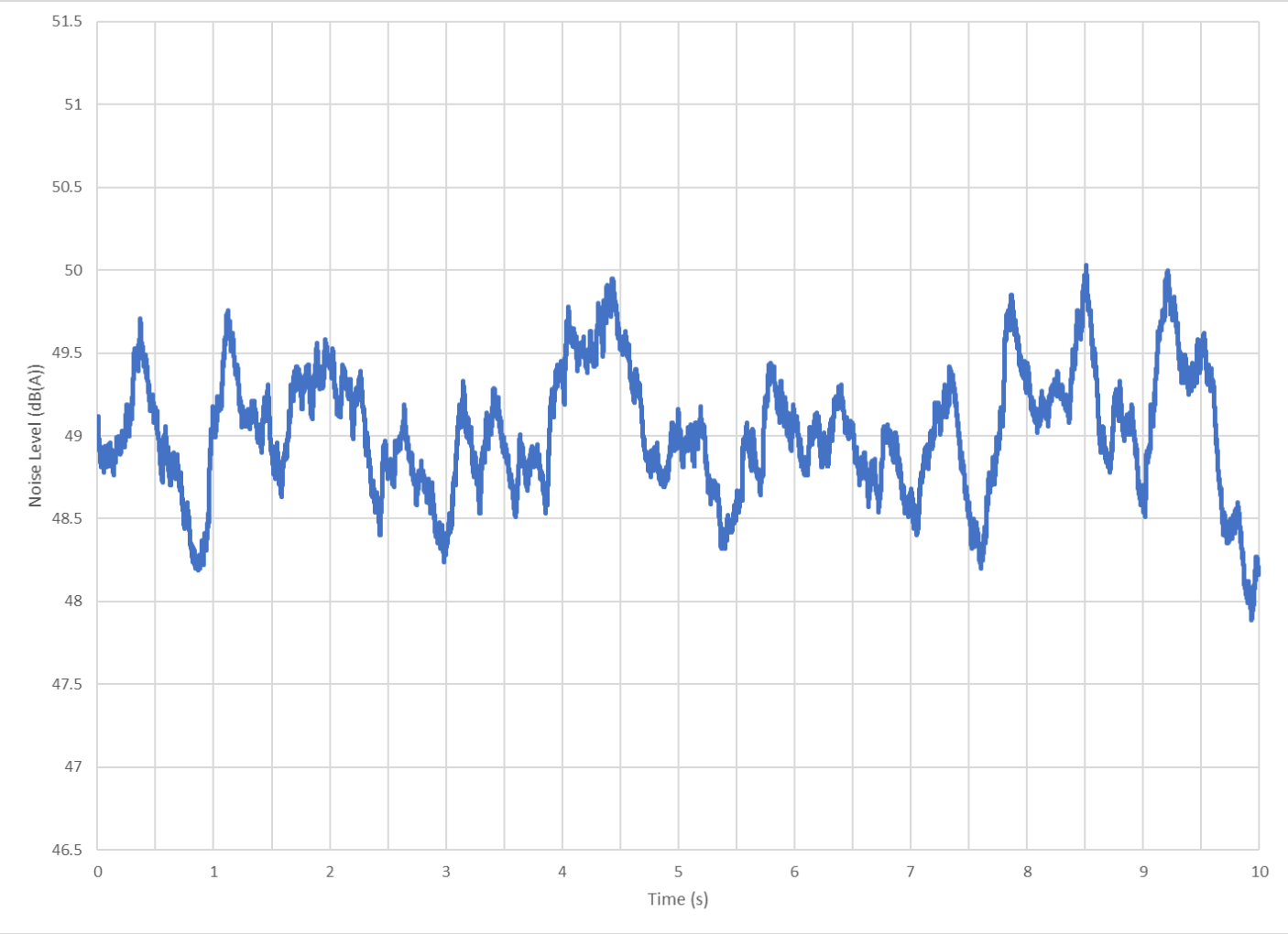

Figure 24: Amplitude Modulation – G06 - 6m/s

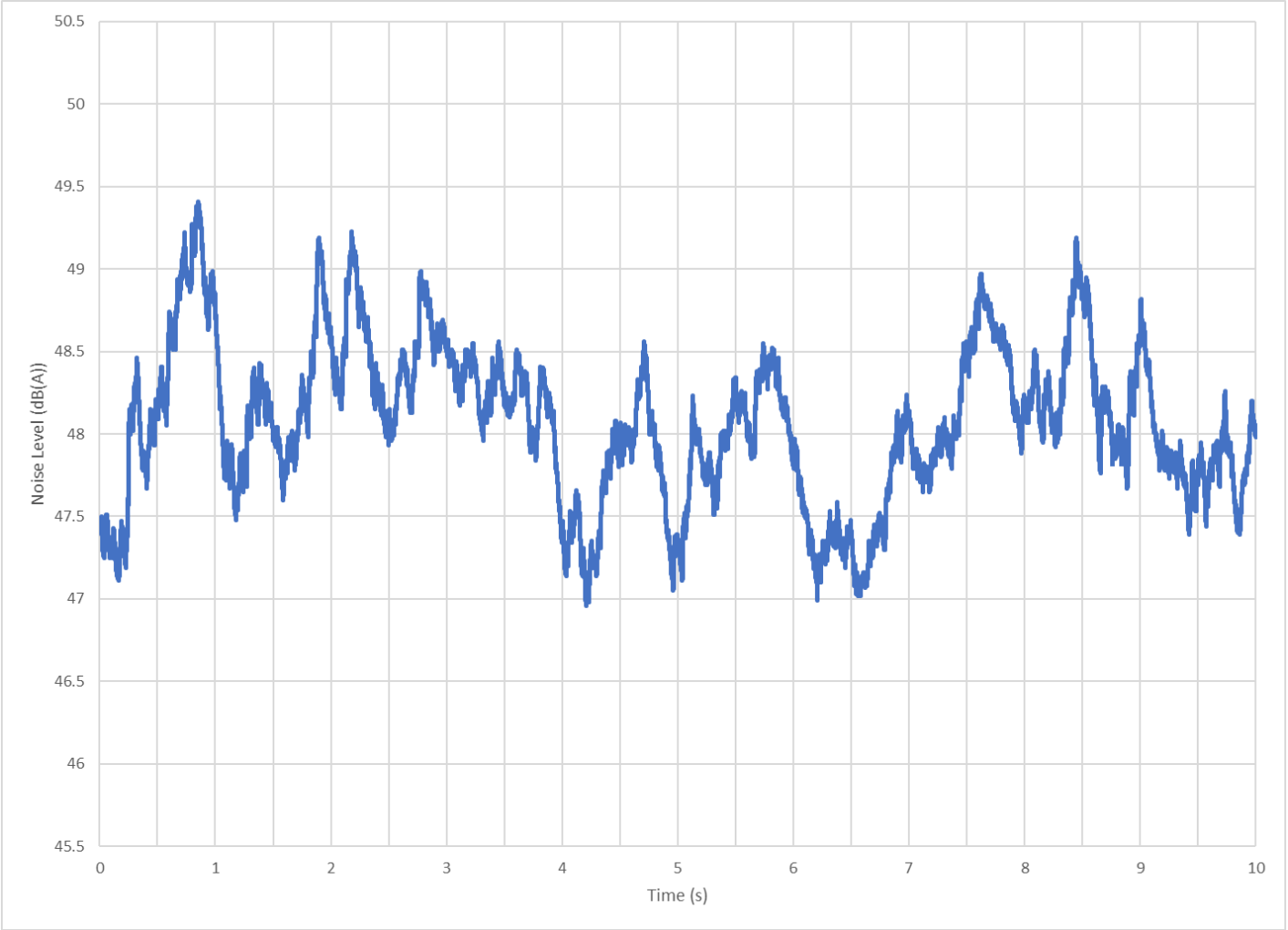

