Canadian Fire Alarm Association –The Journal May 2006

FAULT ISOLATION MODULES

By D. Goodyear

Fault isolation modules are the newest components of fire alarm systems and confusion often surrounds their use. Isolators are devices that improve fire alarm system survivability. These devices allow a wiring fault to happen but allow the remainder of the fire alarm system to still function. There are three applications where circuit isolation is utilized:

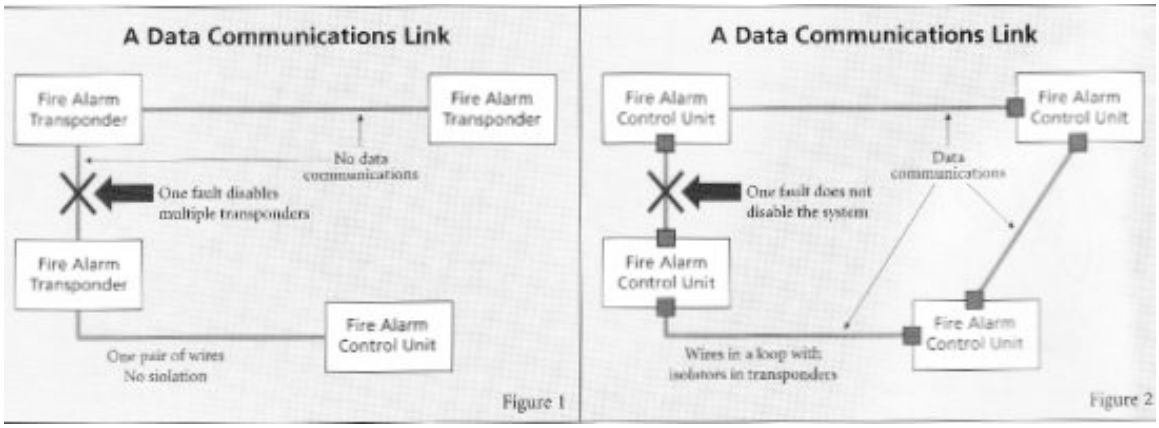
- Fault isolation for alarm signal circuits used with in-suite audible devices,
- Fault isolation capability usually built in to control panels or transponders that protect the data network, Data Communications Links (DCLs), between transponders and
- Fault isolation modules that connect on the DCLs that have addressable devices.

This article focuses on the last two applications.

Fault isolators in these applications protect DCLs. They are not fuses but rather electronic circuits that monitor the data lines. They cannot prevent faults, but when they occur, particularly with short circuit faults, they operate to disconnect the damaged link.

NETWORK DATA COMMUNICATIONS LINKS

Distributed fire alarm systems have more than one interconnected control panel or transponder. The transponders communicate with each other over the DCLs, transmitting device status, display information and command instructions. This network connection is the backbone of the fire alarm system. A failure of the DCL could be disastrous. In order to provide reliability for the networked system, the network must be connected such that each transponder has an alternate path in a loop configuration, somewhat similar to a Class A circuit, or redundant path configuration. (Figure 1) The fault isolator function in the transponder acts as the gatekeeper. When a fault occurs on a segment of the DCL network, the isolator disconnects the faulted segment and data is rerouted or continues to be transmitted along the alternate communications path. (Figure 2) Improved survivability to protect the DCL network during a fire condition is usually accomplished by routing the DCL through fire-protected spaces or providing fire protection by either mineral insulated or circuit integrity cable.



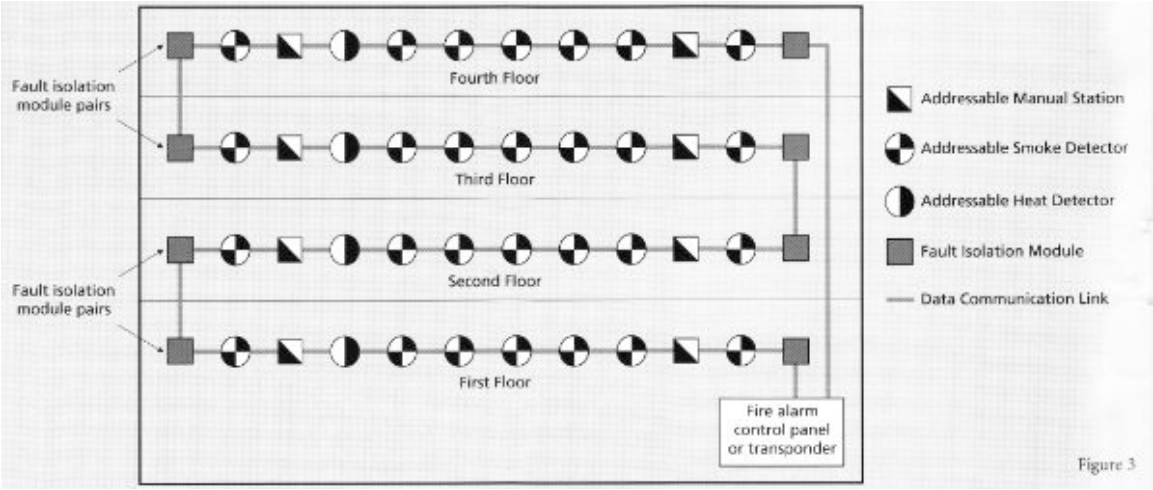
Designing and installing for fire alarm system survivability is not only good design practice but is also partially addressed by the Standard for the Installation of Fire Alarm Systems CAN/ULC S 524. Requirements for DCLs are contained in clauses 4.2.4 D, E and references Part III of Table 3 and DCLR in Table 1. These references require data communications between transponders to remain capable of receiving alarms when a short circuit occurs on a DCL. A short circuit can potentially kill all data communication on the network. Short circuit conditions could be a wiring fault or occur during a fire condition. Fire systems beyond a specific size have not only the requirements of DCL isolation but also additional requirements such as stand-alone operation described under Large Scale Networks. The next edition of ULC S 524 (not yet published) will clarify these DCL requirements and require the primary and alternate DCL paths to be separated: the primary and alternate wiring circuit are to be installed in separate raceways or cable assemblies and be separated by at least 300 mm where installed vertically and 1200 mm where installed horizontally

