



**Independent Acoustic
Consultancy Practice**

Noise Impact Assessment

**External A/C Units
Ystalyfera**

5897/NIA1



Independent Acoustic Consultancy Practice

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Noise Impact Assessment

Project: External A/C Units

Site Address: CKs Foodstores - Cwmilynfell
Ystalyfera
SA9 2GH

HA Reference: 5897/NIA1

Date: 15/10/2021

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ISSUE / REVISION

Rev	Date			
0	15 October 2021	Filename	21.6236_NIA	
		Description	First Issue	
			Prepared by:	Checked by:
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TABLE OF CONTENTS

1. INTRODUCTION	4
2. GUIDANCE.....	5
2.1 British Standard 4142:2014+A1:2019	5
3. ENVIRONMENTAL NOISE SURVEY	7
3.1 Sound Sensitive Receivers.....	8
3.2 Procedure.....	8
3.3 Equipment.....	9
3.4 Weather Conditions	9
3.5 Results	10
4. NOISE IMPACT ASSESSMENT.....	11
4.1 BS 4142 Assessment	12
4.2 Noise Mitigation Assessment.....	13
5. CONCLUSION.....	15
APPENDIX A - ACOUSTIC TERMINOLOGY	16
APPENDIX B - DIAGRAMS, GRAPHS AND TABLES.....	17

1. INTRODUCTION

It is understood complaints have been received from nearby residents relating to new external air conditioning plant installed at CKs Foodstores, Cwmllynfell, Ystalyfera, SA9 2GH.

It is understood a total of 4no condenser units have been introduced to the plant compound area where 2no existing condenser units were already operational.

Hunter Acoustics has been commissioned to carry out a noise impact assessment of the plant. This report details results of a sample sound survey carried out at the site.

Acoustic terminology used in the report are explained in Appendix A.

2. GUIDANCE

2.1 British Standard 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 "Methods for rating and assessing industrial and commercial sound" describes a rating method comparing L_{Aeq} noise levels from the industrial source with pre-existing background L_{A90} levels at the residential receiver. It advises at a difference (industrial noise - background) of:

- +10dB or higher, likely to be an indication of a significant adverse impact, depending on the context.
- A difference of + 5dB, likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

As part of a subjective assessment a sliding scale of penalties can be applied to industrial/commercial sound levels which have acoustically distinguishing characteristics, including tonality, impulsivity and intermittency.

Tonality – A penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

Impulsivity – A penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it clearly perceptible, and 9dB where it is highly perceptible.

Other sound characteristics – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied

Intermittency – If intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.

2.1.1 BS 4142:2014+A1:2019 Section 11

Section 11 of BS 4142:2014+A1:2019 states;

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

- 1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse."

