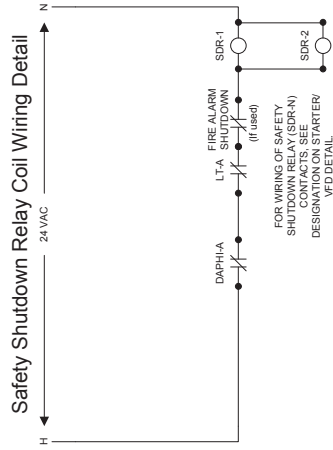
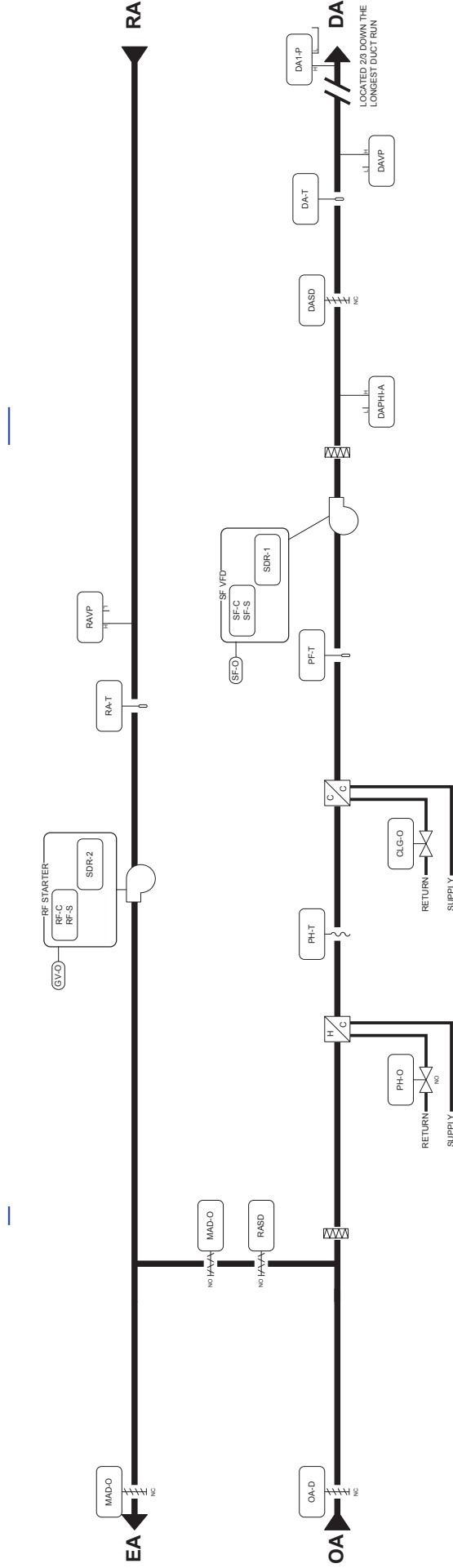


# Type 1 Air Handlers

Typical of AHUs 65/66/67



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Drawing Title  
**Type 1 Air Handlers**

