Quality People. Building Solutions.

Comfort Systems USA (Arkansas), Inc.
P.O. Box 16620
LittleRock, AR 72231
Phone 501-834-3320
Fax 501-834-5416

Date: 8/21/2025
Return Request: 9/4/2025
Project: Hot Springs National Park – Rehabilitate Bathhouses – Buckstaff Bathhouse
Supplier: Harrison Energy Partners
Manufacturer: Not Applicable
Submittal: Sequence of Operations for HVAC Controls
Submittal Number: 230993.001
Spec Section: 230993
Drawing # and Installation Location: M3-1 through M3-4, and M4-1

ARCHITECT
Kenneth Hahn Architects, Inc.
1343 S. 75th Street
Omaha, Nebraska 68124
(402)391-2111

GENERAL CONTRACTOR
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2345 Grand Blvd, Suite 700
Kansas City, Missouri 64108
(816)708-1110

ENGINEER
Alvine Engineering
1201 Cass Street
Omaha, Nebraska 68102
(402)346-7007

MECHANICAL SUBCONTRACTOR
Comfort Systems USA (Arkansas), Inc.
9924 Landers Road
North Little Rock, Arkansas 72117
(501)834-3320

Comments:

CSUSA PROJECT NO.
25-7065
joe@comfortar.com

Harrison
Energy Partners

Controls Submittal

Date: 12/02/2025
Project Name: **Buckstaff Bathhouse**
Project Location: **Hot Springs, AR**

Prepared For:

Comfort Systems

HEP Office:

HARRISON ENERGY PARTNERS
1501 WESTPARK AVE STE 9
LITTLE ROCK, AR 72204

Phone: 501-661-0621
Fax: 501-661-9109
Web: http://www.harrisonenergy.com

HEP Team:

Account Manager: JUSTIN BLAIR

Project Manager: CHRIS MURRELL

Design By: BRENT CORN

BUCKSTAFF BATHHOUSE

SALES PERSON:
JUSTIN BLAIR

PROJECT MANAGER:
CHRIS MURRELL

DESIGN BY:
BRENT CORN

Drawing Title: **COVER SHEET**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 1 of 22

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21	GAS FURNACE SEQUENCE	Original	12/03/2025
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Project Title:
BUCKSTAFF BATHHOUSE

Sales Person:
Lee Wilson

Project Manager:
Chris Murrell

Controls Engineer:
Brent Corn

Harrison Energy Partners
Commercial HVAC Excellence

Harrison Energy Partners
1501 Westpark Dr, Ste 9
Little Rock, AR 72204
(501) 661-0621 phone
(501) 661-9109 fax

Contract Number:
AC125033

Date:
December 3, 2025

ADDRESS SHEET

MS/TP
NETWORK 101

Unit name	Network	MSTP Address	Device ID
CHILLER 1	101	04	10104
DOAS	101	05	10105
CHW SYSTEM	101	06	10106
HW SYSTEM	101	07	10107
FCU B-1	101	08	10108
FCU B-2	101	09	10109
FCU 1-01	101	10	10110
FCU1-02	101	11	10111
FCU 1-03	101	12	10112
FCU1-04	101	13	10113
FCU 1-05	101	14	10114
FCU1-06	101	15	10115
FCU 1-07	101	16	10116
FCU1-08	101	17	10117
FCU 1-09	101	18	10118
FCU1-10	101	19	10119
FCU 1-11	101	20	10120
FCU1-12	101	21	10121
FCU1-13	101	22	10122
FCU 1-14	101	23	10123
FCU1-15	101	24	10124
FCU 1-16	101	25	10125
FCU1-17	101	26	10126

MS/TP
NETWORK 201

Unit name	Network	MSTP Address	Device ID
FCU 2-01	201	04	20104
FCU2-02	201	05	20105
FCU 2-03	201	06	20106
FCU2-04	201	07	20107
FCU 2-05	201	08	20108
FCU2-06	201	09	20109
FCU 2-07	201	10	20110
FCU2-08	201	11	20111
FCU 2-09	201	12	20112
FCU2-10	201	13	20113
FCU 2-11	201	14	20114
FCU2-12	201	15	20115
FCU2-13	201	16	20116
FCU 2-14	201	17	20117
FCU2-15	201	18	20118
FCU 2-16	201	19	20119
FCU2-17	201	20	20120
FUR-01	201	21	20121

Drawing Title:
ADDRESS SHEET

Project Title:
BUCKSTAFF BATHHOUSE

Sales Person:
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Project Manager:
Chris Murrell

Controls Engineer:
Brent Corn

Harrison Energy Partners
Commercial HVAC Excellence

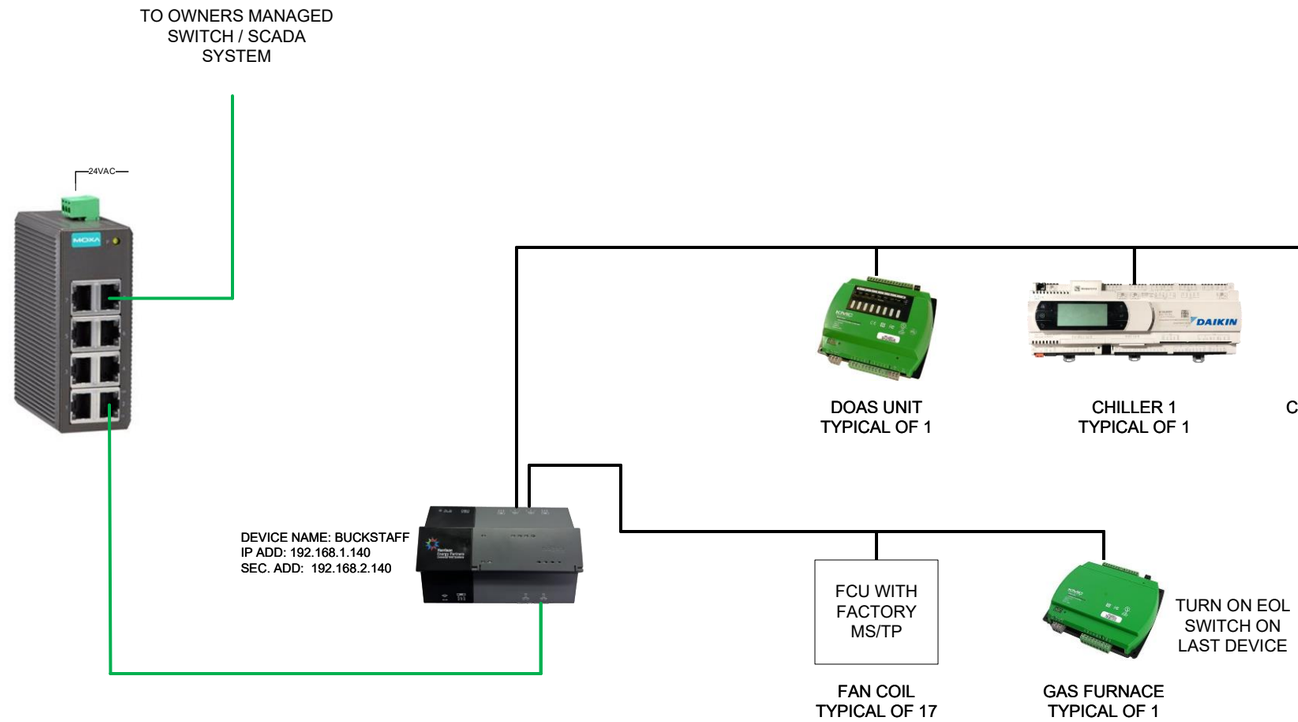
Harrison Energy Partners
1501 Westpark Dr, Ste 9
Little Rock, AR 72204
(501) 661-0621 phone
(501) 661-9109 fax

Contract Number:
AC125033

Date:
December 3, 2025

NETWORK ARCHITECTURE

Tag	Description	Part No.	Vendor	Quantity
ENCLOSURE	ANEL, 18X20X6.5, 100VA, 5 POINT TER	NSTA2018VA100	KELE	1
JACE - KMC	JACE 9000 100 DEVICE LIMIT	KMN-J-9100	KMC	1
JACE - KMC	SMA - JACE 9100, 18 MONTHS	SMA-9100-1YR-INIT	KMC	1



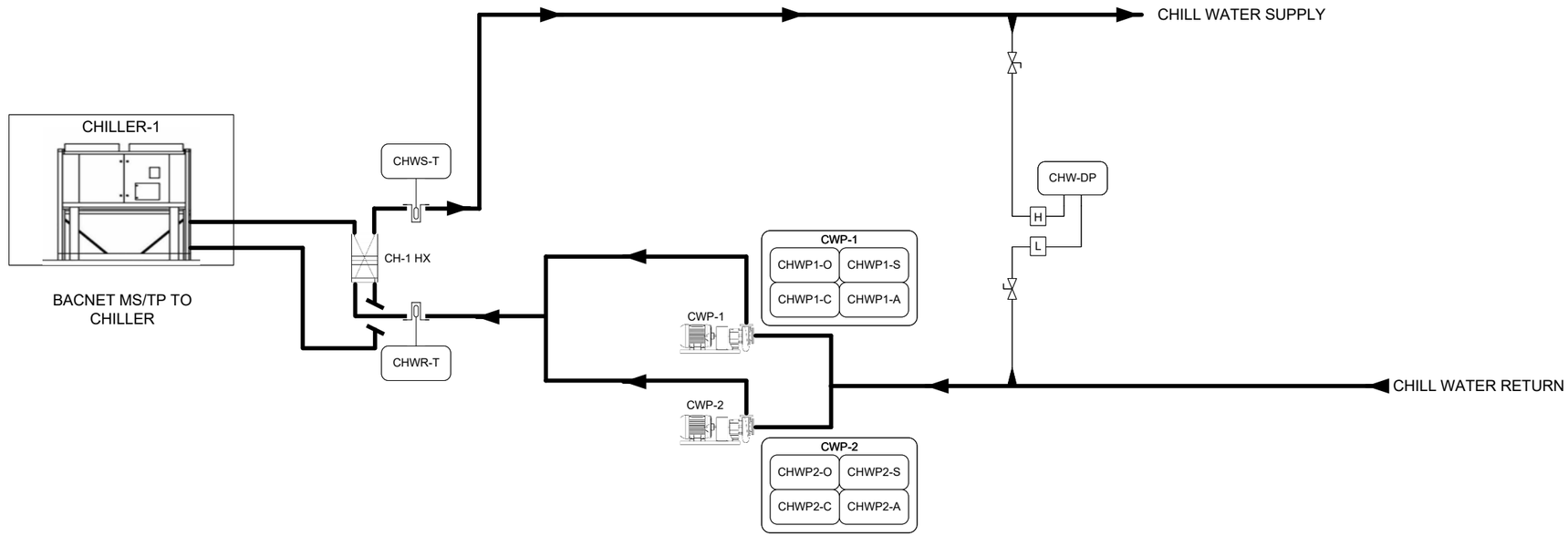
Drawing Title: **NETWORK ARCHITECTURE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 4 of 22

CHILLER LAYOUT

Tag	Description	Part No.	Vendor	Quantity
ENCLOSURE	EXPANSION PANEL, 24X36X6.5, 96VA,	PA0000001BH0	JCI	1
CONTROLLER	ONTROLLER, REAL TIME CLOCK, MS/T	BAC-5901AC	KMC	1
DIFF PRESSURE	0-25PSI 0-10VDC BYPASS MANIFOLD	2301025PD5V2EB	SETRA	1
PERATURE SEN	ATURE SENSOR 6" (HMO-4546 THERM	STE-1424	KMC	2
RATURE THERM	THERMOWELL COVER FOR STE-1424	HMO-4546	KMC	2
URRENT SWITC	NT SWITCH, ADJ PRESETS, SPLITCOI	C-2350VFD	SENVA	2
URRENT SWITC	COMMAND RELAY, 24 VAC/DC COIL	CR3-24	SENVA	2
OUTSIDE AIR	OUTDOOR AIR TEMP	STE-1451	KMC	1

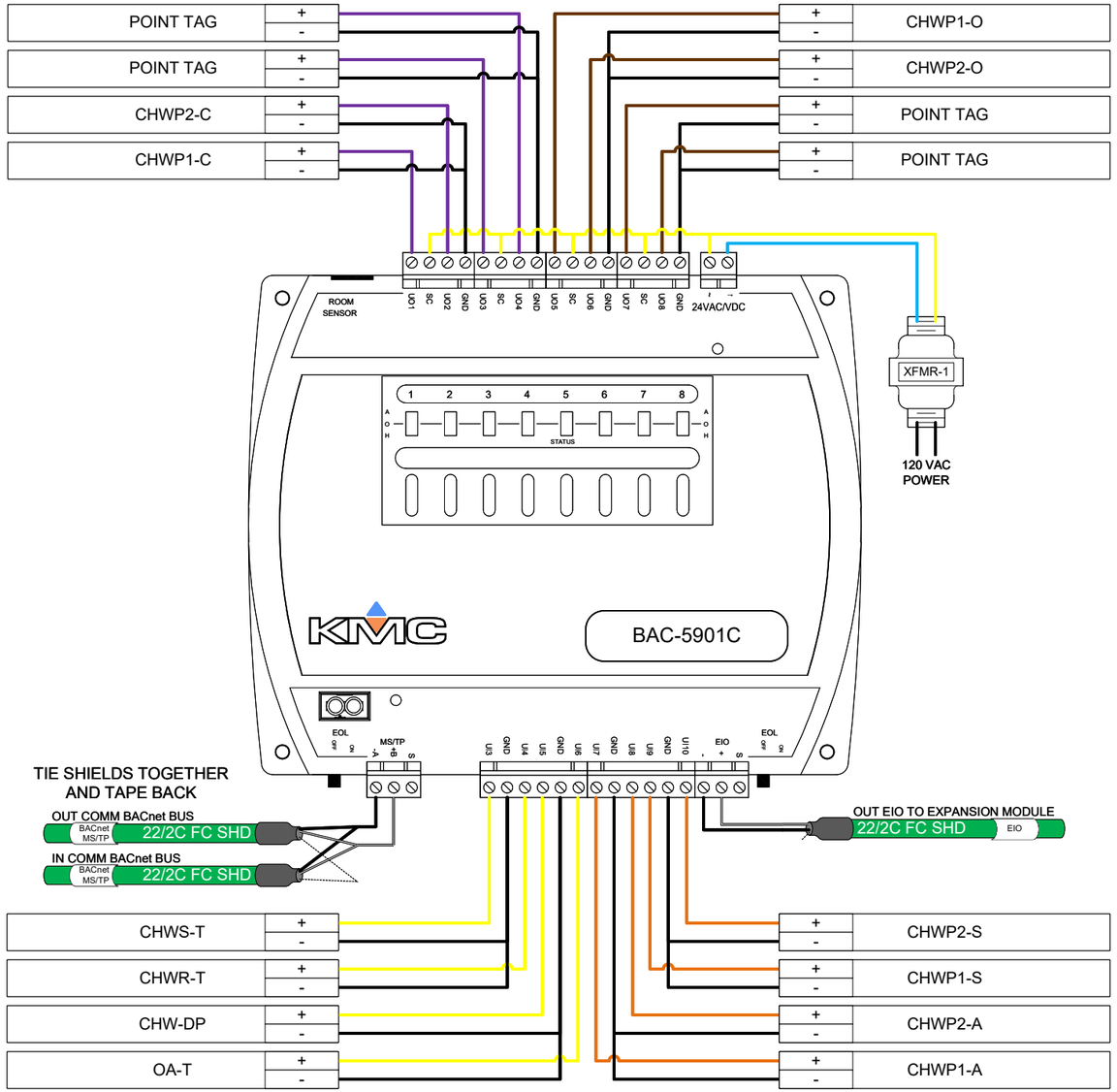
OA-T

MOUNT VERTICALLY ON
NORTH SIDE OF BUILDING



Drawing Title: **CHILLER LAYOUT**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 5 of 22

CHILLER WIRING



Drawing Title: **CHILLER WIRING**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 6 of 22

CHILLER SEQUENCE

COOLING SYSTEM ENABLE:

The cooling system will automatically start when the outside air temperature (OA-T) rises above the system enable setpoint (CLGOATLOCKOUT-SP) while the system enable (SYSTEM-EN) is "ON". When the outside air temperature (OA-T) falls below this setpoint (CLGOATLOCKOUT-SP) or the system enable (SYSTEM-EN) is "OFF", the cooling system will be disabled.

