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Company Profile

THE HISTORY

Vibra-Sonic Control is a privately owned company, incorporated in the Province of British Columbia on June 1st, 1980. It was established to provide cost effective solutions to noise and vibration problems, specifically for the commercial, institutional, industrial and marine markets. The company is unique in North America, having the product and the expertise to address noise and vibration control issues across the board. As needed, the knowledge and experience of its many national and international suppliers and manufacturers is drawn upon, each with their own engineers who specialize in very specific areas of noise or vibration control. Vibra-Sonic Control is also Canada’s most knowledgeable supplier of seismic restraint for resiliently mounted systems.

In the field of interior acoustics, Vibra-Sonic Control is a leading supplier of sound masking and paging systems. The company has installed sound masking in over 1000 corporate offices and medical facilities across Canada. All the systems have the capability of having campus wide paging as an integral part of their sound system.

PRESIDENT

The president of Vibra-Sonic Control, Mr. Chris Wolfe, holds a Bachelor of Science degree (1970 - with Honors) from the University of Victoria, a Master of Arts degree (1974) from the University of Western Ontario and has over 35 years field experience in both noise and vibration control and seismic restraint.

TYPICAL PRODUCTS

Some of the more commonly ordered materials and engineered products are as follows:

- Acoustical foams and laminates
- Acoustic floor mats & underlays
- Seismic restraints
- Air, spring & Elastomeric vibration isolators
- Constrained layer and extensional damping materials
- Sound masking & paging systems
- Die-cut parts
- Engine & blower silencers
- Flexible pipe connectors (acoustic)
- Floating floors, walls & ceilings
- Limp mass barriers
- Marine & NATO approved shock & vibration isolators
- Motor mutes
- Acoustic equipment & personnel enclosures
- Steam & gas blow down silencers
- Active hearing protection & silencers
- Acoustic high mass curtains
In order to provide prompt service and delivery, over $500,000 worth of materials are stocked in Vancouver and Calgary. Large orders and engineered products are shipped direct from our various suppliers’ manufacturing facilities.

**MAJOR SUPPLIERS**

**American Acoustics:** Provides various chemically compounded barium vinyl barriers which have high transmission loss characteristics that are typically required for pipe and equipment lagging as well as in acoustical curtain and plenum barrier applications. ([www.aapusa.com](http://www.aapusa.com))

**Atlas Sound:** Manufactures high quality commercial audio products. ([www.atlassound.com](http://www.atlassound.com))

**Caparo Dynamics:** Manufactures various specialty isolation/shock mounts that are NATO approved for avionic and marine applications. ([www.caparo-dynamics.com](http://www.caparo-dynamics.com))

**Industrial Acoustics:** Largest manufacturer/supplier worldwide of acoustic doors & windows, operable walls, engine test cells, hearing test booths, acoustic panels and enclosures, commercial grade duct silencers, acoustic ceiling panels and specialty silencers. ([www.industrialacoustics.com](http://www.industrialacoustics.com))

**J. P. Environmental:** Manufactures high transmission loss silencers for engine and compressor applications as well as the steam and gas blow down silencers that are typically found in the pulp and paper and petro-chemical industries. ([www.jpenvironmental.com](http://www.jpenvironmental.com))

**Mason Industries:** Largest North American manufacturer/supplier of vibration isolation and associated seismic restraint products. ([www.masonaneheim.com](http://www.masonaneheim.com))

**Milcut:** One of the top 3 polyester/polyether processing companies in North America, Milcut provides Vibra-Sonic Control with a complete range of acoustical foam and laminate products, much of which is laser or water-jet cut for Original Equipment Manufacturers (O.E.M.s). ([www.milcut.com](http://www.milcut.com))

**Sound Masking Inc:** Manufacturer of a SoundMaskIt compact, self-contained, multi-zoned, Digital Signal Processor and Amplification Systems for the simultaneous distribution of Sound Masking, Paging, Security PA, and background music.
SOUND MASKING & PAGING SYSTEMS – SMI SOUNDMASKIT

Sound Masking is an important component in rendering normal conversation unintelligible in open plan office environments and for speech privacy in applications such as closed offices, clinics, interrogation rooms, and meeting rooms. Vibra-Sonic Control is pleased to offer our clients a wide range of Customized Sound Masking Systems. Each of our clients receives an individual proposal predicated on their specific requirements.

**SoundMaskIt’s DSP 8807:** An 8 channel, compact, self-contained, multi-zoned, digital signal processor and amplification system for simultaneous distribution of Sound Masking, paging, security PA and back ground music.

**SoundMaskIt’s DSP 2210:** A two channel , self-contained audio processing system for speech privacy, line and mic level paging, and background music reproduction. This model us an addition to the SoundMaskIt Series of Products, including DSP8807 units.

**SoundMaskIt’s DSP 2212:** A two zone, self-contained audio processing systems for speech privacy, line and mic level paging, and background music reproduction. This model is an addition to the SoundMaskIt Series of Products, including DSP8807 units.

**SoundMaskIt’s NANOMASKIT:** The most recent addition to the SoundMaskIt series of products. It is a high quality, wireless controlled, stand alone, ceiling mount, digital sound masking system developed for smaller projects.

**CLIENT BASE**

Vibra-Sonic Control has addressed the need for noise, vibration control and interior acoustics for thousands of clients over the past 30 years. Some are not heard from again for years, others order product on a monthly basis, but every month orders are placed by between 100 and 300 clients ... some small, some large.

Any company can provide references. They simply have to find a few clients that have been happy with their work. Vibra-Sonic Control, however, invites potential clients to contact any major Acoustical Consulting firm in Western Canada or the head of any major Mechanical or Electrical Consulting firm in Alberta or British Columbia to get a truly independent assessment of our products and service.

In short, Vibra-Sonic Control has provided product and service to practically every sector of the market where noise, vibration and interior acoustics are of concern.
SOME GENERAL INFORMATION AND SOME UNUSUAL APPLICATIONS OF NOTE

• Vibra-Sonic Control has engineered and provided the vibration isolation and seismic restraint on over 2000 major ‘new’ commercial and institutional projects.
• Vibra-Sonic Control/Mason Industries is ‘prime spec.’ on 95%+ of all specifications issued in B.C. for the isolation and seismic restraint of mechanical and electrical equipment and systems.
• Typical applications include the isolation and restraint of cooling towers, power transformers, chillers, emergency generator sets, pumps and air handling equipment. Many pieces of equipment have to be restrained to meet ‘post disaster’ requirements during and after a seismic event.
• Vibra-Sonic Control has provided large quantities of lagging materials and station blow down silencers on many of the large gas pipeline projects that have been in progress over the past few years; as well as vibration and shock mounts on the Canadian ‘Frigate’ program; isolation of exhaust systems to B.C. Ferries; sound masking/paging systems to various corporate headquarters; and die-cut acoustical under lays to large O.E.M.s such as Deere Hitachi.

NOTABLE PROJECTS

• Supplied the isolation/seismic restraint for the pavilions and permanent structures for expo ‘86 in Vancouver.
• Installed sound masking and paging for the City of Calgary’s Whitethorn Multi Service Center, which is the combined 311 and 911 call center.
• Installed a campus-wide paging and sound masking system in a two building complex for Albian Shell in Fort McMurray. Included the challenge of ensuring clearly audible paging in high open ceiling warehouses with multiple fan noises.
• Installed 650 speakers in the Enmax head office in Calgary. The system was originally for sound masking but paging was added to the system.
• At South Calgary Health Centre, 24 zones of paging, 20 zones of sound masking, security paging, telephone and microphone paging were installed. Masking and paging were optimized with ambient sensors in areas such as public health.
• Spring isolated a complete bowling alley, including the pinsetters, on the second floor of the Banff Springs Hotel.
• Provided the complete sound masking system installed in of TransCanada Tower (over 2,000 speakers)
• Floated’ the roof on the ‘Calgary Center for Performing Arts’ to prevent passing aircraft from affecting performances.
• Completely ‘floated’ and seismically restrained 12 theatres and an Omnimax for Famous Players/PCL Construction at the West Edmonton Mall.
• Have isolated drive and/or pulley assemblies for all the major elevator manufacturers, at one time or another, on ‘problem jobs’.
• Have provided various materials and engineered ‘high end’ acoustical products to most of the production and post-production facilities serving the TV, Radio and Movie industries in Western Canada.
• Supplied 11 large Natural Gas blow down silencers to Alberta Natural Gas on three (3) compressor stations.
• Isolated a 30 person adventure ride above a super market in a large Vancouver mall.
Vibra-Sonic Control and its employees are Members or Associate Members of the following organizations:

A.S. A. - Acoustical Society of America (Northwest Chapter).

A.E.S. - Audio Engineering Society

A.S.H.R.A.E - American Associations of Heating, Refrigeration and Air Conditioning Engineers (Northwest Chapter).

C.A.A. - Canadian Acoustical Association

C.S.C. - Construction Specifications Canada

E.C.A. - Electrical Contractors Association (BC)

I.F.M.A. - International Facility Management Association

I.N.C.E. - Institute of Noise Control Engineering

M.C.A. - Mechanical Contractors Association (BC)

S.P.O.S.A. - School Plant Officials Society of Alberta

V.R.C.A. - Vancouver Regional Construction Association
Sound Masking Introduction

The purpose of Sound Masking is to reduce speech intelligibility, thereby, increasing personal privacy in an environment where this would be otherwise difficult to achieve. In practice it involves the introduction of an electronically generated broadband sound into the area of concern, thus unobtrusively increasing the ambient sound level. Originally used in corridors outside interrogation rooms and areas deemed ‘highly confidential’, its greatest use now is in commercial and professional buildings particularly where ‘Open Landscape (a.k.a. ‘Open Plan’) Office Designs’ are involved.

Open Plan Office Environments have evolved as an architectural response to market demands to maximize floor-space usage. The designs offer flexibility, uncomplicated movement of systems and furnishings, and easy re-grouping of employees. Most importantly they allow for the creation of more densely populated floor-plates. However, through a ‘modern’, cost effective approach, to building and renovating, these designs bring with them inherent privacy problems. Furnishings, absorptive partitions and acoustical ceiling tiles are all designed to reduce reverberative sound, while the heating, ventilating and air conditioning systems are typically silenced to minimize offensive noise. Unfortunately, speech tends to travel long distances when such quiet ambient backgrounds are achieved. It is imperative that the design includes a good acoustical environment to compliment the higher density. The associated costs of a flexible, well designed Sound Masking System should be in the original budgets.

Critical Issues & Considerations with Respect to Sound Making

- It must be unobtrusive to those working in the area. It should sound natural and ‘airy’, similar to typical ventilation noise (not too ‘hissy’ or ‘rumbly’).
- The shape of the sound spectrum generated should be consistent with the human ears response to sound. Typically an NC-38-40 curve is used as a criterion.
- The effectiveness of the Sound Masking is maximized when used in conjunction with appropriate barrier and absorptive elements within the space. Pre-planning pays dividends.
- Sound Masking is best introduced before people move into a workplace. Retrofitting an existing area requires slowly raising the sound level over a period of time so people do not have an immediate, negative response to any interference or ‘manipulation’ of their work area.
- It is important that the Sound Masking be as homogenous as possible throughout the sound masked area, yet be flexible enough to be locally adjustable to address individual preferences. This local volume control is also important in terms of responding to localized building elements that might otherwise increase or decrease the sound level generated in the space.
Typical Systems Include:

- Equalization of each zone, allowing for manipulation of the sound spectrum within the given space, is a necessity. Building elements such as the ceiling tile can attenuate from frequencies while leaving other generated frequencies unaffected. The actual space itself can do the same. Adding Equalization simply offers the ability to fine-tune the system in response to the effects of a specific environment on the original sound spectrum generated.
- Multi-Channels to allow for independent spectrum development in each zone
- Centralized Digital Systems are normally requested on large projects where one central control is required for the floors and there are various volume schedule requirements, or other parameters, that need to be addressed.
- Paging is an option that saves the cost of installing a second speaker system with its associated components.
- Background music in specified zones is another possibility.
- Masking and paging optimizers measure the ambient background level of a space, using microphones installed in the ceiling tile. When that zone is noisier due to higher occupancy at different times of the day, the masking and paging volumes increase automatically.
- Network
- IP Addressable

Applications Where Sound Masking is Beneficial:

- Open Plan Office Environments
- Private Offices
- Meeting Rooms & Boardrooms
- Lunch areas
- Libraries
- Breakout Rooms
- Human Resources
- Media Rooms
- Medical Facilities
- Urgent Care
- Observation Rooms
- Call Centres
- CEO Offices
- Reception Areas (hard surfaces)
- Interview Rooms
- Interrogation Rooms
- Administration
- Class Rooms
- Waiting Areas
- Treatment Rooms
- Mental Health Clinics
Sound Masking: The Basics

Sound Masking Systems are manufactured to accommodate small and large multi-floor projects. While some are very basic, others are highly sophisticated and technically advanced with many specialized features. Regardless of which system is selected or specified, its prime function is to render speech unintelligible over distance, so that a degree of inter-personal privacy is attained. It has also been found to reduce one’s awareness of distracting noises; hence concentration and work related effectiveness are increased.

Obviously, every situation and existing physical space is different. However, whether it is specified to introduce speech privacy in a Doctor’s small reception area or for a large, multi-floor space with a variety of environmental features, the system must be equally effective. This explains why there must be various sizes of Sound Masking Systems available and also why a particular system is selected and/or specified for each project.