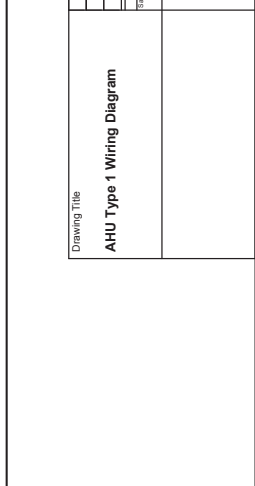
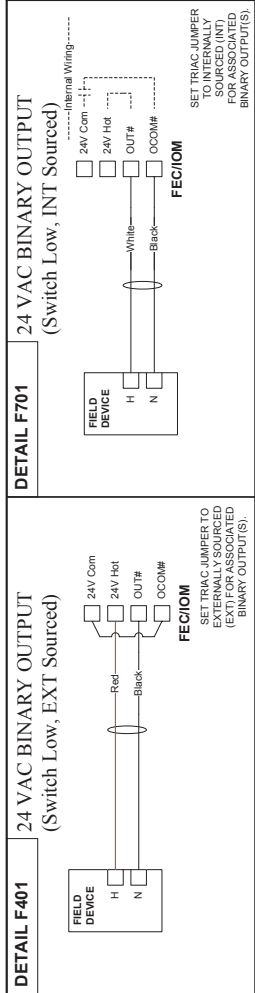
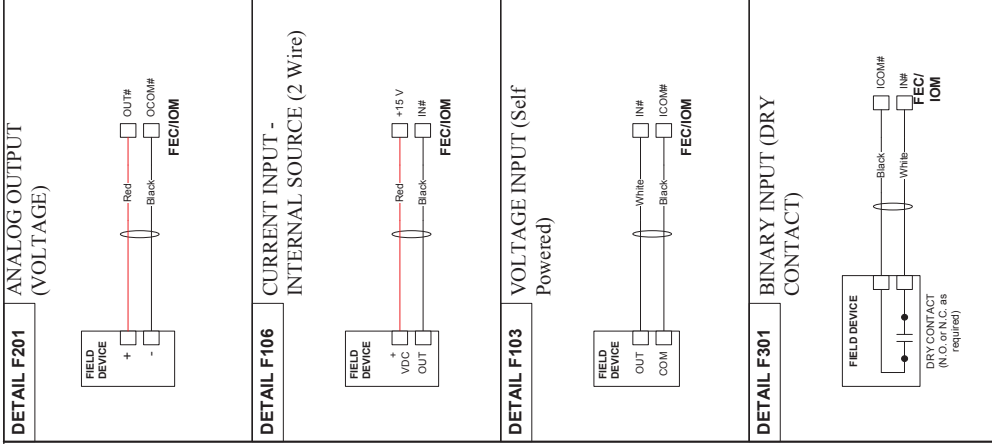
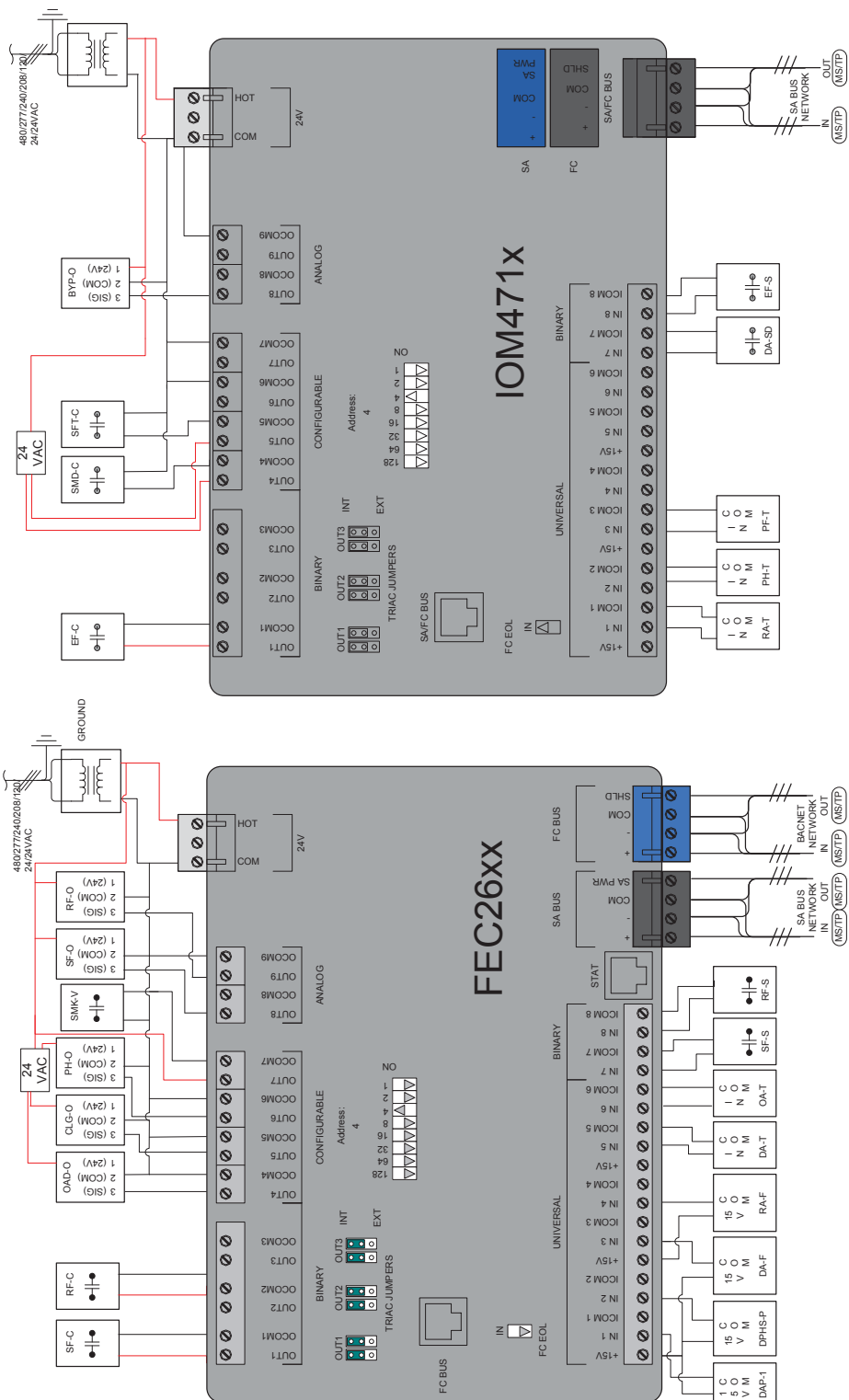
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OP11-0004  
DRAWING NUMBER

