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ZONEWORKS

ZONEWORKS DSE SYSTEM OVERVIEW

1. INTRODUCTION

The Clevertronics Zoneworks® Sound Escape™ System delivers an engineered solution for evacuation from buildings using visual and sound cues.

Exits within a building may be obscured from view for a variety of reasons and visual direction alone is not enough to ensure an adequate evacuation time. Existing emergency lighting standards in Australia do not deal with the effects of smoke and the evacuation process. The effectiveness of Exit and emergency lighting is severely reduced in relatively low smoke densities and exit signs are installed typically at heights of 2.1 to 2.7m above the floor – right in the smoke layer!

By using a localised, directional sound incorporated into the Exit luminaires the exit can be heard as well as seen. The sound is localised and directional allowing an individual to distinguish the origin of the sound attached to the Exit luminaires, therefore defining the evacuation path and the final point of Exit.

The Clevertronics Zoneworks® LW System provides the complete solution for installation, commissioning and configuration of the Sound Escape™ devices and ensures integrity of the system through real time monitoring and automated testing of both Light and Sound.

Directional sound technology was developed at School of Biomedical Sciences of Leeds University during the mid 1990's. The research work was conducted under the direction of Deborah Withington, a professor of auditory neuroscience. Since the development of the technology numerous studies have been conducted that compare occupancy egress time assisted by directional sounders to egress time based on conventional visual signals and signage. These studies have yielded a large body of data that indicates that the use of directional sounders consistently results in a significant reduction of egress time.

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SOUND ESCAPE™ FEATURES

- Directional sounders provide additional sound cues to assist occupants in locating the nearest exit rather then their instinctive urge to exit by the route they entered which may not be the fastest route.
- Sound travels around corners therefore avoids issues of line-of-sight methods (e.g. exit signs)
- Provides cues in adverse conditions of smoke or other low visibility condition. Significant benefit to the visually impaired.
- Reduces evacuation times by up to 70% in smoke obscured and 30% in a clear visibility environment.

SAMPLE TRIAL DATA *(COMPLETE EMPIRICAL SUMMARY AVAILABLE)*

Test Scenario	Time without Sound Escape™	Time with Sound Escape™	Improved Egress Time By
Leeds University television studio (smoke filled)	4m 23s	0m 15s	94%
School building (smoke filled, with signage, open space multiple choice)	15s	5s	66%
Marine trial (smoke filled cabins and corridors)	4m 46s	1m 49s	62%
School building (smoke filled, with signage, complex maze)	1m 38s	51s	48%

2. LOCALISED SOUND

Only certain types of sounds are inherently localisable and what is crucial is that they contain a large spectrum of frequencies that is broadband noise. Pure tones, simple tone combinations or narrow band noise cannot be localised. To understand why this is the case, the cues given by sound, that the brain can recognise, must be considered.

We can hear a vast range of frequencies, from approximately 20Hz to 20kHz, although this range diminishes as we age. There are three main types of information that allow the brain to localise sound. The first two are known as binaural cues because they make use of the fact that we have two ears, separated by the width of our head. A sound, which emanates from either side of the mid-line will arrive first at the ear closest to it and will also be loudest at the ear closest to it.

At low frequencies the brain recognises differences in the time of arrival of the sound between the ears, and at higher frequencies the salient cue is the loudness/ intensity difference between the sound at each ear. Movements of the head can overcome a hearing impairment where only one ear can be used. This effectively places the single ear in different locations to allow the brain to achieve simulated ‘binaural’ cues.

For single frequencies these cues are, however, spatially ambiguous. The inherent ambiguity has been described as the 'cone of confusion' and this arises from the fact that for any given frequency there are numerous spatial positions that generate identical timing/intensity differences and these can be graphically represented in the form of a cone, the apex of which is at the level of the external ear. The cone of confusion is the main reason for our not being able to localise pure tones.

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LOCALISED SOUND CONTINUED....

The technical challenge is to reproduce the necessary broadband sounds, which will be effective in the selected acoustic environment, whilst taking into account the requirement for a cost effective implementation in real world situations.

