PDHonline Course E207W (4 PDH)

Design to the Fire Alarm Code, NFPA 72-2007 (Live Webinar)

Instructor: Thomas Mason, P.E.

2012

PDH Online | PDH Center

5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone & Fax: 703-988-0088
www.PDHonline.org
www.PDHcenter.com

Design to the Fire Alarm Code, NFPA 72-2002

Commentary on New York City School Construction Administration Construction Specification 16720, Fire Alarm

Recently, the New York City School Construction Administration (NYC SCA) has made available to the public copies of their standard construction specifications. Previously, these were available only to design contractors and construction contractors on specific contracts. They were not available to the public, even in response to requests under the Freedom of Information Act.

A sample NYC SCA specification, **16720, Fire Alarm,** is available through **PDH Center** as a download .pdf file for this course. It is not a good specification, but is worthy of study simply as an example and aid in avoiding the defects. It is considerably more valuable in showing differences between conventional specifications and NYC SCA standards. Many of these differences are called out in the following commentary.

Each commentary section is preceded by the referenced section from 16720. Only the first entry is out of order.

Wording similar to the following is commonly used in specifications where the requirement exists for "or equal" but the specifier is trying to avoid substitutions:

1.05.C.3 "If brand names other than those specified are proposed for use, the company shall pay all costs, including travel expenses to the test facility for the Authority's Representative to witness the tests demonstration." [onerous, prohibitory]

The descriptives, onerous and prohibitory, were added by this writer. The result, for NYC SCA Specification 16720, is use of specified vendors as follows and others only following a paid inspection visit:

Approved Vendor Summary

Section	Item	Cnt	GE	H'wll	Whl'k	Other	Other	Other
2.01.A	System7	**X**	**X**	**X**	**Cont Inst**	**Faraday Simplex**	**Siemens**	
2.03.B.7	Pull4	**O**	**X**	**O**		**Faraday Simplex**		**Aames**
2.03.C.6	Horn 2	**X**	**O**	**X**				
2.03.D.7	Strobe2	**X**	**O**	**X**				
2.03.E.4	Smoke2	**X**	**X**	**O**				
2.03.F.1	Heat1	**X**	**O**	**O**				
2.03.H.10	Duct2	**X**	**X**	**O**				
2.03.I.3	Alm In'face2	**X**	**X**	**O**				
2.03.J.2	Ctl In'face1	**O**	**X**	**O**				
2.03.K.4	Door Hold2	**X**	**X**	**O**				
2.03.L.4	Printer2	**X**	**X**	**O**				
2.03.M.2	FACP LCD1	**O**	**X**	**O**				
2.03.N.2	FACP Bell1	**X**	**O**	**O**				
2.03.Q.4	Spklr Bell2	**X**	**X**	**O**				
2.04.A.1	FACP2	**X**	**X**	**O**				
2.04.B.7	FACP PS1	**O**	**X**	**O**				

A reasonable person viewing the above summary could only conclude one of two meanings. 1) The NYC SCA really wants systems of parts from multiple vendors, or, 2) this spec is not enforced as written.

To persons not normally responsible for design of fire alarm systems, there may be nothing particularly interesting about use of multiple vendors. Consider, however, the wording from the current CSI / AIA / MasterSpec / Arcom fire alarm specification is as follows:

1.7.C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

A review of the 2007 issue of NFPA 72 does not support the limitation to a single vendor. However, multiple vendors are often avoided from fear of finger-pointing when the overall system does not operate correctly. The writer has experienced many such finger-pointing meetings.

1.01 DESCRIPTION OF WORK - "...complete addressable multiplex fire alarm system." This wording differs from normal wording of "...analog addressable multiplex fire alarm system." What does the "analog" add? That means that the system transmits the numeric value of the smoke obscuration sensed to the FACP. This permits diagnostic drift compensation and alarming and advanced "smoke signature" analysis to avoid false alarms.

