BAC-10000 Series

FlexStat™ BACnet Programmable Thermostats

Application Guide

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Specifications, design, and operation are subject to change without notice.

Overview and General Installation

This document gives wiring details, schematics of sample applications (including bills of material with KMC Controls products), and other related information.

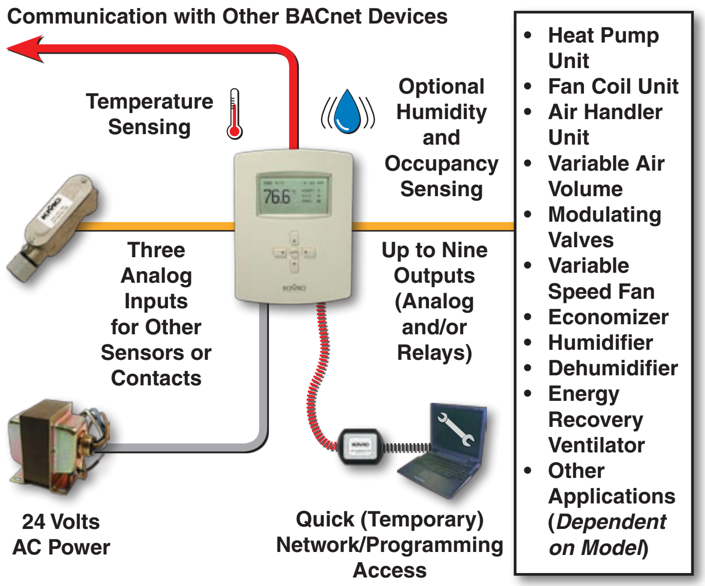


Illustration 1—Overview

Wire the FlexStat to the desired equipment (see below for general purpose wiring and switch configuration) and select the relevant program from the (Advanced) Application submenu of the Advanced Menu and other appropriate menus. **For general mounting and connection details, including network wiring, EOL termination, power connections, input/output connections, pull-up resistor switch settings, see the BAC-10000 Series Installation Guide.**

Inputs and Outputs

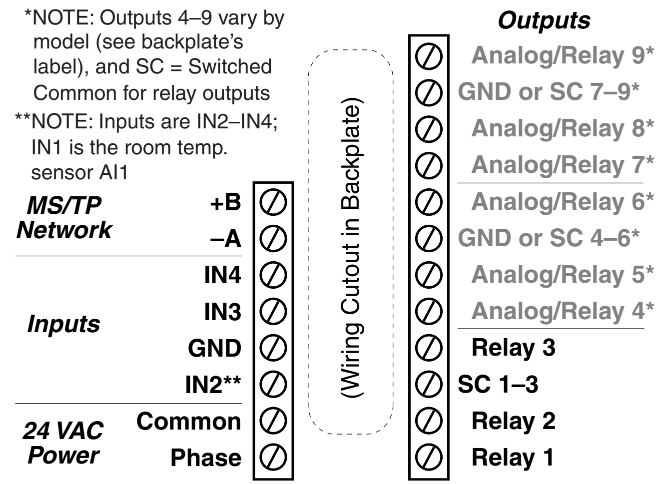


Illustration 2—Terminal Blocks and (General) Connections

Connecting Inputs

Supported input devices include:

- Active 0–12 VDC devices
- Passive contacts
- 10K ohm thermistors

Unsupported input devices include:

- 1K ohm RTDs
- Directly connected 4–20 mA devices—but they can be connected as voltage inputs across an external resistor (see below for information)

Passive input devices require pull-up resistors, which can be switched on inside the thermostat. For **passive** input devices (e.g., switch contacts and 10K ohm thermistors), set the pull-up switch on the back of the circuit board to the **10K** position. For **active** voltage devices, set the switch to the **0–12 VDC** position. (See Illustration 3.)

Be sure pull-up resistor switches are set correctly. Having both pull-up switches to the left can potentially result in oscillating readings that can even affect other inputs. Having both to the right may result in readings that are only about 1/4 the proper value.

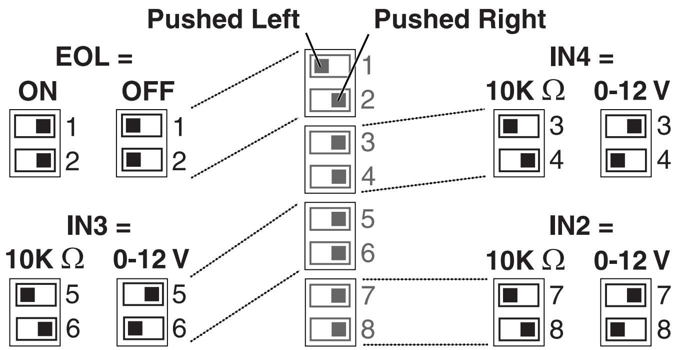


Illustration 3—EOL and Pull-Up Resistor Switch Positions

To use a **4–20 mA current input**, connect an **external** 250 ohm resistor from input to ground. (Do not install the resistor inside the FlexStat's case since the heat generated by the resistor might skew the temperature readings.) The resistor converts the 4–20 mA current input to a 1–5 V voltage that can be read by the thermostat's analog-to-digital converter. Set the pull-up switch to the **0–12 VDC** position. (Custom programming in Control Basic, using BACstage, is required.)

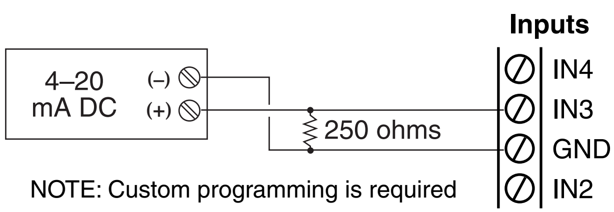


Illustration 4—4 to 20 mA Input

NOTE: Analog inputs can be mapped as binary values in Control Basic (using BACstage). Set an analog voltage less than 0.5 VDC to equal a binary Off state and an analog voltage of 0.5 to 12 VDC to equal a binary On state.

NOTE: Modified or replaced library programs are the responsibility of the user. KMC Controls does not provide support for such programs.

Connecting Outputs

Connect the device under control between the desired output terminal and the related **SC (Switched Common for relays) or GND (Ground for analog outputs)** terminal (see Illustration 4). For each bank of three relays, there is one Switched (relay) Common connection (in place of the GND terminal used with analog outputs—see Illustration 5).

Maximum output current for individual **ANALOG outputs is 20 mA @ 12 VDC.** Max. output current is **1 A for individual RELAYS @ 24 VAC/VDC or a total of 1.5 A per bank of 3 relays** (relays 1–3, 4–6, and 7–9). Do not attach a device that draws current that exceeds the corresponding value. (KMC REE-3111/3112 relays, for example, could be connected to the analog outputs, but REE-3211/3221/3213 relays would exceed the FlexStat's capacity.)

Relays are NO, SPST (Form "A"). (To emulate binary outputs with the analog outputs, set the output voltage to be either 0 or 12 VDC in Control Basic.)

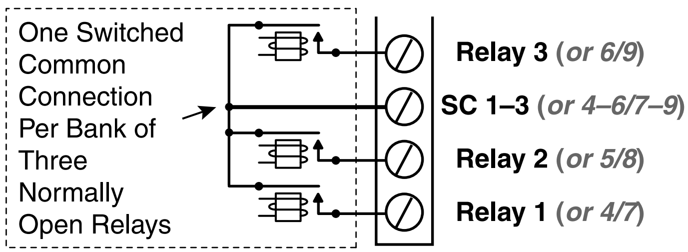


Illustration 5—Switched (Relay) Common and Relays

⚠ CAUTION

Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

⚠ CAUTION

Do not mistakenly connect 24 VAC to an analog output ground. This is not the same as a relay's switched common. See the backplate's terminal label for the correct terminal.

Occupancy Sensor Performance and Applications

For any FlexStat model with a (passive infrared) occupancy sensor option, **be sure to install it where it will have unobstructed view of the most typical traffic area. Do not install it behind curtains or other obstructions. Do not install it where it will be exposed to sunlight or heat sources! Do not install near a heating/cooling duct.**

In larger areas or where obstructions necessarily exist, additional remote occupancy sensors can be connected to one of the FlexStat's available inputs. (See sample illustration below. Custom programming will be required.) Multiple remote sensors with relay contacts can be wired in parallel to monitor a variety of different zones.

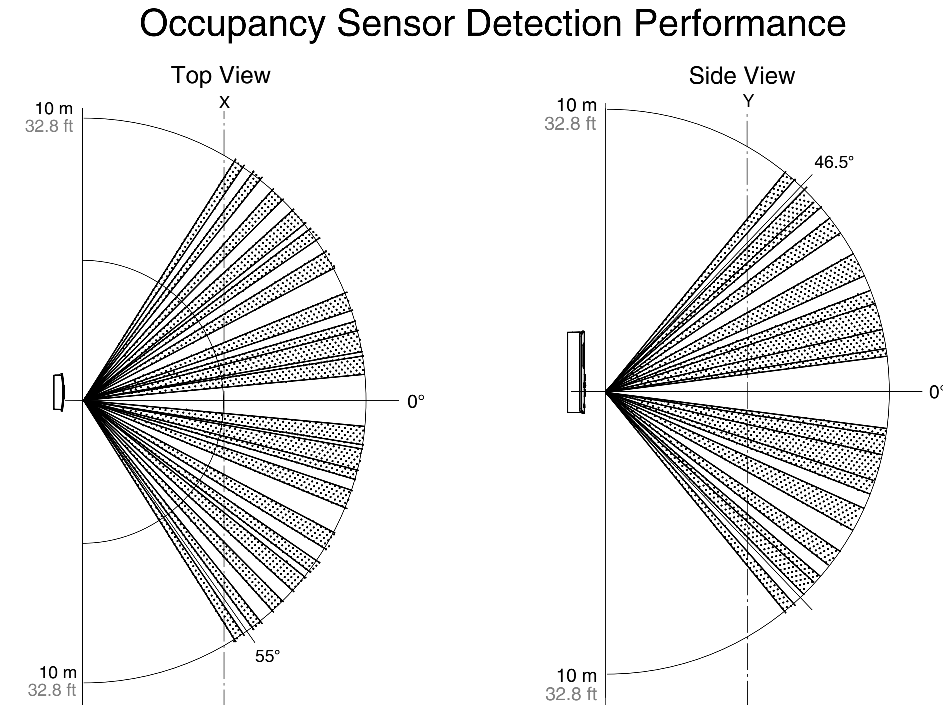
For some applications, such as hotel rooms, bedrooms, and other sleeping quarters, lack of activity may not truly mean "unoccupied." Occupancy sensors coupled with door contacts can prevent such undesired setbacks. If no motion is detected during a predetermined time after a door opening/closing is detected, then the mode changes to unoccupied. However, if motion is detected during the timed period after a door has been opened/closed, then occupied mode shall remain on until the next time a door is opened or closed (and the timed period begins again). (Custom programming is required.)

The effective detection range is approximately 10 meters or 33 feet. Factors that may reduce the range include:

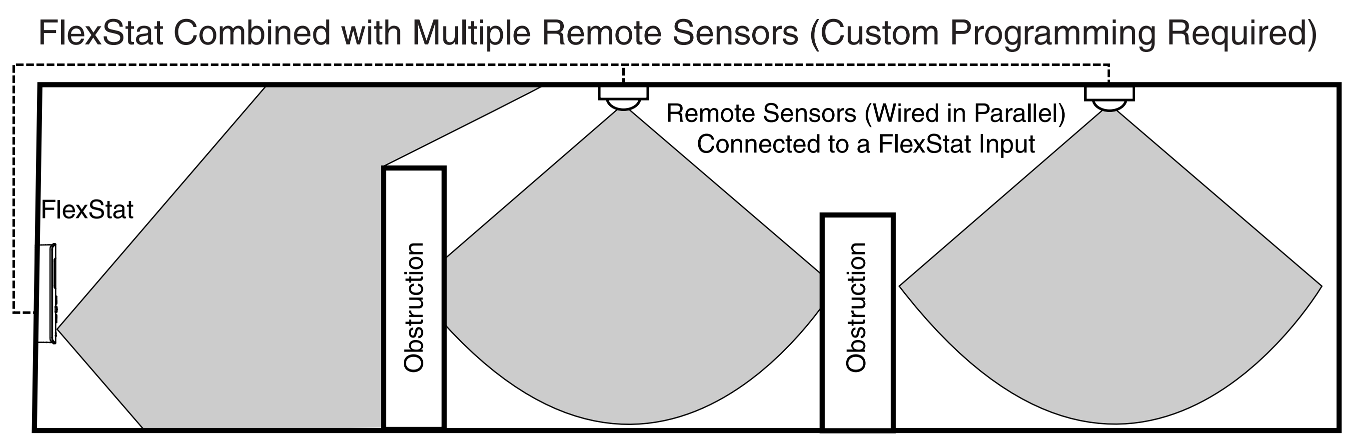
- Too small of a difference in object surface temperature compared to the background temperature.
- Object movement in a direct line toward the sensor.
- Very slow or very fast object movement.
- Obstructions.

