ADDRESSABLE LOUDSPEAKERS

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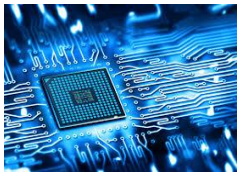

Thank you for your interest in Ziztel - we are a UK based manufacturer of PAGA / MBS and Intercom products. Our systems are mainly designed for use in the Military, Marine, Hazardous Oil, Gas and Petrochemical industries.

The benefits of installing a package which can automatically monitor each loudspeaker voice coil and provide an alert to inform the operator of trouble are as follows:- Major enhancement to safety; enormous reduction in man hours spent executing maintenance patrols. Unfortunately legacy addressable loudspeaker interrogation systems have deservedly gained a poor reputation for reliability. The Ziztel ZADS package eliminates completely the inherent defects of competing systems by combining time proven reliable communication concepts with modern information technology.

BACKGROUND

Intelligent Addressable Loudspeakers are not a new concept and various companies have been supplying systems over the last 20 years.

Traditionally in the Oil & Gas industry PAGA loudspeaker circuits are monitored on either a) current 'load line' monitoring configuration [impedance monitoring] or b) voltage monitored 'loop' basis [end of line monitoring] or combination of both. An out of band inaudible test signal is dispatched from the host PAGA rack to the field loudspeaker circuits which is used as part of a supervisory system to check critical path availability. Neither the voltage or current monitored schemes check the entire critical path *including* loudspeaker voice coils and it has been accepted practice that it is impractical to supervise, for example, individual loudspeaker devices. The monitoring sub system is usually limited to verification of the loudspeaker cabling up to individual loudspeaker devices with some schemes incorporating percentage load current change. To verify the operation of individual loudspeakers a routine manned patrol is initiated at planned service intervals in conjunction with test broadcasts. This only provides assurance of loudspeaker functionality at the time of the patrol and consequently the loudspeaker device-s may become non operative between the service visits leaving an area-s of the site without effective PAGA coverage for potentially long periods of time.

An automated supervisory routine is therefore highly desirable 1) to provide an early warning of field device failure 2) to eliminate the costs of manned surveillance visits. There have been a number of attempts over the years to automatically monitor up to and including individual loudspeaker voice coils thereby providing the operator with ultimate PAGA operational assurance and eliminating the routine service patrols. The intent of these 'addressable loudspeaker' interrogation packages was therefore to enable individual loudspeakers to be regularly supervised by an automated system with a report given to the operator in event of individual loudspeaker failure. Unfortunately none of the solutions presently on the market operate reliably.

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Reasons for this are due to:-

a] choice of 'test' frequency used to check the loudspeaker voice coil integrity.

b] choice of data communications frequency used to transport status of the loudspeaker back to the central rack position.

The impact on the overall system operation are spurious ghost loudspeaker fault reports and inability to check the speaker voice coils reliably.

Loudspeaker voice coil test frequency

To provide the ultimate verification of loudspeaker voice coil performance the unit should be checked at the *same* frequencies that the speaker will be called on to deliver in an emergency. This means that the test signal must be 'in band'.

Addressable systems delivered by other suppliers depend on *out of band tones;* example 20KHz. Whilst this frequency is inaudible during the test interval it has a serious drawback in that the current flow in the speaker circuit voice coil is dwarfed by the leakage inductance in the interposing loudspeaker line transformer, making determination of a voice coil failure (open or short) almost impossible to reliably discern. The situation worsens with lower power loudspeaker wattages where the voice coil current flow is even smaller compared to the effect of the interposing transformer characteristics at the test frequency.

In the Ziztel ZADS system we use 1 KHz as our reference test tone frequency which generated by the central equipment and is delivered to the loudspeaker networks during voice coil checking, the test tone is broadcast by the loudspeaker for less than 250 milli seconds and hence is not unduly obtrusive.

The 1 KHz test tone signal is passed virtually un-attenuated by the interposing line transformer enabling a comprehensive check of the associated voice coil at the centre of the very frequency band that the speaker will be used to broadcast PAGA.

By using an in band test tone frequency the addressable speaker monitoring is able to return a highly reliable confirmation of individual voice coil security.