Why should CSA overlook the analog feature? This comes back to the decision to mix-and-match components. It is fairly easy to multiplex discrete (off-on) signals, as illustrated below:
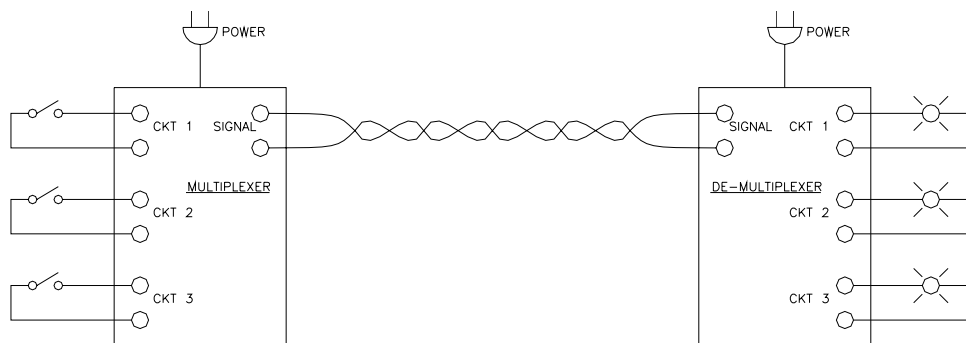

ILLUSTRATION OF MULTIPLEXED OPERATION

The operation indicated is based upon a 12-cent parallel-to-serial / serial-to-parallel converter chip. 24 VDC-in and 24 VDC-out are standard values. If a "power load" is connected, then a driver is needed, but for a solid-state input, chips talk to chips fairly well.

The same concept can be implemented using analog data, but it gets complicated. How much accuracy is needed? One part in 256? How fast an update is needed to perform meaningful signature analysis? 0.1 sec? 0.01 sec? 0.001 sec?

If the analog multiplexer is to be used, then a standard signal must be selected, perhaps 0-10VDC (a standard in process control). That means the smoke detector must convert its internal voltage level to the standard level. The de-multiplexer must convert the standard level to the internal level used by the FACP. These are not serious decisions for a manufacturer who is creating the complete system. They are serious questions for a manufacturer trying to coordinate with other manufacturers - just for the New York City school market. Also, as indicated in the later detailed discussion of alarm interface modules, it is difficult and expensive to get sophisticated digital systems of different manufacturers to "talk".

NYC CSA has selected to use discrete multiplexing. These are the "alarm interface modules" (switch-in, twisted pair-out) and "control interface modules" (twisted pair-in, switch-out) shown in the list above. This way, any 24VDC pull station can be used with the system and any 24VDC strobe or horn can be used with the system. As suggested above, a driver is needed for power loads, but all strobes pull about 250mA, so only a single design decision is required. Similarly, all door magnet-holds pull about 50mA, and will operate on the same control interface module.

"FACP with English text annunciator / printer."   There is a serious operational problem with selecting text over graphics. The Fire Alarm Code requires alarm zones corresponding to evacuation zones. This is extremely valuable information to the firefighter attempting to use the smoke control panel to purge the avenue of egress. It is very difficult to communicate zone perimeters in text. It is very easy to communicate zone perimeters using graphics and graphics are easier to understand during stress conditions. These are the reasons your writer prefers engraved graphics with LED indicators.

"audible annunciators" and "visual annunciators". The conventional term is "notification devices". To me, at least, "annunciator" implies a quiet little screen, whereas "notification" implies enough sound and light to awaken anyone. We will examine details of the devices called for later in this commentary.

"indoor and outdoor sprinkler alarm bell". This wording contradicts that in 2.03.Q.

1.02 Listings

A - "All equipment shall be UL listed for its intended use." There are two problems in using this wording in a mix-and-match system. UL lists systems. That clearly doesn't apply. UL lists components, but is valid only when the components are used in compliance with the manufacturer's instructions. The manufacturer almost universally restricts use of his parts to his systems.