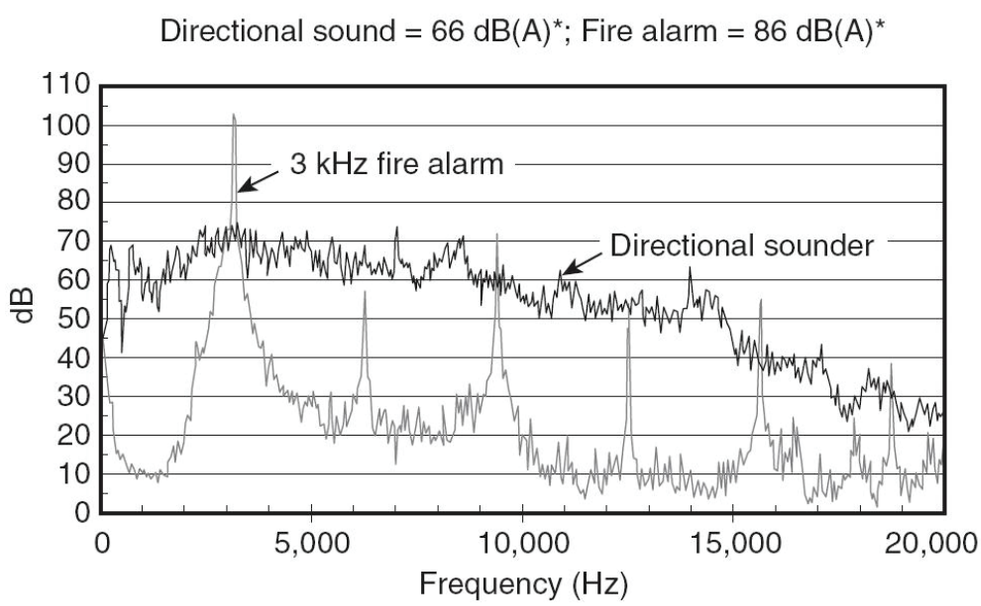
- Required volume
- Current consumption
- Physical size
- Environmental considerations
- Aesthetic appearance
- Interface to existing systems
- Ease of installation
- Cost

Directional Sound Evacuation (DSE) beacons can be used in two fundamental methods of implementation – (a) exit point marking and (b) wayguidance. In an 'exit point marking' scenario all the available exits are marked with the same standard DSE sound (fast pulsing bursts of broadband noise) to identify all possible exits from a given location. In a 'wayguidance' scenario the DSE sound is different dependent upon the location of the beacon. A potential evacuee will follow the pulses always moving towards the beacons with the faster pulsing sounds. In this way the evacuee can follow a complex route out of the structure.

COMPATIBILITY WITH TRADITIONAL FIRE ALARM AND EVACUATION TONES

Conventional alarms and the Sound Escape™ DSE module exceed common background noise in buildings by a significant margin. During an evacuation two alarm sounds would be heard over any background noise, the Fire Alarm/Evacuation tone and the Sound Escape™ DSE broadband pulse.

A typical alarm signal outputs around a single frequency (3000Hz) whereas the Sound Escape™ DSE module outputs over 800-14kHz and is significantly louder than a typical alarm tone over the complete range. The typical alarm tone will only mask a narrow range of frequencies around the nominal output frequency allowing the Sound Escape DSE module to be heard even at volume levels lower than the typical alarm tone. This can be seen in the diagram below.



3. SOUND ESCAPE™ EXIT LUMINAIRE

A directional sound device has been integrated into the Clevertronics range of EXIT Luminaires. The module can be activated into alarm condition via both the Zoneworks® LW System via the “network and/or a contact input from the fire system/EWIS.

The DSE module has its own emergency battery supply, amplifier, processor for generating the broadband noise and general control functions, memory storage for the voice annunciation and speaker. The DSE module takes its power (12V) from the EXIT luminaire and where it is used with the Zoneworks® System there is a communications bus connection to the Lonworks Powerline Node.

The following options can be configured as default parameters for each DSE Exit Luminaire;

- The broadband noise pulse length
- Gap between broadband noise pulses
- Annunciation or no annunciation
- Annunciation message, “Exit Here”, “Exit Left”, “Exit Right”, “Exit Ahead”
- Annunciation Language
- Open/Closed contact to activate the sound On/Off

These options can be factory configured so that upon activation of the System or Fire/EWIS Input the sound will output as per the default setting. It is therefore possible for the unit to be sold as a standalone DSE Exit Luminaire with a contact interface at each device to the Fire/EWIS System.

