

Semi-Permanent Marquee at
Tournerbury Woods Estate, Hayling Island
Noise Assessment

Report prepared on behalf of:

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Executive summary

A semi-permanent marquee has been erected at Tournerbury Woods Estate, Hayling Island, the marquee being situated on level ground amongst trees to the north of Woods Cottage

It is intended that the marquee will be used from April to December (inclusive) to host wedding receptions and similar events. It is anticipated that wedding receptions will take place mainly on Saturday afternoons and evenings, with other events taking place at other times.

For events that run into the evening it is proposed that the normal finishing time will be no later than 02.00 hours, with the playing of amplified music and the serving of refreshments finishing no later than this unless prior agreement has been obtained from the local planning authority, Havant Borough Council.

The use of the proposed marquee for entertainment purposes will have the potential to affect residential properties in the area, the nearest of these being situated to the south-east in Selmore. This potential has been assessed in terms of predicted music noise levels, relevant national guidance and existing baseline noise conditions.

In order to minimise off-site music noise impacts, it is proposed to employ a Zone Array distributed PA system supplied by Direct Acoustic Solutions Ltd. This system minimises music noise levels propagating in a horizontal direction as discussed in detail below, especially at low frequencies.

With this system a music level of **95 dB LAeq,t** on the dance floor will reduce to approximately **60.7 dB LAeq,t** at a distance of 20 metres.

A noise modelling exercise has confirmed that with this system a music level of **95.0 dB LAeq,t** on the dance floor will give rise to music noise levels at the residences around the site that are well below **38 dB LAeq,5m**, ignoring the attenuation that will be provided by the trees around the marquee, and assuming high water in the area to the south of the marquee.

Assuming further attenuation of around **6 dB** or more from the trees around the marquee, the absolute worst-case music noise level at potentially affected residential properties of will be no higher than **28 dB LAeq,t**. This corresponds to an internal noise level with a partially open window of around **15 dB LAeq,t**.

This is expected to equate to inaudibility, and accordingly mitigation in addition to the distributed loudspeaker array supplied by Direct Acoustic Solutions will not be required.

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Chapter 1 - Introduction

A semi-permanent marquee has been erected at Tournerbury Woods Estate, Hayling Island, the marquee being situated on level ground amongst trees to the north of Woods Cottage, the location being shown in Figure 1.

It is intended that the marquee will be used from April to December (inclusive) to host wedding receptions and similar events. It is anticipated that wedding receptions will take place mainly on Saturday afternoons and evenings, with other events taking place at other times.

For events that run into the evening it is proposed that the normal finishing time will be no later than 02.00 hours, with the playing of amplified music and the serving of refreshments finishing no later than this unless prior agreement has been obtained from the local planning authority, Havant Borough Council.

The use of the proposed marquee for entertainment purposes will have the potential to affect residential properties in the area, the nearest of these being situated to the south-east in Selmore. This potential has been assessed in terms of predicted music noise levels, relevant national guidance and existing baseline noise conditions.

In order to minimise off-site music noise impacts, it is proposed to employ a Zone Array distributed PA system supplied by Direct Acoustic Solutions Ltd. This system minimises music noise levels propagating in a horizontal direction as discussed in detail below, especially at low frequencies.

Although the marquee development may have some limited potential to increase road traffic flows on the local road network, such increases are expected to be of no more than minor significance in noise terms, and there is no potential for noise levels on the nearby major roads to be increased.

Chapter 2 – Noise assessment criteria

A glossary of acoustical terms is reproduced in Appendix A.

It is appropriate that the music noise assessment should take account of the guidance provided by:

- National Planning Policy Framework (NPPF) (Ref 1);
- Noise Policy Statement for England (NPSE) (Ref 2);
- Noise Council Code of Practice on Environmental Noise Control at Concerts (NC CoP) (Ref 3);
- Institute of Acoustics Draft Code of Practice on the Control of Noise from Pubs and Clubs - (IOA Draft CoP) (Ref 4);
- Institute of Acoustics Good Practice Guide on the Control of Noise from Pubs and Clubs (IOA GPG) (Ref 5);
- Phase 1 Report on Noise from Pubs and Clubs published by DEFRA (Phase 1 DEFRA Report) (Ref 6); and
- Phase 2 Report on Noise from Pubs and Clubs published by DEFRA (Phase 2 DEFRA Report) (Ref 7).

The content of the reference documentation referred to above is discussed below.

2.1 National Planning Policy Framework

The National Planning Policy Framework was published in March 2012 and came into force with immediate effect. Amongst the documents listed as being replaced by this document is PPG24, which was formerly the central national planning guidance document relating to noise in the UK.

Whereas PPG24 provided quantified advice on the determination of the suitability of sites for residential development on the basis of prevailing noise levels in the form of Noise Exposure Categories, the NPPF provides purely quantitative guidance (although the NPSE refers to assessment criteria in a general sense).

Section 8 of the NPPF 'Promoting healthy communities' makes no reference to environmental noise, the only comments relating to noise being listed below.

Section 11 'Conserving and enhancing the natural environment' advises:

"109. The planning system should contribute to and enhance the natural and local environment by:

-
- preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air,

water or noise pollution or land instability;

-”

and

“123. Planning policies and decisions should aim to:

- avoid noise giving rise to significant adverse impacts²⁷ on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts²⁷ on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of nearby land uses since they were established;²⁸ and
- identify and protect areas of tranquillity that have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”

(Footnote 27 refers to an explanatory note in the NPSE, which is discussed below. Footnote 28 refers to “the provisions of the Environmental Protection Act 1990 and other relevant law”.)

Section 13 ‘Facilitating the sustainable use of materials’ includes guidance relating to noise, but this is provided in the context of minerals extraction activities.

2.2 Noise Policy Statement for England

The Noise Policy Statement for England was published by the Department for Environment, Food and Rural Affairs (Defra) in March 2010.

Key concepts used in the NPSE are:

- **NOEL** or “no observed effect”, meaning the level (of noise) below which no effect on health or quality of life can be detected;
- **LOAEL** or “lowest observed adverse effect”, meaning the level (of noise) above which adverse effects on health and quality of life can be detected; and
- **SOAEL** or “significant observed adverse effect”, meaning the level (of noise) above which significant adverse effects on health and quality of life can occur.

The **first aim** of the NPSE is to: “**Avoid significant adverse impacts** on health and quality of life from environmental, neighbour and neighbourhood noise within the context of the policy on sustainable development”.

The **second aim** of the NPSE is to: “**Mitigate and minimise adverse impacts** on health and quality of life from environmental, neighbour and neighbourhood noise within the context of the policy on sustainable development”.

The **third aim** of the NPSE is to: **“Where possible, contribute to the improvement of health and quality of life through the effective management of environmental, neighbour and neighbourhood noise within the context of the policy on sustainable development”**.

The second aim refers to the situation lies somewhere between **LOAEL** and **SOAEL**.

However, paragraph 2.3 of the Explanatory Note makes it clear that the approach to the minimisation of noise from environmental and related sources should be reasonable and balanced in stating:

- “2.3 Furthermore, the broad aim of noise management has been to separate noise sources from sensitive noise receivers and to “minimise” noise. Of course, taken in isolation and to a literal extreme, noise minimisation would mean no noise at all. In reality, although it has not always been stated, the aim has tended to be to minimise noise “as far as reasonably practical”. This concept can be found in the Environmental Protection Act 1990, where, in some circumstances, there is a defence of “best practicable means” in summary statutory nuisance proceedings.”

2.3 Noise Council Code of Practice on Environmental Noise Control at Concerts

The NC CoP was published by the Noise Council in 1995 to provide guidance on the assessment and control of noise arising from musical events taking place at outdoor sites and similar venues. Specifically, paragraph 1.1 states:

1.1 Large music events involving high powered amplification are held in sporting stadia, arenas, open air sites and within lightweight buildings. These events give pleasure to hundreds and in some cases thousands of people. However, the music from these events can cause disturbance to those living in the vicinity. The purpose of this code is to give guidance on how such disturbance or annoyance can be minimised.”

Chapter 3 of the document sets out a series of guideline entertainment / amplified music noise levels that should not be exceeded in order to provide a level of acoustic protection for the neighbours. This is reproduced in Appendix B, along with Chapter 2 of the document, which provides a list of definitions of the technical terms used in the Code.

Although the events proposed at the Tournerbury Woods marquee will be on a much smaller scale than the larger outdoor concerts covered by the Noise Council Code of Practice, it is considered that the Guideline values set out in the Code are of relevance at Tournerbury Woods. Specifically, it is considered appropriate that at nearby residences:

- for events continuing after 23.00 hours amplified music should not be audible within the habitable rooms of nearby residence with windows open in a typical manner for ventilation.

2.4 IOA Draft Code of Practice on the Control of Noise from Pubs and Clubs

The IOA Draft CoP was published in 1999 by a working party set up by the Institute of Acoustics (IOA) in 1996. At the time of its inception the working party included specialists in acoustics and noise control as well as members representing the licensed and entertainments trades, but latterly the trade representatives withdrew from the working party.

A copy of Chapter 5 of the document is provided in Appendix C. In summary, the noise control criteria recommended are:

- between 23.00 and 07.00 hours amplified music, singing and speech should not be audible inside noise sensitive premises;
- where events are relatively infrequent (once per week or less and less than 30 times per year) the criteria set out in the Noise Council Code of Practice are considered appropriate;
- between 23.00 and 07.00 hours the level of amplified music, singing and speech measured outside noise sensitive premises should show no increase over the prevailing baseline noise level, these levels being measured in terms of dB LAeq,5m; and
- where there are more than 30 events per year and no more than 2 events per week, the level of amplified music, singing and speech measured outside noise sensitive premises should be no more than **3 dB** above the prevailing baseline noise level, these levels being measured in terms of dB LAeq,5m; and
- where there are more than 30 events per year and more than 2 events per week, the level of amplified music, singing and speech measured outside noise sensitive premises should show no increase over the prevailing baseline noise level, these levels being measured in terms of dB LAeq,5m.

As well as the above broad-band criteria there are also corresponding recommended criteria for the octave bands centred on 63 Hz and 125 Hz.

2.5 IOA Good Practice Guide on the Control of Noise from Pubs and Clubs

The IOA GPG was published in 2003 following on from the IOA Draft CoP.

A copy of Chapter 2 of the document is provided in Appendix D. In summary, the bullet points in paragraph 2.4 recommend that:

- for premises where entertainment takes place on a regular basis, music and associated sources should not be audible inside noise sensitive property at any time; and
- for premises where entertainment takes place less frequently, music and associated sources should not be audible inside noise sensitive property between 23.00 and 07.00 hours, while at other times a balance should be struck between the rights of those seeking and providing entertainment and those who may be disturbed by the noise.

The document considers that a noise is not inaudible if its level is sufficiently low to prevent it being recognised as emanating from the source in question and when it does not alter the perception of the ambient noise environment.

2.6 Phase 1 Report on Noise from Pubs and Clubs published by DEFRA

The Phase 1 DEFRA Report was published in 2005 and provides a review of methods employed for the assessment of entertainment noise both within the UK and abroad.

The report discusses a number of criteria that could be applied in the objective assessment of noise from licensed premises, and also sets out the objective standards adopted by a number of UK local authorities and other European countries. Table 3 on page 20 of the document includes details of the internal noise limits applied by seven of the countries excluding the UK. (No internal limit is given for the UK.) The lowest limits adopted by the other European countries range from **22 dB(A)** (France and Norway) to **25 dB(A)** (Germany, Italy, the Netherlands and Sweden).

Assuming that a façade with a partially open window attenuates externally generated noise by approximately **13 dB**, internal noise limits of **22 dB(A)** and **25 dB(A)** correspond to external levels of entertainment noise of **35 dB(A)** and **38 dB(A)** respectively.

Table 3 from the Phase 1 DEFRA report on Noise from Pubs and Clubs is reproduced in Appendix E.

2.7 Phase 2 Report on Noise from Pubs and Clubs published by DEFRA

The Phase 2 DEFRA Report was published in 2006 and extends this review to include a larger number of possible assessment methods. The report also includes the details of laboratory and field tests that were undertaken to establish which objective assessment criteria correlated well with the subjective human response.

The report found that there was a good correlation between the subjective response to entertainment noise and its absolute level as experienced by experimental subjects when specified in terms of L_{Aeq} (although it points out that the use of the measurement of absolute L_{Aeq} levels of entertainment noise is difficult where the level of background noise is close to, equal to or above the level of entertainment noise).

This conclusion therefore confirms that the specifying an appropriate absolute L_{Aeq} level for entertainment noise at potentially affected residential properties is likely to provide an effective means of control.

Table 4 of the document summarises the levels of acceptability that subjects reported for a range of entertainment noise levels from **17.0 to 47.5 dB $L_{Aeq,5m}$** , with **17.0 dB $L_{Aeq,5m}$** being “clearly acceptable” and **47.5 dB $L_{Aeq,5m}$** being “clearly unacceptable”. These figures are for a one-off event.

For events that occur with some regularity it is probably reasonable to assume the level of **17.0 dB $L_{Aeq,5m}$** would also be “clearly acceptable”, although the response “clearly unacceptable” would probably be triggered at a lower level than **47.5 dB $L_{Aeq,5m}$** .

The Executive Summary from the Phase 2 DEFRA report on Noise from Pubs and Clubs is reproduced in Appendix F. Table 4 is also reproduced in Appendix F.

2.8 Criteria adopted for this assessment

On the basis of guidance discussed above, the criteria adopted for this assessment are:

- during the night-time period (23.00 and 07.00 hours) entertainment noise from the proposed marquee should be at a level that is unlikely to be audible in the habitable rooms of any potentially affected residence (with the exception of the residence at Woods Cottage); and
- during the day-time period (07.00 and 23.00 hours) entertainment noise expressed in terms of dB LAeq,15m from the proposed marquee should be no more than **3 dB above** baseline dB LAeq,15m noise level outside the habitable room windows of any potentially affected residence (with the exception of the residence at Woods Cottage).

In order to achieve the proposed night-time standard it is proposed that outside any habitable room window (with the exception of the residence at Woods Cottage) entertainment noise from the marquee should not exceed:

- **38.0 dB LAeq,5m**; or
- **10 dB below** the baseline LAeq noise level, whichever is the greater.

Assuming a partially open window, an external noise level of **38.0 dB LAeq,5m** equates to an internal noise level of **25.0 dB LAeq,5m**.

It is also recommended that octave-band noise levels at 63 Hz and 125 Hz are not excessive. The proposed Zone Array distributed PA system supplied by Direct Acoustic Solutions Ltd is known to be effective in controlling the propagation of low frequency acoustic energy.

The adoption of these criteria is considered to be in accordance with the recommendations of the NPPF and the NPSE.

Chapter 3 – Noise monitoring exercise

3.1 Operational music noise monitoring

Music noise monitoring was undertaken on the afternoon of Tuesday 6 August 2013 using calibrated Type 1 precision integrating equipment.

On-site monitoring was undertaken outside the marquee at a distance of 20 metres from the centre of the PA loudspeaker array, with the microphone elevated to the level of the loudspeaker array (approximately 3.5 metres above the level of the dance floor) with pink noise being played through the PA system. The marquee was fully closed apart from the door, which is on the northern side of the marquee, and did not affect the noise levels prevailing at the external monitoring position. The results obtained at this position are set out in Appendix G. From these results it can be seen that a level of **61.7 dB LAeq,t** was recorded outside the marquee at a distance of 20 metres from the centre of the loudspeaker array.

During the operational noise monitoring exercise a Type 2 sound level meter was left on the dance floor, approximately under the centre of the loudspeaker array. During the period when a level of **61.7 dB LAeq,t** was recorded at 20 metres from the array the Type 2 instrument recorded a level of **93.7 dB LAeq,t** on the dance floor under the array.

The overall level of attenuation found to prevail at a distance of 20 metres including the attenuation provided by the marquee fabric is therefore approximately **32 dB** compared to the pink noise level prevailing on the dance floor.

Subsequently a music noise spectrum was recorded on the dance floor, with typical party music playing. Using this music spectrum and that obtained for pink noise at 20 metres outside the marquee, a music noise spectrum has been derived for a music noise level of **95.0 dB LAeq,t** on the dance floor. This level of music is typical of the kind of music likely to be played for dancing. With this typical music spectrum, **95.0 dB LAeq,t** on the dance floor corresponds to **60.6 dB LAeq,t** at 20 metres outside the marquee.