3. ENVIRONMENTAL NOISE SURVEY

Figure 3.1 - Site Plan

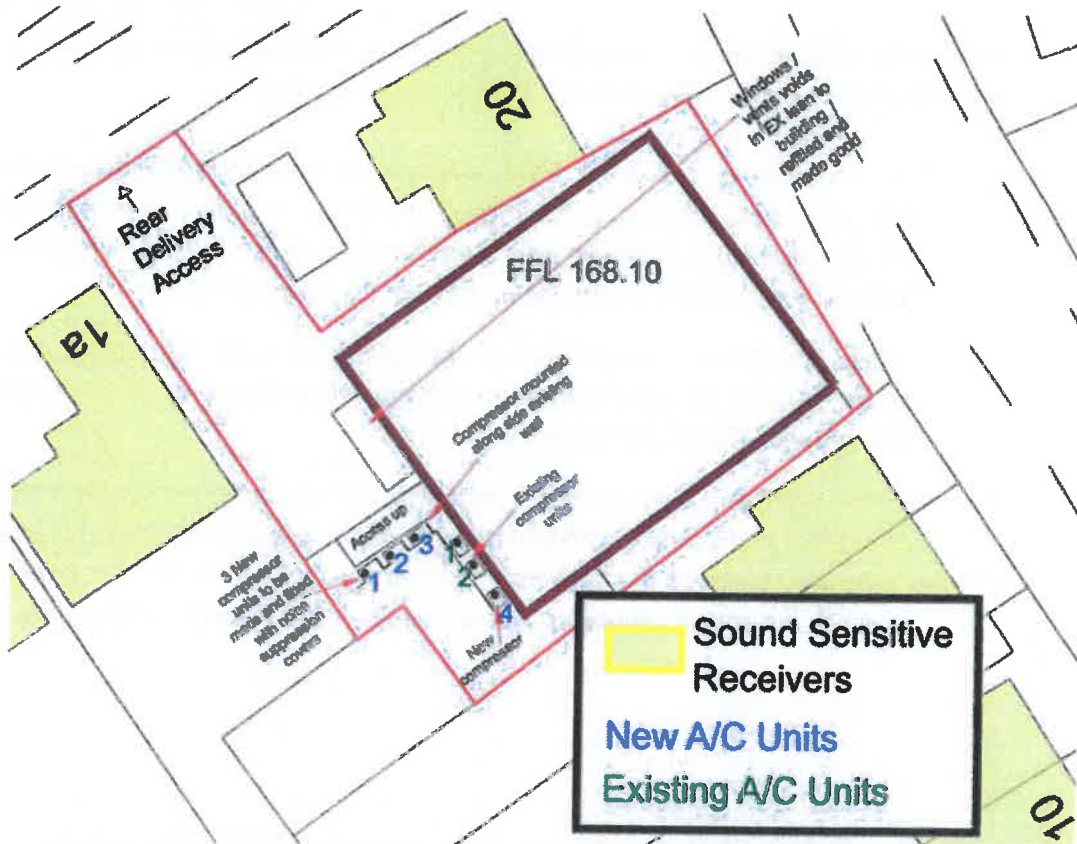


Figure 3.2 – Photo of A/C Units



3.1 Sound Sensitive Receivers

Figure 3.1 above shows the site compound where A/C units are installed and the closest existing SSRs highlighted in **YELLOW**. The most critical SSR is 1a Heol Daniel, located immediately west of the site compound. The property has a bedroom window overlooking the site compound, as indicated in Figure 3.3 below;

Figure 3.3 – View of nearest SSR – 1a Heol Daniel



3.2 Procedure

Sample noise measurements were undertaken on Wednesday 4th August 2021 from 1120hrs. Measurements were undertaken of the plant at source (at 1m distance) and at a position representative of the nearest SSR's first floor window (microphone on extender pole, elevated approximately 4.5m above local ground height).

Data including L_{Aeq} and background L_{A90} was logged over the monitoring period, along with continuous audio and 100ms data to allow for a detailed assessment in line with objective method under BS 4142:2014.

3.3 Equipment

The following equipment was used:

Table 3.1 Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-13022-E0	20 August 2019	TCRT19/1649
	Preamplifier	MA220	6853	20 August 2019	TCRT19/1649
	Microphone capsule	MC230	A14127	20 August 2019	TCRT19/1649
Rion	Calibrator (94.03dB @ 984Hz)	NC-73	10355197	01 June 2021	UCRT20/1265

3.4 Weather Conditions

Weather conditions were generally calm, dry and sunny. An occasional easterly light breeze was measured with an anemometer (up to 3m/s wind speed).

3.5 Results

Table 3.2 – Sample Measurement Results

Measure-ment	Description	Comment	L _{Aeq,T} (dB)
1	Ambient Sound Climate with No Plant Operational	Controlled by distant road traffic.	31.3
2	New A/C Unit 1 @ 1m	Taken in front of unit.	54.7
3	New A/C Unit 3 @ 1m	Taken in front of unit.	57.8
4	New A/C Unit 2 @ 1m	Taken to the rear of the unit.	57.5
5	Existing A/C Unit 1 @ 1m		65.7
6	Existing A/C Unit 1 Only @ Receiver (Outside 1st Floor Window)		44.4 *
7	New A/C Units 1-3 Only @ Receiver (Outside 1st Floor Window)		45.3 *
8	Existing A/C Unit 1 & New A/C Units 1-3. (Outside 1st Floor Window)	Total 4no units operational.	46.0 *

**measurement taken in proximity of a building façade; therefore a -3dB correction has been applied in order to achieve free-field sound levels for comparison with BS 4142:2014 guidance.*

Third-octave band spectra for each measurement is shown in Table B.1 of Appendix B.

