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-Acoustic Report –

-Rail Noise & Vibration Assessment -

for the Proposed Development at

No. 27 Knox St Belmore

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Date	***Revision History***	***Prepared By:***	***Reviewed and Authorised by:***
10/01/2023	Initial Report	Domeniki Tsagaris	Moussa Zaioor
18/01/2023	Final report	Domeniki Tsagaris	Moussa Zaioor

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1.0 SCOPE OF WORK AND DESCRIPTION

The aim of this report is to determine the building materials to be used and the construction methods to be adopted such that the proposed development at No. 27 Knox St Belmore is built to achieve acceptable internal noise levels as per Canterbury Bankstown Council requirements.

In this report, noise intrusion levels and calculations are to be within the limits adopted by the Department of Planning's document titled *"Development Near Rail Corridors and Busy Roads – Interim Guidelines",* Clause 87 of the State Environmental Planning Policy – (Infrastructure) 2007, and Australian Standard/New Zealand Standard AS/NZS 2107:2016 "*Acoustics – Recommended Design Sound Levels and Reverberation Times".*

The site is located on Knox St in the suburb of Belmore (Figure 1 – Site Location). The T3 Bankstown Rail corridor servicing Belmore is located directly adjacent to the rear of the site (Figure 2 – Surrounding Environment). The architectural plans by Boris Grgurevic & Associates P/L dated October 14th, 2022 are for the proposed construction of a dual occupancy unit (Figure 3 – Proposed Site Plan).

2.0 ACOUSTIC AND VIBRATION DESIGN CONTROLS

2.1 DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS – INTERIM GUIDELINES & CLAUSE 87 OF THE SEPP

The development is to comply with the Department of Planning's document titled "*Development Near Rail Corridors and Busy Roads – Interim Guidelines"*. This document is referred to in this report as the Interim Guideline.

Section 3.5.1 of the abovementioned guideline provides a guide as to the level of assessment required when noise sensitive developments are located in the vicinity of existing rail lines. The subject site is approximately 20 meters away from the operational railway track. As per Figure 3.1 (presented below) of the Interim Guideline, noise mitigation should be incorporated into the proposed development.

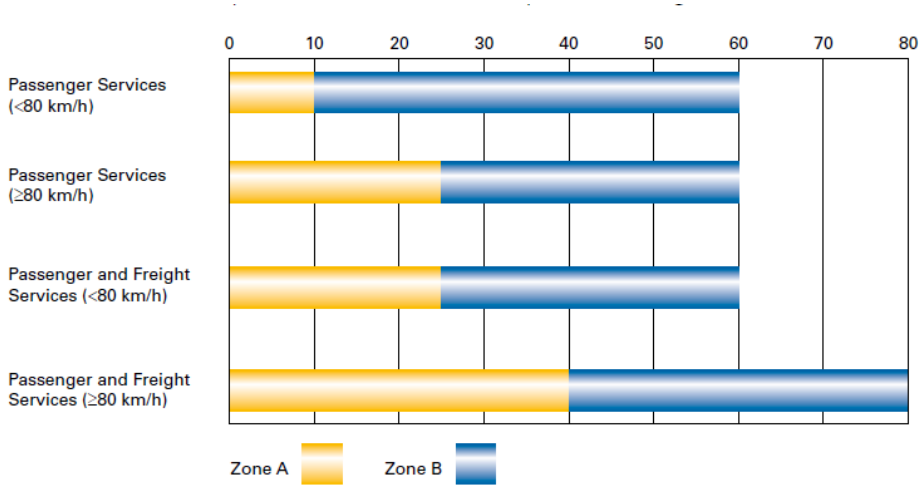

Figure 3.1: Acoustic Assessment Zones based on distance (m) of noise-sensitive development from operational track (not corridor)

The site is in Zone A and Section 3.5.1 of the Interim Guideline states that a full acoustic assessment of the above development should be carried out such that all internal noise levels within the development comply with Clause 87 of the SEPP.

Clause 87 of the SEPP states that where the development is for residential use and is located in or adjacent to a rail corridor, a consent authority must not grant consent unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

- In any bedroom in the building – 35db(A) at any time between 10:00pm and 7:00am and
- Anywhere else in the building (other than a garage, kitchen, bathroom, or hallway) – 40db(A) at any time.

Section 3.6.1 of the Interim Guideline states that when windows and doors are left open, indoor sound levels should not exceed the nominated noise criteria by more than 10 dB(A). If noise levels exceed the nominated rail noise criteria by more than 10 dB(A), then the provision of mechanical ventilation should be incorporated in the design of the building.