Type 1 AHU wiring Diagram



Drawing Title: AHU Type 1 Wiring Diagram

REVISION	DATE	BY	APPROVED	DATE
1	01/11/2004	John Kanouff	John Kanouff	01/11/2004

Johnson Controls

OP11-0004

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## TYPE 1 AIR HANDLER - SEQUENCE OF OPERATIONS

an overhead distribution system.

**B. System Off - When the system is off:**

1. The relief air dampers shall be closed.
2. The minimum outside air dampers shall be closed.
3. The economizer air dampers shall be closed.
4. The return air dampers shall be closed.
5. The supply air and return air fans shall be off.
6. The return fan variable pitch blades shall be positioned for minimum flow.
7. The return fan variable pitch blades shall be closed.
8. The cooling coil control valve shall be closed.
9. The bypass damper shall be closed.
10. The smoke damper shall be closed.
11. All automatic control loops shall be disabled.

**C. Initiation of System Start-Up - The system shall be started:**

1. By an operator manually entered command at the BAS.
2. Automatically whenever a floor is requiring cooling based on time schedule.

**D. System Operation** - When system start-up has been initiated, the following sequences shall be implemented:

## 1. System Start-Up:

- a. The minimum outside air dampers shall open fully.
- b. The smoke dampers shall fully open.
- c. The supply fan shall start at minimum speed. After on operator defined time period, the fans shall be enabled for automatic control. The rate at which the supply fan speed is changed shall be set at the associated VSD.
- d. The return fan shall start.

## 2. System Operation – Supply Fan Automatic Control Mode:

- a. Once the supply fan is released for automatic control, the supply fan speed shall be modulated to maintain the supply static pressure set point.

1. The static pressure set point shall be reset down in operator defined increments at operator defined intervals until such time as the primary air damper to one of the associated variable air volume terminal units has been above the reset down position limit for more than an operator established period of time.