False detections may be triggered by:

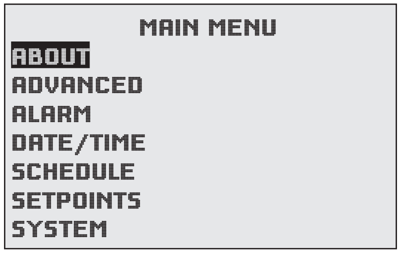
- The **temperature inside the detection range changing suddenly** because of entry of cold or warm air from an air-conditioning or heating unit.
- The **sensor being directly exposed** to sunlight, an incandescent light, or other source of far infrared rays.
- Small animal movement.



To maintain maximum sensitivity, occasionally wipe dust or dirt off the lens—but do not use any fluid on the sensor.



Configuration Screens

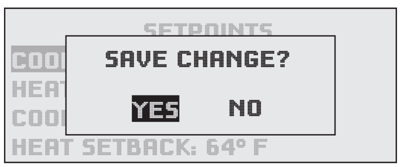


Navigate the menus and change settings by pressing a combination of buttons. Press the:

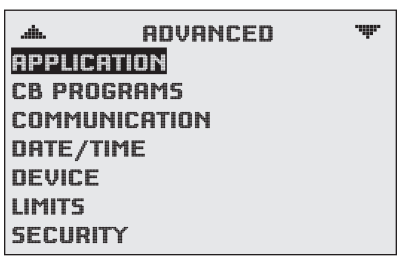
- *Enter* button to select and/or exit value editing.
- *Up/Down* button to move among **entries** (up/down lines).
- *Left/Right* button to move among **value fields** (left/right spaces).
- *Left* button to return to the Home screen.

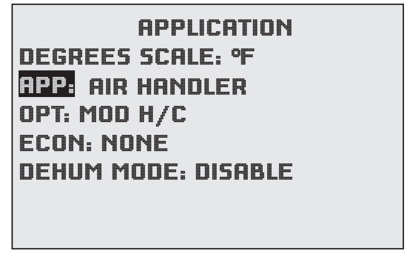
NOTE: A log-in may be required to access menu items.

When prompted about a change (on any menu), press *Right/Left* to select the desired choice and then *Enter*.



From the Main Menu, select Advanced and then Application:

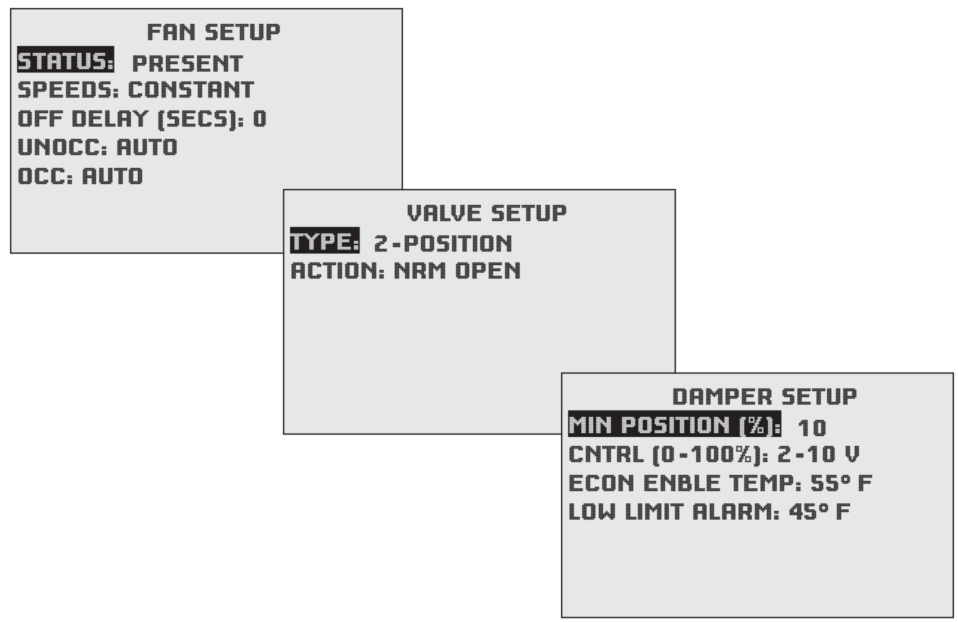




To change the preprogrammed application type and options, press:

1. *Enter* to select.
2. *Up/Down* to move among entries.
3. *Enter* to select.
4. *Left* to exit menu.

Configure other options as needed. See the BAC-10000 Series Operation Guide for more configuration and operation details.



Sample Applications

AHU (Air Handling Unit), General Wiring

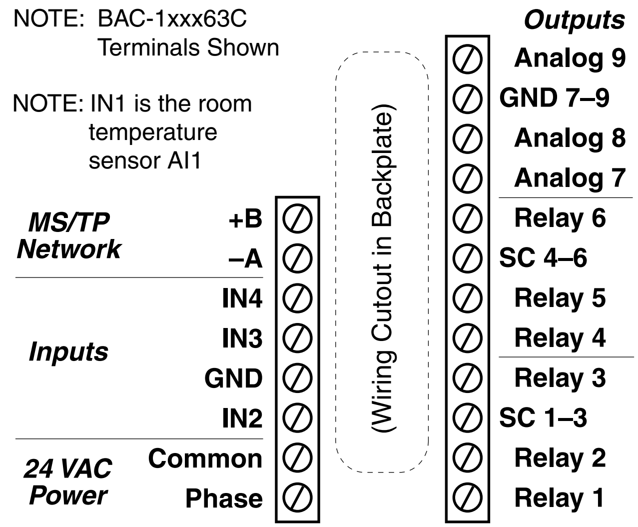
Input Terminals	AHU Input Connections	BACnet Objects
IN4	Outside Air Temp. (OAT)*	AI4
IN3	Mixed Air Temp. (MAT)*	AI3
GND	Ground	
IN2	Fan Status (FST)**	AI2

*When using optional Outside Air Damper, must also have MAT/OAT inputs (typically 10K, Type II thermistors). Ensure pull-up resistor switch positions are set properly—see Illustration 3 on page 2.
**Fan Status is an optional input. Ensure pull-up resistor switch positions are set properly for the relay or switch.
***If optional Outside Air Damper is used, configure damper from the Damper Setup Menu.

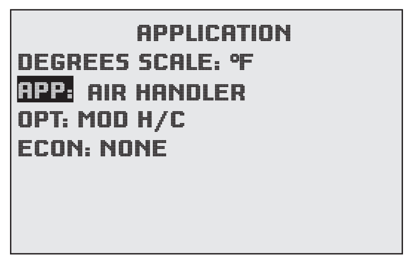
Output Terminals (BAC-1xxx63C)	AHU Output Connections	BACnet Objects
Analog 9	Outside Air Damper (OAD/RTD)***	AO9
GND	Ground (for analog output terminals 7–9)	
Analog 8	Heating Valve (HTV)	AO8
Analog 7	Cooling Valve (CLV)	AO7
Relay 6		*(BO6)*
SC 4–6		
Relay 5		*(BO5)*
Relay 4		*(BO4)*
Relay 3		*(BO3)*
SC 1–3	24 VAC (for relay terminals 1–3)	
Relay 2		*(BO2)*
Relay 1	Fan	BO1

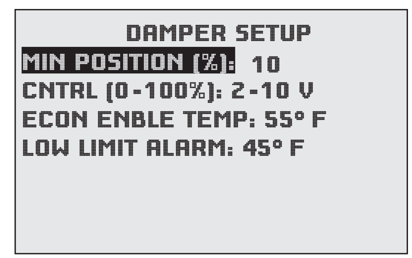
NOTE: Terminal connections reflect firmware version E0.0.0.19 or R1.0.0.0 or later.

NOTE: See also the RTU section for 2-stage options.



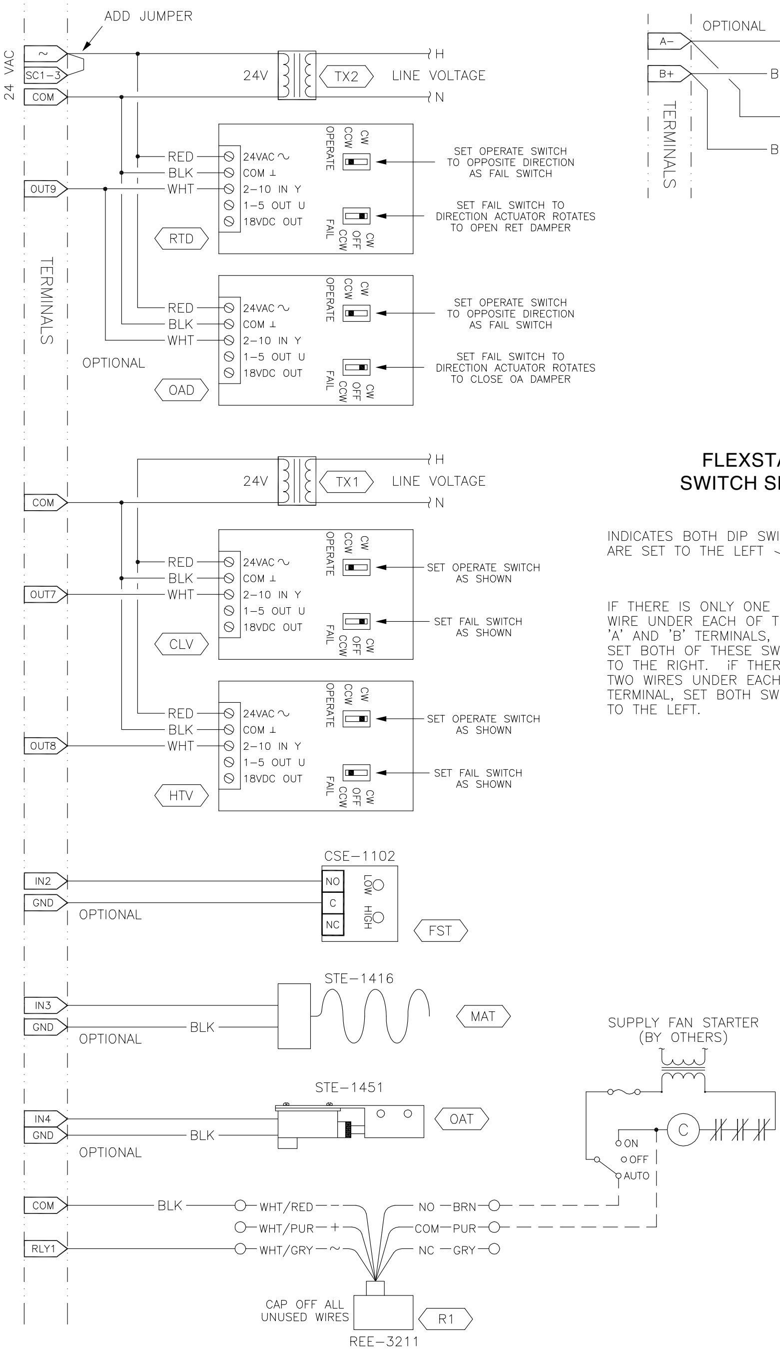
NOTE: This application is one of the packaged programs selectable from the Advanced > Application menu in the BAC-1xxx63C models.

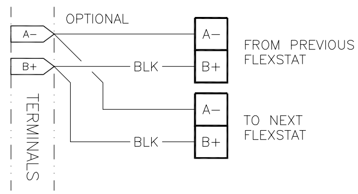




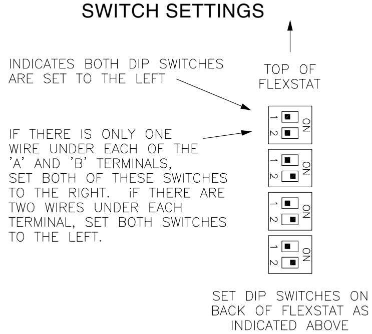
NOTE: See also the Sequence of Operation section.

