![KMC CONTROLS]

Smoke Control Manual

For BACnet Systems

Important notices

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Contents

Purpose

The purpose of this manual is to provide guidelines for control contractors affiliated with KMC Controls when designing, programming, and installing **BACnet (Building Automation Control Network)** equipment in a smoke control system. The design of a complete building smoke control system is a complex task that must be given great thought by trained personnel. Such training is not included here. This manual contains general information to KMC contractors on the subject of smoke management. It also provides details specific to interfacing KMC BACnet equipment with other parts of the building smoke management system.

This manual includes topics on using the BAC-5801, BAC-5802, and BAC-5831 controllers to complete and then test and maintain a smoke control system. (Specific information about these controllers is found in their installation guides.) The BAC-5800 series controllers will generally be involved in the portion of the smoke control system that operates space-conditioning equipment such as air handlers and exhaust fans. The BAC-5800 series controllers may also be used in the **Firefighters' Smoke Control Station (FSCS)**. The BAC-5801 and BAC-5802 are identical to each other except the BAC-5801 contains a real-time clock and will be used as panel number 1 on the subnetwork to keep all boards synchronized to the same time.

Use of the BAC-5800 series controllers in any application requires special training. Contractors installing any KMC BACnet equipment are required to have attended the BACnet training course and have a solid knowledge of building automation. Smoke control system design is beyond the scope of this guide.

What is Smoke Control?

Smoke control in buildings refers to the method and system of manipulating smoke in the event of a fire. This is accomplished by using fans and dampers to control the movement of smoke. Smoke is composed of gas and small particles light enough to float in air. These properties allow smoke to be moved by guiding the air in and around a smoke-filled area. Based on automatic smoke detection, a zone containing burning material can be exhausted to maintain a negative pressure. The intent is to keep the smoke from migrating to a lower pressure area within the building. This is not always an easy task since the fire is producing heat that can cause pressures many times higher than normal building pressures. A building sprinkler system can reduce the heat produced by the fire and make smoke management systems far more effective. Sprinkler systems operate independently of smoke control systems.

To help contain the smoke, zones adjacent to the fire zone can be placed into a pressurization mode. In this mode, 100% outdoor air is supplied continuously to the areas adjacent to the fire zone while exhaust fans are disabled. This is just one possible method to contain the smoke. There are other ways depending on the control intent. The method used is the decision of the company designing the project.

Smoke Control Systems

A smoke control system is the combination of fans, dampers, sprinklers, warning devices, and other equipment that work together to perform the containment function for any smoke event at any location in a building. A properly designed smoke control system should inhibit or prevent the movement of smoke into areas of egress, exit, or other designated safe zones in a building. Smoke control systems by necessity are building specific. No two buildings will likely have exactly the same control requirements. Among other things this means that the smoke control system will

need to be carefully and thoroughly coordinated with the various other life safety systems in the building.

Why Smoke Control?

Smoke control may not be necessary in every installation. The decision to use smoke control may be based on the ability of the existing control and evacuation methods to:
- Save Lives and Prevent Injury
- Reduce Property Damage
- Assist fire-fighting operations

Smoke control is not a substitute for early smoke detection, well-marked exits, an evacuation plan, and sprinkling systems. These items should be considered the primary means of saving lives and reducing property damage. Smoke control can aid in the battle to save lives in the event of a fire by providing and maintaining a tenable path of egress. Property damage can be minimized with smoke control by reducing its spread, a concept known as containment.

UUKL Rating

Underwriters Laboratories' UUKL listing is a category code under UL 864, Control Units and Accessories for Fire Alarm Systems. UUKL is for products covered under the description "Smoke Control System Equipment." Equipment that receives Underwriters Laboratories UUKL rating has been tested for integrity and long-term reliability. The equipment is subjected to extremes in temperature, humidity, and electrical transients and surges. This testing ensures that the devices will continuously perform even under sever and abnormal conditions.

How to Implement

Before developing a system for smoke control, determine the goals. Generally, the specific intent of the smoke control system is established in the job specifications. If questions or discrepancies concerning the specified sequence are found, work out these problems with the architect or designer as early as possible, preferably while engineering your portion of the job. This is the least expensive and safest time to deal with life safety concerns.

Dedicated and Non-Dedicated Equipment

Dedicated smoke control equipment is used for smoke manipulation only. This equipment only runs if there is a fire or a command from the FSCS. **Since it is not used on a daily basis, this equipment requires a weekly self-test to assure it is still in working order.**

Non-dedicated smoke control equipment includes air-handling units, exhaust fans, and dampers used for day to day control of space conditions for human comfort (temperature and humidity). If a failure occurs on non-dedicated equipment the fault is more likely to get reported because occupants will complain about the space conditions. Also, a BACnet system can generate a number of different alarms to indicate some malfunction of the smoke control equipment. But until the unit is running, little valid information can be obtained. For this reason, **non-dedicated smoke control equipment is more reliable**. **KMC products are designed for non-dedicated smoke control systems.**

Smoke control mode may be activated automatically, but it must also allow for a manual override option from the FSCS. The command for a certain action may come from the **Fire Alarm Control Panel (FACP)**. After the requested action has completed, confirmation of the action by monitoring a feedback signal from the actuated device may be required. If the action needs to be performed manually, a switch (AUTO-MANUAL) must be available to do this, and the manual operation must

take precedence over any other command. Any override switches would be in the FSCS located at an easy access point in the building such as the main entrance.

Never tie in directly to a manual fire alarm pull-box to obtain information on smoke zones. Tenants, customers, or employees at the site may pull the alarm in a zone far from the fire location. The smoke control system should receive input from the FACP, which will give commands based on heat, smoke, or sprinkler flow detection.

Smoke control functions must have the highest priority in a system that is also used for human comfort control. If the normal air handling system is part of the smoke control system, in a smoke control mode, all other building controls should be overridden. Hand-Off-Auto starter switches, freeze thermostats, duct smoke detectors, and other non-life-safety limits should be bypassed when the smoke control mode begins. The fan must run to failure in smoke mode. However, high static limits, motor starter overloads, and other safety devices must **not** be bypassed. These devices, if bypassed, would create additional life and property hazards.

The air handler must be designed in such a way that the duct-pressure rating is not exceeded in a smoke mode. If the duct explodes, it will likely no longer provide effective smoke control. Special ducting or spring-loaded access doors may need to be considered on high-pressure air handling systems. Coil bypass ductwork to protect coils from freezing in cold weather may also be worth considering. While frozen coils may not be a high priority during a building fire, the ability to test the system without damaging the air handler is desirable. Also, such considerations will allow recovery from false alarms without damage and downtime.

In a VAV system, additional sequencing may need to be added to prevent damage to ductwork resulting in system failure. Terminal dampers should be driven open before the fan reaches maximum speed. This will allow the air to be distributed safely to the necessary zone.

HVAC System Smoke Control (Non-Dedicated Systems)

There are some advantages to using HVAC system components for smoke control. The biggest advantage is that components are used daily for occupant comfort, and if a piece of equipment fails, you can be informed *before* an emergency situation arises. The failure can be reported by one or more alarms that monitor the unit's performance. An air handler, for instance, may be monitored for such conditions as differential pressure across the fan, current sensing on the motor, or for discharge temperature. Alarms and occupant calls will highlight any equipment failure. Maintenance personnel are less likely to put the repair off for another day if occupants are constantly complaining about the conditions.

A dedicated piece of equipment can fail for some reason or becomes inoperable due to the power being shut off to the device. Since it is not used normally, the failure could go unnoticed until a periodic test is performed, which could be too late.

Generally, the HVAC system receives its smoke control commands from the FSCS. Any command from the FSCS will override any other mode of operation of the HVAC equipment. These commands may be initiated automatically as the result of zone smoke detection or manually by a firefighter at the site. In either case, the equipment should be operated, bypassing normal limits, while allowing the unit to function indefinitely as designed without creating additional hazard or risk to personnel.

As the number of components in the signal path increases, so does the probability of a failure that will keep the end device from performing a desired action. Where life safety is involved, good practice is to keep it simple—fewer parts in series means a smaller chance of failure.

Even on well-planned construction jobs, equipment such as fire or smoke dampers can end up being covered by layers of conduit or other materials. Keep in mind on new construction that damper motors must be accessible for testing and maintenance in the future. The earlier changes can be made in the construction process the easier the task of modification or relocation for all parties involved.

Firefighters Smoke Control Station (FSCS)

A Firefighter's Smoke Control Station is the manual control center for all smoke control equipment in a building. It is usually installed at a main entrance or other easily accessible location. The panel front usually contains a diagram of the building with locations shown of significant smoke control equipment such as air handlers and dampers. Switches allow the operator to modify the state of the equipment at each floor or zone. Lamps (LEDs) on the panel face display the status of the equipment. Any command that fails to execute results in an audible and visual alarm.

As the name indicates, the operator is usually a firefighter who understands smoke control and can operate the panel in an effort to prevent loss of life and limit property damage. Manual commands given at the FSCS are the highest priority of any smoke control signal. The FSCS may control dedicated and/or non-dedicated smoke control equipment.

At the heart of the FSCS are the BAC-5801/5802/5831 controllers. An FSCS may contain multiple controllers, with the number dependent on the point requirements of the panel. The controllers are used to communicate to the control units in the field and read switch commands and display equipment status at the FSCS. A single BAC-5801/5802 controller provides 8 inputs and 8 outputs, which is enough for only the smallest smoke control system. A BAC-5831 controller provides 16 inputs and 12 outputs.

FSCS panels are usually "point hungry." There is a high point density needed for a small area. An FSCS will typically require 6 to 8 inputs *and* 6 to 8 outputs for every zone. A 24 by 36 panel will only be able to control 12 to 16 zones and miscellaneous components. A zone is an area controlled generally by a single air-handling unit than can be placed into a control mode from the FSCS. Examples of modes are automatic, pressurize, off, purge, and exhaust.

It may be necessary to provide for inputs from the building Fire Alarm Control Panel. Spare inputs in the FSCS should be wired to a terminal strip in the panel. These points can then be used to allow dry contacts from the FACP to give automatic smoke control commands.

NOTE: The FSCS and the FACP must be installed within 20 feet of each other, and the wiring must also be enclosed with conduit.

Controller Inputs:
0-5 VDC

IN1
GND
IN2
IN3

Dry contacts from FACP

IN4
GND
IN5
GND

Switches On (to the right)

Style " A " (Class B) Contact Only Initiating Circuit: 5 VDC nominal circuit voltage, 0.5 mA maximum short-circuit current, 5K ohms maximum line impedance (non-supervised).

Figure 1: Sample Input Signals from the FACP

The front panel graphic should be designed to clearly show the location of the smoke control equipment, what it can do and what it is doing. The operating capabilities of the equipment should be represented as modes of operation. For instance, putting an air handling unit into exhaust mode may involve shutting off the supply fan, outside damper, and return damper while starting the exhaust fan and opening the exhaust damper. Putting switches on the FSCS to perform each of these tasks individually can cause the panel to become complicated. Instead, a switch for each zone can be used to select a certain mode.

All fans with a 2000 cfm or higher capacity must have a status indicator on the panel face. The fan status will come from differential air pressure sensing.

Common modes of operation are auto, pressurize, off, purge, and exhaust. Since no two modes can be on at the same time, a rotary switch can index all modes. Auto mode is the typical mode for all non-dedicated smoke control equipment.

All components used in the FSCS panel must be listed for smoke control use. These are components that have passed tests necessary to comply with UL standards for smoke control equipment.