With music playing in the marquee at a level of approximately **95.0 dB LAeq,t** on the dance floor an attempt was also made to monitor music noise levels off-site at a monitoring position to the south-east of the marquee in Selsmore. This position is identified in Figure 1 as:

- **MPS** – a free-field position about 385 metres to the south-west of the marquee (the nearest residence being about 365 metres from the marquee).

The microphone was positioned approximately 5.0 metres above local ground level to represent a first floor bedroom window.

However, with music playing in the marquee at a level of around **95 dB LAeq,t** on the dance floor music was completely inaudible at the monitoring position. Additionally a check was made on the shoreline just to the north of the monitoring position, where the music was also found to be completely inaudible.

Background noise levels prevailing at the microphone at this time were found to be around:

- **47 dB LAeq,t**; and
- **37 dB LA90,t**.

3.2 Background noise monitoring

A night-time background noise monitoring exercise was undertaken between 22.30 and 02.30 hours on the night of Tuesday / Wednesday 6 / 7 August 2013 using calibrated Type 1 precision integrating equipment. The same monitoring position was employed, identified in Figure 1 as:

- **MPS** – a free-field location in Selmore, about 385 metres to the south-east of the marquee.

The microphone was positioned approximately 5 metres above local ground level to represent a first floor bedroom window head.

MPS was adopted as being representative of residential properties in the vicinity of Selmore.

Weather conditions were good throughout the monitoring period, with very low wind speeds, and the results may be taken to be fully representative of the lowest background noise levels expected to prevail in the area. Full details of the background noise monitoring exercise and the results obtained are provided in Appendix H.

The worst-case (ie lowest) night-time background noise levels found to prevail at MPS were found to be:

- **24.1 dB LAeq,15m;** and
- **21.2 dB LA90,15m.**

It should be noted that these absolute lowest figures were recorded under extremely calm weather conditions. It is likely that noise levels prevailing at night would generally be higher than this.

Chapter 4 –Prediction of operational noise levels

A noise model has been used to predict worst-case operational noise levels for the marquee on the basis that amplified music will give rise to an entertainment noise level of **60.6 dB LAeq,t** at 20 metres from the source outside the marquee.

Figures 2 and 3 show operational noise contours plotted at heights of **2.5 metres** and **5.0 metres** respectively above local ground level, these heights corresponding to window heads at ground and first floor level. All noise contours are free-field.

From these noise contours it can be seen that on the basis of a reference music noise level of **95.0 dB LAeq,t** on the dance floor music noise levels at the residences around the site will be well below **38 dB LAeq,5m**.

It should be noted that the music noise predictions do not take account of the attenuation that will be provided by the trees around the marquee, although the noise model does take account of soft ground absorption, and include the sea's surface at high water level as shown on Ordnance Survey mapping.

Trees can give significant levels of attenuation, as indicated by the webpages from Medway Council's website that are reproduced in Appendix I. On the basis of this information, a reduction of around **6 dB or more** is to be expected due to the trees around the marquee.

A reduction of **6 dB** would result in an absolute worst-case music noise level at potentially affected residential properties of around **28 dB LAeq,t**. This corresponds to an internal noise level with a partially open window of around **15 dB LAeq,t**.

This is expected to equate to inaudibility, and accordingly mitigation in addition to the distributed loudspeaker array supplied by Direct Acoustic Solutions will not be required.

Chapter 5 – Proposed mitigation

As discussed above, it is proposed that amplified music will be played via a distributed loudspeaker array positioned above the dance floor area of the marquee, the system supplied by Direct Acoustic Solutions being proposed. The Direct Acoustics Solutions brochures / data sheets are reproduced in Appendix J.

This kind of system has significant advantages over conventional public address loudspeaker systems because:

- the music source is above the dance floor and is therefore closer to the ears of persons on the dance floor, thereby reducing the acoustic energy required to give satisfactory music levels on the dance floor;
- the loudspeaker drive units are mounted on panels that are essentially open at the rear (ie above the panels), which means that low frequency energy emerging above the array is out of phase with low frequency energy emerging below the array, thus cancelling out when propagating in a horizontal direction, ie away from the dance floor;
- absorbent material positioned above the array absorbs higher frequency acoustic energy, thus reducing the potential for disturbance to be caused off-site (while higher frequencies propagating downwards towards the dance floor will be absorbed by persons on the dance floor).

Additionally, the Direct Acoustics Solutions system is installed with a digital limiter, which provides an effective means of limiting overall sound pressure levels on the dance floor and also gives control at specific frequencies if required. Information on the range of limiters employed is provided in Appendix L.

Unlike limiters that cut the signal or mains power when a pre-set music level is exceeded, the type employed by Direct Acoustics Solutions limits the music level to a predetermined level, without cutting out completely.

It is proposed that the limiter will be set to prevent amplified music exceeding a level of around **95 dB LAeq,t** on the dance floor initially, with adjustments being made in the extremely unlikely event that disturbance should be reported from any residential property.

Chapter 6 – Conclusions

The potential for entertainment noise from the marquee development to affect nearby residence has been assessed using national guidance documents, and a scheme of mitigation proposed.

Amplified music will be played via a distributed loudspeaker array positioned above the dance floor area of the marquee, a system such as that supplied by Direct Acoustic Solutions being proposed.

The distributed loudspeaker system and associated amplification will be designed and installed to generate music noise levels on the dance floor of up to approximately **95 dB LAeq,t** only.

The distributed loudspeaker system is designed and installed to give limited low frequency (63 Hz and 125 Hz) acoustic output in a horizontal direction.

With this system a music level of **95 dB LAeq,t** on the dance floor will reduce to approximately **60.7 dB LAeq,t** at a distance of 20 metres.

The noise modelling exercise has confirmed that this level of music on the dance floor will give rise to music noise levels at the residences around the site that are well below **38 dB LAeq,5m**, ignoring the attenuation that will be provided by the trees around the marquee, and assuming high water in the area to the south of the marquee. This is a worst-case assumption. The situation at other states of tide will be more favourable as more sound will be absorbed as it propagates across the creek.

Trees can give significant levels of attenuation, in this case a further reduction of around **6 dB or more** is to be expected due to the trees around the marquee.

A reduction of **6 dB** would result in an absolute worst-case music noise level at potentially affected residential properties of around **28 dB LAeq,t**. This corresponds to an internal noise level with a partially open window of around **15 dB LAeq,t**.

This is expected to equate to inaudibility, and accordingly mitigation in addition to the distributed loudspeaker array supplied by Direct Acoustic Solutions will not be required.

References

- 1 National Planning Policy Framework; Department for Communities and Local Government; 2012
- 2 Noise Policy Statement for England; Department for Environment, Food and Rural Affairs; 2010
- 3 Code of Practice on Environmental Noise Control at Concerts; Noise Council; 1995
- 4 Draft Code of Practice on the Control of Noise from Pubs and Clubs; Institute of Acoustics; 1999
- 5 Good Practice Guide on the Control of Noise from Pubs and Clubs; Institute of Acoustics; 2003
- 6 Phase 1 Report on Noise from Pubs and Clubs; DEFRA; 2005
- 7 Phase 2 Report on Noise from Pubs and Clubs; DEFRA; 2006

Figure 1

Site location plan showing marquee and background noise monitoring position



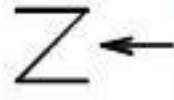
Figure 2

Operational noise contours at 2.5 metres above local ground level

Tournerberry Marquee

Music Level of 95 dB(A) on Dance Floor
Contours 2.5 m above local ground level

Scale 1 : 4000.0 10:17:27 18/08/2013



Noisemap

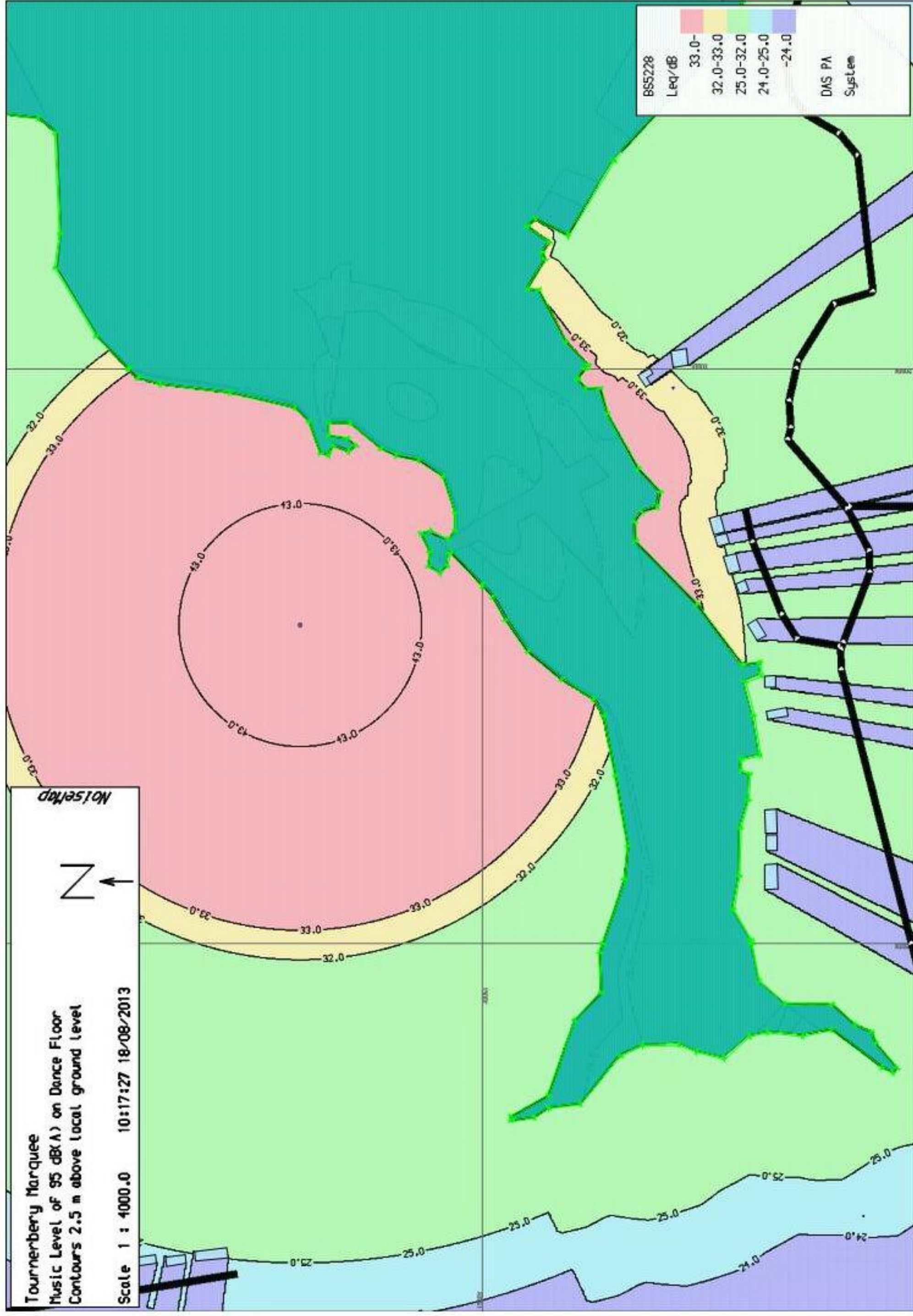


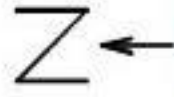
Figure 3

Operational noise contours at 5.0 metres above local ground level

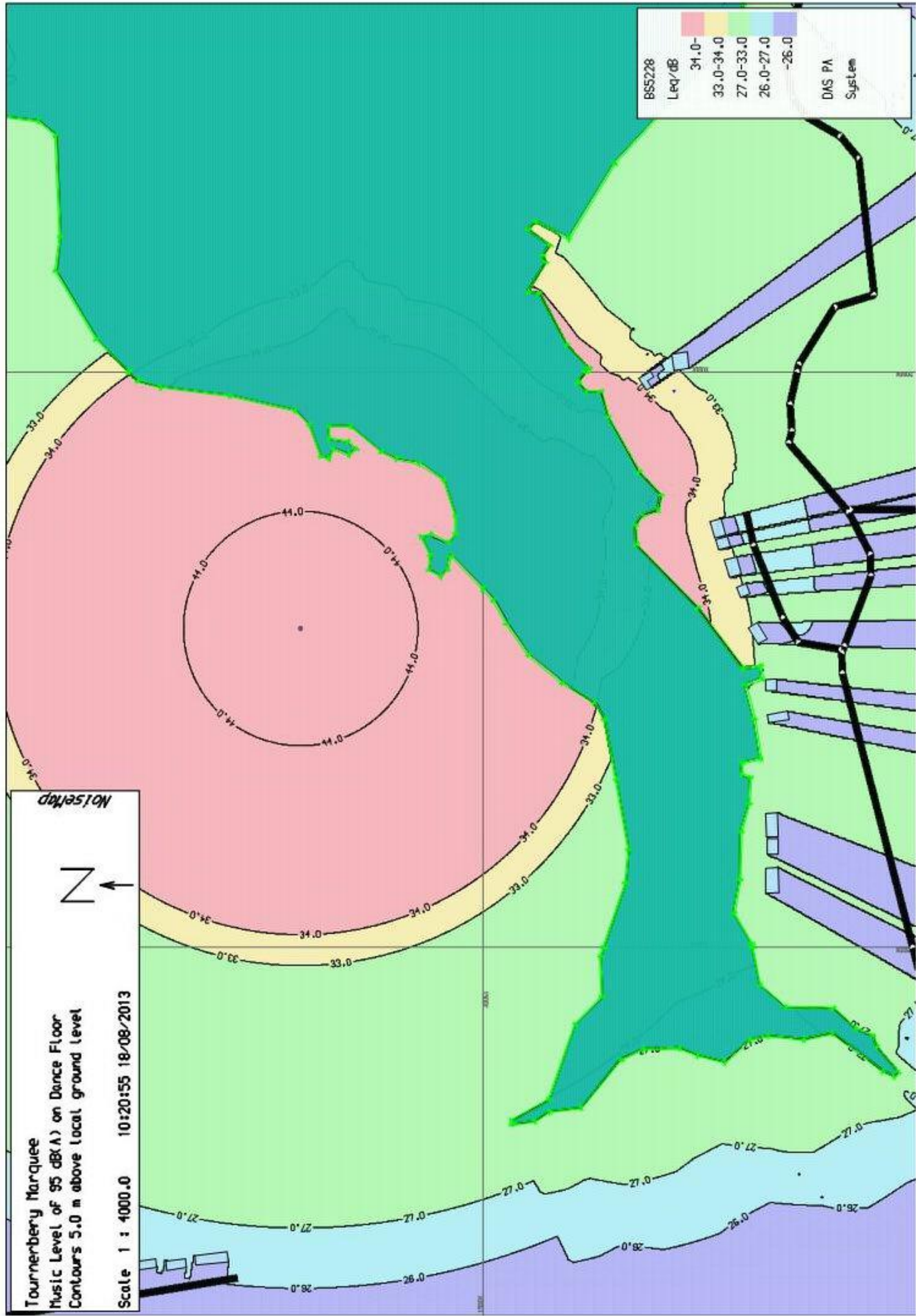
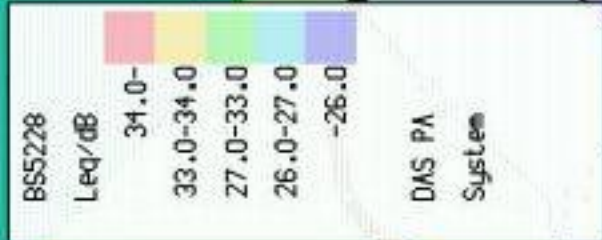
Tournerberry Marquee

Music Level of 95 dB(A) on Dance Floor
Contours 5.0 m above local ground level

Scale 1 : 4000.0 10:20:55 18/08/2013



Noisemap



Appendix A

Glossary of acoustical terms (from PPG24)

Glossary

Below are explanations of terms as they are used in the PPG; they are not definitions.

Decibel (dB): a unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 Pa, the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB(A): decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

Hertz (Hz): unit of frequency, equal to one cycle per second. Frequency is related to the pitch of a sound.

