

# FSKN Application Guide

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For initial start up and LED indications see  
*FSKN Installation Instructions*

For BACnet or Modbus programming see  
*FSKN BACnet and Modbus Information*

For wiring diagrams for various other electrical arrangements see  
*FSKN Application Guide*

[www.belimo.com/us/shop/en\\_US/Actuators/  
Fire-&Smoke-Actuators/FSKN24-BAC](http://www.belimo.com/us/shop/en_US/Actuators/Fire-&Smoke-Actuators/FSKN24-BAC)

or

[www.belimo.com/us/shop/en\\_US/Actuators/  
Fire-&Smoke-Actuators/FSKN120-BAC](http://www.belimo.com/us/shop/en_US/Actuators/Fire-&Smoke-Actuators/FSKN120-BAC)



The FSKN will typically be mounted on the damper sleeve. It may be remote mounted if more convenient for access due to space constraints.

Do not bridge damper sleeve and duct which must be free to fall away in the event of a ceiling collapse.

**Building and Fire Codes require building owners to periodically test fire and smoke dampers**

Containment dampers –  
Every 4 years in commercial buildings  
Every 6 years in hospitals

Smoke control system dampers -  
Non-dedicated – annually  
Dedicated – semi-annually

## Introduction - Fire and smoke dampers

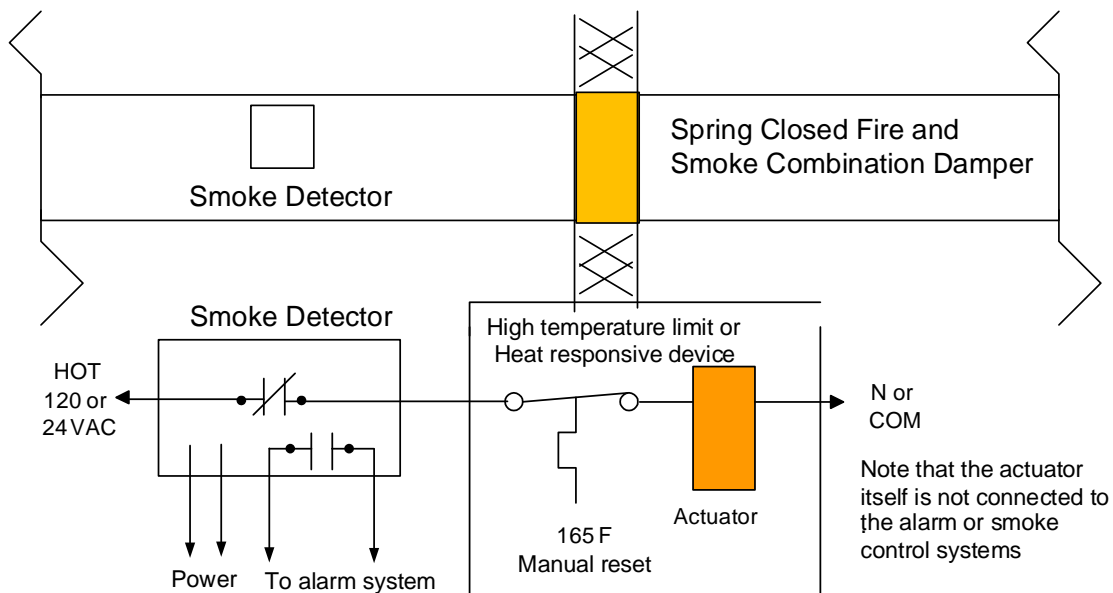
Figure 1 shows the most common combination fire & smoke damper installation and wiring. This is a containment damper required by Chapter 7 of the International Building Code in the US and other codes such as the National Building Code of Canada.

The actuator is powered continuously under normal conditions. If the smoke detector or a relay from an area smoke detection system opens its contact, power is removed from the actuator and it springs the damper closed. Likewise, if the bimetal temperature limit (primary heat responsive device in UL 555's terminology) senses elevated temperature, power is removed from the actuator and it springs the damper closed. Some fire dampers have fusible links and a jackshaft spring instead of the electrical limit.

Most containment dampers do not have switches for position indication.

Some containment applications require only smoke dampers and if so, the bimetal switch is not present. These are containment dampers, not smoke control system dampers. The distinction should be made. Actuated fire dampers are not common. They would not have the smoke detector in series with the power connections.

### Combination Fire & Smoke Damper



**Figure 1 Basic application**

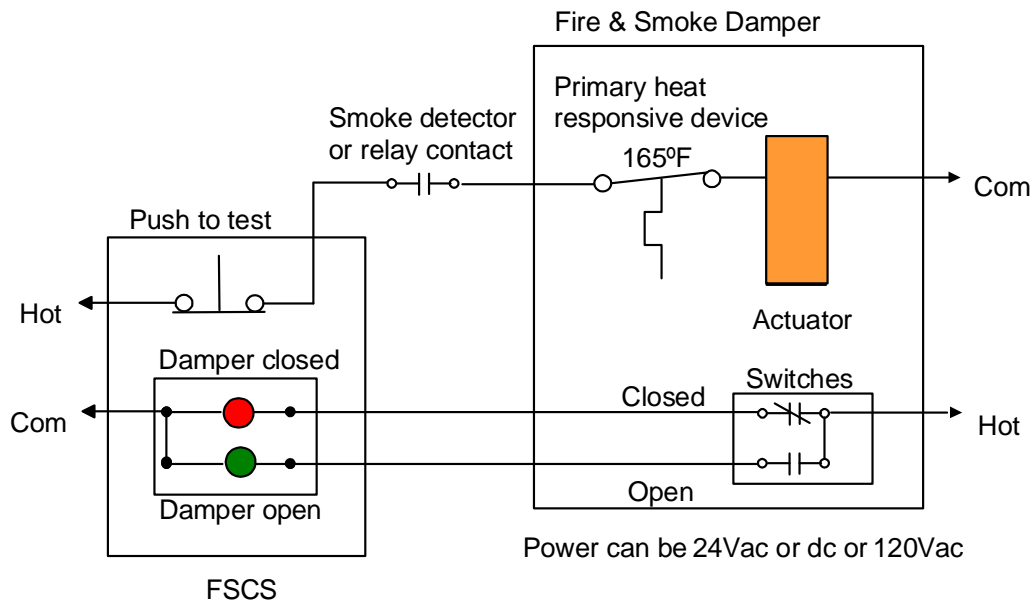
Figure 2 shows a manual test station that is sold by damper manufacturers and can be factory or field installed. Functionally, it is the same as the FSKN except cannot be connected to a network and must be tested locally. The switches are either actuator

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auxiliary switches or damper blade switches. Infrequently, magnetic or whisker blade switches are installed.

The test station has lights that indicate position – open or closed. The FSKN uses the same concept but instead of giving local indication, BACnet records the results.

### Fire & Smoke Damper with manual test station



**Figure 2 Typical manual test station and wiring to combination damper.**

Roughly 90% of actuated life safety dampers are installed to maintain compartmentation (containment, Chapter 7 of the IBC). About 10% are installed in smoke control systems (Chapter 9). The FSKN is for use only with IBC Chapter 7 containment dampers. Smoke control dampers are controlled by proprietary fire alarm or smoke control panels with modules dedicated to the purpose.

The FSKN is not a safety control. It is a testing module only. A large number of variations in Chapter 7 dampers exist. If custom wiring information is needed contact Larry Felker at [larry.felker@us.belimo](mailto:larry.felker@us.belimo) or 775 355-2461.

AC/DC 24 V, AC 120 V, and AC 230 V models are available.

The wiring diagrams here are typical and do not always distinguish among the voltages as the applications are identical as long as all voltages within a system are consistently coordinated.

Consult local codes for any other restrictions or requirements. Local fusing and back-up power are not required by Belimo or UL standards for dampers. If employed observe fuse or breaker ampacity restrictions in the specific actuator data sheet.

### Agency certifications

1. UL 60730 is the basic electrical standard and is required. The FSKNs are cULus listed to UL 60730. Actuators are listed to UL 60730 or UL 873.

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2. UL 2043 low plenum smoke production is not required as the FSKN enclosure is not flammable and would not generate smoke. All the Belimo actuators are UL 2043 listed.
3. UL 864 is the fire alarm code. The subcategory UUKL is smoke control components. Neither is required for containment dampers. Actuated life safety dampers are investigated to UL 555 & UL 555S, not UL 864.
4. The distinction between containment and smoke control (IBC Chapter 9) dampers is important. All major fire alarm companies have proprietary network interface modules for use in Chapter 9 damper connections. Codes require position indication and manual override capabilities for smoke control but not containment. The FSKN cannot override a damper open and may not be used in smoke control applications.
5. The FSKN may not be factory installed. The UL 555S standard does not distinguish between containment and smoke control damper applications. A damper intended for containment could be installed in a smoke control application in error.
6. The FSKN must be shipped separately and field installed. UL 555S testing is not required.
7. The FSKN is a testing interface. Its relay is normally closed so failure of the network, BACnet controller or the FSKN itself will have no effect on the normal damper safety functions. In a 350°F (177°C) test the FSKN continues to provide power to the smoke detector and damper mounted high temperature limit but the BACnet communications will typically fail. This leaves the normal damper safeties in the circuit and presents no danger.
8. The FSKN is for remote testing of containment dampers which all spring closed.