CHILLER CONTROL:

This system consists of one chiller. The chiller shall be controlled via its own internal controls to maintain a chilled water supply temperature setpoint of 44 deg F (ADJ).

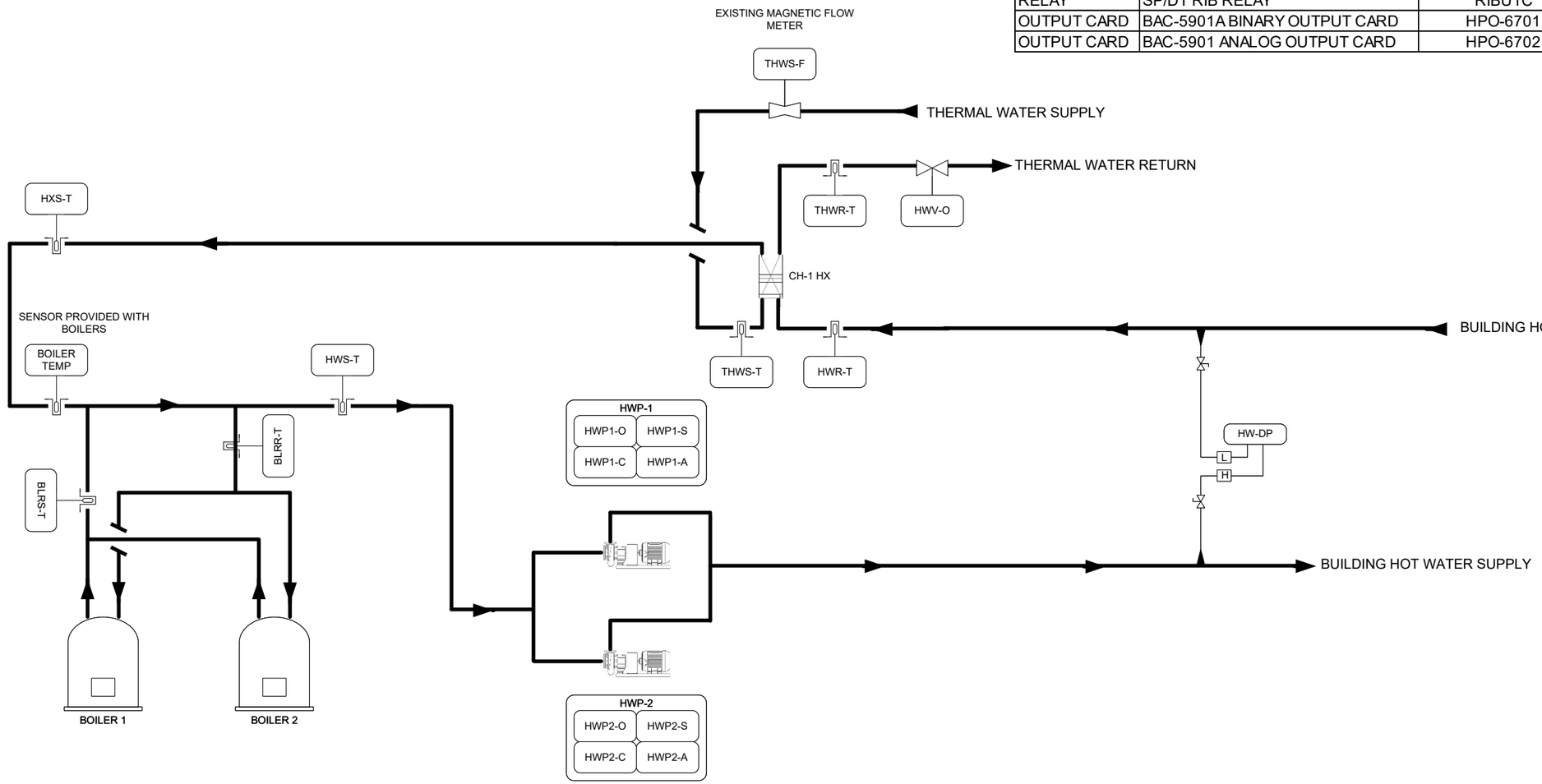
CHILLED WATER PUMP CONTROL:

When enabled, the pump shall run in a lead/lag operation based on runtime hours. If the pump status does not match the command, an alarm will be generated, and the lag pump will be started. If the lag pump does not receive status the chiller will be stopped. Upon loss of status, the pump will restart after the system reset (SYS-RESET) is activated. After the chiller is commanded off, the lead pump will continue to run for a short time (5 mins adj.) to allow the equipment to coast down.

Drawing Title: **CHILLER SEQUENCE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 7 of 22

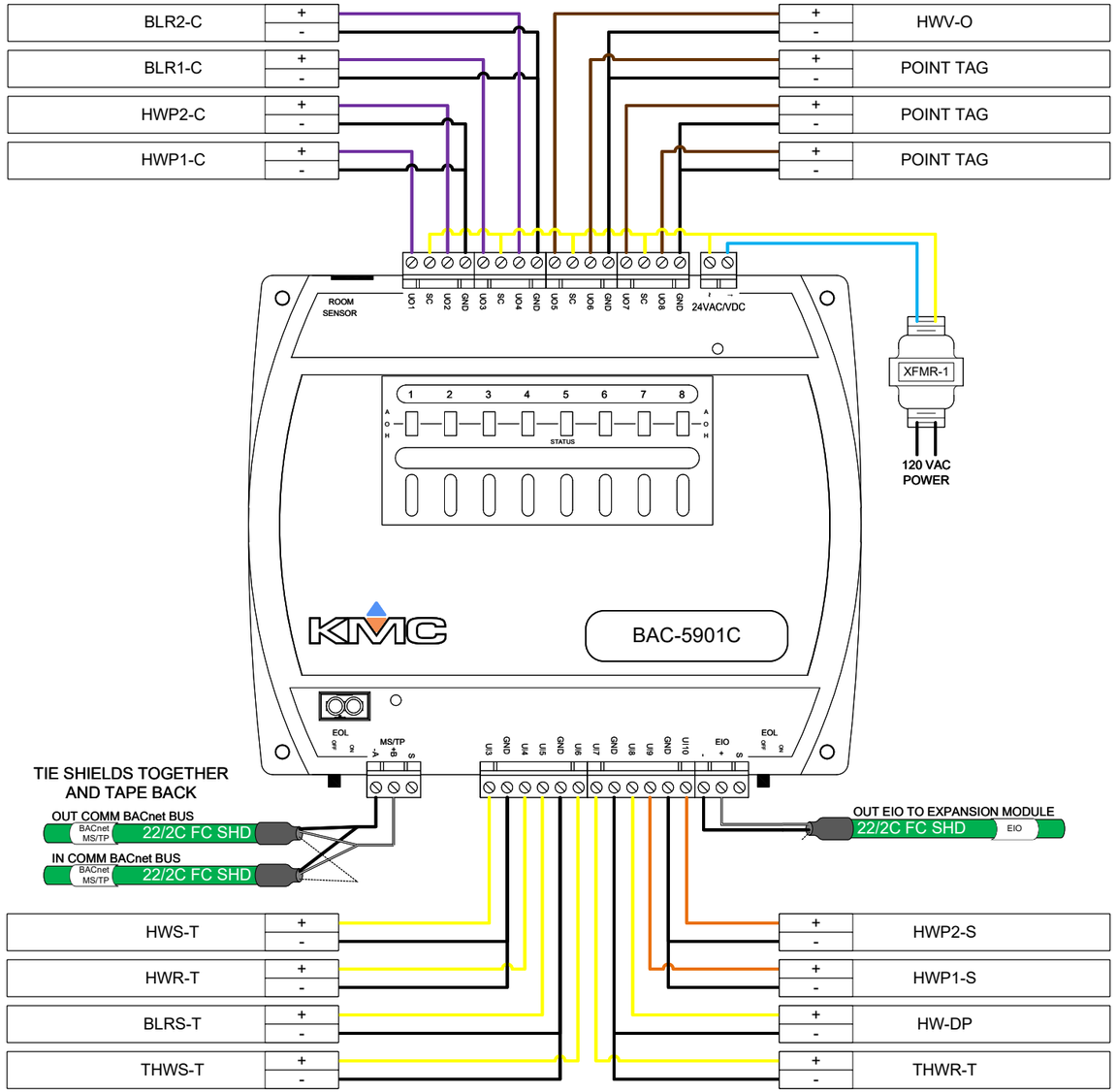
BOILER LAYOUT

Tag	Description	Part No.	Vendor	Quantity
CONTROLLER	ONTROLLER, REAL TIME CLOCK, MS/T	BAC-5901AC	KMC	1
CONTROLLER	EXPANSION MODULE (8 INPUTS - 8 O	CAN-5901	KMC	1
DIFF PRESSURE	0-25PSI 0-10VDC BYPASS MANIFOLD	2301025PD5V2EB	SETRA	1
TEMPERATURE	TEMPERATURE SENSOR 6" (HMO-454	STE-1424	KMC	7
TEMPERATURE	THERMOWELL COVER FOR STE-1424	HMO-4546	KMC	7
URRENT SWITC	NT SWITCH, ADJ PRESETS, SPLITCOI	C-2350VFD	SENVA	2
URRENT SWITC	COMMAND RELAY, 24 VAC/DC COIL	CR3-24	SENVA	2
HW VALVE	2" 2WAY BALL MFT MODULATING	F650HD+AFX24-MFT-X1	BELIMO	1
RELAY	SP/DT RIB RELAY	RIBU1C	KELE	2
OUTPUT CARD	BAC-5901A BINARY OUTPUT CARD	HPO-6701	KMC	4
OUTPUT CARD	BAC-5901 ANALOG OUTPUT CARD	HPO-6702	KMC	4



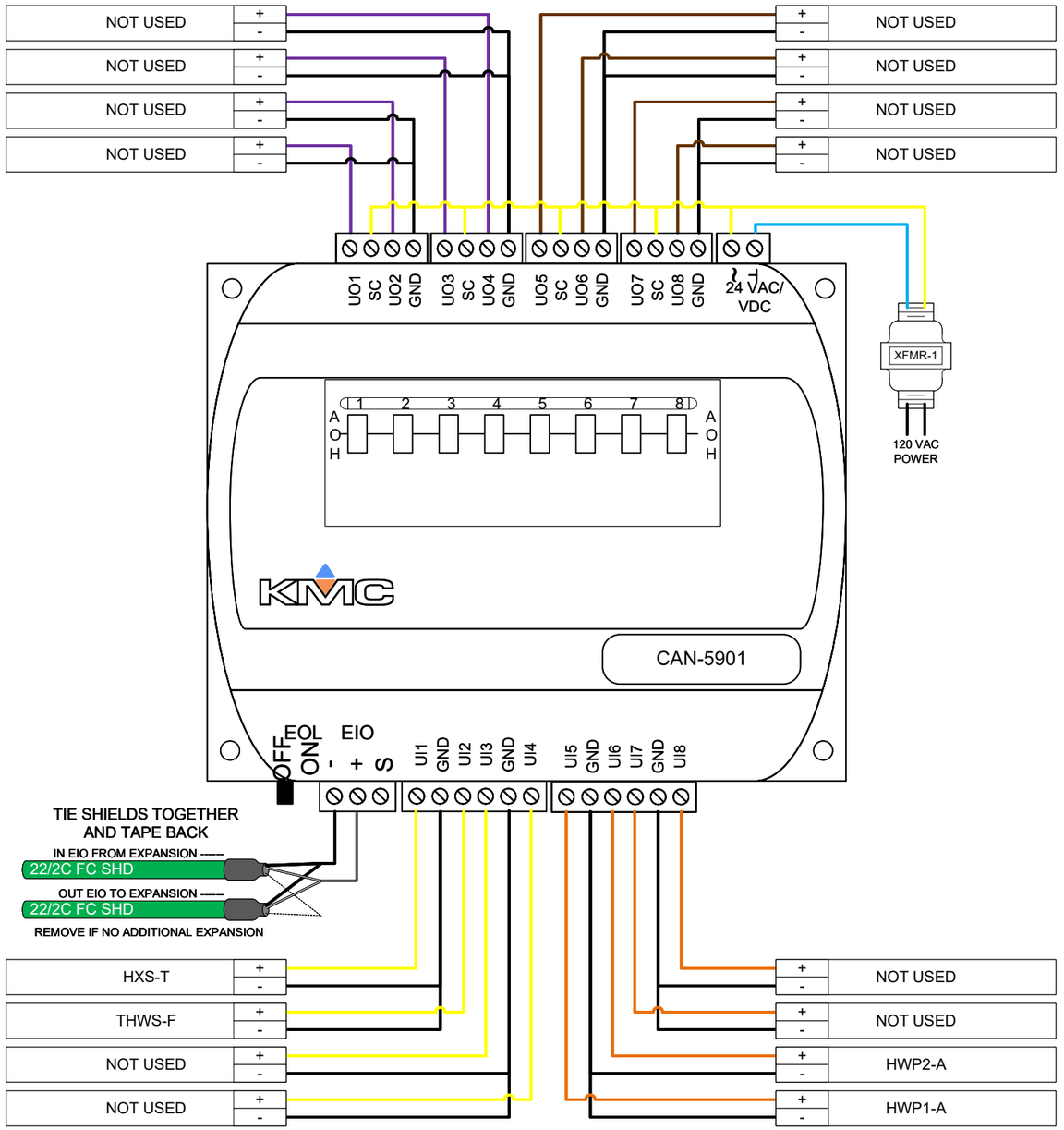
Drawing Title: **BOILER LAYOUT**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 8 of 22

BOILER WIRING



Drawing Title: **BOILER WIRING**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 9 of 22

BOILER WIRING EXP



Drawing Title: **BOILER WIRING EXP**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 10 of 22

HOT WATER SYSTEM SEQUENCE OF OPERATION:

BOILER SEQUENCE

MODE OF OPERATION:

THE SYSTEM MODES OF OPERATION SHALL BE EITHER ENABLED OR DISABLED BASED ON A CALL FOR HEATING FROM ANY UNIT SERVED BY THE SYSTEM OR AN OPERATOR OVERRIDE COMMAND FROM THE BAS. THE HOT WATER SYSTEM SHALL ALSO BE ENABLED ANYTIME THE OUTSIDE AIR TEMPERATURE FALLS BELOW 32°F SO THAT HOT WATER WILL BE CIRCULATED THROUGHOUT THE BUILDING DURING TIMES OF EXTREME COLD CONDITIONS.