Manufacturers commonly say, "UL Listed", but rarely indicate the specific UL test and installation instructions, which may include exclusions, are not available until after purchase. Typical specifications and electrical ratings for a discrete pull station are available at http://www.federalsignal-indust.com/CutSheets/CS_FSF102_103_Fire.pdf and include the following switch contact information:

Model	Description	Voltage	Contact Type	Contact Rating
FSF102	Dual Action	125VAC	SPST NO	10 amps
FSF103	Single Action	125VAC	SPST NO	10 amps

Be aware that industrial switches rated at 10A had trouble talking to early uA PLC inputs.

If you are interested in the more conventional "individually addressable pull station" (no alarm interface module required) you might look at http://xtra.simplexnet.com/a_e/FA/S14099-0001-6.PDF#search='simplex%20pull%20station'. There is no follow-up in the present course.

C. - "NFPA 72" , but no year of issue. This document does change, and the Authority Having Jurisdiction is often one or more issues behind in accepting a version to enforce. Specifically, strobe synchronization has expanded in NFPA 72-2007.

I. - "Contractor shall submit proof in writing from the proposed Fire Alarm System manufacturer that submitted system will be modified and upgraded to meet all new UL 864 standards effective October 1st 2005." It is a bit peculiar to ask for certifications of compliance for individual spec sections.

1.03 Related Work - this is a good list of equipment provided by others which require connection to the fire alarm system by the Electrical Contractor. Missing, however, is any mention of "supervised" connections. NFPA 72 is very explicit in identifying the correct way to connect the fire alarm to the elevator shunt-trip circuit breaker. ["Supervised" means that a wire short or break is alarmed as TROUBLE on the FACP.] This section leaves the contractor wondering whether supervisory relays are required or not.

"...kitchen fire extinguishing system...shall be annunciated at the fire alarm control panel." Is it annunciated as TROUBLE or as EVACUATION? Especially in a school, a good suppression system avoids the need to evacuate after a minor problem in the kitchen or home ec room..

1.04 System Description

C.3 - "Activation of any smoke detector or heat detector shall...operate the exterior sprinkler alarm." This is SO WRONG. The exterior sprinkler alarm is a requirement of NFPA 13, the Sprinkler Code. Most plumbing designers beg the electrical designer to take care of it to simplify piping (I don't know what they normally do with the discharge side of the bell - maybe dump it to city drain.)

The sprinkler bell is to help the firefighters identify the building needing attention and gives early status information (the sprinklers are operating). Connecting the smoke detectors and heat detectors violates the intention of the sprinkler bell.