- ii. If any of the VAV terminal unit air damper positions have been above the reset down position limit value for more than the operator established period of time, then the static pressure setpoint shall be reset up in operator defined increments at operator defined intervals until such time as one of the terminal unit damper positions are below the reset down position limit value for more than an operator established period of time.
- iii. Provide automatic exclusion of any terminal units that are not in automatic mode of operation or are in a failed mode of operation.
- iv. Provide an easily identifiable means to exclude each individual terminal unit from the static pressure setpoint reset sequence.

lower reset limit until the supply air temperature reset control is disabled.

**a.** If the supply air fan VSD fails in operation the supply fan must operate in the manual control mode. Once placed in the manual control mode, the following sequence should occur:

- i. The local H<sub>2</sub>O-A switch shall be changed to the "HAND" position and the supply air fan shall start and operate at a constant speed.

- a. The return fan variable pitch blades shall be modulated to maintain the return air flowrate setpoint.

### 5. System Operation – Non-Economizer Supply Temperature Control:

- a. If the preheat temperature is below the preheat temperature setpoint, the preheat water control valve shall be modulated to maintain the preheat temperature setpoint.

b. If the supply temperature is above the supply air temperature setpoint, the chilled water control valve shall be modulated to maintain the supply air temperature setpoint.

- 6. System Operation – Economizer Control:** There shall be two operator selectable methods of economizer control; Enthalpy based operations and Dry-bulb, Temperature based operations.

**a.** If the enthalpy based economizer operations is enabled and the outside air temperature is between operator defined limits for enthalpy based economizer operation, then the outside air dampers shall be controlled as follows:

1. The BAS shall monitor return air temperature and return air relative humidity and shall calculate the return air enthalpy. The BAS shall monitor the outside air temperature and the outside air relative humidity and shall calculate the outside air enthalpy. The BAS shall compare the outside air enthalpy with the return air enthalpy once every 10 minutes.

ii. If the outside air enthalpy is lower than the return air enthalpy and if the outside air dewpoint is below the outside air dewpoint setpoint, the economizer air dampers and relief air dampers shall be modulated open and the return air damper shall be modulated closed to maintain the supply air temperature setpoint.

- iii. If the economizer air dampers are commanded fully open and cannot maintain the supply air temperature setpoint, then the chilled water control valve shall be enabled to modulate to maintain the setpoint.

- iv. If the economizer air dampers are commanded fully closed and the preheat temperature is below the preheat temperature setpoint, then the preheat valve shall be enabled to modulate to maintain the setpoint.

- v. if the outside air enthalpy is equal to or greater than the return air enthalpy, or if the outside air dewpoint is above the economizer outside air dewpoint setpoint, the economizer mode of operation shall be disabled.

vi. If the return air relative humidity sensor is not functional or if there is no sensor in place, the return air relative humidity would be measured and trended along with outside air humidity to determine the influence of outside air humidity on the return air relative humidity. The return air relative

- humidity would be approximated as a fixed value from the logged data should the outside air humidity influence be minimal. The return air enthalpy calculation would be based on the approximated return air humidity.

bulb based economizer operations is selected and the outside air temperature is between operator defined limits for dry-bulb economizer operation, then the outside air dampers shall be controlled as follows:

1. The BAS shall compare the outside air temperature with the return air temperature once every 10 minutes

ii. If the outside air temperature is lower than the return air temperature, the economizer air dampers and relief air dampers shall be modulated open and the return air damper shall be modulated closed to maintain the supply air temperature setpoint.

- iii. If the economizer air dampers are commanded fully open and cannot maintain the supply air temperature setpoint, then the chilled water control valve shall be enabled to modulate to maintain the setpoint.

- iv. If the economizer air dampers are commanded fully closed and the preheat temperature is below the preheat temperature setpoint, then the preheat valve shall be enabled to maintain the setpoint.