### FSKN function

The FSKN has four inputs and outputs

- a. Power into FSKN
- b. Power out to actuator
- c. Position indication switches from actuator into FSKN
- d. BACnet or Modbus communications.

The hardware for Modbus systems is identical to BACnet. The controller and dipswitch settings are different. Both typically use an R-S485 network. See Figures 3A and 3B.

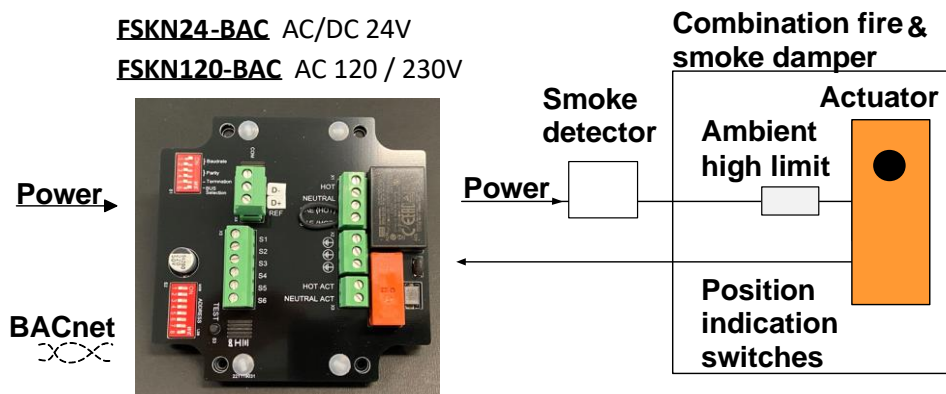
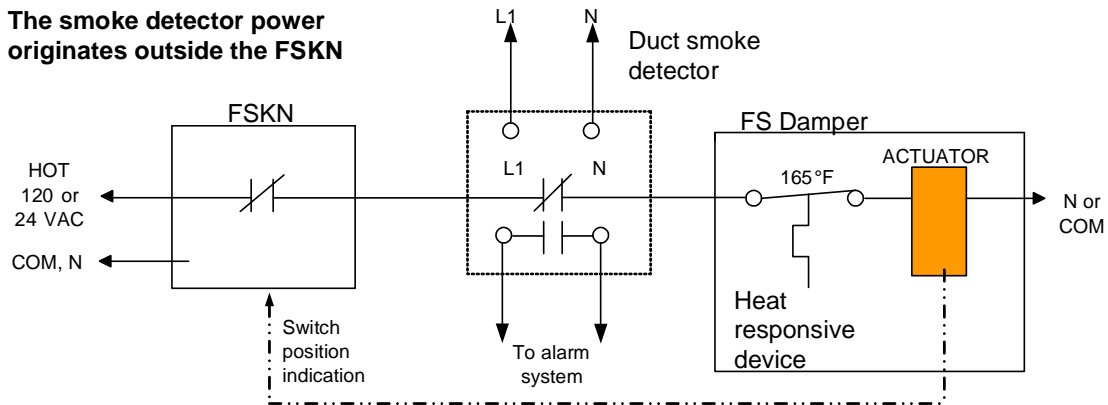


Figure 3A FSKN system

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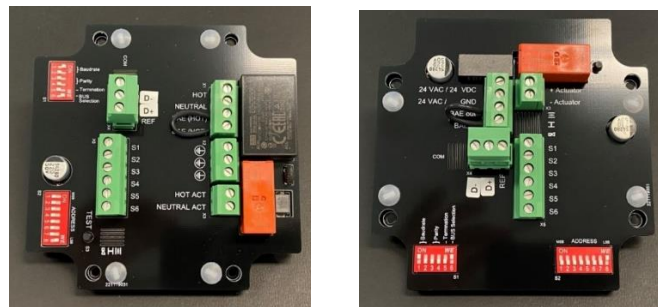
The FSKN is essentially a Normally Closed contact in series with existing safties as shown in the drawings. The BACnet and position indication switches are for testing only.

Figure 3B details the essential connections of a smoke detector. The power from the FSKN does not necessarily power the smoke detector. Its power can be provided by a separate circuit. In the drawings in this guide the power connections and alarm contact are not shown.



**Figure 3B Smoke detector in an FSKN system**

There are a few mechanical differences between the 120V version and the 24V version of the FSKNs. Grounding terminals are on the 120V version for case ground if needed. The LEDs are located in different places but function identically. Both boards have a reference grounding terminal for the RS-485 connections. This is connected to the controller network wiring NOT a local grounding terminal.



FSKN120-BAC

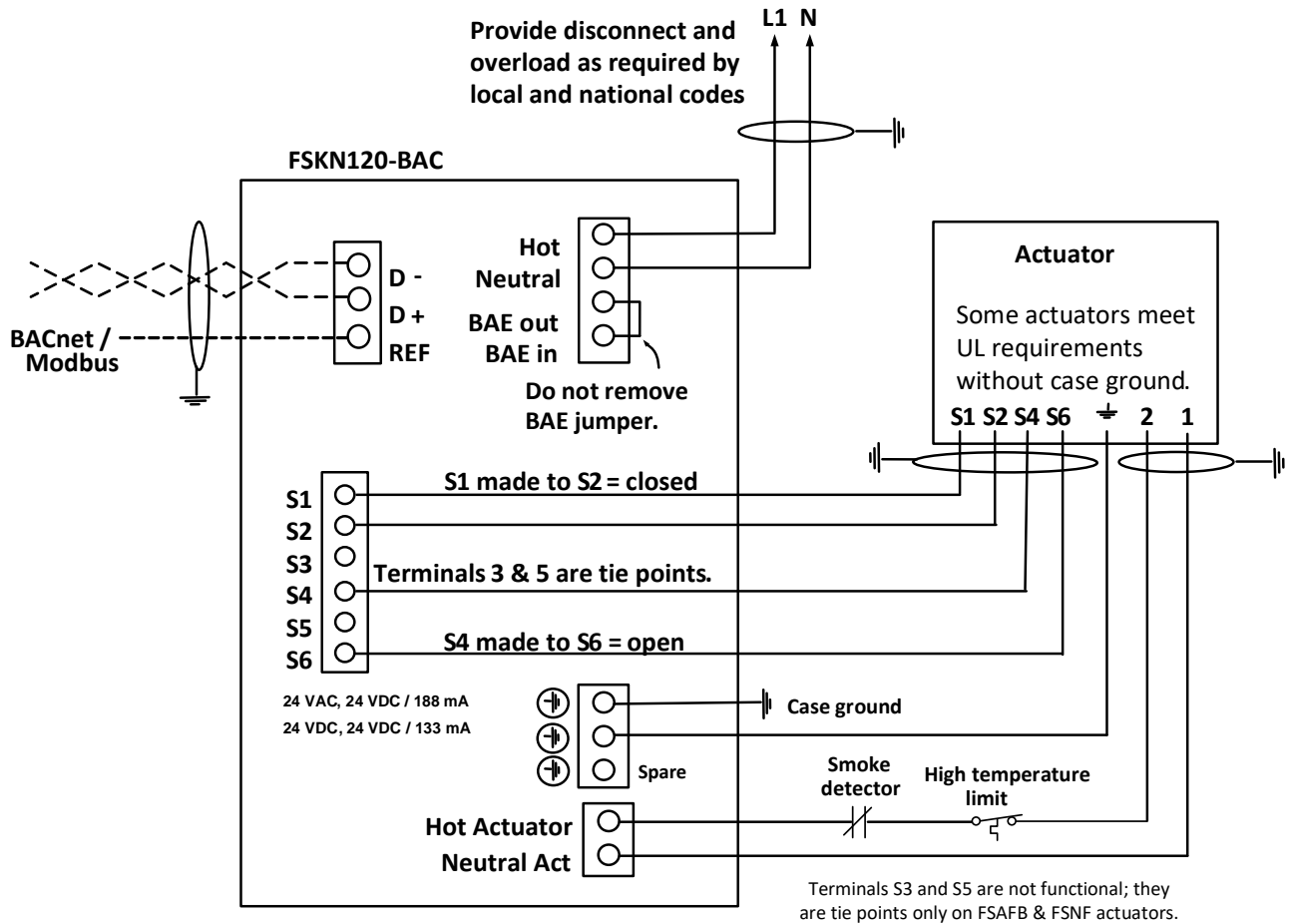
FSKN24-BAC

**Figure 4 120V and 24V boards with terminal strip differences**

## Standard wiring

Figure 5 shows the 120V wiring and Figure 6 shows the 24V wiring.

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**Figure 5 120V wiring connections**

In all drawings the high temperature limit (manual reset, "heat responsive device") is typically damper sleeve mounted while the actuator may be externally or internally mounted on a shaft. The smoke detector is typically duct mounted and must be within 5 feet of the damper. It may be damper sleeve mounted.