$L_{A10,T}$: the A weighted level of noise exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from road traffic. $L_{A10,18h}$ is the arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06.00 to 24.00.

$L_{A90,T}$: the A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 1990 it is used to define background noise level.

$L_{Aeq,T}$: the equivalent continuous sound level -the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter. It is written as L_{eq} in connection with aircraft noise.

L_{Amax} : the highest A weighted noise level recorded during a noise event. The time weighting used (F or S) should be stated.

Additionally, the term *SPL* refers to the quantity Sound Pressure Level as discussed under *Decibel (dB)* above. This can be either a broad-band quantity including all octave-band figures or can refer to individual octave-bands for instance.

The above text is reproduced in full from PPG24

Appendix B

Extracts from the Noise Council Code of Practice on Environmental Noise Control at Concerts

2.0 DEFINITIONS

Background Noise Level:	The prevailing sound level at a location, measured in terms of the $L_{A90,T}$, on an equivalent day and at an equivalent time when no concert or sound checks are taking place.
dB(A):	The A-weighted sound pressure level whereby various frequency components of sound are weighted (equalised) to reflect the way the human ear responds to different frequencies.
Delay Tower:	An additional set of loudspeakers employed to provide a better spread of sound to the audience.
L_{Aeq} :	The equivalent continuous noise level which at a given location and over a given period of time contains the same A-weighted sound energy as the actual fluctuating noise at the same location over the same period.
$L_{A90,T}$:	The A-weighted sound pressure level exceeded for 90% of the measuring period (T).
Mixer:	The location where the main sound system is controlled. As well as ensuring the correct sound balance between the various performers, the overall level of sound for the audience is controlled at this location.

Music Event: A concert or similar event where live or recorded music is performed by a solo or group of artists before an audience.

Music Noise: The noise from the music and vocals during a concert or sound checks and not affected by other local noise sources.

Music Noise Level (MNL): The L_{Aeq} of the music noise measured at a particular location.

Noise Consultant: A person given responsibility by the organiser of the event for monitoring noise levels in accordance with the prevailing conditions, and who has the ability and authority to make decisions and implement changes in noise level during the event.

Noise Monitoring Position: The location of the microphone within the venue from which the level of sound is monitored and controlled. For outdoor venues, this location tends to be at the mixer.

Noise-sensitive Premises: Includes premises used for residential purposes hospitals or similar institutions, education establishments (when in use), or places of worship (during recognised times and days of worship) or any premises used for any other purposes likely to be affected by the Music Noise.

Other Urban Venue: An urban park or similar area which is not normally used for major organised events.

Rural Venue: A park, open space or grounds of a country house in a rural area not normally used for major organised events.

Sound Engineer: Person employed to control the sound quality of the music for the audience.

Urban Stadia or Arenas: A regular venue for major sporting or similar events in an urban area.

3.0 GUIDELINES

- 3.1 The Music Noise Levels (MNL) when assessed at the prediction stage or measured during sound checks or concerts should not exceed the guidelines shown in Table 1 at 1 metre from the façade of any noise sensitive premises for events held between the hours of 0900 and 2300.

TABLE 1

Concert days per calendar year, per venue	Venue Category	Guideline
1 to 3	Urban Stadia or Arenas	The MNL should not exceed 75dB(A) over a 15 minute period
1 to 3	Other Urban and Rural Venues	The MNL should not exceed 65dB(A) over a 15 minute period
4 to 12	All Venues	The MNL should not exceed the background noise level ¹ by more than 15dB(A) over a 15 minute period

Notes to Table 1

1. The value used should be the arithmetic average of the hourly L_{AW} measured over the last four hours of the proposed music event or over the entire period of the proposed music event if scheduled to last for less than four hours.
2. There are many other issues which affect the acceptability of proposed concerts. This code is designed to address the environmental noise issue alone.
3. In locations where individuals may be affected by more than one venue, the impact of all the events should be considered.
4. For those venues where more than three events per calendar year are expected, the frequency and scheduling of the events will affect the level of disturbance. In particular, additional disturbance can arise if events occur on more than three consecutive days without a reduction in the permitted MNL.
5. For indoor venues used for up to about 30 events per calendar year an MNL not exceeding the background noise by more than 5dB(A) over a fifteen minute period is recommended for events finishing no later than 2300 hours.

6. Account should be taken of the noise impact of other events at a venue. It may be appropriate to reduce the permitted noise from a concert if the other events are noisy.
7. For venues where just one event has been held on one day in any one year, it has been found possible to adopt a higher limit value without causing an unacceptable level of disturbance.

3.2 For events continuing or held between the hours 2300 and 0900 the music noise should not be audible within noise-sensitive premises with windows open in a typical manner for ventilation.

Notes to Guideline 3.2

1. The use of inaudibility as a guideline is not universally accepted as an appropriate method of control. References 6 & 7 (Appendix 1) set out the various issues. This guideline is proposed as there is insufficient evidence available to give more precise guidance.
2. Control can be exercised in this situation by limiting the music noise so that it is just audible outside the noise sensitive premises. When that is achieved it can be assumed that the music noise is not audible inside the noise sensitive premises.

3.3 The nature of music events means that these guidelines are best used in the setting of limits prior to the event (see 4.0).

3.4 Assessment of noise in terms of dB(A) is very convenient but it can underestimate the intrusiveness of low frequency noise. Furthermore, low frequency noise can be very noticeable indoors. Thus, even if the dB(A) guideline is being met, unreasonable disturbance may be occurring because of the low frequency noise. With certain types of events, therefore, it may be necessary to set an additional criterion in terms of low frequency noise, or apply additional control conditions.

Notes to Guideline 3.4

1. It has been found that it is the frequency imbalance which causes disturbance. Consequently there is less of a problem from the low frequency content of the music noise near to an open air venue than further away.

2. Although no precise guidance is available the following may be found helpful (Ref 8):
A level up to 70dB in either of the 63Hz or 125Hz octave frequency band is satisfactory; a level of 80dB or more in either of those octave frequency bands causes significant disturbance.

- 3.5 Complaints may occur simply because people some distance from the event can hear it and that, consequently, they feel the music must be loud even though the guidelines are being met. In fact topographical and climatic conditions can be such that the MNL is lower at locations nearer to the venue.
- 3.6 Although care has been taken to make these guidelines compatible with what occurs at existing venues, this may not be the case at every location. Where arrangements are satisfactory with either higher or lower noise levels than those contained in the guidelines, these limits should continue.
- 3.7 It has been found that if there has been good public relations at the planning stage between the event organisers and those living nearby, annoyance can be kept to a minimum.
- 3.8 The music noise level should be measured using an integrating-averaging sound level meter complying with type 2 or better of BS6698. The background noise level should be measured using a sound level meter complying with type 2 or better of BS5969. Time weighting F (fast response) should be used.
- 3.9 When measuring L_{Aeq} in order to determine the music noise level, care must be taken to avoid local noise sources influencing the result. When the local noise is intermittent, a series of short term L_{Aeq} measurements should be made of the music noise while the local source is absent or has subsided to typically low or mean minimum values. An average of these short term

readings will give an estimate of the music noise level. A further option would be to measure the A-weighted sound pressure level on a sound level meter complying with type 2 or better of BS5969 with the time weighting set to S (slow response) when the music is loudest and not influenced by local noise. If the local source is continuous, make a measurement of the L_{Aeq} of the local source when the music is not occurring, and make a correction to the measured L_{Aeq} when the music is occurring to obtain an estimate of the music noise level.

- 3.10 The nature of many concerts requires the sound volume level to be increased during the event to enhance the performance. The prevailing noise control restrictions should be borne in mind so that the sound volume at the start of the event is not too high, hence allowing scope for an increase during the event.
- 3.11 Some concerts are accompanied by associated activities (e.g. fairgrounds) which can be noisy. These should be taken into account when setting the limit for the music noise level.
- 3.12 When monitoring the music noise level, the sound of the audience applause can be a significant contributor. It is not possible to address this issue precisely; instead it is recommended that any such effect be noted.

Appendix C

Chapter 5 of Draft IOA Code of Practice on the Control of Noise from Pubs and Clubs

5 CRITERIA

5.1 General

- 5.1.1 Noise control criteria should be determined by each local authority or group of authorities, according to local circumstances and having regard to this code of practice. The selected noise criteria should be appropriate in relation to any existing licensing, planning and noise nuisance policies. However, for night time music and amplified singing and speech, it should be the aim of all local authorities to adopt a criterion which will ensure, so far as is reasonably practicable, that such noise is inaudible inside noise sensitive premises between 23:00 hours and 10:00 hours.

5.2 Noise from Amplified and Non-amplified Music, Singing and Speech Sourced from Inside and Outside the Premises

- 5.2.1 Where such activities are relatively infrequent (once a week or less and less than 30 times per year), criteria should be selected so as to keep the disturbance produced to a minimum. The guidance contained in the Code of Practice for Environmental Noise Control at Concerts [1] may be considered appropriate for such events, as long as structure-borne noise transmission is not significant.

- 5.2.2 *Trial*s in relation to identifying specific noise level criteria for music, singing and speech noise, which occurs more than 30 times per year are in progress (see Appendix D). However, at this stage, these trials have not provided sufficient information to allow for the inclusion of definitive noise control criteria in this Code of Practice for these sources. However, the Working Party has decided that, in order to stimulate debate on this important subject, the entertainment industry, the public and enforcers will benefit from an early publication of this draft Code of Practice which includes examples of the type of criteria that may eventually be appropriate. These examples are given in paragraphs 5.2.3 and 5.2.4. NB. These examples concern external criteria. Where habitable rooms are attached to a "source" building internal noise measurements in those habitable rooms may be required.

5.2.3 Noise limits between 23:00 and 10:00 hours (example only)

- The $L_{Aeq,5min}$ level measured 1 metre outside a window to a habitable room, with entertainment taking place, shall show no increase when compared with the representative $L_{Aeq,5min}$ level measured from the same position, under the same conditions and during a comparable period with no entertainment taking place; and
- The $L_{eq,5min}$ level in the 63 Hz and 125 Hz octave bands measured 1 metre outside a window to a habitable room, with entertainment taking place, should show no increase when compared with the representative $L_{eq,5min}$ level in the 63 Hz and 125 Hz octave bands measured from the same position, under the same conditions and during a comparable period with no entertainment taking place.

5.2.4 Noise limits between 10:00 and 23:00 hours (example only)

- a) *For venues where live and/or non-live amplified music events take place more than twice in a week, the limits in Section 5.2.3 shall apply.*
- b) *For venues where more than 30 events take place per calendar year but these events do not occur more than twice per week, the following limits shall apply:*
 - *the $L_{Aeq,5min}$ level measured 1 metre outside a window to a habitable room, with entertainment taking place, shall be no more than 3 dB higher than the representative $L_{Aeq,5min}$ level measured from the same position, under the same conditions and during a comparable period with no entertainment taking place; and*
 - *the $L_{eq,5min}$ in the 63 Hz and 125 Hz octave bands measured 1 metre outside a window to a habitable room, with entertainment taking place, shall be no more than 3 dB higher than the representative $L_{eq,5min}$ in the 63 and 125 Hz octave bands measured from the same position, under the same conditions and during a comparable period with no entertainment taking place.*

5.3 Plant and Machinery

- 5.3.1 Local authorities should have existing policies for dealing with noise from plant and machinery. Many of these policies will be based on the procedures and methodology contained in BS 4142[2] or on the use of frequency analysis measurements and the application of Noise Rating Curves [3].
- 5.3.2 The assessment of vibration from plant and machinery, which can cause structure borne noise problems in attached properties, may be undertaken using the methodology and criteria contained in BS 6472 [4]. However, this standard only deals with vibration. It does not address the issue of the resulting noise.

5.4 Use of Gardens and Play Areas

- 5.4.1 At venues in or close to noise sensitive premises, all external activities associated with any form of non-sporting entertainment, or the use of play areas, should normally cease at lighting up time in the area in question. Such activities should not recommence before the start of normal trading hours on the following day.
- 5.4.2 *Trials in relation to identifying specific noise level criteria for noise from gardens and play areas are also in progress. However, at present it is suggested that, for planning/licensing purposes it may be reasonable to assume a "free-field" target criterion of 55 dB $L_{Aeq,5min}$ on noise sensitive premises.*

5.5 Rowdy Behaviour

No criterion is suggested at this stage. However, the recommendations of the impending revision of World Health Organisation Criteria 12 [5] in relation to sleep disturbance may be appropriate.

5.6 Use of Car Parks and Access Roads

No criterion is suggested at this stage. However, the recommendations of the impending revision of World Health Organisation Criteria 12 [5] in relation to sleep disturbance may be appropriate.

5.7 Delivery/Collection Activities

No criterion is suggested at this stage. However, the recommendations of the impending revision of World Health Organisation Criteria 12 [5] in relation to sleep disturbance may be appropriate.

6 MEASUREMENT GUIDELINES

6.1 Introduction

6.1.1 Noise measurements may be required to:

- define acceptable levels for planning purposes;
- establish and keep a record of disturbance;
- assess the nature and severity of a problem;
- record reference sound levels at a venue following action to limit the output of a venue's sound system; and
- to monitor and control events.

The precise type of noise measurements required will depend on the noise sources in question (see Section 3).

6.2 Personnel

6.2.1 All noise measurements/monitoring and resulting assessments should be undertaken by competent personnel. Guidance on what constitutes appropriate training for competency can be obtained from the Institute of Acoustics or the Association of Noise Consultants (see Appendix E). Furthermore, either body can provide a list of members capable of undertaking work of the type required.

6.3 Instrumentation

6.3.1 Noise levels from the various sources shall generally be measured using a sound level meter complying with type 1 of BS EN 60804 [6] and 60651 [7]. In addition, if octave or one-third octave band filters are used for the measurement of frequency these should comply with IEC Publication 225 (Class 3) [8].

6.3.2 Regard should be had for the noise floor of the measuring instrumentation. For example, many sound level meters currently available, and in use, may be only capable of measuring down to around 20 dBA, although the indicated range may suggest otherwise.

6.4 Calibration of Instrumentation

6.4.1 Calibration and verification procedures should conform to those given in BS 4142 [2].

Appendix D

Chapter 2 of IOA Good Practice Guide on the Control of Noise from Pubs and Clubs

2. SCOPE

- 2.1 This document provides guidance for the assessment and control of noise affecting noise-sensitive properties, from the public and private use of public houses, clubs, hotels, discothèques, restaurants, cafés, community or village halls and other similar premises. The main noise sources considered are music; singing; public address (PA) systems; children's play areas; beer gardens; people in general; car parks and access roads; deliveries; collections; materials handling; plant and machinery; and skittle alleys. Noise arising from live sporting events held at such premises is not covered by this document.
- 2.2 The purpose of this Guide is to assist local authority officers and venue management and their staff in the prevention of noise disturbance and in the investigation and resolution of noise complaints. It is also intended to assist with the planning and licensing of proposed or existing premises.
- 2.3 The original intention was to include objective noise criteria in this document, or in a separate but related document, that could have been used to assess and control noise from all the main sources of noise that can be present at pubs, clubs and similar premises. However, it has not been possible to subject the new criteria that have been developed and proposed by the working party to a satisfactory validation process. It is hoped that future research will lead to the publication of criteria that have been fully validated in terms of human response and have been subject to trials which confirm their practicability in terms of measurement, enforcement and use within the planning process. Until such criteria are developed, it is recommended that local authorities and others should devise and apply policies having regard to this Guide and taking into account local circumstances and existing licensing and planning policies.
- 2.4 Music, singing and speech, both amplified and non-amplified, are common sources of noise disturbance arising from the premises listed in 2.1 above. As far as these sources are concerned, the purpose of developing the objective noise criteria mentioned in 2.3, should be to attempt to ensure that:
- for premises where entertainment takes place on a regular basis, music and associated sources should not be audible inside noise-sensitive property at any time. In the absence of the objective criteria mentioned in 2.3, what is 'regular' should be determined on a local basis to reflect local expectations and should be incorporated by local authorities in their planning and enforcement policies (see section 4); and
 - for premises where entertainment takes place less frequently, music and associated sources should not be audible inside noise-sensitive property between 23:00 and 07:00 hours. For other times, appropriate criteria need to be developed which balance the rights of those seeking and providing entertainment, with those who may be disturbed by the noise.