ENABLED MODE:

ALL DIRECT CONTROL OF THE BOILERS IS PERFORMED BY FACTORY BOILER CONTROLS. THE BAS SHALL BE RESPONSIBLE FOR SENDING AN ENABLE/DISABLE SIGNAL AND A HOT WATER SUPPLY TEMPERATURE SETPOINT TO THE MASTER BOILER CONTROLLER. THE MASTER BOILER CONTROLLER SHALL BE INTEGRATED VIA BACNET COMMUNICATION FOR ADDITIONAL BOILER DATA MONITORING.

THE HOT WATER PUMPS SHALL OPERATE ON A LEAD/LAG SCHEDULE. THE LEAD HOT WATER PUMP SHALL BE ROTATED ON A WEEKLY BASIS.

THE HOT WATER SUPPLY TEMPERATURE SETPOINT SHALL BE RESET BASED ON THE OUTSIDE AIR TEMPERATURE. AS THE OUTSIDE AIR TEMPERATURE FALLS FROM 55°F TO 40°F (ADJ), THE HOT WATER SUPPLY TEMPERATURE SETPOINT SHALL BE RAISED FROM 120°F TO 160°F (ADJ).

WHEN CALLED INTO ENABLED OPERATION, THE FIRST STAGE OF HEATING SHALL BE FROM THE THERMAL WATER SUPPLY HEAT EXCHANGER. IF THE THERMAL WATER SUPPLY TEMP IS LESS THAN THE HEATING WATER SUPPLY TEMP THEN THE BAS SHALL CLOSE THERMAL VALVE AND SEND AN ENABLE SIGNAL TO THE MASTER BOILER CONTROLLER. EACH INDIVIDUAL BOILER CONTROLLER SHALL CONTROL ITS RESPECTIVE ISOLATION CONTROL VALVE. THE MASTER BOILER CONTROLLER SHALL CONTROL THE SEQUENCING AND MODULATION OF BOILERS AS REQUIRED TO MAINTAIN

THE HOT WATER SUPPLY TEMPERATURE AT SETPOINT. THE BOILER MASTER CONTROLLER SHALL DIRECTLY MEASURE THE SUPPLY WATER TEMPERATURE VIA DEDICATED TEMPERATURE SENSOR. THE MASTER BOILER CONTROLLER SHALL ALSO CONTROL THE LEAD/LAG OPERATION OF THE INDIVIDUAL BOILERS. THE MINIMUM FLOW REQUIREMENT OF THE BOILERS IS SATISFIED BY THE USE OF MULTIPLE THREE-WAY HOT WATER CONTROL VALVES INSTALLED AT SELECT VAV BOXES.

THE LEAD PUMP SHALL BE ENABLED TO RUN AND SHALL RUN CONTINUOUSLY. THE PUMP VFD SHALL MODULATE THE LEAD PUMP'S SPEED TO MAINTAIN THE HOT WATER DIFFERENTIAL PRESSURE AT SETPOINT. IF THE LEAD PUMP FAILS TO OPERATE, AN ALARM SHALL BE SENT TO THE BAS, AND THE LAG PUMP SHALL ENABLED TO OPERATE AS THE NEW LEAD PUMP.

THE HOT WATER DIFFERENTIAL PRESSURE MINIMUM AND MAXIMUM SETPOINTS SHALL BE DETERMINED BY THE TAB CONTRACTOR DURING TEST AND BALANCE.

THE HOT WATER PRESSURE SETPOINT SHALL BE RESET FROM MINIMUM TO MAXIMUM BASED UPON THE POSITION OF THE MOST OPEN HOT WATER CONTROL VALVE. WHEN THE MOST OPEN HOT WATER CONTROL VALVE IS MORE THAN 95% OPEN, THE HOT WATER SETPOINT SHALL BE INCREASED BY 1 PSIG EVERY 10 MINUTES AS NEEDED UNTIL THE MAXIMUM SETPOINT IS REACHED. WHEN THE MOST OPEN HOT WATER CONTROL VALVE IS LESS THAN 80% OPEN, THE SETPOINT SHALL BE DECREASED BY 1 PSIG EVERY 10 MINUTES UNTIL THE MINIMUM SETPOINT IS REACHED.

IF THE HOT WATER DIFFERENTIAL PRESSURE REMAINS BELOW SETPOINT FOR MORE THAN 30 MINUTES WITH THE LEAD PUMP OPERATING AT MAX SPEED, THE LAG PUMP SHALL BE ENABLED TO RUN AND SHALL MODULATE WITH THE LEAD PUMP TO MAINTAIN THE HOT WATER DIFFERENTIAL PRESSURE AT SETPOINT. AFTER satisfying the HOT WATER DIFFERENTIAL PRESSURE SETPOINT AND WHEN THE SPEED OF BOTH PUMPS HAS FALLEN BELOW 35% FOR AT LEAST 10 MINUTES, THE LAG PUMP SHALL BE COMMANDED OFF AND THE LEAD PUMP SHALL RESUME PRIMARY PUMPING OPERATION.

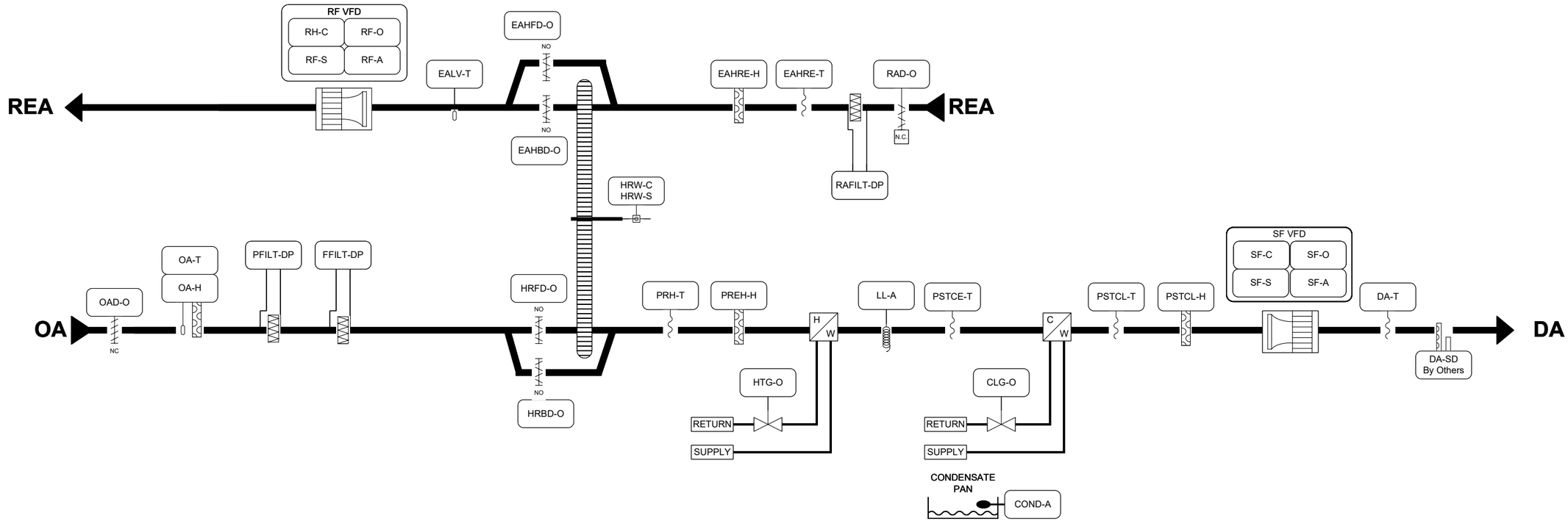
DISABLED MODE:

THE BOILERS SHALL BE DISABLED, THE THERMAL WATER VALVE SHALL BE CLOSED AND THE HOT WATER PUMPS SHALL BE COMMANDED OFF. IF ANY SYSTEM SERVED BY THE HOT WATER SYSTEM ISSUES A CALL FOR HEATING, THE SYSTEM SHALL RESUME OPERATION AS DESCRIBED IN THE ENABLED MODE OF OPERATION UNTIL THERE IS NO LONGER A CALL FOR HEATING FROM THE HOT WATER SYSTEM.

Drawing Title: **BOILER SEQUENCE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 11 of 22

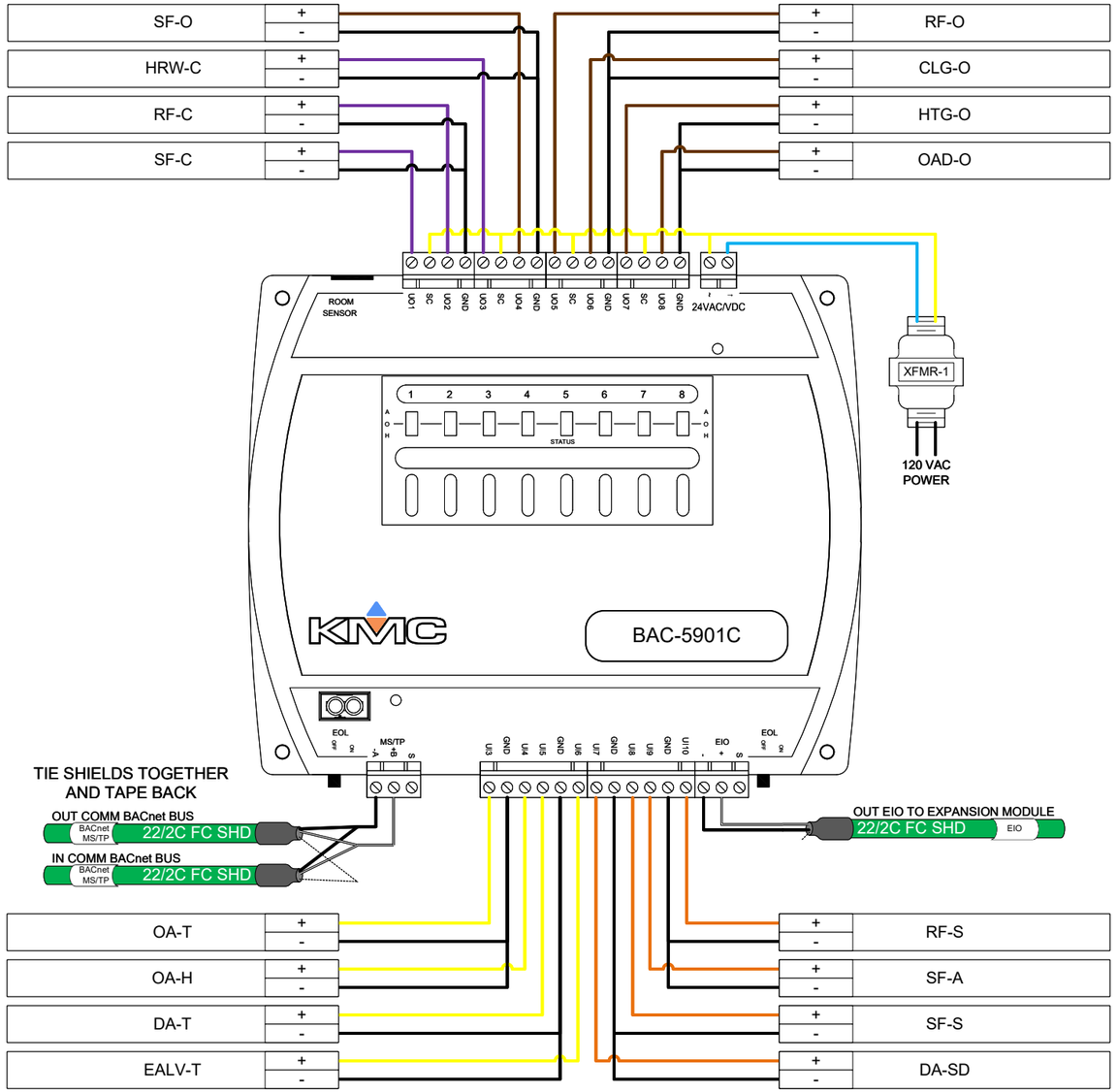
DOAS LAYOUT

Tag	Description	Part No.	Vendor	Quantity
ENCLOSURE	EXPANSION PANEL, 24X36X6.5, 96VA,	PA0000001BH0	JCI	1
CONTROLLER	CONTROLLER, REAL TIME CLOCK, MS	BAC-5901AC	KMC	1
CONTROLLER	EXPANSION MODULE (16 INPUTS)	CAN-5902	KMC	1
CONTROLLER	EXPANSION MODULE (8 INPUTS)	CAN-5901	KMC	1
AVERAGING SEN	DUCT AVERAGING TEMPERATURE, 24	STE-1417	KMC	5
TEMPERATURE S	DUCT TEMPERATURE SENSOR 8"	STE-1402	KMC	1
LL-A	LOW LIMIT ALARM SENSOR	A70HA-1C	KELE	1
HUMIDITY SENS	DUCT HUMIDITY SENSOR	DPDC112000	CAREL	3
ACTUATOR	DAMPER ACTUATOR	AFB24-SR	BELIMO	6
DIFFERENTIAL P	FILTER STATUS	ADPS-04-1-N	KELE	3
TEMP HUMIDITY	TEMP HUMIDITY COMBO SENSOR	A/RH3-CP-D	ACI	1
RELAY	ENCLOSED SPDT RELAY, 24 OR 120 V	RIBU1C	KELE	2
HW VALVE	1.5" MODULATING 2WAY VALVE	B239+AFRB24-SR	BELIMO	1
CW VALVE	2' MODULATING 2WAY VALVE	B248+AFRB24-SR	BELIMO	1
CONDENSATE A	WATER DETECTOR SWITCH	WD-1B	KELE	1
OUTPUT CARD	BAC-5901 ANALOG OUTPUT CARD	HPO-6702	KMC	10
OUTPUT CARD	BAC-5901A BINARY OUTPUT CARD	HPO-6701	KMC	3



