Short-circuit Isolation

in Addressable Fire Detection and Alarm Systems

The requirement for isolation

Analogue addressable fire detection systems are usually designed as loops, with the connecting wires starting and finishing at the fire control panel. Detection devices, manual call points and interfaces are connected at intervals along the cables. Depending on the national or local regulations, audible and visual alarm devices are connected either to the same loop as the detection devices or via dedicated loops. Spurs may be connected at any point of the loop, either directly from the loop wires or from an interface, subject to national or local regulation.

Short-circuits do not occur very often, but when they do, the consequences can be serious, possibly making the affected loop entirely inoperative. It is for this reason that isolators have been designed and incorporated into various devices that are connected to the loop. The purpose of these isolating circuits is to protect the loop in the event of a short or partial short-circuit by disconnecting the part of the loop where the short-circuit has occurred. When the short-circuit fault has been rectified, the isolating circuitry automatically reconnects the affected section of the loop.

Features of isolating circuits

Isolators are available in different forms:

- As a stand-alone 'isolator' which is fitted onto special detector style 'isolator bases'
- Incorporated into the detector mounting base, known as 'isolating bases'
- Integrated into Apollo devices such as manual call points, audible and visual alarm devices, interfaces or detection devices (see Table 1)

Isolators are intended for use with Apollo systems using XP95®, Discovery® and CoreProtocol®. Isolators are polarity sensitive and switch the negative line of the loop.

Devices including or fitted to isolators remain operative when an adjacent loop section is in the isolated state. The isolated state is normally indicated by a LED illuminated yellow on the device and through the protocol for CoreProtocol systems.

Equivalent Detector Load

The Equivalent Detector Load (EDL) is a rating value attributed to each device on an XP95/Discovery/CoreProtocol loop, which enables consistent and correct design of the system, when Isolators are used.

Apollo isolating circuits allow the connection of between one and 20 detectors (an EDL of 20) between isolators. The 'equivalent load' for Apollo devices is one for most devices. The 'equivalent load' for devices which are greater than one is given in Table 1. The maximum load for a node is an EDL of 20, this is calculated by adding up the EDL for all devices fitted between two isolators.

Operating principles

Under normal operating conditions the isolator provides a low resistance in either direction. If the loop voltage falls to a pre-set level, the isolator will switch from the closed state to the open state in order to isolate the loop 'in' and 'out' lines.

The isolated section is automatically tested with a test current and is re-connected at a pre-set load resistance value (see Table 2).

Isolator type

There are three types of isolator used in Apollo products:

- The original circuit known as 20D, has been in use since the introduction of XP95
- The 20I circuit was developed in order to reduce the test current which is applied to isolated sections of the loop. It reduces the test current by half.
- The 20C isolator is the latest development which performs much like the 20I isolator but with advanced features that allow additional control of the isolator through Apollo CoreProtocol.

Fire control panel compatibility

Fire control panels that are certificated by Apollo are also compatible with Apollo isolators.

CoreProtocol enabled control panels are able to send a command to 20C isolators which will set a switch open (isolated) state. When the command is reset the isolator will autonomously revert to a closed switch state if no short-circuit is present. It is not possible for 20C isolators to be remotely switched from an open switch to a closed switch state.

System design

It is essential that both loop loading and isolator requirements are taken into consideration when designing a fire detection system.

Generally the loop devices are wired in sequence, so the number of devices between isolators should equal an EDL of 20. If a star configuration is used at a node in the system there may be more than one isolator being powered at the same time so 4 EDL should be added to the node for each additional isolator being powered simultaneously.

Apollo offers a software programme with which the loop loading viability of a design can be checked. The LoopCalc programme can be downloaded at www.apollo-fire.co.uk

Note: *All detectors and other devices between any two isolators or isolating devices must be in the same fire zone because communications will be lost if a short circuit occurs between isolators. This design consideration may be subject to national or local regulations.*

Quick-start process guide

To work out the isolator loading of a loop:

- Identify the devices between each pair of isolators
- Use Table 1 to determine the EDL of each device

  Note: If any devices are star connected and include isolators, then add four EDL for each device. Do not include any devices past the isolator in this node.
- Verify that the sum of the EDL values is less than or equal to 20
- Put the full loop configuration into the ApolloLoopCalc tool
- Verify that the LoopCalc tool confirms 'Loop Design Satisfactory'