Figure 25: Amplitude Modulation – G06 - 7m/s

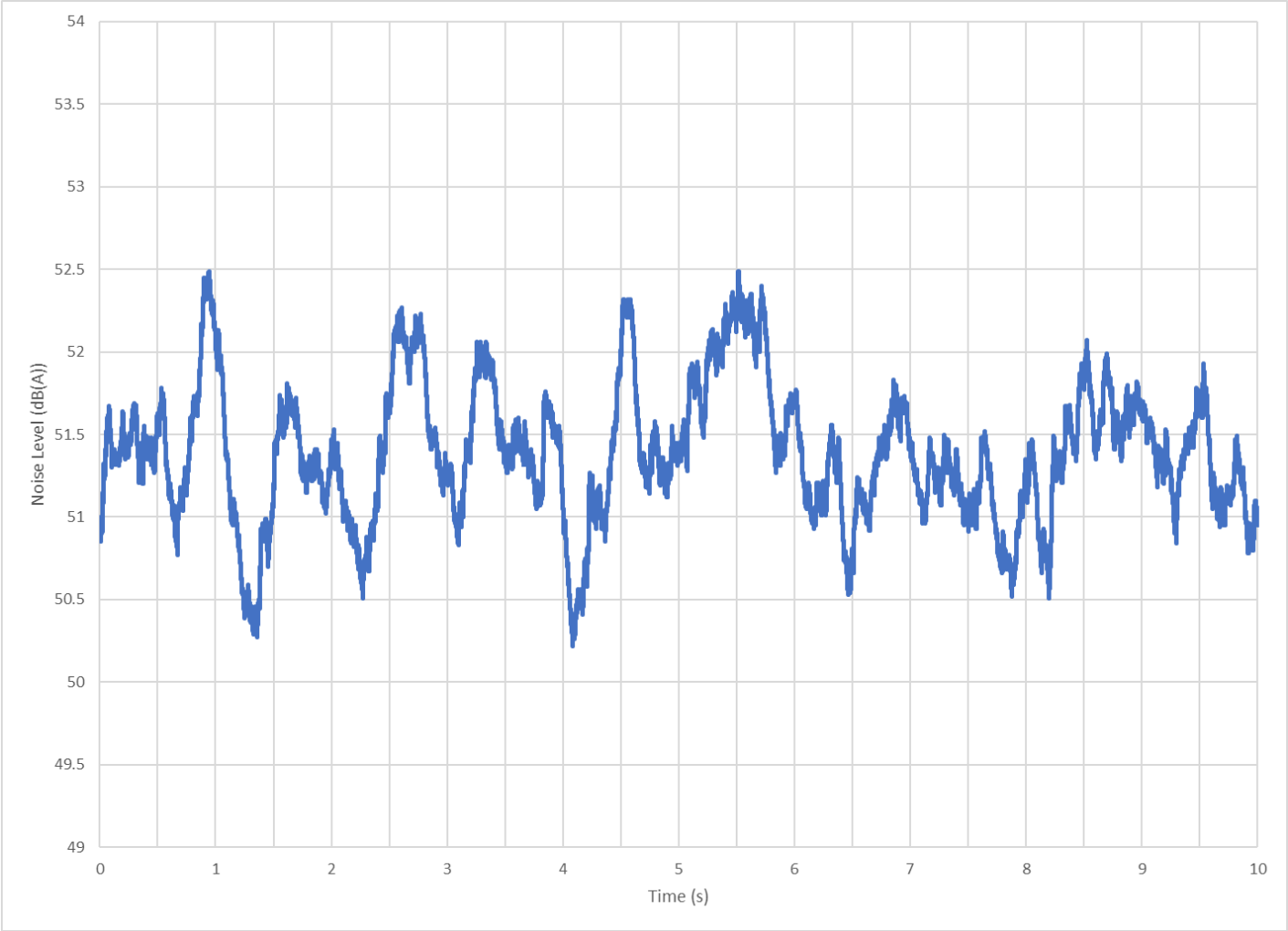

Figure 26: Amplitude Modulation – G06 - 8m/s

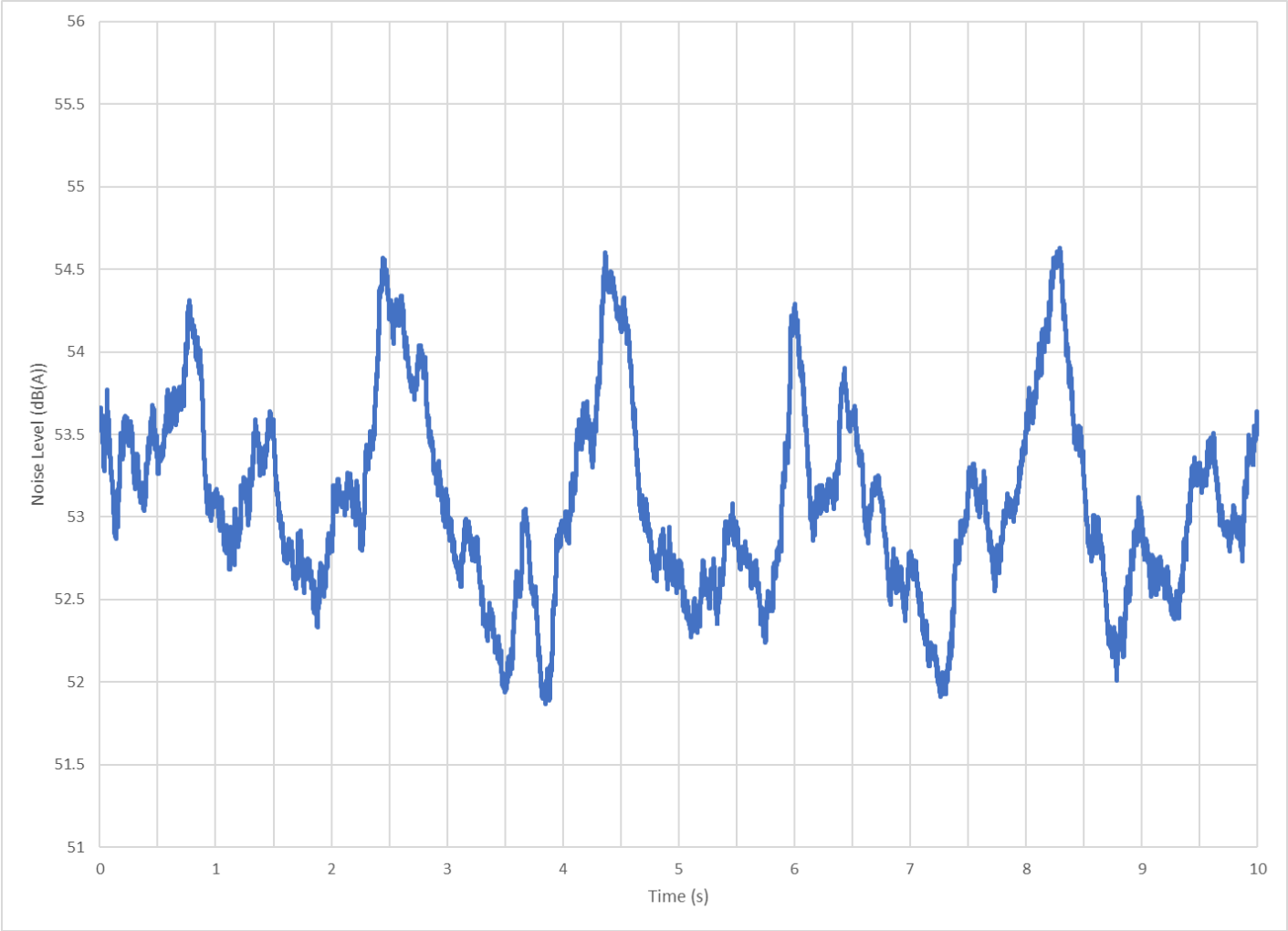

