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Description and Application

The award-winning FlexStat is a **controller and sensor** in a single, attractive package that creates a flexible solution to stand-alone control challenges or BACnet network challenges. Temperature sensing is standard with **optional humidity, motion, and CO₂ sensing**. Flexible input and output configurations and built-in or custom programming ensure that a variety of application needs can be met. Such applications include single- and multi-stage packaged, unitary, and split systems (including high SEER/EER variable speed packaged equipment), as well as factory-packaged and field-applied economizers, water-source and air-to-air heat pumps, fan coil units, central station air handling units, and similar applications.

In addition, an on-board library of programs permits a single model to be rapidly configured for a wide range of HVAC control applications. Thus, a single “one size fits all” FlexStat model can replace multiple competitor models. A single BAC-120163CW, for example, can be quickly configured for any of these application options:

- ◆ Air handling unit, with proportional heating and cooling valves, and with optional economizer, dehumidification, and/or fan status
- ◆ Fan coil unit, 2-pipe or 4-pipe, proportional or 2-position valves, with optional dehumidification (w/ 4-pipe option) and/or fan status



(Shown with Optional Motion and Humidity Sensors)



- ◆ Heat pump unit, with up to two compressor stages, and with optional auxiliary heat, emergency heat, dehumidification, and/or fan status
- ◆ Roof top unit, with up to two H/C stages, and with optional economizer, dehumidification, and/or fan status

FlexStats also provide the capability to customize the standard library of sequences using a KMC programming tool (KMC Connect, KMC Converge, or TotalControl). This enables a local authorized KMC installing contractor to adapt the standard library to the unique site needs and application-specific requirements of a particular project.

BACnet over MS/TP communication is standard. **“E” versions, with an RJ-45 jack, add BACnet over Ethernet, BACnet over IP, and BACnet over IP as Foreign Device** (for communication across the Internet).

Features

Interface and Function

- ◆ User-friendly English-language menus (no obscure numeric codes) on a 64 x 128 pixel, dot-matrix LCD display with 5 buttons for data selection and entry
- ◆ Multiple display options include selectable space temperature display precision, degrees F/C toggle, rotation values, display blanking, hospitality mode, and locked mode
- ◆ Built-in, factory-tested libraries of configurable application control sequences

- ◆ Integral energy management control with optimum start, deadband heating and cooling set-points, and other advanced features to assure comfort while maximizing energy savings
- ◆ Schedules can easily be set uniquely by the entire week (Mon.–Sun.), weekdays (Mon.–Fri.), weekend (Sat.–Sun.), individual days, and/or holidays; six On/Off and independent heating and cooling setpoint periods are available per day
- ◆ Three levels of password-protected access (user/operator/administrator) prevent disruption of operation and configuration—plus Hospitality mode and Locked User Interface mode offer additional tamper resistance
- ◆ Integral temperature and optional humidity, motion, and/or CO₂ sensors
- ◆ All models have 72-hour power (capacitor) backup and a real time clock for network time synchronization or full stand alone operation
- ◆ Models functionally replace most Viconics and other competitors' products

Inputs

- ◆ Six analog inputs for additional configurable remote external sensors, such as remote space temperature (with averaging, highest, and lowest options), remote CO₂, OAT, MAT, DAT, water supply temperature, fan status, and other sensors
- ◆ Inputs accept industry-standard 10K ohm (Type II or III) thermistor sensors, dry contacts, or 0–12 VDC active sensors
- ◆ Input overvoltage protection (24 VAC, continuous)
- ◆ 12-bit analog-to-digital conversion on inputs

Outputs

- ◆ Nine outputs, analog and binary (relays)
- ◆ Each short-circuit protected analog output capable of driving up to 20 mA (at 0–12 VDC)
- ◆ The NO, SPST (Form “A”) relays carry 1 A max. per relay or 1.5 A per bank of 3 relays (relays 1–3 and 4–6) @ 24 VAC/VDC
- ◆ 8-bit PWM digital-to-analog conversion on outputs