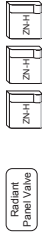
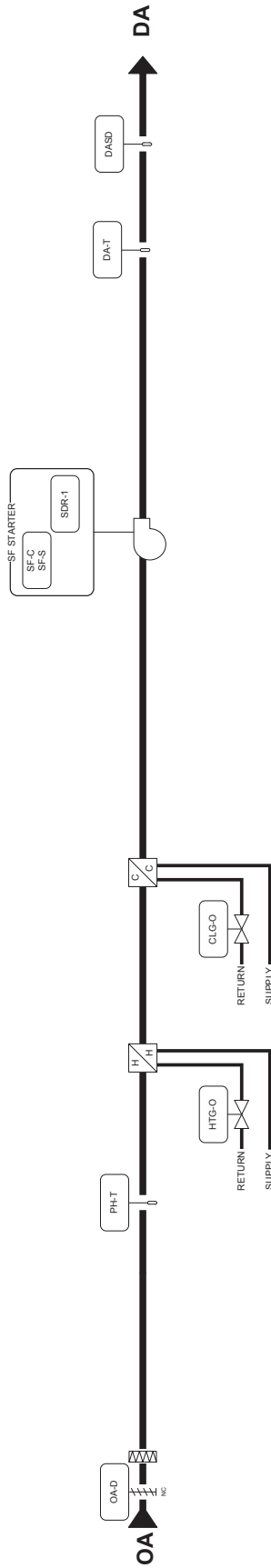
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- i. If the outside air temperature is equal to or greater than the return air temperature, or if the outside air dewpoint is above the economizer outside air dewpoint, the economizer mode of operation shall be disabled.
  - v. System Operation – Supply Air Temperature Reset:
  - a. The supply air temperature setpoint reset program shall be enabled as described above and shall only occur when the static pressure setpoint reset low level limits have been reached and are operating in a stable manner. The supply air temperature setpoint reset shall be reset via a control algorithm to optimize the energy usage.
  - i. The supply air temperature setpoint reset shall be reset up in operator defined increments at operator defined intervals until such time as the primary air damper positions of any one of the associated variable air volume terminal units has been above the maximum position for an operator established period of time.
  - ii. If any of the terminal unit primary air damper positions are at the maximum position for more than the operator established period of time, then the supply air temperature setpoint shall be reset down in operator defined increments at operator defined intervals until such time as all of the primary air damper positions are below the maximum position.
  - iii. If the associated space has a humidity sensor, the sensor shall be used to disable the supply air temperature setpoint reset sequence if the space humidity is above the reset disabled setpoint for a define period of time.
  - iv. If the static pressure setpoint is not at the lower reset limit, the supply air temperature reset shall be disabled.
  - v. If the outside air dewpoint is above the supply air temperature reset outside air dewpoint setpoint, the supply air temperature reset shall be disabled.
  8. Emergency Shutdown Operation:
    - a. If the preheat temperature is below the freeze protection setpoint, the supply and return fan shall stop and the preheat and chilled water valves shall fully open.
    - b. If the supply static pressure is above the high static shutdown setpoint, the supply and return fans shall stop.
    - c. If smoke is detected in the supply and/or return air duct, then the smoke dampers shall close and the supply and return fans shall stop.
  - E. Setpoints - The setpoints for the system shall be defined as follows:
    1. The fan speed shall be released for automatic control after the fan has been running for one minute.
    2. The static pressure setpoint shall be set as the current design setpoint. The reset limits for the static pressure setpoint reset shall be set at the current design setpoint and 50% of the design setpoint respectively.
    3. The reset up increment shall be set at 0.1" w.c. and the reset down increment shall be set at 0.05" w.c.
    4. The time delay for duct static pressure reset down shall be set at 15 minutes.
    5. The terminal unit damper position limit for reset down shall be 100 percent full open.
    6. The terminal unit damper position limit for reset up shall be 50 percent full open.
    7. The time delay for duct static pressure reset up shall be set at 10 minutes.
    8. The return air flowrate shall be the supply fan flowrate minus an adjustable differential setpoint. The differential flowrate setpoint shall be as scheduled on the mechanical drawings.
    9. The outside air temperature limits for enthalpy based economizer operations shall be 68 Deg. F. and 20 Deg. F.
    10. The outside air temperature limits for dry bulb based economizer operations shall be 68 Deg. F. and 20 Deg. F.
    11. The economizer outside air dewpoint setpoint shall be initially set at 58 Deg. F.
    12. The supply air temperature reset outside air dewpoint setpoint shall be set at 50 Deg. F.
    13. Supply air temperature setpoint shall be set per the control drawings for the associated unit.
    14. The supply air temperature reset lower limit shall be the AHU design setpoint and the upper limit shall be the AHU design setpoint plus an operator defined offset. The operator defined offset shall be set at 10 Deg. F.
    15. The time delay for supply air temperature reset up shall be set at 10 minutes.
    16. The time delay for supply air temperature reset down shall be set at 10 minutes.
    17. The supply air reset up increment shall be set at 0.5 Deg. F. and the reset down increment shall be 1 Deg. F.
    18. The space humidity upper limit to disable the supply air temperature setpoint reset program shall be set at 60% RH.
    19. The preheat temperature setpoint shall be set at 40 Deg. F.
    20. The freeze protection setpoint shall be set at 35 Deg. F.
    21. The high static shutdown setpoint shall be set at 2.5" w.c.
  - F. Initiation of System Shutdown - System shutdown shall be initiated:
    1. By operator entered manual command.
    2. Automatic in the event of component failure.
    3. Automatic in the event of a building power/failure of fire alarm.
  - G. Alarms - The BAS shall generate an alarm:
    1. Equipment failure when commanded to be operating.
    2. Equipment failure to start and confirm status within 30 seconds.
    3. If the supply air static pressure is outside the operator established low and high limits, which shall be set at 2 Deg. F. below and above the supply air temperature setpoint respectively for more than five minutes.
    4. If the supply air static pressure is more than 0.5 in. w.g. above or below the setpoint for a period of more than five minutes.
    5. If the return airflow is more than 10% above or below the setpoint for a period of more than five minutes.
    6. If the preheat temperature is below the freeze protection setpoint.
    7. If the return air humidity is below the operator established low and high limits, which shall be set at 45% and 65% relative humidity.
    8. All alarms shall be inhibited when the associated supply/return fan is not in operation. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time set at 2 minutes.