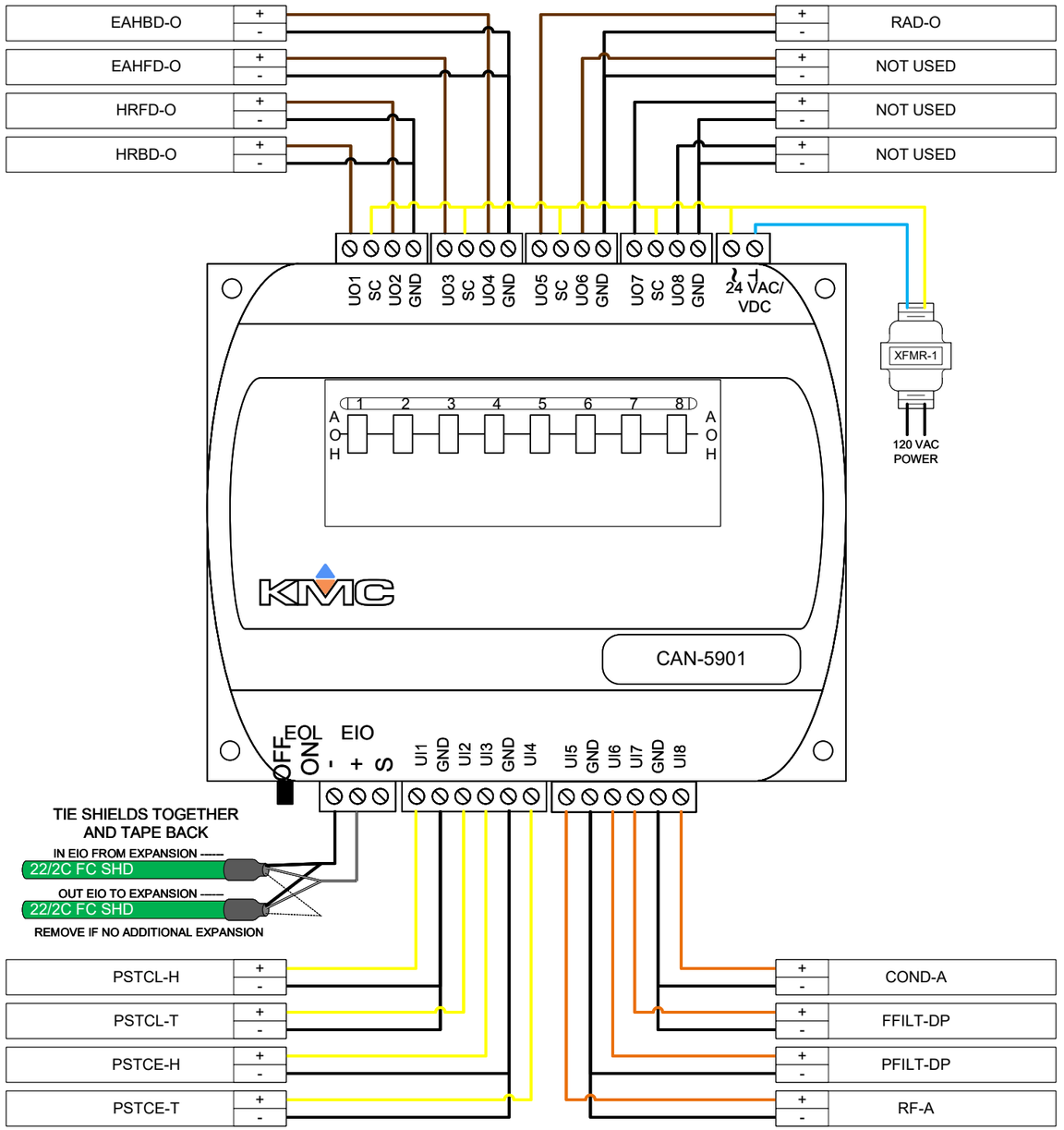
Drawing Title: **DOAS LAYOUT**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 12 of 22

DOAS WIRING



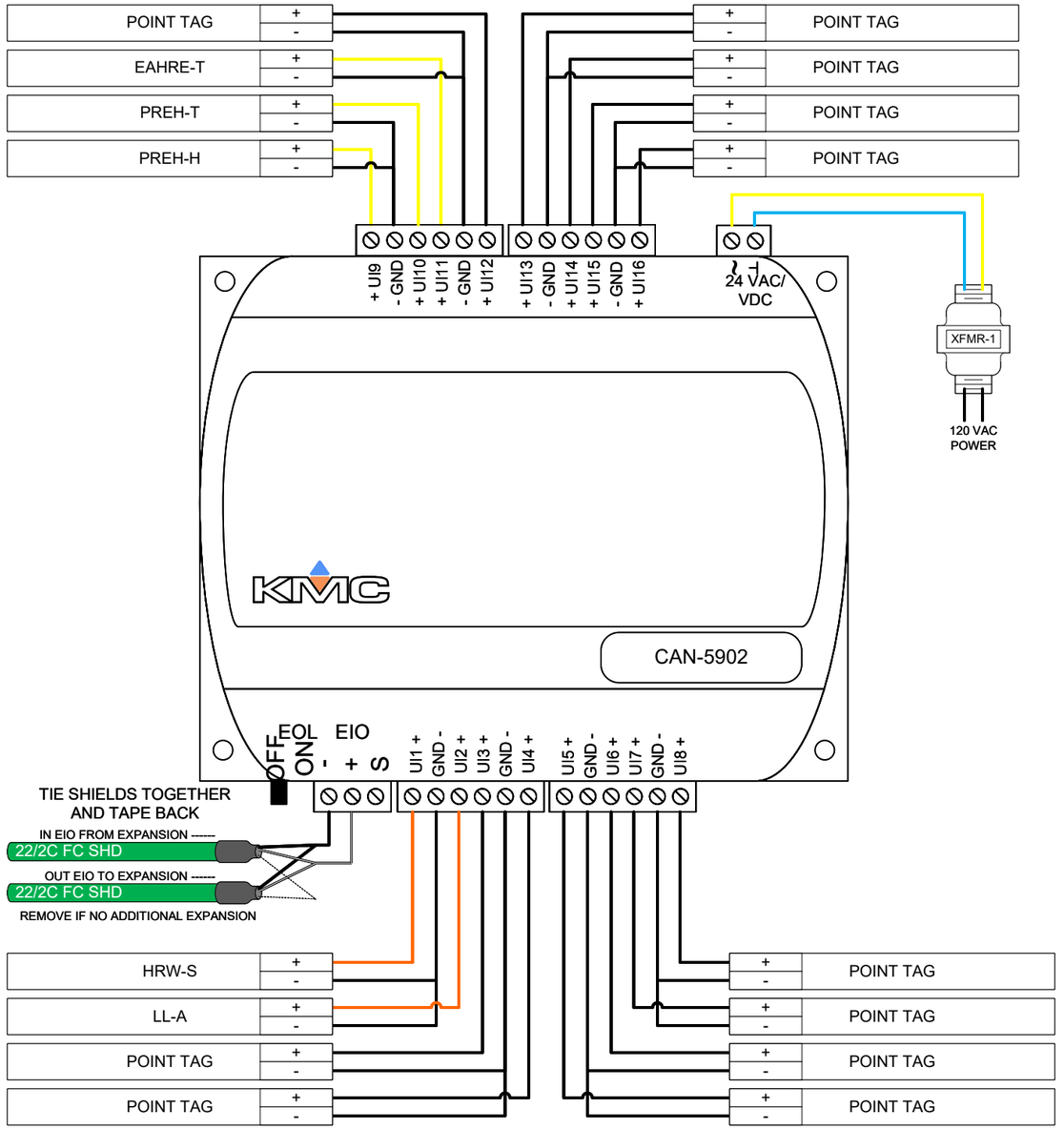
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DOAS WIRING EXP



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DOAS WIRING EXP 1



Drawing Title: **DOAS WIRING EXP 1**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
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DOAS SEQUENCE

SCHEDULING:

THE AIR HANDLING UNIT AND CORRESPONDING EXHAUST FAN SHALL OPERATE SIMULTANEOUSLY AND SHALL OPERATE ACCORDING TO OWNER-DEFINED SCHEDULE SET AT BUILDING AUTOMATION SYSTEM (BAS). DURING OCCUPIED MODES AIR HANDLING UNIT AND EXHAUST FAN SHALL WORK TOGEHTER TO PROVIDE CONSTANT VOLUME, VARIABLE TEMPERATURE CONDITIONED AIR TO THE ZONE AND 100% PURGE OF THE SUPPLY AIR TO THE BUILDING EXTERIOR. DURING UNOCCUPIED MODES BOTH THE AIR HANDLING UNIT AND THE EXHAUST FAN SHALL BE OFF. VARIABLE FREQUENCY DRIVES (VFD'S) SHALL BE PROVIDED ON BOTH FANS FOR CONTROL, BALANCING, AND MONITORING.

OCCUPIED:

DURING OCCUPIED PERIODS:

THE SUPPLY FAN SHALL RUN CONTINUOUSLY

REACTIVATION AIR FAN SHALL RUN CONTNUOUSLY

THE OUTSIDE AIR DAMPERS SHALL OPEN 100%

THE DX COOLING, ELECTRIC HEATING, AND DESSICANT DEHUMIDIFICATION SYSTEM SHALL OPERATE VIA THE FACTORY ON-BOARD CONTROLS AND CYCLE/MODULATE AS REQUIRED TO MAINTAIN SPACE THERMOSTAT AND HUMIDITY SETPOINTS.

UNOCCUPIED:

WHEN THE SPACE TEMPERATURE IS ABOVE THE UNOCCUPIED COOLING SETPOINT OF 80.0 DEG. F (ADJ.) THE SUPPLY FAN AND EXHAUST FAN SHALL BE COMMANDED ON AND THE DX COOLING SHALL BE ENABLED. WHEN THE SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED COOLING SETPOINT OF 80.0 DEG. F (ADJ.) MINUS THE UNOCCUPIED DIFFERENTIAL OF 4.0 DEG. F (ADJ.) THE SUPPLY FAN SHALL STOP AND THE DX COOLING SHALL BE DISABLED.

WHEN THE SPACE TEMPERATURE IS BELOW THE UNOCCUPIED HEATING SETPOINT OF 60.0 DEG. F (ADJ.) THE SUPPLY FAN SHALL BE COMMANDED ON AND THE GAS HEAT SHALL BE ENABLED. WHEN THE SPACE TEMPERATURE RISES ABOVE THE UNOCCUPIED HEATING SETPOINT OF 60.0 DEG. F (ADJ.) PLUS THE UNOCCUPIED DIFFERENTIAL OF 4.0 DEG. F (ADJ.) THE SUPPLY FAN SHALL STOP AND THE GAS HEAT SHALL BE DISABLED.

WHEN THE SPACE RELATIVE HUMIDITY IS ABOVE THE UNOCCUPIED SETPOINT OF 55% (ADJ.), THE SUPPLY FAN AND EXHAUST FAN SHALL BE COMMANDED ON AND THE MODULATING HOT GAS REHEAT SHALL BE ENABLED. WHEN THE SPACE RELATIVE HUMIDITY FALLS BELOW THE UNOCCUPIED RELATIVE HUMIDITY SETPOINT OF 55% (ADJ.) MINUS THE UNOCCUPIED DIFFERENTIAL OF 10% (ADJ.), THE SUPPLY FAN AND EXHAUST FAN SHALL STOP AND THE REHEAT SHALL BE DISABLED.

CONSTANT TORQUE FAN CONTROL:

THE AMFS SHALL MONITOR THE SUPPLY AIR VOLUME AND THE SUPPLY FAN VFD SHALL MODULATE THE SUPPLY FAN SPEED TO MAINTAIN CONSTANT VOLUME TO COMPENSATE FOR FILTER LOADING.

OCCUPIED BYPASS/TIMED LOCAL OVERRIDE:

THE BAS SHALL MONITOR THE STATUS OF THE "ON" AND "CANCEL" BUTTONS OF THE SPACE TEMPERATURE SENSOR. WHEN AN OCCUPIED BYPASS REQUEST IS RECEIVED FROM THE SPACE SENSOR, THE UNIT SHALL TRANSITION FROM ITS CURRENT OCCUPANCY MODE TO OCCUPIED BYPASS MODE AND THE UNIT SHALL MAINTAIN THE SPACE TEMPERATURE TO THE OCCUPIED SETPOINTS (ADJ.).

VENTILATION AIR CONTROL:

DURING OCCUPIED PERIODS, THE AIRFLOW MONITORING STATION (AFMS) SHALL MONITOR AND MODULATE OUTSIDE AIR DAMPER TO MAINTAIN THE SCHEDULED VENTILATION RATE. DURING UNOCCUPIED OPERIODS, THE OUTSIDE AIR DAMPER SHALL BE CLOSED.

SAFETIES AND ALARMS:

FAN RUN STATUS: IF THE SUPPLY FAN AND EXHAUST FAN ARE COMMANDED "ON" AND EITHER FAN DOES NOT START,

BOTH FANS SHALL BE COMMANDED "OFF" AND AN ALARM WILL BE GENERATED AT THE BAS OPERATOR WORKSTATION.

FILTER STATUS: FILTER DIFFERENTIAL PRESSURE SENSORS MONITORED BY BAS. SETPOINT FOR DIRTY FILTER ALARM SHALL BE ADJUSTABLE.

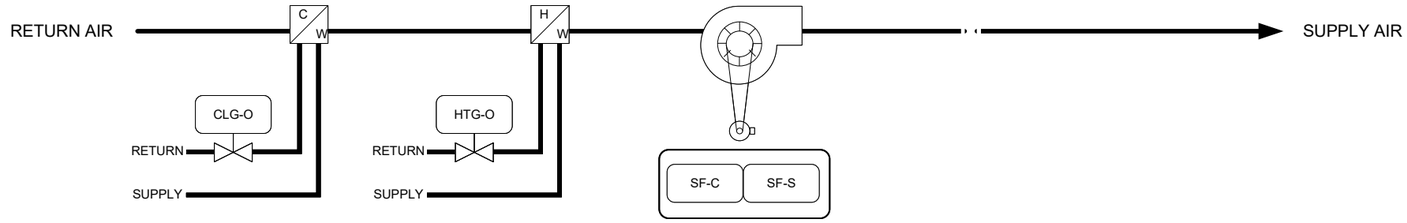
SMOKE DETECTOR SHUTDOWN: THE UNIT SHALL SHUT DOWN IN RESPONSE TO A SIGNAL FROM THE SMOKE DETECTOR(S) INDICATING THE PRESENCE OF SMOKE AND AN ALARM SHALL ANNUNCIATE AT THE BAS. THE SMOKE DETECTOR(S) SHALL BE INTERLOCKED TO THE UNIT THROUGH THE DRY CONTACTS OF THE SMOKE DETECTOR(S). A MANUAL RESET OF THE SMOKE DETECTOR(S) SHALL BE REQUIRED TO RESTART THE UNIT.

CONDENSATE OVERFLOW SHUTDOWN: THE UNIT SHALL SHUT DOWN IN RESPONSE TO A SIGNAL FROM THE CONDENSATE OVERFLOW SENSOR. THE SENSOR SHALL BE INTERLOCKED TO THE UNIT COOLING CONTROLLER FOR IMMEDIATE SHUTDOWN OF COOLING.

Drawing Title: **DOAS SEQUENCE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 16 of 22

FAN COIL LAYOUT

TYPICAL OF 36



ZN-T

ZN-SP

Drawing Title: **FAN COIL LAYOUT**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 17 of 22

FAN COIL SEQUENCE

HEATING AND COOLING FAN COIL UNIT SEQUENCE OF OPERATION

Mode of Operation:

the unit mode of operation shall be either occupied or unoccupied BASED ON A Building Automation System (bas) SCHEDULE, AN OPERATOR OVERRIDE COMMAND FROM THE BAS, OR A TEMPORARY Occupancy OVERRIDE SIGNAL from THE SPACE TEMPERATURE SENSOR. Commands or overrides from the bas shall take priority over any local changes made at the space sensor.

Occupied Mode:

The space temperature sensor shall be set for single setpoint with a SETPOINT DIFFERENTIAL OF 2°f (ADJ). the initial occupied heating setpoint shall be 72°F (adj). the initial occupied cooling setpoint shall be 74°F (adj). the COOLING space temperature setpoint range shall be limited between a minimum of 68°F and maximum of 77°F. the HEATING space temperature setpoint range shall be limited between a minimum of 66°F and maximum of 75°F.

on an increase in space temperature above the cooling setpoint, the unit fan shall be commanded on and the cooling coil control valve shall modulate to maintain the space cooling setpoint. As the space temperature falls below the cooling setpoint, the reverse sequence shall occur to maintain the space temperature cooling setpoint.

on a decrease in space temperature below the heating setpoint, the unit fan shall be commanded on and the heating coil control valve shall modulate to maintain the space heating setpoint. As the space temperature rises above the heating setpoint, the reverse sequence shall occur to maintain the space temperature heating setpoint.

unoccupied mode:

during unoccupied operation, the system shall be subject to the unoccupied mode heating and cooling setpoints. The initial unoccupied heating setpoint shall be 65°F (ADJ). The initial unoccupied cooling setpoint shall be 80°F (ADJ).

