

Evacuation System Integrity and High Powered Devices

The Challenge of Maintaining System Reliability and Performance

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Detection System Safety & Integrity

When designing fire alarm and evacuation systems, compromises and variations to installation standards are often made; not to the detriment of safety but to enhance the suitability and functionality of the system. This might involve a slight adjustment to the position of a fire detector from the 'ideal' location, perhaps to avoid a structural beam or air conditioning unit. However, more fundamental compromises might be required on the use of detection medium. In situations where false alarms are a constant issue for example, a fine balance has to be struck between reducing nuisance alarms and ensuring that the system will actually detect a fire when required.

Once the system design is complete and the equipment is handed over to the building manager he can be sure that, thanks to modern technology, the system has full integrity and functionality in case of any physical damage (short or open-circuit) to the wiring circuit.

BS 5839-1:2002 – Fire Detection and Fire Alarm Systems for Buildings states that:

“A single short circuit or open-circuit fault on an automatic fire detector circuit should neither disable protection within an area of more than 2000 m², nor on more than one floor of the building plus a maximum of five devices (automatic detection, manual call points, sounders or a combination of these) on the floor immediately above and five devices on the floor immediately below that floor.”

Conformity to this important aspect of BS 5839-1 is ensured by either limiting the area covered by a circuit, as with conventional systems, or by strategically installing short circuit isolators along the detection loop for analogue-addressable systems. Isolators may be dedicated devices sited only where needed or may be integral to the addressable devices. Isolators ensure that any short circuit limits the loss of functionality up to the next isolator on the line.

Sounder Circuit Integrity

Ensuring that sounders continue to operate after damage to the circuit can be achieved in the same way as for loop detectors – by wiring in a loop with separate or integrated isolators. Sounders are often added to detection loops as addressable devices where they benefit from the increased protection afforded by loop wiring and isolators. Use of loop powered sounders is frequently where compromises in the fire system design are most telling. Loop powered sounders typically do not offer the same levels of sound output as conventional sounders, nor can they emit true low frequency tones. As a result, designers will often use a high number of lower power loop sounders to ensure that sound output is at least at the level required for conformity to BS 5839-1 (normally 65 dBA or at least 5 dBA above the ambient noise level if above 70 dBA).

Whilst there is little argument that in areas with low ambient noise levels (for example quiet offices, reception areas and meeting rooms) loop powered sounders are a suitable solution to evacuation, there is a limitation to their suitability in other areas. The problem comes when attempting to ensure appropriate sounder coverage in areas with higher ambient noise levels or, as is the case in modern multi-functional buildings, large open areas and high atria. In these instances, the use of low-current loop powered sounders is unquestionably a compromise. Unless every detector point houses a sounder, sounder SPL (sound pressure level) will struggle to reach acceptable levels.

A typical loop powered sounder has an output of around 80 - 90 dBA at 1 metre. This may seem a lot, but with sound dropping off at 6 dBA for each doubling of distance from the device, at only 4 metres the SPL of an average 85 dBA sounder is 73 dBA and at 8 metres it is only 67 dBA – not a lot of safety margin!

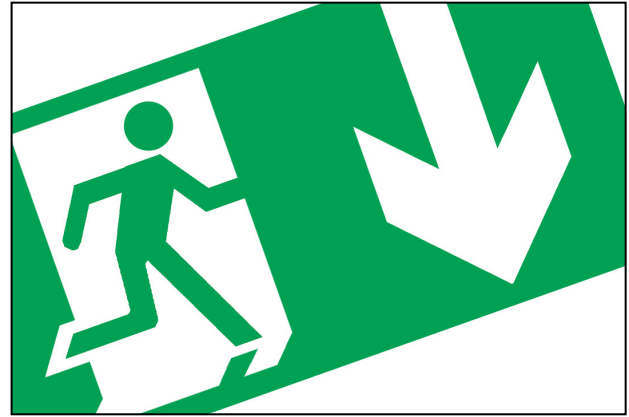


Table 1 - Examples of Ambient Sound Levels (BS 5839-1: 2002)

Building Type	Area	Sound Level (dBA)
Offices	Cellular	40-50
	Open Plan	50-70
	Noisy	70-85
Museums / Galleries	Quiet	48-60
	Noisy	50-60
Factories	Control Rooms	70-75
	Light Assemblies	80-85
Hotel Bedrooms	TV off	28-35
	TV on	60-70

Table 1 shows an extract from BS 5839-1:2002 which emphasises the variation in ambient SPL in different building types. It is questionable whether at low current, low powered loop sounders can cope with larger areas and higher ambient noise levels due to their lower sound output.

Conventional Sounders for Contemporary Problems

We argue then that, in many cases, low powered loop sounders can struggle to reach appropriate sound levels and frequency outputs which are required in areas with higher ambient sound levels. The problem is exacerbated by the growth in modern open plan offices and in the construction of buildings with open atria.

The solution to these design challenges is most commonly answered by utilising conventional sounders; sounders that do not sit on the analogue loop but are installed on a radial sounder circuit either emanating directly from the control panel or via interfaces to the loop. These radial sounder circuits ensure that proper sound coverage can be achieved by using the circuits to power conventional electronic sounders or bells. Radial sounder circuits typically have 1-2 amps of power. With conventional sounders drawing 20-25 mA against a loop powered sounder's 3-6 mA power draw, it is necessary to use radial circuits for higher powered units.

Conventional sounders typically have a higher sounder output of around 95 -105 dBA and due to their sound generating technology - use of transducers rather than piezo discs - they generate true lower frequencies, which means that the sound they generate actually penetrates doors, walls and partitions more effectively than higher frequencies. This is an important consideration where a building is multi-purpose and might have partitions that can be moved dependent on the room use.