AHU, Example Schematic





FLEXSTAT DIP SWITCH SETTINGS



INPUT/OUTPUT LIST: AHU

INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	MIXED AIR TEMP (OPT)	MAT
AI4	OUTSIDE AIR TEMP (OPT)	OAT
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

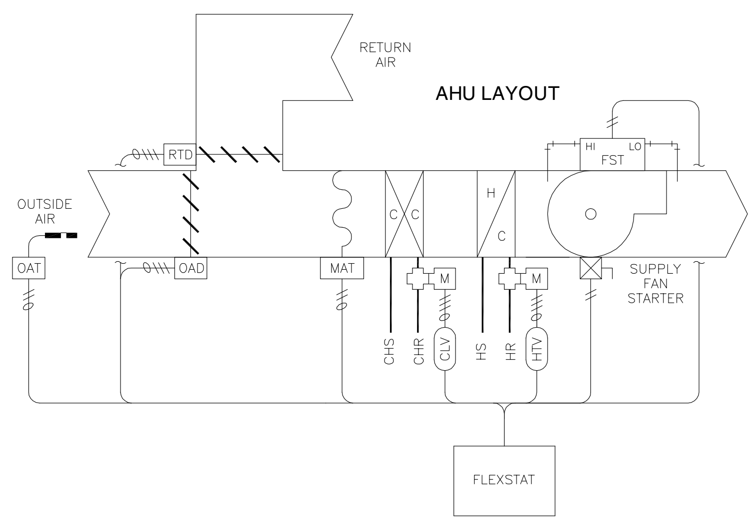
OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN	G
BO2	SPARE	
BO3	SPARE	
BO4	SPARE	
BO5	SPARE	
BO6	SPARE	
AO7	COOLING VALVE	CLV
AO8	HEATING VALVE	HTV
AO9	OA DAMPER (OPTIONAL)	OAD/RTD

BILL OF MATERIAL: AHU

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1xx63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
R1	REE-3211	MULTI-VOLTAGE CONTROL RELAY
CLV HTV	VEP-45xxB895/ VEB-43xxxBDL	FAILSAFE VALVE, W/ MEP-5372 2-10 VDC ACTUATOR
FOR VALVES, CHOOSE CAPACITY/MODEL FROM KMC DATA SHEET		
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
MAT	STE-1416	12' DUCT AVERAGING TEMP SENSOR
OAT	STE-1451	OUTSIDE TEMPERATURE SENSOR
TX1	XEE-6311-075	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 50VA
CHOOSE ONE OF THE FOLLOWING TRANSFORMERS:		
TX2	XEE-6311-075	CONTROL TRANSFORMER, 120/208/240/480:24VAC, 75VA
TX2	XEE-6311-100	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 96VA

BILL OF MATERIAL: AHU, DAMPER ACTUATORS

REFERENCE	MAX DAMPER AREA IN FT^2	PART #	PART DESCRIPTION
OAD or RTD	6.25	MEP-5372	50 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 19VA
OAD or RTD	15	MEP-7252	120 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
OAD or RTD	22.5	MEP-7552	180 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
OAD or RTD	40	MEP-7852	320 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 40VA



HPU (Heat Pump Unit), General Wiring

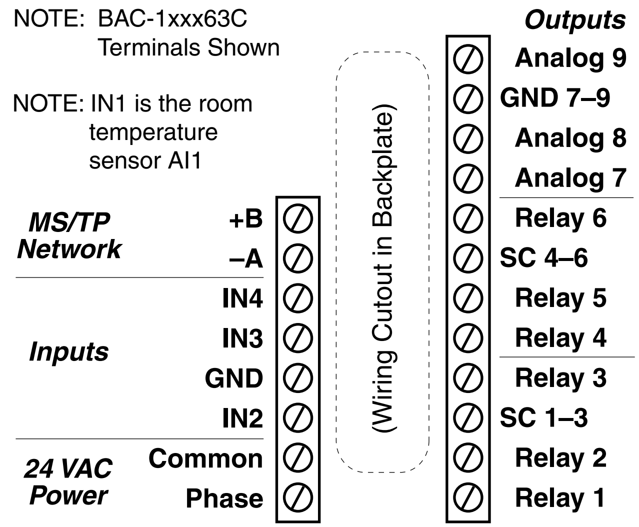
Input Terminals	HPU Input Connections	BACnet Objects
IN4	Outside Air Temp. (OAT)*	AI4
IN3	Mixed Air Temp. (MAT)*	AI3
GND	Ground	
IN2	Fan Status (FST)**	AI2

*When using optional Outside Air Damper, must also have MAT/OAT inputs (typically 10K, Type II thermistors). Ensure pull-up resistor switch positions are set properly—see Illustration 3 on page 2.
**Fan Status is an optional input. Ensure pull-up resistor switch positions are set properly for the relay or switch.
***If optional Outside Air Damper is used, configure damper from the Damper Setup Menu.

Output Terminals (BAC-1xxx63C)	Typical Terminal Codes	HPU Output Connections	BACnet Objects
Analog 9		Outside Air Damper (OAD/RTD)***	AO9
GND		Ground (for analog output terminal 9)	
Analog 8			*(AO8)*
Analog 7			*(AO7)*
Relay 6	W2	Emergency Heat (Optional)	BO6
SC 4–6	R	24 VAC (for relay terminals 4–6)	
Relay 5	W/E	Auxiliary Heat (Optional)	BO5
Relay 4	Y2	Compressor 2 (Optional)	BO4
Relay 3	Y1	Compressor 1	BO3
SC 1–3	R	24 VAC (for relay terminals 1–3)	
Relay 2	O/B	Reversing Valve **(see O/B Note in schematic)**	BO2
Relay 1	G	Fan	BO1

NOTE: Although typical terminal code letters are shown, check the schematics of your unit for wiring details.

NOTE: See also the Sequence of Operation section.



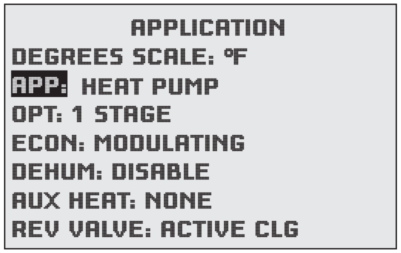
⚠ CAUTION

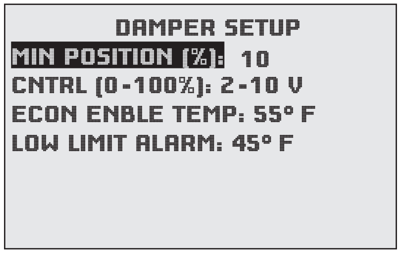
Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

⚠ CAUTION

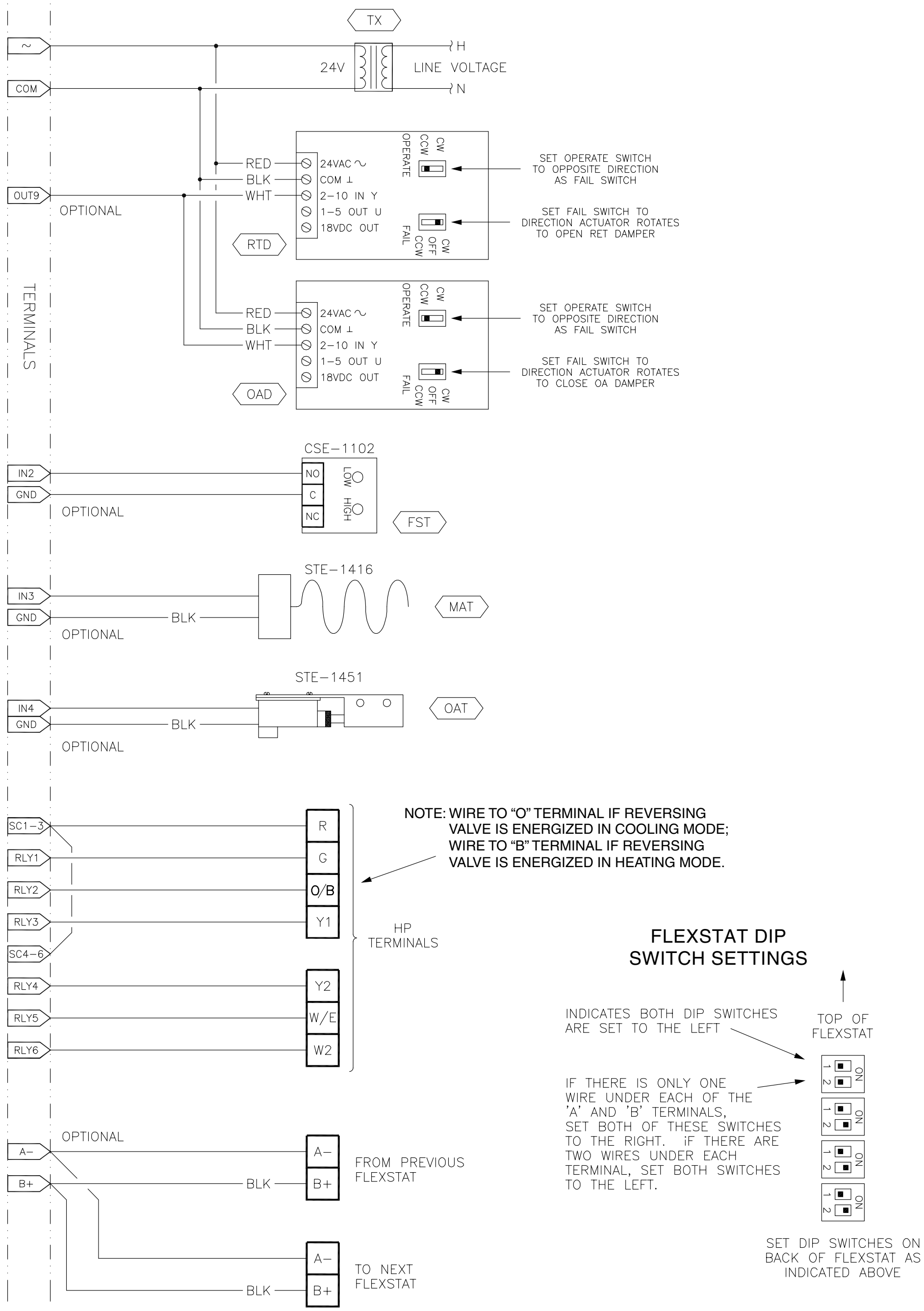
Do not mistakenly connect 24 VAC to an analog output ground. This is not the same as a relay's switched common. See the backplate's terminal label for the correct terminal.

NOTE: This application is one of the packaged programs selectable from the Advanced > Application menu in the BAC-1xxx63C models.





HPU, Example Schematic



INPUT/OUTPUT LIST: HPU

INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	MIXED AIR TEMP (OPT)	MAT
AI4	OUTSIDE AIR TEMP (OPT)	OAT
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN	G
BO2	REV VALVE	O/B
BO3	COMPRESSOR 1	Y1
BO4	COMPRESSOR 2 (OPT)	Y2
BO5	AUX HEAT (OPT)	W/E
BO6	EMER HEAT (OPT)	W2
AO7	SPARE	
AO8	SPARE	
AO9	OA DAMPER (OPTIONAL)	OAD/RTD

BILL OF MATERIAL: HPU

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
MAT	STE-1416	12' DUCT AVERAGING TEMP SENSOR
OAT	STE-1451	OUTSIDE TEMPERATURE SENSOR
CHOOSE ONE OF THE FOLLOWING TRANSFORMERS:		
TX	XEE-6311-075	CONTROL TRANSFORMER, 120/208/240/480:24VAC, 75VA
TX	XEE-6311-100	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 100VA

BILL OF MATERIAL: HPU, DAMPER ACTUATORS

REFERENCE	MAX DAMPER AREA IN FT^2	PART #	PART DESCRIPTION
OAD or RTD	6.25	MEP-5372	50 IN-LB FAILSAFE ACTUATOR, 2-10VDC, 19VA
OAD or RTD	15	MEP-7252	120 IN-LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
OAD or RTD	22.5	MEP-7552	180 IN-LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
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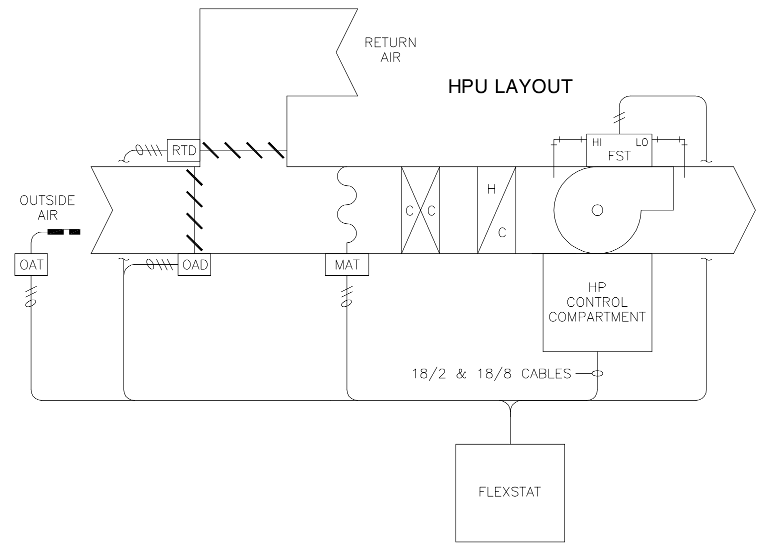