It will be necessary to complete at least a rough sketch of the graphic that will be on the panel cover. This may be a CAD drawing or a hand sketch. The cover will be the interface for firefighting personal. It should be a fairly simple building diagram with switches located and labeled for each zone. LEDs will annunciate the mode each zone is in. The location of the FSCS in relation to the building layout must be clearly marked.

Also, have prepared complete wiring diagrams showing all connections to read the switch inputs and drive the LED outputs. Indicate on the drawing that the boards will supply 12 VDC to power these LEDs. **KMC does not build FSCS panels but can assist in design and recommend suppliers authorized to build such panels.**

Allow at least 3 to 4 months for the application, material approval, and panel construction.

The FSCS is constructed using a 16 gauge steel panel. This UL listed panel comes with a lock on the cover to limit access to the internal circuit boards and power supply.

The FSCS panel comes assembled with the following terminals to land field wiring:
- 120 VAC power, 50/60Hz, 10A (depends on quantity of BACnet panels)
- Communications LAN (for tying into remote devices; field-wiring communications LAN requires 18 AWG twisted shielded pair)
- Dry-contact inputs from the FACP

The FSCS panel is not position sensitive. It should be mounted on a smooth, solid surface generally in a position with the door able to open from right to left. This puts all BAC-5800 series boards with input terminals on the left and output terminals on the right. The panel has multiple knockouts to allow conduit attachment for running the 120 VAC power and other wiring specific to each job. Keep 120 VAC power lines separated from communications and other low voltage wires in the panel.

When designing the smoke control panel, transformers should be sized to allow 10 VA for every BAC-5800 series controller used. The transformer required for smoke control use is the (96 VA) KMC XEE-6112-100. This transformer will accommodate panels with up to 160 points. Point counts over 160 will require multiple 96 VA transformers following the 10 VA per controller rule.

The FSCS should be equipped with both audible and visual indication of communications and equipment problems. A means, such as a key switch, should be provided to silence the audible alarm. The fault light, however, should always remain on while a fault is detected, and if the fault is not cleared within 24 hours, the audible alarm should reactivate. Correcting the fault should automatically clear both the audible and visual indicators.

Setting Up a BACnet System for Smoke Control
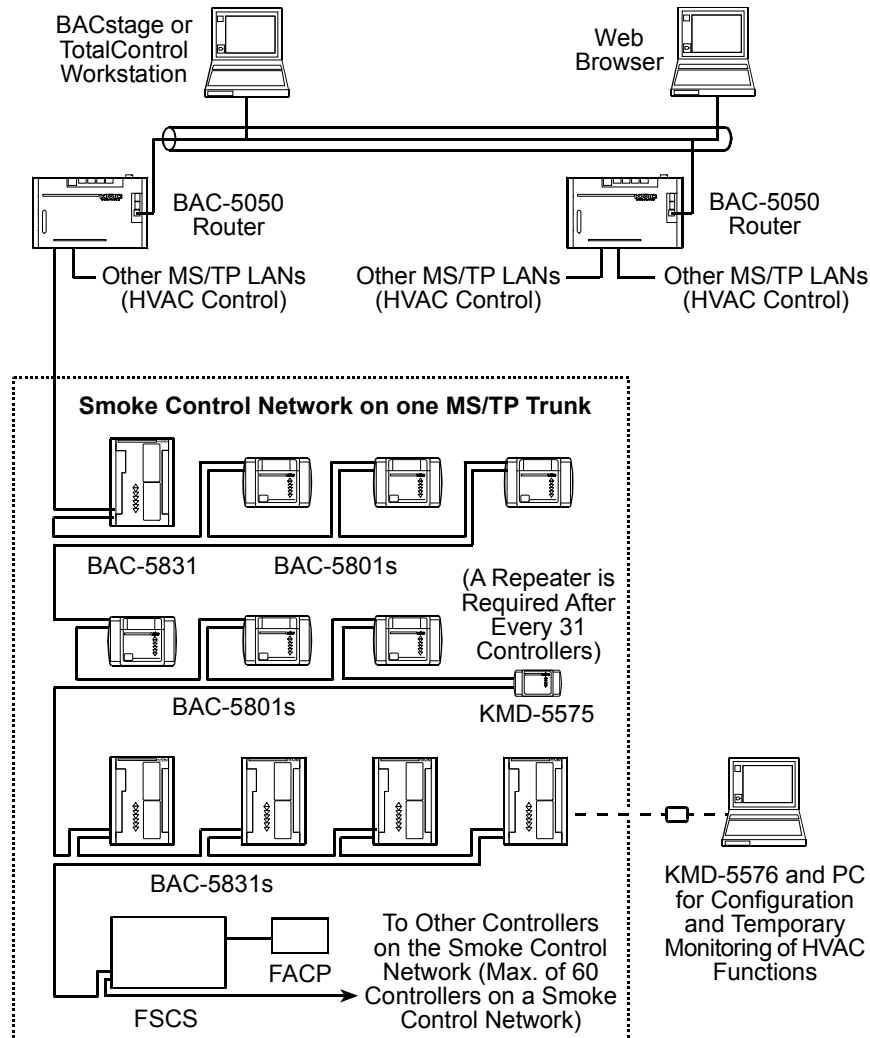
Figure 2: Sample Smoke Control Networks

KMC products approved for smoke control use are the BAC-5801, BAC-5802, and BAC-5831 native BACnet Advanced Application Controllers, as well as the KMD-5575 network repeater-isolator and the XEE-6112-100 (120-to-24 VAC, 96 VA) transformer.

The BAC-5800 series consists of microprocessor-based controllers with many features to accommodate a building automation system. Each BAC-5801/5802 provides 8 inputs and 8 outputs. Each BAC-5831 provides 16 inputs and 12 outputs.

A BAC-5800 series controller will operate as a stand-alone unit without any other network devices or a front end PC. User interface with the BAC-5800 series, however, for programming and configuration requires a PC with BACstage or Total Control software. This software, among other things, allows users to modify point data, view graphic displays, change programs, set user access levels and view trend reports. A connected PC will also allow alarm messages to be

printed for viewing and acknowledgment. **Note that attached computer workstations are intended only for configuration and testing purposes, not for long-term monitoring of fire/smoke alarms. The FACP is the designated smoke/fire alarm annunciator.**

For smoke control, the maximum possible number of controllers in a particular installation is highly dependent on the network configuration and how the FSCS is implemented. The following are KMC's recommendations for optimized installations:

- **The maximum number of KMC controllers (with optimized programming and on an optimized network) is 60** (including the controllers inside the FSCS).
- Inside the FSCS, one controller **must** be dedicated to monitor alarms from the FACP.
- If you need more than 16 zones, call KMC for assistance.
- Each controller can ask for **no more than 3 network points** (requests from one controller to another of a read or write property of a BACnet object).
- All BACnet controllers involved in Smoke Control should be limited to one MS/TP trunk.
- One KMD-5575 repeater is required after every 31 MS/TP devices. (The 60-controller maximum system for smoke control applications, therefore, would require one repeater.)
- The maximum wire length for EIA-485 MS/TP networks in smoke control is 4,000 feet total (including all repeaters).
- A **KMC KMD-5567 surge suppressor (not shown in the illustration above) must be installed on the MS/TP line at every controller and repeater** involved in smoke control as well as anywhere the cable enters or leaves the building.

Every controller involved in the smoke control scheme must receive the start-smoke-control-sequence command within ten seconds (as defined in section 6.4.3.6 of NFPA 92A). If more controllers and/or points are used, the network may not meet timing requirements. Because of the smoke control timing requirements, the maximum number of controllers is less than in a standard HVAC system. Moreover, **this maximum is for an optimized system**. If Control Basic programming is inefficient or read commands are more frequent than necessary, this may reduce the maximum number of controllers in a particular installation. For reading off-panel points without slowing down overall network traffic, use an interval (e.g., ten seconds) in Control Basic for reading such points.

Complete instructions for installing and optimizing networks is beyond the scope of this manual. The installer must be or become familiar with KMC BACnet systems. Training in installation and optimization of KMC BACnet systems is available from KMC.

Basic Control Concept

Principles

The block diagram in Figure 3 shows the simplest configuration for a BAC-5800 series FSCS being used in the smoke control loop.

NOTE: The FSCS and the FACP must be installed within 20 feet of each other, and the wiring must also be enclosed with conduit.
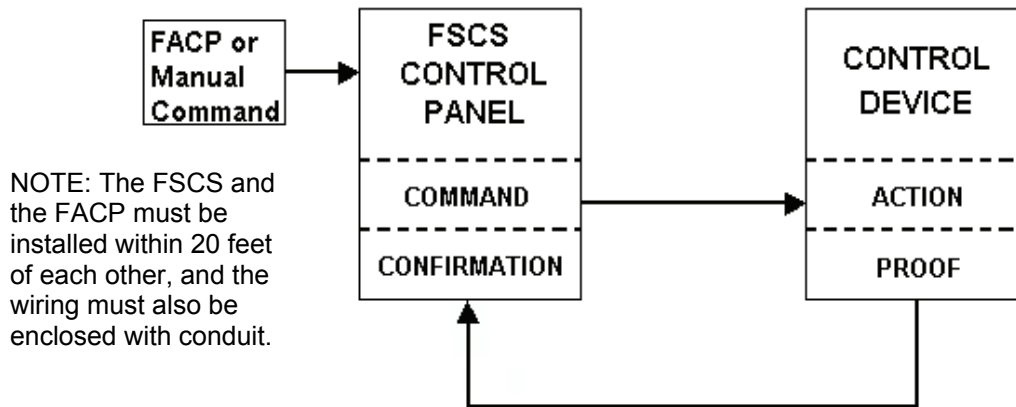
Figure 3: Block Diagram of a Smoke Control System

The BAC-5800 series in the FSCS panel takes commands from the firefighter by reading the switch settings on the panel face. Normally, all switches will remain in the "AUTO" position. In this mode, the FSCS panel is ignored by the HVAC system. Any switch moved from the "AUTO" position will result in a command being sent to the control device. These commands tell the controller at the device which task or series of tasks to perform. The controller at the device sends signals out to actuators or relays to perform a given action. To complete the loop, proof of the desired action is sent back to the FSCS. The proof will come from a switch that makes contact when the device has reached the requested position. If the proof of the action is not received within 60 seconds for fans or 75 seconds for dampers (per NFPA 92A 6.463.6.3), an audible alarm and visual trouble lamp will be activated at the FSCS.

Commands may also enter the FSCS automatically through an alarm initiated by the FACP panel. An alarm from the FACP will be ignored if the FSCS has been placed in a smoke control mode manually. Also, only the first alarm from the FACP will be acted upon. Additional alarms will be ignored. It is necessary to ignore subsequent alarms and assume the first alarm is the actual smoke zone. Other alarms may occur if smoke traverses zone boundaries but only the initial mode remains active.