ADDRESSABLE FIRE ALARM DEVICE CIRCUITS

Addressable devices, as they are commonly referred to, are described in the ULC standards as active or supporting field devices. Addressable devices provide several advantages over conventional fire alarm systems; one advantage being a reduction in the quantity of system wiring required. Addressable technology allows a configuration where all of the detection devices (manual stations, smoke and heat detectors, monitor modules) and output modules controlling audible and visual signaling and ancillary functions could be installed on one circuit: a circuit that could conceivably weave throughout the entire building. The concept of one circuit providing the link to all of the devices in a building conjures up the prospect of a disaster in the making. One fault on the data communications link could be catastrophic. It is not only the usual culprits: open circuits, ground faults and short circuit faults, but also the destructive faults caused by fire that are of concern. Survivability concerns relate to the fire alarm system remaining significantly in tact and operational even when partially attacked by fire. Fault isolation modules are a key element in preventing this disaster scenario. Fault isolation modules are part of the strategy for fire alarm system survivability. In hardwired fire alarm systems, isolators are not required since separate zones are on separate circuits, separate sets of wires, and a fault on one circuit is not permitted to affect any other

circuit. In addressable systems, however, devices from more than one zone are often connected on the same pair of wires.

The requirement for fault isolation modules is referenced in the Standard for the Installation of Fire Alarm Systems CAN/ULC S 524, Clauses 4.2.7 to 4.2.10. Summarized, 4.2.7 of the Standard states the following general performance requirement: when a data loop serves more than one floor area, a fault within one floor area cannot affect normal operation of devices in another floor area. Clause 4.2.8 describes that in Group B Major Occupancy, the loss of information shall be limited to one fire compartment, which contains sleeping rooms. Sentence 4.2.10 states "Fault isolation modules or an equivalent method shall be deployed to achieve compliance with Clauses 4.2.7 and 4.2.8". The ULC Standard describes a fault isolation module as a device used in data communication links for wire-to-wire short circuit protection.



To achieve the performance objective, the modules must be located at the transition point where the DCL leaves one floor area and enters the next fire zone. The DCL loop circuit that extends beyond one floor area must have an alternate connection path. Since wiring for two fire zones are connected to each fault isolation module, exposure of the isolator to fire will cause the failure of the DCL affecting the operation of addressable devices serving two floors. It is therefore apparent that isolators are required in pairs: one fault isolation module on the DCL at a location where the DCL leaves one floor area and one fault isolation module where the DCL enters the next floor. (Figure 3). In the case where the Building Code requires two fire zones by virtue of the size of the zone, but where there is no fire separation, only one fault isolation module is required at the edge of the zone. (Figure 4). Another exception occurs when zones or items that require separate annunciation by the Building Code are within the floor area. These fault isolation modules are considered part of the wiring zone. Examples of this exception would be a sprinkler room where there are multiple water flow detection devices and supervisory switches serving other floors of the building. A similar situation occurs where duct smoke detectors are physically located on one floor but the air-handling ducts serve other floors. (Figure 5).