RTU (Roof Top Unit), General Wiring

Input Terminals	RTU Input Connections	BACnet Objects
IN4	Outside Air Temp. (OAT)*	AI4
IN3	Mixed Air Temp. (MAT)*	AI3
GND	Ground	
IN2	Fan Status (FST)**	AI2

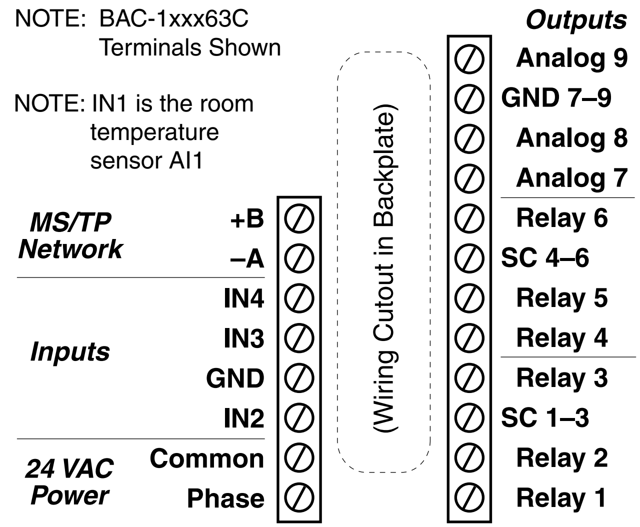
*When using optional Outside Air Damper, must also have MAT/OAT inputs (typically 10K, Type II thermistors). Ensure pull-up resistor switch positions are set properly—see Illustration 3 on page 2.
**Fan Status is an optional input. Ensure pull-up resistor switch positions are set properly for the relay or switch.
***If optional Outside Air Damper is used, configure damper from the Damper Setup Menu.

Output Terminals (BAC-1xxx63C)	Typical Terminal Codes	RTU Output Connections (2H/2C)	BACnet Objects
Analog 9		Outside Air Damper (OAD/RTD)***	AO9
GND		Ground (for analog output terminal 9)	
Analog 8			*(AO8)*
Analog 7			*(AO7)*
Relay 6			*(BO6)*
SC 4–6	RH/R	24 VAC (for relay terminals 4–6)	
Relay 5	W2	Heat 2	BO5
Relay 4	W1	Heat 1	BO4
Relay 3	Y2	Cool 2	BO3
SC 1–3	RC/R	24 VAC (for relay terminals 1–3)	
Relay 2	Y1	Cool 1	BO2
Relay 1	G	Fan	BO1

NOTE: Although typical terminal code letters are shown, check the schematics of your unit for wiring details.

NOTE: Terminal connections reflect firmware versionE0.0.0.19 or R1.0.0.0 or later. (Earlier versions had Relay 3 and 4 terminals swapped.)

NOTE: See also the Sequence of Operation section.



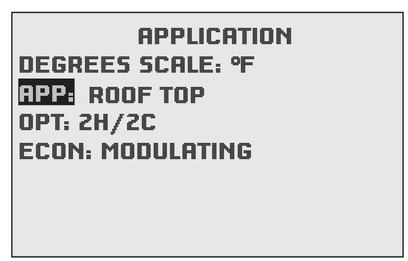
⚠ CAUTION

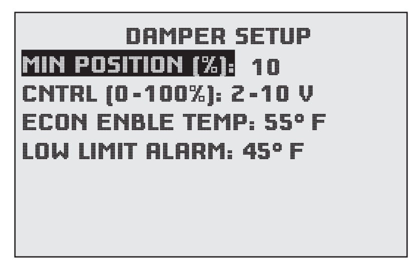
Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

⚠ CAUTION

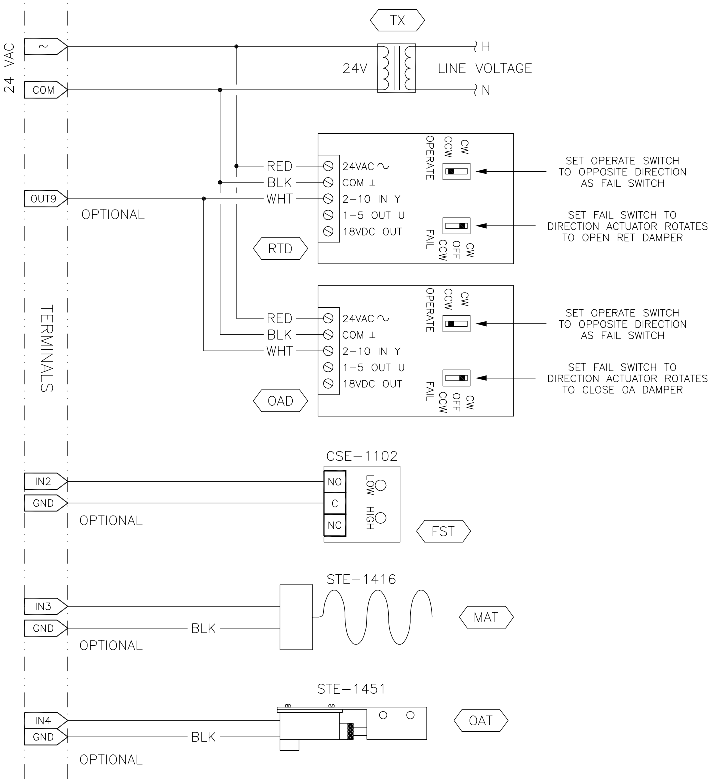
Do not mistakenly connect 24 VAC to an analog output ground. This is not the same as a relay's switched common. See the backplate's terminal label for the correct terminal.

NOTE: This application is one of the packaged programs selectable from the Advanced > Application menu in the BAC-1xxx63C models.

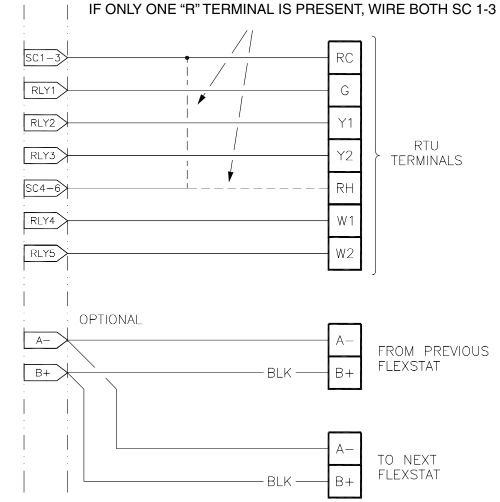




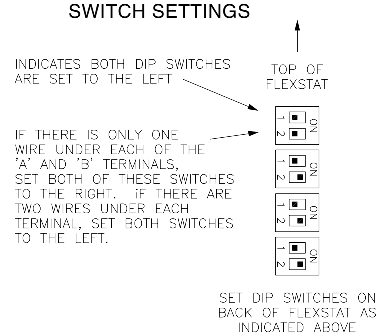
RTU, Example Schematic



IF BOTH RC AND RH TERMINALS ARE PRESENT, WIRE RC TO SC 1-3 AND RH TO SC 4-6.
IF ONLY ONE “R” TERMINAL IS PRESENT, WIRE BOTH SC 1-3 AND SC 4-6 TO R.



FLEXSTAT DIP SWITCH SETTINGS



INPUT/OUTPUT LIST: RTU 2H/2C

INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	MIXED AIR TEMP (OPT)	MAT
AI4	OUTSIDE AIR TEMP (OPT)	OAT
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN	G
BO2	COOL 1	Y1
BO3	COOL 2	Y2
BO4	HEAT 1	W1
BO5	HEAT 2	W2
BO6	SPARE	
AO7	SPARE	
AO8	SPARE	
AO9	OA DAMPER (OPTIONAL)	OAD/RTD

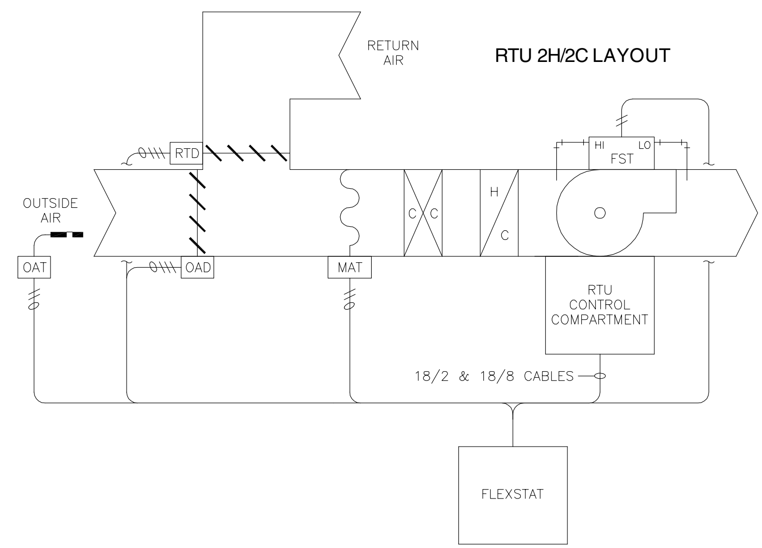
BILL OF MATERIAL: RTU - 2H/2C

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
MAT	STE-1416	12' DUCT AVERAGING TEMP SENSOR
OAT	STE-1451	OUTSIDE TEMPERATURE SENSOR
CHOOSE ONE OF THE FOLLOWING TRANSFORMERS:		
TX	XEE-6311-075	CONTROL TRANSFORMER, 120/208/240/480:24VAC, 75VA
TX	XEE-6311-100	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 96VA

BILL OF MATERIAL: RTU - 2H/2C, DAMPER ACTUATORS

REFERENCE	MAX DAMPER AREA IN FT^2	PART #	PART DESCRIPTION
OAD or RTD	6.25	MEP-5372	50 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 19VA
OAD or RTD	15	MEP-7252	120 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
OAD or RTD	22.5	MEP-7552	180 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 25VA
OAD or RTD	40	MEP-7852	320 IN·LB FAILSAFE ACTUATOR, 2-10VDC, 40VA

RTU 2H/2C LAYOUT



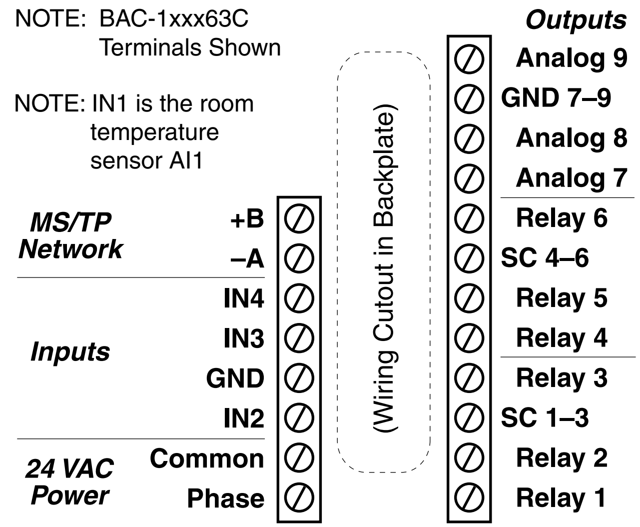
FCU (Fan Coil Unit), General Wiring

Input Terminals	FCU Input Connections	BACnet Objects
IN4		*(AI4)*
IN3	*Supply Water Temp. (W-TMP)**	AI3
GND	Ground	
IN2	Fan Status (FST)**	AI2

*Input for Supply Water Temp (used in 2-pipe systems) is typically a 10K,Type II Thermistor. Ensure pull-up resistor switch positions are set properly—see Illustration 3 on page 2.
**Fan Status is an optional input. Ensure pull-up resistor switch positions are set properly for the relay or switch.

Output Terminals (BAC-1xxx63C)	FCU Output Connections		BACnet Objects
	2-Pipe	4-Pipe	
Analog 9			*(AO9)*
GND	Ground (for analog output terminals 7 and 8)		
Analog 8		Heat Valve, Proportional (CLV)	AO8
Analog 7	Valve, Proportional (VLV)	Cool Valve, Proportional (HLV)	AO7
Relay 6			*(BO6)*
SC 4–6	24 VAC (for relay terminals 4 and 5)		
Relay 5		Heat Valve, 2-Position (HLV)	BO5
Relay 4	Valve, 2-Position (VLV)	Cool Valve, 2-Position (CLV)	BO4
Relay 3	Fan 3		BO3
SC 1–3	24 VAC (for relay terminals 1–3)		
Relay 2	Fan 2		BO2
Relay 1	Fan 1		BO1

NOTE: See also the Sequence of Operation section.