D.1 - "Operation of any automatic fire detection device shall shut down all fans...." This sequence is unlike anything I have seen previously. Until reading this paragraph, I thought one set of contacts on the duct detector shut down only one fan and another set told the FACP what was going on. The FACP then does FACP-stuff. This is illustrated in the following wiring diagram, where the PROCESS MOTOR is the fan, the PROTECTIVE DEVICE contact is the first set of duct detector contacts and the second set of duct detector contacts are not shown. An interlock for motor protection seems to be similar in intent to the function of people protection.
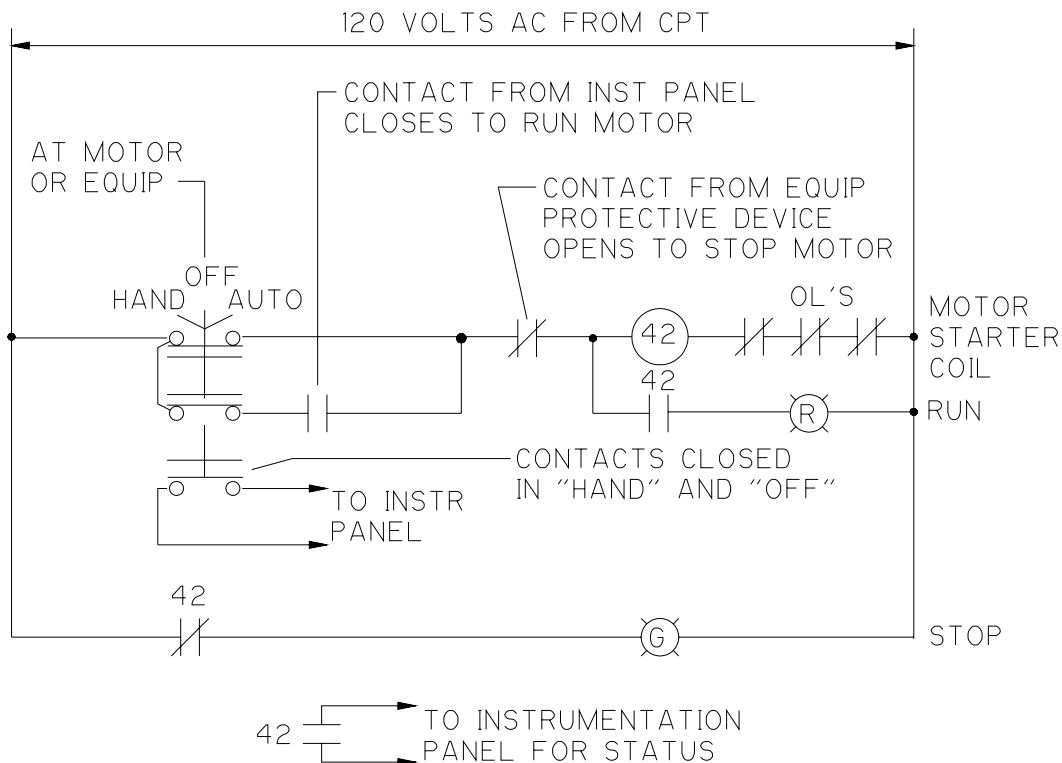
PROCESS EQUIPMENT MOTOR STARTER
CONTROL WIRING DIAGRAM

This process wiring detail can also be used to somewhat visualize the NYC SCA scheme. The "contact from inst panel, closes to run motor" is connected to the FACP. When the duct detector tells the FACP something is going on, the FACP opens the contact and stops the fan. When the firefighter uses the smoke control panel to initiate purge, the contact closes. [Usually "hand" and "off" are used only for maintenance. "Auto" is the normal condition.]

An even more serious problem between air handler fans and the fire alarm is not addressed. That problem is the building automation system (BAS) which is today almost universal. The BAS normally starts and stops each fan - according to time-of-day, stored schedule and the programmer's personal quirks. The BAS is not a UL-listed life-safety system and the BAS programming receives no quality assurance review beyond the fire alarm smoke control panel acceptance testing. However, State and national energy codes mandate BAS. In the future, the only scheme may be that the detector tells the FACP, the FACP tells the BAS and the BAS stops the fan.

D.2 - "...return all elevators in that bank to the main lobby for use by Fire Department Personnel." This is a requirement better not-tested during acceptance. It violates NFPA 72 requirements that an alarming smoke detector in the lobby divert the return to a second exit level. The wording is especially awkward when you realize that the lobby is often not the preferred exit route. Many old schools have raised lobbies that are very, very busy with normal activity and security screening. A basement exit may be at ground level and much more direct.

D.3 - "Operation of the sprinkler water flow switch, the fire alarm control panel shall also activate the elevator recall system."   Poor communication of poor thinking. Any building of reasonable size has several sprinkler zones. Are we really sure that we want sprinkler flow in the remote auto shop to bring down the elevators in the administrative tower?

1.05 Quality Assurance - "The system shall be listed in the UL Fire Protection Equipment Directory under product category 'Control Units System (UOJZ)'". As we discovered initially, if the spec is followed the assembly is a mix-and-match conglomeration, not a system. It is exceedingly unlikely that a distributor has paid for UL testing of the mixed components to receive a system listing. As with other required UL compliance, the standard is not readily available to see if the term "system" is used in its ordinary technical sense.