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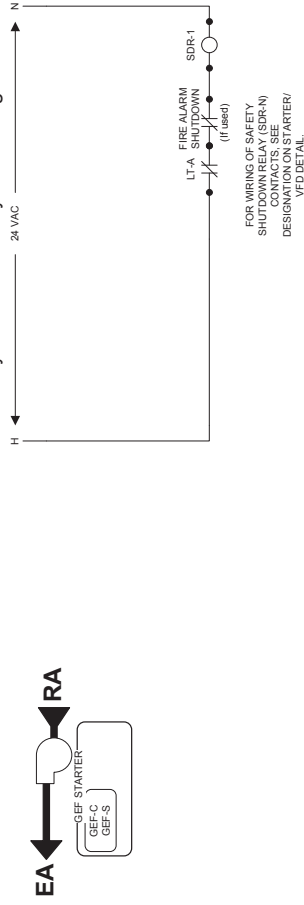
# Type 2 AHU

Typical of AHUs 43, 60, 62, 74, 88,



Space humidity sensors control  
Radiant Panel Chilled water  
Command.

## Safety Shutdown Relay Coil Wiring Detail



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Drawing Title  
**Type 2 Air Handlers**

FOR WIRING OF SAFETY SHUTDOWN RELAY (SDR-N) CONTACTS, SEE DESIGN/INSTALL STARTER/VFD DETAIL.