Data communications

Having used an 'in band test' signal to derive accurate loudspeaker voice coil status readings the requirement is to now reliably transport the results back to the central host equipment and so to the operator position. The data could be carried back to the central rack by a dedicated cable pair or can be superimposed on the loudspeaker cable circuit.

Providing a dedicated data pair is cost prohibitive as this would mean running two separate cable networks – loudspeaker drive and data cables. A practical solution is to utilize the loudspeaker cable to support data communications.

In other systems this is established by, for example, an FSK frequency shift key carrier or other high frequency transportation scheme. Unfortunately the reliability of this arrangement is compromised by the varying cable network conditions found on a typical 70 / 100 Volt line distribution system. The characteristics of a typical loudspeaker circuit cable are not suitable for transportation of a high frequency carrier – the primary loudspeaker

cable requirements are a) to safely distribute 70 or 100V RMS power amplifier audio drive site wide to all respective loudspeakers b) deliver the power to the loudspeaker with minimal volt drop. These characteristics dictate a power cable that is not ideal for data communications.

i) Cable lengths vary according to site / zone / speaker circuit layout and affect the reliability of the communications link leading to some circuits operating consistently and others delivering false reports.
ii) Loudspeaker connection topology varies – radial wired, loop wired, star wired, tree and branch wired; each having an effect on the performance quality of the data transmission sub system.

Ziztel have moved addressable loudspeaker technology forward in a major way by eliminating the deficiencies present in hitherto available systems by applying extensively proven communication techniques which are unaffected by field cable and loudspeaker parameters.

A highly developed signalling algorithm ensures that that data communications is completely reliable on the power type cables used for speaker connectivity and is totally immune to different wiring topologies / cable lengths. High frequency carrier dependency is eliminated from the design and with this the false status reporting when data communications fail due to cable topology / network characteristics.

Simply put – *'if the speaker is able to broadcast PAGA then it can inherently support reliable two way data communications required to / from each loudspeaker to (a) retrieve status (b) allow remote speaker volume tapping adjustment*.

Test signal

Other system manufacturers continue to deliver systems today that depend on *out of band* tones to check the loudspeaker voice coil and associated critical paths. Use of other than voice frequency test tones cannot provide the operator with the ultimate assurance that the speaker will perform when called to deliver PAGA service. Use of subsonic frequencies risk line transformer saturation and false reporting, use of supersonic frequencies are swamped by the leakage inductance in the line transformer and again false reporting.

The Ziztel solution employs checking at 1 KHz i.e. the mid frequency of speech and alarm tones to be broadcast in an emergency.

Why are these inherent weaknesses in existing systems not immediately apparent?

1) Data communications failure to work reliably.

In the case of data communications, the defect is only observed after on site installation of the system, the equipment will have passed witness testing in the factory as the fault is only exhibited once actual 'real' field cable networks are incorporated in to the system. The failure of the system to perform properly may take years from the witness FAT to surface as a real problem on site. The system symptoms are seemingly random fault reports, the irritating factor is that the fault report is not consistent and will possibly seem to correct itself only to be followed by another identical fault report several days later. The issue is caused largely by cable reflections causing 'nulls' and 'peaks' in communication signal amplitude at various points along the cable network. In a fringe location where there is proximity to a null the loudspeaker may sometimes communicate perfectly reliably and then on other occasions fail to communicate at all. There is no 'fix' for this issue other than to turn off the fault reporting from those loudspeakers which suffer from communication errors.

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2) Voice coil status monitoring failure to work properly

In the case of voice coil failure to supervise properly; it is not immediately apparent at witness FAT due to two factors: - 1) The line transformer on most explosion proof loudspeakers is embedded in potting compound preventing access to the voice coil wires (which terminate directly to the secondary of the integral line transformer) and so there is no way of demonstrating a voice coil failure. The vendor will demonstrate the operation of the speaker supervision by removing in an incoming wire from the 70 / 100 volt line termination. This of course removes the line transformer too which is the reason why this demonstration always shows the system working. Had the voice coil been accessible and the wire detached on the secondary side of the line transformer then the unreliability of the arrangement would have been immediately apparent. 2) In the factory the test measurement can be set to very tight limits – sufficient to be able to resolve an open / short voice coil and also to allow compensation for the effects of line transformer leakage inductance. This strategy is practical under factory staging conditions but is not a long term viable proposition as there is the impact of site environmental conditions i.e. the effect of temperature, air pressure and moisture which can all impact on the measurement resolution. By setting the measuring subsystem to sufficiently high gain to resolve the test signal swamped by the line transformer characteristics will inevitably lead to future false reporting.