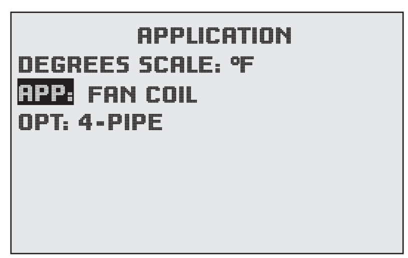
⚠ CAUTION

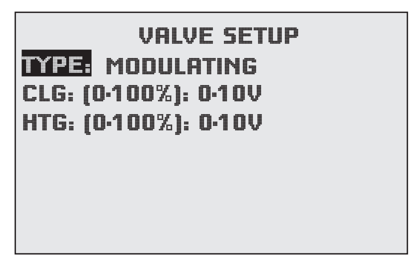
Relays are for Class-2 voltages (24 VAC) only. Do not connect line voltage to the relays!

⚠ CAUTION

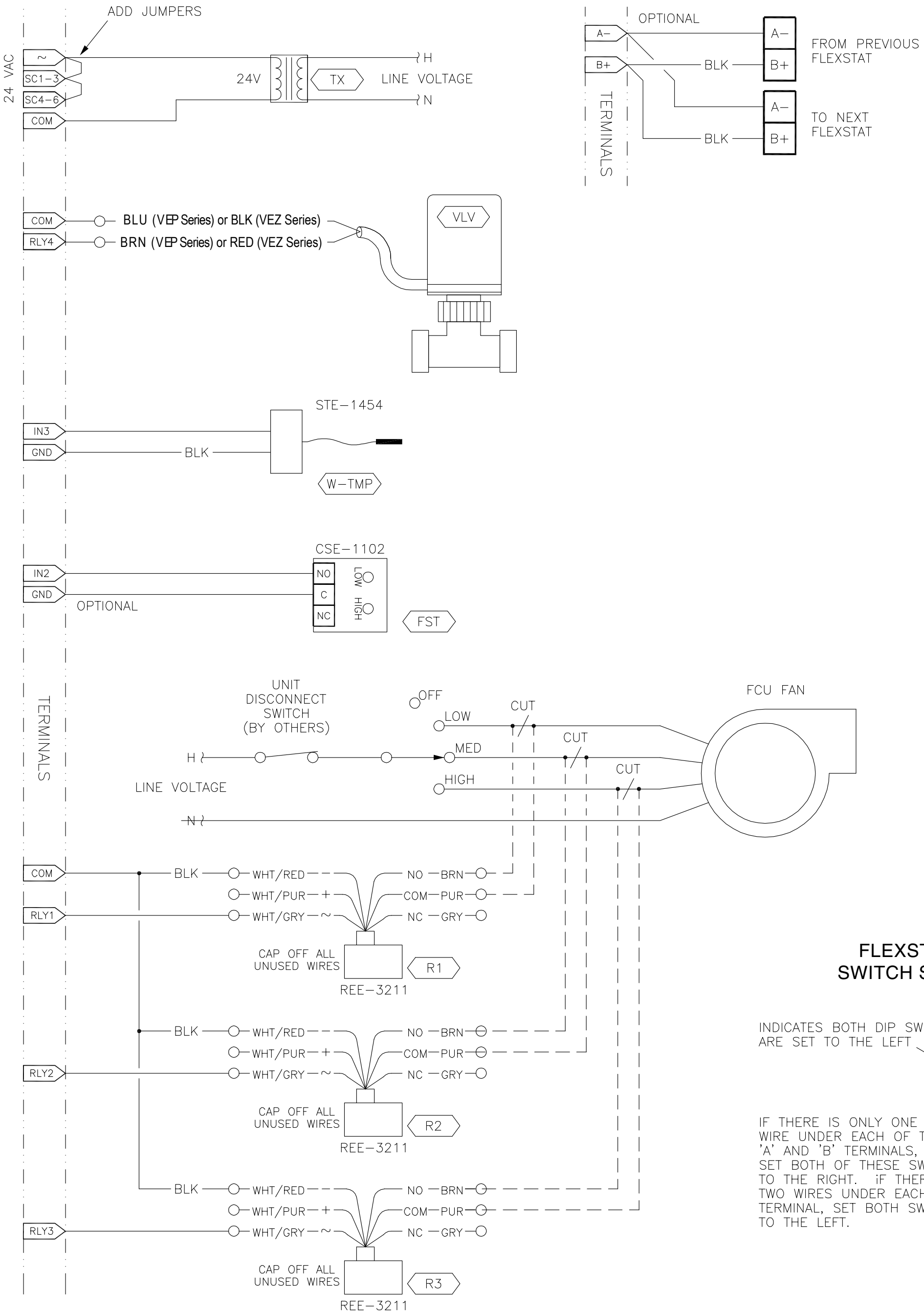
Do not mistakenly connect 24 VAC to an analog output ground. This is not the same as a relay's switched common. See the backplate's terminal label for the correct terminal.

NOTE: This application is one of the packaged programs selectable from the Advanced > Application menu in the BAC-1xxx63C models.





FCU, 2-Pipe/2-Position Example Schematic



INPUT/OUTPUT LIST: FCU, 2-PIPE 2-POS

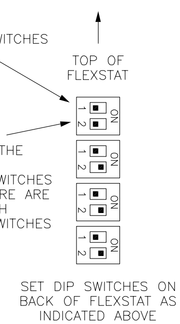
INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	WATER TEMP	W-TMP
AI4	SPARE	
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN 1	FAN1
BO2	FAN 2	FAN2
BO3	FAN 3	FAN3
BO4	WATER VALVE	VLV
BO5	SPARE	
BO6	SPARE	
AO7	SPARE	
AO8	SPARE	
AO9	SPARE	

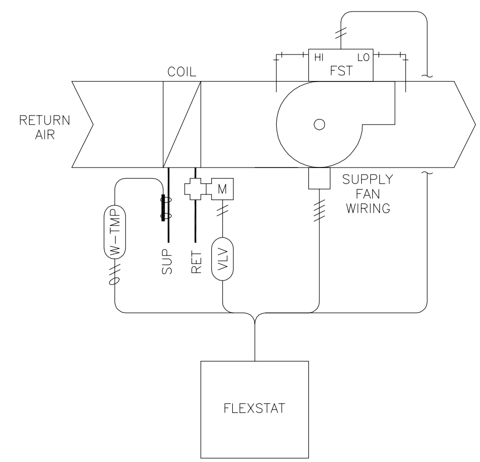
BILL OF MATERIAL: FCU, 2-PIPE 2-POS

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
R1	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R2	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R3	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
VLV	VEP-1xxx0186/ VEZ-4xxxxMBx	FAIL-SAFE CONTROL VALVE, 24VAC, 14VA
FOR VALVE, CHOOSE CAPACITY/FAIL-POSITION/MODEL FROM KMC DATA SHEET		
W-TMP	STE-1454	2" STRAP-ON STAINLESS TEMP SENSOR
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
TX	XEE-6311-050	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 50VA

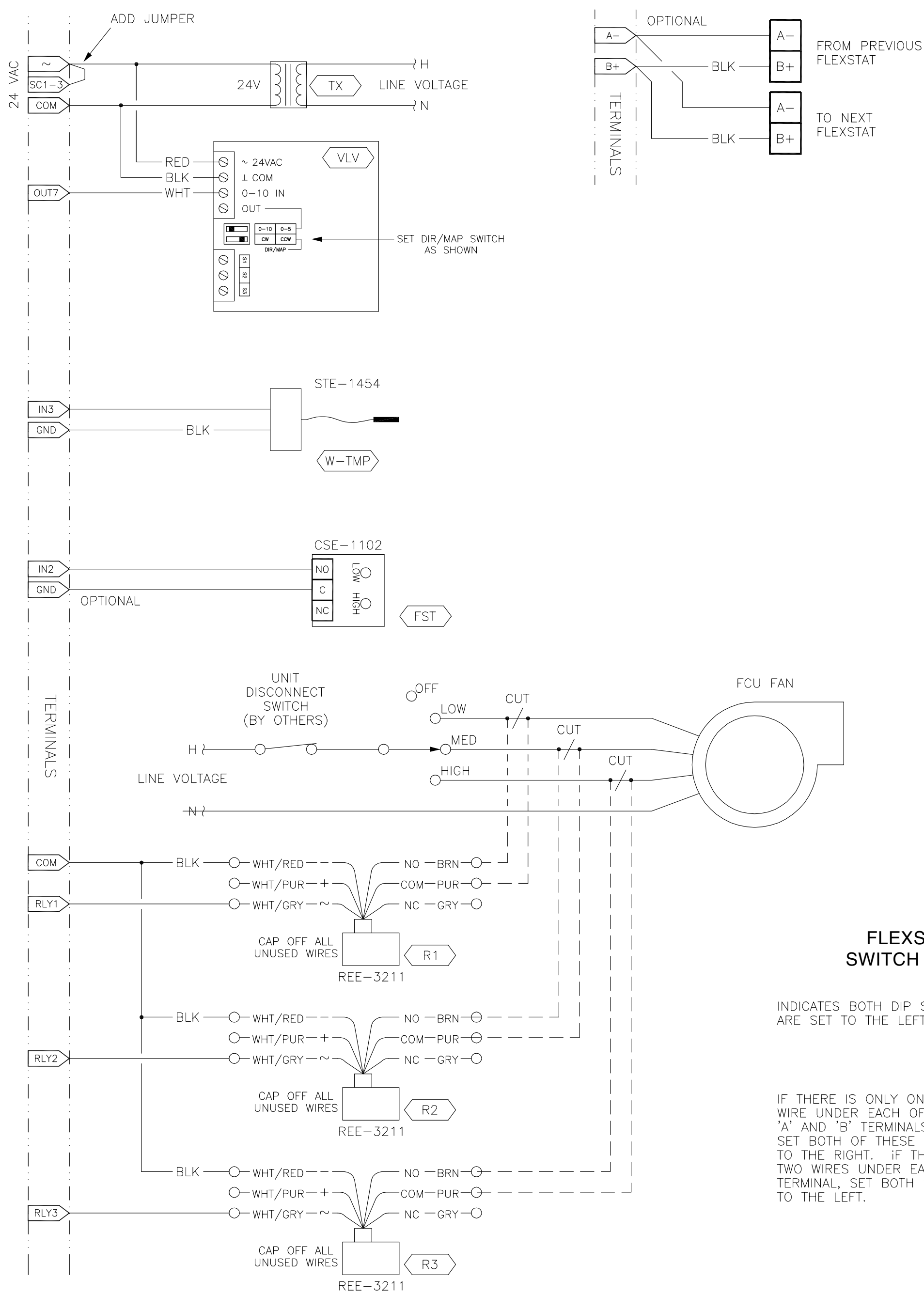
FLEXSTAT DIP SWITCH SETTINGS



FCU 2-PIPE 2-POSITION LAYOUT



FCU, 2-Pipe/Modulating Example Schematic



INPUT/OUTPUT LIST: FCU, 2-PIPE MOD

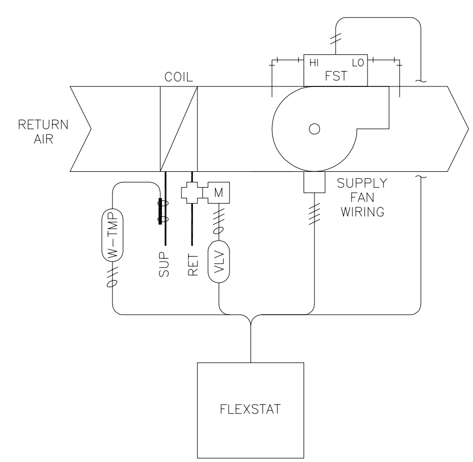
INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	WATER TEMP	W-TMP
AI4	SPARE	
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN 1	FAN1
BO2	FAN 2	FAN2
BO3	FAN 3	FAN3
BO4	SPARE	
BO5	SPARE	
BO6	SPARE	
AO7	WATER VALVE	VLV
AO8	SPARE	
AO9	SPARE	

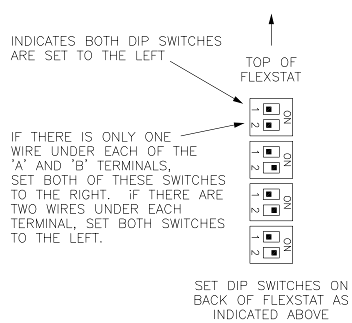
BILL OF MATERIAL: FCU, 2-PIPE MOD

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
R1	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R2	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R3	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
VLV	VEP-45xxB745/ VEB-43xxxBCK	CONTROL VALVE W/ MEP-4002 0-10V ACTUATOR, 4VA
FOR VALVE, CHOOSE CAPACITY/MODEL FROM KMC DATA SHEET		
W-TMP	STE-1454	2" STRAP-ON STAINLESS TEMP SENSOR
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
TX	XEE-6311-050	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 50VA