"All service technicians shall be NICET Level 2 certified, factory certified, and possess a Fire Department Certificate of Fitness per Rule 6 of the Fire Prevention Code." This appears to say that the workmen hanging conduit for the fire alarm must have all the above credentials. Or, it may mean that a single person with the credentials must sign-off on the installation.

If the spec is demanding that only portions of the installation must be performed by credentialed persons, it should identify which portions those are. Programming the FACP makes sense. Doing the battery sizing and notification circuit wire sizing make sense. Hanging pipe does not. This is not a good paragraph.

1.06 Supplemental Submittals - "Provide a schedule ... for each LED/Lamp indictor (sic) for the Smoke Purge Panel." This is the only place where the spec gives any details on the Smoke Purge Panel. Also, this is the place where the engineer first gets to see what the Contractor is offering to comply with the content less spec. [It makes me very happy when the Big Guys miss spelling errors in published documents.]

"Provide a schedule ... for each LED/lamp indicator at the remote annunciator." As we saw in 1.05 Description, annunciator/printer, there is an LCD display and a printer. No graphics. No LED or lamp indicators. This appears to be simply bad spec-writing, very different directions indicated by different spec sections.

2.03 Equipment

B.4 - "The pull station shall be interfaced into the addressable system by means of an addressable interface module. One module shall be provided for each pull station of the manual pull station (?). Separately mounted addressable modules are not acceptable." This is one of those paragraphs that suggest NYC SCA wants only to deal with their close buddies. It would be very hard to decipher this paragraph into what they actually want.

The specific pull stations listed in the paragraph following are 120V, 3A or 10A switches only. This paragraph says an addressable interface module shall be provided for each switch but not separately mounted. The pull station, itself, is only about 1/2-in thick and has no tabs or tapped holes for an electronics module to be attached. You can't mount the module to the pull station and you are not allowed to mount it separately. Clearly, this paragraph is not enforced, or, it is interpreted in a way not consistent with the English language.

B.8 - "Pull station shall be Simplex Cat #RMS-1T, Faraday Cat. #PM 6696 or Aames Security Cat. #RMS 1T-LPKL with Honeywell / Notifier FMM-101 monitor module or approved equal." Below is an Australian picture of the FMM-101 module from http://www.notifier.com.au/?main=%2FCatalogue%2FAnalogue%2520Addressable%2520Fire%2520Alarm%2520Systems%2FModules%2F347D4D57-8155-442C-BE8B-3F0385C7E38A%2FFMM-101%2F%3Fitem%3D656EC143-801C-4A19-BBCA-3945774D9317:
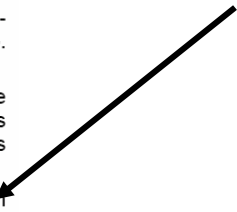
Another vendor describes the proprietary digital communications of the FMM-101 at
http://www.pyrochem.com/pdfs/pyro_data_sheet/PC2001148.pdf. It is reproduced below:

Description

The FMM-101 is a miniature monitor module used to supervise a Class B (Style B) circuit. Its compact design allows the FMM-101 to often be mounted in a single-gang box behind the device it is monitoring. The FMM-101 can be used to replace MMX-101 module, Part No. 417478, in existing systems.

Each FMM-101 uses one of 159* available module addresses on an SLC loop. It responds to regular polls from the control panel and reports its type and the status (open/normal/short) of its Initiating Device Circuit (IDC).

FlashScan (patent pending) is a new communication protocol that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the unit's CPU stops the group poll and concentrates on single points. The net effect is response speed **greater than five times** that of earlier designs.

A Fire Alarm Request For Proposal dated March, 2006, from NYC SCA, is available at http://www.opt-osfns.org/Destination/CMS/Upload/bids/Fire_Alarm_System_Spec.pdf. It calls for single-source module EST model SIGA-CT1. Below is a Mexican picture of the SIGA-CT1 from http://www.dico-mexico.com/catalogo/edwards/pdf/Modulo%20de%20Control.pdf:

INTELLIGENT ANALOG DEVICES

EDWARDS SYSTEMS TECHNOLOGY

Input Modules

Models SIGA-CT1, SIGA-CT2 & SIGA-MCT2

Features

■ **MULTIPLE APPLICATIONS**
Including Alarm, Alarm with delayed latching (retard) for waterflow applications, Supervisory, and Monitor. The installer selects one of four (4) "personality codes" to be downloaded to the module through the loop controller.