FSCS   **Field**

FIRE FIGHTER'S SMOKE CONTROL STATION

Damper Actuator with Feedback Switch

BAC-5802
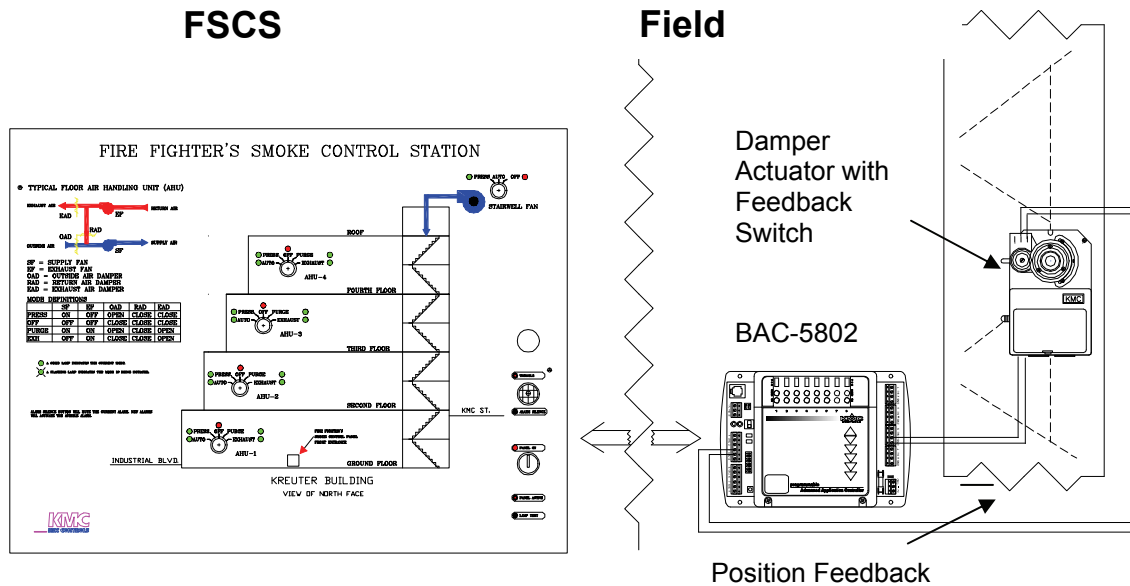
Position Feedback

Figure 4: Example FSCS / Field Interaction

The example in Figure 4 displays typical field connections for a damper with position feedback. The FSCS panel gives a command either from a manual switch or from an automatically activated condition (FACP). The command is transmitted on the SubNetwork to the appropriate device. When the action has completed, the proof is transmitted back to the FSCS. The actuator shown is a "fail-safe" type, meaning it has the ability to drive the damper open or closed after failure of power. The actuators must be configured correctly to fail in the desired direction. (Note that examples in this book may be very different than any particular installation.)

Damper actuators used for smoke control should be UUKL approved and have the ability to provide feedback via approved end switches, potentiometers, or other devices. These feedback devices can be wired to the BAC-5800 to tell the controller that the damper has been driven into position. After the damper actuator has been commanded to drive, if the switch fails to complete the input circuit within a normal time period an alarm can be sounded.

Commands are sent from the FSCS panel into the field unit controller (BAC-5800). Damper end switches or position switches also come into the controller to provide verification that the damper command has completed. Additional contacts for position or state indication may be wired into the controller depending on the equipment involved and the required sequence. Confirmation that all equipment has been placed into the proper position is sent back to the FSCS.

The construction of the FSCS is specific to each job site. The unit shown in Figure 4 shows a graphical representation of the building with mode control switches available on each story. This example panel is detailed in the Appendix.

The controller is capable of reading analog signals of 0 to 5 VDC. An input configured as binary will read 0 volts as an ON condition (input shorted to the ground terminal) and 5 volts as an OFF condition (open). The 5 volts provided by the input can also be used for measuring passive devices such as thermistors.

An emergency circuit should supply the AC line voltage to all devices used for smoke control if one is available. An emergency circuit is generally fed by a generator or alternate source if the main power to the building is lost.

High Rise Example

In multistory buildings, a floor-by-floor containment approach is often chosen to control the flow of smoke. The floor at which the fire occurs will be placed in an exhaust mode to create a low pressure at that level. Floors above and below the smoke filled zone will be pressurized to prevent infiltration and allow time for occupants to escape safely. The stairwell is also pressurized so that occupants can leave any floor including the smoke filled zone and enter a smoke free passage to the outside. Stairwell pressurization can be from a constant volume fan in many applications but in larger buildings this may need to be a variable speed or variable volume fan controlled by the static pressure at some point or points in the stairwell. If the pressure is too high, doors may not open properly, putting lives at risk. If the pressure is too low, due to doors being left open, smoke may enter the stairwell.

In the example shown in Figure 5, a fire has started on the second floor. A command is sent out from the FSCS panel to activate that floor into an exhaust mode. A simple "Exhaust = ON" command is sent to the air handling unit controller on that floor. That local panel handles the logic of what to do in that mode. In this case, it has been programmed to run the exhaust fan and shut the supply fan off. The controllers on the first and third floors receive a "Pressurize" command. The stairwell fan is commanded to pressurize the stairwell tower.
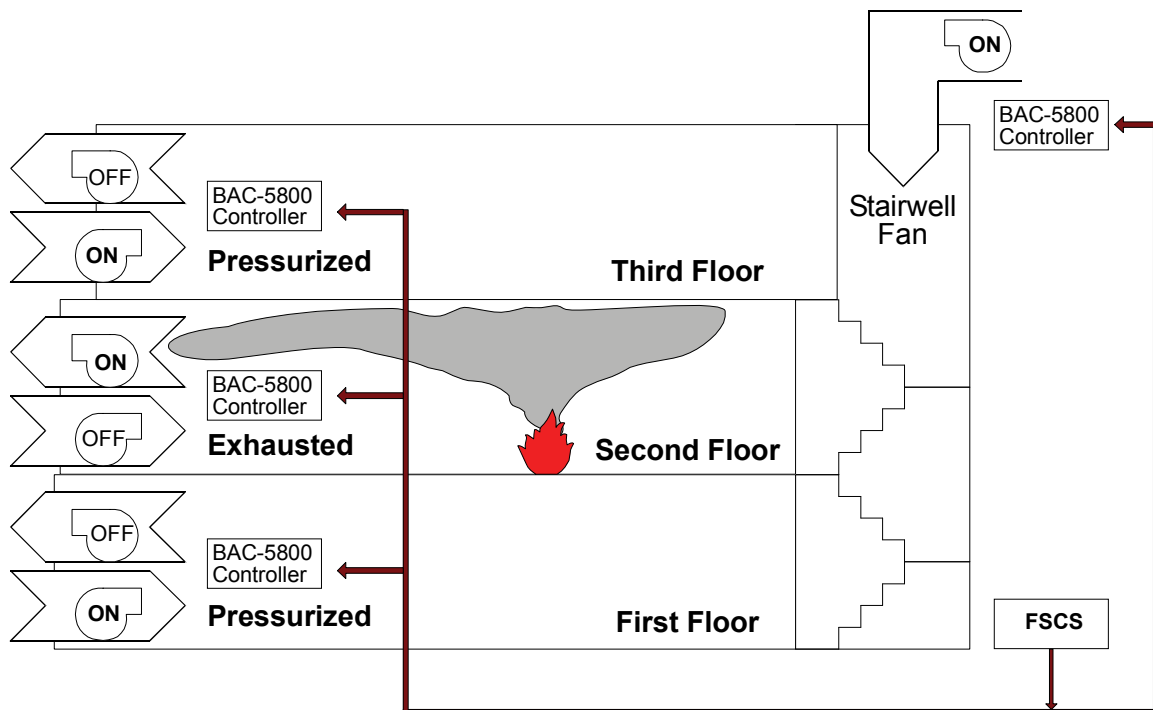
Figure 5: Multiple Story Smoke Control Strategy

Warehouse Example

For a warehouse or other building with large open areas and high ceilings, the smoke is exhausted from the top where it accumulates. The concept is to limit the depth of the smoke or increase the amount of time it takes to reach the escape paths.

In the example shown in Figure 6, the FSCS issues a command to the exhaust fan controller to pull the smoke out of the upper area of the warehouse. At the same time, the supply fan located near the ground is instructed to bring in outside air to assist smoke removal.
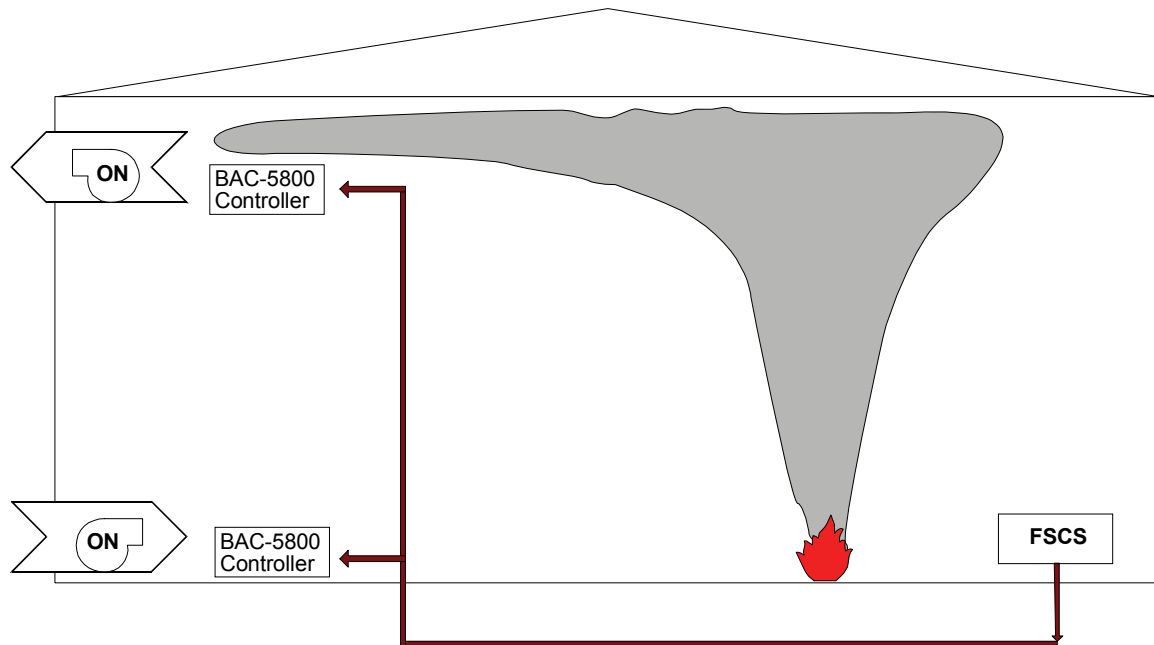
Figure 6: Warehouse Smoke Control Strategy

Stairwell and Zone Pressurization Principles

Contractors designing smoke control systems must be very knowledgeable of smoke control principles. Such knowledge is beyond the scope of this manual. Refer to the latest version of *NFPA 92A Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences* available on the National Fire Protection Agency's web site (www.nfpa.org).

Field Panels Wiring and Programming

Power Wiring Controllers and Repeaters

Figure 7 shows the correct mounting and wiring for the power connector on the controller or repeater. The power terminals are located on the terminal block on the lower right corner of the board.

Next A   Next B

Controller or Repeater

Power Limited

2" Min.

(L)
(N)

Branch Circuit

120 VAC 15 A, 60 Hz

Not Power Limited

Power Limited and Non-Power Limited wiring must be permanently separated by 2 inches (minimum) and shall be accomplished by clamping, routing, or equivalent means

Class 2 Wiring = Power Limited

Power Limited

Provide 15 Amp Branch Circuit:
  120 VAC, 60 Hz, 60° C, Cu Wire 14 AWG
  Panel Disconnect Provided by Installer
  Follow all local regulations and wiring codes when installing these products

2" Min.

Class 1 Wiring = Not Power Limited

Figure 7: Installation and Power Wiring

Enclosure

For smoke control applications, the controller must be mounted in a UL Listed Firefighter's Smoke Control Station (FSCS) enclosure or listed enclosure with minimum dimensions. The minimum enclosure size is 16 x 18 x 6 inches. KMC enclosures HCO-1034, HCO-1035, and HCO-1036 are approved for this application. (See also the Appendix: Installation Instructions for FSCS Enclosures.)