For the purposes of this document, noise may be considered not audible or inaudible when it is at a low enough level such that it is not recognisable as emanating from the source in question and it does not alter the perception of the ambient noise environment that would prevail in the absence of the source in question. A more simplistic explanation of the term 'inaudible' is given in Appendix B.

- 2.5 The determination of "nuisance" is not within the scope of this Guide, however, the Guide may be useful in forming a view on the likelihood that a "nuisance" has occurred, is occurring or could occur.
- 2.6 The Guide should not be used to determine or enforce noise standards for occasional music events of the type covered by the Code of Practice on Environmental Noise Control at Concerts [1].

Appendix E

Table 3 from Phase 1 DEFRA report on Noise from Pubs and Clubs

2.3 International response to the problem

2.3.1 Codes for entertainment noise

2.3.1.1 Regulations applying to pub and club noise in ten European countries are summarised and compared by (Desarnaulds et al., 2003). The regulations vary widely between countries but there are some observable trends and groups in both the types of criteria (e.g. level just outside the club), the methods of expressing them (e.g. L_{Aeq}) and the limit values allowed (e.g. 3 dB above background). There are three main types of criteria: levels at a noise-sensitive property, levels outside the noise-making property and sound insulation requirements where both source and receiver are part of the same building. Most of the ten countries use more than one of the three types; France and Italy use all three. Criteria for allowable levels inside or outside the noise-sensitive property in eight countries are summarised in Table 3.

Country	Text	Descriptor	Requirements inside, dB(A)	Requirements outside, dB(A)
Switzerland*	DEP	$L_{Aeq}(10s)$	24	34
Germany	VDI 2058B11	L_{Aeq} L_{AFmax}	25 35	40 – 45 (DIN 18005)
France	Recommendation CNB (1993)	L_{Aeq}	22	-
Italy	DPCM 14/11/97 No280	$L_{Aeq}(1 min)$	25	40 (open window)
Norway	NS 8175-1997	L_{AFmax}	22 – 37	25 – 45
Netherlands	Catering order (1998)	$L_{Aeq}(19-07)$ L_{AFmax}	25 45	40 60
Sweden	SOSFS 1996:7	L_{Aeq}	25	-
United Kingdom	Code of practice concerts**	$L_{Aeq}(15mins)$		75 (stadia) 65 (other)

* Exploitation after 1985, night time (22-7h) downtown; ** Max. 3 open air concerts/year.

Table 3. European limits at the noise-sensitive property, after (Desarnaulds et al., 2003).

Appendix F

Executive Summary and Table 4 from Phase 2 DEFRA report on Noise from Pubs and Clubs

1 EXECUTIVE SUMMARY

- 1.1 Bringing licensed premises within the scope of the Noise Act 1996 is intended to add to and complement existing powers. It will provide a relatively easy to use mechanism that can be fully implemented in response to a complaint on the night that any problem arises. The aim is to fill any gap in existing legislation and reduce the time to provide effective enforcement. Such a measure is required to help counter the potential for increased noise disturbance due to the liberalisation of the licensing regime brought about by implementation of the Licensing Act 2003 in late 2005.
- 1.2 Changes to the licensing laws in 2005 mean that licensed premises can be open later and for longer hours. Any such changes need to be supported by enforcement powers so that anti-social behaviour, where it occurs, is not tolerated. Extending the provisions of the Noise Act 1996 from dwellings to other premises was also one of the recommendations of the Environmental Audit Committee. The new powers are intended to provide a rapid reaction to problems when they first arise with the penalties aimed at discouraging further repetition of the problem.
- 1.3 Amendments to the Noise Act 1996 mean it is no longer adoptive and local authorities no longer have to respond to all complaints between 11pm and 7am every night. Instead local authorities now have the discretion to provide a response to complaints by targeting particular sources of noise or types of complaint, seasons of the year or nights of the week and any period between 11pm and 7am as they deem appropriate to local circumstances.
- 1.4 From October 2006, extending the provisions of the Noise Act 1996 will include licensed premises, including temporary licenses. This will enable a local authority to serve warning notices where they suspect that noise from licensed premises exceeds the specified permitted noise levels. If after a short warning period the noise continues to exceed the permitted levels, the Council will be able use their discretion to decide whether to prosecute in the Magistrates court, where fines of up to £5000 may be levied, or to serve fixed penalty notices of £500. The new powers also mean that the revenue from the fixed penalty notices will be retained by the local authorities to help fund the service, rather than passed directly to the Treasury, as is the current situation.
- 1.5 Fixed penalty notices for night noise from licensed premises will be a useful, additional tool for dealing quickly with temporary non-persistent noise problems that, whilst disturbing to nearby residents in the short term, are not of sufficiently negative impact to warrant the use of statutory nuisance under the Environmental Protection Act 1990 or the powers to close licensed premises temporarily under the Anti-Social Behaviour Act 2003. This measure will give local authorities an extra option to take a phased enforcement approach to dealing with night noise from licensed premises, and tailor enforcement to the severity and impact of a noise disturbance.
- 1.6 The Noise Act 1996 uses a noise protocol for calculating the accepted level. It is an offence to cause a night noise above the permitted level once a warning has been issued. The current noise protocol was developed for domestic night noise. Noise from licensed premises may be of a different nature, so a

different noise protocol might be more appropriate. This project informs the development of an appropriate noise measurement protocol for licensed premises and Defra will be consulting on the protocol in summer 2006, before the measure is implemented.

- 1.7 At present, the Noise Act 1996 only applies to noise from dwellings and there are concerns that its existing noise level measurement protocol and criteria might not be well suited to entertainment noise from licensed premises. Consequently, Defra commissioned Capita Symonds Ltd and BRE to jointly study methods and criteria for assessment of entertainment noise from licensed premises.
- 1.8 This study comprised extensive laboratory testing of the correlation of 18 variations of 9 different noise measurement methodologies and criteria, with the subjective response of a representative group of ordinary members of the public; field testing of the practicability of EHPs using these methodologies and criteria for the assessment of entertainment noise from licensed premises. The laboratory experiments deliberately constrain some independent and confounding variables in order to test the parameters of interest to the experiment. The conclusions should always be viewed with the understanding that controlled experimental testing cannot, by its nature, model all combinations of variables that exist in the field.
- 1.9 Whilst the primary objective of the study has been to identify which of the methodologies and criteria tested were best suited for assessment of entertainment noise from pubs and clubs late at night, of equal importance is the requirement that they are practicable for EHPs to enforce and are fair and realistic for licensees to comply with.
- 1.10 The outcomes of the study have been as follows:
 - A. The majority of the members of the public reported the ability to tolerate a modest degree of intrusive audible entertainment noise in their home late at night for a "one-off" occurrence (i.e. occurring at intervals of less than six months), and that the onset of audibility of the entertainment noise did not equate to a threshold of acceptability for intrusive entertainment noise.
 - B. The majority of EHPs also reported that a modest degree of intrusive entertainment noise from a "one-off" occurrence was acceptable, and that the onset of audibility of the entertainment noise did not equate to a threshold of acceptability for intrusive entertainment noise in such circumstances. EHPs also reported that a lesser degree of intrusive entertainment noise was acceptable for more regular occurrences (i.e. once a week), and that for either scenario the onset of audibility of the entertainment noise did not equate to a threshold for enforcement action for intrusive entertainment noise in such circumstances.
 - C. The results of the laboratory testing identified several methodologies and criteria, which gave reasonably good correlation with subjective response.
 - D. The noise metric that provided the best overall prediction of subjective ratings of all the entertainment noise types tested by ordinary members of the public was the Absolute L_{Aeq} .

E. However, during the field testing it was apparent that the “highest performers” from the laboratory testing all had clear disadvantages in use under real world conditions, so there is no clear best option for recommendation which combines optimum correlation with subjective response with ease and rapidity of use. The following options are considered the best of the available options, in descending order of correlation with subjective response, each raising different issues regarding practicability of use by EHPs.

- **Absolute L_{Aeq}** – That is an $L_{Aeq,5min}$ noise level value set at a single action level. However an intrusive entertainment noise criteria based on Absolute L_{Aeq} , would be difficult to use where the existing ambient noise level without the entertainment noise was close to, equal to or above the action level. Therefore, we would recommend an action level Absolute L_{Aeq} , with an additional subjective requirement that the entertainment noise itself has a clearly audible (to an otologically normal listener) contribution to the overall noise e.g. the songs/tracks would be recognisable to a listener familiar with the music and any words intelligible. In terms of an action level, a table in this report is provided showing various levels of entertainment noise used in the laboratory testing and the responses of test subject’s. In the context of this study’s objective to determine criteria that represents a clearly unacceptable situation, the noise levels at which test subjects felt the noise was “just unacceptable” for a one off event within a habitable room with windows closed was at 34 dB $L_{Aeq,5 minute}$. The range for the first two scores of unacceptability was $L_{Aeq,5 minute}$ 34 to 37 dB. Analysis of data from the 2000/2001 National Noise Incidence Study (NNIS) indicates that with windows closed, only a small percentage of the UK population (5.5%) are estimated to have internal ambient noise levels above $L_{Aeq,8 hour}$ 34 dB and just 2.1% above $L_{Aeq,8 hour}$ 37 dB.
- **$L_{A90} - L_{A90}$ (no music)** – That is the difference between the $L_{A90,5 min}$ noise level with the intrusive entertainment noise and the equivalent $L_{A90,5 min}$ with no intrusive entertainment noise. This allows consideration of the background level, but requires a measurement without intrusive entertainment noise that may not be possible on the night of a complaint. This in itself may be problem enough to make the metric unusable for “one-off” events or as a quick response to a problem.
- **$L_{Aeq} - L_{A99.95}$ or existing Noise Act methodology ($L_{Aeq} - L_{A99.8}$)**. These metrics include some consideration of the underlying noise level at the same time as any offending noise level is measured, without requiring a separate “no music” measurement to be made. The former is slightly more effective in prediction of subjective response than the latter, but not substantially so, and using the latter has logistical advantages. The performance of both these noise metrics was less good than the previous two options, but they also avoid the practical disadvantages highlighted above.

Table 4 - Semantic descriptor and associated value of acceptability

Semantic descriptor	Score	Absolute $L_{Aeq,5 \text{ minutes}}$
Clearly acceptable	1	17.0
	2	20.4
	3	23.8
	4	27.2
Just acceptable	5	30.6
Just unacceptable	6	34.0
	7	37.4
	8	40.8
	9	44.2
Clearly unacceptable	10	47.5

Appendix G

Operational noise monitoring at 20 metres from loudspeaker array

Results obtained	Outside the marquee on long axis Free-field microphone position approximately Façade reflection(s) estimated to have added			20.0 0.0	m horizontally from music noise source dB to results obtained	3.5	MP20m m above dance floor
Results obtained on	Tuesday 6 August 2013						
Svantek 945A kit	Calibration at start	ok	Battery level at start	ok			
Fast response	Calibration at end	ok	Battery level at end	ok			
Sources:	Only significant noise source is pink noise playing via Direct Acoustics PA system including Zone Array						
Weather:	No other significant noise sources						
	24 degrees C, dry with no cloud and a light breeze generally from west						
	Road surfaces dry throughout monitoring exercise.						
Start time	LAeq	LA10	LA90	LAmix	Notes		
15.04	61.5	62.5	60.3	62.8			
15.04	61.7	62.6	61.0	62.9			
15.04	62.0	62.8	61.1	63.1			
Averages:	61.7	62.6	60.8	62.9	including any façade reflection(s)		
Averages:	61.7	62.6	60.8	62.9	corrected for free-field conditions		

Results obtained

Outside the marquee on long axis
Free-field microphone position approximately
Façade reflection(s) estimated to have added

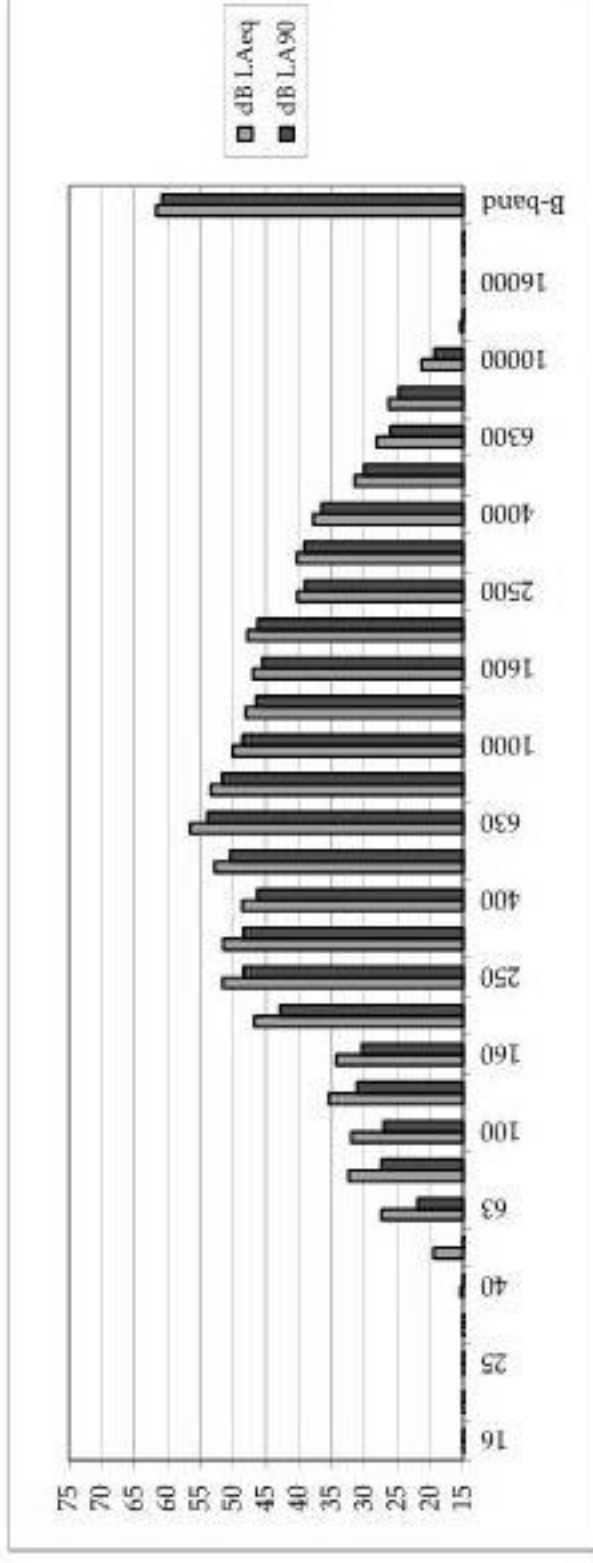
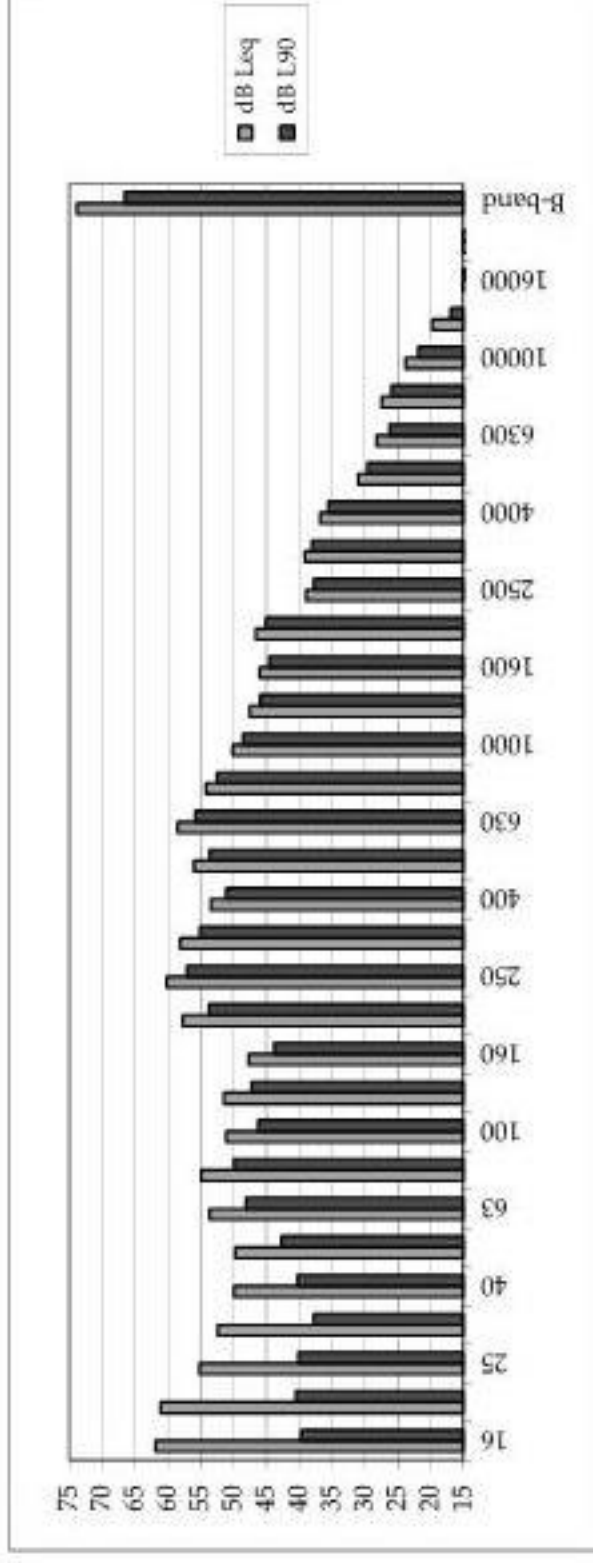
20.0 m horizontally from music noise source
0.0 dB to results obtained