The net result is that the operator receives random spurious reports and eventually the credibility of the system is lost. In practice the resolution is set to a level that does not produce spurious fault reports and accepts the fact that at this level voice coil failure detection is also marginalised.

ZIZTEL ZADS A MAJOR ENHANCEMENT TO PAGA SYSTEM SAFETY

The Ziztel ZADS system operates on the established speaker cable pair, no additional conductors or specialist cables are required. The ZADS system is non-invasive and does not degrade the PAGA critical path. Testing is automatically prescribed at intervals declared by the engineer and is executed ‘in band’ to ensure that the loudspeaker sub system networks, including all voice coils, are reliably checked.

The scheme enables use of a wide range of loudspeaker types and allows the end user to select alternative loudspeaker types ensuring future availability and maintenance of the PAGA system.

The ZADS can be applied site wide to all loudspeakers or it is possible to mix with non ZADS enabled speaker devices ensuring full supervision in mission critical locations.

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ZADSC Control PCB to be mounted in central equipment rack, this provides simple interface to the existing loudspeaker cables.

Field mounted receiver shown below in hazardous area explosion proof Zone 1 IIC IP66 execution (ZLSM)

SIMPLE TO USE ZMIS CORE TOUCHSCREEN INTERFACE

The ZMIS core is installed in the host central equipment and monitors and displays events plus status of the Ziztel PAGA system. The same touchscreen is also used to provide engineer interface to the ZADS sub system.

Up to eight loudspeaker circuits can be displayed on a single screen page, with each circuit being able to support up to fifty ZLSM outstations. Colour coded display enables simple configuration and ‘at a glance’ status capture.

The modular nature of the ZADS system allows interrogation of a virtually limitless number of loudspeaker ZLSM outstations with expansion capability to tens of thousands of devices.

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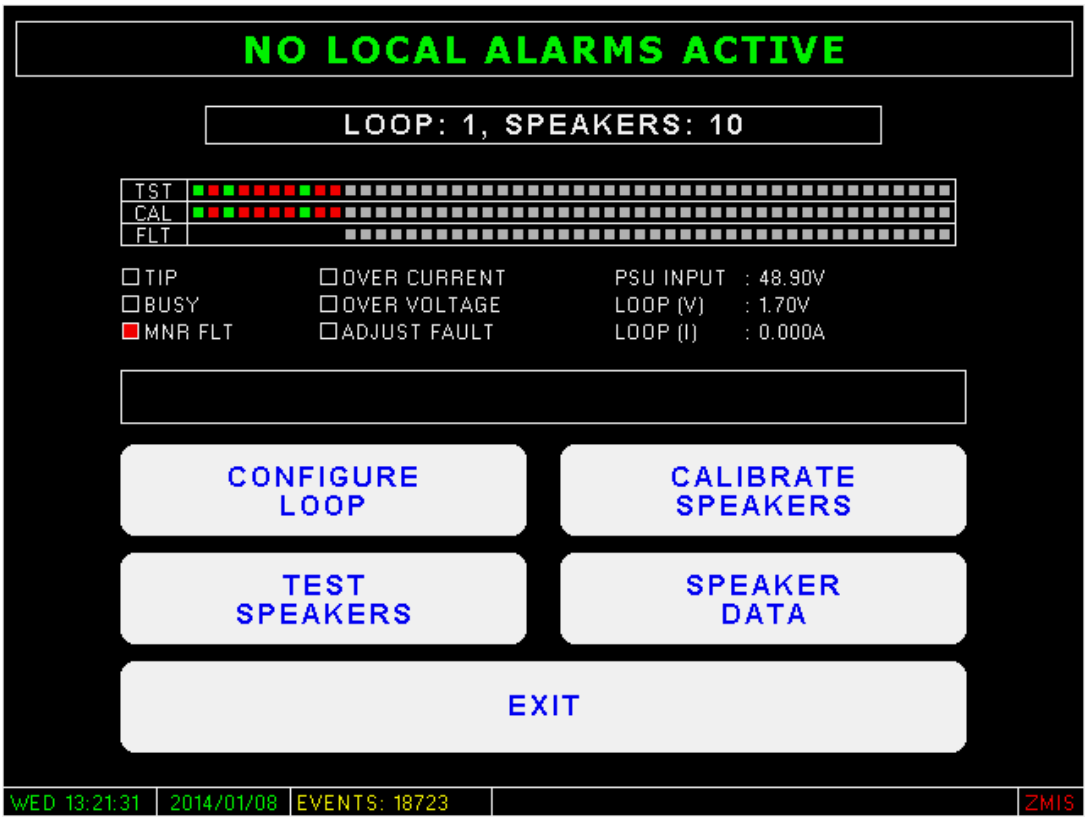
Comprehensive interface for the configuration, testing and status reporting of individual loudspeaker devices.