Transformer

Use only approved transformers for smoke control applications. KMC's model XEE-6112-100 (120-to-24 VAC, 96 VA) transformer has been tested and approved for this application. All circuits, including supply voltage, are power limited. AC power is non-supervised in smoke control applications.

Wiring and terminal blocks

Controller and repeater terminal blocks are removable for wiring convenience. Wire sizes 14–22 AWG can be clamped into each terminal. No more than two (16 AWG) wires can be joined at a common point.

Wiring the BAC-5800 Controllers in a Network

The BAC-5800 series controllers are capable of communicating over shielded, two-wire, twisted pair, EIA-485 wiring. Figure 8 shows the proper wiring for combining controllers on a network. The boards are wired together in a daisy-chain fashion. Any BACnet controller that has only 1 wire under the "A" terminal and 1 wire under the "B" terminal is considered to be an "End Of Line" unit, and the EOL switches should be turned on. All other boards must have End Of Line turned off. To maintain communications in case of an open conductor on the network cable, redundant wiring routed separately enhances reliability.
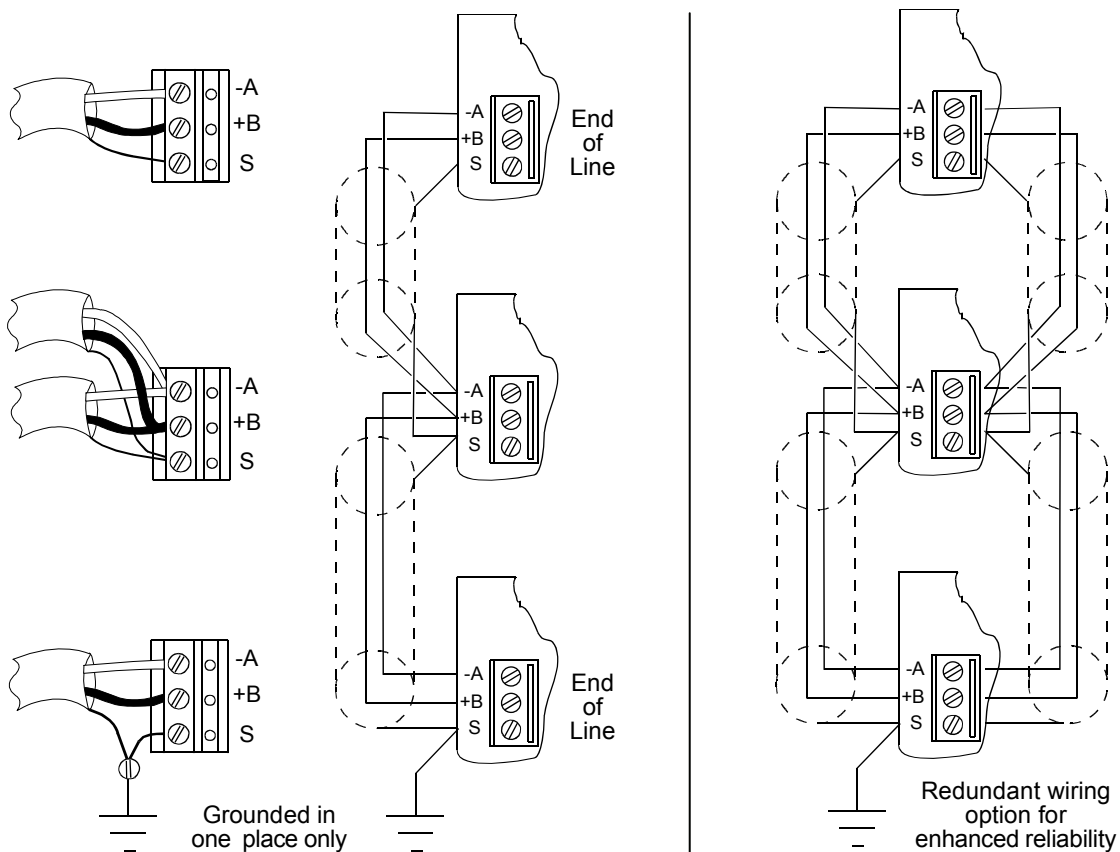
Figure 8: EIA-485 Network Wiring Details and Redundant Option

*NOTE: Only UL 864 components can be connected to the smoke control LAN.

Smoke control schemes should allow for supervising the MS/TP EIA-485 network for integrity. The FSCS should be equipped with both audible and visual indication of communications problems. The ground fault impedance value for the supervised MS/TP EIA-485 communications circuit is 0 ohms.

A KMC KMD-5567 surge suppressor (not shown in the illustration above) must be installed on the MS/TP line at every controller and repeater involved in smoke control as well as anywhere the cable enters or leaves the building. See also the Setting Up a BACnet System for Smoke Control section above.

Input Wiring on BAC-5800 Series Controllers

An HPO-0071 Transient Suppressor Board must be used with all inputs associated with smoke control applications as shown in Figure 9. If a controller has more than eight inputs, two HPO-0071s will be needed. See the HPO-0070/0071 installation guide (717-019-11) for installation details.

The DIP switch located near the Input terminal block provides a means of supplying 5 VDC to each individual Input point. Supplying 5 VDC allows the controller to read passive devices such as thermistors and dry contacts. If the input device is passive or has no power supply of its own, the pull-up resistor DIP switch for that input should be turned **On** (moved to the right). If the input device sends a voltage or current source to the controller, the switch should be turned **Off** (moved to the left).

Devices should be connected between an input and a ground. To use a 4–20 current loop input, connect a 250 ohm resistor from an input to ground. The resistor will convert the current input to a voltage which can be read by the controller analog-to-digital converter.

Input ground terminals are located next to the input terminals.

Inputs are **non**-supervised circuits in smoke control applications.
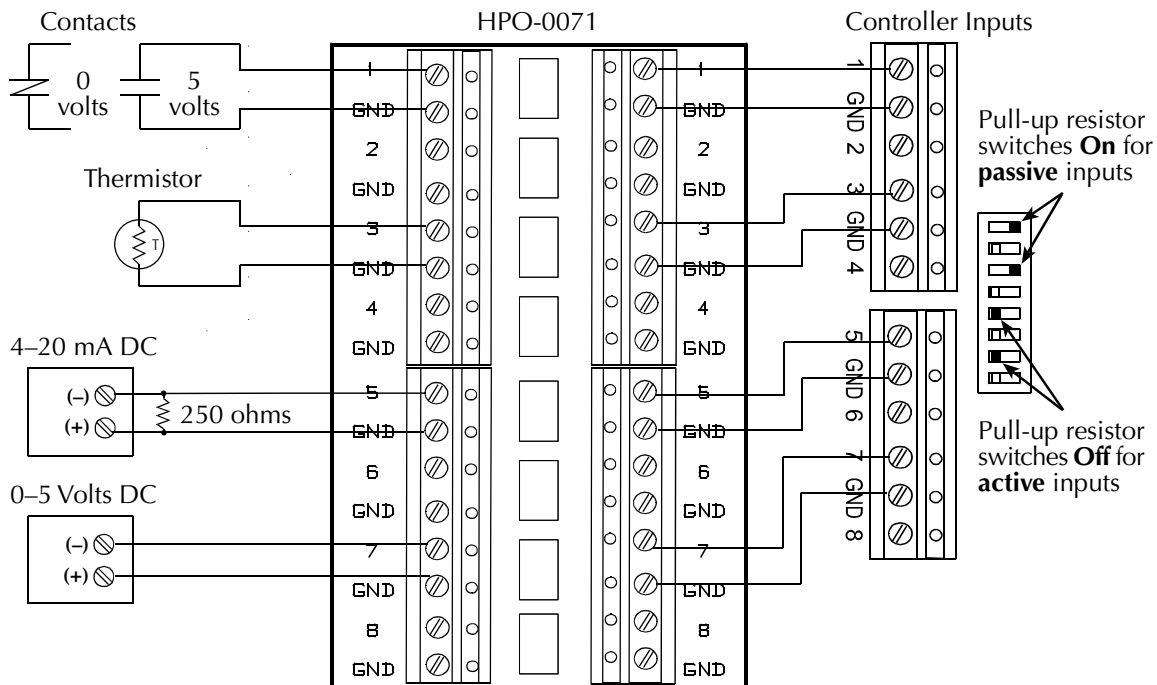
Figure 9: Typical Input Configurations (with HPO-0071 Transient Suppressor Board)

Output Wiring on BAC-5800 Series Controllers

An HPO-0070 Transient Suppressor Board must be used with all outputs associated with smoke control applications as shown in Figure 10. See the HPO-0070/0071 installation guide (717-019-11) for installation details.

The output terminal block is located on the right side of the board when oriented as in Figure 11. Each output point can supply binary 0 or 12 VDC (100 mA max.) to energize relays, lamps, or other two-position devices. Each output point can supply analog 0 to 10 VDC signal (100 mA max.) for proportional devices such as actuators. For either type of output, the DC voltage signals can—within the specification of the output—connect directly to most equipment.

Outputs are **non**-supervised circuits in smoke control applications.

A complete board-wiring example is located in the appendix.
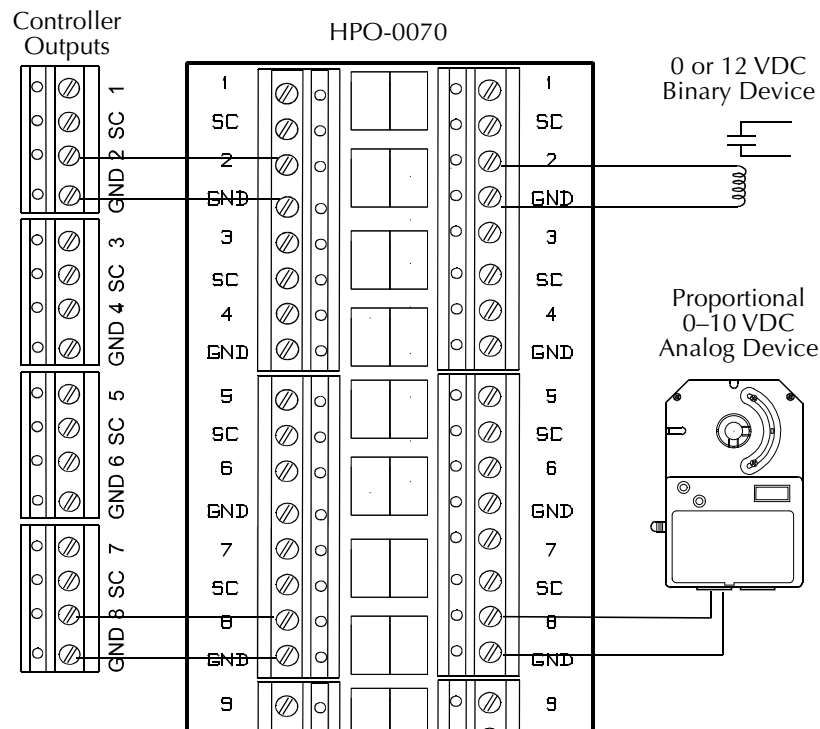
Figure 10: Typical Output Configuration for Binary and Analog Devices (with HPO-0070 Transient Suppressor Board)

For loads that exceed the output specifications of the controller, including loads that require AC, use an output override board.

Switched Common output terminals are unconnected in the controller unless an appropriate override output board is installed. **Use the Switched Common instead of Ground for the HPO-6701 triac.** The Switched Common terminals are isolated from the grounds used for the universal output analog circuitry in the controller.