Installation

- ◆ Backplate mounts on a standard vertical 2 x 4-inch wall handy-box (or, with an HMO-10000 adapter, a horizontal or 4 x 4 handy-box), and the cover is secured to the backplate by two concealed hex screws

- ◆ Two-piece design provides easy wiring and installation (see *Dimensions and Connectors on page 9*)

Connections

- ◆ Screw terminal blocks, wire size 14–22 AWG, for inputs, outputs, power, and MS/TP network
- ◆ “E” versions add an RJ-45 jack
- ◆ A four-pin EIA-485 data port on the underside of the case enables easy temporary computer connection to the BACnet network

BACnet Communication and Standards

- ◆ Integral peer-to-peer BACnet MS/TP LAN network communications on all models (with configurable baud rate from 9600 to 76.8K baud)
- ◆ “E” versions add BACnet over Ethernet, BACnet over IP, and BACnet over IP as Foreign Device
- ◆ Meets or exceeds BACnet AAC specifications in the ANSI/ASHRAE BACnet Standard 135-2008

Configurability

I/O

- ◆ Up to 10 analog input objects (IN1 is space temperature, IN2–IN4 and IN7–IN9 are 0–12 VDC inputs, IN5 is reserved for humidity, IN6 is reserved for motion detection, IN10 is reserved for CO₂)
- ◆ Up to 9 analog or binary output objects

Value

- ◆ 150 analog value objects
- ◆ 100 binary value objects
- ◆ 40 multi-state value objects (with up to 16 states each)

Program and control

- ◆ 20 PID loop objects
- ◆ 10 program objects (contains a library of 5 built-in programs and customized Control Basic programming in the other 5 program objects can be done through KMC Connect, KMC Converge, or TotalControl)

Schedules and trends

- ◆ 2 schedule objects
- ◆ 1 calendar object
- ◆ 8 trend objects, each of which holds 256 samples

Alarms and events

- ◆ 5 notification class (alarm/event) objects
- ◆ 10 event enrollment objects

Models

If your application is a:

- ◆ FCU (Fan Coil Unit) or Packaged Unit, AHU (Air Handling Unit), or RTU (Roof Top Unit)—see all models
- ◆ HPU (Heat Pump Unit)—see the BAC-1xxx63CW models only

For more details, see [Application/Model Selection Guide on page 4](#). See also the [FlexStat Catalog Supplement and Selection Guide](#).

Model*	Outputs**	Optional Sensors***	Typical Applications
<p>BAC-12xxxx models (e.g., BAC-120036CW) are standard and do not have a CO₂ sensor. BAC-13xxxx models have CO₂ sensors to add Demand Control Ventilation to the applications below. DCV is only available when using an AHU, RTU, or HPU application with a modulating economizer option enabled. See Specifications, CO₂ Models Only on page 6 for more information.</p>			
BAC-1x0036CW	3 Relays and 6 Analog Outputs	None	<ul style="list-style-type: none"> • 1H/1C, fan, and 6 universal outputs • 3-speed fan, 2- or 4-pipe FCUs with modulating valves • Central station AHUs with modulating/1/2 Heat/Cool • Variable-speed fan output • Single-stage applications
BAC-1x0136CW		Humidity****	<ul style="list-style-type: none"> • Same as BAC-1x0036CW • Dehumidification sequence • Humidification sequence (AHU or 4-pipe FCU)
BAC-1x1036CW		Motion/Occupancy	<ul style="list-style-type: none"> • Same as BAC-1x0036CW • Occupancy-based operation
BAC-1x1136CW		Humidity and Motion/Occupancy****	<ul style="list-style-type: none"> • Same as BAC-1x0136CW • Occupancy-based operation
BAC-1x0063CW	6 Relays and 3 Analog Outputs	None	<ul style="list-style-type: none"> • 1 or 2 H and 1 or 2 C, fan • Multi-stage packaged or split systems • Multi-stage heat pumps with or without factory-packaged economizers • Central station AHUs with modulating Heat/Cool • 3-speed fan, 2- or 4-pipe FCUs with modulating or 2-position valves
BAC-1x0163CW		Humidity****	<ul style="list-style-type: none"> • Same as BAC-1x0063CW • Dehumidification sequence (AHU, 4-pipe FCU, or RTU)
BAC-1x1063CW		Motion/Occupancy	<ul style="list-style-type: none"> • Same as BAC-1x0063CW • Occupancy-based operation
BAC-1x1163CW		Humidity and Motion/Occupancy****	<ul style="list-style-type: none"> • Same as BAC-1x0163CW • Occupancy-based operation
<p>*The standard color is white. To order the optional light almond color, remove the "W" at the end of the model number (e.g., BAC-121163C instead of BAC-121163CW). To order the IP version, add an E after the C (e.g., BAC-121163CEW). All models have a real-time clock.</p> <p>**Analog outputs produce 0–12 VDC @ 20 mA maximum, and relays carry 1 A max. per relay or 1.5 A per bank of 3 relays (relays 1–3, 4–6, and 7–9) @ 24 VAC/VDC.</p> <p>***All models have a 32-bit processor, an internal temperature sensor, and 6 analog inputs. All models have optional discharge air temperature monitoring/trending and fan status monitoring. Optional sensors include humidity, motion, and CO₂.</p> <p>****In models with CO₂ sensors, humidity sensors come standard.</p>			