All of the above parameters are also configurable by the Zoneworks® LW System via the Graphical User Interface. This allows for a generic type to be issued from production and all the configuration is done as part of the commissioning process. Section 4 will address how a System is structured and configured.

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HARDWARE INPUT - FIRE/EWIS SYSTEM CONNECTION

As mentioned above the hardware input can be configured to activate the sound by either opening or closing contacts. In most cases this will be by opening contacts as is the common practice in fire systems i.e. when the contacts are opened the sound is activated either until the contacts are closed or the DSE unit expires due to battery failure if the mains supply has been disconnected.

CONNECTION BETWEEN THE DSE MODULE AND THE LONWORKS POWERLINE NODE

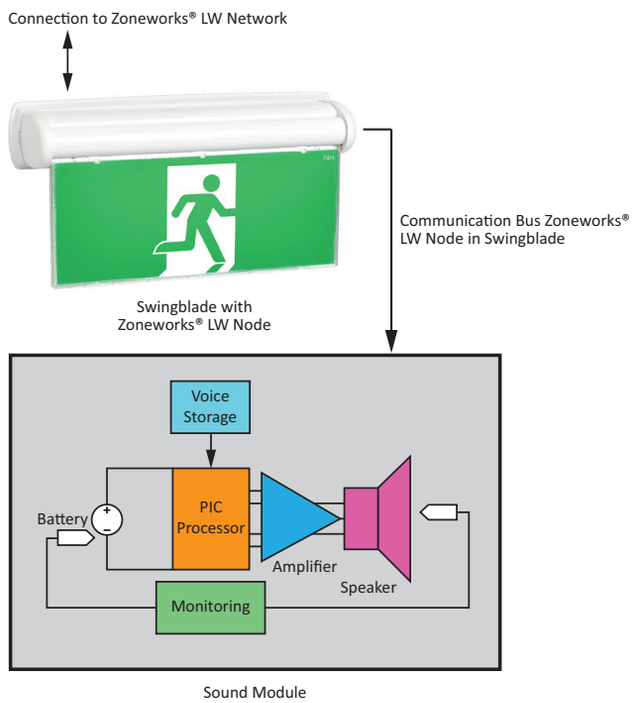
As mentioned earlier when used as part of the Zoneworks® System there is a communication bus connection between the DSE module and the ZWorks PLINENODE. This allows the configuration parameters to be altered at any time, testing of the sound for a specified duration in emergency/battery mode, real time monitoring of the battery charge status, voice coil integrity monitoring and activation of the sound based upon a Fire/EWIS alarm event.

The battery backup supply facility in the DSE module also supplies the PLINENODE so that powerline communications can be maintained between devices on the same section of the power supply network.

AMPLIFIER, SPEAKER AND SOUND PRESSURE

Sound Escape DSE module parameters:

- Input power handling capacity - 5W
- Amplifier 6.5W
- Sensitivity - 89 dB/m/W
- Weight - 120g
- Cone – Mylar
- Frequency response – 450hz to 15kHz
- Volume > 92dBA @ 1m (SPL measured on axis (0˚))
- Diameter – 66.5mm



TEST BUTTON SOUND ACTIVATION

When the test button on the ELM is pressed on for 2 seconds off for 2 seconds and then back on for 2 seconds the neuron will send a test message to the sound device.

If the test button on the ELM is held down for 10 seconds the neuron will send an off message to the sound module to stop the sound output. This is to allow override in the event that the sound output continues when it shouldn't or is no longer needed.

When an off message is received from the neuron the sound module must stop outputting until the fire, test or power fail inputs become active again i.e. if they are currently active then they must go inactive then reactivate for the sound to be broadcast again.

POWER UP/REST STATE

If a device comes out of reset and an input is active then the device should assume that input has just gone active and act accordingly.