The FSKN can be mounted on the damper sleeve or near the damper where convenient. Do not mount in any way that restricts the duct from falling away from the damper.

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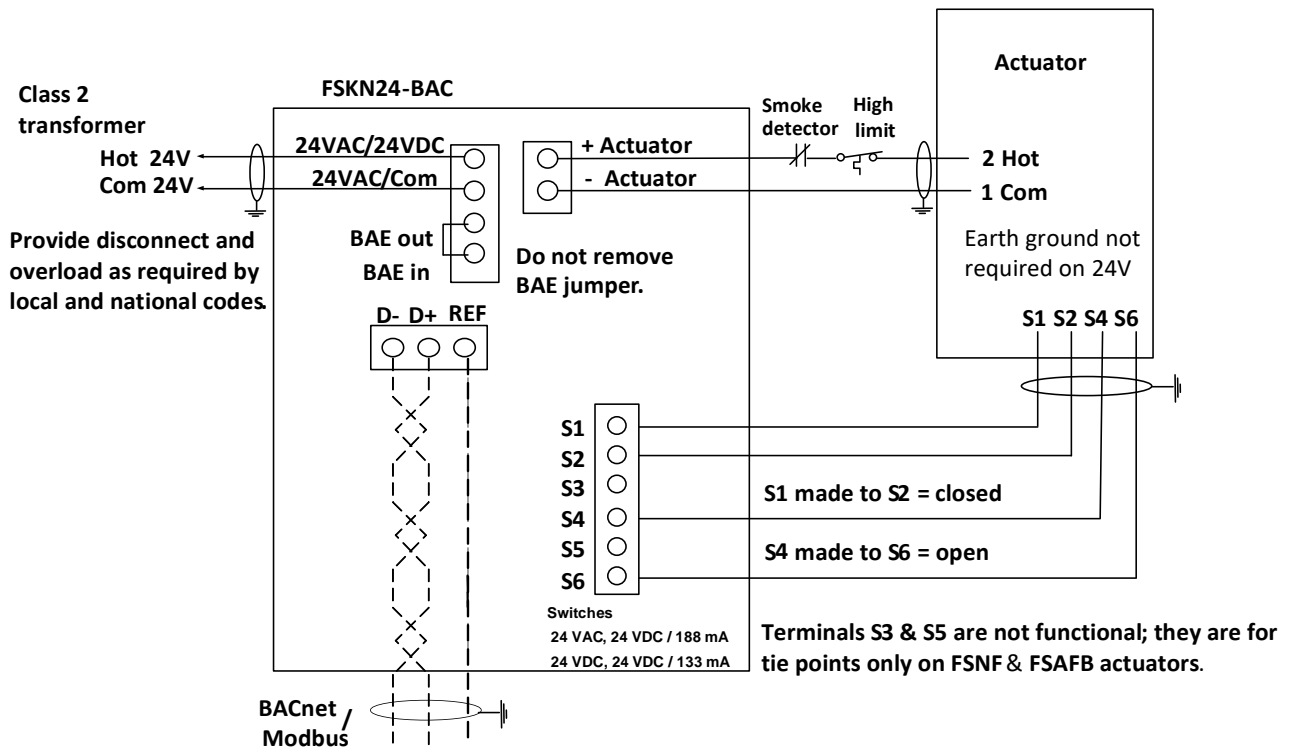


Figure 6 24V wiring connections

### Network Note:

If connected to a network with a mix of 2-wire (non-isolated) and 3-wire (isolated) devices, refer to the ASHRAE BACnet Standard or Modbus controller installation instructions for wiring and grounding information.

**3-wire networks are preferred to avoid any problems.**



## Applications and wiring diagrams

### Standard FSKN wiring

#### Standard duct smoke detector wired between FSKN and damper

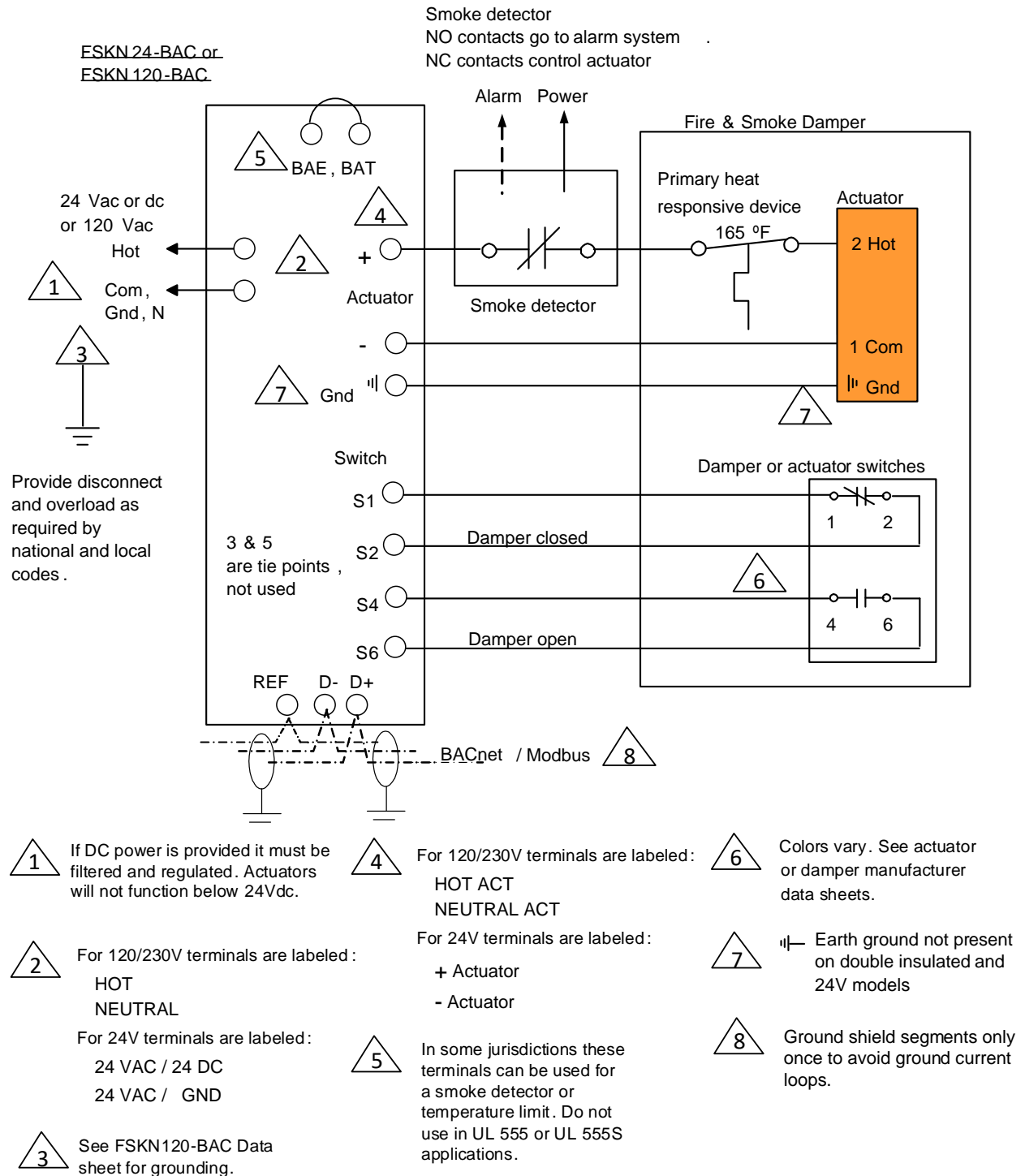


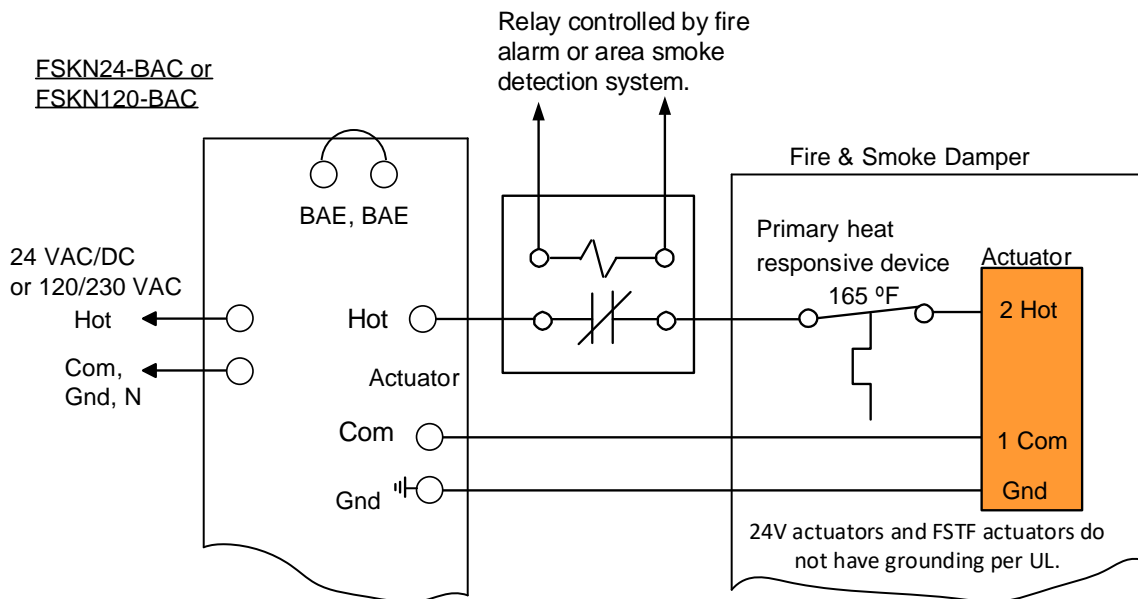
Figure 8 Standard combination fire and smoke damper with duct smoke detector

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### Relay from smoke detection system in containment applications

In some systems with area smoke detection a relay is used instead of connection to a smoke detector. This is shown in Figure 9. Connection to the fire alarm or smoke control system is only allowed for containment dampers that spring closed.