Figure 27: Amplitude Modulation – G06 - 9m/s

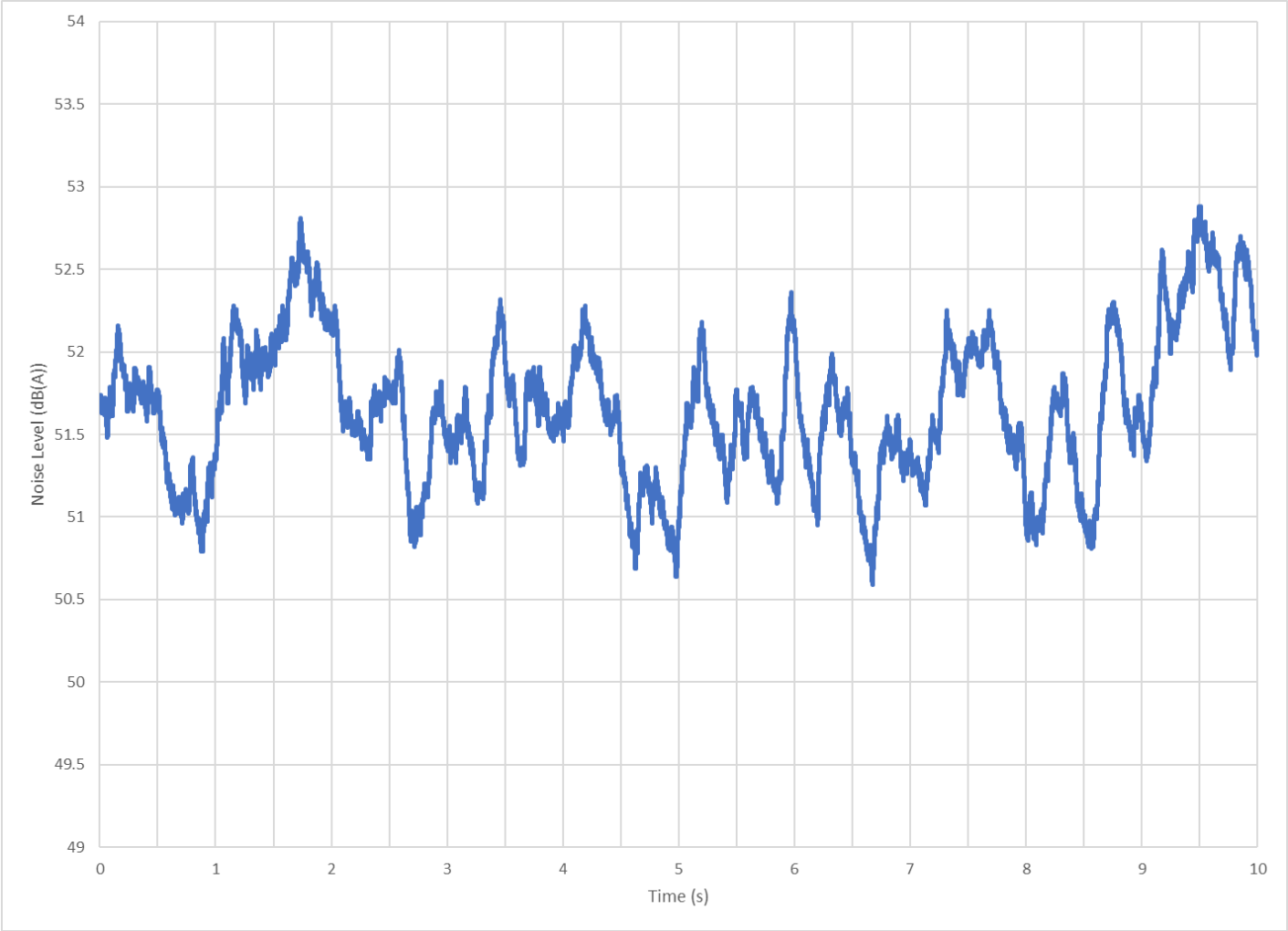

Figure 28: Amplitude Modulation – G06 - 10m/s