Output override boards also offer enhanced output options. All include a "Hand-Off-Auto" switch for manual control. They are power limited and non-supervised. The following KMC output boards are approved for smoke control applications:

- HPO-6701   **Triac** (AC only): Zero-cross switching, optical isolation, 12 VAC min. and 30 VAC max. voltage, 20 mA min. current and max. current = 1 A for 1 board (0.8 A max. for 2 boards, 0.6 A max. for 3–4 boards, and 0.5 A max. for 5–8 boards)
- HPO-6704   **4–20 mA (@10 VDC) current loop**: Short protection, 100 ohm min. and 500 ohm max., adjustable override potentiometer (since the HPO-6704 supplies the power, it will not work with a 4–20 mA device that also supplies its own power)
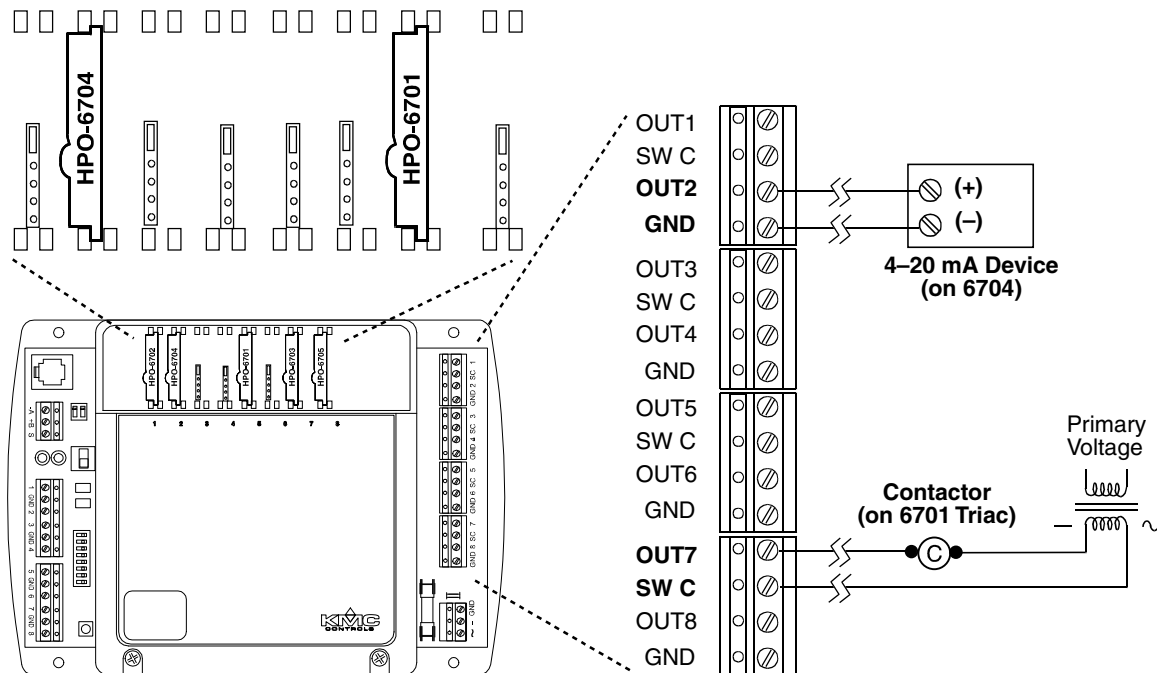
Figure 11: Output Override Board Options (Required HPO-0070 NOT Shown)

Programming the FSCS

The controllers in the FSCS perform the following functions:
- Read switch inputs
- Determine the proper mode for each piece of equipment
- Activate panel lamps and buzzers needed to display system conditions

The panel face of an FSCS contains switches to allow a fire fighter to put floors or zones into specific modes. Each switch position is tied to an input on the control board except for the "AUTO" position. When all inputs to a card are off, all smoke control commands are off and the field boards resume normal operation.

The following tables are for reference to the objects called for in the sample Control Basic programs. All objects listed in these tables would not be used on all controllers for a smoke control system:

SMOKE CONTROL INPUTS					
BI#	Description	Name	Present Value	Units	Object type
1	ALARM BUZZER SILENCE	ALMSILNC	Off	Off/On	Binary
2	DAMPER OPEN LIIMIT	DMPOPEN	Open	Closed/Open	Binary
3	DAMPER CLOSE LIMIT	DMPCLOSE	Open	Closed/Open	Binary
4	AHU-1 PRESSURIZE	1PRES.SW	Off	Off/On	Binary
5	AHU-1 OFF	1OFF.SW	Off	Off/On	Binary
6	AHU-1 PURGE	1PURGE.SW	Off	Off/On	Binary
7	AHU-1 EXHAUST	1EXH.SW	Off	Off/On	Binary
8	LED TEST	1LED.SW	Off	Off/On	Binary

SMOKE CONTROL OUTPUTS					
BO#	Description	Name	Present Value	Units	Object type
1	AUDIBLE ALARM	ALARM	Off	Off/On	Binary
2			Off	Off/On	Binary
3	AHU-1 AUTO LED	1AUTOLED	Off	Off/On	Binary
4	AHU-1 PRESS LED	1PRESSLED	Off	Off/On	Binary
5	AHU-1 OFF LED	1OFFLED	Off	Off/On	Binary
6	AHU-1 PURGE LED	1PURGLED	Off	Off/On	Binary
7	AHU-1 EXHAUST LED	1EXHLED	Off	Off/On	Binary
8	COMM FAULT	1COMMLED	Off	Off/On	Binary

SMOKE CONTROL BINARY VALUES					
BV#	Description	Name	Present Value	Units	Object type
1	AHU-1 PRESSURIZE STATUS	1_PRESS	Off	Off/On	Binary
2	AHU-1 OFF STATUS	1_OFF	Off	Off/On	Binary
3	AHU-1 PURGE STATUS	1_PURGE	Off	Off/On	Binary
4	AHU-1 EXHAUST STATUS	1_EXH	Off	Off/On	Binary
5	AHU-1 AUTO STATUS	1_AUTO	Off	Off/On	Binary
10	EXHAUST MODE	1EXHMD	Disabled	Disabled/Enabled	Binary
11	AUTO MODE	1AUTOMD	Disabled	Disabled/Enabled	Binary
30	SYSTEM TEST	1SYSTST	Disabled	Disabled/Enabled	Binary

39	NETWORK COMM FINISH	NETFIN	Off	Off/On	Binary
40	NETWORK COMM START	NETSTART	Off	Off/On	Binary

SMOKE CONTROL ANALOG VALUES					
AV#	Description	Name	Present Value	Units	Object type
29	MINIMUM NETWORK TIMER	1MINTIME		Seconds	Analog
30	NETWORK TIMER	1NETTIME		Seconds	Analog
31	START TIME	1START		Seconds	Analog
32	STOP TIME	1STOP		Seconds	Analog
33	TOTAL NETWORK TIME	1TOTAL		Seconds	Analog
34	ALARM COUNTER	1ALMCNT			Analog

Programming Example: FSCS AHU 1 MODE
```
100 REM *** SET LAMP STATE BASED ON CONFIRMED MODE ***
109 REM AUTO MODE
110 IF BV5 AND BV11 THEN START BO3
115 IF NOT BV11 AND NOT BV5 THEN STOP BO3

119 REM PRESSURIZE MODE
120 IF BV1 AND BI4 THEN START BO4@1
125 IF NOT BI4 AND NOT BV1 THEN STOP BO4@1
```

(Note that programming examples in this book are only excerpts of complete programs, and they may differ from the needs of a particular installation.)

The naming convention for the example is as follows:

- Physical input points (switch positions) are BI#, and output points (LEDs) are BO#.
- Mode status returned from a panel are BV#.

Each switch position has been named in software to represent its function. When one of the rotary switches is moved from the Auto position, the FSCS interprets this as a command to start a given mode. It starts the mode by turning on a variable that can be read by a field unit such as an air handling unit controller. When the field unit positions its associated equipment in the proper configuration to achieve this mode, it sends a confirmation back to the FSCS. When the FSCS sees that the mode has been set, it turns on a lamp on the panel cover to show the request has been completed.

There may be more than three modes of operation, depending on the application. Additional details for programming the FSCS can be found in the Appendix.

Programming Field Devices

A simple program can be written in the KMC BACnet FSCS to perform the required functions (shown in Figure 3). Programs are written in a Basic language called Control Basic. Control Basic offers convenient commands for use in operating HVAC and other equipment. For a complete list of commands available see, for example, the BAC-5000 Reference Guide: BACstage Operator Workstation (902-019-63).

See the BACstage or TotalControl manuals for information on how to set up alarms on individual points. Note that, unlike KMD proprietary software, BACstage does not yet support using point names in Control Basic.

Writing at Priority 1 or 2 (Life Safety) in the BACnet Priority Array

In the standard command priorities of BACnet, **priority slot 1 is *Manual* Life Safety and priority slot 2 is *Automatic* Life Safety.**

If priority levels are not specified in Control Basic, values are written to priority level (or slot) 9, but all smoke control commands should be written at priority slot 1 ("xxx@1" in Control Basic, e.g., BO1@1) **or slot 2**. This will maintain the command until it is relinquished (e.g., by switching back to auto mode and no other alarms are active).

The relinquish command is "RLQ xxxxx" (e.g., RLQ BO1@1). This sets the present value to the value at the next highest priority in the array. If there are no other priorities with a value set, then it will go to the relinquish default.

Programs that control HVAC equipment based on human comfort or energy management **must** be written on lower priority slot (3–16) of the priority array, so they cannot override any life safety commands.

Isolating the Smoke Control System from the HVAC System

The equipment controllers in non-dedicated control systems perform both daily HVAC and emergency smoke control. Both of these operations utilize the same hardware to perform different tasks. However, they need to be maintained as separate "systems." In other words, the operation of the equipment for HVAC must **not** interfere with the Smoke Control system.

This is done to a large extent by programming smoke control in the field controllers as described in the previous topic. Also it is required that any component not listed for UL864 must be isolated from the smoke control bus. Finally, an interruption to the ability to perform smoke control must be annunciated at the FSCS. Any circumstance that will prevent a smoke control command from being executed must cause an audible alarm even during normal (non-smoke control) operation. A monitoring program will determine within 75 seconds if the smoke control commands can be sent. The following program will be in one of the controllers (the example assumes "Panel 1," device instance 1501) on the network:

```
10 REM *** NETWORK COMMUNICATION TIME MONITOR - FSCS PANEL 1 ***

20 IF POWER-LOSS THEN START P
30 IF P THEN GOTO 230
35 IF+ BI8 THEN START BO8 , START BO1 : REM *** LED TEST ***
37 IF- BI8 THEN STOP BO8 , STOP BO1

40 REM *** TEST TIMER ***
45 IF AV30 = 0 THEN END
50 IF AV30 < AV29 THEN AV30 = AV29
60 IF INTERVAL( AV30 ) THEN GOTO 180

70 REM *** POINT BV39 BEING WRITTEN BY PANEL 2 ***
80 IF+ BV39 THEN AV32 = TIME , AV33 = AV32 - AV31
90 IF- BV39 THEN AV32 = TIME , AV33 = AV32 - AV31

100 IF AV33 > 90 THEN START BO1 ELSE STOP BO1 : REM *** START AUDIBLE ALARM
        ***
```

```
110 IF AV33 > 90 THEN START BO8 ELSE STOP BO8 : REM *** START COMM ERROR
    LED ***
130 IF+ BO1 THEN INC( AV34 )
140 END

150 REM *** PANEL 1 WRITES BV40 ON THE LAST PANEL ***
160 REM *** EACH PANEL THEN WRITES BV40 ON CONTROLLER ONE MAC ADDRESS
    ***
170 REM *** LESS THAN ITSELF. PANEL 1 WILL TIME THE COMPLETE CYCLE. ***
180 1504-BV40 = NOT BV40
190 AV31 = TIME
200 BV40 = NOT BV40
210 END

220 REM *** ON POWER LOSS WAIT 30 SECONDS THEN RUN CHECK ***
230 IF TIME-ON( P ) < 0:00:30 THEN END ELSE STOP P
240 GOTO 180
250 END
```

The remaining controllers have the following program with the "1502" modified so that each monitors the controller with the device instance that is one less than their own.

```
5 REM *** COMM CHECK - ALL OTHER BOARDS***
10 IF+ BV40 THEN 1502-BV40 = BV40
20 IF- BV40 THEN 1502-BV40 = BV40
30 END
```

Note Panel 1 (device instance 1501) is the only one that uses the "NOT" statement in line 180.