2.2 AUSTRALIAN/NEW ZEALAND STANDARD AS/NZS 2107:2016

It is usual practice, when we find it necessary to recommend internal sound levels in buildings to refer to Australian/New Zealand Standard AS/NZS 2107:2016 *"Acoustics – Recommended Design Sound Levels and Reverberations times for Building Interiors"*.

This standard provides recommended noise levels for steady state such as noise from building services and quasi-steady state sounds, such as traffic and rail noise. The noise levels recommended in AS/NZS 2107:2016 take into account the function of the area and apply to the sound level measured within the space unoccupied although ready for occupancy.

The standard recommends the following noise levels for residential developments:

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
7	RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)		
	Houses and apartments in inner city areas or entertainment districts or near major roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	35 to 45	—
	Sleeping areas (night time)	35 to 40	—
	Work areas	35 to 45	—
	Houses and apartments in suburban areas or near minor roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	30 to 40	
	Sleeping areas (night time)	30 to 35	
	Work areas	35 to 40	—

2.3 DEPARTMENT OF ENVIRONMENT & CONSERVATION NSW 'ASSESSING VIBRATION: A TECHNICAL GUIDELINE'

In addition to noise limits, floor vibration levels in habitable rooms should comply with the Department of Environment & Conservation NSW document titled *"Assessing Vibration: A Technical Guideline".* Most of these vibration limits stated in the document above are adopted from the British Standard BS 6472-1:2008 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80 Hz)"* criteria.

The acceptable values for intermittent vibration limits within the proposed residence as stated in section 2.4 of the NSW *"Assessing Vibration: A Technical Guideline"* are listed in Table 2.3.1 below.

Table 2.3.1– Acceptable Vibration Dose Values ($m/s^{1.75}$) for Residential Buildings

Location	***Vibration Limit $m/s^{1.75}$***
Residential buildings 16hr day (Daytime)	0.2 to 0.4
Residential buildings 8hr night (Night-time)	0.13 to 0.26

3.0 NOISE SURVEY, INSTRUMENTATION AND RESULTS

On January 16th, 2023 an engineer from this office went to No. 27 Knox St Belmore and carried out unattended acoustic measurements at a location representative of the proposed boundary line facing the rail corridor (Figure 4 – Noise & Vibration Readings Location – Point A).

All sound level measurements and analysis performed throughout this project are carried out with a NSRTW_MK3 wireless sound level data logger (Serial No.

CPp0Dd04c1c9iLtiSwBRPD- Office Tag -Machine 1-). The sound logger specifications are as follows:

- Type 1 digital MEMS microphone
- Non-volatile 128 Mb recording memory
- Records L-max, L-min and Leq levels
- Log interval adjustable from 125 ms (8 points per second) up to hours
- A, C and Z weighting curves
- Oscilloscope and spectrum analyser features
- Observes and records 100% of the acoustic signal
- Software calculates global Leq according to ISO and OSHA methods
- WIFI connectivity to report measured levels remotely
- Weatherproof casing designed for indoor/outdoor applications
- Activity detection and logging.
- Long-term measurement and recording of acoustic levels for environmental impact studies.

The logger is factory calibrated and the manufacturer's calibration certificate dated 15/09/2021 is presented in Figure 5 - Calibration Certificate.

The microphone was positioned at 1.5m from ground level. The machine was calibrated prior and after reading using our Svantek SV 33A S/N: 90200 Class 1 Calibrator with no significant drift recorded. All readings affected by strong wind or rain have been disregarded

A summary of the day and night noise readings are presented in the table below.

Table 3.1- Results of Noise Readings on January 16th, 2023*

January 16th, 2023	**L_{Aeq}**
Day & Evening Time – 7:00am-10:00pm	61 dB(A) **
Night & Early Morning Time – 10:00pm-7:00am	57 dB(A)***

*Noise logger was deployed to site for one day.
** Highest 10 th percentile L_{Aeq} recorded during the Day and Evening (15 hrs)
*** Highest 10 th percentile L_{Aeq} recorded during the Night (9 hrs)

4.0 RAIL VIBRATION MEASUREMENTS AND RESULTS

The floor vibration levels in habitable rooms should comply with the criteria stated in Section 2.3 of this report. Vibration measurements were carried out at Point A using a Vibrock V901 vibration monitor - SN :1574 calibration date: May 2021. The vibration dose, eVDV, for each train pass-by is calculated using the following formula:

$$eVDV = eVDV = 1.4 \times a_{rms} \times t^{0.25}$$

where, a_{rms} = weighted rms acceleration of train (m/s^2); and

t = time taken for the train pass-by

The total vibration for the train pass-by is eVDV (total) = $[N(V_e)^4]^{0.25}$ where N = the number of identical events.