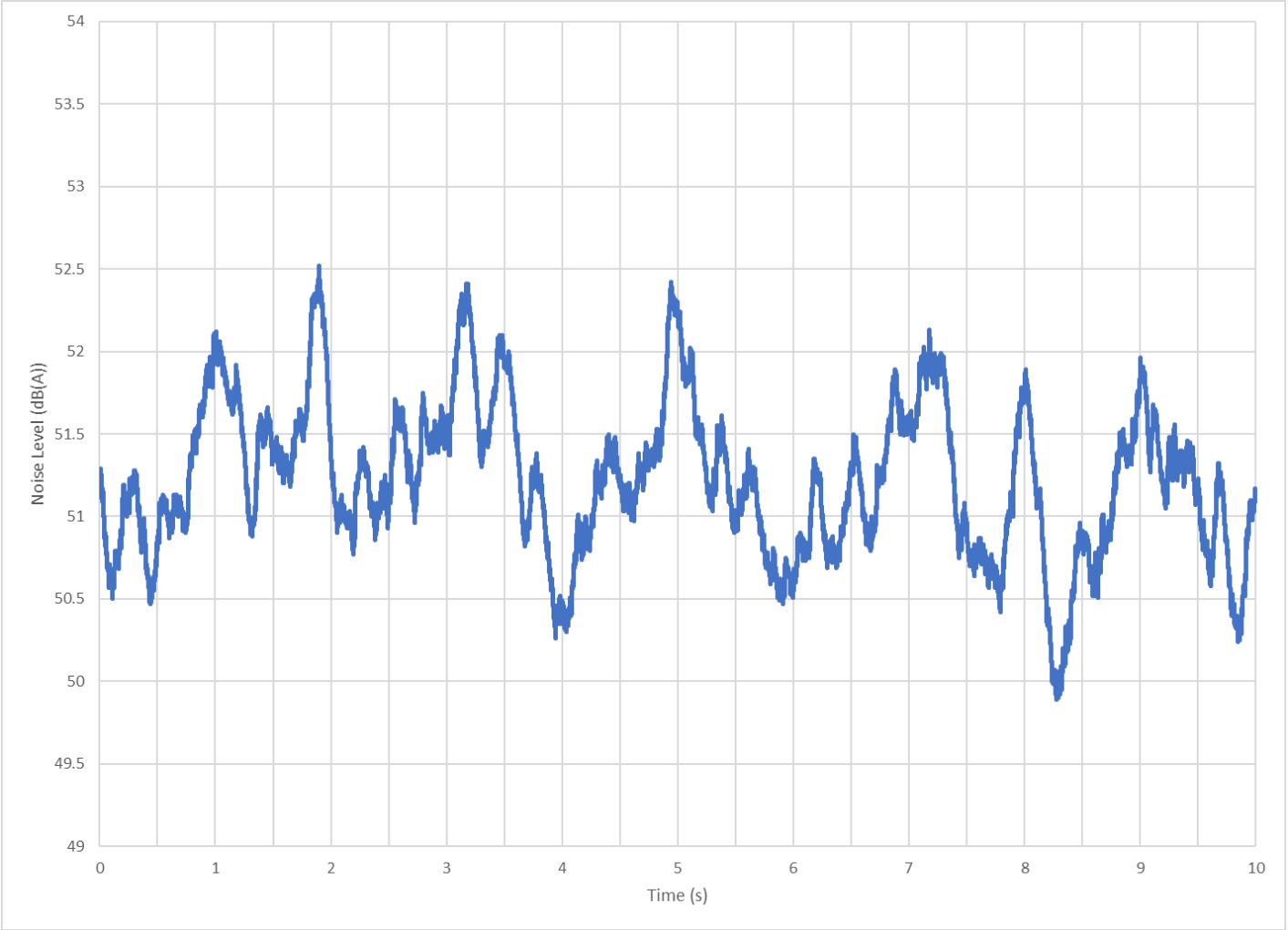

Figure 29: Amplitude Modulation – G06 - 11m/s

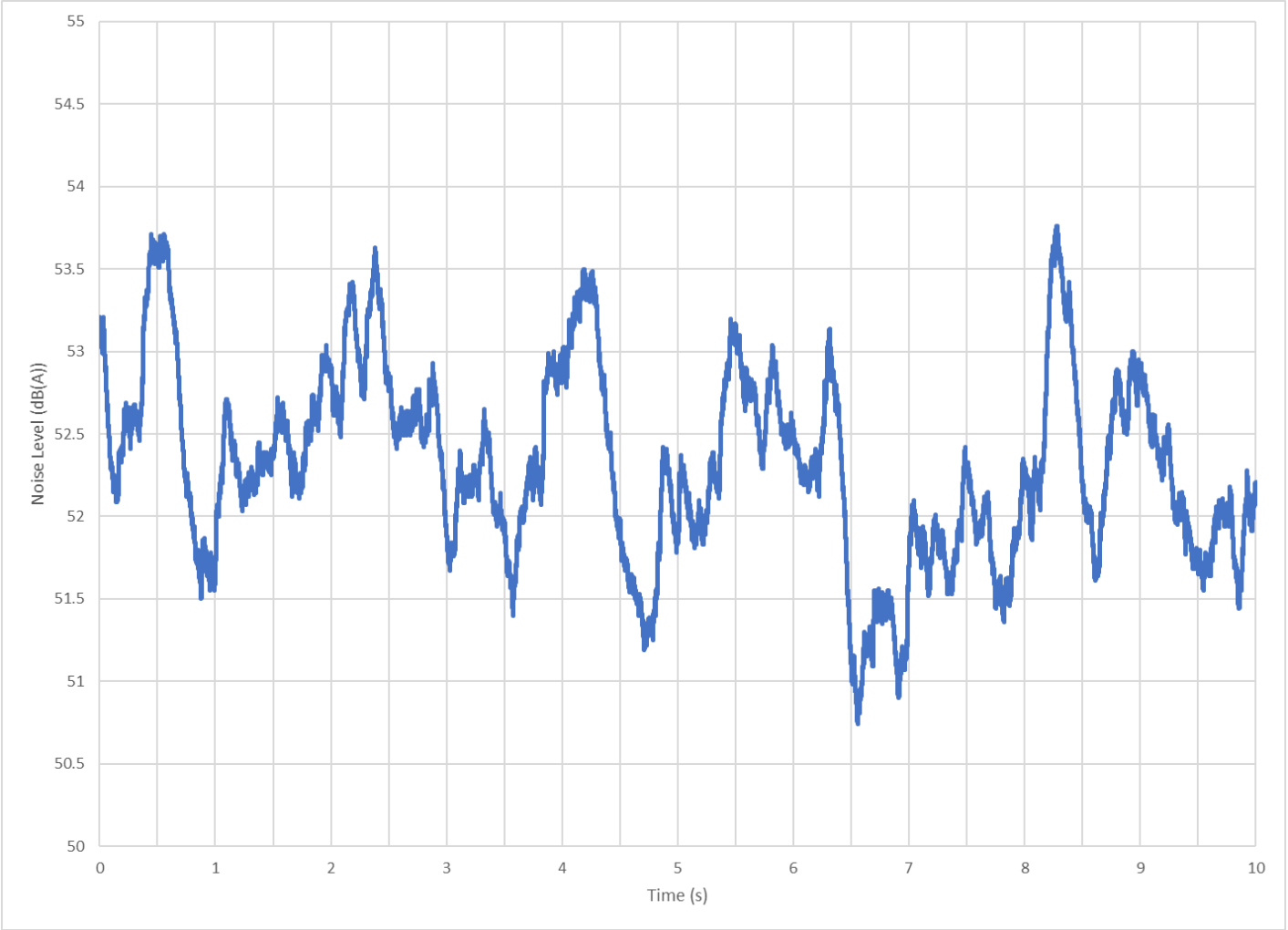

Figure 30: Amplitude Modulation – G06 - 12m/s

8 APPENDIX C: LOGGER LOCATION PHOTOS

Figure 31: H18 – First View

Figure 32: H18 – Second View

Figure 33: H46 – First View

Figure 34: H46 - Second View

Figure 35: H46 - Third View

Figure 36: H51 – First View

Figure 37: H51 - Second View

Figure 38: H51 - Third View

Figure 39: H62 – First View

Figure 40: H62- Second View

Figure 41: H62 - Third View

Figure 42:Turbine H09