Basic Elements of a Sound Masking System

The basic elements that are necessary to ensure the successful introduction of Sound Masking in a defined area are:

- RANDOM Pink Noise generation
- A speaker layout custom tailored to the space, which zones distinct acoustical environments separately.
- 1/3 Octave equalization for each zone of masking
- Separate channels of amplification for each masking zone
- The volume control down to 225 square feet
- A Class “A” 1/3 or ‘real time’ sound level meter for tuning each environmental zone independently
- A trained specialist to tune the masking system with the Class “A” sound level meter
- Defined specifications for a Sound Masking spectrum that is suitable for each of the diverse acoustical environment that may be encountered.

Acoustical Environments

<table>
<thead>
<tr>
<th>Closed Offices</th>
<th>Open Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drywall Ceilings</td>
<td>Acoustic Tile Ceilings</td>
</tr>
<tr>
<td>Meeting Rooms</td>
<td>Call Centres (Low cubicles)</td>
</tr>
<tr>
<td>Open Plenum Ceilings</td>
<td>Raised Flooring</td>
</tr>
<tr>
<td>Carpeted Areas</td>
<td>Hard Surface Flooring</td>
</tr>
<tr>
<td>Glass Walls</td>
<td>Modular Wall Systems</td>
</tr>
<tr>
<td>Drywall Walls</td>
<td>High ceilings 20 to 25 ft</td>
</tr>
<tr>
<td>Normal 9ft Ceiling Height</td>
<td>3 Foot Plenum Space</td>
</tr>
<tr>
<td>30 Foot Plenum Height</td>
<td>Reception and waiting areas with all hard surfaces</td>
</tr>
</tbody>
</table>
Tuning

The person who tunes the Sound Masking System must be trained to use a Class “A” specialized sound meter. The human ear or a simple sound level meter will not provide the required accuracy nor enough detailed information to properly tune a system.

Proper tuning must take into consideration:

- The acoustical environment of each zone
- The dB by frequency and dBA levels of an area before the pink noise is generated in the space
- Any high ambient background sound levels that would make tuning difficult
- The masking spectrum best suited to the space, if not pre-specified

The specialist must be capable of:

- Measuring sound pressure levels by 1/3 octave frequencies
- Reading dBA levels
- Sensing the development of a spectrum
- Adjusting the levels on the equalizer so a specific masking spectrum develops correctly
- Customizing a masking spectrum to better suite a zone
- Judging if suggested dBA levels are too low or too high for an area
- Testing the level of speech privacy once the masking spectrum is developed
- Sensing the comfort level the occupants will experience

In order to properly tune a project, the system must have the components that allow for proper tuning. Volume control alone, does “NOT” replace an equalizer for proper tuning. A system pre-tuned at the factory does not allow for tailoring of the sound to the zone’s unique acoustical characteristics.

Every system must be tuned with a sound meter that measures the sound levels generated through the speakers. The person tuning must stand within the zone in order to read the proper measurements and re-measure each time adjustments are made on the equalizer. Once the proper spectrum has been developed, small volume adjustments can help to reach the exact dBA level for maximum speech privacy.

Tuning the sound masking system WELL is the most significant aspect of a project.
Purchasing Sound Masking

Sound Masking is an acoustical technique designed to reduce voice intelligibility, thereby increasing speech privacy. In order to achieve this, an electronically generated, broad-band noise spectrum is generated and introduced into the area of concern through speakers installed on a 15 foot grid pattern to ensure a consistent distribution of this masking sound throughout the area. These speakers are typically installed above the ceiling tiles in the plenum space, facing the structural ceiling above. The sound generated by the speakers is dispersed and reflected downward through the acoustic tiles, into the space below, by the structural ceiling. This sound energy path results in a homogeneous distribution of the masking sound spectrum throughout the open or closed office environment.

Sound Masking should be used in conjunction with high quality acoustic tiles, other absorptive elements and barrier components to maximize overall effectiveness. Sound Masking systems utilizing speakers mounted on walls, in partitions, in or under solid surfaced raised floors or facing downward through the acoustic tiles can be used in critical situations.

In order to realize the best results from your investment, Sound Masking Systems should be designed, installed, fine-tuned and maintained by those who specialize in noise and vibration control. Where overall office acoustics is a major issue and concern, the cost of an Acoustical Consultant is a worthwhile investment as they can not only look at all aspects of the space but can recommend the reputable specialist suppliers of acoustic tiles, partitions, barriers and masking systems. If sound masking is the only aspect that you are considering, the following provides a solid outline and approach to getting an effective and quality system:

First Things First

- Meet with the Sound Masking Professional and become familiar with the variety of systems available (avoid those who only have a single, ‘one-size-fits-all’ system to offer)
- Have a floor plan available (auto-cad or hard copy)
- Prepare a list of information about your facility.
  1. Square footage
  2. Plenum space – height, amount of congestion
  3. Ceiling – concrete or steel, coated with fire-insulation
  4. T-bar - distance from floor
  5. Acoustic ceiling tile - mineral fiber, fiberglass, and foil backed etc.
  6. Indicate location of any drywall ceilings
  7. Walls – modular system walls, drywall (to the T-bar?, to the slab?)
  8. Cubicle panels – height, fabrication
  9. Carpeting?
  10. Density of occupation in the area
  11. Best location for the electronic equipment of the masking system
- When possible take the consultant on a tour of your facility
- Make your expectations clear and be sure to understand the limitations
- Once the furnishings are installed you will need to organize a completely quiet time within the area where the sound masking is installed so the system can be properly tuned

**Combinations and Possibilities**

There is a sound masking system to meet every acoustical requirement!!

- Small spaces
- Large floor plates
- Open environments
- Closed offices
- High ceilings
- Ceiling pods
- Warehouse-type open ceilings
- Single floor or multi-floor

**Vibra-Sonic Control Sound Masking Systems**

- **1 - 12 Speakers** – SoundMaskIt NanoMaskIt, wireless system. All system components are installed in the ceiling. (225 – 2000 square feet).

- **12 - 30 Speakers, 2 zone** – SoundMaskIt DSP2210/2212, 2 zone system. All system components are installed in a free standing rack, or mounted on the wall. (2000 - 6750 square feet)

- **30 Plus Speakers** – Centralized Digital Sound Masking/Paging/Music system – Multiple SoundMaskIt DSP2210/2212 and/or SoundMaskIt DSP8807 combinations customized to however many zones required. Single, multi-floor and full building projects.

**Once we understand:**

*Your facility,
Your requirements,
Your expectations and,
Your budget*

*We can design your customized Sound Masking System!*
Creating an Acoustically Friendly Office Environment

Providing an acoustically balanced working environment benefits both employers and employees directly by significantly improving overall productivity. Unfortunately, it is often the least considered aspect in workspace design. The highest overhead and investment for most businesses is its staff. In order to capitalize on that investment, it is critical that employees are as productive as possible. That means an office environment with high speech privacy and less annoying distractions.

Employees’ most productive time is spent doing quiet and focused work. Yet, employee surveys have shown that the number one facility issue is noise within the office environment with its associated distraction, stress, and loss of productivity. Not only is there an immediate and ongoing cost to the company, but also some employees may choose to seek a better work environment, further impacting corporate efficiency and generating unnecessary hiring and retraining costs.

There are three acoustical issues that must be addressed by employers who wish to be proactive: Ambient Sound Level, Speech Privacy, and Sound Transmission Paths.

First we will address ambient sound levels. Every office has a level of background ‘noise’ that is directly related to the type of work being performed. The most distracting and counter-productive sounds are those associated with overheard conversations, noisy mechanical systems, and intermittent sounds such as ringing telephones, photocopiers and other intrusive ‘noises’.

Speech privacy is the most critical issue in any office environment. If speech is indirectly intelligible to others, employees feel extremely restricted in their communications with colleagues within their own workspace and during their telephone conversations. Normal levels of speech should be unintelligible between closed offices and over 15 to 20 feet in open areas.

Now let’s examine the sound transmission paths. There are four distinct paths by which sound is transmitted from source to receiver:

1. The direct route that is unimpeded between a sound source and a receiver.
2. The indirect path in which there is a material or structure between the sound source and the receiver but which lacks the density and/or mass to significantly reduce the sound energy.
3. The reflected path when a sound reflects off hard surfaces, such as walls, windows, floors and ceilings, and is received by the receiver even though the source is not in the direct line of sight.
4. And there is a diffracted path by which sound travels between source and receiver and goes around otherwise effective barriers in the direct path.

Knowing how sound travels, three basic remedial techniques can eliminate distracting noises and maximize speech privacy in office environments: Absorption, Blocking and Masking.
Reflected sound energy can be absorbed and blocked by introducing ‘soft’, porous surfaces. The liberal use of ceiling tiles with a high absorption coefficient, fabric covered furnishings, open area partitions and carpets will reduce the ambient sound level and speech intelligibility within an area.

Blocking with dense, heavy materials reflect the sound back towards the source and significantly reduce the amount of sound getting to the receiver. Hence, open area partitions require a dense, high mass material core with absorptive material on both sides and should be 5 ft and 6 inches in height wherever possible to reduce the diffracted sound paths.

The third remedial technique, which is the introduction of low level / broadband sound in the work area, is an effective way to reduce speech intelligibility. This is achieved though Sound Masking, which generates a sound spectrum that broadly, covers speech frequencies and is contoured to the human ear’s sensitivity to sound. Hence, by rendering distracting conversations less intelligible, those directly involved in the conversation have a sense of privacy.

It is important to note that Sound Masking systems must be tuned after an installation, and re-tuned if and when an office area is reconfigured. A poorly tuned system not only fails to adequately reduce speech intelligibility but can actually become a source of annoyance in itself.

All three of the above noted materials and systems need to be considered in order to control the acoustic environment in the workplace. This is particularly important in ‘open landscape’ designs and where ‘closed’ office walls do not go fully up to the structural ceiling. The construction and height of area partitions, selection of acoustical ceiling tile, and the quality and flexibility of a Sound Masking system can mean the difference between success and failure in achieving an acoustically ‘friendly’ environment.
The Acoustical Design of Conventional Open Plan Offices

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Institute for Research in Construction, National Research Council, Montreal Rd. Ottawa, K1A 0R6

Abstract

This paper uses a previously developed model of sound propagation in conventional open plan offices to explore the influence of each parameter of the office design on the expected speech privacy in the office. The ceiling absorption, the height of partial height panels and the workstation plan size are shown to be most important. However, it is not possible to achieve ‘acceptable’ speech privacy if all design parameters do not have near to optimum values. A successful open office should also include an optimum masking sound spectrum and an office etiquette that encourages talking at lower voice levels.

Résumé

Cet article s'appuie sur un modèle de propagation du son dans les bureaux à aires ouvertes mis au point antérieurement afin d'analyser l'influence de chaque paramètre de la conception du bureau sur l'insonorisation du local en question. L'absorption du plafond, la hauteur des cloisons et les dimensions du poste de travail apparaissent être les 3 paramètres les plus importants. Il est cependant impossible d'atteindre une insonorisation "acceptable" si tous les paramètres conceptuels ne sont pas proches de leurs valeurs optimales. Un bureau à aires ouvertes réussi doit aussi comprendre un spectre de son masquant optimal et une politique de bureau qui encourage à parler à voix basse.

Introduction

Open plan offices have existed for many years, and they have gradually become the predominant format of office space for a wide range of work activities. Older designs incorporating stand-alone screens and furniture have usually been replaced by modular workstations that are frequently referred to as cubicles. There are modern trends to experiment with so-called innovative designs such as 'team spaces' and other variations where the partial height panels between office workers are absent or much reduced in size. However the vast majority of open plan offices today consist of the rectangular cubicle format and this paper is concerned with the design of this type of open plan office.

Conventional open plan offices are said to be less costly to construct and less costly to rearrange to meet changing accommodation needs. Of course, there are counter arguments that lack of privacy and increased distraction will make office workers less efficient, and that at least point to the need for good acoustical design. Optimising the acoustical design of an open plan office can be a complex task because of the number of design parameters that must be considered. This problem has recently been made much easier to solve as a result of the development of a mathematical model of sound propagation between workstations in conventional open plan offices [1-4]. Using this model one can conveniently and quite accurately predict the speech privacy of a particular open plan office design. This model is used here to demonstrate the importance of each open office design parameter.

This paper will first describe measures of speech privacy that can be used to rate the acceptability of an open plan office design. Then design criteria for speech privacy and office noise levels are reviewed. The influence on speech privacy of ten office design parameters are then demonstrated and finally the overall approach to a successful design is discussed.

Speech Privacy and Noise Level Criteria

Because of the absence of full height partitions, the challenge for the acoustical design of open offices is to achieve an acceptable degree of acoustical or speech privacy between workstations. This must be done without creating unacceptably noisy conditions. Speech privacy is related to the speech-to-noise ratio and is more or less the opposite of speech intelligibility. If the level of speech is high relative to ambient noise levels, then the speech will be quite intelligible as would be desired in a meeting room. In an open office we would like the level of the speech to be low relative to the ambient noise so that speech is less intelligible or so that we will have some speech privacy. An appropriate level of noise can mask or cover up unwanted speech sounds. It is important to mask speech sounds because they are much more disturbing than relatively constant levels of more neutral noises such as those of typical ventilation noise. Although higher noise levels may better mask the unwanted speech sounds, the higher noise levels can become a source of annoyance and cause people to talk louder and hence they will not optimally improve speech privacy.

The Articulation Index (AI) [5] has been used to assess speech privacy in open plan offices. AI is a weighted signal-to-noise ratio with a value between 0 and 1. It was originally developed to evaluate communication systems and has been widely used to assess conditions for speech
in rooms. A value close to 1 should correspond to near perfect speech intelligibility. A value near 0 should indicate near perfect speech privacy. More recently the AI has been replaced by the Speech Intelligibility Index (SII) [6]. This is a little more complex to calculate than AI and includes the masking effect of lower frequency components on each frequency band. Like AI it has a value between 0 and 1, but for the same condition SII values are a little larger than AI values. Appendix I gives a detailed comparison of the two measures.