4. SYSTEM DESIGN - ZONEWORKS® SYSTEM WITH DSE CAPABILITY

FIGURE 3

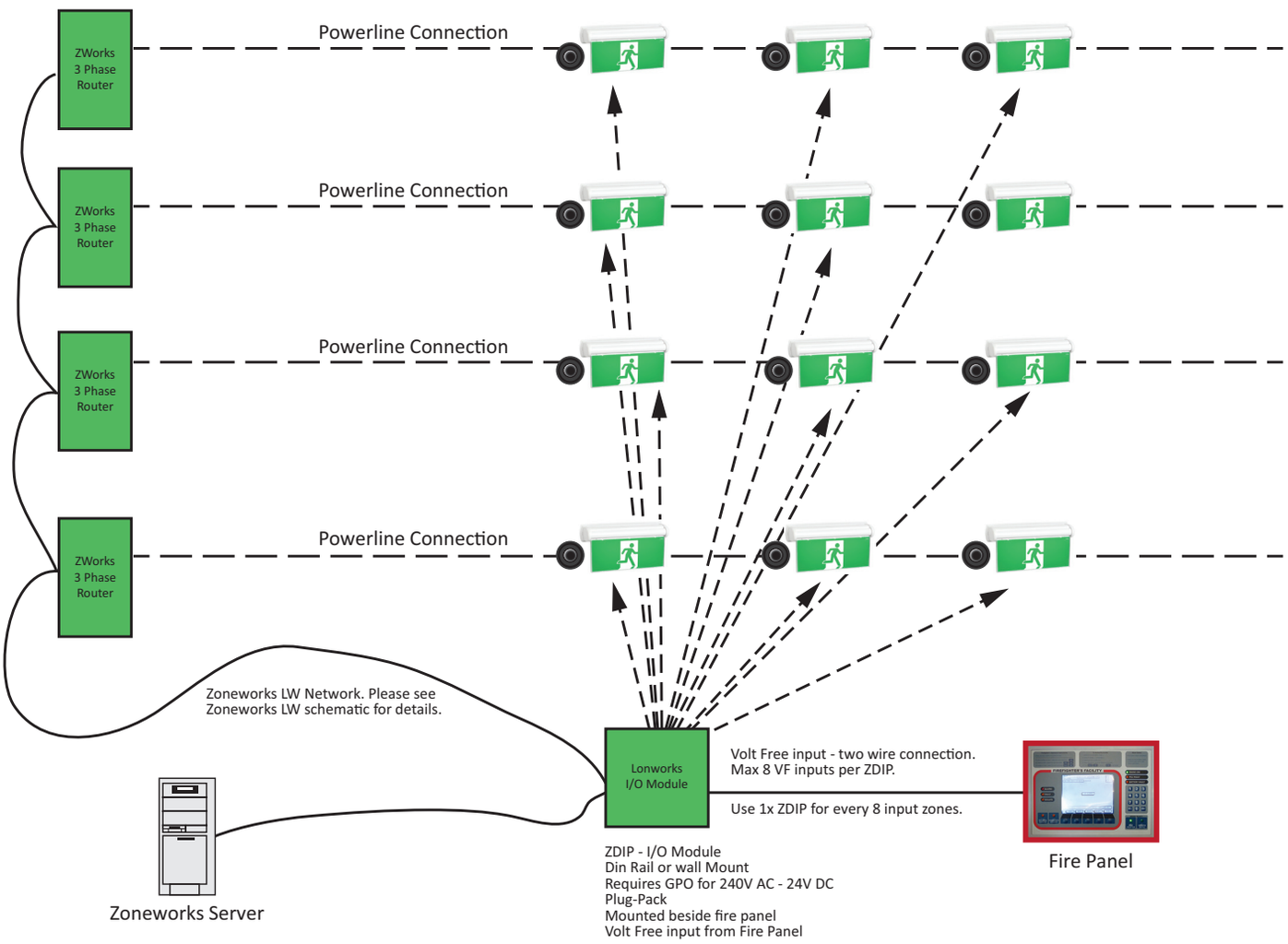


Figure 3 shows the most typical application where the Zoneworks® Emergency Luminaires and DSE Exit Luminaires are connected as part of a network via the powerline, routers and data cable back to the Zoneworks® LW Server.

Figure 3 also shows a Fire panel interface to a Lonworks Digital I/O module via contact inputs. In this scenario if the contacts are open the I/O module would send a network variable update to all the devices it is bound to. In the case above the I/O module is bound to all devices but this could be “zoned” based upon multiple inputs to the I/O module. There is a limit of 15 inputs and zone outputs per I/O module but there is no limit to the number of I/O modules allowed in the system. The user will be able to bind selected DSE Exit Luminaires to the output NV associated with a particular contact input on the Lonworks I/O module.