IF the FSCS monitor program does not see the change take place in the last panel within 90 seconds, an alarm (BO1) will sound to indicate trouble.

In the event of a power loss, the Real Time Clock (in BAC-5831 and BAC-5801) will maintain time and date information for 72 hours. After 72 hours, time and data information may be lost. The functions affected by this loss include Schedules and Trend Log time and date stamps. Neither of these would affect smoke control sequences in a non-dedicated system. They would affect normal HVAC operation and would be noticed by building personnel and would be corrected. RAM memory backup is maintained for 6 hours after power loss. After 6 hours, there may be loss of Trend Log data and the last recorded point information. Executive software and application programming is not affected since it is stored in nonvolatile flash memory. After power is restored, the executive program and application programs will be restored into the RAM memory, and the system will operate normally.

Testing and Maintenance

How to Test

A commissioning procedure takes place after the completion of the smoke management system to verify that it does work according to plan. Prior to installation of a smoke control system, a test procedure should be established. This procedure will describe the sequence that will take place for each scenario of the design. Such a procedure can be represented in a flow chart with an area for acceptance signatures.

Figure 13 shows an example of how a flow chart might look. Make sure a method for verifying the end result, and perhaps important steps along the path, are specified. Just because the exhaust fan is on in a zone does not mean the required pressure differential is being maintained. Measuring the zone pressures developed may indicate a problem or the need for a design change.

UNIT	A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	C-3	COMMENT
	ACTIVATED			ZONE			(WING-FLOOR)			
AHU-1	RUN	RUN	RUN	RUN	RUN	RUN	OFF	RUN	RUN	
AHU-2	RUN	RUN	RUN	RUN	RUN	RUN	OFF	RUN	RUN	
AHU-3	RUN	RUN	RUN	RUN	RUN	RUN	OFF	RUN	RUN	
AHU-4	RUN	RUN	RUN	RUN	RUN	RUN	OFF	OFF	OFF	
AHU-5	OFF	OFF	OFF	RUN	RUN	RUN	RUN	RUN	RUN	
AHU-6	RUN	RUN	RUN	OFF	OFF	OFF	OFF	OFF	OFF	
EF-A1	RUN	OFF	OFF	X	X	X	X	X	X	
EF-A2	OFF	RUN	OFF	X	X	X	X	X	X	
EF-A3	OFF	OFF	RUN	X	X	X	X	X	X	
EF-B1	X	X	X	RUN	OFF	OFF	X	X	X	
EF-B2	X	X	X	OFF	RUN	OFF	X	X	X	
EF-B3	X	X	X	OFF	OFF	RUN	X	X	X	
EF-C1	X	X	X	X	X	X	RUN	OFF	OFF	
EF-C2	X	X	X	X	X	X	OFF	RUN	OFF	
EF-C3	X	X	X	X	X	X	OFF	OFF	RUN	
DPR-1	OPEN	OPEN	OPEN	OPEN	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	
DPR-2	CLOSE	CLOSE	CLOSE	OPEN	OPEN	OPEN	CLOSE	CLOSE	CLOSE	
DPR-3	CLOSE	CLOSE	CLOSE	OPEN	OPEN	OPEN	CLOSE	CLOSE	CLOSE	
DPR-4	CLOSE	CLOSE	CLOSE	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	
APPROVED										
"X" INDICATES ANY STATE IS LEGAL IN THIS CONDITION										

Figure 13: Commissioning Flow Chart

Each test condition should include a failure simulation to verify the proper alarm is triggered in installations with automatic test routines. This will confirm that all the software is written correctly.

System Testing

KMC products are designed for non-dedicated smoke control systems. A weekly self-test is not required, but refer to local authorities for any testing requirements.

Security

BACstage and Total Control software provide system security by requiring a user name and password to use the program. Access via user names and passwords can range from full control to monitoring only. The system administrator can, for example:

- Add or delete the names of operators that have permission to view or change a system.
- Assign a password and grant permissions to individual operators.
- Assign a group display that will open when an operator signs on.
- Assign the highest level of write priority in a priority array that the operator may use when changing a present value.

After the system is set up and approved, changes in configuration and programming should not be available to typical users. Set passwords to keep unauthorized users from modifying smoke control programs.

Maintaining the System

Once the KMC BACnet system has been configured and tested, it will continue to function for many years without maintenance of any kind. The BAC-5800 series controller contains a flash memory to maintain programming during power outages. There are, however, precautions that can be taken to ensure the integrity of the controller against human influences.

BACstage and Total Control software provide system security by requiring a password to use the program. **Set passwords to keep unauthorized users from modifying smoke control software after it has been approved.** User security can be set to allow/disallow users access to Control Basic programs. Control Basic programs should be written with smoke control separate from and higher in priority than daily HVAC operation. Highly visible warnings will also aid in keeping inadvertent changes from taking place. Remark statements like the ones shown below can be placed at the beginning of each program to prevent accidental modification.

```
10 REM ***    This is an example of a warning that could be included as a program header.
20 REM ***    Smoke damper control - first floor central
30 REM ***    DO NOT MODIFY THIS PROGRAM  !!!
40 REM ***    MODIFICATION OF THIS CODE SHOULD BE PERFORMED ONLY BY
50 REM ***    THE SYSTEM ADMINISTRATOR !!!
```

These precautions will help keep proven code intact. It is advised also to maintain a backup of all controllers on the network and a backup of the approved Control Basic code.

To document all points and programs contained on a controller, you can print individual screens or open the panel file in Notepad and print the text file.

Replacing the Fuse

KMC controllers do not require routine maintenance. If a fuse blows, investigate the cause, and then replace the fuse. To replace the fuse:

1. Remove the power jumper located near the fuse. (On a BAC-5831, remove the lower "override board" cover to access the fuse and power jumper.)
2. Carefully pull out the blown fuse from the fuse holder.
3. Carefully snap an identical fuse into the fuse holder. Use a (KMC P/N 902-600-05) 1.6 A, fast-acting, 5 x 20 mm fuse in a BAC-5831, or a (KMC P/N 902-600-04) 1 A, fast-acting, 5 x 20 mm fuse in a BAC-5801/5802.
4. Reinstall the power jumper.

Conclusion

A smoke control system should not be considered a primary system in the battle against fire produced smoke. It can, however, deliver an added safety factor with only moderate cost by integrating it into the existing air handling system. The diversity of the BAC-5800 series controllers makes them useful tools in implementing smoke control functions.

This manual is not an attempt to make smoke control system designers out of its readers. It is intended as a guide for using the BAC-5800 series controllers to interface with the building's FSCS. The intent is also to provide ideas on commissioning and testing of equipment under the responsibility of the BAC-5800 series boards.

References

KMC BACnet Smoke Control Devices and Documents			
Model	**Description**	**Data Sheet Number**	**Installation Guide Number**
Smoke Control Manual	KMC Controls Smoke Control Manual for BACnet Systems	NA	000-035-08
BAC-5831	Advanced Application Controller	902-035-50	902-019-50
BAC-5801/5802	Advanced Application Controllers	902-035-40	902-019-40
HPO-0070/0071	I/O Transient Suppressor Boards	NA	717-019-11
HPO-6701/6704	(2 Models of HPO-6700 Series) Output Override Boards	902-035-10	902-019-02
KMD-5567	Suppressor Module and Terminal Connector	717-035-03	717-019-01
KMD-5575	Network Repeater-Isolator	873-035-02	873-019-02
XEE-6112-100	(1 Model of XEE-6000 Series) Transformers	717-035-20	NA

For more detailed information, the National Fire Protection Association publication *NFPA 92A Smoke-Control Systems* describes the recommended practices for smoke control systems utilizing an HVAC system. *NFPA 92B Smoke Management Systems in Malls, Atria, and Large Areas* may also be helpful.

The safety standard for smoke control systems is *the UL Standard for Safety for Control Units for Fire-Protective Signaling Systems, UL 864*.

The *National Electrical Code* is an important reference when designing and constructing any control system.

Another source for Engineers of smoke control systems is the ASHRAE publication of *Design of Smoke Management Systems* by John H. Klote and James A. Milke.

Glossary

BACnet	Building Automation Control Network, a nonproprietary, open, communication protocol standard, conceived by a consortium of building managers, system users, and manufacturers under the auspices of ASHRAE. BACnet defines how information is packaged for transportation between building automation system vendors.
BACstage	KMC software tool for configuring BACnet controllers that allows users to modify point data, view graphic displays, change programs, set user access levels, and view trend reports.
BAC-5800	KMC BACnet controller series.
BAC-5801	BACnet controller with 8 universal inputs, 8 universal outputs, and real time clock.
BAC-5802	BACnet controller with 8 universal inputs and 8 universal outputs (no real-time clock.
BAC-5831	BACnet controller with 16 universal inputs, 12 universal outputs, and real time clock.
Commission	A process of ensuring, verifying, and documenting that new equipment and systems are installed and able to operate according to the design intent.
Controller	A device that changes its output based on some sensed condition (feedback).
DDC	Direct Digital Control, a microprocessor-based device or network of devices that controls a system or process such as an HVAC system.
Field	Units or wiring external to the main device are referred to as field units or field wiring.
Field Panel	A protective metal housing containing one or more controllers. A field panel controls local devices, such as dampers and fans, and the field panel is networked to and controlled by the FSCS.
FACP	Fire Alarm Control Panel, a device for receiving and announcing the location of a fire, based upon input from smoke/flame/heat detectors, manual call points, or pull stations. It also sends a signal to the FSCS to initiate programmed smoke control procedures. (This manual does not address building or installing an FACP.)
FSCS	Firefighters' Smoke Control Station, a panel for use by the fire department for monitoring and overriding smoke-control systems and equipment. It receives fire/smoke information from an FACP and may initiate automatic pressurization and depressurization of appropriate zones to contain/exhaust smoke and allow for safe evacuation of the building.
HVAC	Heating, Ventilation, and Air Conditioning, a term generally used to describe a building's comfort system.
KMC	Kreuter Manufacturing Company, short for KMC Controls, which is the only privately held manufacturer of a full line of HVAC and building automation controls.

NFPA   National Fire Protection Association, an independent, voluntary-membership, nonprofit organization striving to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training, and education.

PC   Personal Computer, a microcomputer with price, size, and capabilities that make it suitable for personal usage. Common usage today indicates an IBM PC compatible that uses a Microsoft® Windows® operating system.

Points   Requests from one controller to another of a read or write property of a BACnet object.

TotalControl   New KMC software for configuring BACnet controllers (and other types of systems) that allows users to modify point data, view graphic displays, change programs, set user access levels, and view trend reports.