Using the formulas above and the number of train pass-bys (plus 1 freight train for 2 minutes per hour), the eVDV (total) for the day period was found to be $0.1 m/s^{1.75}$ and much lower for the nighttime which complies with the NSW document titled *"Assessing Vibration: A Technical Guideline"*.

5.0 FAÇADE WEIGHTED SOUND REDUCTION INDEX R_W

The building façade weighted sound reduction index R_w is determined using the following formula:

$R_w = L_{(ext)} - L_{(int)} + 10 \log (S/A) + ADJ$ where

$R_{w=}$ Transmission loss of façade
$L_{(ext)=}$ External Noise level L eq $_{x\ hrs}$.= dB(A) at the façade.
$L_{(int)=}$ Internal Noise level L eq $_{x\ hrs}$.= dB(A) as determined by the noise criteria.
S = Total exterior surface area of the room.
A = Total sabins of absorption of the room.
ADJ = 3 + F+ G where F = 2 for Rail noise, F= 4 for Traffic noise with negligible trucks [percentage < 10%], and F= 6 for Traffic Noise with more than 10% trucks.

G allows for Primary angles of sound per the table below;

Angle of Incidence, deg.	Adjustment (G), dB
0-30	-3
30-60	-1
Random	0
60-80	+2

As the façade is made up of individual elements with different transmission coefficients. The total transmission loss of the façade is calculated using the following equation where n represents each material components of the façade :

$$R_{Total} = -10log_{10}\left(\frac{1}{\sum_{n=1}^{N} S_n}\sum_{n=1}^{N} S_n \tau_n\right)$$

External façade building recommendations calculated using above formulas are provided in Section 6.0 below to ensure compliance with the noise criteria stated in sections 2.0 of this report.

6.0 FAÇADE & ROOF BUILDING COMPONENTS

The most practical building façade and roof components and material specifications to suit the required noise reduction indices for the above project are provided in Table 6.1 below:

Table 6.1 Windows/Sliders, Doors, Walls & Roof Specifications

Building Component	*Rw Rating Achieved*
Dwellings 1 & 2 :	
• **Windows and Sliding Doors in Bedroom 4, Bedroom 3 & Sitting on 1st floor and Family area on ground floor are to be 10.38** mm laminated with full perimeter Mohair Fin acoustic seals (1)(2)(3).	**35**
• **Windows and Sliding Doors in all other habitable areas are to be 6.38** mm laminated with full perimeter Mohair Fin acoustic seals (1)(2)(3).	**32**
• **Windows and Sliding Doors in all other Non-Habitable Areas – Toilets, Laundries,.-** are to be unrestricted in accordance with AS 2047 (Windows in Buildings) (1)(2)(3).	**28**
Entry Doors are to be solid core with acoustic seals fitted around the doors. A drop seal is also required at the base of the doors(2).	**30-33**
External Walls are to be double skin 250 mm standard brick veneer construction with 50mm thick R2 insulation in the wall cavity (2)(3).	**50**
Roof is to be Colorbond Roofing with R2 insulation over battens, and 13mm plasterboard ceiling with 75mm thick, 11kg/m3 insulation, in the ceiling cavity (2), (3).	**48**

NB: This report is to be read in conjunction with the BASIX certificate and any other related building specifications.

(1). No see- through weep holes in windows/sliders.

(2) All gaps between window & door frames and the masonry walls are to be sealed using acoustic foam Hilti CP620 or similar. Glass wool batts should be applied prior to the application of the foam to seal larger gaps.

(3) All gaps are to be acoustically sealed.

Glazing Notes - Leaks and Glazing Attenuation:

- The Acoustic performance of a glazing system highly depends on the leaks around and within the glazing frame and façade. A double-glazing system with R_w of 40 will have its acoustic performance dropped to R_w of 30 (less than that of 6.38 mm glass) at a leak of 0.1 %. Moreover, a double-glazing system with R_w of 40 will have its acoustic performance dropped to R_w of 20 (less than that of 3.0 mm float glass) at a leak of 1 % of the glazing area.
- A 10.38mm laminated glazing system with R_w of 35 will have its acoustic performance dropped to R_w of 29 (less than that of 6.38 mm glass) at a leak of 0.1 %. Moreover, 10.38m mm laminated glazing system with R_w of 35 will have its acoustic performance dropped to R_w of 20 (less than that of 3.0 mm float glass) at a leak of 1 % of the glazing area.
- A double-glazing system with R_w of 40, a 10.38m laminated glazing system with Rw of 35, and a 6.38 mm laminated glazing system with R_w of 32 will all attain almost the same R_w of around 20 (less than that of 3.0 mm float glass) at a leak of 1 % in the façade or within/around the glazing system.