3.5.1 Discussion

Throughout the survey period, A/C unit 4 (Panasonic U-140PZ2E8 Inverter) was not operational. It is therefore proposed to use manufacturer's sound data for the noise impact assessment. The manufacturer's data sheet can be found in Figure B.2 of Appendix B.

Existing A/C unit 2 was also not operational for the survey period – it has since been confirmed that the condenser is a back-up unit, used only when existing unit 1 is down/not operational. As both existing units 1 & 2 are identical, we have used sound level data from existing unit 1 for the noise impact assessment.

Observations made on site were that all 6no units had direct line of sight to the most critical SSR bedroom window (1a Heol Daniel), overlooking the compound. It was also observed during the survey that existing unit 1 (and likely unit 2 also) was significantly louder than the newer units.

4. NOISE IMPACT ASSESSMENT

A strict BS 4142:2014+A1:2019 type assessment of plant in the context of residential near an existing well established commercial site can be overly critical, and BS 4142 emphasises the importance of context.

We have carried out our assessment based on the background sound climate at the nearest Sound Sensitive Receivers (SSRs) being controlled by the existing 1no Condenser Unit within the site compound.

The A/C units are observed to have an intermittent operation; switching on and off whenever cooling/heating is required within the commercial premises. The units are shown to automatically switch on for an undeterminable length of time.

It is therefore assessed that the pre-existing sound climate already had an 'intermittent' and 'fluctuating' nature; and consequently, the introduction of 4no similar units does not significantly alter the characteristics of the overall sound climate – only potentially increase the absolute sound levels to the SSRs and perception of intermittency/tonality.

It is therefore put forward that the rating sound level (a sum of all 6no units operational at the same time with added penalties [BS 4142]) should be compared with a background sound level that includes the operation of the existing condenser unit. This is deemed suitable for a conducive assessment in line with BS 4142:2014+A1:2019. (Note: we understand there were no complaints received of A/C unit noise prior to the recent addition of the 4no units – please confirm).

Sound mitigation measures for the condenser units, outlined in order to reduce the overall noise impact, are detailed in section 4.2.

4.1 BS 4142 Assessment

In line with procedures outlined in BS4142:2014+A1:2019, the specific sound level for all 6no condenser plant units operational (worst-case scenario) was calculated by summing the following noise levels;

Table 4.1 – Specific Sound Level at Sound Sensitive Receiver Calculation

Description	Sound Level @ SSR		Commentary
	L_{Aeq} (dB)	L_{A90} (dB)	
Existing A/C Unit 1 Only	44.4	43.3	Measurement 6 of Table 3.2
Existing A/C Units 1 & 2 Only	47.4	46.3	Measurement 6 + 3dB
New A/C Units 1-3 Only	45.3	N/A	Measurement 7 of Table 3.2
Panasonic U-140PZ2E8 Inverter (New A/C Unit 4)	44.0	N/A	Based on Manufacturer's data - predicted back to SSR
Total (Specific Sound Level) = 50.6 dB L_{Aeq}			All 6no units operational

Referring to the table above, a BS4142 assessment has been undertaken for the introduction of the 4no new A/C units and can be seen in Table B.2 of Appendix B.

The assessment is based on a scenario where all 6 condensers are operational 100% on-time of a 15-min night-time assessment period – this is considered a robust assessment; in realistic terms, all 6 running is considered unlikely. Individual units may switch off and on during a 15-minute period, however the overall change in specific noise level is likely to be negligible and not clearly perceptible – unless all 6 condenser units switch on and off at exactly the same time, which we would again consider unlikely. No penalties for intermittency have therefore been included. (The rating level over background is already +10dB). A 2dB penalty has been included for tonality, as measured and assessed at the residence from the existing units.