Application/Model Selection Guide

Applications and Options	FlexStat Models							
	6 Relays and 3 Analog Outputs				3 Relays and 6 Analog Outputs			
	BAC-1x0063CW	BAC-1x0163CW (+ Humidity)	BAC-1x1063CW (+ Motion)	BAC-1x1163CW (+ Humidity/Motion)	BAC-1x0036CW	BAC-1x0136CW (+ Humidity)	BAC-1x1036CW (+ Motion)	BAC-1x1136CW (+ Humidity/Motion)
Packaged Unit (Air Handling Unit and Roof Top Unit)								
1 Heat and 1 Cool					✓	✓	✓	✓
1 or 2 Heat and 1 or 2 Cool (in BAC-1xxx63 RTU Menu Only)	RTU	RTU	RTU	RTU				
1 or 2 Heat and Modulating Cool					✓	✓	✓	✓
Modulating Heat and 1 or 2 Cool					✓	✓	✓	✓
Modulating Heat and Modulating Cool (in AHU Menu Only)	AHU	AHU	AHU	AHU	✓	✓	✓	✓
Opt. Outside Air Damper, Modulating	✓	✓	✓	✓	✓	✓	✓	✓
Opt. Outside Air Damper, 2 Position (in RTU Menu Only)	RTU	RTU	RTU	RTU	✓	✓	✓	✓
Opt. Fan Speed Control					✓	✓	✓	✓
Opt. Dehumidification		✓		✓		✓		✓
Opt. Humidifier						✓		✓
Opt. Motion/Occupancy Sensor			✓	✓			✓	✓
Opt. CO2 Sensor with DCV (Demand Control Ventilation)	BAC-13xxxx							
Opt. IP/Ethernet BACnet Communications	Add an E to the model number: BAC-1xxxxxCEx (see Model Code)							
FCU (Fan Coil Unit)	With 3-speed fan							
2 Pipe, Modulating	✓	✓	✓	✓	✓	✓	✓	✓
2 Pipe, 2 Position	✓	✓	✓	✓				
4 Pipe, Modulating	✓	✓	✓	✓	✓	✓	✓	✓
4 Pipe, 2 Position	✓	✓	✓	✓				
Opt. Dehumidification (4 pipe only)		✓		✓		✓		✓
Opt. Humidifier (4 pipe only)						✓		✓
Opt. Motion/Occupancy Sensor			✓	✓			✓	✓
Opt. CO2 Sensor with DCV (Demand Control Ventilation)	DCV N/A for FCU applications, but CO2 levels still displayed							
Opt. IP/Ethernet BACnet Communications	Add an E to the model number: BAC-1xxxxxCEx (see Model Code)							
HPU (Heat Pump Unit)	1 or 2 compressors with auxiliary and emergency heat							
Opt. Outside Air Damper, Modulating	✓	✓	✓	✓	N/A			
Opt. Dehumidification		✓		✓				
Opt. Motion/Occupancy Sensor			✓	✓				
Opt. CO2 Sensor with DCV (Demand Control Ventilation)	BAC-13xxxx							
Opt. IP/Ethernet BACnet Communications	Add an E to the model number: BAC-1xxxxxCEx (see Model Code)							