#### Relay wired between FSKN and damper actuator



**.Figure 9 Relay from area smoke detection system**

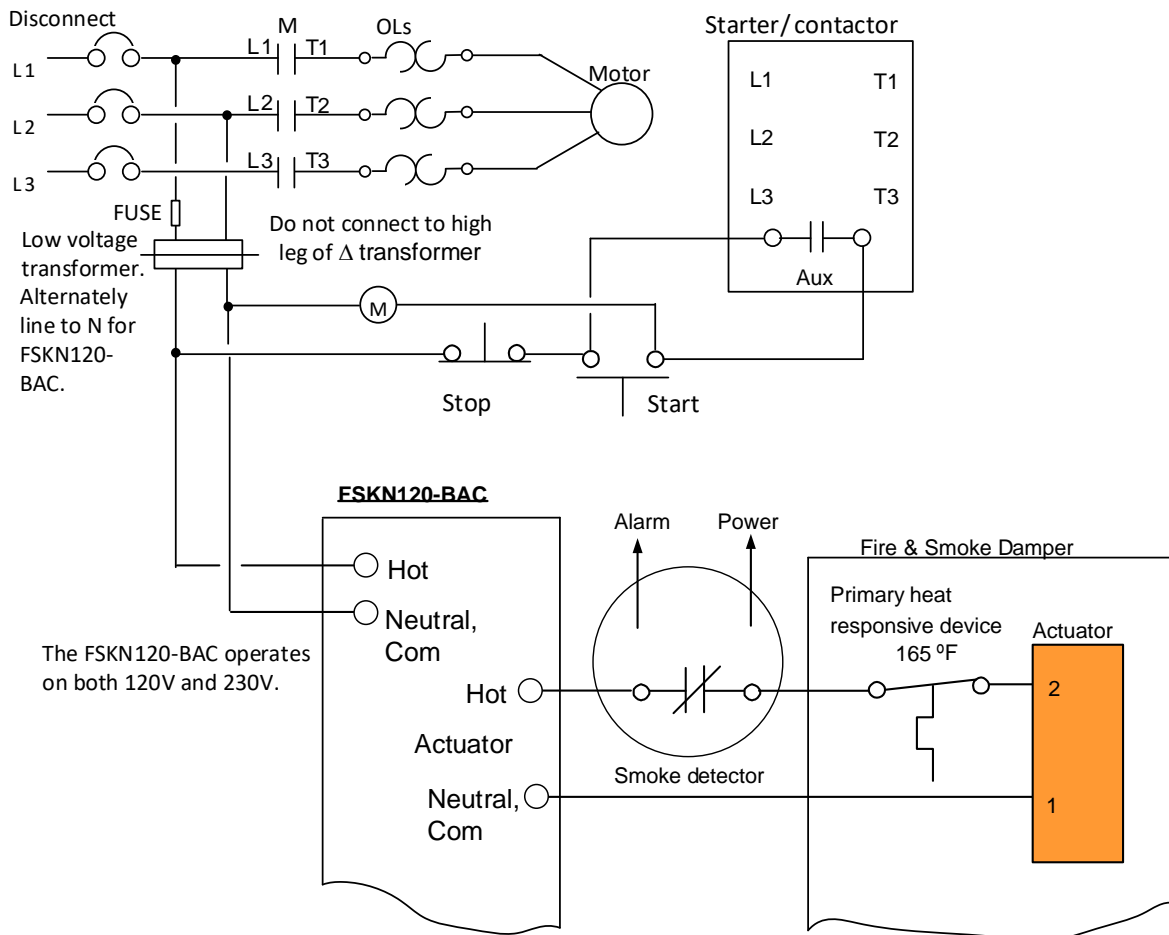
Notes:

## Fan wiring

### FSKN24-BAC and damper actuators powered open when fan is off

If it is desired to obtain damper position via the FSKN when fan is off, power the FSKN from the line side of the fan starter/contactator. The dampers then remain open when fan is off. FSKN and dampers could be powered from a circuit other than the motor control center.

**Starter and power wiring is typical. Do not use for field wiring without confirming sequence of operation**



**Figure 10 FSKN and actuator powered when fan is off**

## Fan shutdown considerations

In Figures 10 and 11, the power to the FSKN and actuator is maintained when the fan is shut down by the starter or contactor. Power to the FSKN and actuator is cut when the disconnect is opened. Two different fan start methods are shown.

The BACnet controller software needs to be told if any out of service message should be ignored or validated depending on the sequence of operation. Unoccupied periods are the main concern. However, if the controller software is not aware of the sequence, it could generate an exception report or failure message the same as loss of power, open wire, or open network would generate.

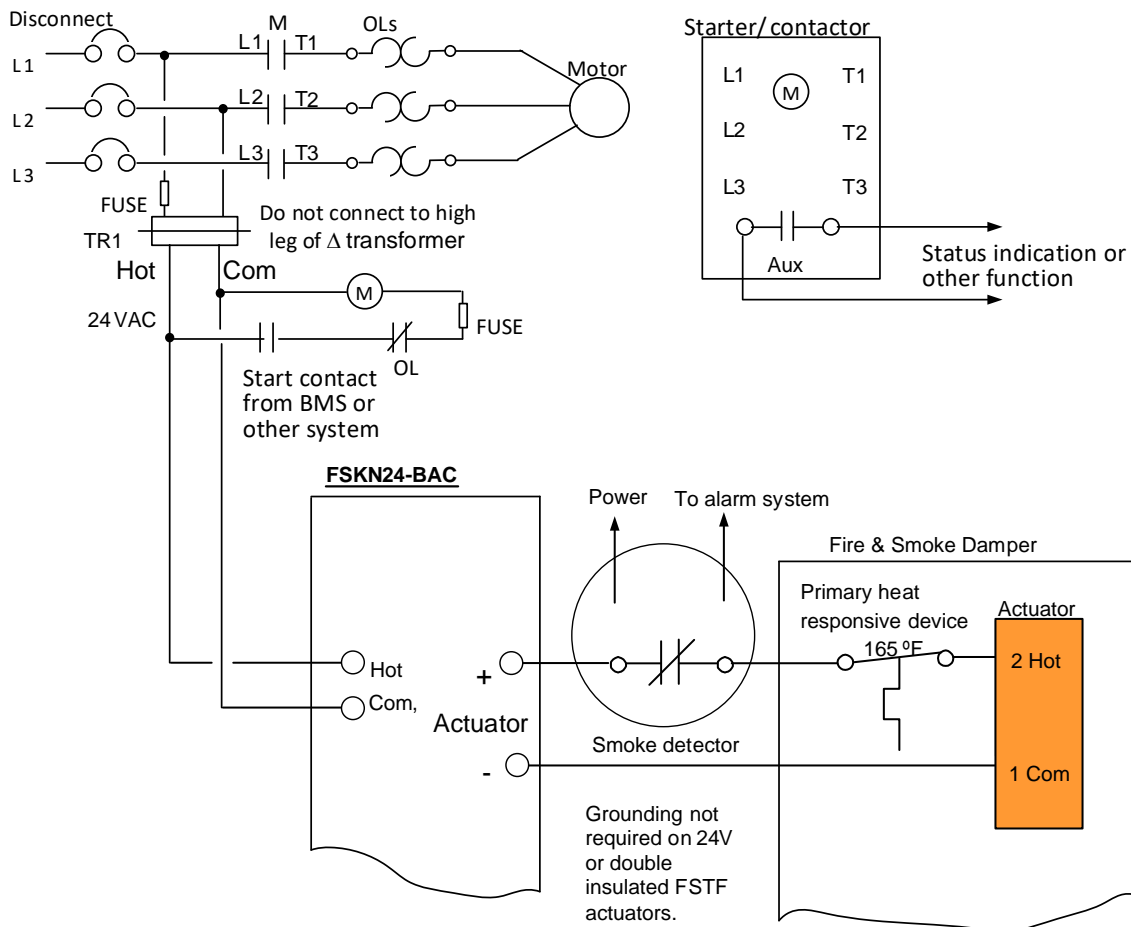
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No particular method is preferred with respect to the FSKN. The occupancy, application, or local codes should determine which method is chosen. NFPA recognizes both leaving the actuators powered and cutting power when fan is off.