It has been conventional to refer to two levels of criteria for speech privacy and to relate them to corresponding AI values. ‘Confidential privacy’ has been said to correspond to AI ≤ 0.05 [7, 8]. This has been defined as corresponding to ‘zero phrase intelligibility with some isolated words being intelligible’. Conditions corresponding to AI ≤ 0.15 have been described as ‘acceptable’ or ‘normal privacy’ for open plan offices [9]. Such conditions are said to be not too distracting. In practice they correspond to a level of speech privacy that can be achieved in a well designed open plan office. These two speech privacy criteria and their equivalent SII values are included in Table 1.

<table>
<thead>
<tr>
<th>Level of speech privacy</th>
<th>AI</th>
<th>SII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidential</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Acceptable</td>
<td>0.15</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Table 1. Speech privacy criteria in terms of AI and SII values.

Speech privacy and the calculation of AI and SII values depend on the speech and noise levels in open plan offices. The AI and SII standards [5, 6] include standard speech spectra for ‘normal’ speech. The ‘normal’ voice level spectrum in the SII standard corresponds to 59.2 dBA. Although ‘normal’ speech levels have frequently been used to estimate speech privacy in open plan offices, Warnock and Chu [10] have recently published measurements of speech levels in open offices that indicate people talk more quietly than this ‘normal’ spectrum. Their data indicate average speech source levels of 50.2 dBA, which are essentially the same as Pearson’s ‘casual’ speech levels [11]. This level represents the average of all talkers that they measured in a number of open plan offices. If this level were used in design calculations, it would underestimate the disturbance caused by the louder half of the talkers that talk more loudly than this average level. Therefore, an Intermediate Office Speech Level (IOSL) spectrum was created that had an A-weighted level approximately 1 standard deviation higher in level than the mean value and corresponds to a speech source level of 53.2 dBA. This is a more conservative speech source level to use in open office design and only about 16% of talkers are expected to talk louder than this. The actual speech spectra are included in Appendix II.

The level and spectrum shape of ambient noise in the office also significantly influences the degree of speech privacy as well as the related AI and SII values. Although increasing noise levels lead to reduced speech privacy, there is a limiting noise level above which the noise becomes more disturbing and less beneficial. Because it is difficult to carefully control the level and spectrum of actual ventilation noise, and because it will vary with the operation of the ventilation system, the desired speech privacy can be more precisely achieved using electronic masking sound. The spectrum of such masking sound should include energy at all frequencies with significant speech energy, and should sound like a neutral ventilation noise. Such spectrum shapes have been specified [12] and an optimum masking spectrum shape is included in Appendix II. There are also rules of thumb that the overall level of masking sound (or natural ambient noise) should not exceed 48 dBA [13]. Recent studies of worker satisfaction in an experimental open office found that an ambient noise level of 45 dBA was preferred [14]. Therefore we can say that an optimum masking noise should have a spectrum like that in Appendix II and have an overall level of ≤ 46 dBA. Masking sound levels should probably never exceed 48 dBA.

Effects of Office Design Parameters

The model described by Wang [1-4] was implemented in open office design software and was used here to demonstrate the effects of varying office design parameters. It assumes that the source talker is at the centre of one workstation and the receiver listener is at the centre of an adjacent workstation. The user can specify speech source and noise spectra, geometrical dimensions, as well as the sound absorbing properties of surfaces. The programme calculates speech privacy in terms of the SII value due to the speech propagating from the adjacent workstation and the specified office noise spectrum and level.

In the program the effects of various reflecting surfaces are determined using an image sources technique. It also includes diffraction over the partial height panel separating the two workstations and includes further reflections of this diffracted sound energy. It was developed because available room acoustics ray tracing programs were not able to include diffraction and subsequent reflections of the diffracted energy. The program also includes empirical corrections for the difference between laboratory measurements of ceiling absorption and those values measured in a large series of tests of propagation in a mock up open office. There are similarly empirical corrections for the effects of ceiling mounted light fixtures. Comparisons with actual measurements have validated the accuracy of the program in the original evaluations [1-4] as
well as in more recent tests in actual offices. The RMS
differences between measured and predicted SII values
have been between 0.02 and 0.03.

The following sections show the results of calculated SII
values for variations of 10 different open office design
parameters. One could perform calculations for many
combinations of these 10 parameters. However, most of
these results would lead to unacceptably low speech
privacy. ‘Acceptable’ speech privacy can only be achieved
when key office design parameters are close to optimum.
Therefore the calculations that are presented are deviations
from an ‘acceptable’ Base case design. These illustrate the
range of conditions that should be of most interest to
designers.

The sound absorption and sound transmission loss data
used were generic data representative of real screens and
ceilings. They were obtained by averaging groups of test
results for products with similar acoustical properties. The
sound absorption ratings are referred to by their Sound
Absorption Average (SAA) value [15]. The Sound
Transmission Class (STC) [16] is used to describe the
transmission loss of panels.

The ‘acceptable’ Base case condition is described in Table
2. It had a calculated SII value of 0.19, which is just inside
the desired range of SII \( \leq 0.2 \) for ‘acceptable’ privacy.

<table>
<thead>
<tr>
<th>Office Design Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling absorption</td>
<td>SAA=0.95</td>
</tr>
<tr>
<td>Screen/panel height</td>
<td>1.7 m (5.6 ft)</td>
</tr>
<tr>
<td>Screen/panel absorption</td>
<td>SAA= 0.90</td>
</tr>
<tr>
<td>Workstation plan size</td>
<td>3.0 m by 3.0 m (9.8 ft by 9.8 ft)</td>
</tr>
<tr>
<td>Floor absorption</td>
<td>SAA=0.19</td>
</tr>
<tr>
<td>Screen/panel transmission loss</td>
<td>STC=21</td>
</tr>
<tr>
<td>Ceiling height</td>
<td>2.7 m (8.9 ft)</td>
</tr>
<tr>
<td>Light fixtures</td>
<td>None</td>
</tr>
<tr>
<td>Speech source level</td>
<td>53.2 dBA (IOSL speech)</td>
</tr>
<tr>
<td>Noise level</td>
<td>45 dBA (optimum masking spectrum)</td>
</tr>
</tbody>
</table>

Table 2. Details of the ‘acceptable’ Base case used in
calculations. (SAA, Sound Absorption Average [15],
STC, Sound Transmission Class [16], IOSL,
Intermediate Office Speech Level).

(a) Ceiling absorption

Figure 1 shows the effect of varying only the ceiling
absorption of the Base case workstation design. Reducing
the ceiling absorption much below SAA=0.95 significantly
increases SII values to well above the range for
‘acceptable’ privacy. On the other hand a more absorptive
ceiling could further enhance speech privacy or in other
designs compensate for other less effective components
than those in the Base case design. By re-plotting this data
as a scatter plot, one can deduce that if the ceiling
absorption is less than SAA=0.90, it is not possible to
achieve acceptable privacy in an otherwise well designed
workstation such as that of the Base case. Earlier work had
recommended this same minimum ceiling absorption [17].
The ceiling is the most important reflecting surface in open
plan offices and it is most important that it be as highly
absorbing as possible.

![Fig. 1. Effect of varied ceiling absorption on Base case design.](image1)

(b) Screen/panel height

The partial height panels separating workstations must be
high enough to block the direct path of speech sounds from
one workstation to another and also must be high enough
that the level of the sound diffracted over the panel is
reduced enough to make possible ‘acceptable’ speech

![Fig. 2. Effect of varied screen height on Base case design.](image2)
privacy. Figure 2 shows calculated SII values for varied screen heights from 1.3 to 1.9 m high. Again these are variations to the Base case open office workstation design. When seated the mouth of a talker and the ear of the listener in adjacent workstations are approximately 1.2 m above floor level. The height of the separating panel must be substantially greater than this to make it possible to achieve ‘acceptable’ privacy. However above a height of 1.7 m, further increases in the height of the separating panel have quite small effects on calculated SII values.

(c) Screen/panel absorption

Figure 3 shows the calculated effects of varying the sound absorption of the workstation panels. Decreasing the SAA from 0.9 to 0.6 increased the calculated SII from 0.19 to 0.22. However, using non-absorbing workstation panels (SAA=0.10) is seen to increase the SII much more to a value of 0.29. It is important to have sound absorbing panels but the change in privacy between typical medium and higher absorption workstation panels is small.

(d) Workstation plan size

Workstation plan size was varied from a minimum of 2 m by 2 m to a maximum of 4 m by 4 m. SII values systematically decrease as the workstation size is increased. This is due to the increasing distance between the source and receiver at the centre of each workstation. Clearly there is an advantage to having larger workstations when attempting to achieve good speech privacy. Decreasing the workstation size below the base case (3 m by 3 m) decreased speech privacy. Even the 2.5 m by 2.5 m (8.2 ft by 8.2 ft) workstation would not quite meet the ‘acceptable’ speech privacy criteria.

(e) Floor absorption

Figure 5 shows the results of calculations when the floor absorption of the Base case workstation design was varied. These results correspond to thin carpet (SAA=0.19), thick carpet (SAA=0.25) and a hard non-absorbing floor (SAA=0.05). There are only very tiny differences between the two calculations for varied carpet thickness. However, having a non-absorbing floor does decrease the speech privacy above the acceptable SII value. There are other reasons to recommend the use of carpet too. It will reduce some sources of noise such as footsteps and the moving of chairs. It will also help to minimize sound propagation through gaps at the bottom of screens. Although there is no reason to select thicker carpets, it is important to include a carpeted floor in open plan offices.

(f) Screen transmission loss

Some recommendations specify that the transmission loss of the separating partial height panel should have an STC of at least 20 [17]. This is intended to ensure that the propagation of speech sound energy through the separating panel does not limit speech privacy. Figure 6 shows calculated SII values for varied STC of the separating panel. Decreasing the panel STC from 21 to 15 increased speech privacy to a little above the ‘acceptable’ criterion. However, increasing the transmission loss of the panel from STC 21 to STC 25 produced only a negligible improvement in SII. A minimum STC of 20 for the separating panel is seen to be adequate to avoid degrading speech privacy.
(g) Ceiling height

The height of the ceiling in most open plan offices is usually quite similar to that of the base case (2.7 m). The calculated results in Figure 7 show that increasing the height to 3.5 m had a negligible effect on the calculated SII. However, decreasing the height from 2.7 m to 2.4 m did decrease speech privacy to a little above the ‘acceptable’ privacy criterion. One should therefore avoid particularly low ceiling heights in open plan offices.

Fig. 7. Effect of ceiling height on Base case design.

(h) Light fixtures

Calculations were made for three different ceiling lighting conditions and are shown in Figure 8. The Base case had no ceiling mounted lights. The empirical corrections in the software were then used to estimate the effect of a flat lens light positioned over the separating partial height panel. This would represent the worst possible effect of ceiling light fixtures. This condition led to a substantial increase in the SII values and hence would correspond to significantly decreasing speech privacy. Clearly this lighting configuration should be avoided. Using open grill lighting either positioned over the separating screen or over the centre of the workstations would have a smaller effect but again decreases the speech privacy of the base case so that it is no longer ‘acceptable’. Locating flat lens fixtures over the centre of the workstations is more acceptable than over the separating panel. However, lights are usually installed before workstations and it is usually difficult to control their position relative to the location of each workstation. This is especially true after the workstation layout has been modified from the original plan. It is obviously better to use open grill light fixtures if ceiling mounted lighting is required.

Fig. 8. Effect of Ceiling lighting fixtures on Base case design.

(i) Speech level

Figure 9 shows the calculated SII values when the source speech levels were varied for the Base case office design. Results were calculated for the ‘normal’ voice level from the SII standard [6], for the Intermediate Office Speech Level (IOSL), and for a ‘casual’ speech source level. Voice level can have a very large effect on the resulting SII values. Clearly it is important to use a representative speech source level. As explained earlier, it is thought best to use the IOSL speech spectrum. However, there are further large benefits to be obtained by encouraging office workers to talk with lower voice levels. It is important to promote an office etiquette that encourages the use of lower voice levels and relocating to closed meeting rooms when more extensive discussions are needed. It may be difficult to accommodate work that includes telephone conversations of a more confidential nature in open plan environments.

(j) Ambient noise

The effect of varied ambient noise is illustrated in Figure 10. The Base case office included the optimum-masking spectrum described previously and included in Appendix II. Increasing this masking noise from 45 dBA to 48 dBA (corresponding to the maximum masking noise spectrum) is seen to substantially decrease SII values. Although speech privacy would be significantly improved, experience has shown that this will begin to lead to decreased occupant satisfaction. A further calculation was performed with an ambient noise with an RC35 shaped spectrum (corresponding to 42 dBA). This would be
representative of a little quieter ventilation noise type spectrum and leads to a substantial decrease in speech privacy. It is clearly important to optimise the level and spectrum of ambient noise by using a masking sound system to create exactly the desired masking sound that will lead to a desirable level of speech privacy without leading to further disturbance of office workers.

The Various Calculations show clear indications of the importance of each of the office design parameters. The most important factors for achieving ‘acceptable’ speech privacy are: (a) the sound absorption of the ceiling, (b) the height of panels between workstations, and (c) the workstation plan size. Although less important, one cannot ignore the other open office design parameters: (a) panel absorption, (b) panel transmission loss, (c) floor absorption, (d) ceiling height and (e) the details of ceiling mounted lighting.