NOTE: All models have a real-time clock (see Model Code). On models with a CO2 sensor, the humidity sensor is standard and Demand Control Ventilation is only available when using an AHU, RTU, or HPU application with a modulating economizer option enabled. The BAC-12xxxx has no CO2 sensor.

Model Code for BAC-1xmhraCEW:

BAC = BACnet Device	r = Number of Relay Outputs (3 or 6 standard, or 5 relays & 1 triac)
1 = Model Series	a = Number of Analog Outputs (3 or 6)
x = CO2 Sensor (3) or None (2)	C = Real-Time Clock (RTC standard on all models)
m = Motion Sensor (1) or None (0)	E = IP/Ethernet Communications Option (no E = MS/TP only)
h = Humidity Sensor (1) or None (0)	W = White Color (no W = light almond)

NOTE: See also [Models on page 3](#). For details about the CO₂ model option, see [Specifications, CO₂ Models Only on page 6](#). See also the [FlexStat Catalog Supplement and Selection Guide](#).

Specifications, General

Supply Voltage	24 VAC (+20%/−10%), Class 2 only
Supply Power	13 VA (not including relays)
Outputs (3/6 or 6/3)	Binary outputs (NO, SPST, Form “A” relays) carry 1 A max. per relay or a total of 1.5 A per bank of 3 relays (relays 1–3 and 4–6) @ 24 VAC/VDC Analog outputs produce 0–12 VDC, 20 mA maximum
External Inputs (6)	Analog 0–12 VDC (active, passive contacts, 10K thermistors)
Connections	Wire clamp type terminal blocks; 14–22 AWG, copper Four-pin EIA-485 (Opt.) eight-pin Ethernet jack
Display	64 x 128 pixel dot matrix LCD
Case Material	White (standard) or light almond flame-retardant plastic
Dimensions*	5.551 x 4.192 x 1.125 inches (141 x 106 x 28.6 mm)
Weight*	0.48 lbs. (0.22 kg)
Approvals	
UL	UL 916 Energy Management Equipment listed
BTL	BACnet Testing Laboratory listed as Advanced Application Controller (B-AAC)
FCC	FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B**

**This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Humidity Sensor (optional internal)

Sensor Type	CMOS
Range	0 to 100% RH
Accuracy @ 25°C	±2% RH (10 to 90% RH)
Response Time	Less than or equal to 4 seconds

Temperature Sensor (without humidity sensor)

Sensor Type	Thermistor, Type II
Accuracy	±0.36° F (±0.2° C)
Resistance	10,000 ohms at 77° F (25° C)
Operating Range	48 to 96° F (8.8 to 35.5° C)

Temperature Sensor (with humidity sensor)