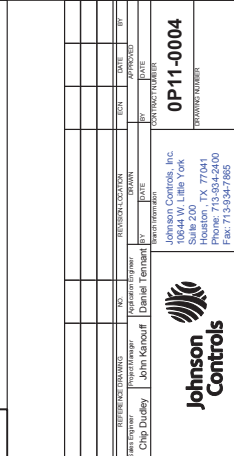
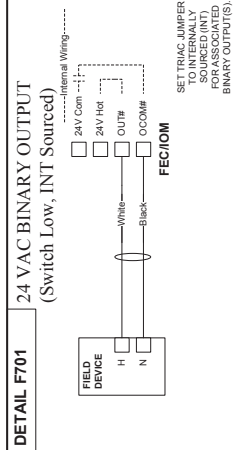
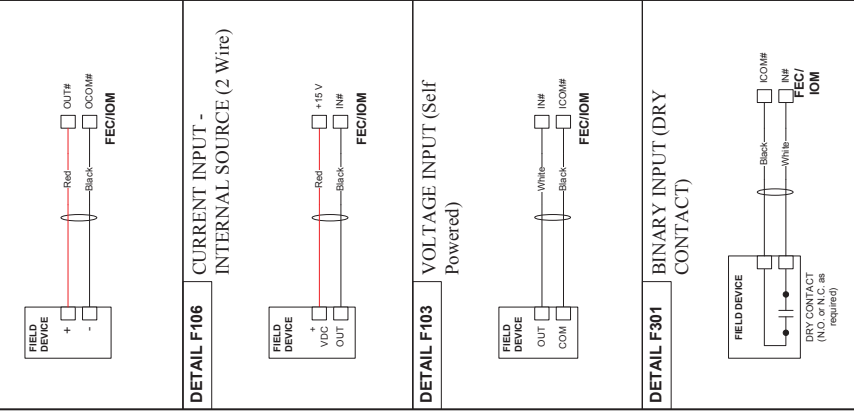
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100	01/11/00	John Kanouff	Chip Dudley



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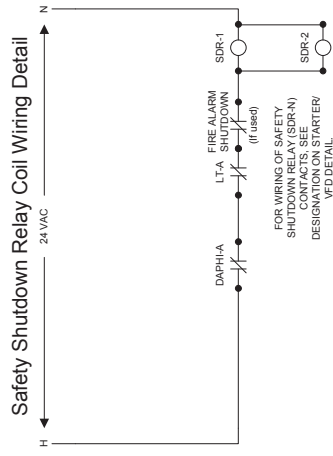
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DRAWING NUMBER

DETAIL F201

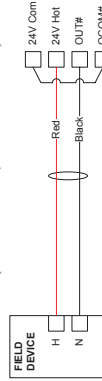




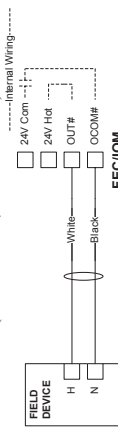
**Typical For AHU-2, 59, 61, 68, 75, 87, 89, 91, 95, 97**

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**FEC/IOM**      SET TRIAC JUMPER TO  
                         EXTERNALLY SOURCED  
                         (EXT) FOR ASSOCIATED  
                         BINARY OUTPUT(S).



SET TRIAC JUMPER  
TO INTERNALLY  
SOURCED (INT)  
FOR ASSOCIATED  
BINARY OUTPUT(S).

Drawing Title									
AHU Type 3 Wiring Diagram									
REFERENCE DRAWING	NO.	DATE	BY	REVISION LOCATION	DATE	BY			
REVISED	DATE	BY							
Chip Dudley	John Kanouff	Daniel Tennant	DATE	BY	DATE	BY			
CONTRACT NUMBER							0P11-0004		
							Johnson Controls, Inc. 10844 W. Little York Suite 200 Houston, TX 77041 Phone: 713-934-2400 Fax: 713-934-7865		
DRAWING NUMBER									

for more than an operator established period of time.