Results of the BS 4142 assessment shows a “significant adverse impact, depending on the context” – in line with BS 4142:2014 methodology.

The context of the assessment is 4no new items of plant introduced to a plant compound with other existing items of plant (2no existing units). The existing ambient & background sound climate at the nearest Sound Sensitive Receivers (SSRs) is likely controlled by the existing condenser plant within the site compound.

Noise mitigation measures in the form of barrier screening or an acoustic enclosure is deemed necessary.

Noise Map modelling software has been used in order to assess the feasibility of using barriers to control the plant noise – this is discussed in Section 4.2 below.

4.2 Noise Mitigation Assessment

There is currently no screening between the A/C units and the nearest residences, overlooking the plant compound. First floor windows have direct line-of-sight to the condensers.

The A/C units are shown to be located approximately 1m above site ground level.

4.2.1 Screening

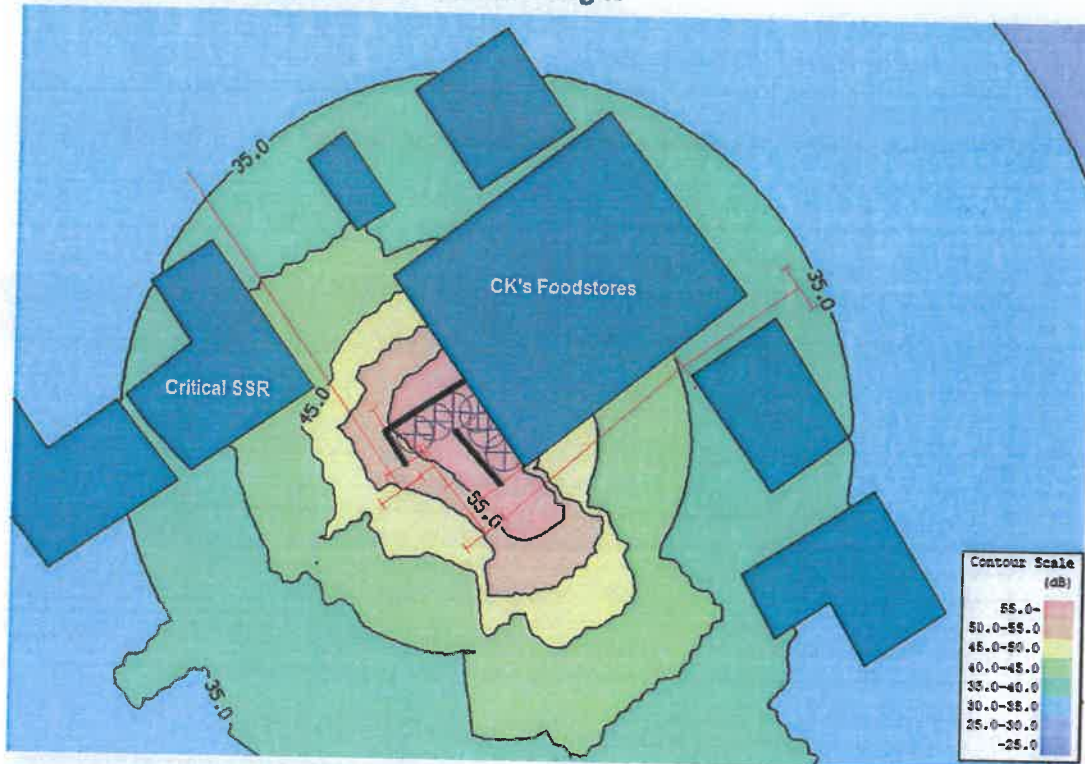
A minimum 2m high barrier located 1m from the condenser plant is indicated to be required, encompassing the units. (A minimum 2m high barrier height is determined in order to shield line-of-sight to the SSRs).