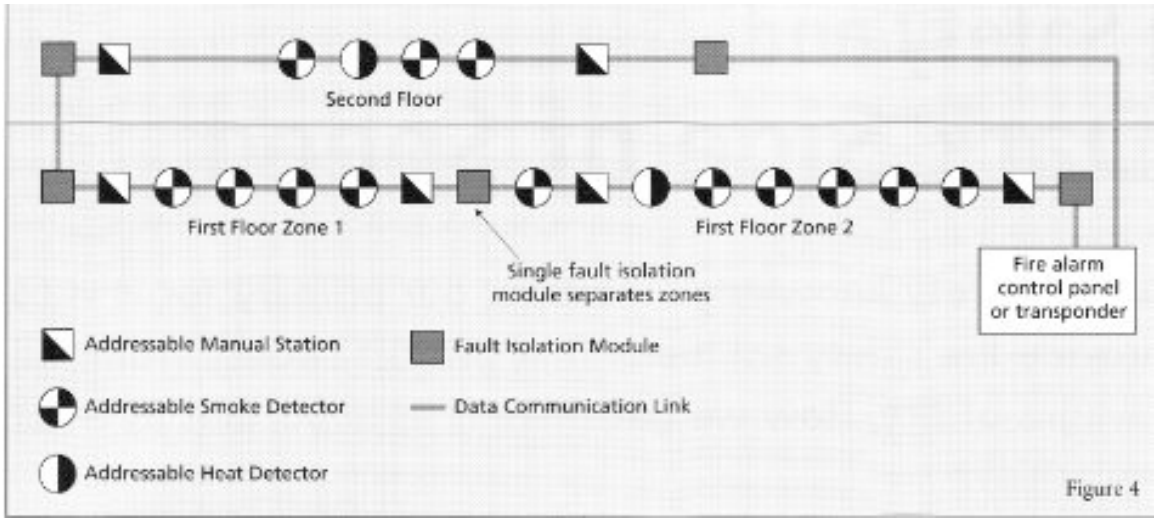


Figure 4

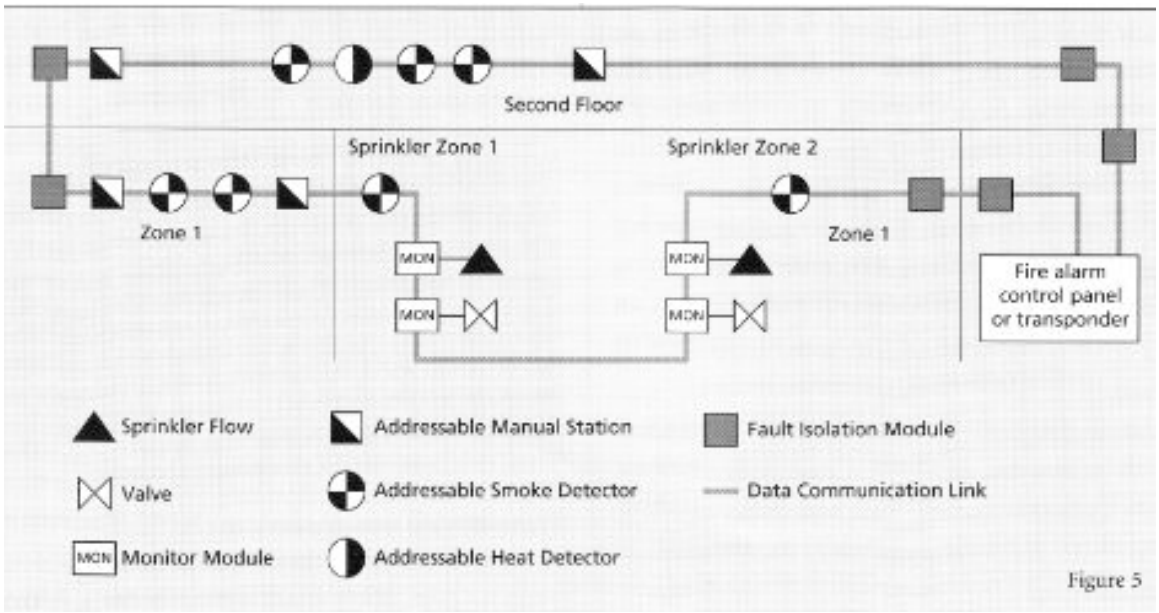


Figure 5

Some manufacturers supply fault isolation module functions built into the base of detectors. When these devices are used on the DCL, it is necessary to satisfy both the requirements for circuit isolation and the criteria for the mounting location for the detector.

The Standard for the Installation of Fire Alarm Systems CAN/ULC S 524 is not the only reference to fault isolation modules. CAN/ULC S537 and CAN/ULC S 536 have new tests to confirm that fault isolation modules work. Tests are to be performed on the DCL at each module to ensure that a trouble condition is received under an open circuit condition on the DCL. A test is also performed on the DCL by short circuiting the wires on the isolated side of each module and confirming the operation of devices from the other side of the module. These testing requirements suggest that the fault isolation modules should be installed where they are visible and accessible.

Fault isolation is a critical function in achieving the system survivability and performance levels established in the ULC standards. Since DCLs are the backbone of new fire alarms systems, understanding the objectives and application of fault isolation modules is essential.

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