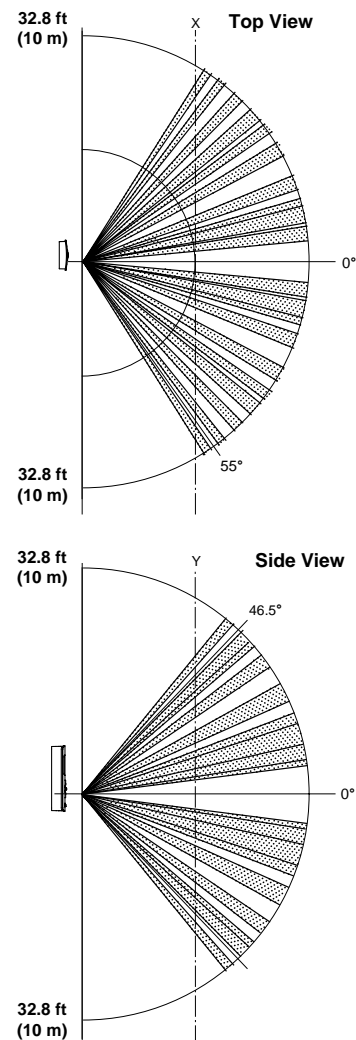
Sensor Type	CMOS
Accuracy	±0.9° F (±0.5° C) offset from 40 to 104° F (4.4 to 40° C)
Operating Range	36 to 120° F (2.2 to 48.8° C)
Environmental Limits*	
Operating	34 to 125° F (1.1 to 51.6° C)
Shipping	−22 to 140° F (−30 to 60° C)
Humidity	0 to 95% RH (non-condensing)
Warranty	5 years (from mfg. date code)

*NOTE: Except for CO₂ sensor models—see the next page for those specifications.

Specifications, Motion Sensor

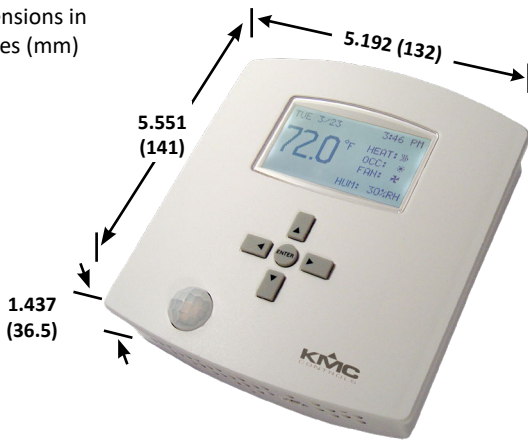
Motion Sensor (Opt.) Passive infrared with approx. 10 meter (32.8 feet) range (for details about operation of the motion sensor, see the [FlexStat Application Guide](#))

Motion/Occupancy Sensor Detection Performance



Specifications, CO₂ Models Only

Dimensions in
Inches (mm)



Dimensions	5.551 x 5.192 x 1.437 inches (141 x 132 x 36.5 mm)
Weight	0.5 lbs. (0.28 kg)
Environmental Limits	
Operating	34 to 122° F (1.1 to 50° C)
Approvals	FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A

NOTE: See the previous page for specifications in common with other models.

NOTE: The CO₂ models are not approved for residential applications.

CO ₂ Sensor	BAC-13xxxx
Applications	For zones with occupied/unoccupied times*
Method	Non Dispersive Infrared (NDIR), with ABC Logic*
Calibration	Self-calibrates over several weeks*
Typical Life of Sensor	15 years
Measurement Range	400 to 2000 ppm
Accuracy (at nominal operating temperature)	±35 ppm @ 500 ppm, ±60 ppm @ 800 ppm, ±75 ppm @ 1000 ppm, ±90 ppm @ 1200 ppm
Altitude Correction	Configurable from 0 to 32,000 feet
Pressure Dependence	0.135 of reading per mm Hg
Temperature Dependence	0.2% FS (full scale) per °C
Stability	< 2% of FS over life of sensor
Response Time	< 2 minutes for 90% step change typical
Warm Up Time	< 2 minutes (operational) and 10 minutes (maximum accuracy)
*The BAC-13xxxx series has been certified to comply with CA Title 24, Section 121(c), as well as sub-paragraph 4.F. See explanations below.	

The BAC-13xxxx series uses Automatic Background Calibration Logic, or ABC Logic, a patented self-calibration technique designed to be used in applications **where concentrations will drop to outside ambient conditions** (approximately 400 ppm) at least three times in a 14 day period, typically during unoccupied periods. With ABC Logic enabled, the sensor will typically reach its operational accuracy after 25 hours of continuous operation if it was exposed to ambient reference levels of air at 400 ±10 ppm CO₂. The sensor will maintain accuracy specifications with ABC Logic enabled, given that it is at least four times in 21 days exposed to the reference value and this reference value is the lowest concentration to which the sensor is exposed. ABC Logic requires continuous operation of the sensor for periods of at least 24 hours.