### **FSKN24-BAC and damper actuators powered open when fan is off**

If it is desired to obtain damper position via the FSKN when fan is off power the FSKN on the line side of the fan starter/contactors. The dampers then remain open when fan is off FSKN and dampers could be powered from a circuit other than the motor control center.

**Starter and power wiring is typical Do not use for field wiring without confirming sequence of operation**



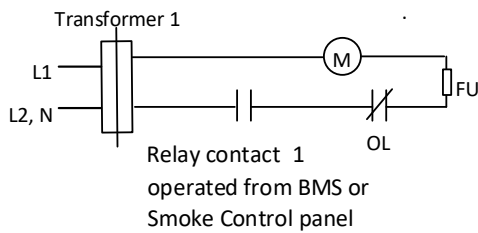
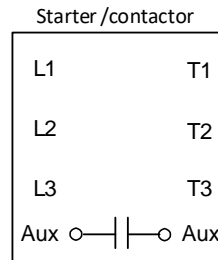
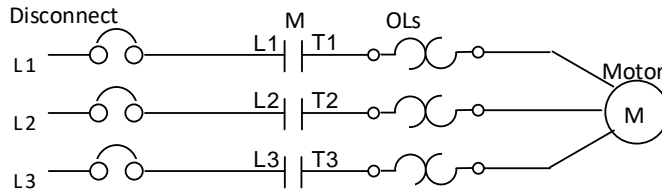
**Figure 11 Fan shutdown does not close dampers nor stop FSKN from reporting position**

The FSKN can be continuously powered as shown below in Figure 12 while the dampers close when the fan is off. The FSKN cannot perform a test until the fan is on and dampers are open.

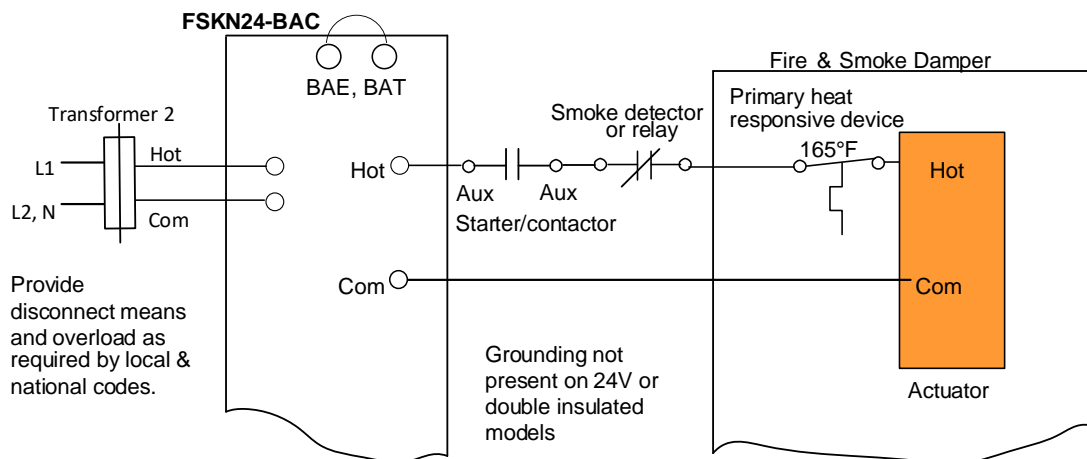
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### FSKN24-BAC powered while damper actuators and fan off

If it is desired to obtain damper position via the FSKN while fan is off and dampers are closed, power to the FSKN can be retained and the auxiliary starter contact used as shown. An FSKN120-BAC could be used and several variations in sequence of operation and wiring are possible.



Relay contact 1 energizes fan starter. Auxiliary contact makes which gives damper actuator power and it drives open. FSKN is continuously powered by Transformer 2. A test cannot be performed until the fan is on.



**Figure 12 Alternate wiring for FSKN24-BAC with fan off and dampers closed**

Notes:

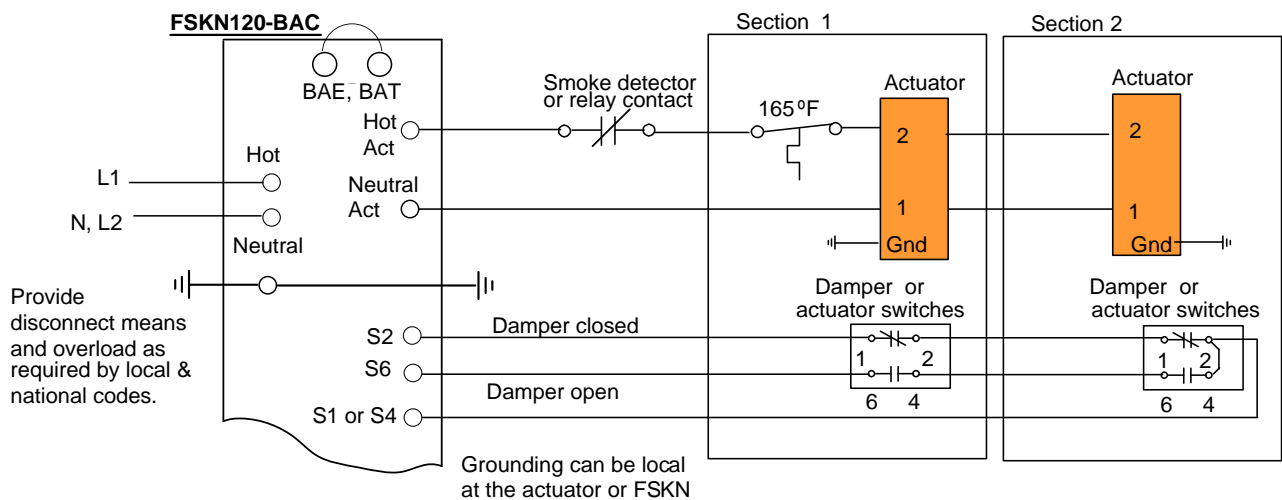
## Multiple dampers on one FSKN

If one FSKN is being used to test several dampers then the concepts in Figures 13A, B, or C can be used.

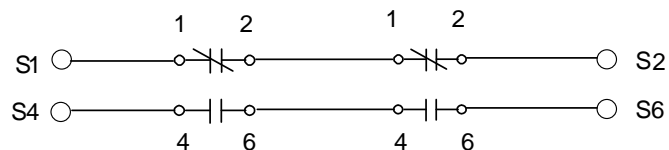
In Figure 13A there is one damper with two sections and two actuators. Note there is only one primary heat responsive device that cuts power to both actuators. This is a matter for the damper manufacturer and UL 555S. There are two sets of switches in this configuration. There is no code or standard regarding the switches. Refer to the damper manufacturer's instructions.

Note that terminals S1 and S4 on the FSKN are the voltage output terminals and are internally connected. Either a 3-wire or a 4-wire switch approach will work.

### One FSKN120-BAC connected to a two section damper with two actuators



3-wire method shown in drawing. Alternate below. Belimo number terminology shown.