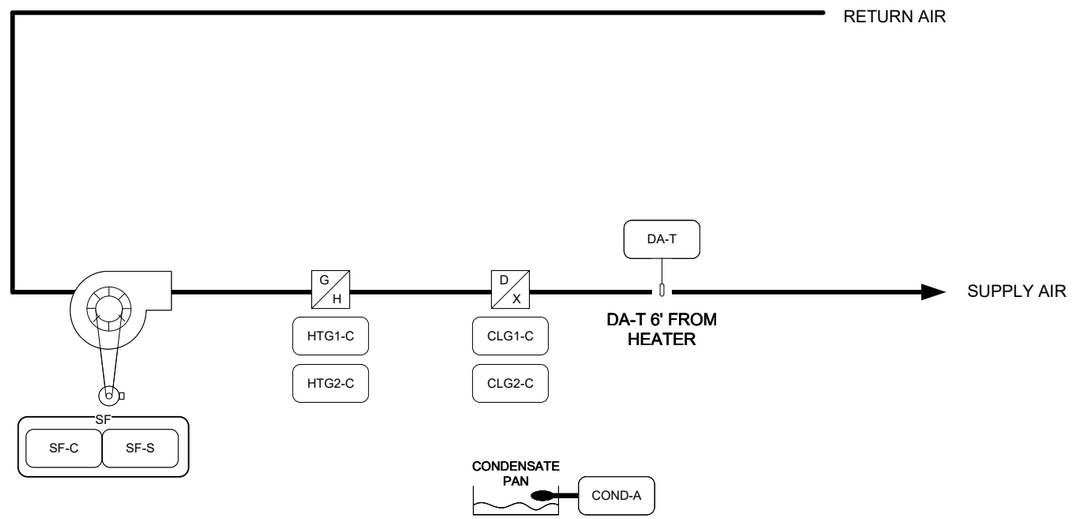
The space temperature sensor shall be equipped with a temporary occupancy override feature that shall override the system into occupied mode for a period of 2 hours(ADJ).

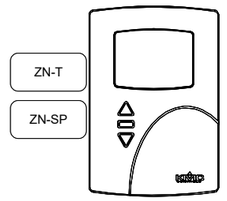
Drawing Title: **FAN COIL SEQUENCE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 18 of 22

GAS FURNACE LAYOUT

TYPICAL OF 1

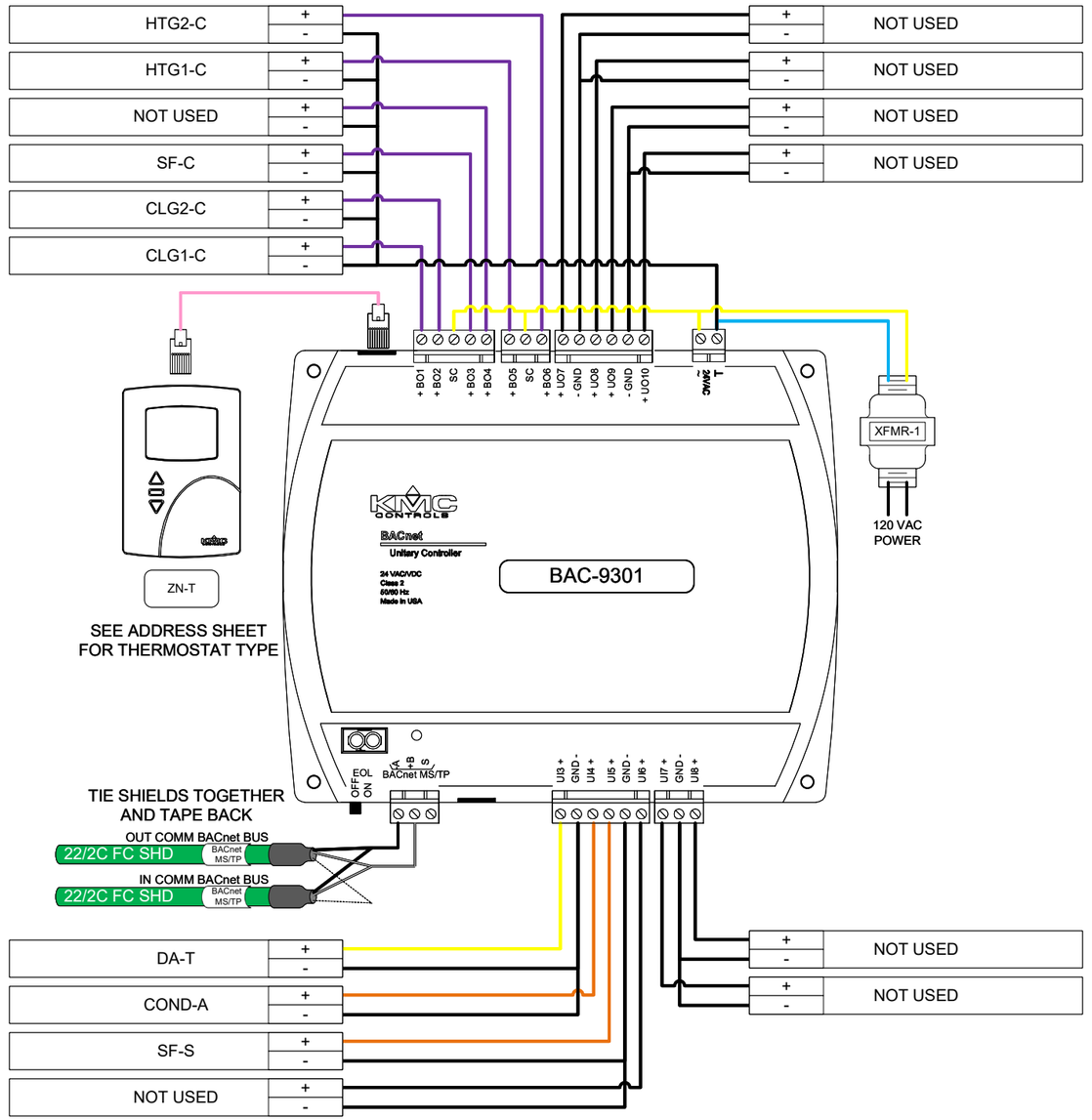
Tag	Description	Part No.	Vendor	Quantity
ENCLOSURE	ENCLOSURE 12X12X4	ASE12X12X4	KELE	1
CONTROLLER	GENERAL CONTROLLER, MS/TP	BAC-9301A	KMC	1
TEMPERATURE S	DUCT TEMPERATURE PROBE 4"	STE-1405	KMC	1
CURRENT SWIT	CURRENT SWITCH, ADJ PRESETS, S	C-2320	KELE	1
ONDENSATE ALA	SATE OVERFLOW SWITCH, IN SECOND	SS2	KELE	1
THERMOSTAT	SPACE TEMPERATURE	STE-9001W	KMC	1





Drawing Title: **GAS FURNACE LAYOUT**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
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GAS FURNACE WIRING



Drawing Title: **GAS FURNACE WIRING**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
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GAS FURNACE SEQUENCE

SPLIT SYSTEM UNIT SEQUENCE OF OPERATION

MODE OF OPERATION:

THE UNIT MODE OF OPERATION SHALL BE EITHER OCCUPIED OR UNOCCUPIED BASED ON A BUILDING AUTOMATION SYSTEM (BAS) SCHEDULE, AN OPERATOR OVERRIDE COMMAND FROM THE BAS, OR A TEMPORARY OCCUPANCY OVERRIDE SIGNAL AT THE THERMOSTAT.

OCCUPIED MODE:

THE THERMOSTAT SHALL BE SET FOR SINGLE SETPOINT WITH 2 DEGREE DEADBAND. THE INITIAL OCCUPIED HEATING SETPOINT SHALL BE 70°F (ADJ). THE INITIAL OCCUPIED COOLING SETPOINT SHALL BE 72°F (ADJ). THE SPACE TEMPERATURE SETPOINT RANGE SHALL BE LIMITED BETWEEN A MINIMUM OF 68°F AND MAXIMUM OF 75°F.

THE SUPPLY FAN SHALL RUN CONTINUOUSLY FOR VENTILATION. THE VENTILATION RATE SHALL BE SET DURING TEST AND BALANCE WITH A MANUAL BALANCE DAMPER.

ON AN INCREASE IN SPACE TEMPERATURE ABOVE THE COOLING SETPOINT, THE COMPRESSOR SHALL BE COMMANDED ON TO MAINTAIN THE SPACE COOLING SETPOINT.

ON A DECREASE IN SPACE TEMPERATURE BELOW THE HEATING SETPOINT, THE FURNACE SHALL BE COMMANDED ON TO MAINTAIN THE SPACE HEATING SETPOINT.

UNOCCUPIED MODE:

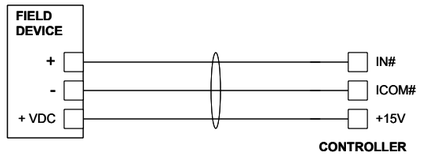
DURING UNOCCUPIED MODE, THE UNIT SHALL BE OFF. THE THERMOSTAT SHALL BE EQUIPPED WITH A TEMPORARY OCCUPANCY OVERRIDE FEATURE THAT SHALL OVERRIDE THE SYSTEM INTO OCCUPIED MODE FOR A PERIOD OF 2 HOURS (ADJ).

DURING UNOCCUPIED MODE, THE FAN SHALL TYPICALLY BE OFF AND THE HEATING AND COOLING SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE SUBJECT TO THE UNOCCUPIED MODE HEATING AND COOLING SETPOINTS. THE INITIAL UNOCCUPIED HEATING SETPOINT SHALL BE 65°F (ADJ). THE INITIAL UNOCCUPIED COOLING SETPOINT SHALL BE 78°F (ADJ).

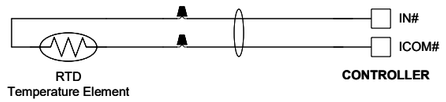
Drawing Title: **GAS FURNACE SEQUENCE**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 21 of 22

INSTALLATION DETAIL

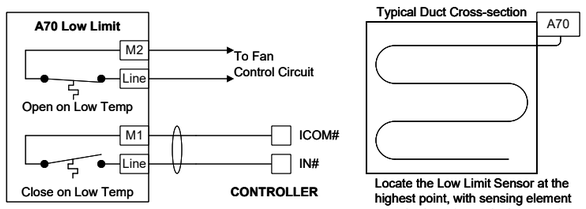
DETAIL F102 VOLTAGE INPUT - INTERNAL SOURCE 15VDC



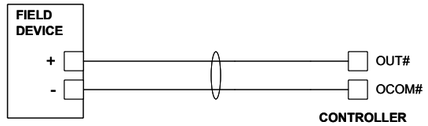
DETAIL F131 TEMPERATURE SENSOR INPUT



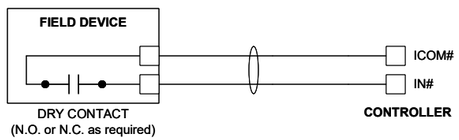
DETAIL F302 N.O. BINARY INPUT - A70



DETAIL F201 ANALOG OUTPUT (VOLTAGE)

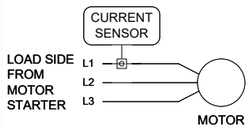


DETAIL F307 CURRENT SENSOR (GO/NO GO)

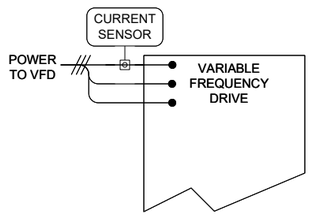


PLACEMENT

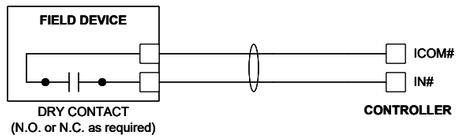
ON MOTORS CONTECTED TO A STARTER CLAMP THE CURRENT SENSOR ON THE LINE SIDE OF THE STARTER



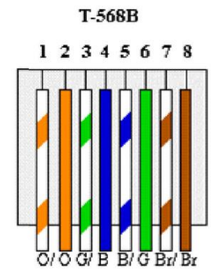
ON MOTORS CONTECTED TO A VFD CLAMP THE CURRENT SENSOR ON THE INCOMING POWER TO THE DRIVE.

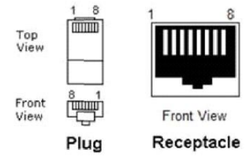


DETAIL F301 BINARY INPUT (DRY CONTACT)



Standard Ethernet Pin Out





Pinout of the RJ45 connector on the STE-9000:

1. No Connect - Setpoint
2. NS-485-A
3. GND - Common
4. MS/TP B+
5. MS/TP A-
6. +3.3V
7. NS-485-B
8. No Connect - Sensor

Drawing Title: **INSTALLATION DETAIL**	Project Title: **BUCKSTAFF BATHHOUSE**	Sales Person: Lee Wilson Project Manager: Chris Murrell Controls Engineer: Brent Corn
Harrison Energy Partners Commercial HVAC Excellence	Harrison Energy Partners 1501 Westpark Dr, Ste 9 Little Rock, AR 72204 (501) 661-0621 phone (501) 661-9109 fax	Contract Number: AC125033 Date: December 3, 2025 Page Number: Page 22 of 22

JACE 9000

Controller

OVERVIEW

The KMN-J-9000 is a compact, embedded Niagara Framework based controller and server platform for connecting multiple and diverse devices and sub-systems. The controller is designed as a Network Automation Controller optimized for BAS applications. With Internet connectivity and web-serving capability, the JACE 9000 controller provides integrated control, supervision, data logging, alarming, scheduling, and network management. It streams data and rich graphical displays to a standard Web browser via an Ethernet connection or remotely over the Internet.

The controller is optimized for Niagara 4, which takes the Internet of Things "defense-in-depth" approach to security. In larger facilities, multi-building applications, and large-scale control system integrations, Niagara 4 Supervisors can be used with JACE 9000 controllers to aggregate information, including real-time data, history, and alarms, to create a single, unified application.

LICENSING

For ultimate flexibility and expandability, the licensing model for the JACE 9000 controller includes standard Tridium drivers along with optional IO and field bus expansion modules. The controller requires requires a Software Maintenance Agreement (SMA) available for a 1-, 3-, or 5-year term. The initial maintenance license is a separate line item that must be chosen at the time of purchase.