The Base case design, described in Table 2, represents a combination of values that just meet the criterion for ‘acceptable’ privacy. Small degradations of one design parameter can be compensated for by augmenting the values of other parameters to still achieve ‘acceptable’ speech privacy. For example, decreasing the workstation plan size to 2.5 m by 2.5 m, reducing the separating panel height to 1.6 m and reducing the panel absorption to SAA=0.70 would still result in an SII of 0.19 if the ceiling absorption were increased to an SAA of 1.03. Alternatively the same increased ceiling absorption could be used to compensate for reduced plan size and the addition of open grill lighting. The details of these examples are compared with those of the Base case in Table 3.

The examples illustrate that there is not much room to compromise in trading off increases in one parameter to compensate for decreases in another. Most significant deviations from the Base case will result in open offices with less than ‘acceptable’ speech privacy. In particular the reduction of workstation plan size must be accompanied by an improved ceiling absorption to maintain conditions of ‘acceptable’ speech privacy. Thus the expected cost saving of a higher density office with smaller workstations may be reduced by the increased cost of a more absorptive ceiling.

The speech and noise levels in the open plan office are at least as important as the office design for achieving ‘acceptable’ speech privacy. Therefore, in addition to a near-perfect office design, one is forced to the conclusion that an electronic masking sound system is an essential part of a successful open office design. The masking sound system should produce ambient noise levels similar to the optimum masking spectrum in Appendix II. These levels should be evenly distributed throughout the office. When adding such systems to existing offices, it is usually desirable to increase the level gradually over several weeks to allow office workers a chance to adapt to the new conditions.

The design of the open office can reduce the propagation of speech sounds from one workstation to another. It is also very important to reduce speech levels at the source by encouraging an office etiquette of talking more quietly. More extensive discussions, and especially those involving more than 2 people, should be relocated to a closed meeting room. Of course telephone conversations can be a source of disturbance. Where reduced voice levels are not possible or where the information is confidential, this activity is not compatible with a typical open office environment.

Although the new model allows precise examination of the effects of various parameters, in many cases such detailed design may not be necessary. Success requires that almost all design parameters are near to optimum and one could readily specify minimum requirements for most of them. This would avoid the need for future detailed design calculations. The examples in Table 3 could form a basis
for such minimum design values. Using these values will result in conditions that approximately correspond to the minimum criterion for ‘acceptable’ speech privacy. Of course this approach should include an optimum masking noise spectrum and an office etiquette that encourages using lower voice levels.

**Conclusions**

The results in this paper demonstrate the effects of each open office design parameter. They indicate that the values of each parameter must be near to optimum to ensure ‘acceptable’ speech privacy. Although one can, to some extent, trade off increases in one parameter to compensate for decreases in another, the range of such compromises is very limited. The present results describe the average characteristics of cubicle type open plan offices because the source and receiver were positioned at the centre of adjacent workstations. The actual speech privacy experienced will also depend on each individual’s location within their workstation as well as the direction in which talkers are facing.

The main argument in favour of open plan offices is the expected reduced cost relative to closed offices with full height partitions. The cost savings may be a little reduced with the extra expense of meeting ‘acceptable’ speech privacy requirements. However, these additional costs are usually assumed to be small relative to the costs of decreased performance by distracted office workers. It is difficult to accurately assess the costs of poor office design and future research should consider this issue. It would also be useful to investigate which types of office work activity are most suitable to be performed in open plan office environments.

**Acknowledgments**

The model used here was developed as a part of the COPE project supported by Public Works and Government Services Canada, Ontario Realty Corporation, USG Corporation, Natural Resources Canada, Steelcase, British Columbia Buildings Corporation, and The Building Technology Transfer Forum.

**References**

5. ANSI S3.5-1969, American National Standard Methods for the Calculation of the Articulation Index, Standards Secretariat, Acoustical Society of America, New York, USA.
Appendix I. Relation Between SII and AI Values

Measured attenuations in a series of mock up workstation tests were used to calculate both AI and SII values. By repeating these calculations for a range of speech and noise levels a very wide range of values of each measure was obtained. The resulting SI values are plotted versus AI values in Figure A1. The regression line shown on this plot is a fourth order polynomial that very accurately fits the data between AI values of 0 and 0.5. Its equation is as follows,

\[ \text{SII} = 0.0194 + 1.942\, \text{AI} - 5.263\, \text{AI}^2 + 11.731\, \text{AI}^3 - 9.247\, \text{AI}^4 \]

Alternatively one can approximate the relationship by two simple straight lines.

For \(0 \leq \text{AI} \leq 0.05\), \(\text{SII} = 1.9755\, \text{AI} + 0.0163\),

For \(0.05 \leq \text{AI} \leq 0.5\), \(\text{SII} = 0.9915\, \text{AI} + 0.0721\).

Figure A2 plots the speech source level spectra used in the calculations. Figure A3 plots the Optimum masking spectrum and the Maximum masking spectrum that were used in the calculations of the current work.

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### DATA - NanoMaskIt

**High Quality, Wireless Control, Ceiling Mount, Digital Sound Masking System**

#### FEATURES

- Stand-Alone (unmanaged) operation
- Random pink noise - non repeating up to 215 hours
- 1x Zone of 15 Watt, Digital Class “D” Amplification
- Noise output with full 1/3 octave equalization
- Non-volatile memory for system settings - up to 10 years retention
- Full function Application Software suite to setup and tune zones
- Robust 2.4GHz Wireless Interface for setup and system tuning
- 4.5” wide x 6” deep x 1” tall unit
- Mounting options for Atlas M1000 and Wall Mount

#### POWER SUPPLY

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains Input Voltage</td>
<td>100V - 240V (AC)</td>
</tr>
<tr>
<td>Main Frequency</td>
<td>47Hz - 63Hz</td>
</tr>
<tr>
<td>Power Supply Efficiency</td>
<td>83%</td>
</tr>
<tr>
<td>AC Current</td>
<td>1.0A - 110VAC</td>
</tr>
<tr>
<td></td>
<td>0.5A - 240VAC</td>
</tr>
<tr>
<td>Inrush Current</td>
<td>Cold Start 18A - 115VAC</td>
</tr>
<tr>
<td></td>
<td>Cold Start 36A - 230VAC</td>
</tr>
</tbody>
</table>

#### SYSTEM OUTPUTS

<table>
<thead>
<tr>
<th>Zone Output (x1, 2 pin Phoenix)</th>
<th>25Vp-p Output</th>
</tr>
</thead>
</table>
System Performance

- Resolution: 24 bit
- Sample Rate: 48kHz
- Frequency Response: 80Hz – 20kHz ±3dB
- THD-N (1kHz): Full Power <1%

Wireless Link

- NanoMaskIt is uniquely designed for wireless control applications to ensure reliable communications
- Built-in RF protocol with interleaving, interpolation, forward error correction and retransmissions
- 5Mbps/channel with only 3.8MHz occupied bandwidth helps achieve low duty-cycle and more RF channels to work with when transmitting signals – providing a very robust audio link (future)

Block Diagram
1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010  Electrical General Requirements
.2 Section 16120  Wire and Cable
.3 Section 16993  Electrical Starting and Testing General Requirements

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)


1.2.2 American Society for Testing and Materials (ASTM):

.4 ASTM E 1374-02 Standard Guide for Open Office Acoustics and Applicable ASTM Standards

1.2.3 International Electro-technical Vocabulary (IEC):

.1 IEC 651, Live Working.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEZEE SP1122.

1.4 DESCRIPTION OF A DIGITAL WIRELESS SINGLE ZONE MASKING SYSTEM

An electronic, frequency contoured sound masking system which includes the following:

.1 Strategically located speaker assemblies installed above conventional suspended acoustic tile, drywall, wood or open ceiling, in areas indicated.
.2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.
.3 System Components Must Include: The Vibra–Sonic, Digital Sound Masking System is based on the DSP 110 Processor. It is a self-contained single-zone digital DSP-GUI controlled processor with Digital Class D Amplifiers, Third Octave 31 Band Equalizers, Power, All onboard.

.4 Processor must be housed in a 4.5" w x 1" h (11.5 cm x 2.75 cm) speaker or wall mountable chassis that is black powder coat CRS cold roll steel.

.5 Must include an 11" (28 cm) bracket for speaker or wall mounting.

.6 The system shall be (1) programmable channel and serve a single Zone up to 15 speakers.

.7 Each DSP110 must have one 1/3 octave band equalizer allowing the development of 1 sound masking spectrum.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide sound masking in accordance with the system description to all areas indicated on drawings and/or schedule. Sound level performance shall comply with the following one-third octave sound pressure levels and tolerances:

<table>
<thead>
<tr>
<th>1/3 Octave ISO Centre Frequency (Hz)</th>
<th>1/3 Octave Band Sound Pressure Levels (dB)</th>
<th>Tolerance (± dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>44</td>
<td>± 3</td>
</tr>
<tr>
<td>160</td>
<td>43</td>
<td>± 3</td>
</tr>
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<td>200</td>
<td>42</td>
<td>+2-3</td>
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</tr>
<tr>
<td>8,000</td>
<td>14</td>
<td>+1-2</td>
</tr>
</tbody>
</table>

Note: The above values are graphically illustrated on detail drawing 27 51 20.01.

.2 Spatial Average Overall Sound Pressure Levels: Minimum 43 decibels and maximum 45 decibels, A-weighted (dBA).

1.6 SUBMITTALS

.1 Provide requested items in accordance with Section 013300 – Submittals.
.2 Submit shop drawings indicating proposed quantity and location of all system components and related wiring and accessories

.3 Obtain Owner’s approval for any changes in quantity or location of sound masking units from Owner reviewed shop drawings.

1.6.1 After completing installation, testing, adjusting and balancing, submit the following:

.1 Project record drawings in the form of the above noted shop drawings, revised as necessary to accurately indicate locations of all system components, as installed.

.2 Copy of all final sound pressure levels readings taken, including accurate description of reading locations and test methods and equipment used.

1.7 QUALITY ASSURANCE

1.7.1 Quality Assurance: in accordance with Section 04 45 00 – Quality Control.

1.7.2 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower, vocational training and qualification.

.1 Employees registered in provincial apprentices programs: permitted, under direct supervision of a qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7.3 Site Meetings

.1 As determined by general contractor

1.7.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

1.8.1 Material Delivery Schedule: provide Engineer with schedule within 2 weeks after award of contract.

1.8.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.9 SYSTEM STARTUP

1.9.1 Owner will [appoint and pay for services of testing agency] [utilise his own forces] to take measurements to verify that the installed sound masking system meets specified acoustical performance requirements in accordance with ASTM E1041.

.2 Performance verification will be performed [after Substantial Performance of the Work] [during Performance Testing, and sub-phases of Facility start-up].
Installer shall make measurements to verify that the installed sound masking system meets specified acoustical performance requirements with Owner’s agent.

Verification by the Owner will be performed with mechanical systems shut down in area being tested.

Verification will be performed with mechanical systems in full operation in area being tested.

1.10 OPERATING INSTRUCTIONS

.1 Testing, tuning, and balancing will be performed after normal working hours of facility users, or as otherwise required by Owner.

.2 Schedule testing, adjusting, and balancing will be performed after above-ceiling mechanical and electrical work, suspended acoustic tile ceiling, and sound masking system installation are complete.

2 PRODUCTS

2.1 SPEAKER

.1 Cone: 100-200mm (3.9” – 7.9”), single, Low Q* type.

.2 Frequency Response: 125-8000 Hz +/- 4dB on axis.

.3 Sensitivity: 94 dB EIA minimum.

.4 Power Handling: 5 watts EIA minimum.

.5 Resonant Frequency: 99 Hz maximum.

.6 Mounting: four screws (studs) to grill cover.

2.2 TRANSFORMERS:

.1 Type: 70.7volt

.2 Minimum Primary Power Taps: COM, 0.25, 0.5, 1, 2, 4 watts set with exterior switch.

.3 Mounting: directly to speaker frame.

2.3 SPEAKER ENCLOSURES:

.1 Size: 300mm (11.8”) square (round) 100mm (3.9”) deep.

.2 Construction: 0.6mm (1/42”) minimum thickness sheet steel.

.3 Undercoating: factory applied to eliminate resonance.

.4 Mounting: Bracket

2.4 GRILLE COVERS:

.1 Construction: one piece, 0.6mm (1/42”) minimum thickness sheet steel.

.2 Perforated speaker opening to suit speaker size.

.3 Four screw clip opening to enclosure.

2.5 MICRO PROCESSOR CONTROL

.1 The DSP110 digital processor/amp shall be capable of producing pink noise and 15 watts of amplification.

.2 The DSP is integrated in the self contained unit.
.3 The system shall be monitored and adjusted with a computer connected to the Nano Controller.
.4 Processing capacity: 264 MIPS, 528 MFLOPS sustained operation
.6 Memory storage is non-volatile RAM (Random Access Memory) for all programs and set up parameters which are stored and recoverable during power outages for up to ten (10) years.
.7 DSP must be capable of control of volume and equalization for one zone.

2.6 POWER SUPPLY

.1 Input voltage: 85 to 264VAC
.2 Output current: 0 to 1.56A continuous
.3 Power factor: >.90 at full load
.4 Overload protection: Shall incorporate current limit to protect from damage
.5 Power mains: I.T.E Power Supply 24V~0.0-.5A UL Listed.