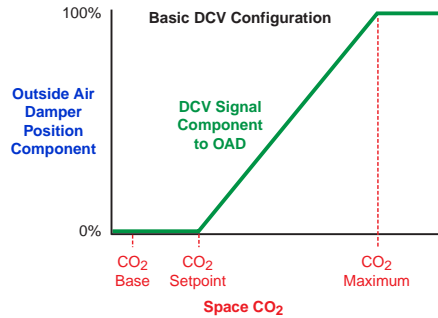
NOTE: The BAC-13xxxx series, with ABC Logic, has been certified to comply with **CA Title 24, Section 121(c), as well as sub-paragraph 4.F** that specifies accuracy will be maintained within tolerance for a minimum of 5 years without recalibration and that a detected sensor failure will cause the controller to take appropriate corrective action.

NOTE: See also the **Demand Control Ventilation (DCV) section on the next page.**

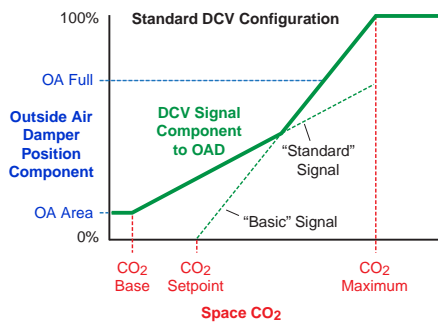
Demand Control Ventilation (DCV)

When using applications with a modulating economizer option, the three types of Demand Control Ventilation (DCV) configurations available are:

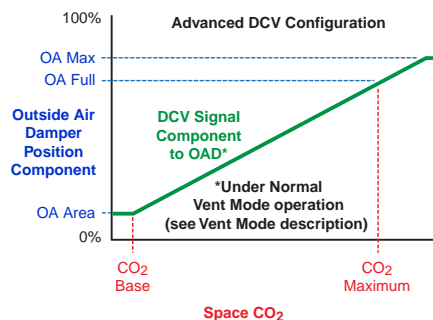
- ◆ **Basic**—Provides simple DCV, modulating the outside air damper in direct response to the current CO₂ level with respect to its setpoint. Basic DCV is much more energy efficient than no DCV at all, while maintaining adequate IAQ (Indoor Air Quality). It is the easiest DCV method to configure. However, where VOCs, radon, or other pollutants become excessive during unoccupied times (with no ventilation), the FlexStat's Standard or Advanced DCV configuration is recommended.



- ◆ **Standard**—When the BAC-13xxxx settings are properly configured, this complies with CA Title 24, Section 121(c). This would also apply to a properly configured BAC-12xxxx with a remote SAE-10xx CO₂ sensor. Standard DCV, under most conditions, is somewhat less energy efficient than Basic, but it enhances IAQ.



- ◆ **Advanced**—When the settings are properly configured, this configuration complies with CA Title 24, Section 121(c) and **ASHRAE Standard 62.1-2007** and follows guidelines by **Portland Energy Conservation, Inc. (PECI)**. Although Advanced DCV is the most complex to configure, it is more energy efficient than Standard while still optimizing IAQ.

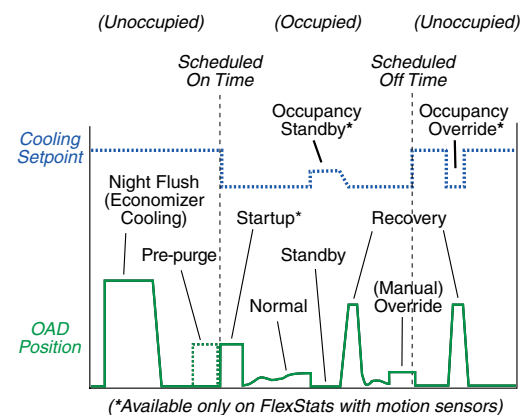


Although BAC-12xxxx FlexStats do not have a built-in CO₂ sensor, they still have DCV control sequences available. When DCV is enabled in these models, IN9 is assumed to be connected to an external KMC SAE-10xx CO₂ sensor. BAC-13xxxx FlexStats also have the external sensor option, and if used, the highest of the two readings (internal vs. external) will be used to control DCV sequences. The CO₂ ppm display (when enabled) also shows the highest of the two levels.