MP20m
3.5 m above dance floor

Average spectra for Tuesday 6 August 2013

including any façade reflection(s)

Centre Freq Hz	Averages dB Leq	Averages dB LAeq	Averages dB LA90
16	61.9	5.2	-17.0
20	61.1	10.6	-10.0
25	55.2	10.5	-4.6
31.5	52.4	13.0	-1.7
40	49.9	15.3	5.6
50	49.7	19.5	12.5
63	53.6	27.4	21.9
80	54.9	32.4	27.4
100	51.1	32.0	27.1
125	51.5	35.4	31.1
160	47.7	34.3	30.4
200	57.7	46.8	42.9
250	60.2	51.6	48.5
315	58.1	51.5	48.5
400	53.4	48.6	46.3
500	56.0	52.8	50.4
630	58.5	56.6	53.9
800	54.2	53.4	51.7
1000	50.1	50.1	48.6
1250	47.5	48.1	46.5
1600	46.0	47.0	45.5
2000	46.6	47.8	46.2
2500	38.9	40.2	39.0
3150	39.1	40.3	39.2
4000	36.8	37.8	36.5
5000	31.0	31.5	30.1
6300	28.2	28.1	26.1
8000	27.4	26.3	24.8
10000	23.8	21.3	19.4
12500	19.7	15.4	12.6
16000	15.1	8.5	7.8
20000	9.5	0.2	4.8
B-band	73.8	61.7	60.8



Appendix H

Background noise monitoring at MPS

Results obtained	Outside the marquee on long axis Free-field microphone position approximately Façade reflection(s) estimated to have added				385 0.0	m horizontally from music noise source dB to results obtained	MPS m above local ground
Results obtained on	Tuesday 6 August 2013						
Svantek 945A kit	Calibration at start	ok	Battery level at start	ok			
Fast response	Calibration at end	ok	Battery level at end	ok			
Sources:	Only significant noise source is pink noise playing via Direct Acoustics PA system including Zone Array						
Weather:	No other significant noise sources 24 degrees C, dry with no cloud and a light breeze generally from west Road surfaces dry throughout monitoring exercise.						
Start time	LAeq	LAeq,15m	LA10	LA90	LA90,15m	LAmix	Notes
22.30	29.9		34.2	20.7		42.7	
22.35	28.6		31.7	24.0		42.6	
22.40	27.9	28.8	28.4	22.5	22.4	52.9	
22.45	28.1	28.2	32.9	22.2	22.9	38.1	
22.50	22.7	26.2	23.9	21.1	21.9	31.9	
22.55	22.1	24.3	22.9	20.5	21.3	32.8	
23.00	27.6	24.1	29.8	22.1	21.2	51.0	
23.05	28.5	26.1	33.3	23.1	21.9	39.3	
23.10	31.7	29.3	36.2	23.7	23.0	39.5	
23.15	32.3	30.8	36.2	26.5	24.4	41.4	
23.20	29.6	31.2	33.6	24.5	24.9	39.5	
23.25	26.1	29.3	27.0	25.0	25.3	40.8	
Averages:	28.8		30.8	23.0		45.4	including any façade reflection(s)
Averages:	28.8		30.8	23.0		45.4	corrected for free-field conditions
Lowest:	22.1	24.1	22.9	20.5	21.2	31.9	including any façade reflection(s)
Lowest:	22.1	24.1	22.9	20.5	21.2	31.9	corrected for free-field conditions

Results obtained

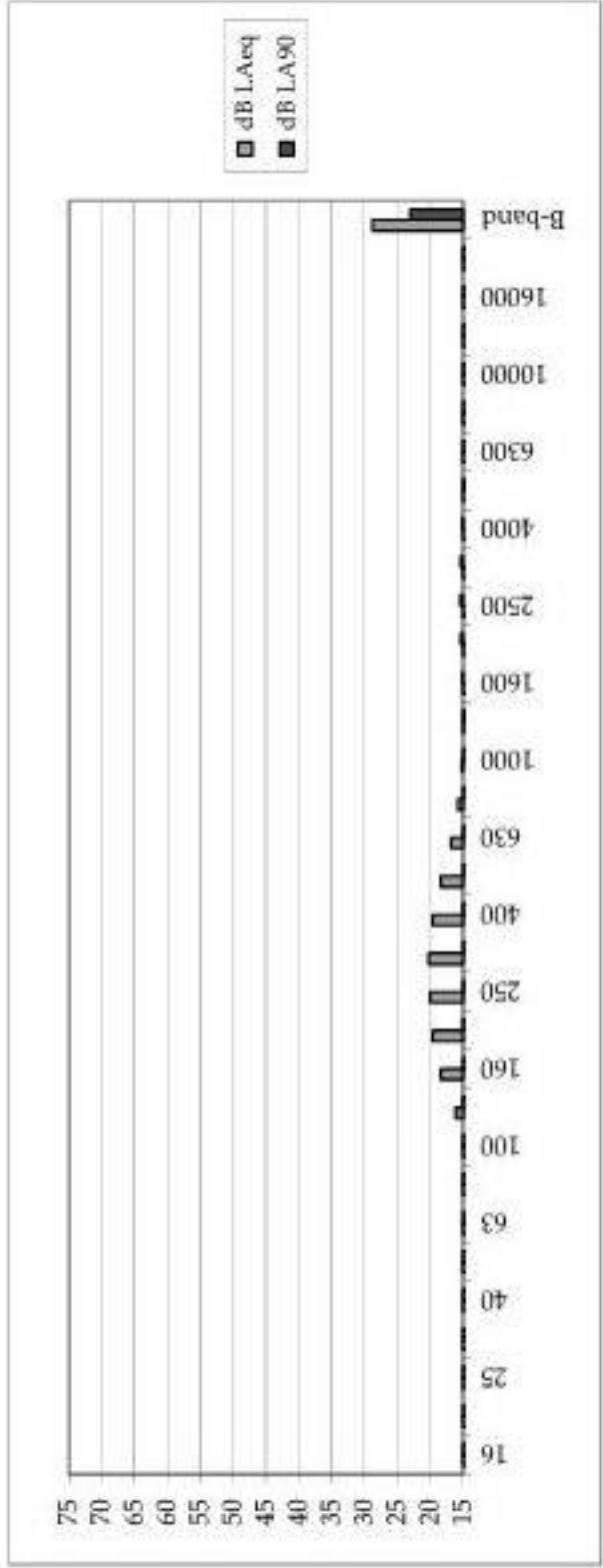
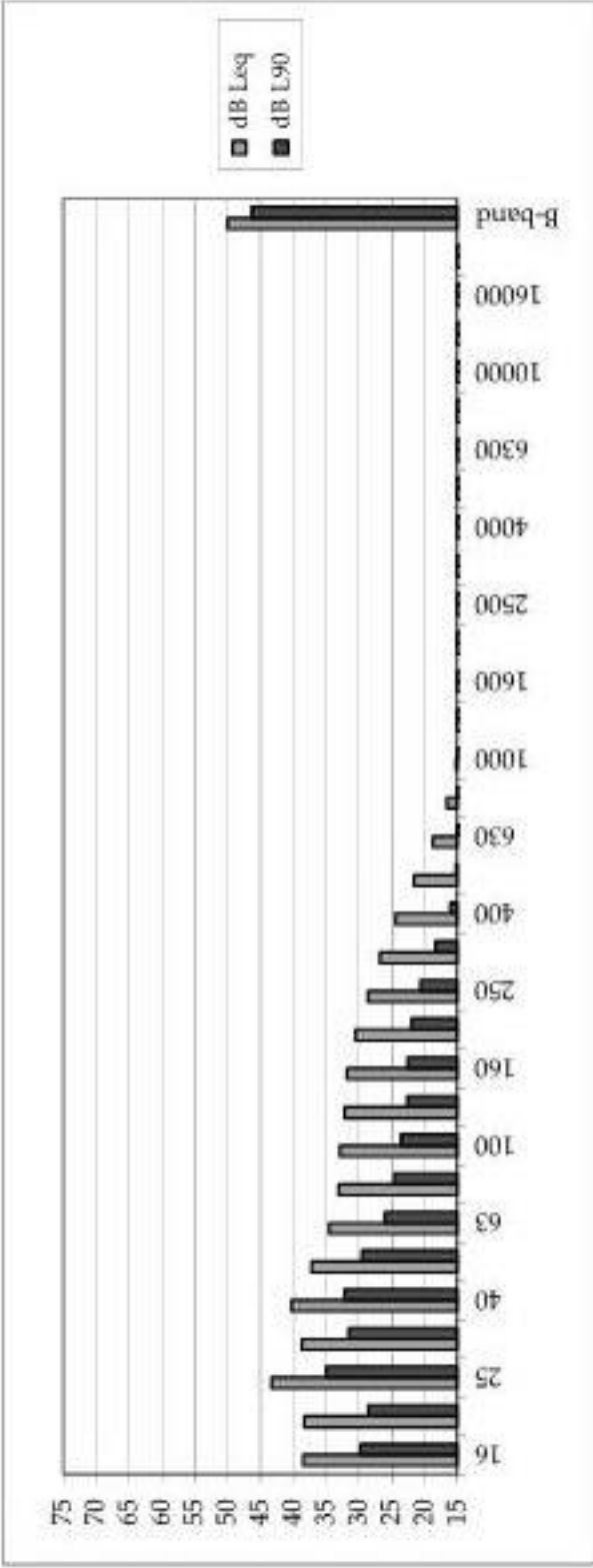
Outside the marquee on long axis
Free-field microphone position approximately
Façade reflection(s) estimated to have added

385.0 m horizontally from music noise source
0.0 dB to results obtained
5.0 m above local ground
MPS

Average spectra for Tuesday 6 August 2013

including any façade reflection(s)

Centre Freq Hz	Averages dB Leq	Averages dB L90	Averages dB LAeq	Averages dB LA90
16	38.5	29.7	-18.2	-27.0
20	38.3	28.5	-12.2	-22.0
25	43.3	35.0	-1.4	-9.7
31.5	38.7	31.5	-0.7	-7.9
40	40.2	32.2	5.6	-2.4
50	37.2	29.5	7.0	-0.7
63	34.5	26.0	8.3	-0.2
80	33.1	24.6	10.6	2.1
100	32.9	23.6	13.8	4.5
125	32.2	22.6	16.1	6.5
160	31.8	22.5	18.4	9.1
200	30.5	22.0	19.6	11.1
250	28.6	20.6	20.0	12.0
315	26.8	18.3	20.2	11.7
400	24.4	16.1	19.6	11.3
500	21.6	15.2	18.4	12.0
630	18.7	14.5	16.8	12.6
800	16.6	14.2	15.8	13.4
1000	15.2	14.1	15.2	14.1
1250	14.3	14.1	14.9	14.7
1600	10.4	14.1	11.4	15.1
2000	9.4	14.1	10.6	15.3
2500	6.5	14.1	7.8	15.4
3150	5.4	14.1	6.6	15.3
4000	4.8	14.1	5.8	15.1
5000	4.3	14.1	4.8	14.6
6300	3.0	14.1	2.9	14.0
8000	2.0	14.1	0.9	13.0
10000	-0.6	14.1	-3.1	11.6
12500	-0.6	14.1	-4.9	9.8
16000	-0.6	14.1	-7.2	7.5
20000	-0.6	14.1	-9.9	4.8
B-band	50.0	46.3	28.8	23.0



Results obtained	Outside the marquee on long axis				Free-field microphone position approximately		385		m horizontally from music noise source		MPS
	Facade reflection(s) estimated to have added				0.0		dB to results obtained		5.0		
Results obtained on	Tuesday 6 August 2013										
Svantek 945A kit	Calibration at start		ok		Battery level at start		ok				
Fast response	Calibration at end		ok		Battery level at end		ok				
Sources:	Only significant noise source is pink noise playing via Direct Acoustics PA system including Zone Array										
Weather:	No other significant noise sources 24 degrees C, dry with no cloud and a light breeze generally from west Road surfaces dry throughout monitoring exercise.										
Start time	L Aeq	L Aeq,15m	LA10	LA90	LA90,15m	L Amax	Notes				
23.30	25.3	27.0	26.5	24.1	24.5	28.5					
23.35	39.0	30.1	41.9	24.0	24.4	53.8					
23.40	28.3	30.9	32.4	23.3	23.8	39.4					
23.45	29.8	32.4	34.0	24.2	23.8	45.4					
23.50	27.2	28.4	28.9	25.0	24.2	40.7					
23.55	29.2	28.7	32.1	25.6	24.9	38.4					
00.00	28.9	28.4	31.3	25.4	25.3	37.3					
00.05	28.9	29.0	31.8	25.2	25.4	37.9					
00.10	29.5	29.1	33.5	24.9	25.2	40.6					
00.15	27.7	28.7	30.1	25.3	25.1	32.4					
00.20	27.4	28.2	28.9	25.4	25.2	33.9					
00.25	30.3	28.5	32.6	25.9	25.5	41.4					
Averages:	31.2		32.0	24.9		44.6	including any façade reflection(s)				
Averages:	31.2		32.0	24.9		44.6	corrected for free-field conditions				
Lowest:	25.3	27.0	26.5	23.3	23.8	28.5	including any façade reflection(s)				
Lowest:	25.3	27.0	26.5	23.3	23.8	28.5	corrected for free-field conditions				