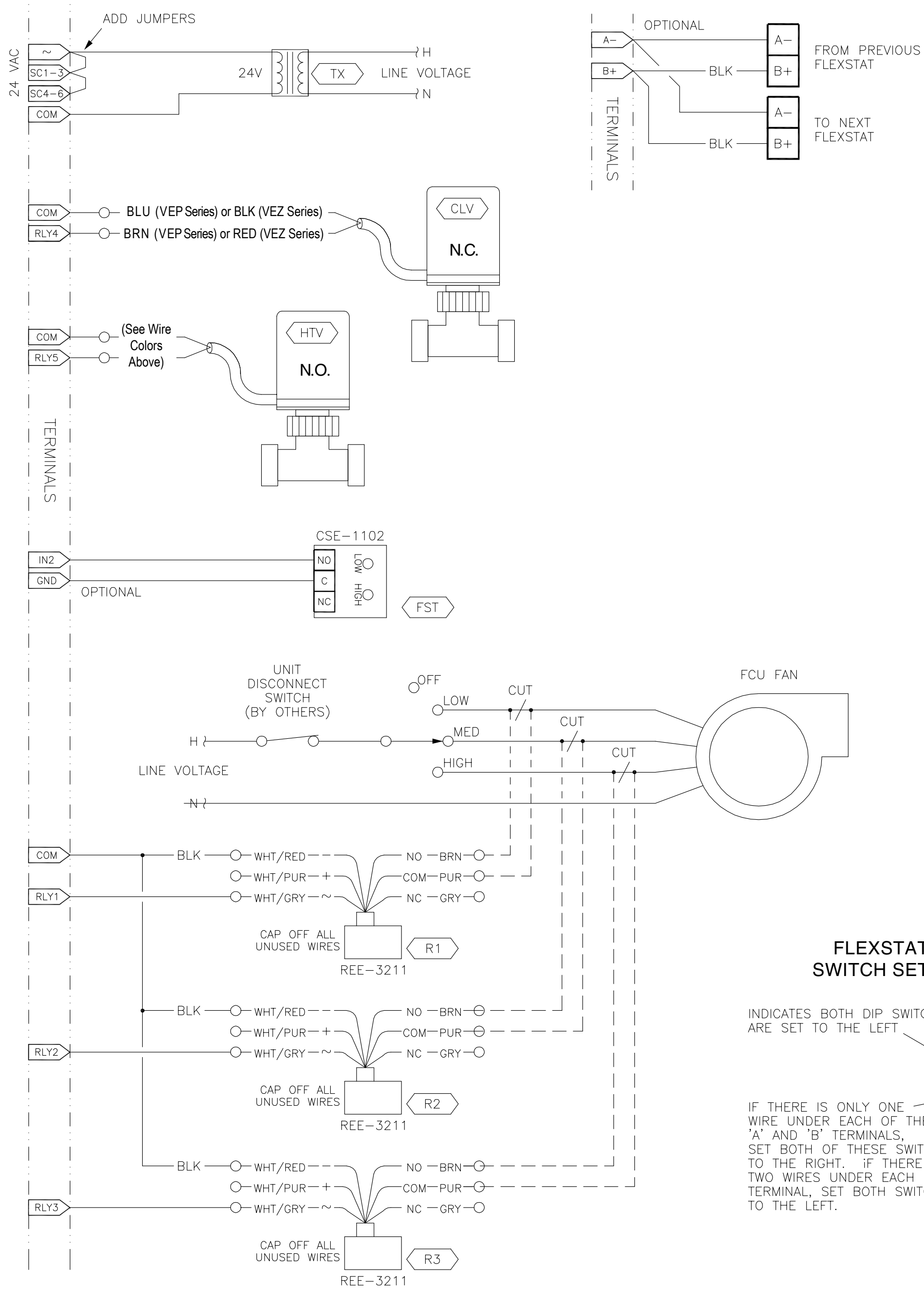
FCU 2-PIPE MODULATING LAYOUT



FLEXSTAT DIP SWITCH SETTINGS



FCU, 4-Pipe/2-Position Example Schematic



INPUT/OUTPUT LIST: FCU, 4-PIPE 2-POS

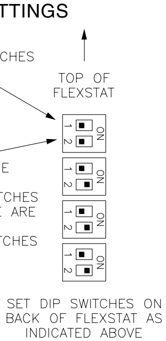
INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	SPARE	
AI4	SPARE	
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN 1	FAN1
BO2	FAN 2	FAN2
BO3	FAN 3	FAN3
BO4	COOLING VALVE	CLV
BO5	HEATING VALVE	HTV
BO6	SPARE	
AO7	SPARE	
AO8	SPARE	
AO9	SPARE	

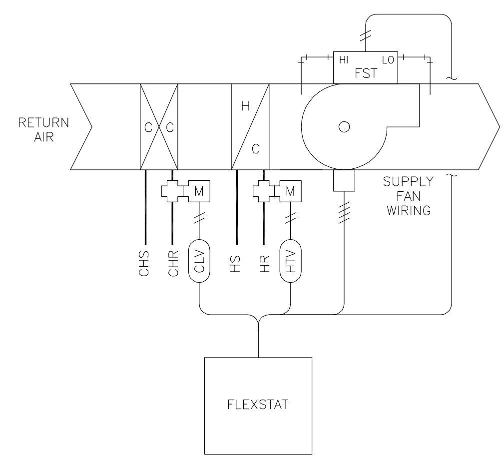
BILL OF MATERIAL: FCU, 4-PIPE 2-POS

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
R1	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R2	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R3	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
CLV	VEP-1xxx0186/	N.C. FAIL-SAFE CONTROL VALVE, 24VAC, 14VA
HTV	VEZ-4xxxxMBx	N.O. FAIL-SAFE CONTROL VALVE, 24VAC, 14VA
FOR VALVES, CHOOSE CAPACITY/FAIL-POSITION/MODEL FROM KMC DATA SHEET		
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
TX	XEE-6311-050	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 50VA

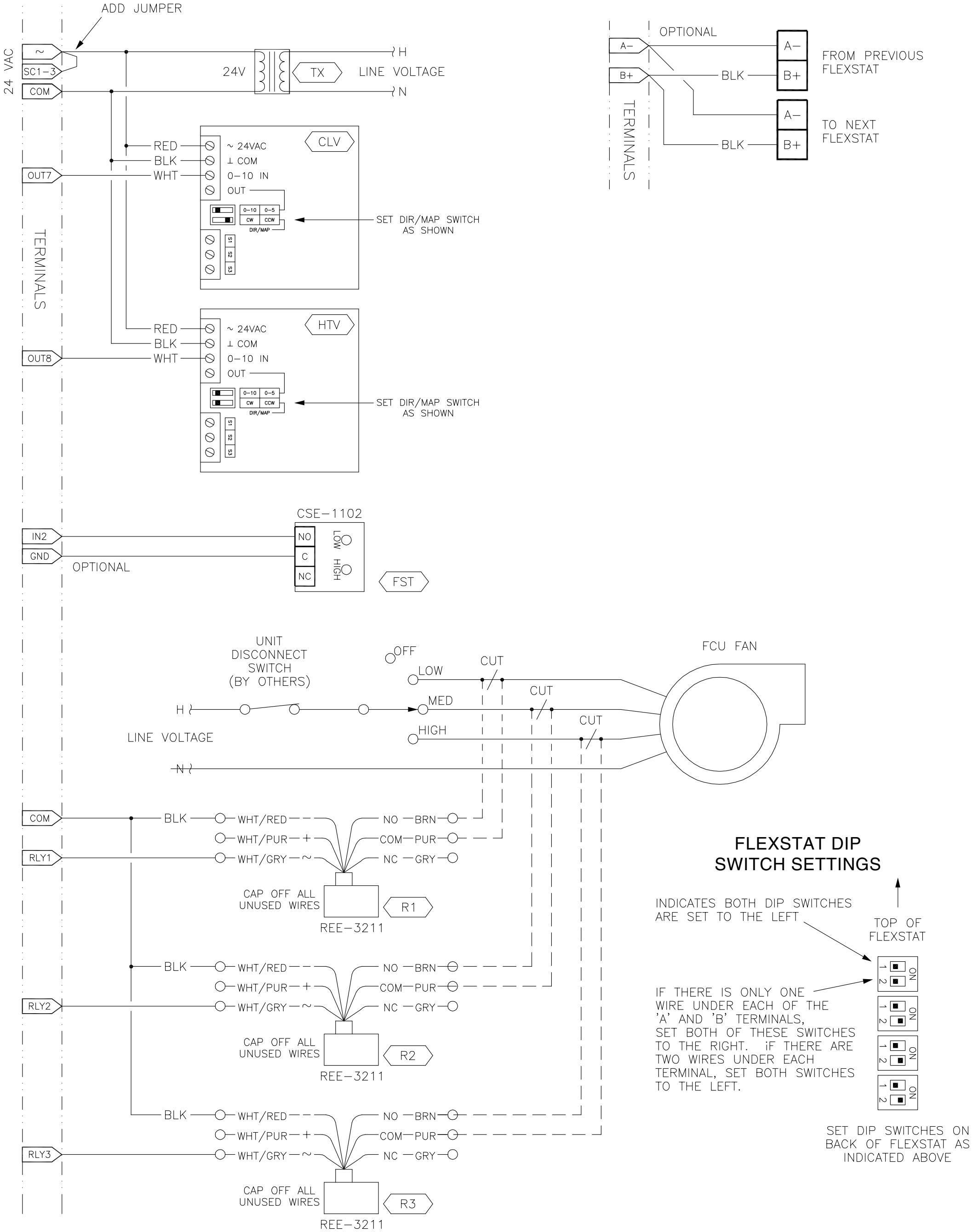
FLEXSTAT DIP SWITCH SETTINGS



FCU 4-PIPE 2-POSITION LAYOUT



FCU, 4-Pipe/Modulating Example Schematic



INPUT/OUTPUT LIST: FCU, 4-PIPE MOD

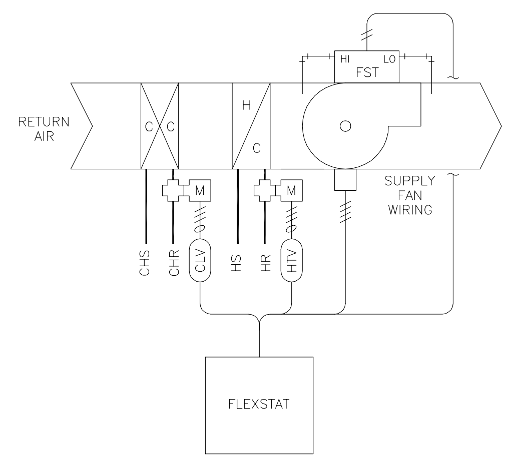
INPUTS		
#	INPUT NAME	REFERENCE
1	SPACE TEMP (INTERNAL)	ST
AI2	FAN STATUS (OPT)	FST
AI3	SPARE	
AI4	SPARE	
5	SPACE HUM (INT - OPT)	SH
6	OCCUPANCY (INT - OPT)	OCC

OUTPUTS		
#	OUTPUT NAME	REFERENCE
BO1	FAN 1	FAN1
BO2	FAN 2	FAN2
BO3	FAN 3	FAN3
BO4	SPARE	
BO5	SPARE	
BO6	SPARE	
AO7	COOLING VALVE	CLV
AO8	HEATING VALVE	HTV
AO9	SPARE	

BILL OF MATERIAL: FCU, 4-PIPE MOD

REFERENCE	PART #	PART DESCRIPTION
FLEXSTAT	BAC-1XX63C	BACNET THERMOSTAT, 6 RELAY/3 ANALOG OUTPUTS, 3VA
R1	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R2	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
R3	REE-3211	MULTI-VOLTAGE CONTROL RELAY, 1.2VA
CLV	VEP-45xxB745/	CONTROL VALVE W/ MEP-4002 0-10V ACTUATOR, 4VA
HTV	VEB-43xxxBCK	
FOR VALVE, CHOOSE CAPACITY/MODEL FROM KMC DATA SHEET		
FST	CSE-1102	AIR DIFFERENTIAL PRESSURE SWITCH, 0.05-12"WC
TX	XEE-6311-050	CONTROL TRANSFORMER, 120/240/277/480:24VAC, 50VA

FCU 4-PIPE MODULATING LAYOUT



Sequence of Operation

NOTE: This information reflects firmware version E0.0.0.19 or R1.0.0.0 or later (but specifications are subject to change).