Drawing Title  <b>Type 3 Air Handlers Sequence of Operations</b>	REFERENCE DRAWING	NO.	REVISION/LOCATION	TCN	DATE	BY
	CHIPS DUDLEY	John Kinnaird	John Kinnaird	REV	DATE	
	In which location Daniel Tennant					
						
	<b>Johnson Controls</b>					
				CONTRACT NUMBER <b>0P11-0004</b>		
				DRAWING NUMBER		



9. The outside air temperature limits for enthalpy based economizer operations shall be 68 Deg. F. and 20 Deg. F.
10. The outside air temperature limits for dry bulb based economizer operations shall be 68 Deg. F. and 20 Deg. F.
11. The economizer outside air dewpoint setpoint shall be initially set at 58 Deg. F.
12. The supply air temperature reset outside air dewpoint setpoint shall be set at 50 Deg. F.
13. Supply air temperature setpoint shall be set per the control drawings for the associated unit.
14. The supply air temperature reset lower limit shall be the AHU design setpoint and the upper limit shall be 10 Deg. F.
15. The time delay for supply air temperature reset up shall be set at 10 minutes.
16. The time delay for supply air temperature reset down shall be set at 10 minutes.
17. The supply air reset up increment shall be set at 0.5 Deg. F. and the reset down increment shall be 1 Deg. F.
18. The space humidity upper limit to disable the supply air temperature reset program shall be set at 60% RH.
19. The preheat temperature setpoint shall be set at 40 Deg. F.
20. The freeze protection setpoint shall be set at 35 Deg. F.
21. The high static shutdown setpoint shall be set at 2.5" w.c.

**F. Initiation of System Shutdown - System shutdown shall be initiated:**


1. By operator entered manual command.
2. Automatic in the event of component failure.
3. Automatic in the event of a building power failure of fire alarm.

G. Alarms - The BAS shall generate an alarm:

1. Equipment failure when commanded to be operating.
2. Equipment failure to start and confirm status within 30 seconds.
3. If the supply air temperature is outside the operator established low and high limits, which shall be set at 2 Deg. F. below and above the supply air temperature setpoint respectively for more than five minutes.
4. If the supply air static pressure is more than 0.5 in. w.g. above or below the setpoint for a period of more than five minutes.
5. If the return airflow is more than 10% above or below the setpoint for a period of more than five minutes.
6. If the preheat temperature is below the freeze protection setpoint.
7. If the return air humidity is outside the operator established low and high limits, which shall be set at 45% and 65% relative humidity.
8. All alarms shall be inhibited when the associated supply/return fan is not in operation. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following startup of the unit.

H. Failure positions - When a BAS component failure occurs:

- 1 The return air damper shall remain in the last commanded position.
- 2 The minimum outside air damper shall remain in the last commanded position.
- 3 The economizer air damper shall remain in the last commanded position.
- 4 The relief air damper shall remain in the last commanded position.
- 5 The supply fan shall remain in the last commanded state.
- 6 The return fan shall remain in the last commanded state.
- 7 The preheat valve shall remain in the last commanded position.
- 8 The cooling valve shall remain in the last commanded position.

Drawing Title <b>Type 3 Air Handlers</b> <b>Sequence of Operations</b>	REFERENCE ENGINEERING		PROJECT NO.	REVISION LOCATION	DATE	BY
	Prepared by		Revision Engineer	REVISION	APPROVED	
	Chip Dudley		Daniel Tennant	DATE	BY	
<div style="display: flex; justify-content: space-between; align-items: center;"> <div>  </div> <div> <p>Johnson Controls, Inc.              10844 W. Little York              Suite 200              Littleton, CO 80120              Phone: 713-934-2400              Fax: 713-934-7865</p> </div> </div>						
				CONTRACT NUMBER <b>0P11-0004</b>		
				DRAWING NUMBER		