Calibration and self-checking screen.

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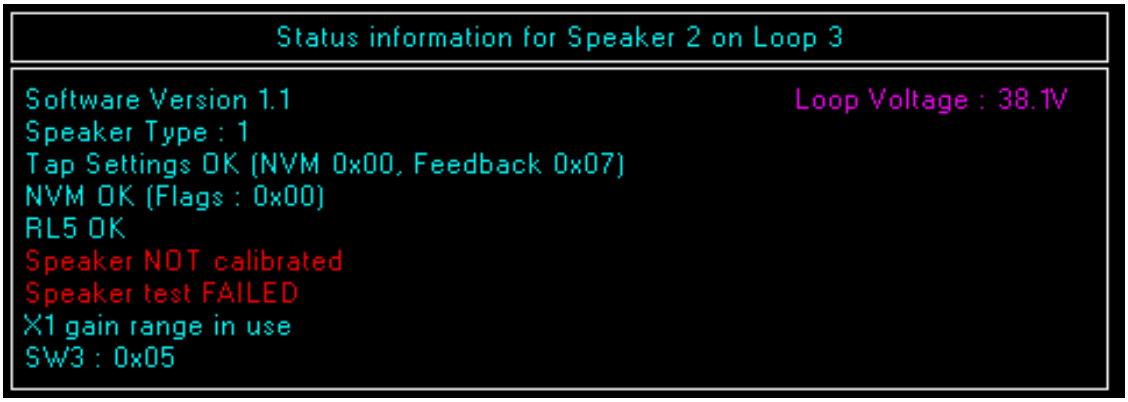