The barrier shall be a solid structure with no gaps, typically a standard close board timber fence with overlapped panels. Close board fence sections shall achieve a minimum mass per unit area of 10kg/m² (typically 20-25mm thickness), imperforate, vermin and rot proof and able to withstand wind forces.

A suggested barrier arrangement (highlighted in **BLACK**) has been modelled in Noise Map, and is shown in Figure 4.1 below.

We would advise confirming with the condenser unit manufacturer / building services engineer whether installing an imperforate barrier in close proximity of the units is feasible. Fundamentally, any screening solution that removes line-of-sight from the units to the SSRs is likely to provide a significant reduction in overall plant noise levels.

Figure 4.1 - New Arrangement Scenario (6no A/C Units) with Barrier Attenuation Measures – 4.5m above Local Ground Height



Noise Map model results indicate an overall level of 44dB $L_{Aeq,T}$ from all 6no A/C units, at the most critical window overlooking the plant compound, with barrier attenuation measures installed.

Barriers in this arrangement are indicated to provide an approximate reduction in plant noise to the SSR of 7dB, resulting in a +3dB rating level over background. BS 4142:2014 would describe this as "likely to be an indication of adverse impact, depending on the context". The renewed context would be mitigated plant noise levels reduced to the pre-existing ambient noise climate.

Section 11 of BS4142:2014+A1:2019 refers to taking into account absolute noise levels into context. At 44dB $L_{Aeq,15min}$ at the SSR, this represents an absolute level that is in line with the existing scenario, with only 1no unit operational.

As we are assessing at first floor level at night, the internal noise level is also more important to consider than the external noise level.

Allowing 15dB attenuation through a partially open window, internal plant noise levels would equate to 29dB $L_{Aeq,15mins}$, meeting the 30dB L_{Aeq} guidance value quoted in World Health Organisation (WHO) 'Guidelines for Community Noise, 1999' and British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings'.

4.2.2 Acoustic Enclosure

As an alternative to local screening, an acoustic enclosure that encompasses each (or a group of) units could be installed.

The following list is not exhaustive but outlines a number of UK suppliers of acoustic enclosures:

Table 4.2 - Acoustic Enclosure Supplier List

Supplier	Website	Telephone
Allaway Acoustics	http://www.allawayacoustics.co.uk/	01992 550825
Ambient Acoustics Ltd	https://www.ambientacoustics.co.uk/	01934 712802
Caice	https://www.caice.co.uk/	0118 918 6470
Emtec	http://emtecproducts.co.uk/	020 8848 3031
IAC Acoustics	https://www.iacacoustics.global/	01962 873000
Wakefield Acoustics	https://www.wakefieldacoustics.co.uk/	0203 143 5800

An enclosure solution that entirely covers the condenser units is likely to provide a ≥ 10 dB reduction to the SSR however, a further review of the proposed acoustic enclosure could be carried out if this option is selected.

5. CONCLUSION

A noise impact assessment has been carried out in regards to the inclusion of 4no new condenser plant units installed to an existing plant compound at CKs Foodstores - Cwmllynfell, Ystalyfera, SA9 2GH. The 4no new units join 2no existing condensers within the plant compound.

The noise impact assessment has been carried out in line with BS4142:2014+A1:2019 and indicates a "significant adverse impact, depending on the context". A noise map model has been generated in order to assess possible barrier/enclosure solutions.

With the inclusion of barrier/enclosure noise mitigation, absolute sound levels from all 6no condenser units to the nearest Sound Sensitive Receivers are indicated to fall in line with pre-existing sound levels, with only 1no condenser unit operational. A renewed BS4142 assessment would describe this as "likely to be an indication of adverse impact, depending on the context".

Assessing noise intrusion through a partially open window, internal plant noise levels are indicated to fall within 'desirable' internal ambient noise criteria for habitable rooms, as quoted in WHO & BS 8233:2014 guidance.