Results obtained

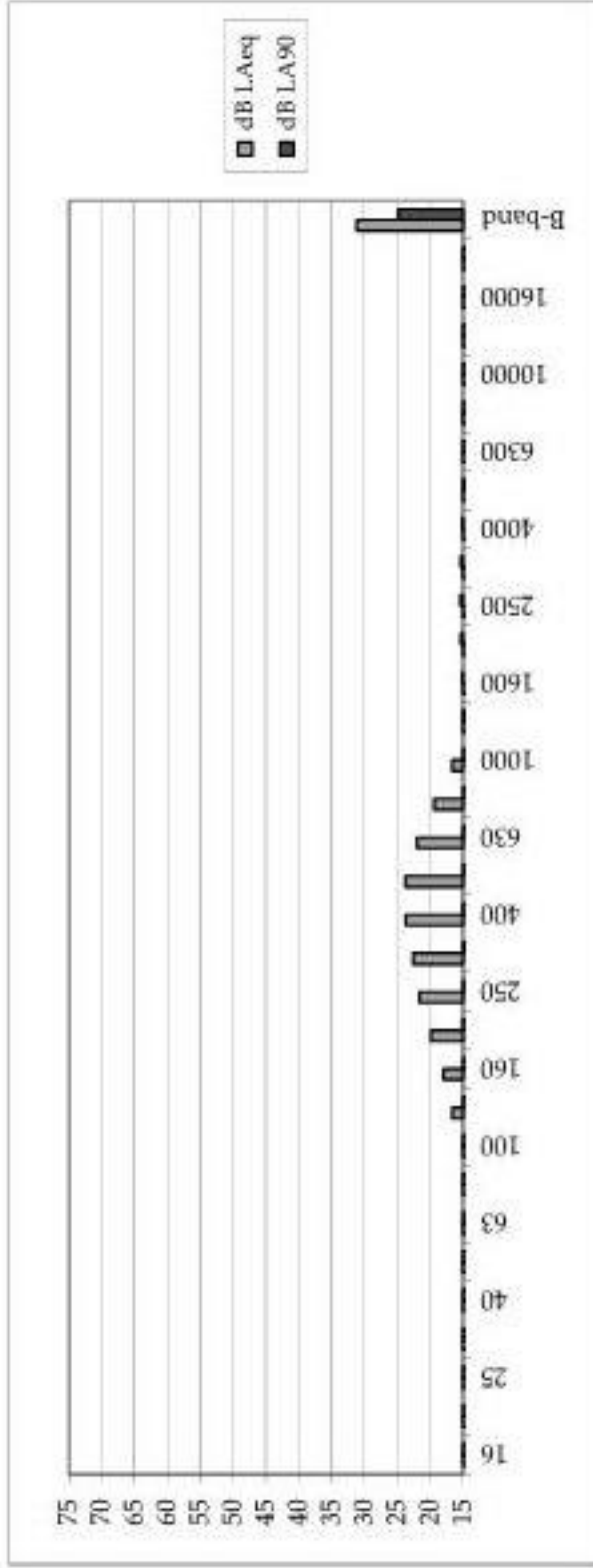
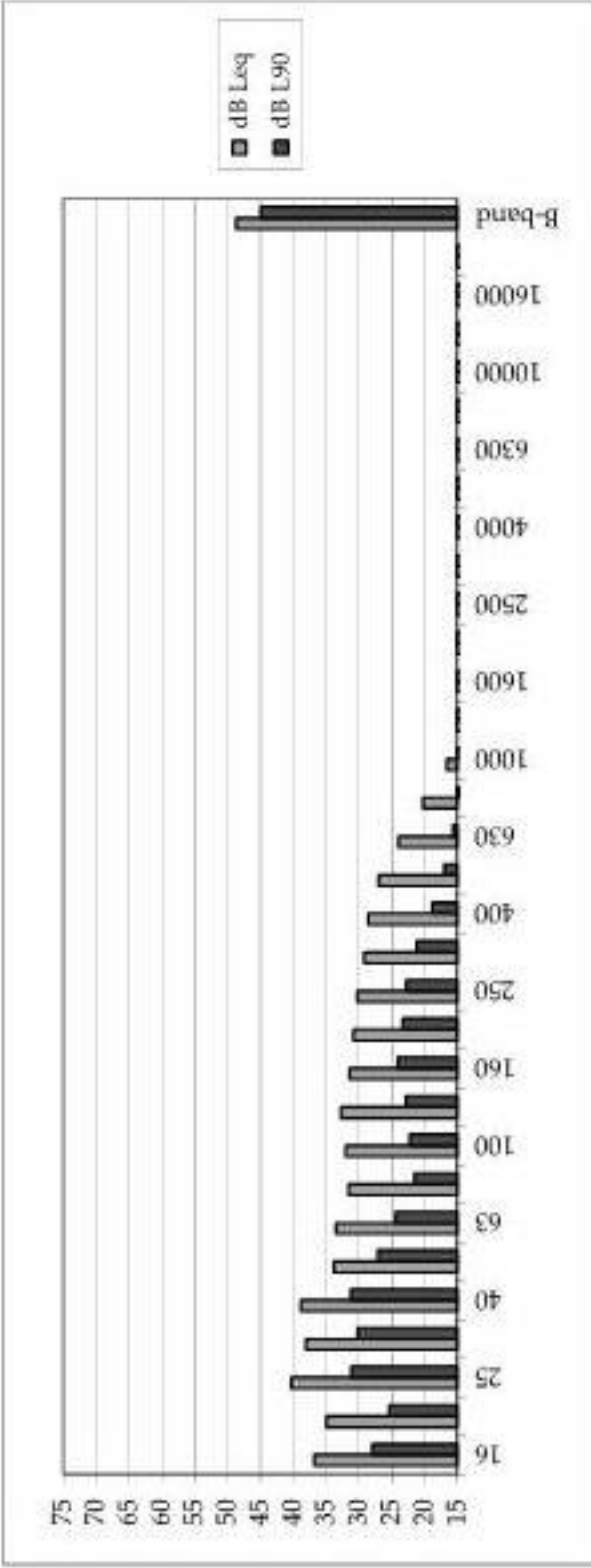
Outside the marquee on long axis
Free-field microphone position approximately
Façade reflection(s) estimated to have added

385.0 m horizontally from music noise source
0.0 dB to results obtained
5.0 m above local ground
MPS

Average spectra for Tuesday 6 August 2013

including any façade reflection(s)

Centre Freq Hz	Averages dB Leq	Averages dB L90	Averages dB LAeq	Averages dB LA90
16	36.8	27.9	-19.9	-28.8
20	34.9	25.4	-15.6	-25.1
25	40.3	31.1	-4.4	-13.6
31.5	38.0	30.2	-1.4	-9.2
40	38.8	31.2	4.2	-3.4
50	33.8	27.1	3.6	-3.1
63	33.5	24.3	7.3	-1.9
80	31.5	21.5	9.0	-1.0
100	32.0	22.2	12.9	3.1
125	32.7	22.8	16.6	6.7
160	31.4	24.1	18.0	10.7
200	30.8	23.3	19.9	12.4
250	30.2	22.7	21.6	14.1
315	29.2	21.2	22.6	14.6
400	28.5	18.8	23.7	14.0
500	27.0	17.0	23.8	13.8
630	23.9	15.6	22.0	13.7
800	20.2	14.6	19.4	13.8
1000	16.6	14.1	16.6	14.1
1250	13.4	14.1	14.0	14.7
1600	10.5	14.1	11.5	15.1
2000	8.1	14.1	9.3	15.3
2500	6.1	14.1	7.4	15.4
3150	6.0	14.1	7.2	15.3
4000	5.9	14.1	6.9	15.1
5000	5.6	14.1	6.1	14.6
6300	5.1	14.1	5.0	14.0
8000	4.9	14.1	3.8	13.0
10000	-0.6	14.1	-3.1	11.6
12500	1.9	14.1	-2.4	9.8
16000	-0.6	14.1	-7.2	7.5
20000	-0.6	14.1	-9.9	4.8
B-band	48.7	44.9	31.2	24.9



Results obtained	Outside the marquee on long axis				Free-field microphone position approximately		385 m horizontally from music noise source		5.0 m above local ground		MPS
	Facade reflection(s) estimated to have added				0.0		dB to results obtained				
Results obtained on	Tuesday 6 August 2013										
Svantek 945A kit	Calibration at start		ok		Battery level at start		ok				
Fast response	Calibration at end		ok		Battery level at end		ok				
Sources:	Only significant noise source is pink noise playing via Direct Acoustics PA system including Zone Array										
Weather:	No other significant noise sources										
	24 degrees C, dry with no cloud and a light breeze generally from west										
	Road surfaces dry throughout monitoring exercise.										
Start time	LAeq	LAeq,15m	LA10	LA90	LA90,15m	LAmix	Notes				
00.30	29.4	29.0	32.6	25.6	25.6	40.6					
00.35	36.3	32.0	40.9	26.4	26.0	49.0					
00.40	30.5	32.1	33.1	26.4	26.1	44.3					
00.45	33.8	33.5	38.1	27.4	26.7	44.9					
00.50	29.8	31.4	31.8	26.1	26.6	41.3					
00.55	33.8	32.5	36.9	25.6	26.4	47.5					
01.00	26.4	30.0	27.7	24.8	25.5	37.4					
01.05	27.2	29.1	28.6	25.6	25.3	33.9					
01.10	26.2	26.6	27.4	25.0	25.1	36.8					
01.15	26.3	26.6	27.5	25.0	25.2	33.6					
01.20	26.9	26.5	28.0	25.5	25.2	36.5					
01.25	27.8	27.0	28.7	26.0	25.5	47.2					
Averages:	30.9		31.8	25.8		43.8	including any façade reflection(s)				
Averages:	30.9		31.8	25.8		43.8	corrected for free-field conditions				
Lowest:	26.2	26.5	27.4	24.8	25.1	33.6	including any façade reflection(s)				
Lowest:	26.2	26.5	27.4	24.8	25.1	33.6	corrected for free-field conditions				

Results obtained

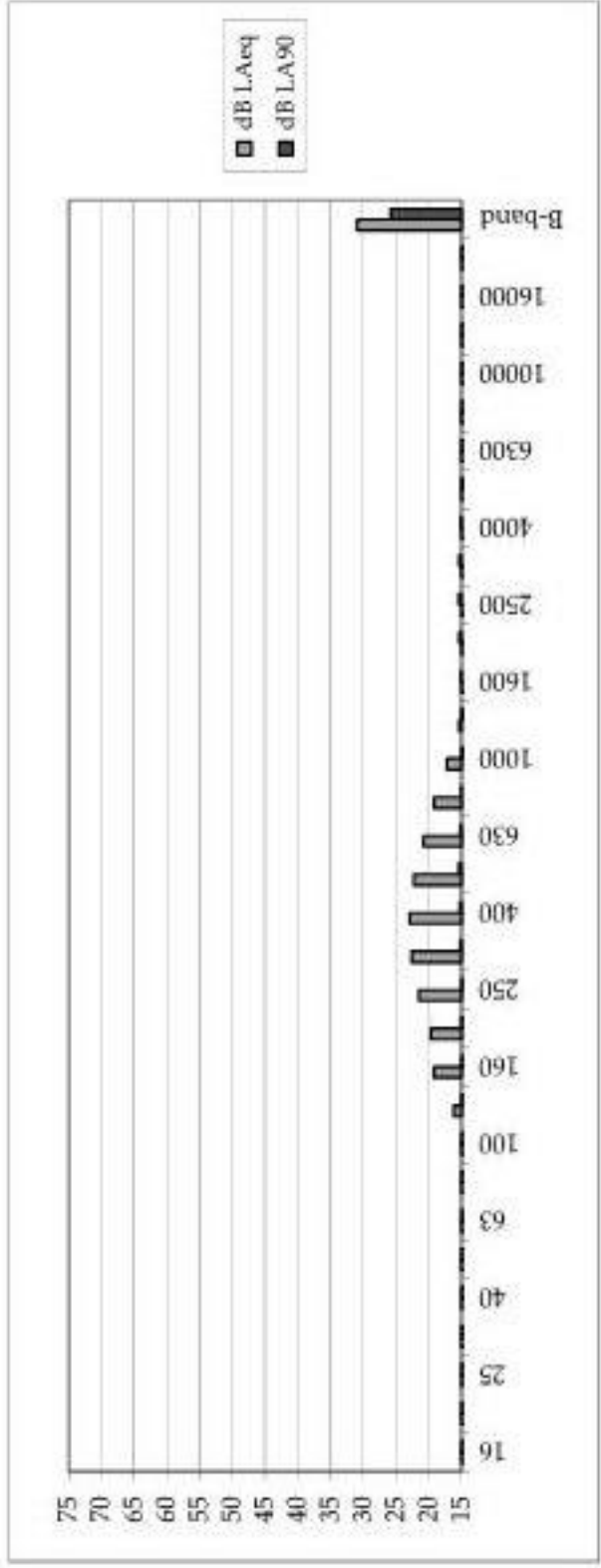
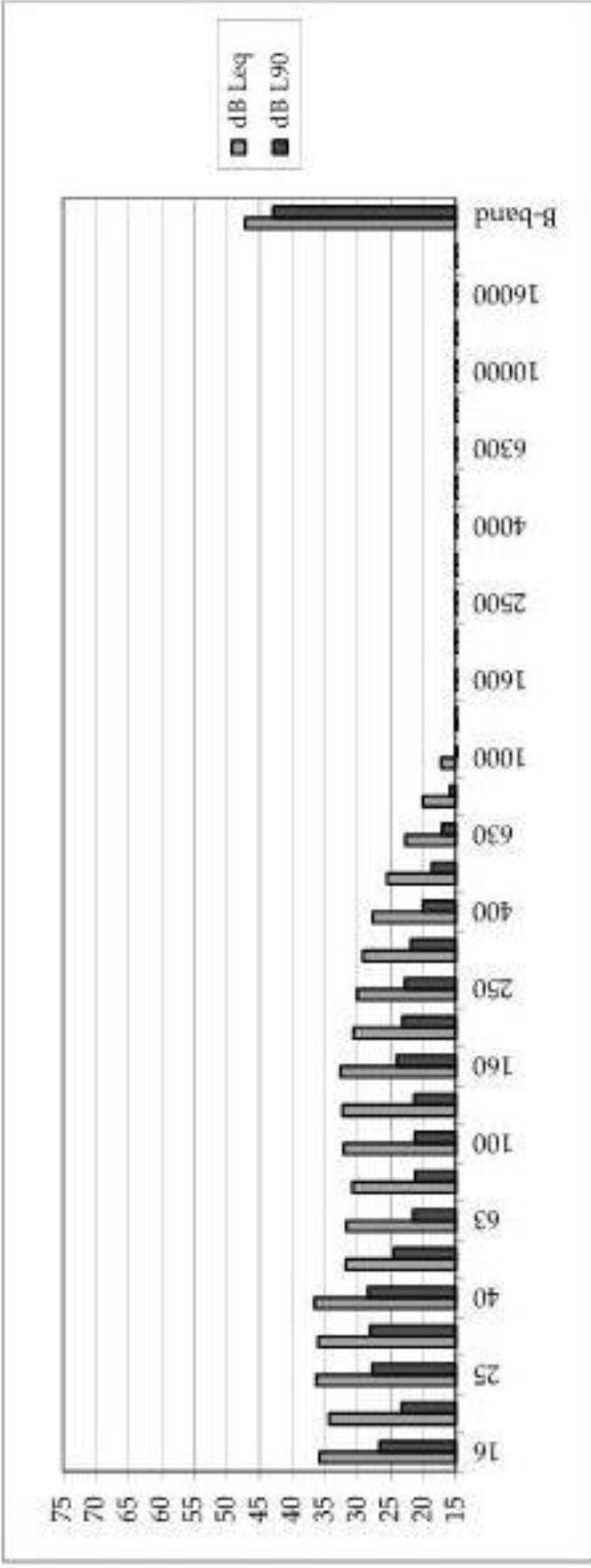
Outside the marquee on long axis
Free-field microphone position approximately
Façade reflection(s) estimated to have added

MPS
m above local ground
5.0

Average spectra for Tuesday 6 August 2013

including any façade reflection(s)

Centre Freq Hz	Averages dB Leq	Averages dB L90	Averages dB LAeq	Averages dB LA90
16	35.8	26.7	-20.9	-30.0
20	34.3	23.3	-16.2	-27.2
25	36.3	27.8	-8.4	-16.9
31.5	36.0	28.1	-3.4	-11.3
40	36.6	28.4	2.0	-6.2
50	31.8	24.5	1.6	-5.7
63	31.7	21.5	5.5	-4.7
80	30.8	21.2	8.3	-1.3
100	32.1	21.2	13.0	2.1
125	32.3	21.3	16.2	5.2
160	32.6	24.0	19.2	10.6
200	30.6	23.2	19.7	12.3
250	30.1	22.7	21.5	14.1
315	29.2	21.8	22.6	15.2
400	27.7	20.0	22.9	15.2
500	25.5	18.6	22.3	15.4
630	22.7	17.1	20.8	15.2
800	20.0	15.9	19.2	15.1
1000	17.2	14.5	17.2	14.5
1250	14.7	14.1	15.3	14.7
1600	12.5	14.1	13.5	15.1
2000	11.9	14.1	13.1	15.3
2500	10.9	14.1	12.2	15.4
3150	7.3	14.1	8.5	15.3
4000	6.1	14.1	7.1	15.1
5000	5.7	14.1	6.2	14.6
6300	5.1	14.1	5.0	14.0
8000	4.8	14.1	3.7	13.0
10000	-0.6	14.1	-3.1	11.6
12500	1.7	14.1	-2.6	9.8
16000	8.5	14.1	1.9	7.5
20000	2.9	14.1	-6.4	4.8
B-band	47.2	42.9	30.9	25.8