**Figure 13A One FSKN120-BAC testing multiple actuators on one damper**

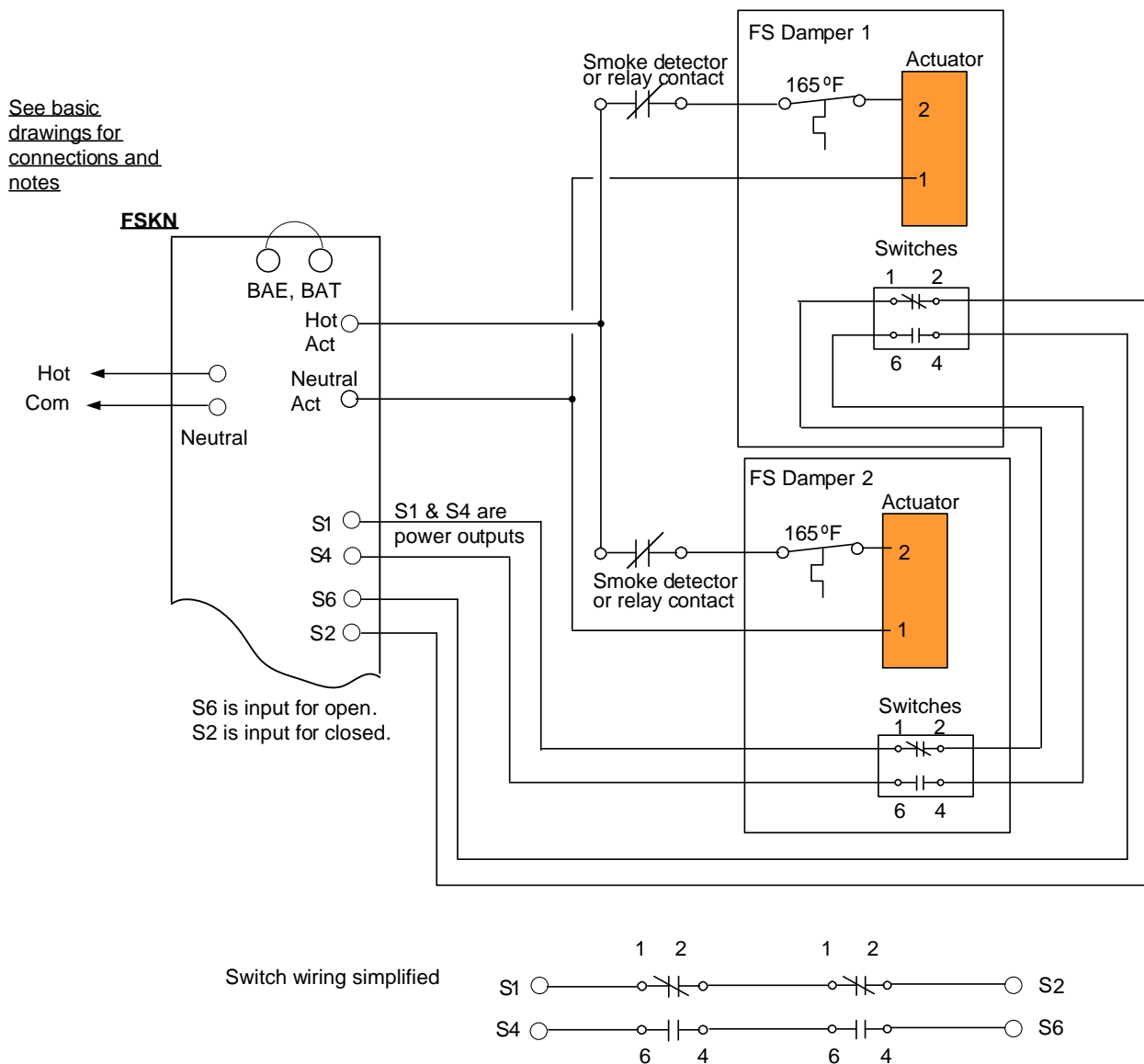
In Figure 13B there are two separate dampers. A typical application would be dampers in a supply and a return to the same floor or zone. There are two heat responsive bimetals. Each damper must have its own end proving switches so that both are tested.

The FSKN interrupts power to both dampers. Both sets of auxiliary or damper blade switches must make at the proper times to pass the test.

This is similar to Figure 13A but there are two high limits as the damper actuators are widely separated.

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## One FSKN connected to two actuators on separate dampers



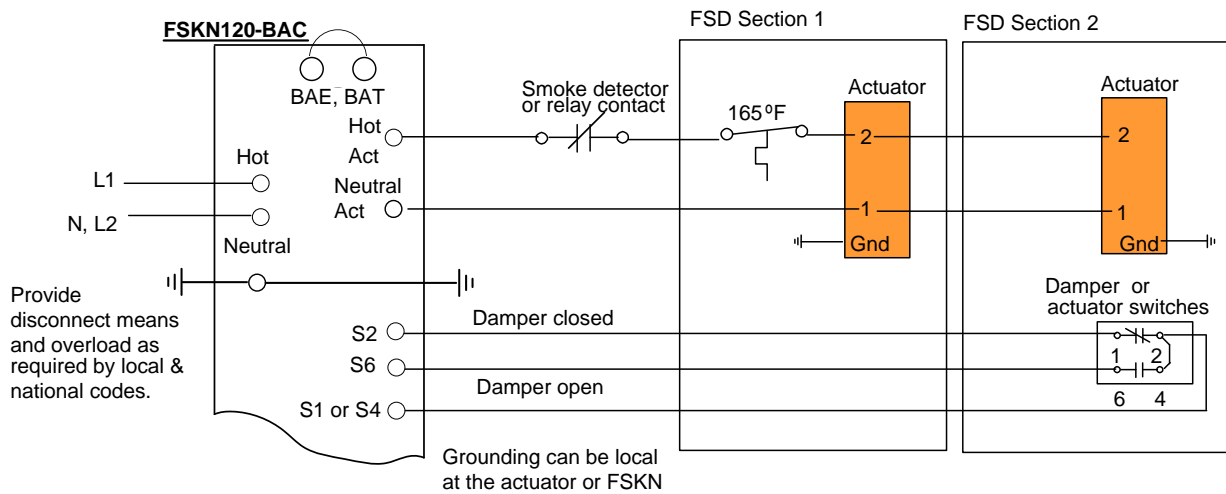
**Figure 13B Two separate dampers to be tested by one FSKN**

Figure 13C shows an alternate method. In addition to the drawings here other methods are viable. For example, one auxiliary switch could drive other actuators that are mechanically paralleled and just one damper actuator's aux switch signal position to the FSKN.

Figure 13C can be used in place of the method shown in Figure 13A. It shows just one set of switches used for a multi-section damper. Note there is only one heat responsive high limit since horizontally mounted sections are jack-shafted and vertical sections are connected by a tie-bar. Damper details not shown.

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### One FSKN120-BAC connected to two actuators on separate sections of the same damper assembly



**Figure 13C One FSKN connected to two actuators on a multi-section damper**

More than two actuators can be paralleled. If the current draw exceeds the FSKN ratings, use an isolation relay as shown in Figure 14.

If the actuators are mechanically paralleled, use the proper switch wiring methods shown in Figures 13A, B, or C

If the actuators are electrically paralleled but not mechanically paralleled, use the method shown in Figures 13A & 13B.

**Contact Belimo for wiring diagram advice in other situations**

Notes:



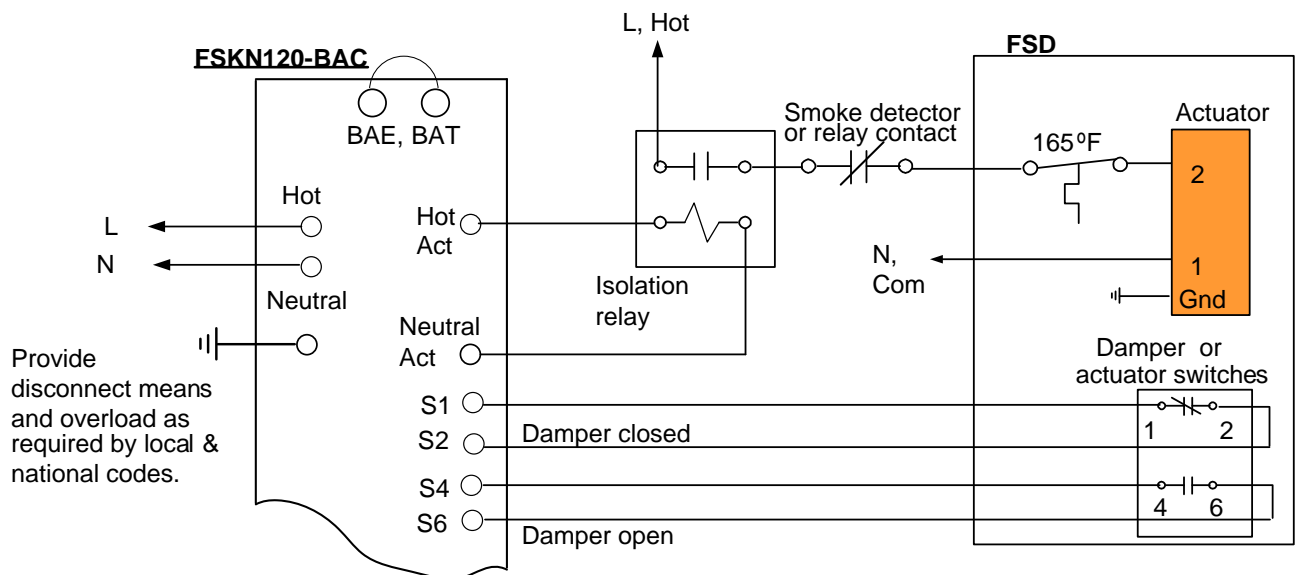
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### Isolation relay for separate FSKN and actuator circuits

Figure 14 shows an isolation relay used to test a two section damper. If the damper sections were horizontal and jackshafted together or vertical connected with a tie bar, only one actuator or damper would need to have the position indication switch. See Figure 13C.

The isolation relay can be used when the FSKN is a different voltage than the damper actuator(s) or if the existing power to the damper actuators is limited in current capacity and a second source is needed for the FSKN. Whether 24V to 120V or 120V to 24V is inconsequential.