Table1: Apollo products

Part No.	Product name	Isolator type and EL value			
		20D	20I	20C	EDL*
	DIN MCP (PCB Assy 43785-378)			X	1
45681-277, 278	Integrated Base Sounder 55-91dB (with Isolator)	X			2
45681-284	Isolating Base	X			0
45681-286	Marine Isolating Base	X			0
45681-321	Isolating Base	X**			0
45681-330, 331	Sounder Visual Indicator Base 55-91dB (with isolator)		X		3
45681-333, 335	Visual Indicator Base (with Isolator)		X		2
45681-393	Discovery Sounder Visual Indicator Base (with isolator)		X		3
45681-394	Marine Sounder VID Base		X		3
45681-518	Deep Isolator Base used with 55000-001/-005/-009		X		3
45681-700	Discovery Sounder VAD Base (Cat 0)		X		3
45681-702	Discovery Sounder Base (with isolator)		X		3
45681-702	Discovery Sounder Base				3
45681-705	Sounder VAD Base (Cat 0)		X		3
55000-001	Intelligent Open-area Sounder		X		3
55000-005	Intelligent Open-area Sounder Visual Indicator		X		3
55000-009	Intelligent Open-area Visual Indicator		X		3
55000-024	XP95 Base Mounted Flame Detector				9
55000-182	XP95 Sounder Control Unit – DIN-rail				3
55000-261	XP95 Sounder 100 dB				2
55000-265	XP95 Beam Detector Receiver and Interface				20
55000-266	XP95A Beam Detector Receiver and Interface				20
55000-268	Intelligent Reflective Beam Detector (with isolator)	X			10
55000-268	Intelligent Reflective Beam Detector				10
55000-280	XP95 Flame Detector				20
55000-291	Multi-tone Open-area Sounder Visual Indicator				2
55000-293	Multi-tone Open-area Sounder with Isolator		X		2
55000-293	Multi-tone Open-area Sounder Visual Indicator				2
55000-293/-294	Multi-tone Open-area Sounder/Visual Indicator with Isolator		X		3
55000-298	Weatherproof Multi-tone Open-area Sounder with Isolator		X		2
55000-298/-299	Weatherproof Multi-tone Open-area Sounder/Visual Indicator with Isolator		X		3
55000-588	XP95 Input/Output Unit - 3 Channel (with Isolator)	X			7

Table1: Apollo products

Part No.	Product name	Isolator type and EL value			
		20D	20I	20C	EDL*
55000-588	XP95 Input/Output Unit – Three channel	X			7
55000-709	VAD Base (Cat O)				2
55000-720	Plug in Isolator	X			0
55000-721	Marine Plug in Isolator		X		0
55000-741/744	Loop-powered VAD (Cat W – 6 m) *(must be fitted to an Isolating Base)*				20
55000-742/745	Loop-powered VAD (Cat C - 8.5 m) *(must be fitted to an Isolating Base)*				20
55000-750	Plug in Isolator (up to Q1 2019)	X**			0
55000-750	Plug in Isolator (from Q1 2019)	X			0
55000-760, 765	XP95 Mini Switch Monitor		X		3
55000-770	Marine DIN Rail Dual Isolator	X**			0
55000-773	Marine DIN Rail Zone Monitor Unit	X**			10
55000-775	Marine Mini Switch Monitor		X		3
55000-797	XP95 Mains Input/Output Unit – DIN-rail				6
55000-802	DIN Rail Dual Isolator	X**			0
55000-803	XP95 Input/Output Unit – DIN-rail				4
55000-804	XP95 Output Unit – DIN -rail				3
55000-809	XP95 Switch Monitor Plus				3
55000-810	XP95 Switch Monitor				3
55000-812	DIN Rail ZMU	X**			10
55000-813	XP95 Zone Monitor				6
55000-818	XP95 Input/Output Unit				4
55000-819	XP95 Output Unit				3
55000-820	XP95A Switch Monitor Input/Output Unit				4
55000-821	XP95 Switch Monitor Plus – DIN-rail				3
55000-822	XP95 Switch Monitor – DIN rail				3
55000-823	XP95 Sounder Control Unit				3
55000-825	XP95A Sounder Control Module				6
55000-832	XP95 Mini Switch Monitor with interrupt				3
55000-833	XP95 Mini Switch Monitor				1
55000-841	XP95 Switch Monitor Plus (with Isolator)	X			3
55000-843	XP95 Switch Monitor (with Isolator)	X			3
55000-845	XP95 Zone Monitor (with Isolator)	X			10
55000-847	XP95 Input/Output Unit (with Isolator)	X			3
55000-849	XP95 Output Unit (with Isolator)	X			3
55000-852	XP95 Sounder Control Unit (with Isolator)	X			3
55000-875	XP95 Input/Output Unit – Mains switching				4
55000-891	XP95 Locally Powered Zone Monitor (with isolator)		X		3
55000-891	XP95 Locally Powered Zone Monitor				4
55100-9XX	XP95 Manual Call Point (with Isolator) - various housings		X		1
58000-005	Discovery Open-area Sounder Visual Indicator				3
58000-005/-007	Discovery Open-area Sounder Visual Indicator (with Isolator)		X		3
58000-010	Discovery Open-area Voice Sounder				3
58000-010/-020	Discovery Open-area Voice Sounder (with isolator)		X		3
58000-030	Discovery Open-area Voice Sounder Visual Indicator				3
58000-030/-040	Discovery Open-area Voice Sounder Visual Indicator (with isolator)		X		3