APPENDIX A - ACOUSTIC TERMINOLOGY

Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver

APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Table B.1 – Third-Octave Band Spectra

Measure- ment	Description	Comment	$L_{Aeq,T}$ (dB)	Third-Octave Band L_{eq} (dB)																									
				50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz		
1	Background (No Plant Operational)	Controlled by distant road traffic.	31.3	42.6	37.6	39.4	36	31.6	32.3	28.9	28.4	26.1	24.6	24.6	21.4	21.7	20.6	18.9	17.6	16.1	14.7	14	12.8	12.9	11.8	11.8	11.8		
2	New A/C Unit 1 @ 1m	Taken in front of unit.	54.7	63.7	44.6	44.2	64.2	44.4	51.9	52.6	51.5	48.8	50.5	42	42.9	41	48.6	43.9	36.6	40.5	38.9	31.1	30.9	29.1	28.2	26.7	24.4		
3	New A/C Unit 3 @ 1m	Taken in front of unit.	57.8	64.8	49.8	44	63.2	47	58.1	54.1	53.3	54.7	47.9	44.6	46.4	40.3	53	50.7	37.7	39.5	40	34.9	35.9	30.4	29	25.9	22.1		
4	New A/C Unit 2 @ 1m	Taken to the rear of the unit.	57.5	59.2	47.6	47.3	60.1	44.3	48.7	57.8	48.1	49.9	43.7	49.3	46.5	51.3	52.4	46.7	40	39.5	38.8	33.4	34.4	33.6	31	26.3	23.1		
5	Existing A/C Unit 1 @ 1m		65.7	62.1	67.1	58.2	67.2	63.6	65.1	61.9	59.4	58.5	57.8	58.7	58.7	56.7	56.6	55.4	51.7	49.7	47.7	46	43.5	41.1	37.9	35.9	32.8		
6	Existing A/C Unit 1 Only @ Receiver (Outside 1st Floor Window)		44.4 *	49.9	46.2	41.6	49	42.5	44.4	45.1	42.7	40.2	37.4	37.1	35.7	35.4	34.3	32.1	30.1	28.5	25.7	23.5	22.3	18.9	18.2	13.1	10.9		
7	New A/C Units 1-3 Only @ Receiver (Outside 1st Floor Window)		45.3 *	52.2	47.6	40.9	45.2	39.6	42.3	42.1	40.5	42.1	37.8	36.8	35.5	36.6	38.1	34.3	30.7	29.2	27.1	24	21.8	20.2	16.5	14.9	12.2		
8	Existing A/C Unit 1 & New A/C Units 1-3.	Total 4no units operational.	46 *	52.3	42.7	41.5	47.9	39.6	43.1	43.4	41.5	42.3	37.6	36.8	36.5	37.2	39.8	35.5	31.7	30.2	27.4	25	25.2	21.3	17.7	15.5	12.6		

* Measurement taken in proximity of a building façade, therefore a -3dB correction has been applied in order to achieve free-field sound levels for comparison with BS 4142:2014 guidance.