### Isolation relay for different voltages or power requirements



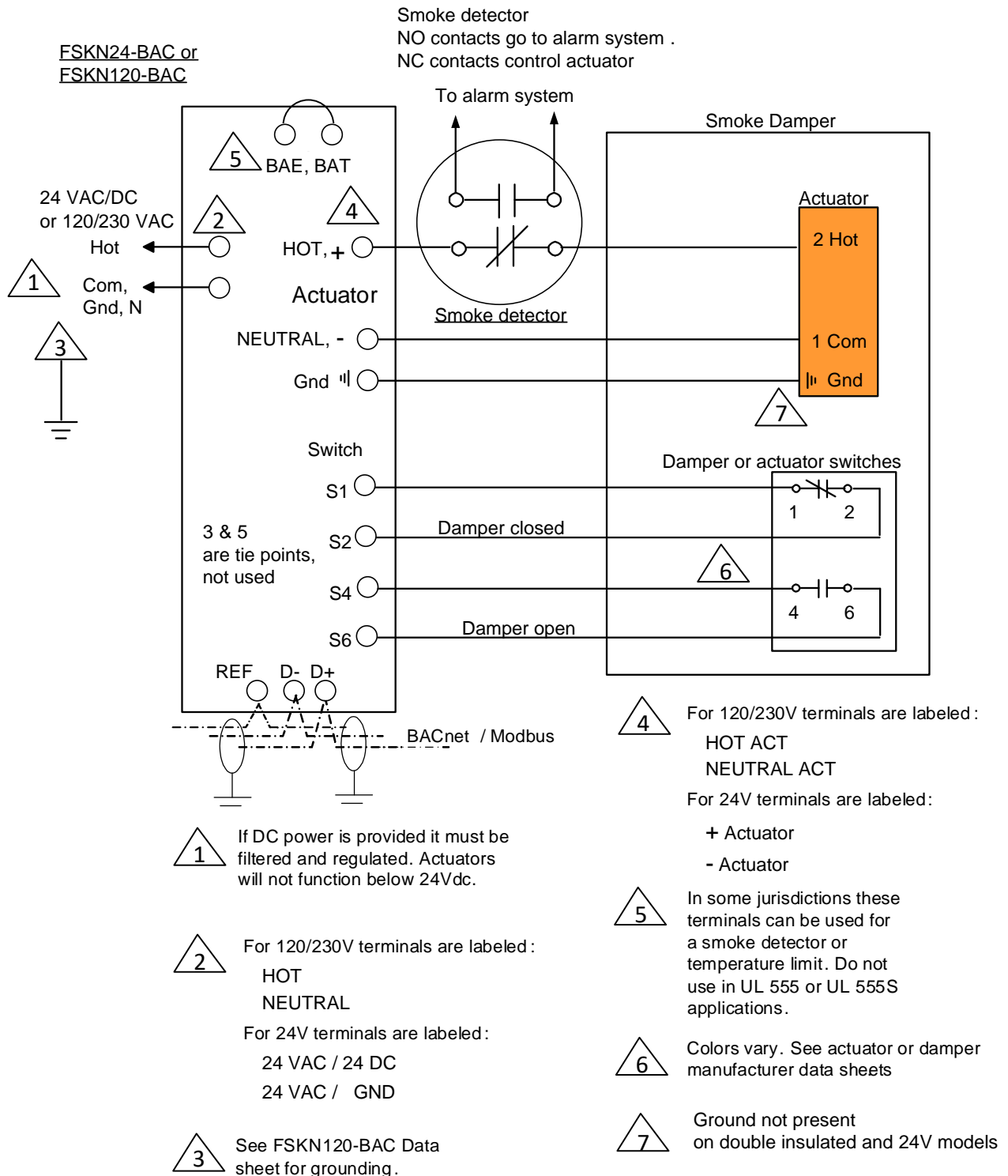
**Figure 14 Isolation relay for 120V circuits on different breakers or 24V to 120V isolation**

Notes:

## Smoke dampers

In some Chapter 7 containment applications a smoke damper will be installed (with a separate fire damper if required). The wiring connections are the same as for a combination damper except there is no high temperature limit. See Figure 15 below.

### Standard connection to smoke damper



**Figure 15 Smoke damper connection to FS**

## Normally open (spring open) dampers

**The FSKN may not be used in applications where the damper springs open. Spring open dampers are only used in smoke control systems.**

All containment damper applications are spring closed. No normally open dampers are allowed. Some smoke control system dampers, Chapter 9 of the IBC, are spring open. Atria make-up air dampers are an example. They open to supply fresh air while the atria exhaust fans remove the smoke.

## Modulating actuators

### FSAFB24-SR-S WITH TWO TRANSFORMERS

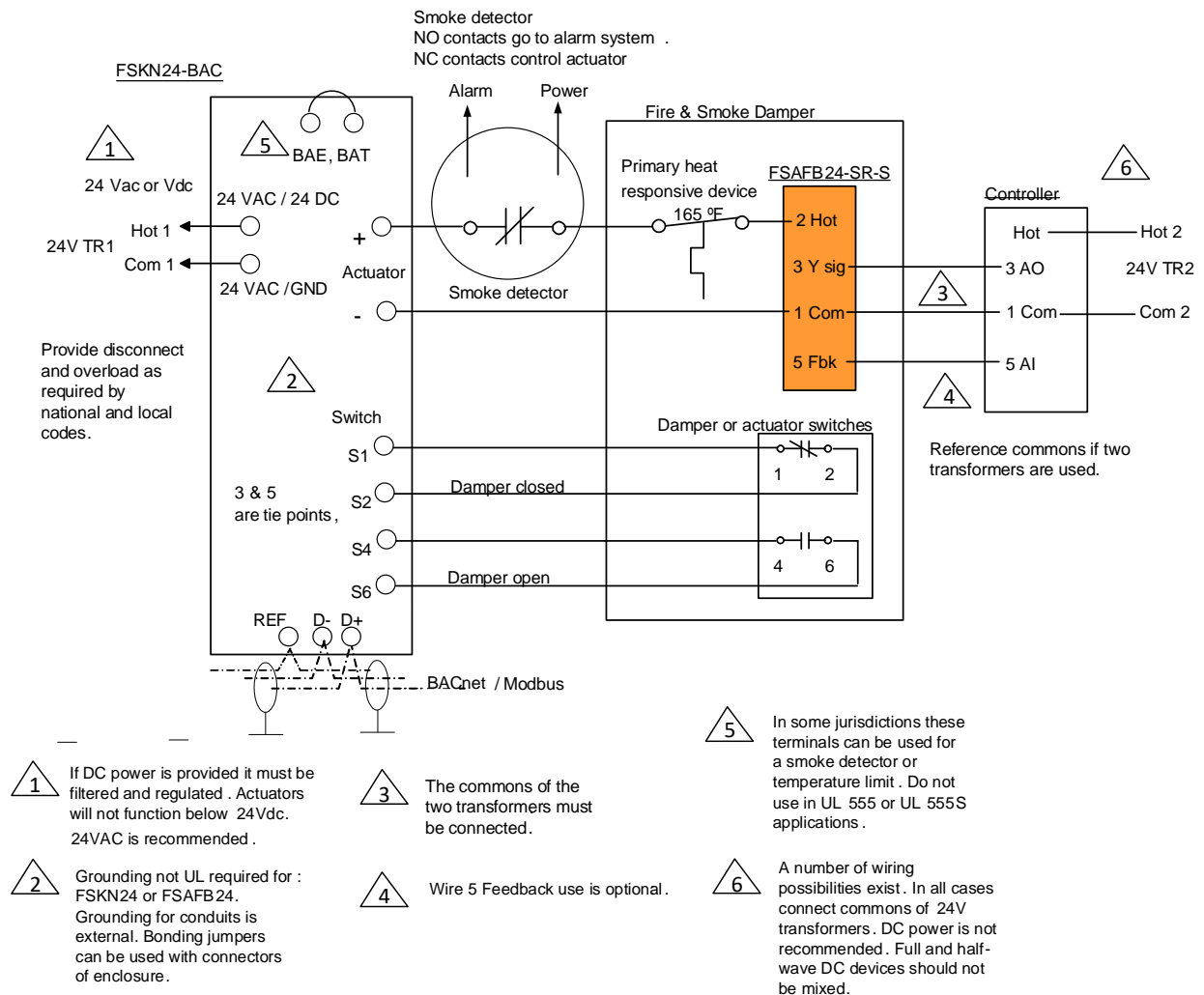
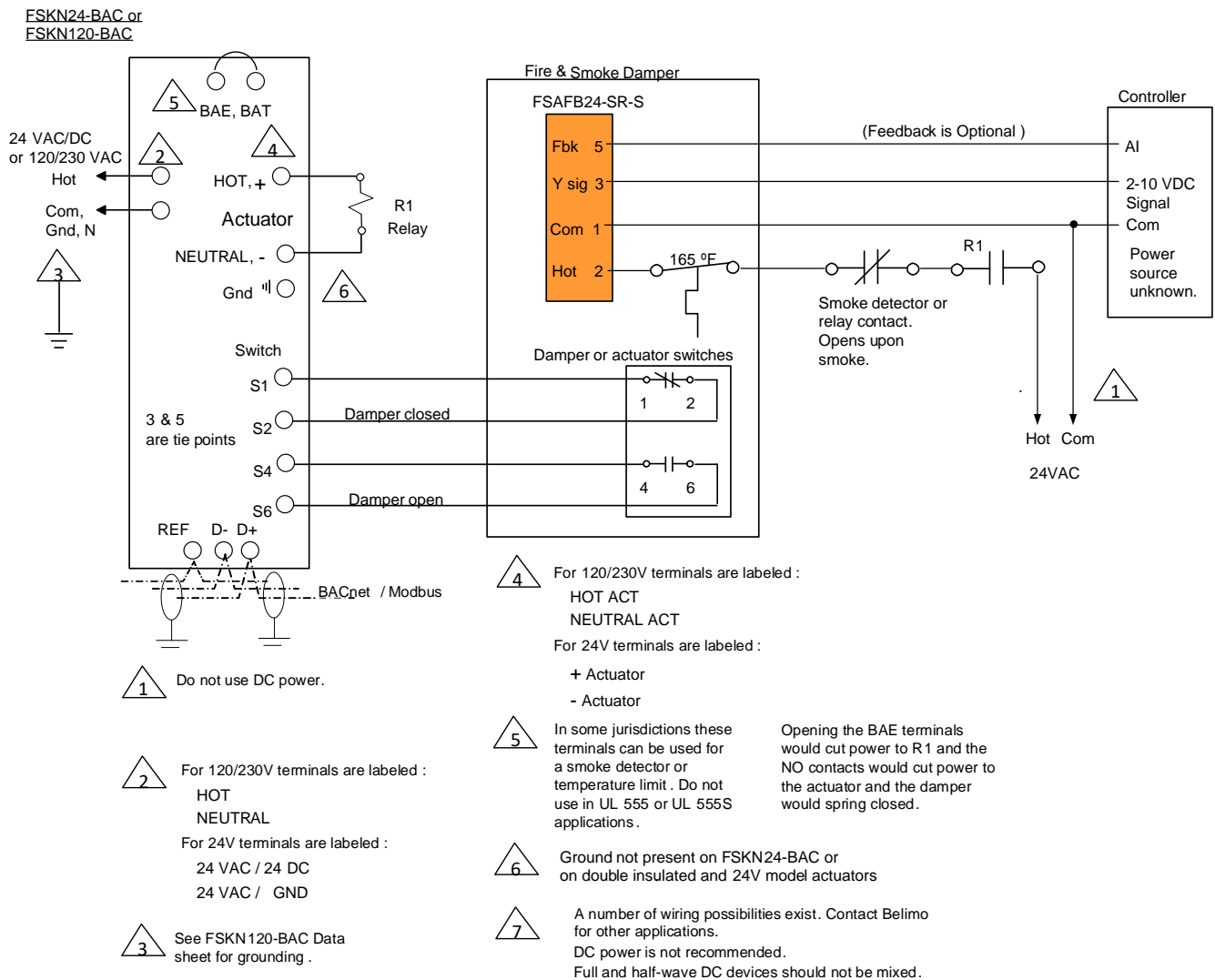