2.7 NOISE GENERATION

.1 1 channel independent, uncorrelated full random non-repeating noise generation with constant energy per octave bandwidth.
.2 Minimum spectrum accuracy: 1 dB from 40-10,000 Hz
.3 Repetition Rate: repeats every 271 hours.
.4 Mounting: Integrated within Digital Signal Processing

2.8 EQUALIZER FILTERS

.1 Requirement on the output channel with control over 31 - 1/3 octave.
.2 Integrated within Digital Signal Processing unit.
.3 Equalization: 1/3 octave using ISO standard frequencies from 63-12,500 Hz minimum.
.4 Output: 600 ohms balanced and adjustable.
.5 Filters: adjustable minimum 20 dB adjustment per band.
.6 Level Tolerance: +/- 1 dB from 200-4000 Hz.
.7 Total Harmonic Distortion: less than 0.5% at full rated output.
.8 Equivalent Input Noise: less than –85 dBA from 20-20,000 Hz unweighted.
.9 Output: transformer isolated.
.10 Front panel security cover.
.11 Mounting: Integrated in self contained unit

2.9 AMPLIFIERS

.1 1 Channel, CLASS D solid state, EIA rated
.2 Audio power handling: continuous for speaker load plus minimum 3 dB margin (single or multi-channel).
.3 Frequency response +/- 0.3 dB 20Hz – 20kHz at 100 Ω
.4 Total Harmonic Distortion: less than 1% at 1kHz at rated output.
.5 Transformer Output: 25 volts
.6 Manual gain control adjustable to 34 dB
.7 Output Regulation within 2dB, from no load to full load.
.8 Power Supply: self-contained and CSA approved.
.9 Mounting: Integrated self contained unit to be mounted on an M1000 speaker or a wall.
.10 Input impedance: 50KΩ
.11 Output impedance: 0.08Ω
.12 Carrier Frequency: 400kHz
.13 Constant voltage at 50W
.14 +/- 15VDC and 100kHz square sine wave
.15 Peak current: 1.2 Amps

2.12 MATERIALS

.1 All plastics shall meet UL94VO flammability rating
.2 Cold roll steel - 18 AWG - .047” nominal
.3 Black powder coat paint
.4 Corrosion resistant
.5 White silk screen on rear
.6 Front LCD Lights
.7 Wireless Antennae

2.13 ACCEPTABLE MATERIALS:

2.13.1 Subject to compliance with requirements, products that may be incorporated into the Work include:

.1 NanoMaskIt Digital Centralized remote, Single Zone Sound Masking Systems as designed by Vibra-Sonic Control
  Vancouver - (604) 294-9495 fax - (604) 294-8033
  Calgary - (403) 237-5035 fax - (403) 237-5064

3 EXECUTION

3.1 INSTALLATION

.1 Install system components above suspended ceiling in accordance with manufacturer's instructions and in a manner that will permit specified acoustical performance requirements will be met.
.2 Suspend sound masking units with mounting chains securely anchored to underside of structure. Ensure that there is no strain on any electrical wiring. Avoid mounting that could result in generation of vibration noise or distortion.
.3 Mount closed enclosure to radiate sound upward.
.4 Install centralized Single Zone Digital Signal Processors securely mounted to M1000 speaker in plenum.
.5 Ground audio system to building power supply ground.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identifications nameplates are visible and legible after equipment is installed

3.3 INSTALLATION, CABLE

.1 Avoid damage to cables. Provide adequate cable strain relief.
.2 Run cables parallel and perpendicular to building lines. Attach wiring to top of structural elements in a non-obstructive fashion. Secure every 2 meters and at changes in direction.

.3 Connect each speaker wire pair to one terminal pair on screw terminal blocks at plenum located NanoMaskIt.

### 3.4 LOCATION OF OUTLETS

.1 Indicated within Installation Information.

### 3.5 MOUNTING HEIGHTS

.1 Indicated within Installation Information.

### 3.6 TESTING, ADJUSTING, AND BALANCING

.1 Comply with requirements of Section 16993 - Electrical starting and testing by Contractor.

OR

.1 Calibrate the microphone and related test equipment prior to testing.

.2 Test, adjust, and balance system with mechanical system and other noise generating equipment shut down in areas receiving sound masking.

.3 Test, adjust, and balance system until sound spectrum and levels meet specified performance requirements. Adjust settings of installed units, relocate installed units, or add additional units, if and as required.

.4 Upon completion of tests, perform walk-through verification of areas that will be covered by sound masking. Adjust and re-test areas having abnormal characteristics or levels.

#### 3.7 TESTS AND TEST METHODS:

.1 Test to determine each zone’s octave band sound pressure levels. Take a series of readings for unit coverage area.

.2 Test to determine spatial average overall sound pressure levels. Take minimum of one reading for each enclosed room covered by sound masking and minimum of one reading per 20 m² (215 ft²) of floor area in all open spaces covered by sound masking.

.3 Position of Measuring Microphone: 1220 mm (48") above floor and minimum 1000 mm (40") away from any sound reflecting surface, in locations representative of each area that are sound masked.

### 3.8 MEASURE SOUND PRESSURE LEVELS USING ONE OF FOLLOWING METHODS:

.1 An Equivalent Continuous Sound Level (LEQ) mode for minimum interval of 15 seconds.

.2 IEC 651 ‘slow’ time constant, average reading of the highest and lowest level during 15 second intervals.
3.9 TEST EQUIPMENT:

.1 Sound Level Meter: to ANSI S1.4-1983, Type 1 or better.
.2 Octave Band Filter: to ANSI S1.11, Class II or better.
.3 Accuracy of Acoustic Calibrator: within ±0.3 dB at 25°C.

3.10 SCHEDULE

SPEC NOTE: Unless indicated on drawings, schedule locations where sound masking is required.

3.10.1 Provide sound masking coverage in the following rooms and areas:

.1 [ ].
.2 [ ].
.3 [ ].

END OF SECTION
INTRODUCTION

The **DSP2210** is a two zone, self-contained audio processing system for Speech Privacy, Mic Level Paging and Background Music Reproduction. This model is an addition to the SoundMaskIt Series of Products, which include the DSP8807, DSP2212 and the NanoMaskIt systems.

The unit include I/O processing, enhanced audio DSP controlled from a Software application through a Mini-USB Port, Class “D” output amplification, and transformers to provide 70.7Vrms speaker output drive at 25W/zone.

FEATURES

- Stand-Alone Sound Masking System (NON - NETWORKABLE)
- 2 channels of random pink noise – non repeating up to 215 hours
- 2 outputs of 25 Watt Digital Class “D” Amplification
- 2 independent Noise outputs with full 1/3 octave equalization on each
- 1 music source input – stereo to mono
- Non-volatile memory for system settings – up to 10 years retention
- Full function Application Software suite to setup and tune zones according to facility needs
- Functional control via a Front Panel Rotary Encoder and Alpha-Numeric LCD Display
- 1RU tall by 10” deep
- Worldwide Agency Approvals
**POWER SUPPLY**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains Input Voltage</td>
<td>90V - 264V (AC)</td>
</tr>
<tr>
<td>Main Frequency</td>
<td>47Hz - 63Hz</td>
</tr>
<tr>
<td>Efficiency</td>
<td>83%</td>
</tr>
<tr>
<td>AC Current</td>
<td>1.9A – 115VAC</td>
</tr>
<tr>
<td></td>
<td>1.1A – 230VAC</td>
</tr>
<tr>
<td>Inrush Current</td>
<td>Cold Start 18A – 115VAC</td>
</tr>
<tr>
<td></td>
<td>Cold Start 36A – 230VAC</td>
</tr>
<tr>
<td>Regulatory Approvals</td>
<td>UL60950-1, TUV EN60950-1 Approved</td>
</tr>
</tbody>
</table>

**SYSTEM INPUTS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Input (Dual RCA)</td>
<td>2Vrms max</td>
</tr>
<tr>
<td>Music Input Impedance</td>
<td>20kΩ</td>
</tr>
<tr>
<td>Mic Input (x1, 3 pin Phoenix)</td>
<td>+30dB ⇔ +60dB Gain</td>
</tr>
<tr>
<td>Mic Input Sensitivity</td>
<td>250mV</td>
</tr>
</tbody>
</table>

**SYSTEM OUTPUTS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone Outputs (x2, 2 pin Phoenix) - Class 2 Wiring</td>
<td>70.7Vrms Output</td>
</tr>
</tbody>
</table>

**SYSTEM PERFORMANCE**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>24 bit</td>
</tr>
<tr>
<td>Sample Rate</td>
<td>48kHz</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>80Hz – 20kHz 3dB</td>
</tr>
<tr>
<td>THD-N (1kHz)</td>
<td>Full Power &lt;1%</td>
</tr>
<tr>
<td>@ 10W</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>@ 1W</td>
<td>&lt;0.004%</td>
</tr>
<tr>
<td>Signal to Noise Ratio (A-Weighted)</td>
<td>&gt;100dB</td>
</tr>
<tr>
<td>Inter-Channel Crosstalk</td>
<td>&gt;82dB</td>
</tr>
</tbody>
</table>
DATA – SoundMaskIt DSP2212

INTRODUCTION

The DSP2212 is a two zone, self-contained audio processing system for Speech Privacy, Mic Level Paging and Background Music Reproduction. This model is an addition to the SoundMaskIt Series of Products, which include the DSP8807, DSP2210 and the NanoMaskIt systems.

The unit includes I/O processing, enhanced audio DSP controlled from a Software application through a Mini-USB Port, Class “D” output amplification, and transformers to provide 70.7Vrms speaker output drive at 25W/zone.

Additionally, the DSP2212 has a Network Port used for control of the unit and/or distribution of Paging Messages between network enabled units in the SoundMaskIt Series. This model uses the emerging IEEE802.1AS Audio-Video Bridging protocol for Paging across the Ethernet LAN. The DSP2212 is compatible with the Networked DSP8807 units.

FEATURES

- Networks with the DSP8807 or other DSP2212 units
- 2 channels of random pink noise – non repeating up to 215 hours
- 2 outputs of 25 Watt Digital Class “D” Amplification
- 2 independent Noise outputs with full 1/3 octave equalization on each
- 1 music source input – stereo to mono
- Non-volatile memory for system settings – up to 10 years retention
- IEEE802.1AS AVB (Audio-Video Bridge) Interface for easy and time-aligned networking of multiple SoundMaskIt Systems (DSP2212 and DSP8807)
- AVB Interface allows for campus wide paging via an Ethernet LAN when connected to a DSP8807 - 8 channel system
- Full function Application Software suite to setup and tune zones according to facility needs
- Functional control via a Front Panel Rotary Encoder and Alpha-Numeric LCD Display
- 1RU tall by 10” deep
- Worldwide Agency Approvals
## POWER SUPPLY

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains Input Voltage</td>
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<td>Main Frequency</td>
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<td>Inrush Current</td>
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## SYSTEM INPUTS

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Inputs (Dual RCA)</td>
<td>2Vrms max</td>
</tr>
<tr>
<td>Music Input Impedance</td>
<td>20kΩ</td>
</tr>
<tr>
<td>Mic Input (x1, 3 pin Phoenix)</td>
<td>+30dB +60dB Gain</td>
</tr>
<tr>
<td>Mic Input Sensitivity</td>
<td>250mV</td>
</tr>
<tr>
<td>Mini-USB (System Setup and Control)</td>
<td>Standard Connector</td>
</tr>
<tr>
<td>RJ45 (Ethernet LAN)</td>
<td>Cat5e/Cat6</td>
</tr>
</tbody>
</table>

## SYSTEM OUTPUTS

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone Outputs (x2, 2 pin Phoenix)</td>
<td>70.7Vrms Output</td>
</tr>
</tbody>
</table>

## SYSTEM PERFORMANCE

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
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<td>&gt;100dB</td>
</tr>
<tr>
<td>Inter-Channel Crosstalk</td>
<td>&gt;82dB</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 Electrical General Requirements
.2 Section 16120 Wire and Cable
.3 Section 16993 Electrical Starting and Testing General Requirements

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

1.2.2 American Society for Testing and Materials (ASTM):
   .4 ASTM E 1374-02 Standard Guide for Open Office Acoustics and Applicable ASTM Standards

1.2.3 International Electro-technical Vocabulary (IEC):
   .1 IEC 651, Live Working.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEZEE SP1122.

1.4 DESCRIPTION OF A DIGITAL CENTRALIZED MASKING/PA SYSTEM

An electronic, frequency contoured sound masking system which includes the following:

.1 Strategically located speaker assemblies installed above conventional suspended acoustic tile, drywall, wood or open ceiling, in areas indicated.
.2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.
.3 System Components Must Include: The Vibra–Sonic, Digital Sound Masking System is based on the DSP2210 Digital Signal Processor. It is a self-contained multi-zone digital DSP-GUI controlled processor with Digital Class D Amplifiers, Third Octave 31 Band Equalizers, Power, Public Address Paging and Music Inputs, all onboard.

.4 Processor must be housed in a 19"w x 3.5"h (48.3 cm x 8.9 cm) - (2 Rack Units high) rack or wall mount chassis that is black powder coat CRS cold roll steel.

.5 Must include adjustable brackets for 19" (48.3 cm) rack or wall mounting.

.6 The system shall be (2) independent programmable channels.