UL   Underwriters Laboratories Inc., a testing laboratory that develops standards and test procedures for materials, components, assemblies, tools, equipment, and procedures that relate mainly to product safety and utility.

UUKL Listing   Underwriters Laboratories' UUKL listing is a category code under UL 864, Control Units and Accessories for Fire Alarm Systems. UUKL is for products covered under the description "Smoke Control System Equipment."

XEE-6112-100   KMC's 120 to 24 VAC, 96 VA, power transformer. (Only transformers, such as the XEE-6112-100, that have been tested and approved for smoke control applications may be used in these systems.)

Appendixes

Air Handler Smoke Control Modes

The diagrams below define the equipment configuration for the various modes used in the FSCS in the example programming.
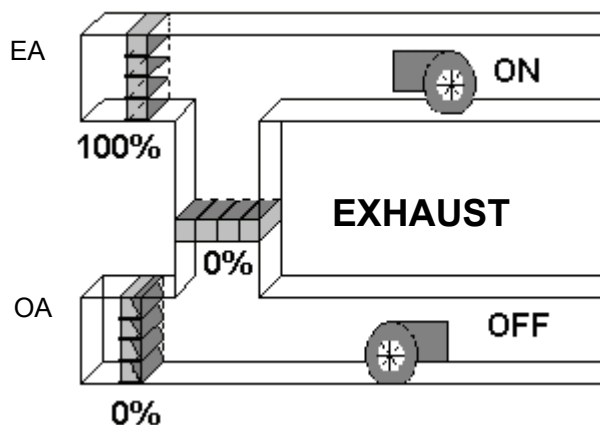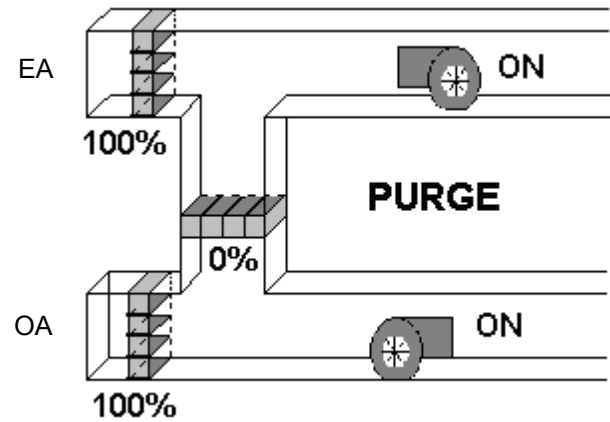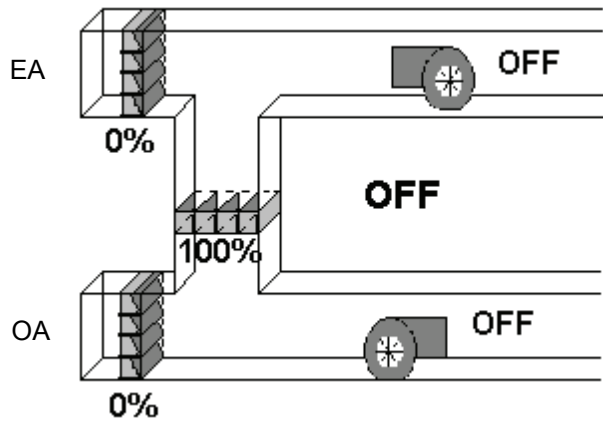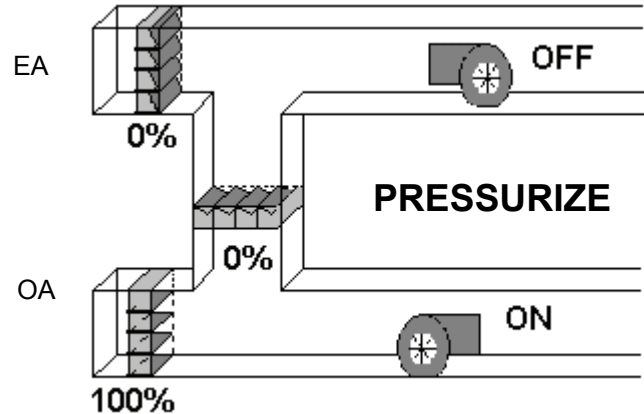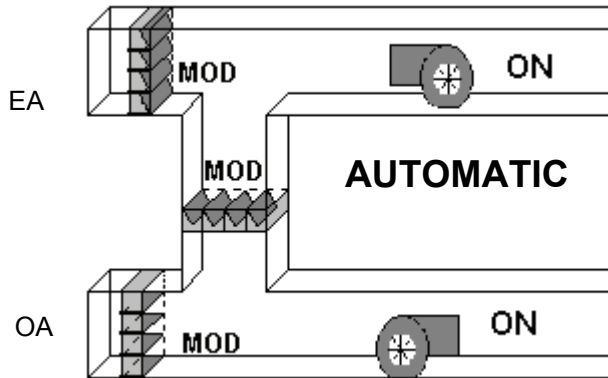
KEY

EA—Exhaust Air
OA—Outside Air

0%—Fully Closed
100%—Fully open
MOD—Modulating, controlling based on temperature or air flow; any position is acceptable

ON—Fan is running, moving air
OFF—Power is removed from fan

Installation Instructions for FSCS Enclosures

Enclosures should be securely mounted to the wall. The wall should be structurally capable of supporting the weight of the enclosure. (See also Figure 7.)

All wire entries to the enclosure shall be in conduit. Typical conduit entries should be located on the centerline of the sides, top or bottom of the enclosure. Actual location of conduit entry points varies per project and reasonable variations are allowed using the following guidelines.

- No conduit should be located within 1½ inch of any corner of the enclosure. No conduit entries should be located behind the electronics subplate mounted in the enclosure. (See attached sketch.)
- Care should be taken not to locate conduits where they will interfere or damage control panel electronics.
- Power-limited and non-power-limited circuits must be in separate conduits.
- Panel power input conduit should be located near the power supply input terminals. Power supply location varies per project.
- Conduits for data lines and optional remote fire system inputs should be located near their associated input terminals. Location of terminals for data lines and remote inputs varies per project.
- Your FSCS is provided from the manufacturer with transient suppressors for all external inputs including signal and power lines per the design specification of your particular job. Do not under any circumstances connect additional external circuits that are not part of the original panel specification to your FSCS without first consulting the factory.
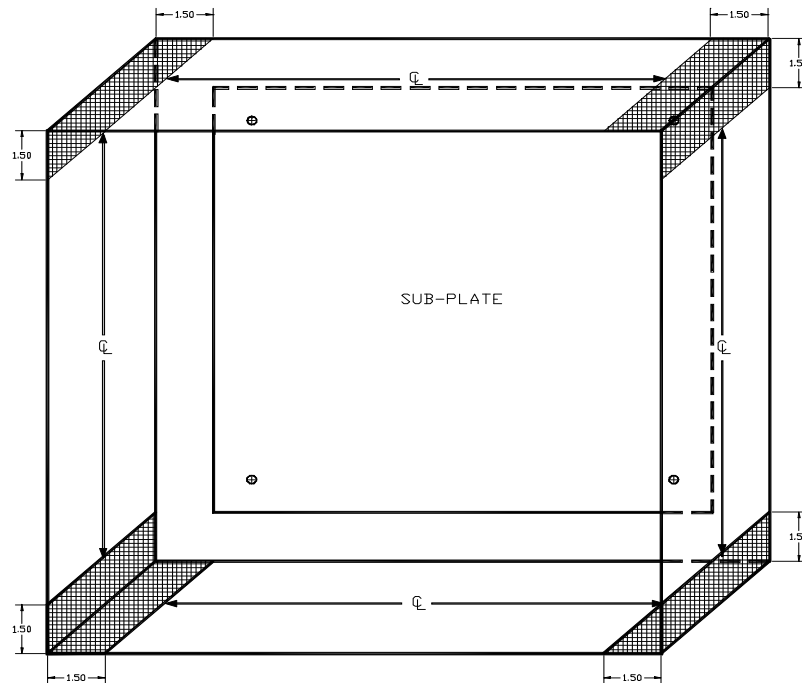
Adapted from August 23, 2000

FSCS and Field Panel Drawings

The following two pages contain sample drawings for a small FSCS panel. The example uses a four-story building with an air handler at each floor. There is also a stairwell fan for stair pressurization. A switch at each level allows the firefighting personnel to set each floor to the appropriate mode to isolate the smoke in the event of a fire.

In this example, all fans supply less than 2000 cfm. If fans have a capacity greater than 2000 cfm, the status of each fan must be indicated on the panel. This status must be sensed with a differential pressure sensor across the fan.

Two different examples for field panels are also given.
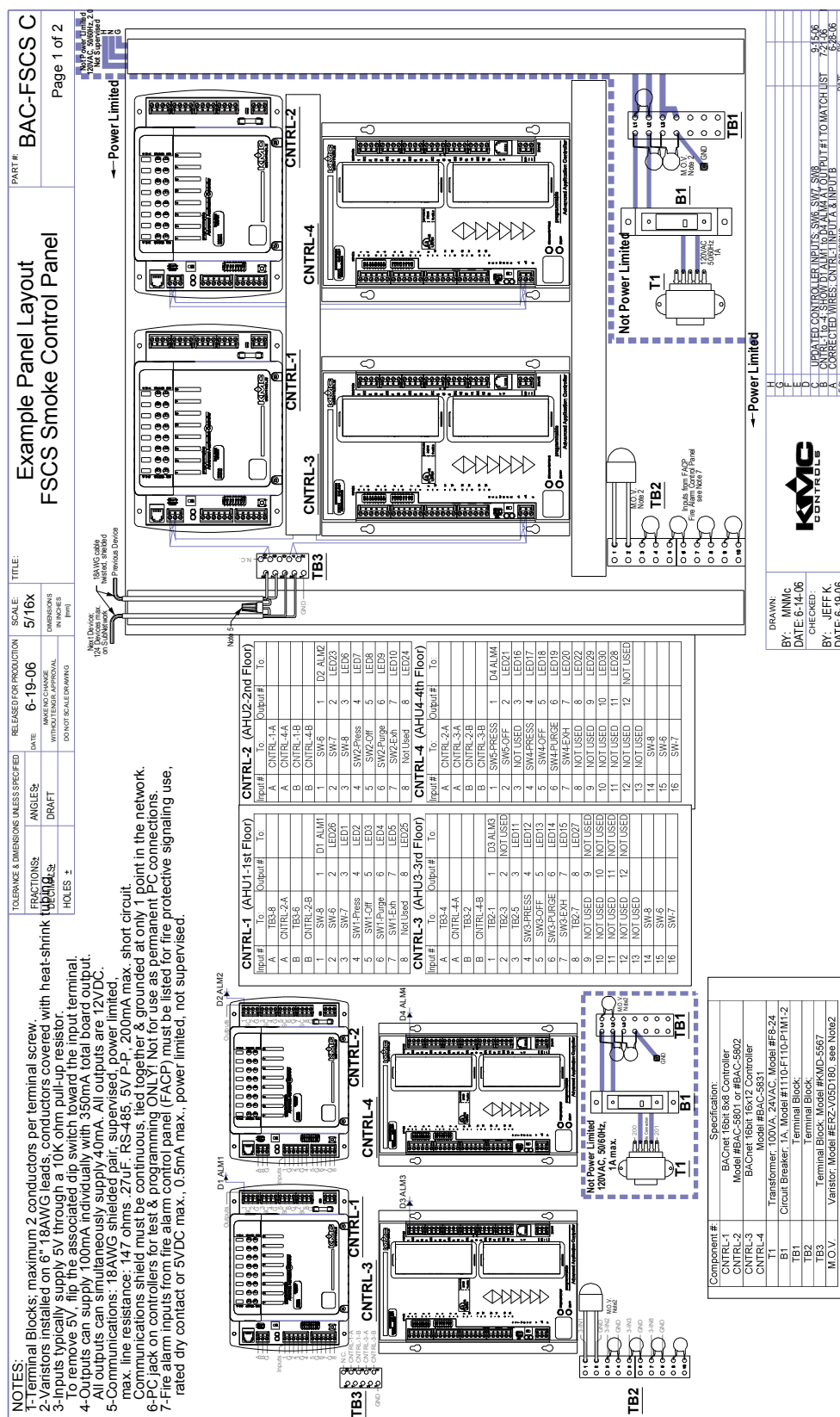
Example Panel Layout
FSCS Smoke Control Panel