SPECIFICATIONS

- NXP iMX8M+ Quad Core CPU
- 2GB LPDDR4 RAM
- Removable 8GB micro-SD card
- USB type C connector for back-up and restore support
- (2) isolated RS-485 with switch-selectable bias and termination
- (2) 10/100MB Ethernet ports 24VAC/DC power supply
- Requires Niagara 4.13 or later
- Real time clock
- Batteryless
- Supports SSL and TLS encryption



Powered by niagara FRAMEWORK®

ENVIRONMENTAL SPECIFICATIONS

- Operating temperature: -20–60°C
- Storage temperature: -40–85°C
- Humidity: 5%–95% — Non condensing
- Shipping & vibration: ASTM D4169, Assurance Level II
- MTTF: 10 years+

AGENCY LISTINGS

- UL 916
- CE EN 61326-1
- RCM
- FCC Part 15 Subpart B, Class B
- FCC Part 15 Subpart C
- C-UL listed to Canadian Standards Association (CSA) C22.2 No. 205-M1983 "Signal Equipment"
- 1999/5/EC R&TTE Directive
- CCC
- SRRC
- RSS
- RoHS

EXPANSION & REMOTE IO MODULES

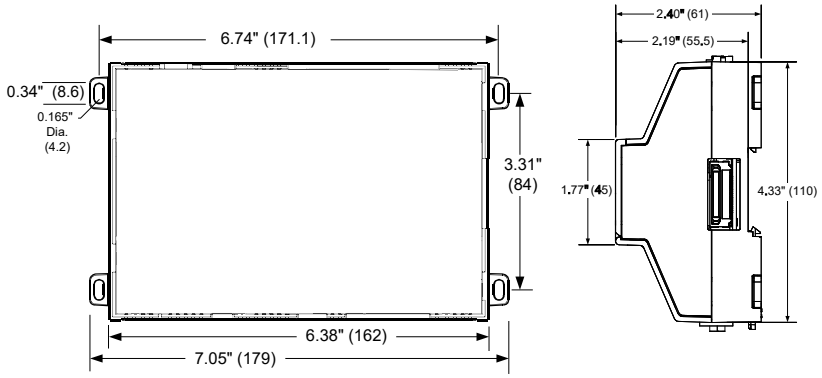
The JACE 9000 supports up to four expansion modules and up to 16 remote IO modules. See the JACE IO and Expansion modules data sheets for details.

MAXIMUM EXPANSION MODULES	MAXIMUM IO MODULES
NPB-8000-LON (4)	IO-R-16 (16)
NPB-8000-232 (4)	IO-R-34 (8)
NPB-8000-2X-485 (2)	

JACE, Niagara, Niagara Framework, and Niagara N4 are egistered trademarks of Tridium, Inc.

DIMENSIONS

Allow at least 1.5 inches (38 cm) clearance around all sides.



ORDERING INFORMATION

JACE and Options

DESCRIPTION	MODEL
JACE 9000 licensed for 5 devices/250 points	KMN-J-9005
JACE 9000 licensed for 10 devices/500 points	KMN-J-9010
JACE 9000 licensed for 25 devices/1,250 points	KMN-J-9025
JACE 9000 licensed for 100 devices/5,000 points	KMN-J-9100
JACE 9000 licensed for 200 devices/10,000 points	KMN-J-9200
JACE 9000 DEMO kit unit, licensed for 500 devices/25,000 points	KMN-J-9000-DEMO
Add 1 device/50 points	DEVICE-1
Add 10 devices/500 points	DEVICE-10
Add 25 devices/1,250 points	DEVICE-25
Add 50 devices/2,500 points	DEVICE-50
JACE 9000 100-240 volt universal power supply	WPM-8000

Optional Modules

DESCRIPTION	MODEL
Add-on dual port RS-485 expansion module for KMN-J-9000 controller	NPB-8000-2X-485
Add-on single port LON FTT10A expansion module for KMN-J-9000 controller	NPB-8000-LON
Add-on single port RS-232 expansion module for KMN-J-9000 controller	NPB-8000-232
Remote IO module, compatible with the JACE 9000 controller. Communication using RS-485. JACE can support up to 16 total IO-R-16 modules.**	IO-R-16
Remote IO module, compatible with the JACE 9000 controller. Communication using RS-485. JACE can support up to 8 total IO-R-34 modules.**	IO-R-34
** Refer to the installation guide for various combinations of IO-R-16s and IO-R-34s.	

SUPPORT

Additional resources for installation, configuration, application, operation, programming, upgrading, and much more are available on the web at **www.kmccontrols.com**. To see all available files, log-in to the KMC Partners site.



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BAC-5900A Series

BACnet General Purpose Controllers (B-AAC)

DESCRIPTION

KMC Conquest™ BAC-5900A series controllers are designed to control building systems and HVAC equipment. The integrated alarming, scheduling, and trending enable these BACnet Advanced Application Controllers to be powerful edge devices for the modern smart building ecosystem.

The controllers feature simple, menu-driven setup choices using an STE-9000 series digital sensor, which can be installed permanently as the room sensor or used temporarily as a technician's service tool.

Alternately, quick configuration of controller properties can be done using NFC (Near Field Communication) from a smart phone, tablet, or computer (using KMC Connect Lite™ app) while the controller is unpowered.

The Ethernet-enabled BAC-5901AC**E** can also be configured by connecting an HTML5-compatible web browser to the built-in configuration web pages.

To meet the most demanding building automation custom requirements, these controllers are also fully programmable. Custom configuration and programming, with wizards for application programming selection/configuration, are enabled by KMC Connect™ software and the KMC Converge™ module for Niagara Workbench.

KMC Converge and TotalControl™ software additionally provide the capability of creating custom graphical web pages (hosted on a remote web server) to use as a custom user-interface for the controllers.

The 10 inputs and 8 outputs can be expanded up to 72 inputs and 40 outputs using CAN-5900 Series Expansion Modules.



KMC Conquest™ Automation Hardware

RoHS COMPLIANT LEAD FREE

APPLICATIONS

Can be used with the following types of equipment:

- Air handling units
- Boilers
- Chillers
- Chilled beams
- Cooling towers
- Fan coil units
- Heat pump units
- Pumps
- Roof top units
- Unit ventilators
- Other HVAC and building automation system equipment

NOTE: Applications generally require custom programming. (See also **Sample Installation on page 6**.)

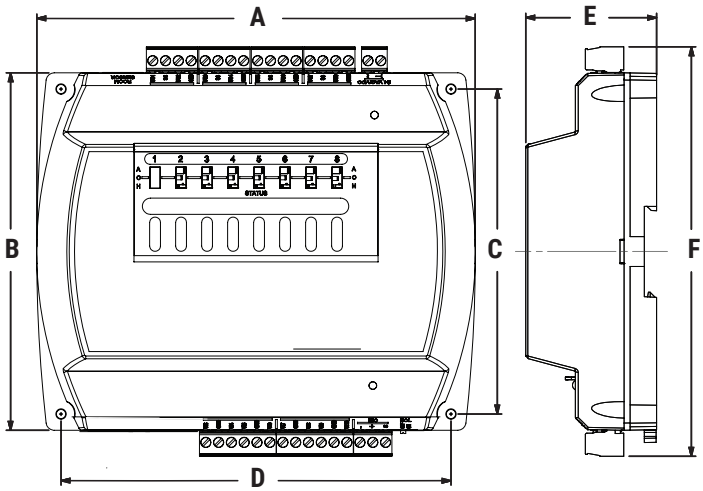
MODEL

APPLICATIONS	INPUTS*	OUTPUTS*	FEATURES			MODEL
			Real Time Clock	Ethernet Port	MS/TP Port	
AHU, chillers, boilers, cooling towers, pumps, lighting, FCU, HPU, RTU, unit ventilators, other HVAC	10 total: • 2 analog (temperature sensor port) • 8 universal inputs (software configurable as analog, binary, or accumulator on terminals)	8 universal: • Software configurable as analog or binary • Override boards give additional options**	✓		✓	BAC-5901AC
				✓		BAC-5901ACE

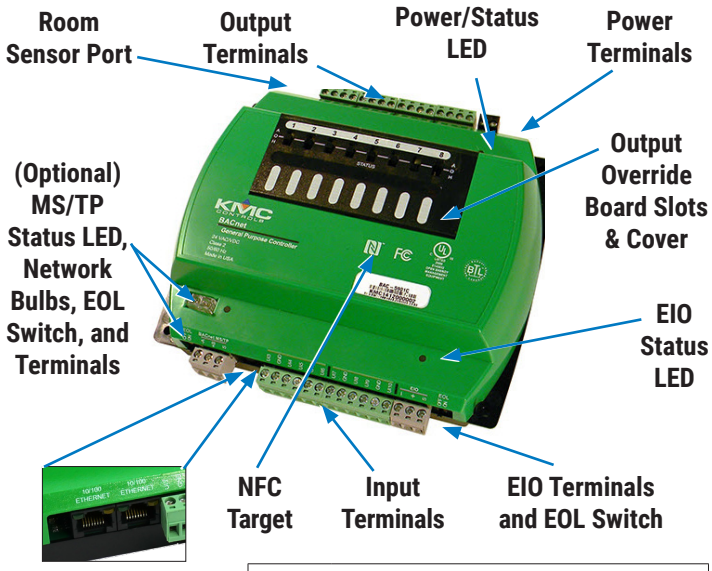
*Up to four CAN-5900 series I/O expansion modules can be used with BAC-5900A series controllers to provide up to 74 physical (Room Sensor port and terminal block) inputs and up to 40 outputs.

**HPO-6700 series output override board series provide (triac, NC/NO relays, 4–20 mA, adjustable 0–10 VDC) options for devices that cannot be powered from a standard universal output. The boards can also be used with the CAN-5901.

SPECIFICATIONS



DIMENSIONS		
A	6.750 inches	171 mm
B	5.500 inches	140 mm
C	5.000 inches	127 mm
D	6.000 inches	152 mm
E	2.012 inches	51 mm
F	6.300 inches	160 mm



TERMINAL COLOR CODE	
Black	24 VAC/VDC Power
Gray	MS/TP and CAN Communications
Green	Inputs and Outputs

Inputs and Outputs

Inputs, Universal (8 on Terminal Blocks)

Universal inputs	Configurable as analog, binary, or accumulator objects
Termination	1K and 10K ohm sensors, 0–12 VDC, or 0–20 mA (without need for an external resistor)
Resolution	16-bit analog-to-digital conversion
Protection	Overvoltage protection (24 VAC, continuous)
Wire size	12–24 AWG, copper, in removable screw terminal blocks

Input, Dedicated Room Sensor Port

Connector	Modular connector for STE-9xx1 series digital wall sensors or STE-6010/6014/6017 analog temperature sensors
Cable	Uses standard Ethernet patch cable up to 150 feet (45 meters)

Outputs, Universal (8 on Terminal Blocks)

Universal outputs	Configurable as an analog (0 to 12 VDC) or binary object (0 or 12 VDC, on/off); alternately, an output override board is installed for devices that cannot be powered from a standard universal output
Power/protection	Each short-circuit protected universal output capable of driving up to 100 mA (at 0–12 VDC) or 300 mA total for all outputs
Resolution	12-bit digital-to-analog conversion
Wire size	12–24 AWG, copper, in removable screw terminal blocks

Communications

Auxiliary	One serial port with mini Type B connector (reserved for future use)
Expansion (EIO)	One CAN serial bus connection (terminal block) for daisy-chaining I/O expansion modules up to 200 feet (61 meters) from the controller via standard shielded twisted-pair wire
Ethernet (optional)	Two 10/100BaseT Ethernet connectors for BACnet IP, Foreign Device, and Ethernet 802.3 (ISO 8802-3); segmentation supported; up to 328 ft (100 m) between controllers (using T568B Category 5 or better cable)
MS/TP (optional)	One EIA-485 port (removable terminal block) for BACnet MS/TP, operating at 9.6, 19.2, 38.4, 57.6, 76.8, or 115.2 kilobaud; max. length of up to 4,000 feet (1,200 meters) or 18 AWG shielded twisted-pair, no more than 51 pf/ft (167 pf/m); use repeaters for longer distances.

NFC	NFC (Near Field Communication) up to 1 inch (2.54 cm) from the top of the enclosure
Room sensor	Modular STE connection jack for STE-9000 series digital sensors and STE-6010/6014/6017 analog sensors

Configurability

OBJECTS*	MAXIMUM #**
Inputs and Outputs	
Analog, binary, or accumulator input	106
Analog or binary output	40
Values	
Analog value	300
Binary value	300
Multi-state value	100
Program and Control	
Program (Control Basic)	30
PID loop	50
Schedules	
Schedule	20
Calendar	10
Logs	
Trend log	40
Trend log multiple	20
Alarms and Events	
Notification class	20
Event enrollment	100
Tables	
Input tables	20
Control Basic tables	20

*Configuration allows creation and deletion of objects (with the maximum number of objects shown). The number and configuration of default objects depends on the selected application. For lists of default objects, see the **KMC Conquest Controller Application Guide**. See also the PIC statement for all supported BACnet objects.

**Maximum number values are for 4 MB expanded-memory BAC-5900 series controllers that started shipping on May 1, 2018. Earlier controllers had 2 MB memory and a reduced maximum number of objects. Up to four CAN-5900 series I/O expansion modules can be added to provide up to 74 physical (Room Sensor port and terminal block) inputs and up to 40 outputs.

Configuring, Programming, and Designing

SETUP PROCESS			KMC CONTROLS TOOL
Configuration	**Programming (Control Basic)**	**Web Page Graphics***	
✓			Conquest NetSensor
✓			Internal configuration web pages in Conquest Ethernet "E" models**
✓			KMC Connect Lite™ (NFC) app***
✓	✓		KMC Connect™ software
✓****	✓****	✓	TotalControl™ software
✓	✓		KMC Converge™ module for Niagara WorkBench
		✓	KMC Converge **GFX** module for Niagara WorkBench

*Custom graphical user-interface web pages can be hosted on a remote web server, but not in the controller.

Conquest Ethernet-enabled "E" models with the latest firmware can be configured with an HTML5 compatible web browser from pages served from within the controller. For information, see the **Conquest Ethernet Controller Configuration Web Pages Application Guide.

***Near Field Communication via enabled smart phone or tablet running the KMC Connect Lite app.

****Full configuration and programming of KMC Conquest controllers is supported starting with TotalControl ver. 4.0.

Hardware Features

Processor, Memory, and Clock

Processor	32-bit ARM® Cortex-M4
Memory	Programs and configuration parameters are stored in nonvolatile memory; auto restart on power failure
RTC	Real time clock with (capacitor) power backup for 72 hours ("C" model only) for network time synchronization or full stand-alone operation

Indicators and Isolation

LED indicators	Power/status, EIO (CAN) communication, Ethernet status
MST/TP bulbs	One network bulb assembly indicates reversed polarity and isolates circuit
Switches	EOL (end of line) for MS/TP network and EIO (CAN bus)

Installation

Power

Supply voltage	24 VAC (50/60 Hz) or 24 VDC; –15%, +20%; Class 2 only; non-supervised (all circuits, including supply voltage, are power limited circuits)
Required power	14 VA, plus external loads
Wire size	12–24 AWG, copper, in a removable screw terminal block

Enclosure and Mounting

Weight	13.8 ounces (0.39 kg)
Case material	Green and black flame retardant plastic
Mounting	Direct mounting to panels or DIN rails

Environmental Limits

Operating	32 to 120° F (0 to 49° C)
Shipping	–40 to 160° F (–40 to 71° C)
Humidity	0 to 95% relative humidity (non-condensing)

Warranty, Protocol, and Approvals

Warranty

KMC Limited Warranty	5 years (from mfg. date code)

BACnet Protocol

Standard	Meets or exceeds the specifications in ANSI/ASHRAE BACnet Standard 135-2010 for Advanced Application Controllers
Type	BTL-certified as a B-AAC controller type

CAN (External Inputs Outputs) Protocol

CAN	CAN (Controller Area Network) bus on (EIO) terminals

Regulatory Approvals

UL	UL 916 Energy Management Equipment listed
	UL 864 Smoke Control Equipment listed (UUKL), 10th edition—for smoke control applications, see **Smoke Control Manual for KMC Conquest Systems**, P/N 000-035-18)
BTL	BACnet Testing Laboratory listed as Advanced Application Controller (B-AAC)
RoHS 2	RoHS 2 compliant
FCC	FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A*

*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. (NFC operation meets FCC compliance while the controller is in an unpowered state.)