Figure 16 FSAFB24-SR-S Modulating damper actuator

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## FSAFB24 with 24V or 120V FSKN and isolation relay



**Figure 17 Isolation relay for 120V FSKN or separate transformers**

## Purpose of the BAE terminals

The terminals labeled BAE in and out are in series with the output to the actuator. (The BAT is the present version.) In some jurisdictions they can be connected to a temperature sensor which opens at 72°C or 95°C (165°F or 200°F). This is not generally allowed in the Americas. The smoke detector could be connected to the terminals; the AHJ should specifically approve. The control and safety would function completely, but the method is irregular in the Americas.

See the internal schematic for location of the contact. It is essentially the same as standard wiring but the FSKN would record it as open if polled by the BACnet system.

The use of the BAT is forbidden in the Americas. It is not UL listed.

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## Use of BAE terminals for smoke detector

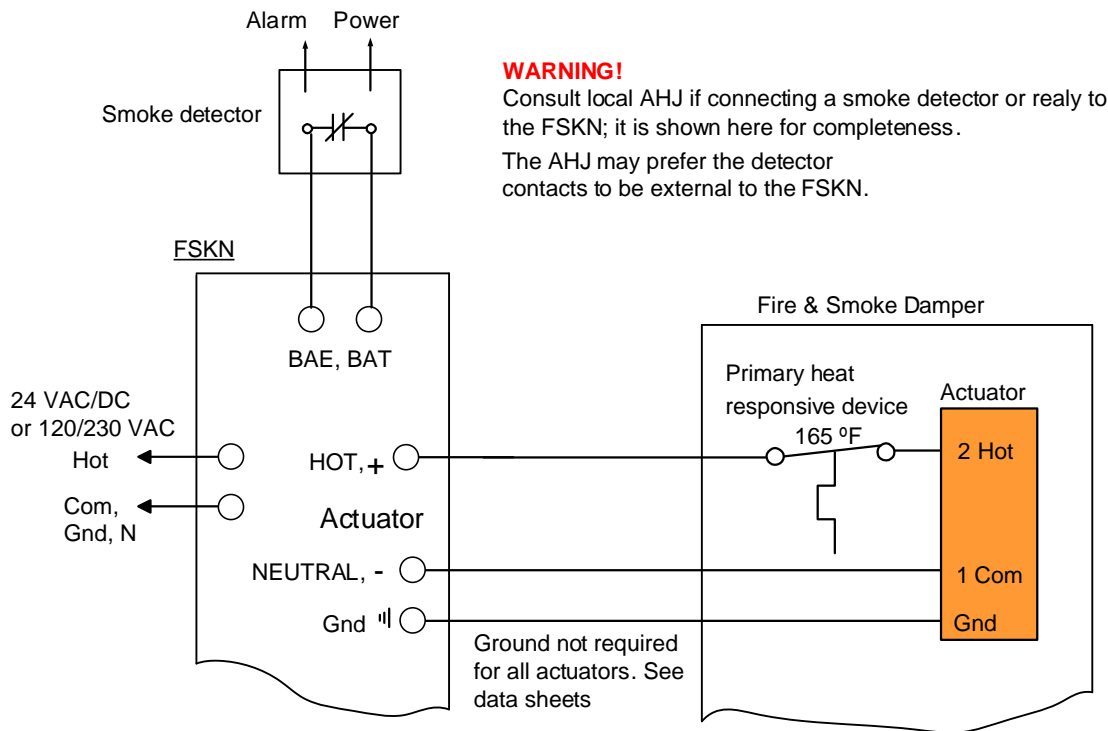


Figure 18 Smoke detector connected to FSKN BAE terminals

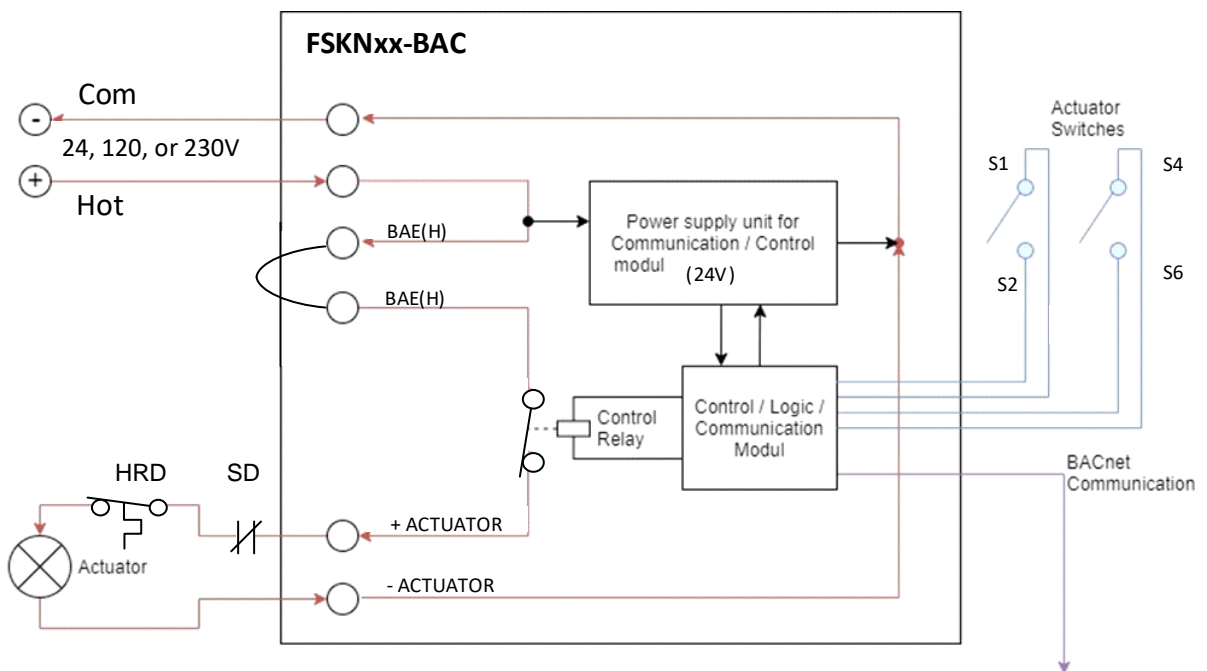


Figure 19 Schematic