■ **PLUG-IN (UIO) OR STANDARD 1-GANG MOUNT**
UIO versions allow quick installation where multiple modules are required. The 1-gang mount version is ideal for remote locations that require a single module.

■ **AUTOMATIC DEVICE MAPPING**
Signature modules transmit information to the loop controller regarding their circuit locations with respect to other Signature devices on the wire loop.
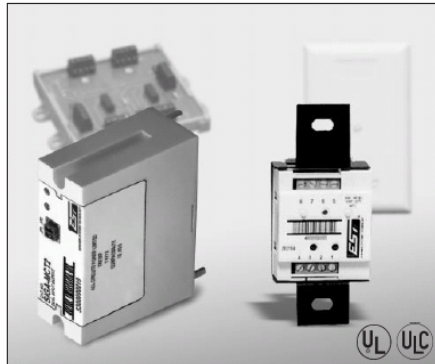
■ **ELECTRONIC ADDRESSING**
Programmable addresses are downloaded from the loop controller, a PC, or the SIGA-PRO Signature Program/ Service Tool. There are no switches or dials to set.

■ **INTELLIGENT DEVICE WITH MICROPROCESSOR**
All decisions are made at the module to allow lower commu-nication speed with substantially improved control panel response time and less sensitivity to line noise and loop wiring properties; twisted or shielded wire is not required.

■ **NON-VOLATILE MEMORY**
Permanently stores serial number, type of device, and job number. Automatically updates historic information including hours of operation, last maintenance date, number of alarms and troubles, and time and date of last alarm.

■ **STAND-ALONE OPERATION**
The module makes decisions and inputs an alarm from initiating devices connected to it even if the loop control-ler's polling interrogation stops. (Function availability dependent upon control panel.)

■ **DIAGNOSTIC LEDs**
Flashing GREEN shows normal polling; flashing RED shows alarm/active state.

■ **HIGH AMBIENT TEMPERATURE OPERATION**
Install in ambient temperatures up to 120ºF (49ºC).

■ **DESIGNED TO ISO 9001 STANDARDS**
All Signature products are manufactured to strict interna-tional quality standards to ensure highest reliability.

Description

The SIGA-CT1 Single Input Module and SIGA-CT2/SIGA-MCT2 Dual Input Modules are intelligent analog addressable devices used to connect one or two Class B normally-open Alarm, Supervisory, or Monitor type dry contact Initiating Device Circuits (IDC).

The actual function of these modules is determined by the "personality code" selected by the installer. This code is downloaded to the module from the Signature loop controller during system configuration.

The input modules gather analog information from the initiating devices connected to them and convert it into digital signals. The module's on-board microprocessor analyzes the signal and decides whether or not to input an alarm.

The SIGA-CT1 and SIGA-CT2 mount to standard North American 1-gang electrical boxes, making them ideal for locations where only one module is required. Separate I/O and data loop connections are made to each module.

The SIGA-MCT2 is part of the UIO family of plug-in Signa-ture Series modules. It functions identically to the SIGA-CT2 but takes advantage of the modular flexibility and easy installation that characterizes all UIO modules. Two- and six-module UIO motherboards are available. All wiring connec-tions are made to terminal blocks on the motherboard. UIO assemblies may be mounted in EST enclosures.

Compatibility

The Signature Series modules are compatible only with EST's Signature Loop Controller.

Note that this device is in the INTELLIGENT ANALOG DEVICES section of the catalog and is being used with off-on switches. This is not a coordination problem. The application portion of the catalog demonstrates this use and gives wiring details. Again, however, the sole-source interface forces selection of the FACP.