The graph below shows the actual transmission loss achieved inside a room with different glazing thicknesses relative to small leaks occurring along the window frame and façade.

A test report is to be provided from a recognized acoustic laboratory, verifying that the glazing system (glass, frame, and seals) will meet the nominated sound rating required.

7.0 DISCUSSION AND CONCLUSION

The proposed development at No. 27 Knox St Belmore, if carried out as recommended in plans and specifications and in accordance with the acoustic recommendations detailed in this report, will meet the required noise reduction levels as required by Clause 87 of the State Environmental Planning Policy – (Infrastructure) 2007, NSW Department of Planning's "*Development Near Rail Corridors and Busy Roads – Interim Guidelines"*, Australian/New Zealand Standard AS/NZS 2107 *"Acoustics – Recommended Design Sound Levels and Reverberation Times"*, and Canterbury Bankstown Council requirements.

Should you require further explanations, please do not hesitate to contact us.

Yours Sincerely,

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8.0 APPENDIX

Figure 1 - Site Plan

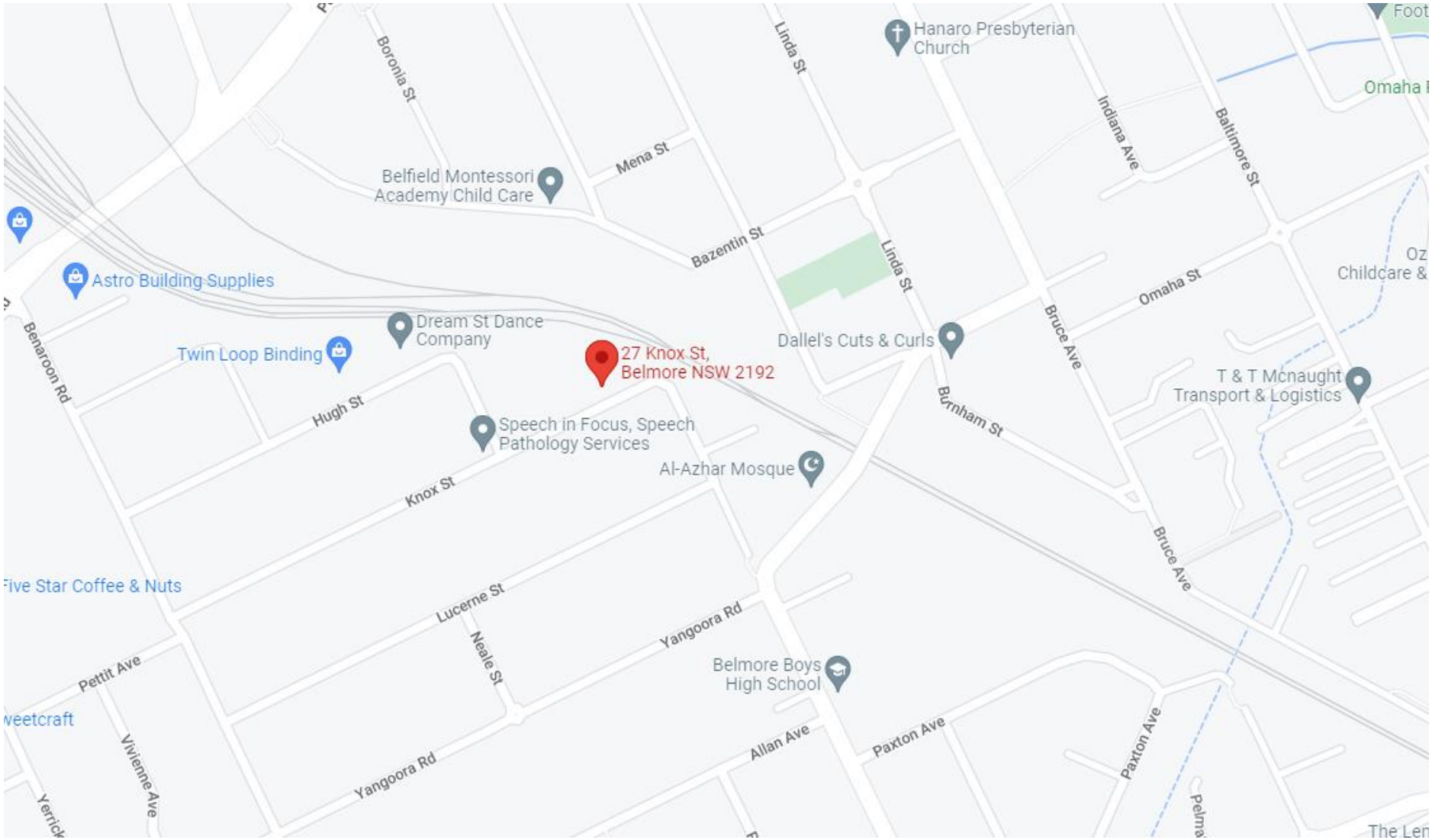

Figure 2 - Surrounding Environment

Figure 3 - Proposed Site Plan

Figure 4 - Noise & Vibration Readings Location (Point A)