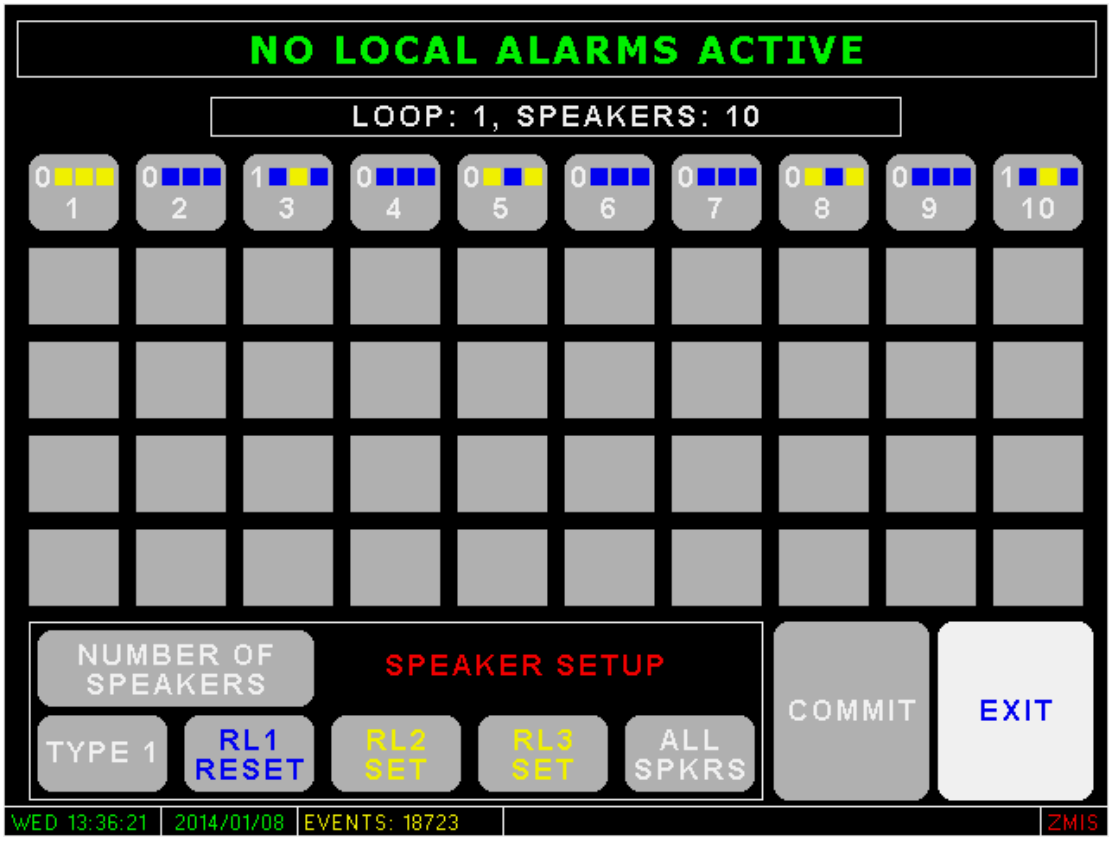
Event recording with time and date stamp enables post incident forensic investigation.

REMOTE SPEAKER TAPPING

The ZADS system allows the engineer to remotely set the sound pressure level tappings for individual loudspeakers from the central host ZMIS core touchscreen display.

Changes to a selected loudspeaker tap is executed in minutes without the need for a costly visit to the speaker location or powering down the system. At a recent demonstration, one