ACCESSORIES

NOTE: For accessory details, see the respective product data sheets and installation guides.

Actuators

MEP-4xxx	Actuators, 25 to 90 in-lb., fail-safe and non-fail-safe
MEP-7xxx	Actuators, 180 and 320 in-lb., fail-safe and non-fail-safe

Communications

BAC-5051AE	BACnet router with dual Ethernet/IP and single MS/TP ports
HPO-0055	Replacement network bulb assembly (pack of 5)
HPO-5551	Router technician cable kit
HPO-9003	NFC Bluetooth/USB module (fob)
HSO-9001	Ethernet patch cable, 50 feet
HSO-9011	Ethernet patch cable, 50 feet, plenum rated
HSO-9012	Ethernet patch cable, 75 feet, plenum rated
KMD-5567	Network surge suppressor

I/O Expansion and Output Override Boards

CAN-5901	8-input, 8-output expansion module*
CAN-5902	16-input expansion module*
HPO-6701	Triac output w/ zero-cross switching (AC only)**
HPO-6702	0–10 VDC analog with adjustable override potentiometer
HPO-6703	Relay, NO contacts (AC/DC)
HPO-6704	4–20 mA DC current loop with adjustable override potentiometer**
HPO-6705	Relay, NC contacts (AC/DC)

***NOTE:** Up to four CAN-5900 series I/O expansion modules can be used with BAC-5900 series controllers to provide up to 74 physical (Room Sensor port and terminal block) inputs and up to 40 outputs.

****NOTE:** Only the HPO-6701 and HPO-6704 of the HPO-6700 series output override boards are approved for smoke control applications.

Miscellaneous Hardware

HCO-1103	Steel control enclosure (single controller) with DIN rail mounting, 10 x 7.5 x 2.5 inches (257 x 67 x 193 mm)
HCO-1035	Steel control enclosure, 20 x 24 x 6 inches (508 x 610 x 152 mm)*
HCO-1036	Steel control enclosure, 24 x 36 x 6 inches (610 x 914 x 152 mm)*
HPO-0063	Replacement output (override board) jumper, 2-pin (pack of 5)
HPO-9901	Controller replacement parts kit with terminal blocks (1 gray, 1 black, 2 green 3-terminal, 4 green 4-terminal, 2 green 5-terminal, 2 green 6-terminal) and DIN clips (2 small for router and 1 large for controllers)
KMD-5567	MS/TP suppressor module and terminal connector (required for EIA-485 terminals of MS/TP model controllers in smoke control applications)
SP-001	(KMC branded) screwdriver with a hex end (for NetSensor cover screws) and a flat blade end (for controller terminals)

***NOTE**: For smoke control applications, the controller must be mounted in a UL Listed FSCS enclosure or listed enclosure with minimum dimensions. The HCO-1035 and HCO-1036 are approved for such applications.

Room Sensors, Analog

STE-6010W10	Temperature sensor, white
STE-6014W10	Sensor with rotary setpoint dial, white
STE-6017W10	Sensor with rotary setpoint dial and override button, white
HPO-9005	Room sensor adapter allows the use of other sensors and optional setpoint potentiometers (with wire leads or terminal blocks) to be used instead of STE-601x sensor models with modular jacks

NOTE: Other STE-6000 series sensors are not fully compatible with the dedicated sensor port. However, various other models can be used with an HPO-9005 adapter or with the controller screw terminals. See the STE-6000 series data sheet for more information. For digital sensor information, see the STE-9000 series.

NOTE: To order the STE-601x sensor with light almond color instead of white, drop the W on the end of the model number (e.g., STE-6010W is white and STE-6010 is light almond).

Room Sensors, Digital (LCD Display)

STE-9000 Series	KMC Conquest NetSensor digital room temperature sensors for viewing, configuring, and optional humidity, occupancy, and CO_2 sensing
HPO-9001	NetSensor distribution module

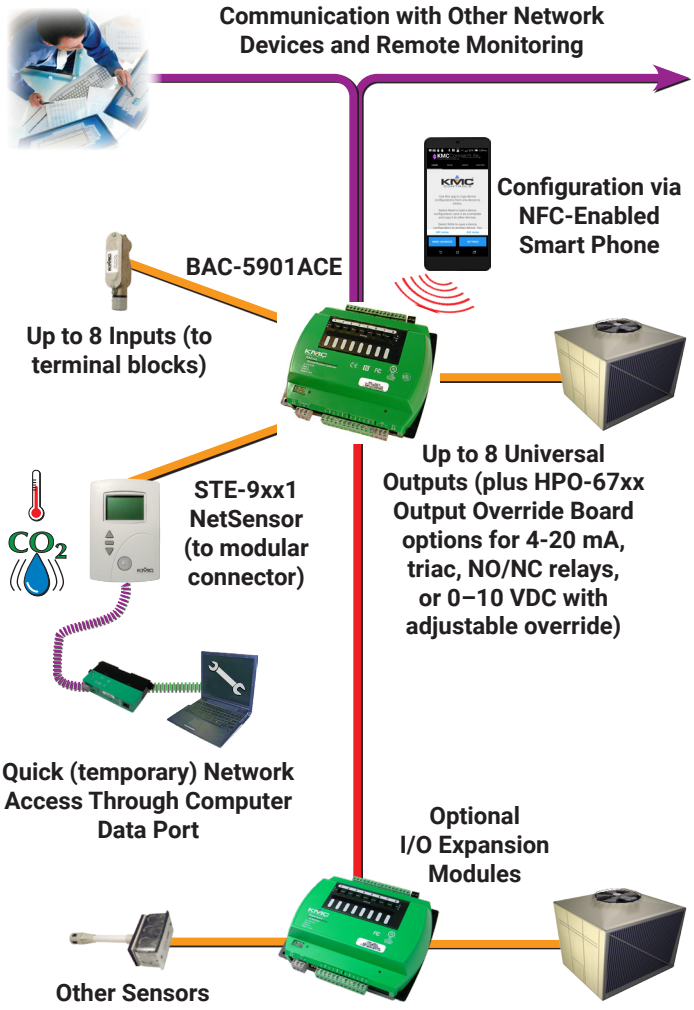
Sensors, Miscellaneous

STE-1405	DAT sensor with plenum-rated cable
STE-1451	OAT sensor

Transformers, 120 to 24 VAC

XEE-6111-050	50 VA, single-hub
XEE-6112-050	50 VA, dual-hub
XEE-6112-100	96 VA, dual-hub (approved for smoke control applications)

SAMPLE INSTALLATION



For more information about installation and operation, see:

- **BAC-5900 Series Controller Installation Guide**
- **KMC Conquest Controller Application Guide**
- **KMC Conquest Wiring: BAC-5900 Series Controllers (Video)**
- **Smoke Control Manual for KMC Conquest Systems**

SUPPORT

Additional resources for installation, configuration, application, operation, programming, upgrading, and much more are available on the web at **www.kmccontrols.com**. Log-in to see all available files.



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BAC-5900A Series Controller

Installation Guide

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INTRODUCTION

Complete the following steps to install a KMC Conquest BAC-5900A Series BACnet General Purpose Controller. For controller specifications, see the **data sheet** at **kmccontrols.com**. For additional information, see the **KMC Conquest Controller Application Guide**.

MOUNT CONTROLLER

NOTE: Mount the controller inside a metal enclosure for RF shielding and physical protection.

NOTE: Input accuracy can be directly affected by both internal and external factors. Pay close attention to installation best practices, mount product and temperature measuring devices and other input devices away from outside walls and drafts that can Interfere with accurate measurements.

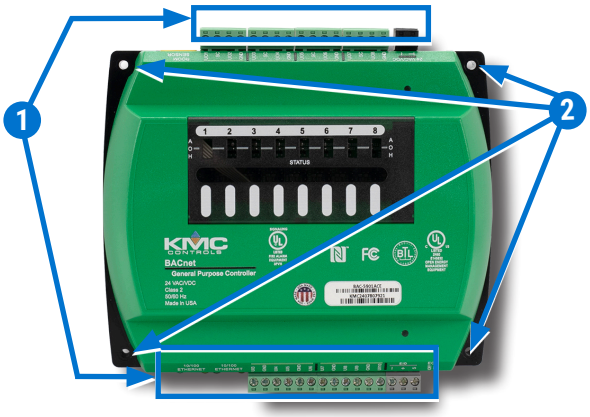
NOTE: To mount the controller with **screws** on a flat surface, complete the steps in **On a Flat Surface on page 1**. Or to mount the controller on a 35 mm **DIN rail** (such as integrated in an **HCO-1103** enclosure), complete the steps in **On a DIN Rail on page 1**.

On a Flat Surface

1. Position the controller on a flat surface so that the color-coded **terminal blocks** (1) are easy to access for wiring after the controller is mounted.

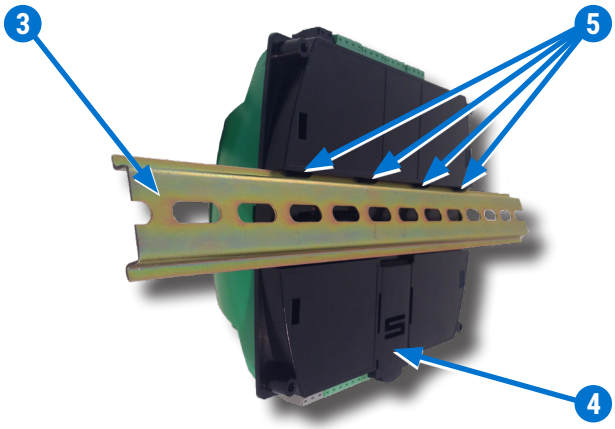
   NOTE: The black terminals are for power. The green terminals are for inputs and outputs. The gray terminals are for communication.

2. Secure a #6 sheet metal screw through **each corner** (2) of the controller.



On a DIN Rail

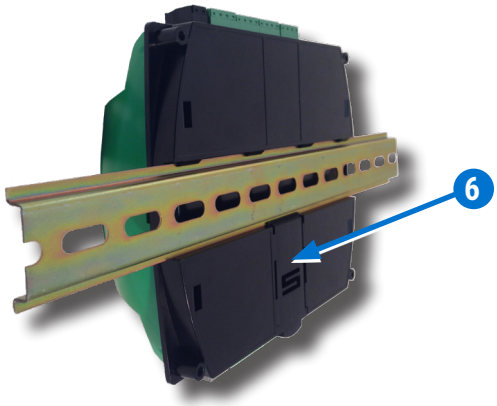
1. Position the **DIN rail** (3) so that the color-coded terminal blocks are easy to access for wiring after the controller is mounted.
2. Pull out the **DIN latch** (4) until it clicks once.
3. Position the controller so that the top **four tabs** (5) of the back channel rest on the DIN rail.



4. Lower the controller against the DIN rail.

5. Push in the **DIN latch** 6 to engage the rail.

   NOTE: To remove the controller, pull the DIN latch until it clicks once and lift the controller off the DIN rail.

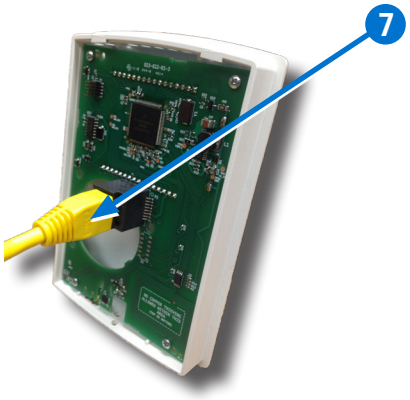


CONNECT SENSORS AND EQUIPMENT

NOTE: A digital **STE-9000 Series NetSensor** can be used for configuring the controller (see **Configure/Program the Controller on page 7**). After the controller has been configured, an **STE-6010**, **STE-6014**, or **STE-6017** analog sensor can be connected to the controller in place of the NetSensor. See the relevant installation guide for additional details.

NOTE: See **Sample (BAC-5900A) Wiring on page 8** for more information.

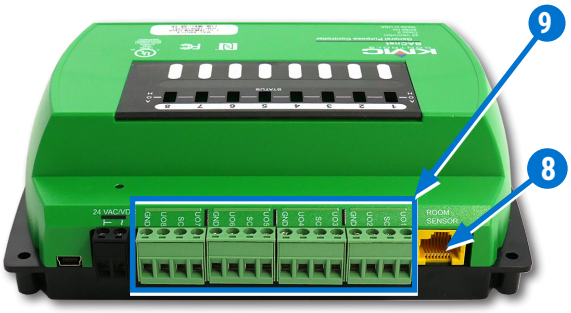
1. Plug an **Ethernet patch cable** 7 connected to an STE-9000 Series or STE-6010/6014/6017 sensor into the (yellow) **ROOM SENSOR** port 8 of the controller.



NOTE: The Ethernet patch cable should be a maximum of 150 feet (45 meters).

⚠ CAUTION

On Conquest "E" models, do NOT plug a cable meant for Ethernet communications into the Room Sensor port! The Room Sensor port powers a NetSensor, and the supplied voltage may damage an Ethernet switch or router.



2. Verify the controller is not connected to power.

3. Wire any additional sensors to the **green (input) terminal blocks** 9. See **Sample (BAC-5900A) Wiring on page 8**.

   NOTE: Wire sizes 12–24 AWG can be clamped together into each terminal.

   NOTE: No more than two 16 AWG wires can be joined at a common point.



4. Connect equipment to the **green (output) terminals** 10. See **Sample (BAC-5900A) Wiring on page 8** and BAC-5900A series videos on the **KMC Conquest Controller Wiring** playlist.

⚠ CAUTION

Do NOT connect 24 VAC to any output without first installing an HPO-6701, HPO-6703, or HPO-6705 override board first!

INSTALL (OPTIONAL) OVERRIDE BOARDS

NOTE: Install output override boards for enhanced output options, such as manual control, using large relays, or for devices that cannot be powered directly from a standard output.

1. Verify the controller is not connected to power.

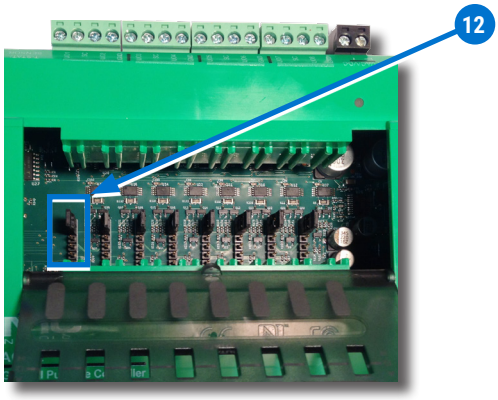
⚠ CAUTION

Connecting 24 VAC or other signals that exceed the operation specifications of the controller before an override board is installed will damage the controller.