.7 Each channel must have independent equalization allowing separate sound masking spectrums for each zone.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide sound masking in accordance with the system description to all areas indicated on drawings and/or schedule. Sound level performance shall comply with the following one-third octave sound pressure levels and tolerances:

<table>
<thead>
<tr>
<th>1/3 Octave ISO Centre Frequency (Hz)</th>
<th>1/3 Octave Band Sound Pressure Levels (dB)</th>
<th>Tolerances (± dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>44</td>
<td>± 3</td>
</tr>
<tr>
<td>160</td>
<td>43</td>
<td>± 3</td>
</tr>
<tr>
<td>200</td>
<td>42</td>
<td>+2-3</td>
</tr>
<tr>
<td>250</td>
<td>41</td>
<td>+1-2</td>
</tr>
<tr>
<td>315</td>
<td>40</td>
<td>± 1</td>
</tr>
<tr>
<td>400</td>
<td>39</td>
<td>± 1</td>
</tr>
<tr>
<td>500</td>
<td>37.5</td>
<td>± 1</td>
</tr>
<tr>
<td>630</td>
<td>36</td>
<td>± 1</td>
</tr>
<tr>
<td>800</td>
<td>34.5</td>
<td>± 1</td>
</tr>
<tr>
<td>1,000</td>
<td>33</td>
<td>± 1</td>
</tr>
<tr>
<td>1,250</td>
<td>31.5</td>
<td>± 1</td>
</tr>
<tr>
<td>1,600</td>
<td>30</td>
<td>± 1</td>
</tr>
<tr>
<td>2,000</td>
<td>28</td>
<td>± 1</td>
</tr>
<tr>
<td>2,500</td>
<td>26</td>
<td>± 1</td>
</tr>
<tr>
<td>3,150</td>
<td>24</td>
<td>± 1</td>
</tr>
<tr>
<td>4,000</td>
<td>22</td>
<td>± 1</td>
</tr>
<tr>
<td>5,000</td>
<td>20</td>
<td>± 1</td>
</tr>
<tr>
<td>6,300</td>
<td>17</td>
<td>+1-2</td>
</tr>
<tr>
<td>8,000</td>
<td>14</td>
<td>+1-2</td>
</tr>
</tbody>
</table>

Note: The above values are graphically illustrated on detail drawing 27 51 20.01.

.2 Spatial Average Overall Sound Pressure Levels: Minimum 43 decibels and maximum 45 decibels, A-weighted (dBA).
1.6 SUBMITTALS

.1 Provide requested items in accordance with Section 013300 – Submittals.
.2 Submit shop drawings indicating proposed quantity and location of all system components and related wiring and accessories.
.3 Obtain Owner’s approval for any changes in quantity or location of sound masking units from Owner reviewed shop drawings.

1.6.1 After completing installation, testing, adjusting and balancing, submit the following:

.1 Project record drawings in the form of the above noted shop drawings, revised as necessary to accurately indicate locations of all system components, as installed.
.2 Copy of all final sound pressure levels readings taken, including accurate description of reading locations and test methods and equipment used.

1.7 QUALITY ASSURANCE

1.7.1 Quality Assurance: in accordance with Section 04 45 00 – Quality Control.

1.7.2 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices programs: permitted, under direct supervision of a qualified licensed electrician, to perform specific tasks.
.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7.3 Site Meetings

.1 As determined by general contractor

1.7.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Engineer with schedule within 2 weeks after award of contract.
.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
1.9 SYSTEM STARTUP

.1 Owner will [appoint and pay for services of testing agency] [utilize his own forces] to take measurements to verify that the installed sound masking system meets specified acoustical performance requirements in accordance with ASTM E1041.

.2 Performance verification will be performed [after Substantial Performance of the Work] [during Performance Testing, and sub-phases of Facility start-up].

.3 Installer shall make measurements to verify that the installed sound masking system meets specified acoustical performance requirements with Owner’s agent.

.4 Verification by the Owner will be performed with mechanical systems shut down in area being tested.

.5 Verification will be performed with mechanical systems in full operation in area being tested.

1.10 OPERATING INSTRUCTIONS

.1 Testing, tuning, and balancing will be performed after normal working hours of facility users, or as otherwise required by Owner.

.2 Schedule testing, adjusting, and balancing will be performed after above-ceiling mechanical and electrical work, suspended acoustic tile ceiling, and sound masking system installation are complete.

2 PRODUCTS

2.1 SPEAKER

.1 Cone: 100-200mm (3.9” – 7.9”), single, Low Q™ type.

.2 Frequency Response: 125-8000 Hz +/- 4dB on axis.

.3 Sensitivity: 94 dB EIA minimum.

.4 Power Handling: 5 watts EIA minimum.

.5 Resonant Frequency: 99 Hz maximum.

.6 Mounting: four screws (studs) to grill cover.

2.2 TRANSFORMERS:

.1 Type: 70.7volt

.2 Minimum Primary Power Taps: COM, 0.25, 0.5, 1, 2, 4 watts set with exterior switch.

.3 Mounting: directly to speaker frame.

2.3 SPEAKER ENCLOSURES:

.1 Size: 300mm (11.8") square (round) 100mm (3.9") deep.

.2 Construction: 0.6mm (1/42") minimum thickness sheet steel.

.3 Undercoating: factory applied to eliminate resonance.

.4 Mounting: Bracket
2.4 **GRILLE COVERS:**

.1 Construction: one piece, 0.6mm (1/42”) minimum thickness sheet steel.
.2 Perforated speaker opening to suit speaker size.
.3 Four screw clip opening to enclosure.

2.5 **MICRO PROCESSOR CONTROL**

.1 The DSP2210 digital processor/amp shall be capable of automatic mixing, set-up and administration of all 2 inputs per zone via GUI from a desktop PC or laptop.
.2 The DSP is integrated within the self contained unit.
.3 The system shall be monitored and adjusted with a computer from a centralized control area.
.4 Processing capacity: 264 MIPS, 528 MFLOPS sustained operation.
.5 Memory storage is non-volatile RAM (Random Access Memory) for all programs and set up parameters which are stored and recoverable during power outages for up to ten (10) years.
.6 DSP must be capable of control of volume and equalization of zonal PA and music, if required initially on project or at some future date.

2.6 **POWER SUPPLY**

.1 Input voltage: 85 to 264VAC
.2 Output current: 0 to 1.56A continuous
.3 Power factor: >.90 at full load
.4 Overload protection: Shall incorporate current limit to protect from damage
.5 Power mains: IEC 3-pin with ground.
.6 Packaging: Integrated within 1RU metal chassis

2.7 **NOISE GENERATION**

.1 2 channel independent, uncorrelated full random non-repeating noise generation with constant energy per octave bandwidth.
.2 Minimum spectrum accuracy: 1 dB from 40-10,000 Hz
.3 Repetition Rate: repeats every 271 hours.
.4 Mounting: Integrated within Digital Signal Processing

2.8 **SYSTEM INPUTS**

.1 **PA:** 3-pin phoenix connector at over 2KΩ
  Microphone pre-gain: 30-60dB
  Frequency: 80Hz – 18kHz
.2 **Background Music:** RCA terminations at over 10KΩ
  Frequency: 50Hz – 20 kHz
.3 **Audio** – 2 Channels

2.9 **EQUALIZER FILTERS**

.1 Requirement on each output channel with control over 31 - 1/3 octave bands on each channel.
.2 Integrated within Digital Signal Processing unit.
.3 Equalization: 1/3 octave using ISO standard frequencies from 63-12,500 Hz minimum.

.4 Output: 600 ohms balanced and adjustable.

.5 Filters: adjustable minimum 20 dB adjustment per band.

.6 Level Tolerance: +/- 1 dB from 200-4000 Hz.

.7 Total Harmonic Distortion: less than 0.5% at full rated output.

.8 Equivalent Input Noise: less than –85 dBA from 20-20,000 Hz unweighted.

.9 Output: transformer isolated.

.10 Front panel security cover.

.11 Mounting: Integrated in self contained unit to be mounted in 1 RU chassis

2.10 AMPLIFIERS

.1 2 Channel, CLASS D solid state, EIA rated

.2 Audio power handling: continuous for speaker load plus minimum 3 dB margin (single or multi-channel).

.3 Frequency response +/- 0.3 dB 20Hz – 20kHz at 100 Ω

.4 Total Harmonic Distortion: less than 1% at 1kHz at rated output.

.5 Transformer Output: 70.7 volt line and audio line level.

.6 Automatic and manual gain control adjustable to 34 dB

.7 Output Regulation within 2dB, from no load to full load.

.8 Power Supply: self-contained and CSA approved.

.9 Mounting: Integrated in self contained unit to be mounted in 1RU chassis

.10 Input impedance: 50KΩ

.11 Output impedance: 0.08Ω

.12 Carrier Frequency: 400kHz

.13 Constant voltage at 25W

.14 +/- 15VDC and 100kHz square sine wave

.15 Peak current: 1.2 Amps

2.11 MATERIALS

.1 All electronic components shall be ROHS and UL recognized

.2 All plastics shall meet UL94VO flammability rating

.3 Cold roll steel - 18 AWG - .047” nominal

.4 Black powder coat paint

.5 Corrosion resistant

.6 White silk screen on rear

.7 Molex front cover
2.12 SCHEDULER: PROGRAMMABLE TIMER

.1 Adjusts masking volume levels according to a calendar-based, programmed schedule with automatic adjustment of Daylight Savings Time.
.2 Assigns schedules to each specified zone.
.3 Offers a programmed acclimatization process with independent schedules for each timer zone.
.4 Allows for independent timer schedules for each day of the week.

2.13 ACCEPTABLE MATERIALS:

2.13.1 Subject to compliance with requirements, products that may be incorporated into the Work include:

.1 SoundMaskIt Digital Centralized Sound Masking Systems as designed by Vibra-Sonic Control
   Vancouver - (604) 294-9495   fax - (604) 294-8033
   Calgary      - (403) 237-5035   fax - (403) 237-5064

3 EXECUTION

3.1 INSTALLATION

.1 Install system components above suspended ceiling in accordance with manufacturer's instructions and in a manner that will permit specified acoustical performance requirements will be met.
.2 Suspend sound masking units with mounting brackets/chain securely anchored to underside of structure. Ensure that there is no strain on any electrical wiring. Avoid mounting that could result in generation of vibration noise or distortion.
.3 Mount closed enclosure to radiate sound upward (unless otherwise specified).
.4 Install centralized Digital Signal Processors securely inside equipment cabinet(s) / client’s rack or on to the wall using supplied mounting hardware. Locate equipment cabinet at location directed by the consultant.
.5 Ground audio system to building power supply ground.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer’s nameplates, CSA labels and identifications nameplates are visible and legible after equipment is installed.
3.3 INSTALLATION, CABLE

.1 Avoid damage to cables. Provide adequate cable strain relief.
.2 Run cables parallel and perpendicular to building lines. Attach wiring to top of structural elements in a non-obstructive fashion. Secure every 2 meters and at changes in direction.
.3 Connect each speaker wire pair to one terminal pair on screw terminal blocks at centralized cabinet equipment.

3.4 LOCATION OF OUTLETS

.1 Indicated within Installation Information.

3.5 MOUNTING HEIGHTS

.1 Indicated within Installation Information.

3.6 TESTING, ADJUSTING AND BALANCING

.1 Comply with requirements of Section 16993 - Electrical starting and testing by Contractor.

OR

.1 Calibrate the microphone and related test equipment prior to testing.
.2 Test, adjust, and balance system with mechanical system and other noise generating equipment shut down in areas receiving sound masking.
.3 Test, adjust and balance system until sound spectrum and levels meet specified performance requirements. Adjust settings of installed units, relocate installed units, or add additional units, if and as required.
.4 Upon completion of tests, perform walk-through verification of areas that will be covered by sound masking. Adjust and re-test areas having abnormal characteristics or levels.

3.7 TESTS AND TEST METHODS:

.1 Test to determine each zone’s octave band sound pressure levels. Take a series of readings for unit coverage area.
.2 Test to determine spatial average overall sound pressure levels. Take minimum of one reading for each enclosed room covered by sound masking and minimum of one reading per 20 m² (215 ft²) of floor area in all open spaces covered by sound masking.
.3 Position of Measuring Microphone: 1220 mm (48”) above floor and minimum 1000 mm (40”) away from any sound reflecting surface, in locations representative of each area that are sound masked.

3.8 MEASURE SOUND PRESSURE LEVELS USING ONE OF FOLLOWING METHODS:

.1 An Equivalent Continuous Sound Level (LEQ) mode for minimum interval of 15 seconds.
.2 IEC 651 'slow' time constant, average reading of the highest and lowest level during 15 second intervals.
3.9 TEST EQUIPMENT:

.1 Sound Level Meter: to ANSI S1.4-1983, Type 1 or better.
.2 Octave Band Filter: to ANSI S1.11, Class II or better.
.3 Accuracy of Acoustic Calibrator: within ±0.3 dB at 25°C.

3.10 SCHEDULE

SPEC NOTE: Unless indicated on drawings, schedule locations where sound masking is required.