NOTE: The three DCV Configuration graphs on the left show the DCV **component** of the signal to the outside air damper. Depending on the conditions and the DCV configuration, the signal to the damper might be controlled by Minimum Position, Economizer Loop, or other components. The **maximum** of these component values is used, not the sum of them. (If there is a Low Limit alarm, however, these signals are overridden, and the damper is closed.)

NOTE: DCV is only available when using an AHU, RTU, or HPU application with a modulating economizer option enabled. Without that configuration, DCV will not appear in menus, but the CO₂ ppm readings will (unless turned off in the User Interface menu) still show on the lower right of the display.

The graph below shows an example of how a cooling setpoint and the outside air damper position could be efficiently controlled by a FlexStat's built-in combination of schedule, motion sensor (configured for occupancy standby and occupancy override), and CO₂ sensor (configured for Advanced DCV).



For more details about DCV configuration and operation, see the **FlexStat Operation Guide** and **FlexStat Application Guide**.

Accessories

Damper (OAD/RTD) Actuators (Fail-Safe)

- MEP-4552** 5.6 ft² max. damper area, 45 in-lb., proportional, 19 VA
- MEP-7552** 22.5 ft² max. damper area, 180 in-lb., proportional, 25 VA
- MEP-7852** 40 ft² max. damper area, 320 in-lb., proportional, 40 VA



Mounting Hardware

- HMO-10000** Horizontal or 4 x 4 handy box wall mounting plate for BAC-12xxxx models (not needed for BAC-13xxxx models), light almond (shown)
- HMO-10000W** HMO-10000 in white
- HPO-1602** Replacement backplate for BAC-12xxxx models
- HPO-1603** Replacement backplate for BAC-13xxxx models (shown)
- SP-001** Screwdriver (KMC branded) with flat blade (for terminals) and hex end (for cover screws)



Network Communications and Firmware

- BAC-5051E** BACnet router
- HPO-5551** Router technician cable kit
- HTO-1104** FlexStat firmware upgrade kit
- KMD-5567** Network surge suppressor
- KMD-5575** Network repeater/isolator
- KMD-5624** PC data port (EIA-485) cable (FlexStat to USB Communicator)—included with the KMD-5576



Relays (External)

- REE-3112** (HUM) SPDT, 12/24 VDC control relay

Sensors (External)

- CSE-110x** (FST) differential air pressure switch
- STE-1402** (DAT) duct temperature sensor w/ 8" rigid probe
- STE-1416** (MAT) 12' (flexible) duct averaging temp. sensor
- STE-1451** (OAT) outside air temp. sensor
- STE-6011** Remote space temp. sensor
- SAE-10xx** Remote CO₂ sensor, space or duct
- STE-1454/1455** (W-TMP) 2" strap-on water temp. sensor (with or without enclosure)



Transformers, 120 to 24 VAC (TX)

- XEE-6311-050** 50 VA, dual-hub
- XEE-6112-050** 50 VA, dual-hub

Valves (Heating/Cooling/Humidification)