Noise Impact Assessment

Project: External A/C Units, Ystalyfera



Figure B.1 – Narrow-band Tonality Analysis – New A/C Units 1-3 @ Nearest SSR

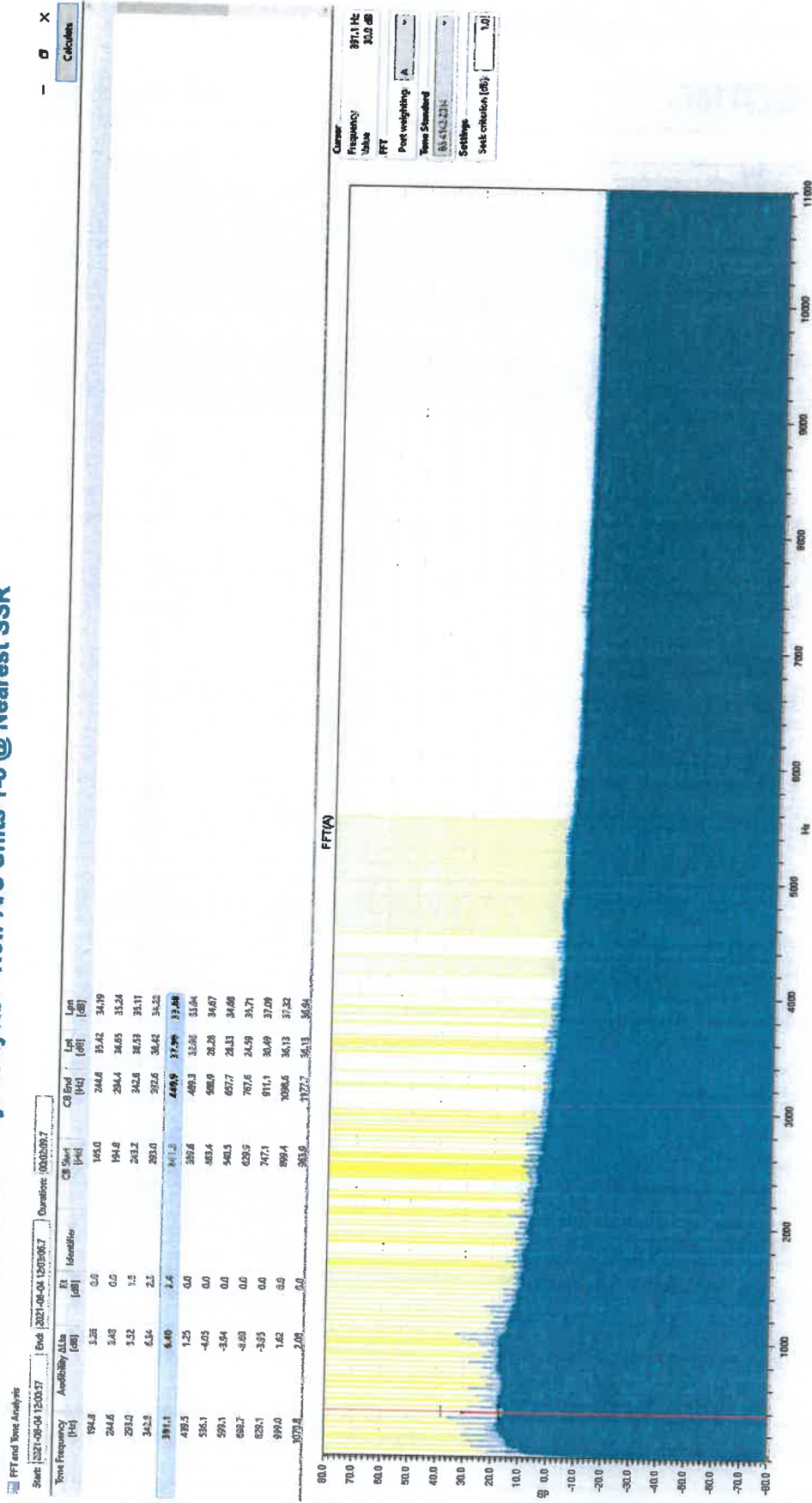


Figure B.2 – Panasonic Inverter Data Sheet

Panasonic

heating & cooling solutions

PAC Standard 4 Way 90x90 • R32		Three Phase
KX		24.9 kW
Remote controller		KRT-140PU22B
Cooling capacity (Nominal)		CT-RTC38
Cooling capacity (Min)	kW	14.0
Cooling capacity (Max)	kW	3.3
EER (Nominal) (1)	W/W	15.0
EER (Min) (1)	W/W	3.23
EER (Max) (1)	W/W	5.32
SEER (2)	W/W	2.73
Pdesign (cooling)	kW	6.5
Input power cooling (Nominal)	kW	14.0
Annual energy consumption cooling (3)	kWh/a	4.34
Input power cooling (Min)	kW	—
Input power cooling (Max)	kW	0.62
Heating capacity (Nominal)	kW	3.30
Heating capacity (Min)	kW	14.0
Heating capacity (Max)	kW	3.4
COP (Nominal) (1)	W/W	16.0
COP (Min) (1)	W/W	4.18
COP (Max) (1)	W/W	3.33
SCOP (2)	W/W	5.48
Pdesign at -18°C	kW	3.9
Input power heating (Nominal)	kW	14.0
Input power heating (Min)	kW	3.35
Input power heating (Max)	kW	9.62
Annual energy consumption heating (3)	kWh/a	4.80
Indoor unit		S-140PU2E3B
Indoor air flow (Hi)	m³/min	36.0
Indoor air flow (Med)	m³/min	29.0
Indoor air flow (Lo)	m³/min	20.0
Moisture removal volume	L/h	6.0
Indoor sound pressure (Med) (4)	dB(A)	40
Indoor sound pressure (Lo) (4)	dB(A)	34
Indoor sound power (Hi)	dB(A)	62
Indoor sound power (Med)	dB(A)	55
Indoor sound power (Lo)	dB(A)	49
Indoor dimension (Height)	mm	319
Indoor dimension (Width)	mm	840
Indoor dimension (Depth)	mm	840
Panel dimension (Height)	mm	38.5
Panel dimension (Depth)	mm	950
Indoor net weight	kg	25
Panel net weight	kg	5
Panasonic X Generator		Mark 1
Outdoor unit		U-140P22E3B
Outdoor power source		380 - 400 - 415
Current in cooling (1p 220V / 3p 380)	A	6.85
Current in cooling (1p 230V / 3p 400)	A	6.50
Current in cooling (1p 240V / 3p 415)	A	6.25
Current in heating (1p 220V / 3p 380)	A	5.25
Current in heating (1p 230V / 3p 400)	A	4.85
Current in heating (1p 240V / 3p 415)	A	4.60
Outdoor air flow (Cool)	m³/min	80