More Compromises

On installation of a radial sounder circuit, the system integrity is immediately compromised as there is no way of isolating conventional sounders on a radial circuit. BS 5839-1:2002 attempts to moderate this compromise by recommending that the installer should:

“wire all fire alarm sounders within the building on a single sounder circuit, with the additional provision of a second, independent sounder circuit, to which only a single sounder, located in the vicinity of the control and indicating equipment, is connected.”

If an area is designed to accommodate more than 500 members of the general public or if the floor area is greater than 4000 m², for example shopping centres, museums, places of entertainment, then it is recommended that two interleaved sounder circuits be installed. In practice, a diligent designer would interleave sounder circuits in all but the smallest evacuation zone. Not to do would leave the radial circuits at massive risk of almost total loss of sounders. A short or open-circuit at the beginning of a conventional radial sounder circuit means the potential loss of nearly the entire evacuation system – a major compromise and a serious lack of integrity.

Building High-Integrity Sounder Circuits Using a Single Loop

Innovative new Loop Sounder Systems appearing on the market allow a fire alarm sounder circuit to be built using a single loop, whilst providing enhanced circuit integrity and reliability and realising potential cable savings. By wiring the sounder circuit in a single loop instead of a traditional dual radial, all sounders will remain operational in the event of a single short-circuit or open-circuit fault.

Such systems consist of a Loop Controller Module and conventional sounders and sounder/beacons, which are fitted with bi-directional short-circuit isolators in their base. A module is installed between the standard sounder circuit and the sounder loop, being designed for DIN rail mounting within a wall-mounted enclosure. Such sounder loops can accommodate up to 45 sounders and multiple modules can be installed dependant on the size of system. All component parts should be approved by LPCB to relevant parts of EN 54 and such systems should be fully compliant with BS 5839-1 using a single sounder loop.



Vimpex's new Loop Sounder System components

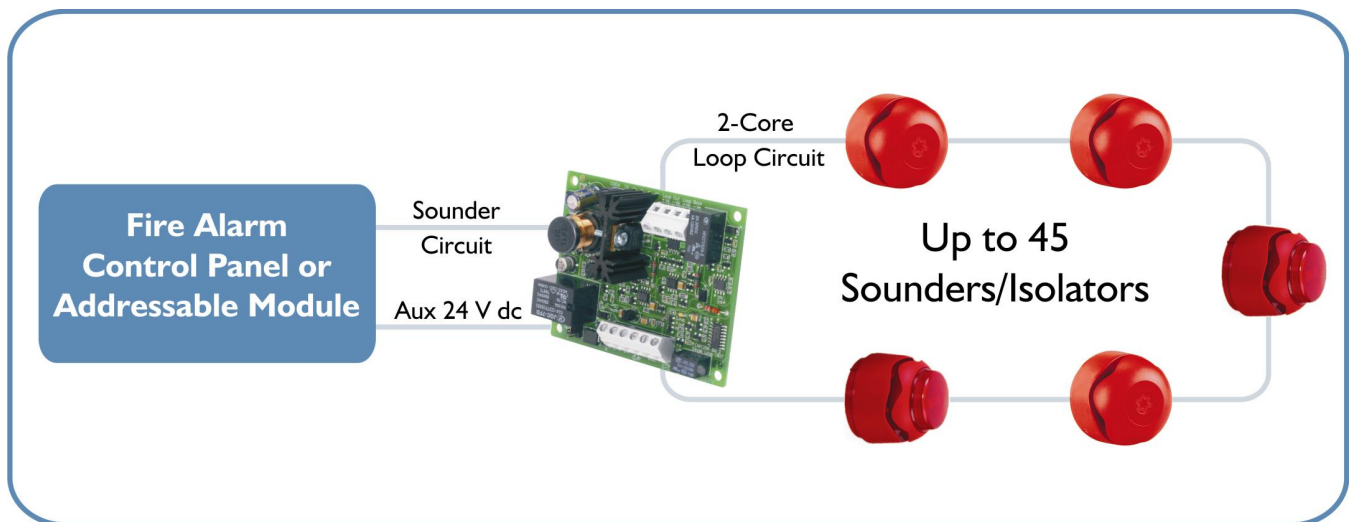


Diagram 1 – Vimpex's Loop Sounder System

In the event of a short-circuit, sounder isolators activate and disconnect the faulty section of cable and report (in monitoring mode) the fault to the control panel. When sounders are activated, the loop is driven by an auxiliary power supply from both ends ensuring that all sounders will remain operational even in the event of a single short-circuit or open-circuit fault. Circuitry in the Loop Controller Modules ensures a fixed voltage output even with mains failure thereby guaranteeing full SPL output from all devices on the loop.

Sounders and their isolator bases are installed just like any other conventional sounders on a twin core circuit. With Loop Sounder Systems loss of even a single sounder on a circuit is very unlikely thereby producing a system with the integrity of an analogue loop and the performance of conventional sounders.

Visual Alarms

The future will see the use of higher powered strobes in most fire alarm installations. The upcoming ratification of EN 54-23 - a product standard for strobe lights and beacons - will mean the eventual update of BS5839-1 to incorporate high-output visual alarm devices. Whilst it will be possible to use low powered beacons and strobes on analogue addressable loops, these would have to be low output units - thereby requiring designers to make the same compromises as they do now with sounders. As evacuation systems based on loop technology develop, they will offer higher power loops with the ability to power strobes, sounders and other higher output devices.

Summary

Installation of Loop Sounder Systems can provide savings in cable when used instead of interleaved radial circuits. Loop Sounder Systems offer the same level of integrity to sounder circuits as do analogue loops for detectors, but with the advantage of more power available to drive higher output sounders and strobes. Use of such systems can avoid the forced compromises that modern buildings require in the use of radial sounder circuits.

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