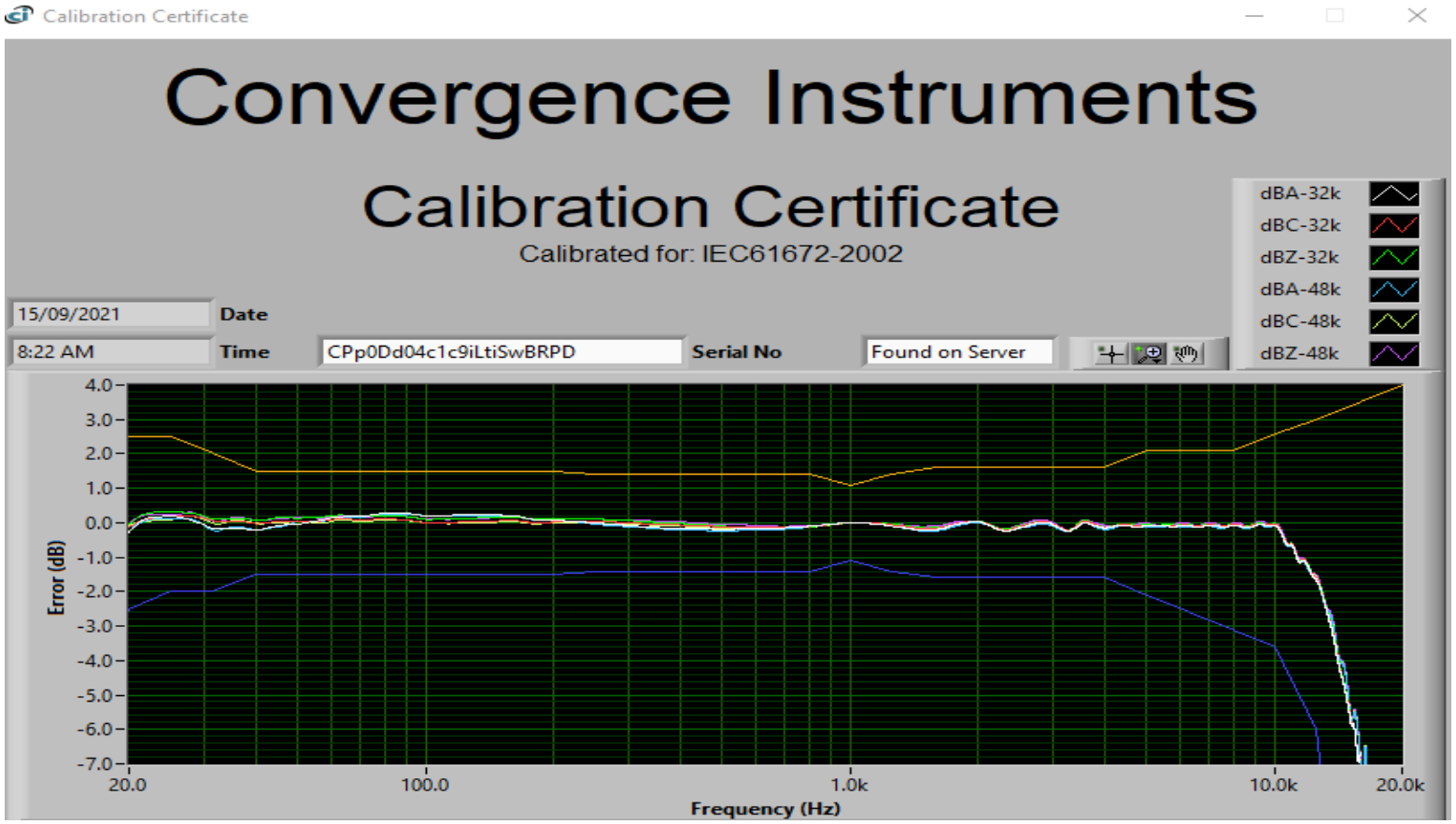

Figure 5 - Calibration Certificate