Outdoor air flow (Heat)	m³/min	88
Outdoor sound pressure (Cool - Hi)	dB(A)	56
Outdoor sound pressure (Heat - Hi)	dB(A)	56
Outdoor sound power (Cool - Hi)	dB(A)	74
Outdoor sound power (Heat - Hi)	dB(A)	74
Outdoor dimension (Height)	mm	896
Outdoor dimension (Width)	mm	990
Outdoor dimension (Depth)	mm	370
Outdoor net weight	kg	94
Pipe diameter (Liquid)	inch (mm)	3/8 (9.52)
Pipe diameter (Gas)	inch (mm)	5/8 (15.88)
Pipe length range	m	5 - 50
Elevation difference (input) (5)	m	30
Pipe length for additional gas	m	30
Additional gas amount	g/m	45
Refrigerant (R32) / CO2 Eq.	kg / T	2.98 / 2.0115
Operating range (Cool - Min)	°C	-10
Operating range (Cool - Max)	°C	43
Operating range (Heat - Min)	°C	-15
Operating range (Heat - Max)	°C	24

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Table B.2 – BS 4142:2014 Assessment at 1a Heol Daniel (Background with existing 1no A/C Unit)

Results		Relevant Clause	Commentary
Measured Levels at SSR	See measurement results for all items of plant in Table 3.2.	7.3.2	
Residual sound level	N/A	7.3.3	N/A
Background sound level	$L_{A90,15min} = 43\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at SSR controlled by Existing A/C unit 1.
Assessment made during the night-time so the reference time interval is 15-mins.		7.2	
Specific sound level.	$L_{Aeq,15min} = 51\text{dB}$	7.3.4	Calculated sum of plant sound levels predicted to the SSR – see Table 4.1.
Acoustic feature correction	Tonality = 2dB	9.2	Narrow-band analysis indicates audible tone at 391Hz – See Figure B.1.
Rating Level	$(51+2) = 53\text{dB}$		
Background sound level (night-time)	$L_{A90(0700-2300hrs)} = 43\text{dB}$	8.3	
Excess of rating over background sound level	$(53 - 43) \text{ dB} = 10\text{dB}$	11	
Assessment indicates significant adverse impact likely, depending on context		11	At 10dB above background BS 4142:2014 advises: "likely to be an indication of a significant adverse impact, depending on the context."
Uncertainty of assessment		10	Uncertainty in noise measurements is considered low.