customer stated it could take up to 5 days to change a loudspeaker tapping due to health and safety requirements, the associated paperwork and the need to power down the system while carrying out the changes.

Fast and flexible loudspeaker sound pressure level configuration.



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.A to B – B to A Handshake Test

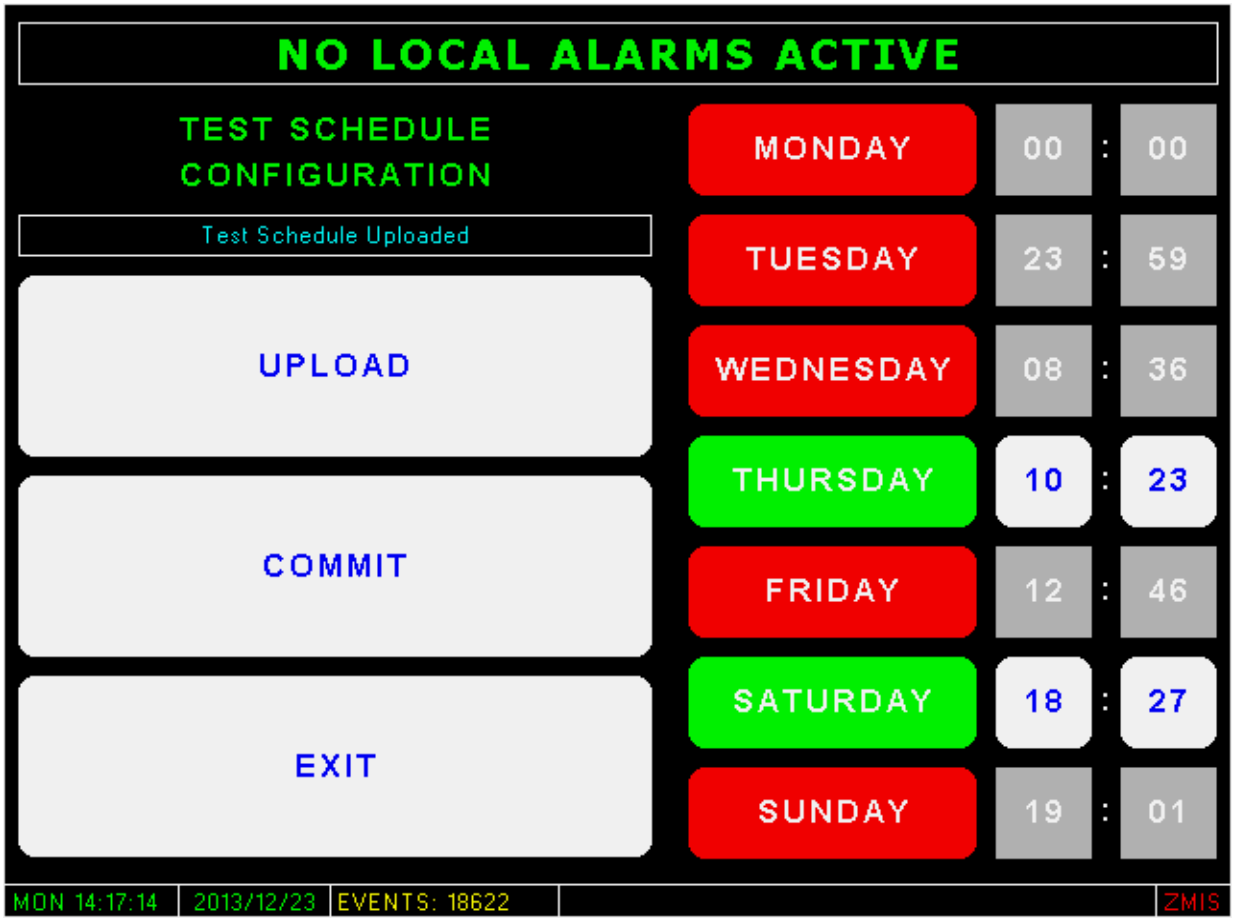
The *ultimate* security check of a high integrity life safety redundant A + B dual PAGA system.