Results obtained	Outside the marquee on long axis				Free-field microphone position approximately		385 m horizontally from music noise source		5.0 m above local ground		MPS
	Facade reflection(s) estimated to have added				0.0		dB to results obtained				
Results obtained on	Tuesday 6 August 2013										
Svantek 945A kit	Calibration at start		ok		Battery level at start		ok				
Fast response	Calibration at end		ok		Battery level at end		ok				
Sources:	Only significant noise source is pink noise playing via Direct Acoustics PA system including Zone Array										
Weather:	No other significant noise sources 24 degrees C, dry with no cloud and a light breeze generally from west Road surfaces dry throughout monitoring exercise.										
Start time	L Aeq	L Aeq,15m	LA10	LA90	LA90,15m	L Amax	Notes				
01.30	27.3	27.3	28.5	25.8	25.8	42.3					
01.35	27.4	27.5	28.4	25.4	25.7	44.1					
01.40	27.2	27.3	28.5	25.6	25.6	31.4					
01.45	27.4	27.3	28.7	26.0	25.7	34.7					
01.50	29.6	28.1	32.0	27.3	26.3	36.3					
01.55	28.0	28.3	29.3	26.3	26.5	33.5					
02.00	27.0	28.2	28.2	25.1	26.2	38.4					
02.05	46.6	33.9	51.3	24.3	25.2	61.6					
02.10	28.5	34.0	30.3	26.2	25.2	41.9					
02.15	29.4	34.8	30.8	27.5	26.0	41.1					
02.20	31.3	29.7	34.0	27.5	27.1	45.8					
02.25	30.5	30.4	33.1	27.3	27.4	41.0					
Averages:	36.5		31.9	26.2		51.2	including any façade reflection(s)				
Averages:	36.5		31.9	26.2		51.2	corrected for free-field conditions				
Lowest:	27.0	27.3	28.2	24.3	25.2	31.4	including any façade reflection(s)				
Lowest:	27.0	27.3	28.2	24.3	25.2	31.4	corrected for free-field conditions				
Overall Lowest:	24.1				21.2		corrected for free-field conditions				

Results obtained

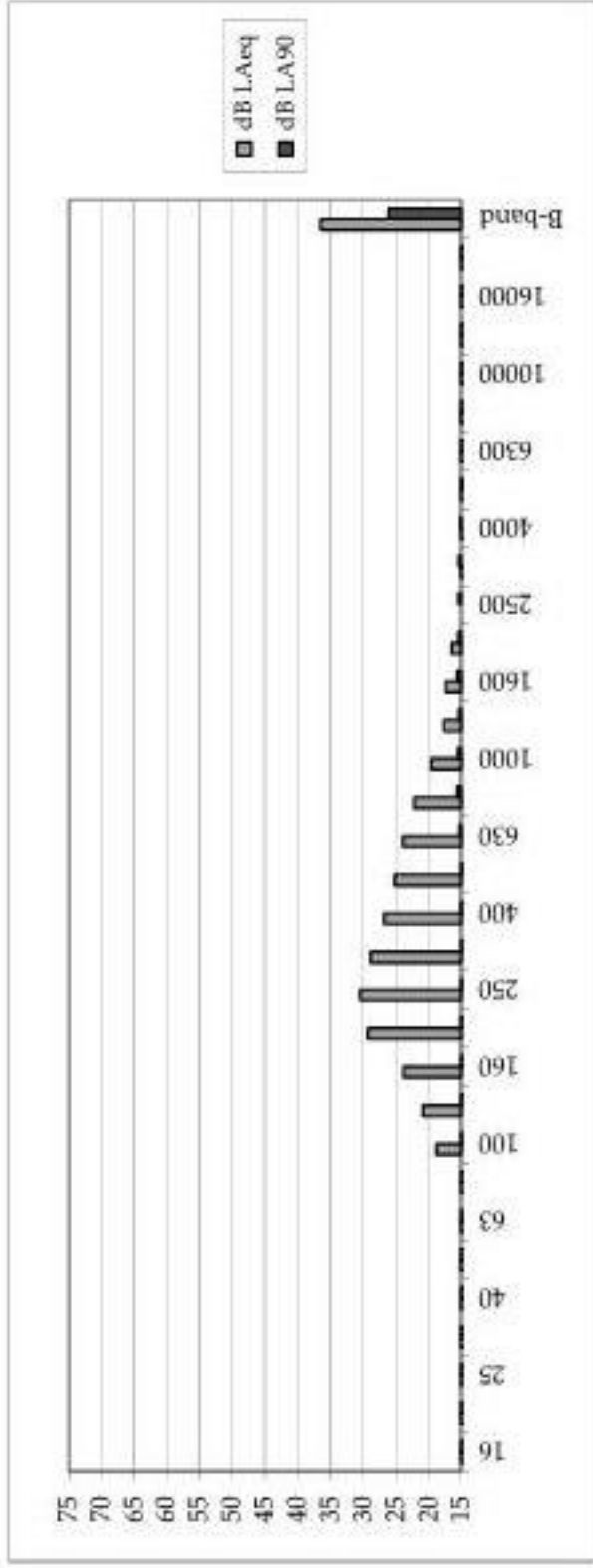
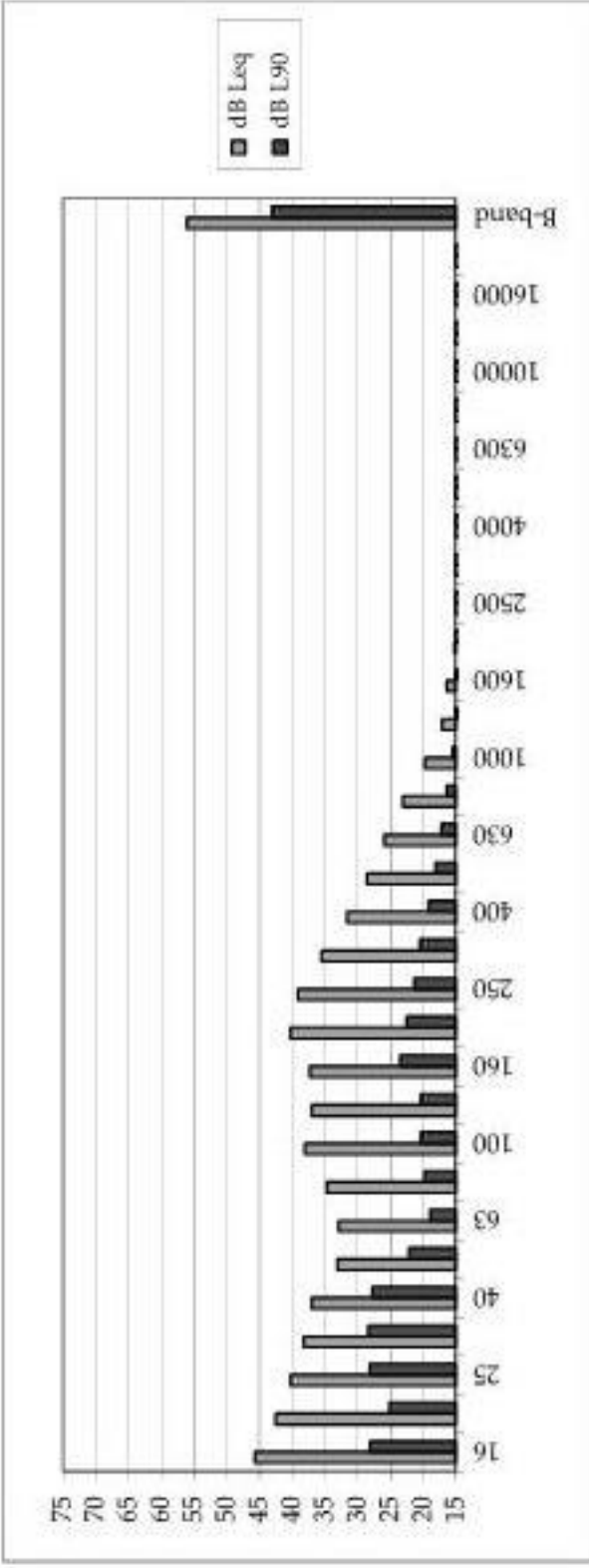
Outside the marquee on long axis
Free-field microphone position approximately
Façade reflection(s) estimated to have added

385.0 m horizontally from music noise source
0.0 dB to results obtained
5.0 m above local ground
MPS

Average spectra for Tuesday 6 August 2013

including any façade reflection(s)

Centre Freq Hz	Averages dB Leq	Averages dB L90	Averages dB LAeq	Averages dB LA90
16	45.7	28.1	-11.0	-28.6
20	42.5	25.1	-8.0	-25.4
25	40.2	28.1	-4.5	-16.6
31.5	38.2	28.3	-1.2	-11.1
40	37.0	27.8	2.4	-6.8
50	33.1	22.2	2.9	-8.0
63	32.9	18.9	6.7	-7.3
80	34.7	19.8	12.2	-2.7
100	38.0	20.4	18.9	1.3
125	37.0	20.3	20.9	4.2
160	37.3	23.5	23.9	10.1
200	40.2	22.5	29.3	11.6
250	39.1	21.3	30.5	12.7
315	35.5	20.4	28.9	13.8
400	31.6	19.1	26.8	14.3
500	28.5	18.1	25.3	14.9
630	25.9	17.1	24.0	15.2
800	23.1	16.4	22.3	15.6
1000	19.7	15.5	19.7	15.5
1250	17.1	14.7	17.7	15.3
1600	16.4	14.6	17.4	15.6
2000	15.2	14.2	16.4	15.4
2500	13.7	14.1	15.0	15.4
3150	11.1	14.1	12.3	15.3
4000	9.7	14.1	10.7	15.1
5000	8.7	14.1	9.2	14.6
6300	7.9	14.1	7.8	14.0
8000	7.0	14.1	5.9	13.0
10000	3.3	14.1	0.8	11.6
12500	3.6	14.1	-0.7	9.8
16000	-0.6	14.1	-7.2	7.5
20000	-0.6	14.1	-9.9	4.8
B-band	56.1	43.1	36.5	26.2



Appendix I

Attenuation provided by trees

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Monday 25 October 2004



Environment

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Trees

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Trees and noise control

Noise can be one of the most problematic environmental factors in both urban and rural areas. Traffic noise in particular is a common problem. Noise attenuation can be achieved by increasing the distance between the noise source and the hearer. However, very often this is not possible and other methods, such as erecting a solid barrier, can be adopted. Where space permits, trees and shrubs can make effective noise barriers and at the same time be visually attractive.

Research has indicated that trees and shrubs can make a contribution to noise reduction. Usually, comparisons have been made between noise propagated over a grass surface and noise propagated through tree and shrub belts. The difference between this two is known as *insertion loss* and is the amount of noise reduction directly attributable to the trees. Published results on the effectiveness of tree and shrub barriers vary enormously, however: in some instances, noise can be reduced by six decibels (dB) over a distance of 30m where planting is particularly dense. A belt of trees and shrubs between 15 and 30m wide can reduce sound levels by as much as 10dB.

There are several factors to be considered before deciding to create a tree and shrub barrier against noise. Where possible, use trees that will develop dense foliage and relatively uniform vertical foliage distribution or combinations of shrubs and taller trees to give this effect. Where the use of trees is restricted, use combinations of shrubs and tall grass or similar soft ground cover, in preference to paved, tarmac or gravel surfaces, to encourage absorption of noise rather than reflection.

Some other points to bear in mind are:

- Noise is more effectively attenuated by completely screening the source from view. Although gaps and partial views through a barrier may create an impression of greater noise reduction, they will allow noise to penetrate.
- A noise barrier should be planted as close to the noise source as possible.
- Widely spaced trees do not reduce noise effectively. Wide belts of high densities are required to achieve significant noise reduction.

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- Effectiveness is closely related to the density of stems, branches and leaves. Use trees with dense foliage and branches that reach close to the ground. Alternatively, plant an understorey of dense shrubs or a surrounding hedge.
- Where year-round noise screening is desired, use broadleaved evergreens or a combination of conifer and broadleaved evergreen species.
- Soft ground is an efficient noise absorber. Avoid hard surfaces – asphalt and concrete reflect virtually all incident sound at any angle. Cultivating ground before planting and the addition of well-rotted organic matter to the soil surface, may also help to reduce noise while vegetation becomes established.

For further information contact:



Email : customer.services@medway.gov.uk



Telephone : **The Tree Team on 01634 333333 or out of normal working hours call 01634 304400**



Write to :
Medway Council
Civic Centre
Strood
Rochester
Kent ME2 4AU



Minicom : **01634 333111**

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Appendix J

Direct Acoustic Solutions brochures / data sheets



ZoneArray

The targeted sound solution.



Entertainment Noise Control

Direct Acoustic Solutions are an independent company who specialise in providing products, advice and bespoke solutions to the entertainment and events industry - specifically venues that are struggling to contain noise. Designing and manufacturing the pioneering zoneArray sound system has enabled us to provide a lifeline for many venues where noise restrictions have made operating increasingly difficult.

Our team is working day in day out with venues and events professionals that are either already suffering with noise issues or are aiming to create a controlled noise environment. Passing on the knowledge and skills we have gained we are able to offer innovative solutions and advice at any stage of this process. Our track record speaks for itself with numerous previous clients having gained planning and licence consent, created new event spaces, and put on exclusive and unique events as a direct result of our work.



Directional Sound

Using the zoneArray allows you to target music directly into the areas it is required with unbelievable control. Selected zones can be filled with full frequency high quality sound whilst everyone else is left undisturbed. So effective, the zoneArray has previously been the sole factor in licences being granted and noise abatement notices being adhered to, whilst also offering a cutting edge to many boutique venues and events.

If you are seeking to solve an existing noise issue, create a new event space, hold an exclusive party, or have any other need for a targeted audio solution, the zoneArray offers unique control and quality of sound that outperforms anything else on the market.

- **Solve noise issues**
- **Create a new event space**
- **Apply for a licence**
- **Improve the atmosphere**
- **Party for longer**
- **Events in unique locations**



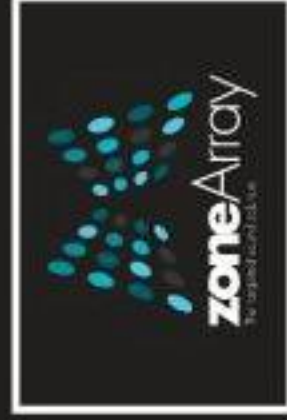
Neighbours and guests sleep through the night without being disturbed

A Marquee Sound Solution

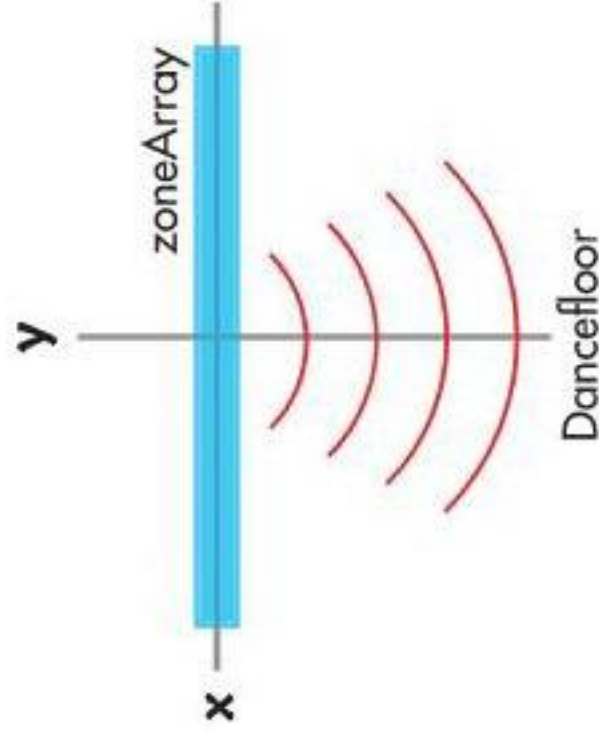
A marquee with its obvious weakness in containing high volume music has for a long time been the cause of many sleepless nights on both side of the fence - neighbours kept awake by late night parties and the venue owners/event organisers struggling to find a solution that actually works.

Whenever a noise issue arises, our initial thought process naturally tells us to introduce some kind of barrier (soundproofing) - unfortunately the science behind sound control is extremely complex and acoustic energy is especially good at finding any weaknesses soundproofing will inevitably have. What the zoneArray does differently is control the issue at source - instead of fighting against trying to effectively soundproof a tent, the fact a marquee attenuates almost nothing does not matter, high volume levels are targeted to those that want them and everyone else is left in peace.