FIGURE 4

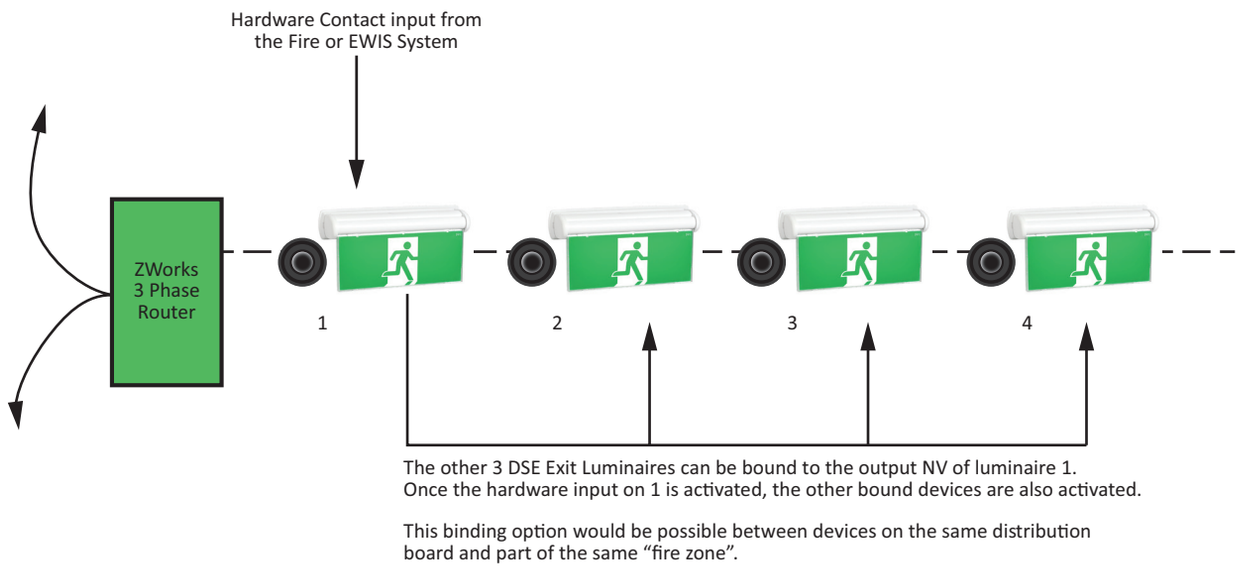


Figure 4 shows how a one device can be bound to another or many devices. This may be required in certain circumstances and can be used in combination with the setup in figure 3 i.e. devices can be bound to the Lonworks I/O module and bound to another device. Device 1 above may be bound to the I/O module, physically connected to the fire system via contact inputs and then bound to other devices.

POSITIONING OF THE SOUND ESCAPE™ DSE EXIT LUMINAIRES

The Sound Escape™ EXIT sign can be configured to output the Broadband pulse at different rates and different volumes depending on the position of the Luminaire relative to the final exit door of an evacuation path.

As an example the system could be configured for the following purposes:

- EXIT or "Perimeter Marking"
- EXIT and Evacuation path marking

Perimeter marking is a simple method for identifying just the EXIT doors within a building or large space. The rate of the Broadband Pulse would typically be configured at its fastest combined with a Voice Annunciation of "EXIT Here" between three broadband pulse bursts at the loudest volume level.

Exit and Evacuation Path marking is achieved by configuring each Sound Escape™ EXIT sign according to its position in the evacuation path to the final exit door. As a building occupant moves along the evacuation path, the broadband pulse rate become faster and annunciation is used to indicate critical changes in direction. The number of possible scenarios is extensive and this highlights the significance of the configuration options available for each Sound Escape™ Exit sign. A DSE module pulsing at a slow rate could indicate the beginning of an evacuation path and upon reaching this point the occupant would hear the next sign pulsing at a faster rate and perhaps the final sign may be configured with a Voice Annunciation of "EXIT Here" between three broadband pulse bursts at the loudest volume level.

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SYSTEM COMMISSIONING

The Clevertronics support team can assist with design, configuration, commissioning and maintenance of the Zoneworks® Sound Escape™ System. The Zoneworks® LW framework provides all the necessary configuration tools for the Emergency and Sound Escape™ luminaires allowing for a flexible, scalable design and efficient, configurable commissioning process.

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VISIT THE SOUND ESCAPE™ WEBSITE FOR:

- Data sheets
- Videos and Demonstrations
- Case Studies
- Empirical Summary
- System Overview and Installation

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Emergency lighting innovation