This unique feature brings major safety and security benefits by providing the operator with assurance of not only the electrical critical paths within the PAGA package but also the acoustical effectiveness of the loudspeaker sub system.

An audible tone is issued by the A system loudspeakers at prescribed intervals, the signal is delivered for a short period of less than one second. The broadcast tone is acoustically monitored by the B loudspeakers, which if correctly assigned, will deliver a healthy status to the host equipment ZMIS core.

After completion of interrogation of the A loudspeakers the system reverses the action and now the B loudspeakers deliver the test signal whilst A loudspeakers revert to 'listen'. The result is an inter locking check of A / B loudspeaker performance which is also capable of revealing unauthorized muting of speakers [for example by foreign objects covering loudspeaker fascia's]

This useful feature significantly reduces commissioning of PAGA field equipment and whilst assuring that fully redundant A+B acoustic coverage has been achieved.



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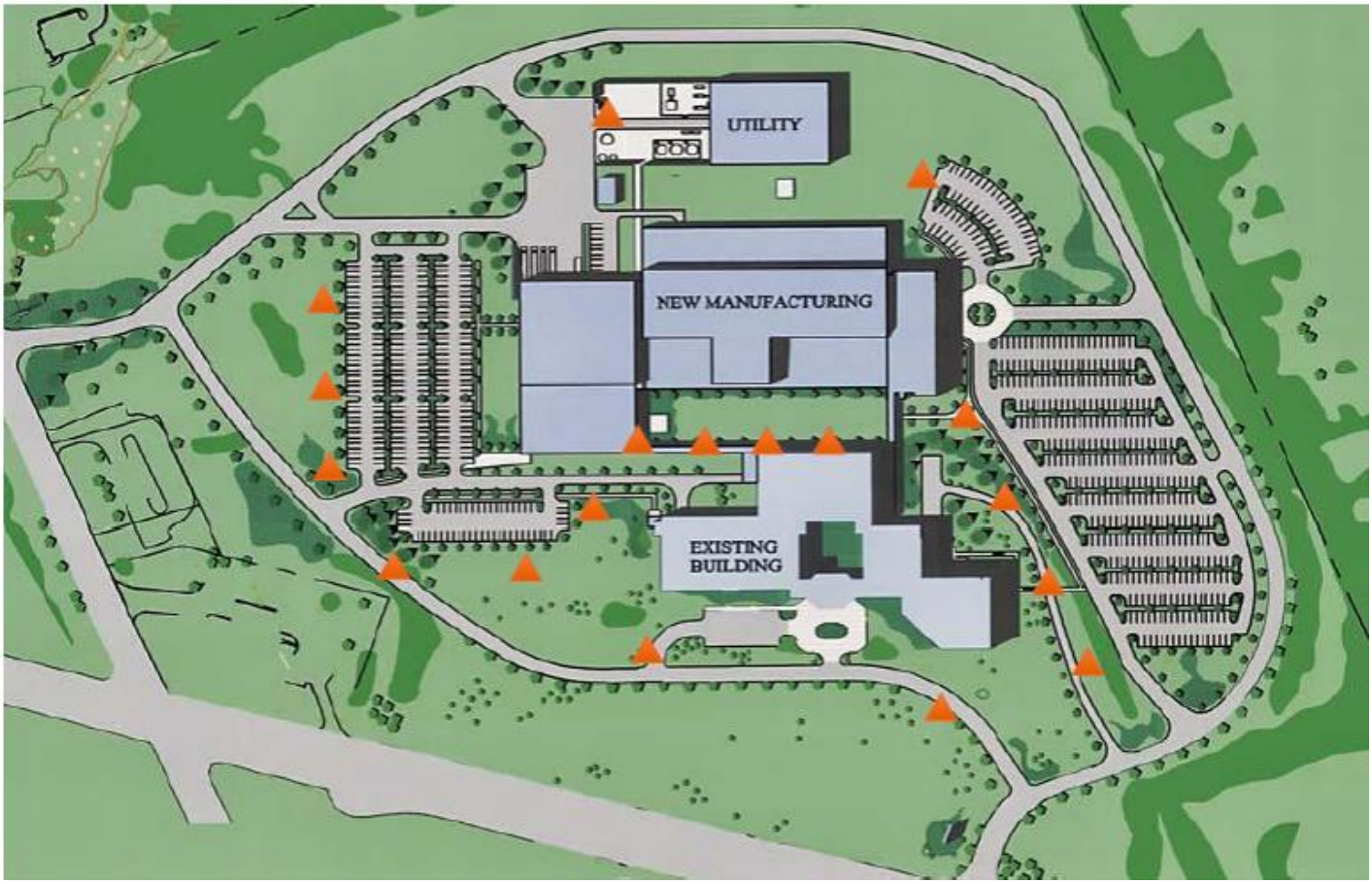
MAPPING OF THE SPEAKERS ON THE SITE

The ZADS software can incorporate a plot plan of the site onto which actual physical loudspeaker locations can be dragged and dropped.

This enables extremely rapid suspect loudspeaker location thereby speeding service and ensuring that PAGA broadcast audibility is maintained in all areas of the site.



RETROFIT TO AN EXISTING SITE

The ZADS system can be retrofitted to an existing operational PAGA system. To do this you will not need to change the main backbone cable infrastructure as the Ziztel system operates over the existing single pair loudspeaker cable.

The ZADS is non-invasive and packages can be engineered by Ziztel Projects department to guarantee seamless integration into a wide range of alternate vendor amplification.

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ADVANTAGES OF THE ZIZTEL SYSTEM

In addition to all the above points the Ziztel system also has the following unique advantages over other systems:

- Cannot compromise safe operation of the PAGA system
- Provides early warning of individual loudspeaker voice coil, loudspeaker line transformer and field cable deterioration.
- Can be used with almost any type of loudspeaker.
- No additional cabling requirements. Works with standard 2 conductor screened cable.
- In-band audio testing of loudspeaker coil eliminates unreliability associated with out of band test methodologies
- Inaudible audio frequency communications enables reliable operation on long cable runs with loop or radial topologies. Eliminates spurious operation associated with high frequency signalling due to nulls, reflections and other detrimental cabling effects.
- Simple to install and commission
- Unparalleled advanced diagnostics assists the engineer in identifying and rectifying faults minimising down time of the PAGA system
- Acoustic monitoring option for dual A + B systems
- Fully integrated with ZMIS Local and ZMIS Global allowing monitoring of loudspeaker status from the Central Control Room or remotely via the web

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