BAC-FSCS C
Page 1 of 2

FIREFIGHTER'S SMOKE CONTROL STATION

TITLE: Example Panel Layout — FSCS Smoke Control Panel

PART #: BAC-FSCS C

Page 2 of 2

SCALE: 3/8x

RELEASED FOR PRODUCTION
DATE: 6-19-06
MAKE NO CHANGE WITHOUT ENGR. APPROVAL
DO NOT SCALE DRAWING

TOLERANCE & DIMENSIONS UNLESS SPECIFIED
FRACTIONS± ANGLES± DRAFT
DECIMALS±
HOLES ±

DIMENSIONS IN INCHES [mm]

DRAWN: MNMc
BY: DATE: 6-14-06
CHECKED:
BY: JEFF K.
DATE: 6-19-06

SEE PAGE 1 FOR ALL REVISIONS

ECO | REVISIONS | DATE | BY

KREUTER BUILDING
VIEW OF NORTH FACE

KMC CONTROLS

MODE DEFINITIONS

	SF	EF	OAD	RAD	EAD
PRESS	ON	OFF	OPEN	CLOSE	CLOSE
OFF	OFF	OFF	CLOSE	CLOSE	OPEN
PURGE	ON	ON	OPEN	CLOSE	OPEN
EXH	OFF	ON	OPEN	CLOSE	OPEN

SF = SUPPLY FAN
EF = EXHAUST FAN
OAD = OUTSIDE AIR DAMPER
RAD = RETURN AIR DAMPER
EAD = EXHAUST AIR DAMPER

Controller 1:

Inputs:
Alarm Silence	IN1 -	SW8	
Enable Key Switch	IN2 -	SW6	
Lamp Test Pushbutton	IN3 -	SW7	
AHU-1 Press	IN4 -	SW1	
AHU-1 Off	IN5 -	SW1	
AHU-1 Purge	IN6 -	SW1	
AHU-1 Exh	IN7 -	SW1	
Not Used	IN8 -		

Outputs:
Alarm	OUT1 -	ALM1	
1st Floor Fault LED	OUT2 -	LED26	
AHU-1 Auto LED	OUT3 -	LED1	
AHU-1 Press LED	OUT4 -	LED2	
AHU-1 Off LED	OUT5 -	LED3	
AHU-1 Purge LED	OUT6 -	LED4	
AHU-1 Exhaust LED	OUT7 -	LED5	
Comm. Fault	OUT8 -	LED25	

Controller 2:

Inputs:
Enable Key Switch	IN1 -	SW6	
Lamp Test Pushbutton	IN2 -	SW7	
Alarm Silence	IN3 -	SW8	
AHU-2 Press	IN4 -	SW2	
AHU-2 Off	IN5 -	SW2	
AHU-2 Purge	IN6 -	SW2	
AHU-2 Exh	IN7 -	SW2	
Not Used	IN8 -		

Outputs:
Alarm	OUT1 -	ALM1	
Panel Power LED	OUT2 -	LED23	
AHU-2 Auto LED	OUT3 -	LED6	
AHU-2 Press LED	OUT4 -	LED7	
AHU-2 Off LED	OUT5 -	LED8	
AHU-2 Purge LED	OUT6 -	LED9	
AHU-2 Exhaust LED	OUT7 -	LED10	
2nd Floor Fault LED	OUT8 -	LED24	

Controller 3:

Inputs:
Dry Contact Input	IN1 -	TB2.1	
Dry Contact Input	IN2 -	TB2.3	
Dry Contact Input	IN3 -	TB2.5	
AHU-3 Press	IN4 -	SW3	
AHU-3 Off	IN5 -	SW3	
AHU-3 Purge	IN6 -	SW3	
AHU-3 Exhaust	IN7 -	SW3	
Dry Contact Input	IN8 -	TB2.7	
Not Used	IN9 -		
Not Used	IN10-		
Not Used	IN11-		
Not Used	IN12-		
Not Used	IN13-		
Alarm Silence	IN14 -	SW8	
Enable Key Switch	IN15-	SW6	
Lamp Test Pushbutton	IN16-	SW7	

Outputs:
Alarm	OUT1-	ALM1	
Not Used	OUT2-		
AHU-3 Auto LED	OUT3-	LED11	
AHU-3 Press LED	OUT4-	LED12	
AHU-3 Off LED	OUT5-	LED13	
AHU-3 Purge LED	OUT6-	LED14	
AHU-3 Exhaust LED	OUT7-	LED15	
3rd Floor Fault LED	OUT8-	LED27	
Not Used	OUT9-		
Not Used	OUT10-		
Not Used	OUT11-		
Not Used	OUT12-		

Controller 4:

Inputs:
Stairwell Press	IN1 -	SW5	
Stairwell Off	IN2 -	SW5	
Not Used	IN3 -		
AHU-4 Press	IN4 -	SW4	
AHU-4 Off	IN5 -	SW4	
AHU-4 Purge	IN6 -	SW4	
AHU-4 Exhaust	IN7 -	SW4	
Not Used	IN8 -		
Not Used	IN9 -		
Not Used	IN10 -		
Not Used	IN11 -		
Not Used	IN12 -		
Not Used	IN13 -		
Alarm Silence	IN14 -	SW8	
Enable Key Switch	IN15 -	SW6	
Lamp Test Pushbutton	IN16 -	SW7	

Outputs:
Alarm	OUT1-	ALM1	
Stairwell Press LED	OUT2 -	LED21	
AHU-4 Auto LED	OUT3 -	LED16	
AHU-4 Press LED	OUT4 -	LED17	
AHU-4 Off LED	OUT5 -	LED18	
AHU-4 Purge LED	OUT6 -	LED19	
AHU-4 Exhaust LED	OUT7 -	LED20	
Stairwell Off LED	OUT8 -	LED22	
Stairwell Auto LED	OUT9 -	LED30	
Stairwell Fan Fault	OUT10-	LED29	
4th Floor Fault LED	OUT11-	LED28	
Not Used	OUT12-		

BACnet Field Panel Wiring Example #1

PART #: BAC FPW1

Page 1 of 1

Additional Controllers as needed

CNTRL-1

T1

TB1

next next B∘
∘A

NOTES:
1- Terminal Blocks; maximum 2 conductors per terminal screw.
2- Inputs typically supply 5V through a 10K ohm pull-up resistor.
   To remove 5V, flip the associated dip switch toward the input terminal.
3- Outputs can supply 100mA individually with 350mA total board output.
   All outputs can simultaneously supply 40mA. All outputs are 12VDC.
4- Communications: 18AWG shielded pair, supervised, power limited, max.
   line resistance: 147 ohms .27uF. RS-485, 5V P-P, 200mA max.short circuit.
   Communications shield must be continuous, tied together
   & grounded at only 1 point in the network.
5- PC jack on controllers for test & programming ONLY!
   Not for use as permanent PC connections.
6- Minimum enclosure size: 16" width x 18" height x 6" depth.

TOLERANCE & DIMENSIONS UNLESS SPECIFIED		RELEASED FOR PRODUCTION		SCALE:	TITLE:
FRACTIONS±	ANGLES±	DATE:	6-28-06	5/16x	
DECIMALS±	DRAFT	MAKE NO CHANGE WITHOUT ENGR. APPROVAL		DIMENSIONS IN INCHES [mm]	
HOLES ±		DO NOT SCALE DRAWING			

CNTRL-1

Input#	To:	Output#	To:
A	TB1-8		
A	next A		
B	TB1-6		
B	next B		
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	

Component #:	Specification:		
CNTRL-1	BACnet 16bit 8x8 Controller		
CNTRL-2	Model #: BAC-5801 or BAC-5802		
T1	Transformer Model #: XEE-6112-100		
TB1	Suppressor Module #KMD-5567 EDCO Model PC64C-015		

KMC Ring Panel #:	KMC Ring Panel Size:	Max. Qty. Controllers:
HCO-1034	16"w x 18"h x 6"d	2
HCO-1035	20"w x 24"h x 6"d	3
HCO-1036	24"w x 36"h x 6"d	8

DRAWN:
BY: MNMc
DATE: 6-27-06

CHECKED:
BY: JEFF K.
DATE: 6-28-06

KMC CONTROLS

H			
G			
F			
E			
D			
C			
B			
A			
ECL	REVISIONS	DATE	BY

BACnet Field Panel
Wiring Example #2

PART #:   **BAC FPW2**

Page 1 of 1

Additional Controllers as needed

T1

TB1

CNTRL-1

CNTRL-2

TOLERANCE & DIMENSIONS UNLESS SPECIFIED		RELEASED FOR PRODUCTION	SCALE:	TITLE:
FRACTIONS:±	ANGLES±	DATE: 6-28-06	1/4x	
DECIMALS±	DRAFT	MAKE NO CHANGE WITHOUT ENGR. APPROVAL	DIMENSIONS IN INCHES [mm]	
HOLES ±		DO NOT SCALE DRAWING		

NOTES:
1-Terminal Blocks; maximum 2 conductors per terminal screw.
2-Inputs typically supply 5V through a 10K ohm pull-up resistor.
  To remove 5V, flip the associated dip switch toward the input terminal.
3-Outputs can supply 100mA individually with 350mA total board output.
  All outputs can simultaneously supply 40mA. All outputs are 12VDC.
4-Communications: 18AWG shielded pair, supervised, power limited, max.
  line resistance: 147 ohms .27uF. RS-485, 5V P-P, 200mA max.short circuit.
  Communications shield must be continuous, tied together
  & grounded at only 1 point in the network.
5-PC jack on controllers for test & programming ONLY!
  Not for use as permanent PC connections.
6-Minimum enclosure size: 16" width x 18" height x 6" depth.

CNTRL-1

Input#:	To:	Output#:	To:
A			
A			
B			
B			
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	

CNTRL-2

Input#:	To:	Output#:	To:
A			
A			
B			
B			
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	

Component #:	Specification:
CNTRL-1 CNTRL-2	BACnet 16bit 8x8 Controller Model #: BAC-5801 or BAC-5802
T1	Transformer Model #: XEE-6112-100
TB1	Suppressor Module #KMD-5567 EDCO Model PC64C-015

KMC Ring Panel #:	KMC Ring Panel Size:	Max. Qty. Controllers:
HCO-1034	16"w x 18"h x 6"d	2
HCO-1035	20"w x 24"h x 6"d	3
HCO-1036	24"w x 36"h x 6"d	8

DRAWN:
BY: MNMc
DATE: 6-28-06

CHECKED:
BY: JEFF K.
DATE: 6-28-06

KMC CONTROLS

H					
G					
F					
E					
D					
C					
B					
A					
ECL	REVISIONS		DATE	BY	

Notes