Table1: Apollo products					
Part No.	Product name	Isolator type and EL value			
		20D	20I	20C	EDL*
58100-971	Discovery Marine MCP with Isolator		X		1
58100-976	Discovery Waterproof Marine MCP with Isolator		X		1
58100-9XX	Discovery Manual Call Point (with Isolator) - various housings		X		1
58200-976	Discovery Waterproof Marine MCP with Isolator		X		1
FL5100-600	Soteria Dimension Optical Detector			X	1
FL6100-600	Soteria Dimension Specialist Optical Detector			X	1
SA4700-100	Intelligent Switch Monitor			X	1
SA4700-102	Intelligent Input/Output Unit			X	1
SA4700-103	Intelligent Mains Input/Output Unit			X	2
SA4700-300	Intelligent Switch Monitor - DIN Rail			X	1
SA4700-302	Intelligent Input/Output Unit - DIN-rail			X	1
SA4700-403	Intelligent Mains Input/Output Unit - DIN-rail			X	2
SA5100-400	Soteria Heat Detector (with Isolator)			X	1
SA5150-450	Soteria UL Heat Detector			X	1
SA5150-650	Soteria UL Photoelectric Smoke Detector			X	1
SA5150-750	Soteria UL Multi-Criteria Detector (Photoelectric/Heat)			X	1
SA5100-600	Soteria Optical Detector (with Isolator)			X	1
SA5100-700	Soteria Multi-Sensor Detector (with Isolator)			X	1
SA5900-908	Intelligent Manual Call Point with Isolator			X	1
SA5900-928	Marine Intelligent MCP			X	1
SA7100-100	Intelligent Reflective Beam Detector			X	7
XPA-IN-14007-APO	XPander Loop Interface		X		2

EDL - Equivalent Detector Load*
*X** - Early version of the 20D isolator with similar characteristics*

Table 2: EN 54-17 parameters				
EN 54-17 parameter	Description	Isolator type		
		20D	20I	20C
V_{min}	Loop dc voltage	17 V	17 V	17 v
V_{max}	Loop dc voltage + Pulse V	28 V + 9 V	28 V + 9 V	35 V + 13 V
$V_{SO\ max}$	Isolation voltage	14.8 V	14.8 V	15 V
$V_{SO\ min}$	Isolation voltage	13.6 V	13.6 V	12.5 V
$V_{SC\ min}$	Voltage to de-isolate (on isolated section with test current applied)	12.9 V	12.9 V	12.8 V
$V_{SC\ max}$	Voltage to de-isolate (on isolated section with test current applied)	18 V	18 V	19.1 V
$I_{C\ max}$	Continuous switch current	1 A	1 A	1 A
$I_{S\ max}$	Maximum switch current	3 A	3 A	3 A
$I_{L\ max\ dc}$	Maximum Isolator leakage current (Test Current)	50mA	22mA	33mA
$Z_{C\ max}$	Maximum series resistance - switch closed	0.12Ω	0.12Ω	0.08Ω