3.10.1 Provide sound masking coverage in the following rooms and areas:

.1 [ ].
.2 [ ].
.3 [ ].
DATA - SoundMaskIt DSP8807

SYSTEM PERFORMANCE / DSP PROCESSORS

- Dynamic range: >102dB A-weighted
- Frequency response: 80Hz – 20kHz ± 3dB at rated output
- Distortion THD+N: ≤ 0.001% typical at +4dBu, 1kHz, 0dB gain
- Input sensitivity: ≤ 0.1% at 1kHz at rated output
- Interchannel crosstalk: > 80dB typical
- Crosstalk input to output: > 80dB
- Channel separation: > 100dB at 1kHz (in thru out)
- Common mode rejection ratio (CMRR): > 50dB, 80Hz – 20kHz typical > 55dB at 1kHz
- Processor capacity: 264 MIPS, 528MFLOPS, continuous operation
- Sample rate audio conversion: 48kHz
- D/A converter type (Audio): 24-bit Sigma Delta
- D/A performance dynamic range (converter): > 100dB A-weighted
- A/D performance dynamic range: > 110dB A-weighted
- Non-volatile memory: Memory storage for all programs and set up protected for (24) hours in power brown out, interruption or computer shut down. Data settings good for (10) years w/o refresh
- DSP manual restart: Front manual restart button to reboot DSP’s
- CODEC – DSP protection: All I/O protected with buffers from spikes and transients or sneak currents

SYSTEM INPUTS (unless noted located on rear panel)

- Power AC Mains: IEC 3-pin with ground, 100-240VAC, 50-60HZ with ON/OFF manual switch with replaceable fuse
- Network – Data: RJ45 module jack (EIA 568B)
- Telco Loop start: 2-pin dockable keyed connector, 600 Ohm, 105v – 14v (POTS – VoIP), Single, Group or All Page
- Microphone: 3-pin dockable keyed connector
- Background Music: Dual RCA connector 10kOhm (sum to mono)
- Master Override: 2-pin dockable keyed connector (1v – 70v nominal)
- Emergency Audio Off (EAO): 2-pin dockable keyed connector, ‘NO’ normally open contact closure
- Ambient Sensing Microphones (x8): RJ45 modular jack (EIA 568B) no polarity
**SYSTEM OUTPUTS** (unless noted located on rear panel)

- **Speakers (x8)**
  - 2-pin dockable keyed connector (70v at 50WRMS)
- **Audio Line level (x8)**
  - 3-pin dockable keyed connector (1v nominal)
  - Microphone frequency level: 80Hz – 18kHz
  - Music: 80Hz – 20kHz
  - Line out: 80Hz – 18kHz
  - Telco: 250Hz – 4kHz
- **Network system link**
  - RJ45 modular jack (EIA 568B)
- **Ancillary line out (x2)**
  - 2-pin dockable keyed connector, contact closure

**SYSTEM AMPLIFIERS (x8)**

- **Frequency response**
  - 80Hz – 20kHz, ± .25dB
- **Total distortion**
  - .001% typical at +4dB, 1kHz, 0dB gain
- **Transformer output**
  - 70,7v and Iv line level
- **Efficiency**
  - 85% or better
- **Gain control**
  - adjustable to 34dB
- **Power supply**
  - UL / CUL / CE recognized
- **Input impedance**
  - 50kOhm
- **Output impedance**
  - 8 Ohm
- **Carrier frequency**
  - 400kHz
- **Peak current**
  - 1.2A
- **MTBF (Mean Time Between Failure)**
  - 100,000 hours
- **EMC / EMI radiation**
  - FCC Part 15 Class B, EN61000, CISPR 22

**SYSTEM MECHANICAL DATA**

- **Dimensions (L x W x H)**
  - 14.0” (358mm) x 19.0” (482.6mm) x 3.5” (88.9mm)
- **Material (outer housing)**
  - CRS (cold roll steel) 18AWG (.047” nominal)
- **Finish**
  - Flat black powder coat with zinc undercoat corrosion resistant
- **Printed circuit boards**
  - UL recognized UL94VO
- **Electronic components**
  - RoHS
- **Operating temperature**
  - 0˚ to +50˚C
- **Storage temperature**
  - -40˚ to + 85˚C
- **Humidity**
  - 95% non-condensing (max.)

**PHYSICAL DATA**

- **Dimensions**
  - 19.0” (48.3cm) x 16.0” (40.6cm) [MAX.] x 3.0” (8.75cm)
- **Weight**
  - 22lb
- **Warranty**
  - 1 year limited warranty
BASIC FUNCTIONS

- (8) channels of random pink noise generation non-repeating up to 215 hours
- (8) audio outputs of 50WRMS digital Class-D amplification at 85% efficiency
- (8) audio line outputs at 1v/600 Ohm (nominal) for unlimited power per zone
- (8) independent outputs of 1/3 Octave 28-band EQ defined and shaped in GUI
- IEEE 802.1 AVB (Audio Video Bridging) technology for time aligned networking of multiple units
- AVB operation allows IP based paging via Ethernet connection
- (8) Ambient sensing microphone inputs (RJ45) for automatic level sensing (6dB) and control
- Compatible with ALM-1 ambient sensing microphones operating up to 1,000 feet of CAT5e
- Multiple audio source inputs for Background Music, Paging and Emergency Alarm Overrides
- Telco paging input (Loop Start) with 2 digit only DTMF (touch tone) dial plan defined in GUI
- Multiple ‘form-C’ contact closure relay inputs (x4) for ancillary devices
- Microphone input with Background Music mute
- Emergency Alarm Override input for automatic system mute
- On-board MAC Address for IP addressability and remote control compatible with DHCP MS server
- User friendly GUI (Sound Media Interface) for set up
- Zone expansion from 1 to 2,048 via standard CAT5e – CAT6 cabling (up to 253 systems)
- All-Call page, Group Zone page and single zone page defined in GUI
- Independent Parametric EQ for all paging sources
- Microphone balanced input with on-board Phantom Power at 32VDC
- On board signal generators for paging confirmation, busy and pre-announce tones
- Non-volatile DSP memory components for all system controls with (10) year memory
- DSP8807 multiple mounting options; Rack, Cabinet, Shelf or wall at 2RU (3.5”) height x 15” deep
- Visual status front multicolor LED’s for all major inputs and outputs
- Rear access network connection (RJ45) with front manual DSP reset button
- Overload, short and current limit protection with automatic reset for all critical components
- All power components are UL recognized, boards are UL94V0 and RoHS
- DSP8807 is UL / CUL / FCC and CB (International) listed
1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 Electrical General Requirements
.2 Section 16120 Wire and Cable
.3 Section 16993 Electrical Starting and Testing General Requirements

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)


1.2.2 American Society for Testing and Materials (ASTM):


1.2.3 International Electro-technical Vocabulary (IEC):

.1 IEC 651, Live Working.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEZEE SP1122.

1.4 DESCRIPTION OF A DIGITAL DUAL NETWORKED CENTRALIZED MASKING/PA SYSTEM

An electronic, frequency contoured sound masking system which includes the following:

.1 Strategically located speaker assemblies installed above conventional suspended acoustic tile, drywall, wood or open ceiling, in areas indicated.
.2 Speaker assemblies generating unique, diffuse and unobtrusive sound with spatial and temporal uniformity, and having a spectrum shape designed to mask speech and low level unwanted noise.
.3 System Components Must Include: The Vibra–Sonic, Digital Sound Masking System is based on the DSP 8807 Processor. It is a self-contained multi-zone digital DSP-GUI controlled processor with Digital Class D Amplifiers, Third Octave 31 Band Equalizers, Ambient Sensing Components, Power, Telco Paging, Music Inputs, an IP Addressable Network, an AVB (Audio-Video-Bridge) compliant Network Port, all onboard.
.4 Processor must be housed in a 19”w x 3.5”h (48.3 cm x 8.9 cm) - (2 Rack Units high) rack or wall mount chassis that is black powder coat CRS cold roll steel.

.5 Must include adjustable brackets for 19” (48.3 cm) rack or wall mounting.

.6 The system shall be (8) independent programmable channels and serve a single floor plate, multi-floor plate or multi-building facility with capability to support up to 2,048 channels within one networked system.

.7 Each channel must have independent equalization allowing separate sound masking spectrums for each zone.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide sound masking in accordance with the system description to all areas indicated on drawings and/or schedule. Sound level performance shall comply with the following one-third octave sound pressure levels and tolerances:

<table>
<thead>
<tr>
<th>1/3 Octave ISO Centre Frequency (Hz)</th>
<th>1/3 Octave Band Sound Pressure Levels (dB)</th>
<th>Tolerances (± dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>44</td>
<td>± 3</td>
</tr>
<tr>
<td>160</td>
<td>43</td>
<td>± 3</td>
</tr>
<tr>
<td>200</td>
<td>42</td>
<td>+2-3</td>
</tr>
<tr>
<td>250</td>
<td>41</td>
<td>+1-2</td>
</tr>
<tr>
<td>315</td>
<td>40</td>
<td>± 1</td>
</tr>
<tr>
<td>400</td>
<td>39</td>
<td>± 1</td>
</tr>
<tr>
<td>500</td>
<td>37.5</td>
<td>± 1</td>
</tr>
<tr>
<td>630</td>
<td>36</td>
<td>± 1</td>
</tr>
<tr>
<td>800</td>
<td>34.5</td>
<td>± 1</td>
</tr>
<tr>
<td>1,000</td>
<td>33</td>
<td>± 1</td>
</tr>
<tr>
<td>1,250</td>
<td>31.5</td>
<td>± 1</td>
</tr>
<tr>
<td>1,600</td>
<td>30</td>
<td>± 1</td>
</tr>
<tr>
<td>2,000</td>
<td>28</td>
<td>± 1</td>
</tr>
<tr>
<td>2,500</td>
<td>26</td>
<td>± 1</td>
</tr>
<tr>
<td>3,150</td>
<td>24</td>
<td>± 1</td>
</tr>
<tr>
<td>4,000</td>
<td>22</td>
<td>± 1</td>
</tr>
<tr>
<td>5,000</td>
<td>20</td>
<td>± 1</td>
</tr>
<tr>
<td>6,300</td>
<td>17</td>
<td>+1-2</td>
</tr>
<tr>
<td>8,000</td>
<td>14</td>
<td>+1-2</td>
</tr>
</tbody>
</table>

Note: The above values are graphically illustrated on detail drawing 27 51 20.01.

.2 Spatial Average Overall Sound Pressure Levels: Minimum 43 decibels and maximum 45 decibels, A-weighted (dBA).

1.6 SUBMITTALS

.1 Provide requested items in accordance with Section 013300 – Submittals.

.2 Submit shop drawings indicating proposed quantity and location of all system components and related wiring and accessories.

.3 Obtain Owner’s approval for any changes in quantity or location of sound masking units from Owner reviewed shop drawings.
1.6.1 After completing installation, testing, adjusting and balancing, submit the following:

.1 Project record drawings in the form of the above noted shop drawings, revised as necessary to accurately indicate locations of all system components, as installed.

.2 Copy of all final sound pressure levels readings taken, including accurate description of reading locations and test methods and equipment used.

1.7 QUALITY ASSURANCE

1.7.1 Quality Assurance: in accordance with Section 04 45 00 – Quality Control.

1.7.2 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices programs: permitted, under direct supervisions of a qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7.3 Site Meetings

.1 As determined by general contractor

1.7.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Engineer with schedule within 2 weeks after award of contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.9 SYSTEM STARTUP

.1 Owner will [appoint and pay for services of testing agency] [utilise his own forces] to take measurements to verify that the installed sound masking system meets specified acoustical performance requirements in accordance with ASTM E1041.

.2 Performance verification will be performed [after Substantial Performance of the Work] [during Performance Testing, and sub-phases of Facility start-up].

.3 Installer shall make measurements to verify that the installed sound masking system meets specified acoustical performance requirements with Owner’s agent.

.4 Verification by the Owner will be performed with mechanical systems shut down in area being tested.
.5 Verification will be performed with mechanical systems in full operation in area being tested.

1.10 OPERATING INSTRUCTIONS

.1 Testing, tuning, and balancing will be performed after normal working hours of facility users, or as otherwise required by Owner.

.2 Schedule testing, adjusting, and balancing will be performed after above-ceiling mechanical and electrical work, suspended acoustic tile ceiling, and sound masking system installation are complete.

2 PRODUCTS

2.1 SPEAKER

.1 Cone: 100-200mm (3.9” – 7.9”), single, Low Q” type.
.2 Frequency Response: 125-8000 Hz +/- 4dB on axis.
.3 Sensitivity: 94 dB EIA minimum.
.4 Power Handling: 5 watts EIA minimum.
.5 Resonant Frequency: 99 Hz maximum.
.6 Mounting: four screws (studs) to grill cover.

2.2 TRANSFORMERS:

.1 Type: 70.7volt
.2 Minimum Primary Power Taps: COM, 0.25, 0.5, 1, 2, 4 watts set with exterior switch.
.3 Mounting: directly to speaker frame.

2.3 SPEAKER ENCLOSURES:

.1 Size: 300mm (11.8") square (round) 100mm (3.9") deep.
.2 Construction: 0.6mm (1/42") minimum thickness sheet steel.
.3 Undercoating: factory applied to eliminate resonance.
.4 Mounting: Bracket

2.4 GRILLE COVERS:

.1 Construction: one piece, 0.6mm (1/42") minimum thickness sheet steel.
.2 Perforated speaker opening to suit speaker size.
.3 Four screw clip opening to enclosure.

2.5 MICRO PROCESSOR CONTROL

.1 The DP8807 digital processor/amp shall be capable of automatic mixing, set-up and administration of all 8 inputs per zone via GUI from a desktop PC or laptop.
.2 The DSP is integrated in the self contained unit.
.3 The system shall be monitored and adjusted with a computer from a centralized control area.
.4 System link: Capability to expand up to 2,048 zones (256 systems) Linked via RJ45 telephone jack and CAT5e cables.
.5 Processing capacity: 264 MIPS, 528 MFLOPS sustained operation
.6 Memory storage is non-volatile RAM (Random Access Memory) for all programs and set up parameters which are stored and recoverable during power outages for up to ten (10) years.

.7 DSP must be capable of control of volume and equalization of zonal paging and/or music, if required initially on project or at some future date.

.8 DSP must have an IEEE802.1 AVB (Audio-Visual-Bridge) Interface for easy and Time-Aligned networking of multiple SoundMaskIt Systems.

.9 DSP must be IP Addressable for minor system adjustments.

2.6 POWER SUPPLY

.1 Input voltage: 85 to 264VAC
.2 Output current: 0 to 1.56A continuous
.3 Power factor: >.90 at full load
.4 Overload protection: Shall incorporate current limit to protect from damage
.5 Power mains: IEC 3-pin with ground.
.6 Packaging: Integrated within 2RU metal chassis

2.7 NOISE GENERATION

.1 8 channel independent, uncorrelated full random non-repeating noise generation with constant energy per octave bandwidth.
.2 Minimum spectrum accuracy: 1 dB from 40-10,000 Hz
.3 Repetition Rate: repeats every 271 hours.
.4 Mounting: Integrated within Digital Signal Processing
.5 Ducking/mute controls on all zones for page over masking noise. System capable of 3 different dB levels per zone
.6 Alarm: 4 distinct tones with variable frequency assignable to any zone.
.7 Page tones: Tone generators for Telco confirmation, busy tone and pre-announce tone for paging.