Common Features

Space Temperature Setpoints and Modes

The first step in setting up an unconfigured FlexStat is to select the units of operation, Celsius or Fahrenheit. Once set, temperature values are adjusted in both firmware and Control Basic for the proper values/units.

The most basic operating parameters controlling the FlexStats operation are the space temperature setpoints. There are **four setpoints** during normal operation of the FlexStat; unoccupied heating setpoint, unoccupied cooling setpoint, occupied heating setpoint and occupied cooling setpoint.

Likewise, there are **four corresponding setpoint limiters**: unoccupied heating max, unoccupied cooling min, occupied heating max, and occupied cooling min. When the setpoints are adjusted from the FlexStat's user interface display, firmware applies the appropriate limit to the setpoint being edited.

Another limit that applies to setpoints is the **minimum setpoint differential**. This differential is adjustable via the user interface. It cannot, however, be set less than the minimum setpoint differential limit (default of 1° F/C), which itself is only adjustable from interface software. The function of the limit works in two ways. If either the occupied or unoccupied heating setpoint is being edited from the user interface, it cannot be raised any closer to the corresponding occupied or unoccupied cooling setpoint than the minimum setpoint differential even if the heating setpoint being edited is less than its maximum limit. Conversely, if the occupied or unoccupied cooling setpoint is being edited from the user interface, the cooling setpoint is allowed to be adjusted down to its minimum limit. However, the corresponding occupied or unoccupied heating setpoint is always maintained at this minimum setpoint differential distance from the cooling setpoint with the heating setpoint being lowered if necessary.

The FlexStat controls its output operations based on two setpoints, **active heating setpoint and active cooling setpoint**. Under normal, non-override operation, these setpoints are set, based on the current schedule state being on, to either the occupied heating and occupied cooling setpoints. If the present schedule state is off, then the active heating and active cooling setpoints are set to the unoccupied heating and unoccupied cooling setpoints. Active heating and cooling setpoints can be set to other values under the circumstances described in the occupancy override sequence under the Occupancy Mode section.

Deadband is adjustable from the user interface and is used in staging or modulating the outputs throughout the various application configurations. A parameter, minimum deadband, governs the lower limit of the deadband and is adjustable only from interface software. The specific use of deadband is described further in following sequences.

The current heating/cooling mode of the FlexStat is displayed on the user interface. This mode determines which outputs are energized based on space temperature and active setpoint values. The heating/cooling mode is set to heating if the space temperature falls below the active heating setpoint. If the space temperature rises above the active cooling setpoint, the heating/cooling mode is set to cooling.

The heating/cooling mode can also be manually set by adjusting the "**System Mode**" through the user interface. The System Mode can be set to Auto, Heat, Cool and Off. On the heat pump application, the System Mode can also be set to Emergency Heat. If the System Mode is set to Auto, the FlexStat will automatically determine the heating or cooling mode as described above. Setting the System Mode to "Heat" or "Cool" (or Emer Ht) forces the unit into that mode. Setting the System Mode to "Off" turns off all heating and cooling functions but has no effect on fan control.

Occupancy Modes

Occupied mode is normally determined by the weekly schedule. It is used for determining which space temperature setpoints to use, whether to run the fan in constant or intermittent mode and whether to ventilate (outside air damper minimum position) or not.

In addition to temporarily placing the controller into the occupied mode if it is not already in occupied mode, **occupancy override is used to temporarily override the space temperature** setpoints for a predetermined period of time. As such, occupancy override may be activated during either occupied mode or unoccupied mode. This is done by either changing the setpoint via the Up/Down buttons from the home screen of the FlexStat or starting the override mode from the override menu (Left and then Enter buttons on the OCC icon of the home screen).

Once activated, the occupancy override mode functions in one of two ways, depending on configuration. After initial activation (if the occupancy override timer is set to a non-zero value), the occupancy override mode will turn itself off after the period of time set by the timer expires. Alternately, it will turn off at the next schedule change if that comes first.

If the override timer value is set to zero, the schedule state (occupied or unoccupied) is logged just prior to the activation of the override mode. Once activated in this zero timer mode, the occupancy override will expire upon the next normal scheduled change of state of the scheduled occupied mode. The following two examples illustrate this operation. For both examples, assume the override timer is set to zero and the scheduled occupied mode is on at 8:00 AM and off at 5:00 PM:

- Example 1. The override mode is activated at 4:57 PM. The occupancy override starts at 4:57 PM and expires at 5:00 PM.
- Example 2. The override mode is activated at 5:01 PM. The occupancy override starts at 5:01 PM and expires at 8:00 AM the following morning.

How the override mode affects temperature setpoints depends on how the mode was initiated:

If the mode was initiated from entering on the occupancy icon on the home screen, the FlexStat will maintain the normal occupied heating and occupied cooling setpoints until the expiration of the override mode.

If the override mode was initiated by modifying the setpoint via the up/down buttons of the home screen on the user interface, then the active setpoint of the current heating or cooling mode is adjusted according to the buttons. The complimentary active setpoint (i.e., cooling, if the FlexStat is presently in the heating mode) is then set to the minimum setpoint differential away from the present mode active setpoint (limits allowing). The FlexStat will attempt to maintain the space temp setpoint as entered at the start of the occupied override mode. However, minimum setpoint differential and occupied heating max and occupied cooling min limits still apply to override mode setpoint adjustments and operations.

If, during occupancy override mode via setpoint adjust, the unit is in heating mode and the temperature passes the active cooling setpoint, the active mode becomes cooling. The active cooling setpoint then becomes the old active heating setpoint and the active heating setpoint is lowered by the minimum setpoint differential. Again, occupied heating max and occupied cooling min limits still apply. Similar setpoint swapping occurs if the unit was in the cooling mode and the temperature falls below the active heating setpoint.

On FlexStat models with an occupancy sensor, the occupancy sensor is **not** currently tied via programming to the occupied mode. This may be done in a custom Control Basic program. It should be noted that the minimum on time for the occupancy sensor input is adjustable and can be used to trigger a timer for a timed-occupancy sensor override function.

The FlexStat is considered in the “occupied” mode whether it is set by normal schedule operation or occupied override mode. If the FlexStat is not scheduled on or in the occupancy override mode, it is considered in “unoccupied” state.

Fan Control

The following is the base sequence for fan operation.

The occupied and the unoccupied modes have separate configurations for fan control. Each scheduled mode can be configured to operate the fan in either continuous or automatic mode.

If the configuration for a particular occupancy mode is set to "On," there will be a continuous call for fan during that scheduled state. If the fan is set to "Auto," the fan will cycle only on a call for heating or cooling. Because PI control is used in heating and cooling, values may be slightly skewed, but generally a call for heating turns on at active heating set-point (minus deadband) and off at active heating setpoint. Generally, a call for cooling turns on at active cooling setpoint (plus deadband) and off at active cooling setpoint.

There are certain application-specific variations of how the fan control functions that are detailed in the specific application sections below.

The FlexStat has two options concerning fan status:

- If the unit is configured to not have fan status, then the fan motor is assumed to always respond when commanded to run.
- If the unit is configured to have fan status, and if the fan is com-manded to run and the FlexStat does not see a response on the fan status input within 5 seconds, a fan alarm is generated. Upon fan alarm, all outputs are deenergized.

There is a fan status icon on the user interface that indicates the fan run command status. This is controllable through Control Basic.

If a low limit alarm is present, all fan outputs are deenergized.

Economizer

Certain applications can be configured for an economizer option. If the economizer option is enabled, the economizer mode is determined by comparing **outside air temperature** (**OAT**) to the economizer enable temperature. The economizer mode is enabled if the OAT is 1.0° F (0.56° C) below the economizer enable temperature and disabled if the OAT is 1.0° F (0.56° C) above the econ enable temp.

During occupied mode, if the economizer mode is enabled, the outside air damper will open to the greater of the minimum damper position setting (adjustable, for ventilation) or the mixed air temperature PI loop. The mixed air temp loop will modulate from 0 to 100% as the mixed air temp rises above the mixed air temp setpoint.

During occupied mode, the mixed air temp setpoint is determined based on a reset schedule. If the space temperature is at or below the active cooling setpoint, the mixed air temp setpoint is 68.0° F (20.0° C). If the space temperature is 2.0° F (1.1° C) above the active cooling setpoint, the mixed air temp setpoint will be 53.0° F (11.7° C). The mixed air setpoint will vary linearly in between.

During unoccupied mode, if the space temp exceeds the cooling setback setpoint by deadband and the econ mode is enabled, the outside air damper shall open as called for by the mixed air temp loop. The outside air damper shall modulate to maintain 53.0° F (11.7° C) until the space temp reaches the cooling setback setpoint, at which point it shall close. If at any time during unoccupied mode the economizer mode is disabled based on OAT, the outside air damper will close.

If the system mode is set to "heating" during occupied mode, the damper will open to minimum position when the fan is on. If the system mode is set to "heating" during unoccupied mode or is set to "off" in any occupancy mode, the outside damper will close. If at any time there is a fan alarm, the outside air damper shall shut.

If the mixed air temp drops below the low limit alarm temp, a low limit alarm is generated and the outside air damper will close. Other safety actions are taken and described in their respective sections below.

Dehumidification

On FlexStat models BAC-10163C/11163C, dehumidification is offered as an option. Once the dehumidification sequence is enabled through the user interface, the dehumidification mode starts if the space humidity rises above the dehum setpoint (adjustable, default 60%). The dehum mode is stopped if the space humidity drops below the dehum setpoint minus the dehum deadband (adjustable, default 5%). Dehumidification mode being started also generates a call for fan if the fan mode is set to "Auto."

Staged Heating and Cooling Parameters

On applications with staged heating and cooling, there will be a 3 minute (adjustable) delay between calls for stages (stage delay).

Once a stage of heating or cooling turns off, there is a 3 minute (adjustable) minimum off time before that stages output can be reenergized.

Once all stages of heating and cooling have turned off, the fan will remain energized for 3 minutes (adjustable, off delay).

User Interface Display Backlight

The user interface display backlight will illuminate any time any button is pushed on the FlexStat. It will remain illuminated for 60 seconds (adjustable, inactivity). The display is also controllable from Control Basic programming.

Applications

AHU (Air Handling Unit)

Fan Control

The fan follows the base sequence for fan operation as listed above.

Valve Control

The method of controlling the heating and cooling valves is based on the fan configuration:

- **If the fan mode for a particular occupancy mode is set to constant or "On," the valves function in a modulating fashion.** Actual response may vary slightly due to PI action of the control loops, but generally the heating valve will start to open as the space temperature drops below the active heating setpoint and modulate to fully open when space temperature reaches active heating setpoint minus deadband. Likewise, the cooling valve will generally begin opening as the space temperature rises above the active cooling setpoint and be fully open by the time the space temp reaches the active cooling setpoint plus deadband, modulating linearly in between.
- **With the fan mode set to "Auto," the heating valve will open 100%** if the space temperature falls below active heating setpoint minus deadband and fully close when space temp rises above active heating setpoint. The cooling valve similarly opens 100% if the space temp rises above the active cooling setpoint plus deadband and fully closes if the space temp falls below the active cooling setpoint.

If at any time there is a low limit alarm, the cooling valve is forced closed and the heating valve opens fully.

If at any time there is a fan failure alarm, the cooling and heating valves are both forced closed.

Economizer Control

If the AHU application is configured for the economizer option, the economizer sequence described in the Common Features section is followed.

Dehumidification

If the dehumidification sequence is enabled on models BAC-10163C/11163C, the dehumidification mode is started and stopped as described in the Common Features section. Upon activation of the dehumidification mode, the cooling valve is opened 100%. The heating valve then reheats the space as called for in the normal heating sequence to maintain the active heating setpoint. Upon termination of the dehumidification mode, the valves return to their normal sequence.

HPU (Heat Pump Unit)

Fan Control

The fan follows the base sequence for fan operation as listed above if the heat pump application is configured for one stage of compressor.

If the heat pump application is configured for two stages of compressor, the fan follows the base sequence for fan operation described in the Common Features section with the following exception. If the fan mode is set to "Auto," the fan will start if the space temp rises above the active cooling setpoint plus one half the deadband and will stop if the space temp drops below the active cooling setpoint. If the space temp drops below the active heating setpoint minus one half the deadband, the fan will start and stop when the fan rises above the active heating setpoint. This will allow only one stage of heating or cooling to run if necessary.

Fan off delays apply as previously described.

Reversing Valve

The reversing valve can be configured through the user interface to be energized on a call for heating ("B" function) or energized on a call for cooling ("O" function). If the reversing valve is configured to be **energized on a call for heating ("B")**, the reversing valve output will be energized any time there is a call for heating and deenergized on a call for cooling.If the reversing valve is configured to be **energized on a call for cooling ("O")**, the reversing valve output will be energized any time there is a call for cooling and deenergized on a call for heating.