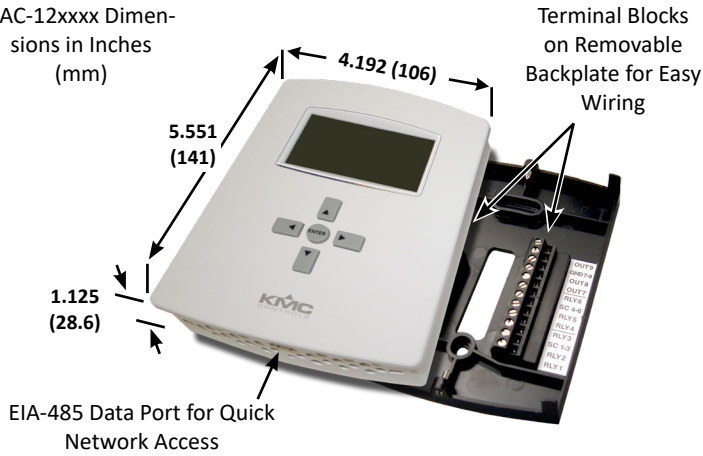
- VEB-43xxxBCL** (HUMV/CLV/HTV) Fail-safe control valve, w/ MEP-4x52 proportional actuator, 20 VA
- VEB-43xxxBCK** (VLV/CLV/HTV) control valve w/ MEP-4002 proportional actuator, 4 VA
- VEZ-4xxxxMBx** (VLV/CLV/HTV) fail-safe control valve, 24 VAC, 9.8 VA



NOTE: For details, see the respective product data sheets and installation guides. See also the [FlexStat Application Guide](#).

Dimensions and Connectors

BAC-12xxxx Dimensions in Inches (mm)



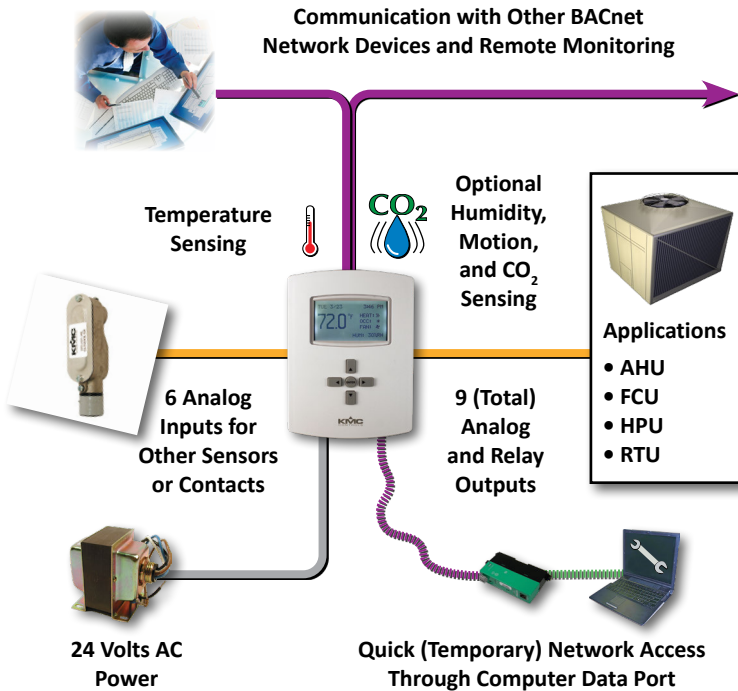
NOTE: Two-piece design allows field rough-in and termination of field wiring to the backplate without needing the FlexStat at the site—permitting FlexStats to be bulk-configured off-site and plugged into the wired backplates at a later time if desired.

Product and Documentation Awards

- ◆ Gold medal in the Networked/BAS category of *Consulting-Specifying Engineer* magazine's Product of the Year competition (September 2010)
- ◆ Editors' Choice product in *Commercial Building Products* (October 2010)
- ◆ Winner in the HVAC & Plumbing category of *Green Thinker Network's Sustainability 2012* competition (April 2012)
- ◆ FlexStat support documents also won an Award of Merit in the 2009–2010 publications competition sponsored by the Chicago Chapter of the Society for Technical Communication (April 2010)



Sample Installation



Support

Award-winning resources for installation, configuration, application, operation, programming, upgrading and much more are available on the KMC Controls web site (www.kmcccontrols.com). To see all available files, log-in to the KMC Partners site.

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