2.8 SYSTEM INPUTS

.1 Telco: RJ45 and RJ11 compatible
   Input: transformer coupled at 600Ω impedance
   Frequency: 250Hz – 4 kHz
.2 Data: RJ45 input for LAN Ethernet for connection to desktop PC/Computer com port for software download and GUI control
.3 Network Paging: RJ45 connecting to Enterprise Network Switch for IEE802.1 AVB (Audio-Video-Bridge) functionality.
.4 Paging: 3-pin phoenix connector at over 2KΩ
   Microphone pre-gain: 30-60dB
   Frequency: 80Hz – 18kHz
.5 Background Music: RCA terminations at over 10KΩ
   Frequency: 50Hz – 20 kHz
.6 Audio – 8 Channels

2.9 EQUALIZER FILTERS

.1 Requirement on each output channel with control over 31 - 1/3 octave bands on each channel.
.2 Integrated within Digital Signal Processing unit.
.3 Equalization: 1/3 octave using ISO standard frequencies from 63-12,500 Hz minimum.
.4 Output: 600 ohms balanced and adjustable.
.5 Filters: adjustable minimum 20 dB adjustment per band.
.6 Level Tolerance: +/- 1 dB from 200-4000 Hz.
.7 Total Harmonic Distortion: less than 0.5% at full rated output.
.8 Equivalent Input Noise: less than –85 dBA from 20-20,000 Hz unweighted.
.9 Output: transformer isolated.
.10 Front panel security cover.
.11 Mounting: Integrated in self contained unit to be mounted in 2 RU chassis

2.10 AMPLIFIERS
.1 8 Channel, CLASS D solid state, EIA rated
.2 Audio power handling: continuous for speaker load plus minimum 3 dB margin (single or multi-channel).
.3 Frequency response +/- 0.3 dB 20Hz – 20kHz at 100 Ω
.4 Total Harmonic Distortion: less than 1% at 1kHz at rated output.
.5 Transformer Output: 70.7 volt line and audio line level.
.6 Automatic and manual gain control adjustable to 34 dB
.7 Output Regulation within 2dB, from no load to full load.
.8 Power Supply: self-contained and CSA approved.
.9 Mounting: Integrated in self contained unit to be mounted in 2RU chassis
.10 Input impedance: 50KΩ
.11 Output impedance: 0.08Ω
.12 Carrier Frequency: 400kHz
.13 Constant voltage at 50W
.14 +/- 15VDC and 100kHz square sine wave
.15 Peak current: 1.2 Amps

2.11 AMBIENT SENSING OPTIMIZER - ONBOARD
.1 Shall dynamically adjust masking/paging levels real time within 6 dB @ 45dB nominal + - 3dB (range from 42-48dB) while allowing paging to be used in the same zone.
.2 Unit includes (1) Model CLM8 (current loop microphone) in a 2- gang plate for easy mounting into a 2-gang electrical box (by others) for use up to 1,000 feet from the DP8807 unit via CAT 5e cabling.

2.12 SCHEDULER: PROGRAMMABLE TIMER
.1 Adjusts masking volume levels according to a calendar-based, programmed schedule with automatic adjustment of Daylight Savings Time.
.2 Assigns schedules to each specified zone.
.3 Offers a programmed acclimatization process with independent schedules for each timer zone.
.4 Allows for independent timer schedules for each day of the week.

2.13 MATERIALS
.1 All electronic components shall be ROHS and UL recognized
.2 All plastics shall meet UL94VO flammability rating
.3 Cold roll steel - 18 AWG - .047" nominal  
.4 Black powder coat paint  
.5 Corrosion resistant  
.6 White silk screen on rear  
.7 Molex front cover with LCD Lights

2.14 ACCEPTABLE MATERIALS:  
2.14.1 Subject to compliance with requirements, products that may be incorporated into the Work include:  
   .1 SoundMaskIt Digital Centralized, Dual Networked Sound Masking Systems as designed by Vibra-Sonic Control  
      Vancouver - (604) 294-9495 fax - (604) 294-8033  
      Calgary - (403) 237-5035 fax - (403) 237-5064

3 EXECUTION

3.1 INSTALLATION  
   .1 Install system components above suspended ceiling in accordance with manufacturer's instructions and in a manner that will permit specified acoustical performance requirements will be met.  
   .2 Suspend sound masking units with mounting chains securely anchored to underside of structure. Ensure that there is no strain on any electrical wiring. Avoid mounting that could result in generation of vibration noise or distortion.  
   .3 Mount closed enclosure to radiate sound upward.  
   .4 Install centralized Dual Networked Digital Signal Processors securely inside equipment cabinet(s) or client's rack. Locate equipment cabinet at location directed by the consultant.  
   .5 Ground audio system to building power supply ground.

3.2 NAMEPLATES AND LABELS  
   .1 Ensure manufacturer's nameplates, CSA labels and identifications nameplates are visible and legible after equipment is installed.

3.3 INSTALLATION, CABLE  
   .1 Avoid damage to cables. Provide adequate cable strain relief.  
   .2 Run cables parallel and perpendicular to building lines. Attach wiring to top of structural elements in a non-obstructive fashion. Secure every 2 meters and at changes in direction.  
   .3 Connect each speaker wire pair to one terminal pair on screw terminal blocks at centralized cabinet equipment.

3.4 LOCATION OF OUTLETS  
   .1 Indicated within Installation Information.

3.5 MOUNTING HEIGHTS  
   .1 Indicated within Installation Information.
3.6 TESTING, ADJUSTING AND BALANCING

.1 Comply with requirements of Section 16993 - Electrical starting and testing by Contractor.

OR

.1 Calibrate the microphone and related test equipment prior to testing.
.2 Test, adjust, and balance system with mechanical system and other noise generating equipment shut down in areas receiving sound masking.
.3 Test, adjust and balance system until sound spectrum and levels meet specified performance requirements. Adjust settings of installed units, relocate installed units, or add additional units, if and as required.
.4 Upon completion of tests, perform walk-through verification of areas that will be covered by sound masking. Adjust and re-test areas having abnormal characteristics or levels.

3.7 TESTS AND TEST METHODS:

.1 Test to determine each zone’s octave band sound pressure levels. Take a series of readings for unit coverage area.
.2 Test to determine spatial average overall sound pressure levels. Take minimum of one reading for each enclosed room covered by sound masking and minimum of one reading per 20 m² (215 ft²) of floor area in all open spaces covered by sound masking.
.3 Position of Measuring Microphone: 1220 mm (48”) above floor and minimum 1000 mm (40”) away from any sound reflecting surface, in locations representative of each area that are sound masked.

3.8 MEASURE SOUND PRESSURE LEVELS USING ONE OF FOLLOWING METHODS:

.1 An Equivalent Continuous Sound Level (LEQ) mode for minimum interval of 15 seconds.
.2 IEC 651 ‘slow’ time constant, average reading of the highest and lowest level during 15 second intervals.

3.9 TEST EQUIPMENT:

.1 Sound Level Meter: to ANSI S1.4-1983, Type 1 or better.
.2 Octave Band Filter: to ANSI S1.11, Class II or better.
.3 Accuracy of Acoustic Calibrator: within ±0.3 dB at 25°C.

3.10 SCHEDULE

SPEC NOTE: Unless indicated on drawings, schedule locations where sound masking is required.

3.10.1 Provide sound masking coverage in the following rooms and areas:

.1 [   ].
.2 [   ].
.3 [   ].

END OF SECTION
M1000 & M1000-W

Sound Masking Loudspeaker Assemblies

General Description
With a majority of America’s workplaces having adopted an open office plan, favoring a labyrinth of cubicles over traditional closed offices, conversational privacy has become an increasingly sensitive issue. A properly designed sound masking system can significantly increase speech privacy and improve the overall work environment.

The new Atlas Sound M1000 masking speaker assembly is designed to accurately reproduce the needed spectrum of masking sound into the plenum space. The innovative 734 in³ square enclosure ensures ample low frequency response. A specially designed 8” dual cone loudspeaker is included in the package. A high efficiency 70.7V internal transformer is coupled to an external selector switch for easy system tuning. For more precise adjustments, an off switch and a wide selection of wattage taps ranging from .25 watts to 4 watts are provided. Along with the various wattage tap selections, the M1000-W comes with an 8 Ω bypass setting.

The exclusive Atlas Sound EZ hang brackets simplify installation. This innovative suspension system utilizes two collapsible galvanized hangers configured to allow quick upward, downward, or horizontal hanging. The hangers are factory-installed on the unit and fold flat for shipping. To meet most local code requirement, the M1000 includes an innovative cover containing both knockouts and a strain relief. This system will allow the use of rigid or flexible conduit (if required) and easily accommodates “through” connections on the removable plate. To fit continually shrinking construction budgets, the M1000 is very aggressively priced. Contact your regional Atlas Sound representative for details.

Architect & Engineer Specifications
Sound masking assembly shall be Atlas Sound model M1000 or M1000-W. Unit shall contain Atlas Sound 8” diameter Loudspeaker equipped with a 70.7V transformer, an enclosure, baffle, and related mounting hardware. It shall be factory assembled, wired and ready for installation. Model M1000 shall include external tap selector switch with an off position and .25, .5, 1, 2, & 4 watts power taps clearly identified. Model M1000-W shall include an external tap selector switch with an off position and .25, .5, 1, 2, & 4 watts power taps and an 8 Ω bypass clearly identified. Suitable strain relief shall be installed to protect hook-up leads and accommodate conduit installations. Provisions on input panel also included to facilitate up to 4-conduit.

The CRS enclosure shall measure $\frac{11}{16}” (243 mm) L \times \frac{11}{16}” (243 mm) W \times \frac{5}{16}” (140 mm) H$ and have a volume of $734$ in³ ($12,075.1$ cm³). It shall include fiberglass material to further dampen the enclosure. Baffle shall be a sturdy steel one-piece CRS grille measuring $\frac{11}{16}” (243 mm) L \times \frac{11}{16}” (243 mm) W$. Grille shall have a perforated loudspeaker opening. Baffle and enclosure shall be finished in textured black epoxy or white epoxy finish on the M1000-W. Assembly shall include a dual suspension hanger system which fastens via holes provided on the enclosure. Hangers shall be adjusted for (upward, downward or horizontal radiation).
M1000R-W
Round Pendant Mount Sound Masking Speaker System

Technical Specifications

- **Loudspeaker Type**: 8" Dual Cone
- **Magnet Size**: 10oz (260g)
- **Transformer Taps**: .25, .5, 1, 2 & 4 Watts, plus off
- **Sound Dispersion**: Upward
- **Enclosure Volume**: 382in³ (6.26 ltrs.)
- **Height**: 3.937" (100mm)
- **Outside Diameter**: 12.992" (330mm)
- **Weight**: 9.2lbs (4.17Kg)

Features

- Sleek, round appearance designed for mounting in open plenum areas where speakers may be visible
- Balanced enclosure design to ensure level orientation when suspended (78” (2m) suspension chain included)
- Fully assembled package includes 8” transducer with high quality line matching transformer
- .25 to 4 watt (@70.7V) power selection (plus OFF) via external switch
- 382in³ (6.26L) enclosure volume for accurate low frequency masking spectrum reproduction
- Strain relief to facilitate input termination
- Tasted and approved to UL2043 standard for use in air handling (plenum) spaces
- White finish to blend in with almost any ceiling décor

General Description

The M1000R-W is a perfect solution for contemporary office spaces with open ceiling designs where sound masking is used to enhance speech privacy. The sleek round design and low gloss white finish will blend in nicely with painted ductwork, lighting and other devices suspended overhead.

A high efficient 8” paper cone transducer coupled with a low insertion loss 70.7V transformer are factory assembled into the 382 in³ round enclosure. System level tuning is easily achieved via an external tap selector switch that includes settings for .25, .5, 1, 2 & 4 watts plus an OFF position.

Installation is made easy via the included 78’ (2m) suspension chain system that allows quick mounting and height adjustment of the M1000R-W. An integral wire strain relief strategically located on the top of the enclosure allows for secure speaker cable termination.

Architect & Engineer Specifications

Sound masking assembly shall be Atlas Sound model M1000R-W. Unit shall contain Atlas Sound 8” diameter Loudspeaker equipped with a 70.7V transformer, round enclosure, baffle, and related mounting hardware. It shall be factory assembled, wired and ready for installation. Unit shall include external tap selector switch with an OFF position and .25 .5, 1, 2, & 4 watts power taps plus “OFF” clearly identified. Suitable strain relief shall be included to protect hook-up leads and accommodate conduit installations. CRS enclosure shall measure 12.992” (330mm) in diameter by 3.937” (100mm) in Depth and have a volume of 382in³ (6.26ltrs.). System shall include a 78” (2m) mounting chain which shall fasten via eyelets provided on the enclosure top to ensure level orientation when suspended for upward sound radiation.

Assembly shall be finished in textured white epoxy
M1000R-W Beamwidth (-6 dB)

M1000R-W Polars (Normalized to Zero on Axis) (-6 dB)
Over the past 30 years, Vibra-Sonic Control has proudly provided hundreds of clients with Sound Masking Systems. Some of our most recent clients include:

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<th>Vancouver Coastal Health</th>
<th>Fraser Health Authority</th>
<th>Stantec</th>
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