Compressor Staging

The sequence for the compressor staging depends on the number of configured stages in the heat pump application:

- If the application is **configured for one compressor stage**, the following sequence is used. If the space temperature rises above the active cooling setpoint plus the deadband AND the compressor has been off at least the minimum off time, the compressor is energized. If the space temp drops below the active cooling setpoint, the compressor is deenergized. If the space temp drops below the active heating setpoint minus the deadband AND the compressor has been off the minimum off time, the compressor will be energized. If the space temp rises above the active heating setpoint, the compressor is deenergized.
- If the application is **configured for two compressor stages**, the following sequence is used. In the heating mode, if the space temperature drops below the active heating setpoint minus one half the deadband AND the first stage of compressor has been off for at least the minimum off time, the first stage of compressor will be energized. If the space temp further drops below the active heating setpoint minus the deadband AND the first stage of compressor has been energized for at least the stage delay AND the second stage of compressor has been off for at least the minimum off time, the second stage of compressor will be energized. Upon rise in temperature above the active heating setpoint minus one half the deadband, the second stage of compressor

will be deenergized. Upon further rise in temperature above the active heating setpoint, the first stage of compressor will be deenergized. In the cooling mode, if the space temp rises above the active cooling setpoint plus one half the deadband AND the first stage of compressor has been off for at least the minimum off time, the first stage of compressor will be energized. If the space temp further rises above the active cooling setpoint plus the deadband AND the first stage of compressor has been energized for at least the stage delay AND the second stage of compressor has been off for at least the minimum off time, the second stage of compressor will be energized. Upon decrease in space temp below the active cooling setpoint plus one half the deadband, the second stage of compressor shall be deenergized. Upon further decrease in space temp below the active cooling setpoint, the first stage of compressor shall be deenergized.

If at any time there is a fan failure alarm or low limit alarm, all compressor stages are deenergized.

Auxiliary/Emergency Heat

The heat pump application can be configured with auxiliary heat in three methods: no auxiliary heat, auxiliary heat with outside air temp compressor lockout, and auxiliary heat without outside air temp compressor lockout.

If the unit is **configured for auxiliary heat without compressor lockout**, the auxiliary heat and emergency heat function as third and fourth stages of heat. If the space temperature drops below the active heating setpoint minus 1.5 times the deadband and remains below that temperature for the Auxiliary Heat Delay (adjustable), the auxiliary heat is energized. If the space temperature further falls below the active heating setpoint minus 2 times deadband and the auxiliary heat is energized, the emergency heat is then energized. If the space temperature rises above the active heating setpoint minus 1.5 times deadband, the emergency heat is deenergized. If the space temp further rises above the active heating setpoint minus the deadband, the auxiliary heat is deenergized.

If the heat pump application is configured for auxiliary heat with compressor lockout, a compressor lockout mode is enabled if the outside air temperature drops 1.0° F (0.56° C) below the Compressor OAT Low Limit. The compressor lockout mode is disabled if the outside air temperature rises 1.0° F (0.56° C) above the Compressor OAT Low Limit. If the compressor lockout mode is disabled, the auxiliary and emergency heat function as described above. If the compressor lockout mode is enabled, all stages of compressor are deenergized and the auxiliary and emergency heat function as described above but without the Auxiliary Heat Delay.

If the **System Mode is set to "Emer Ht,"** the compressors are locked out and the emergency heat is forced on. If the space temp drops below the active heating setpoint minus the deadband, the auxiliary heat is energized. If the space temp rises above the active heating setpoint, the auxiliary heat is deenergized.

Any time there is a fan failure alarm or low limit alarm, auxiliary and emergency heating are deenergized.

Economizer Control

If the HPU application is configured for the economizer option, the base economizer sequence described in the Common Features section is followed.

Dehumidification

Upon activation of the dehumidification mode, configured stages of compressor are energized after they have been off for at least the minimum off time. The reversing valve is set to the cooling mode based on the reversing valve configuration. Auxiliary and emergency heating stages then follow their normal sequence to maintain the active heating setpoint.

FCU (Fan Coil Unit), 2-Pipe

Fan Control

The fan follows the base sequence for fan operation as listed in the Common Features section above with the following modifications. When the fan runs, whether in "Auto" or "On" mode, the fan speed is determined by the Fixed Speed setting. If the Fixed Speed setting is set to a particular speed ("1," "2," or "3"), then any time the fan is called for, it will run at that speed. This allows fan speed to be set by a balancer. If the Fixed Speed is set to "Auto," then the speed the fan runs is determined by the heating or cooling PI loops. The fan is started at low speed upon call for heating or cooling and remains there until the active heating or cooling PI loop reaches 60%. Once above 60%, the fan is incrementally sped up based on the upper 40% of the heating or cooling PI loop, whichever is active based on the number of fan stages configured. The fan slows down in the reverse sequence. This operation allows the FCU to attempt to maintain space temperature setpoint using the valve at low fan speed. If space temp setpoint cannot be maintained at low speed, increasing the fan speed will allow more heat transfer to/from the coil.

Water Valve Operation and H/C Water Available Determination

The application is capable of determining whether heating or cooling water is available even in a stand-alone configuration. If the FlexStat has a call for heating or cooling greater than 10% and the unit does not know what type of water is available (both valves are fully closed), the FlexStat will initiate a **water evaluation mode**. During the water evaluation mode, all fan outputs are deenergized and the water valve opens for three minutes. After three minutes, the valve closes and a water temperature reading is immediately taken. If the water temp is below 63° F (17.2° C), a chilled water available flag is started. If the water temp is above 90° F (32.2° C), a heating water available flag is started. These flags will stay on until the valve goes fully shut or the water drops 2.0° (1.1° C) out of range. If the opposite type of water is available from what type of water is needed (e.g., cooling water is available and there is a call for heating), another flag indicating opposite water available is started. If the unit goes into "opposite water available" mode and the unit remains calling for the same temperature mode (heating or cooling), every fifteen minutes the unit will reinitiate the water evaluation mode.

The method of controlling the valve is based on the fan configuration as well as the valve configuration:

- For a **modulating valve configuration**, if the fan mode for a particular occupancy mode is set to constant or "On," the valve functions in a modulating fashion. Actual response may vary slightly due to PI action of the control loops, but generally, if heating water is available, the valve will start to open as the space temperature drops below the active heating setpoint and modulate to fully open when space temperature reaches active heating setpoint minus deadband. The valve modulates closed as the space temp rises towards the active heating setpoint. Likewise, the valve will generally begin opening as the space temperature rises above the active cooling setpoint and be fully open by the time the space temp reaches the active cooling setpoint plus deadband, modulating linearly in between. Once the valve closes fully in either heating or cooling mode, all water available flags are turned off.
- For a **two-position valve configuration**, with the fan mode set to "Auto," the valve will open 100% if the space temperature falls below active heating setpoint minus deadband and fully close when space temp rises above active heating setpoint if heating water is available. The valve similarly opens 100% if the space temp rises above the active cooling setpoint plus deadband and fully closes if the space temp falls below the active cooling setpoint if cooling water is available.

Any time there is a fan failure alarm, the valve will be fully closed.

FCU (Fan Coil Unit), 4-Pipe

Fan Control

The fan follows the base sequence for fan operation as listed in the Common Features section above with the following modifications. When the fan runs, whether in “Auto” or “On” mode, the fan speed is determined by the Fixed Speed setting. If the Fixed Speed setting is set to a particular speed (“1,” “2,” or “3”), then any time the fan is called for, it will run at that speed. This allows the fan speed to be set by a balancer. If the Fixed Speed is set to “Auto,” then the speed the fan runs is determined by the heating or cooling PI loops. The fan is started at low speed upon call for heating or cooling and remains there until the active heating or cooling PI loop reaches 60%. Once above 60%, the fan is incrementally sped up based on the upper 40% of the heating or cooling PI loop, whichever is active based on the number of fan stages configured. The fan slows down in the reverse sequence. This operation allows the FCU to attempt to maintain space temperature setpoint using the valve at low fan speed. If space temp setpoint cannot be maintained at low speed, increasing the fan speed will allow more heat transfer to/from the coil.

Valve Control

The method of controlling the heating and cooling valves is based on the fan configuration as well as the valve configuration:

- **If the valves are configured for modulating action and the fan mode for a particular occupancy mode is set to constant or “On,”** the valves function in a modulating fashion. Actual response may vary slightly due to PI action of the control loops, but generally, the heating valve will start to open as the space temperature drops below the active heating setpoint and modulate to fully open when space temperature reaches active heating setpoint minus deadband. Likewise, the cooling valve will generally begin opening as the space temperature rises above the active cooling setpoint and be fully open by the time the space temp reaches the active cooling setpoint plus deadband, modulating linearly in between.
- **With the fan mode set to “Auto” or the valves are configured for two-position operation**, the heating valve will open 100% if the space temperature falls below active heating setpoint minus deadband and fully close when space temp rises above active heating setpoint. The cooling valve similarly opens 100% if the space temp rises above the active cooling setpoint plus deadband and fully closes if the space temp falls below the active cooling setpoint.

If at any time there is a fan failure alarm, the cooling and heating valves are both forced closed.

Dehumidification

If the dehumidification sequence is enabled on models BAC-10163C/11163C, the dehumidification mode is started and stopped as described in the Common Features section above. Upon activation of the dehumidification mode, the cooling valve is opened 100%. The heating valve then reheats the space as called for in the normal heating sequence to maintain the active heating setpoint. Upon termination of the dehumidification mode, the valves return to their normal sequence.

RTU (Roof Top Unit)

Fan Control

The fan follows the base sequence for fan operation as listed in the Common Features section above with the following exception. If the fan mode is set to "Auto," the fan will start if the space temp rises above the active cooling setpoint plus one half the deadband and will stop if the space temp drops below the active cooling setpoint. If the space temp drops below the active heating setpoint minus one half the deadband, the fan will start and stop when the fan rises above the active heating setpoint. This will allow only one stage of heating or cooling to run if necessary.

Fan off delays apply as previously described.

Heating/Cooling Staging

In the heating mode, if the space temperature drops below the active heating setpoint minus one half the deadband AND the first stage of heating has been off for at least the minimum off time, the first stage of heating will be energized. If the space temp further drops below the active heating setpoint minus the deadband AND the first stage of heating has been energized for at least the stage delay AND the second stage of heating has been off for at least the minimum off time, the second stage of heating will be energized. Upon rise in temperature above the active heating setpoint minus one half the deadband, the second stage of heating will be deenergized. Upon further rise in temperature above the active heating setpoint, the first stage of heating will be deenergized.

In the cooling mode, if the space temp rises above the active cooling setpoint plus one half the deadband AND the first stage of cooling has been off for at least the minimum off time, the first stage of cooling will be energized. If the space temp further rises above the active cooling setpoint plus the deadband AND the first stage of cooling has been energized for at least the stage delay AND the second stage of cooling has been off for at least the minimum off time, the second stage of cooling will be energized. Upon decrease in space temp below the active cooling setpoint plus one half the deadband, the second stage of cooling shall be deenergized. Upon further decrease in space temp below the active cooling setpoint, the first stage of cooing shall be deenergized.

If the economizer option is set to modulating economizer and the economizer mode is enabled, the stages of cooling will be held off until the outside air damper is 100% open. When the outside air damper is fully open, normal staging of cooling is allowed. If the economizer option is set to "Econ Dis/En" and the economizer mode is enabled, cooling is allowed to stage normally.

If at any time there is a fan failure alarm or a low limit alarm, all stages of heating and cooling are stopped at priority 5, bypassing any minimum on times (minimum on times added by others, not part of the base sequence).

Economizer Control

If the RTU application is configured for the modulating economizer option, the above economizer sequence is followed. If the application is configured for econ disable/enable, the economizer mode is determined as above. Any time the econ mode is enabled, the econ dis/en output is energized. If the econ mode is disabled, the econ dis/en output is deenergized.

Dehumidification

Upon activation of the dehumidification mode, both stages of cooling are energized after they have been off for at least the minimum off time. Heating stages then follow their normal sequence to maintain the active heating setpoint.

Additional Information

The latest support files for the FlexStat are always available on the KMC Controls web site (www.kmccontrols.com). You will need to log-in to see all available files.

For operation, configuration, and other information, see the BAC-1000 Series Operation Guide (P/N 913-019-02).

For additional instructions on programming a thermostat with BACstage, see the BACstage User's Guide (902-019-62) and the Help system with that program.

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KMC Controls, Inc.
19476 Industrial Drive, New Paris, IN 46553; 574.831.5250; www.kmccontrols.com; info@kmccontrols.com