Within a rigid frame marquee installation is simple - using cadger clamps to provide fixing points needed and then installing a bespoke aluminium frame to house the zoneArray. Orientation generally follows the marquees roof pitch and when linings are pulled back the system is completely hidden from view.



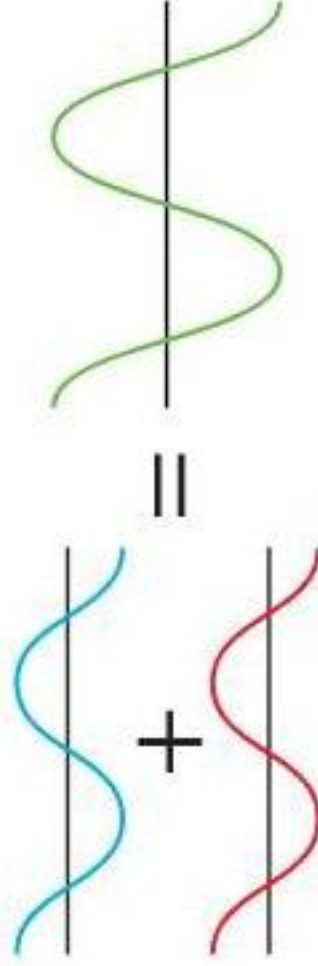
Technology



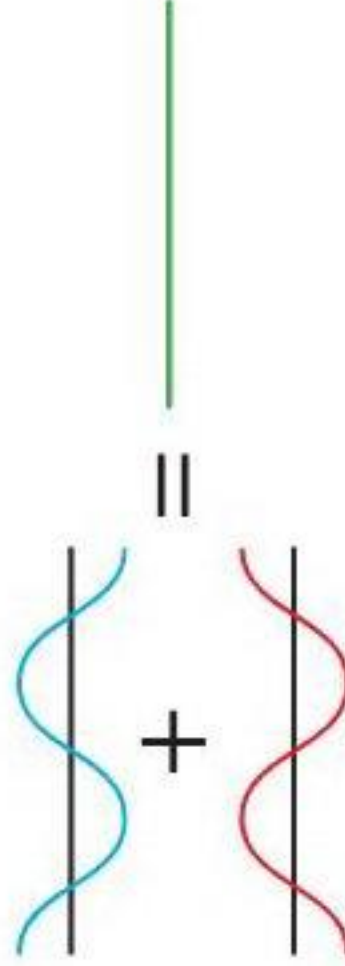
y axis - waveforms are in-phase - constructive interference causes amplitude to increase.

x axis - waveforms are 180° out of phase - destructive interference causes amplitude to decrease.

In-phase



180° Out of Phase



Although using arrays of speakers to control audio is not an entirely new principle, the zoneArray takes this control onto a completely new level. Specifically focusing on troublesome frequencies and without substituting quality of sound, it has been designed to provide noise sensitive venues with a long term solution when creating a controlled audio environment. A zoneArray system allows you to select specific areas within the venue by introducing "hot zones" of sound, outside of these zones volume levels drop-off at a much faster rate in comparison to a conventional speaker system.

Manipulating waveforms through the use of multiple sound sources is a technique that has been used for many years to gain control over audio signals - line array systems have now become industry standard when projecting audio to a large audience. The zoneArray focuses energy in two ways, firstly the directivity of any soundwave is relative to the physical size of its source - therefore the larger the actual loudspeaker (the source), the more directional the sound it produces. Whilst creating a speaker driver many metres wide is not functional, a source with equivalent directivity at the lower frequencies can be constructed by utilizing an array of smaller loudspeakers - all driven together in-phase.

By then taking advantage of wave interference it is possible to both increase the overall amplitude (volume level) created whilst underneath the system (constructive interference) and significantly reduce the amplitude when to the side of the system (destructive interference). This all means that once installed the zoneArray offers an unbelievable level of directivity and control inside selected zones the system produces full frequency dancefloor volume sound, as soon as you step outside of this designated area the volume levels, and most importantly the bass frequencies, drop off at a remarkable rate.

Flexibility & Design

The system is modular and can be specified to cater for venues of any size, and, because of the fundamental physics around which the zoneArray has been designed, the larger the system, the larger the array, and therefore the more directional the sound produced.

Black and White systems are available as standard, should your project require unique design specifications - the zoneArray is built in house to order and a huge range of colours and unlimited shape arrangements can be incorporated to create a truly unique and impressive sound solution, bespoke to your venue.



Don't Just Take Our Word For It

"Made my life so much easier, the guys completely took the issue off my hands and appeased our neighbours and environmental health. It's been a turn-key solution and without the zoneArray we would not be able to run the events which are so important to our venue."

Jon West, Technical Manager - New Hall Hotel

"When I was initially approached about the possibility of using a zoneArray sound system to alleviate the noise issues we had, I couldn't help but be sceptical after trying so many other supposedly guaranteed solutions which hadn't worked. Since installing the zoneArray we were firstly able to trade through our first year without any complaints and have since applied and been granted a permanent licence for the marquee. I can't speak highly enough of the Direct Acoustics team and would be happy to recommend them to anyone with a noise concern."

Emmet Hannan, Owner - Mountains Country House Events

"We are extremely pleased with the effectiveness of the zoneArray sound system in reducing noise pollution. It has enabled Greenwoods to host large marquee functions at any time of the year without causing problems of noise pollution, this is a huge advantage to the business."

Clare Knott, Events Manager - Greenwoods Hotel

"With Adventure International being located in the town centre, sound emanating from the marquee was a key issue - having been referred to Direct Acoustic Solutions I was blown away by the results they were able to achieve in controlling noise and since the zoneArray was installed we have not received a single complaint."

Keith Marshall, Managing Director - Adventure International



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At Direct Acoustics we understand that when striving for acoustic control each project must be treated on an individual basis, there are many factors which must be taken into account in order to find a workable solution for each case. Our experience and unique products put us in the best possible position to provide our clients with the exact service, advice and solutions they require.

From an initial meeting through to installation and onwards we are always happy to share with you the knowledge we've gained from dealing with these issues daily on a professional basis. If you have questions about creating a controlled audio environment in any scenario, whether it's at concept, completion or in crisis please feel to contact us through the details below and one of the team will be happy to help.

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zoneArray Speaker System Acoustic Performance

Description

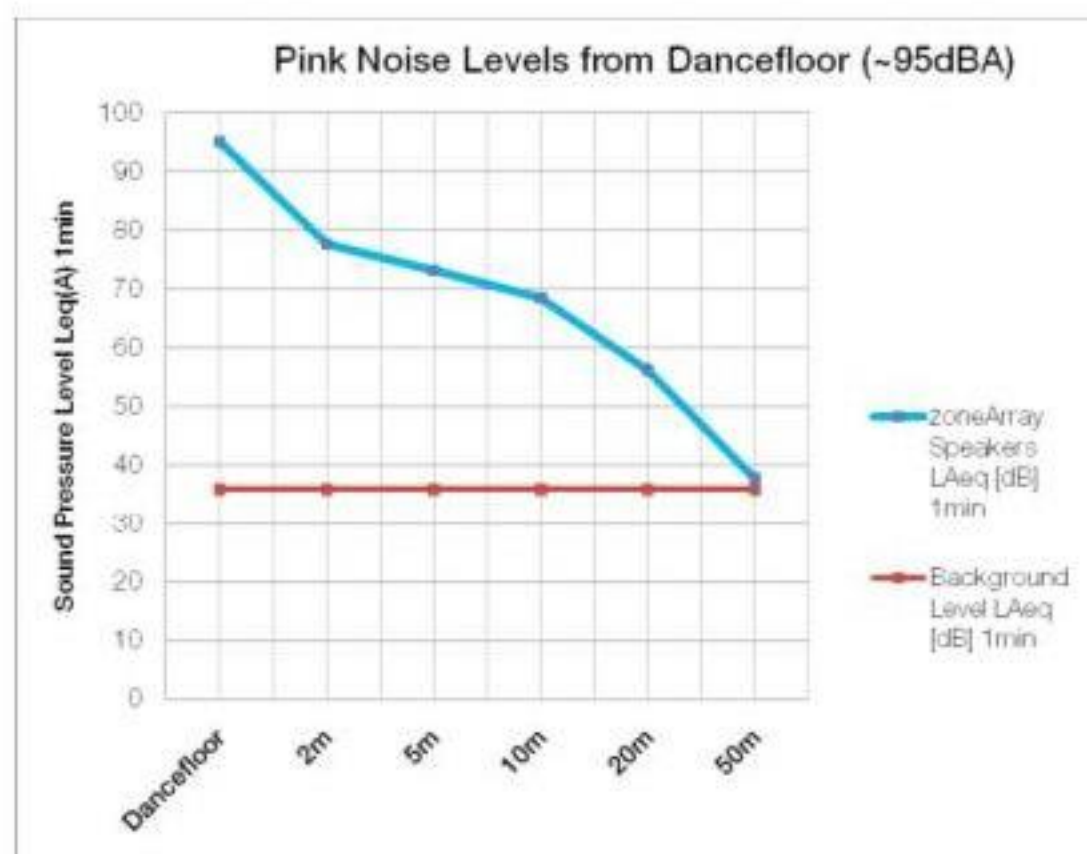
A speaker system engineered to target specific areas with full frequency high volume audio whilst adjacent areas are left free from excessive noise.

Application

Slight variations within the product range make installation possible into a range of scenarios. These include marquees, nightclubs, hotel function rooms, etc.

Acoustic Performance

Tests carried out utilising 36x zoneArray speaker panels installed on a pitched configuration inside a standard clear span marquee with linings.



	Dancefloor	2m	5m	10m	20m	50m
zoneArray Speakers LAeq [dB] 1min	95.1	77.6	73.2	68.5	56.2	37.7
Background Level LAeq [dB] 1min	35.8	35.8	35.8	35.8	35.8	35.8

Special Information

Acoustic performance is also dependent upon adjacent structures/materials, the surrounding environmental landscape and proximity in relation to the actual system. Our technical department can advise upon the most effective installation method for individual cases.

DATA SHEET: SymNet Solus

Solus • 4

Four inputs and four outputs

Solus • 8

Eight inputs and eight outputs

Solus • 16

Sixteen inputs and eight outputs



Solus is powerful SymNet DSP hardware, ideal for small to mid-size installations not requiring I/O expansion. The entire family of SymNet hardware, including Solus, is configured using open architecture SymNet Designer software. System designers have the option to use or modify Solus DSP design templates for basic projects, or, to create unique designs entirely from scratch.

The three Solus hardware offerings differ only in their audio input and output counts: Solus 4 with four inputs and four outputs, Solus 8 with eight mic/line inputs and eight outputs and Solus 16 with sixteen mic/line inputs and eight outputs. Ethernet, ARC port, RS-232 port, two control inputs, and four logic outputs complete the control feature set. To simplify set-up, a front panel LCD displays system settings. Solus supports Symetrix ARC wall panels, third party control systems, and SymVue, a SymNet end-user control panel application.

When system designers need more than a fixed architecture box can offer, Solus delivers powerful standalone open architecture DSP.

Find Solus at www.symetrix.co.



The Vision Behind the Sound

Benefits and Features

- The most powerful SymNet DSP hardware yet. Ideal for small to mid-size installations not requiring I/O expansion.
- Configured using open architecture SymNet Designer 10 to customize signal path and DSP modules.
- The most cost-effective SymNet solution to date.
- Four mic/line inputs and four outputs on Solus 4, eight mic/line inputs and eight outputs on Solus 8 and sixteen mic/line inputs and eight outputs on Solus 16.
- Ethernet, ARC port, RS-232 port, two control inputs, and four logic outputs.



DATA SHEET: SymNet Solus



The Vision Behind the Sound

Solus 8 (8 inputs, 8 outputs) rear panel shown. Solus 4 (4 inputs, 4 outputs) and Solus 16 (16 inputs, 8 outputs) differ only by their number of audio inputs and outputs.



A&E Specifications

The device shall provide four, eight or sixteen inputs (Solus 4, 8 or 16, respectively) that are selectable as line or mic level with phantom power and four or eight (Solus 4 or Solus 8 and 16, respectively) line level outputs. All signal processing, mixing and routing functions (including input gains) shall be controllable via software. Audio inputs and outputs shall be accessed via rear panel 3.81 mm terminal block connectors.

A designer software application shall be provided that operates on a Windows computer, with network interface installed, running Windows® XP or higher operating system. Computer connection for configuration shall be via the device's rear panel Ethernet connector. All internal processing shall be digital (DSP). Available DSP components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, onboard logic, and diagnostics.

The front panel shall include input and output signal level indicators as well as indicators for POWER, NETWORK, and ARC.

External control shall include dedicated software screens as well as preset selection, I/O level control and muting using the optional ARC wall panel remote controls via industry-standard CAT5 cable with RJ45 connectors. All program memory shall be non-volatile and provide program security should power fail. The device shall provide an on board real time clock to facilitate automatic, timed changing of presets. Third-party control systems may interface over IP and RS-232 using a published ASCII control protocol.

Audio conversion shall be 24-bit, 48 kHz. The dynamic range of the processor shall not be lower than 110 dB A-weighted.

The device shall have a captive power input socket for an external 24 VDC supply. The device shall meet UL/CSA and CE safety requirements and comply with CE and FCC Part 15 emissions limits. The device shall be RoHS compliant. The chassis shall be constructed of cold rolled steel and moulded plastic, and mount into a standard 19" 1U EIA rack. The device shall be a **Symetrix SymNet Solus model 4, 8 or 16**.

Performance Data

INPUTS

Number of Inputs: Four (4), eight (8) or sixteen (16) switchable balanced mic or line level on Solus 4, 8 or 16, respectively.
Connectors: 3.81 mm terminal blocks.
Nominal Input Level: +4 dBu line or -36 dBu mic level (software selectable) with 20 dB of headroom.
Mic Pre-amp Gain: +40 dB.
Input Trim: +/- 24 dB.
Maximum Input Level: +23 dBu.
Input Impedance: > 18 kΩ balanced, > 9 kΩ unbalanced, > 2 kΩ with phantom power engaged.
CMRR: > 50 dB @ 1 kHz, unity gain.
Mic Pre-amp EIN: < -125 dBu, 22 Hz - 22 kHz, 100 Ω source impedance
Phantom Power: +20 VDC, 20 mA maximum per input.

OUTPUTS

Number of Outputs: Four (4) or eight (8) line level on Solus 4 or Solus 8 and 16, respectively.
Connectors: 3.81 mm terminal blocks.
Nominal Output Level: +4 dBu line level with 20 dB of headroom. For unbalanced analog output, do not connect the minus output terminal. Unbalanced configuration results in 6 dB lower output level.
Maximum Output Level: +24 dBu.
Output Impedance: 200 Ω balanced, 100 Ω unbalanced.

SYSTEM

Sample Rate: 48 kHz.
Frequency Response: 20 Hz - 20 kHz, +/- 0.5 dB.
Dynamic Range: > 110 dB (A-Weighted), input to output.
THD+Noise: < -85 dB (un-weighted); 1 kHz @ +22 dBu with 0 dB gain.
Interchannel Crosstalk: < -90 dB @ 1 kHz, typical.
Latency: < 1.6 ms, input routed to output.

Mechanical Data

SPACE REQUIRED:

1U (WDH: 48.02 cm x 19.05 cm x 4.37 cm / 18.91 in x 7.5 in x 1.72 in), depth is specified from front panel to back of connectors.

Allow at least 3 inches additional clearance for rear panel connections. Additional depth may be required depending upon your specific wiring and connections.

ELECTRICAL:

100-240 VAC, 50/60 Hz, 25 Watts maximum, Universal input.

VENTILATION:

Maximum recommended ambient operating temperature is 30 °C / 86 °F. Ensure that the left and right equipment sides are unobstructed (5.08 cm, 2 in, minimum clearance). The ventilation should not be impeded by covering the ventilation openings with items such as newspapers, tablecloths, curtains, etc.

CERTIFICATIONS OR COMPLIANCE:

UL 60065, cUL 60065, IEC 60065, EN 55103-1, EN 55103-2, FCC Part 15, RoHS

SHIPPING WEIGHT:

8 lbs. (3.63 kg), Solus 4 and 8
11.5 lbs. (5.22 kg), Solus 16

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