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KB007 Impedance Monitoring For PAGA System Loudspeaker Network Integrity

1.0 Introduction

Where a Public address and general alarm system (PAGA) is installed for the safety of life of personnel working on the target site, a means shall be incorporated to verify the integrity of the broadcast system critical path. Monitoring is required to provide an early warning of system deterioration to the operators enabling resources to be mobilised to restore the PAGA package to 100% availability/capability.

Checking of loudspeaker circuits is an important element of the overall PAGA supervisory and monitoring should be capable of providing clear unambiguous indication as to the security of the associated critical path.

Specifications often refer to “supervision of the loudspeaker load” as a means of determining the availability of loudspeaker networks. Loudspeaker load checking is commonly called impedance or current monitoring.

Therefore the requirement is the need to regularly check loudspeaker integrity and do this in an inaudible in obtrusive manor. To achieve this latter requirement supervision is executed by test signals which are “out of band” i.e. 20kHz and above or 30Hz and below.

2.0 Current Monitored System

There are many PAGA systems in service today which are fitted with a current monitored system with test signal execution set to 20kHz and above. These systems, whilst operating perfectly reliably in factory/workshop condition, are unable to perform satisfactorily when fitted on a “real” site applications. Very often current monitored systems tolerate gross changes in loudspeaker load conditions before indicating loudspeaker network trouble, even though their apparent resolution maybe plus/minus a few percent. Depending upon the physical location of a potential circuit fault the current monitor may even be incapable of resolving catastrophic short or open circuit cable failures with possible disastrous results.

2.1 Test Frequency Used By Monitoring System

Current monitored systems do not work due to the selection of 20kHz as the test frequency (the situation is improved by reducing the frequency although utilisation of low frequency testing bring a separate set of problems).

At frequencies above about 3kHz of the current monitor performance. Depending on cable layout/architecture certain cable network topologies may have even greater impact to resolution.

2.2 Cable Impedance

At 20kHz cable impedance dominates the loudspeaker load with consequence that large numbers of loudspeakers can be disconnected from the system with proportionally insufficient current change to stimulate fault recognition in the monitoring hardware. The monitor can be made more sensitive to local change but then the equipment is prone to spurious/false alarm reports due to possible drift in the set up. (it has been noted that even changes in climatic conditions are sufficient to trigger an alarm report).

2.3 Predictable Monitoring

Current monitoring starts to become more predictable as frequency is reduced however: this means that now the test signal is audible. This maybe acceptable if the test is performed in-frequently but this compromises the requirement to alert the operator to a critical path fault condition within a reasonable time (usually within minutes).

2.4 Sub-audible Test Frequency

Current monitoring can be executed at sub-audible frequencies where performance is much more reliable and inaudible. Testing would need to be performed below about 30Hz for this to be effective. However this would require loudspeaker and amplifier frequency response to be capable of sustaining checking at low frequencies. In practise PAGA systems utilise industrial loudspeakers including re-entrant horn loaded loudspeaker units. Limitations to checking at low frequencies is the presence of the line transformer which would have to be physically large to prevent core saturation. Such saturation would itself give rise to spurious current monitor performance and resolution. A nasty side effect of sub-audible testing is that loudspeakers would be exposed to potentially damaging low frequency drive. This is especially relevant to horn loudspeakers which have cut off frequencies in the region of 200 – 300hz (determined by the wave length of the horn assembly). Low frequency drive below cut off frequency could permanently damage or significantly reduce reliability with ultimate early failure of the units(s).

3.0 Conclusion

Current monitored systems provide very limited assurance of loudspeaker network availability and are unable to provide confirmation as to overall security of the PAGA critical path. Vodec employ End of Line (EOL) voltage monitoring configurations which provide absolute assurance of PAGA critical path. EOL can be executed at high frequency (inaudible) and at regular intervals to provide an early warning of any condition that could inhibit the distribution of loudspeaker drive signals.

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