2. Open the **plastic cover** 11.

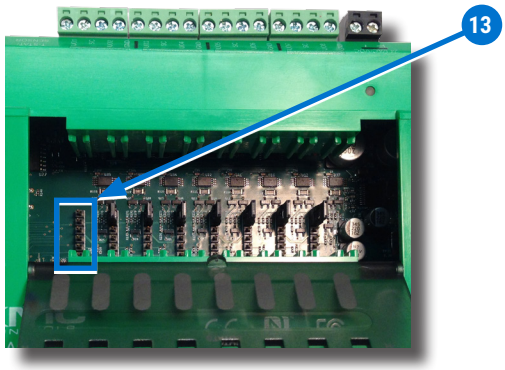


3. Remove the **jumper** 12 from the slot in which the override board will be installed.

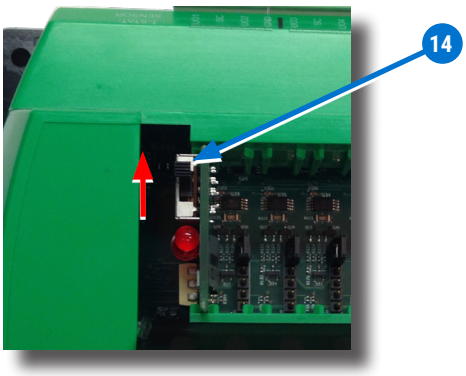


NOTE: Each of the eight override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Install the override board in the slot in which the jumper was removed 13.



NOTE: Position the board with the **selection switch** 14 towards the top of the controller.

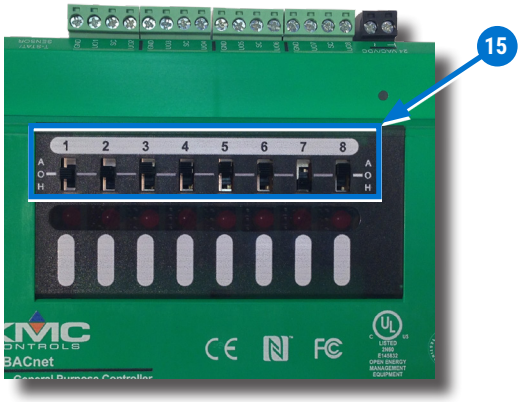


5. Close the plastic cover.

6. Move the **A-O-H selection switch** 15 on the override board to the appropriate position.

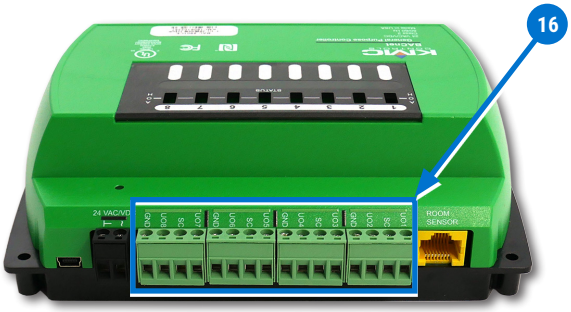
NOTE: A = Automatic (Controller Operated)
O = Off

H = Hand (On)



NOTE: For more information, see the **HPO-6700 Series** installation guide and the HPO-6700 series videos in the **KMC Conquest Controller Wiring** playlist.

7. Wire the output device to the corresponding **green (output) terminal block** 16 of the override board.



NOTE: HPO-6701 triac and HPO-6703/6705 relay board circuits use the Switched Common **SC** terminal—not the Ground Common **GND** terminal.

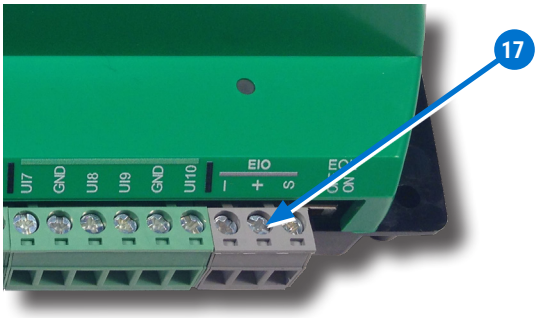
NOTE: HPO-6701 triac outputs are for 24 V**AC** only.

CONNECT (OPT.) EXPANSION MODULES

NOTE: Up to four CAN-5901 I/O expansion modules can be connected in series (daisy-chained) to a BAC-5900A series controller to add additional inputs and outputs.

1. Wire the **gray EIO (Expansion Input Output) terminal block** 17 of the BAC-5900A series controller to the **gray EIO terminal block** of the CAN-5901.

NOTE: See the **CAN-5901 I/O Expansion Module Installation Guide** for details.



CONNECT (OPT.) ETHERNET NETWORK

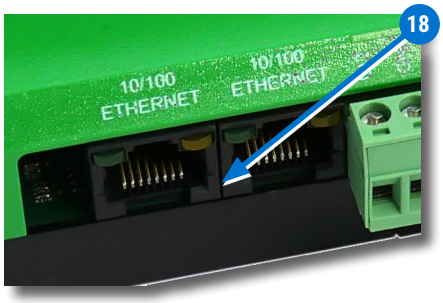
1. For a BAC-5901AC**E**, connect an **Ethernet patch cable** 7 to the **10/100 ETHERNET port** 18.

⚠ CAUTION

On Conquest "E" models, do NOT plug a cable meant for Ethernet communications into the Room Sensor port! The Room Sensor port powers a NetSensor, and the supplied voltage may damage an Ethernet switch or router.

NOTE: The Ethernet patch cable should be T568B Category 5 or better and a maximum of 328 feet (100 meters) between devices.

NOTE: BAC-xxxxACE models have **dual Ethernet ports** 18, enabling daisy-chaining of controllers. See the **Daisy-Chaining Conquest Ethernet Controllers Technical Bulletin** for more information.



CONNECT (OPTIONAL) MS/TP NETWORK

1. For a BAC-5901AC, connect the network to the **gray BACnet MS/TP terminal block** 19.

NOTE: Use 18 gauge AWG shielded twisted pair cable with maximum capacitance of 51 picofarads per foot (0.3 meters) for all network wiring (Belden cable #82760 or equivalent).

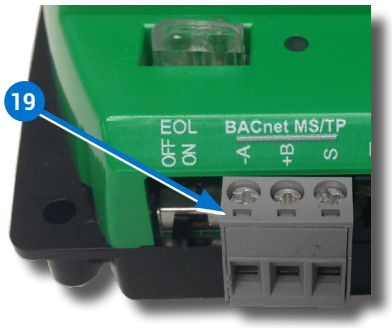
A. Connect the **–A** terminals in parallel with all other **–A** terminals on the network.

B. Connect the **+B** terminals in parallel with all other **+B** terminals on the network.

C. Connect the **shields** of the cable together at each device using a **wire nut** or the **S** terminal on KMC controllers.

NOTE: For more information, see **Sample (BAC-5900A) Wiring on page 8** and the BAC-5900 series videos in the **KMC Conquest Controller Wiring** playlist.

2. Connect the cable shield to a good earth ground at **one end only**.



NOTE: For principles and good practices when connecting an MS/TP network, see **Planning BACnet Networks (Application Note AN0404A)**.

SELECT END OF LINES (EOL)

NOTE: EOL switches are shipped in the OFF position.

1. If the controller is at either end of a **BACnet MS/TP** network (only one wire under each terminal), turn that **EOL switch** 20 to **ON**.

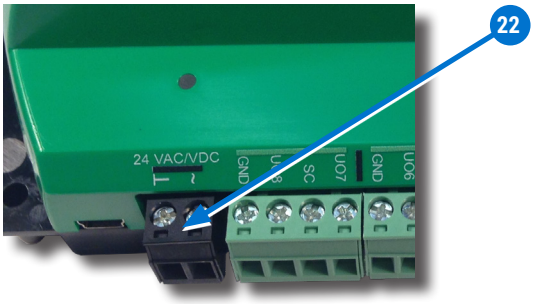
2. If the controller is at the end of an **EIO** (Expansion Input Output) network, turn that **EOL switch** 21 to **ON**.



CONNECT POWER

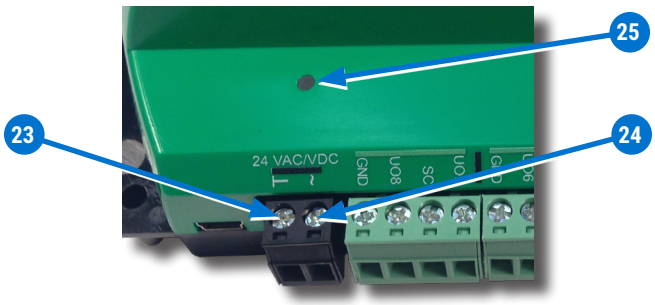
NOTE: Follow all local regulations and wiring codes.

1. Connect a 24 VAC, Class-2 transformer to the **black power terminal block** 22 of the controller.



A. Connect the neutral side of the transformer to the controller's **common terminal** 23.

B. Connect the AC phase side of the transformer to the controller's **phase terminal** 24.



NOTE: Connect only one controller to each 24 VAC, Class-2 transformer with 12–24 AWG copper wire.

NOTE: Use either shielded connecting cables or enclose all cables in conduit to maintain RF emissions specifications.

NOTE: To use **DC** power supply instead of AC, see the Power (Controller) Connections section of the **KMC Conquest Controller Application Guide**.

NOTE: For more information, see **Sample (BAC-5900A) Wiring on page 8** and the BAC-5900 series videos in the **KMC Conquest Controller Wiring** playlist.

POWER AND COMMUNICATION STATUS

The **status LEDs** indicate power connection and network communication. The following descriptions detail their activity during **normal operation** (at least 5 to 20 seconds **after** power-up/initialization or restart).

NOTE: If both the green READY LED and the amber COMM LED remain OFF, check the power and cable connections to the controller.

Green READY LED 25

After controller power-up or restart is complete, the READY LED flashes steadily about once per second, indicating normal operation.

Amber (BACnet MS/TP) COMM LED 26

- During normal operation, the COMM LED flickers as the controller receives and passes the token over the BACnet MS/TP network.
- When the network is **not** connected or communicating properly, the COMM LED flashes more slowly (about once a second).

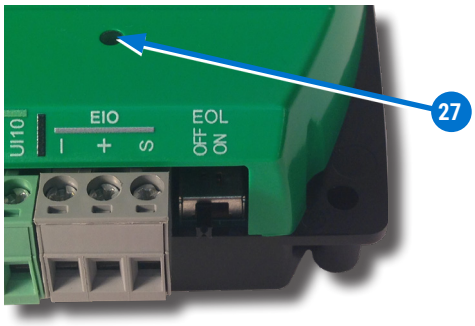


Green (EIO) COMM LED 27

The **Expansion Input Output (EIO) status LED** indicates EIO network communication with one or more CAN-5901 expansion modules. After controller power-up or restart, the LED flickers as it receives and passes the token:

- The EIO LED flashes when the controller is communicating with the EIO network
- The EIO LED remains OFF when the (powered) controller is **not** communicating with the EIO network. Check the power and EIO network connections.

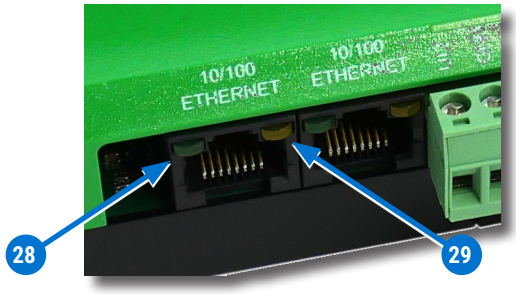
NOTE: See the **CAN-5901 I/O Expansion Module Installation Guide** for more information.



Green ETHERNET LED 28

The **Ethernet status LEDs** indicate network connection and communication speed.

- The green Ethernet LED is ON when the controller is communicating with the network.
- The green Ethernet LED is OFF when the (powered) controller is **not** communicating with the network.



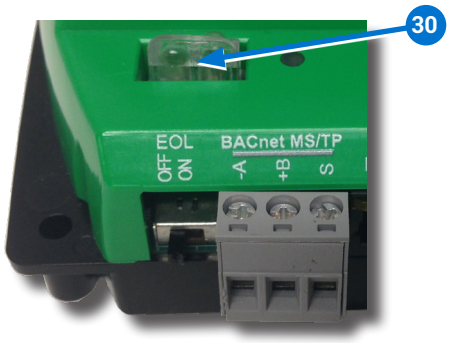
Amber ETHERNET LED 29

- The amber Ethernet LED flashes when the controller is communicating with a 100BaseT Ethernet network.
- The amber Ethernet LED remains OFF when the (powered) controller is communicating with the

network at only **10** Mbps (instead of 100 Mbps).

NOTE: If both the green and amber Ethernet LEDs remain OFF, check the power and network cable connections.

MS/TP NETWORK ISOLATION BULBS



The two **MS/TP network isolation bulbs** 30 serve three functions:

- Removing the (**HPO-0055**) bulb assembly opens the MS/TP circuit and isolates the controller from the network.
- If one or both bulbs are ON, the network is improperly phased. This means the ground potential of the controller is not the same as other controllers on the network. If this happens, fix the wiring. See **Connect (Optional) MS/TP Network on page 4**.
- If the voltage or current on the network exceeds safe levels, the bulbs blow, opening the circuit. If this happens, fix the problem and replace the bulb assembly.

CONFIGURE/PROGRAM THE CONTROLLER

See the table for the most relevant KMC Controls tool for configuring, programming, and/or creating graphics for the controller. See the tools' documents or Help systems for more information.

NOTE: After the controller has been configured, an **STE-6010/6014/6017 series** analog sensor can be connected to the controller in place of an **STE-9000 series** digital NetSensor.

NOTE: A BAC-5901AC**E** can be configured by connecting an HTML5-compatible web browser to the controller's default IP address (192.168.1.251). Refer to the **Conquest Ethernet Controller Configuration Web Pages Application Guide** for more information about the built-in configuration web pages.

SETUP PROCESS			KMC CONTROLS TOOL
Configuration	**Programming (Control Basic)**	**Web Page Graphics***	
✓			Conquest NetSensor
✓			Internal configuration web pages in Conquest Ethernet "E" models**
✓			KMC Connect Lite™ (NFC) app***
✓	✓		KMC Connect™ software
✓****	✓****	✓	TotalControl™ software
✓	✓		KMC Converge™ module for Niagara Workbench
		✓	KMC Converge™ **GFX** module for Niagara Workbench

*Custom graphical user-interface web pages can be hosted on a remote web server, but not in the controller.

Conquest Ethernet-enabled "E" models with the latest firmware can be configured with an HTML5 compatible web browser from pages served from within the controller. For information, see the **Conquest Ethernet Controller Configuration Web Pages Application Guide.

***Near Field Communication via enabled smart phone or tablet running the KMC Connect Lite app.

****Full configuration and programming of KMC Conquest controllers is supported starting with TotalControl™ ver. 4.0.

SAMPLE (BAC-5900A) WIRING

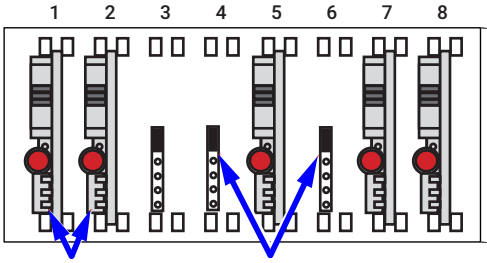
(General Purpose Applications)

CAUTION: Do NOT connect 24 VAC to the outputs unless an HPO-6701, HPO-6703, or HPO-6705 are installed!

NOTE: Connect the **STE-9xxx** (or **STE-6010/6014/6017** with no ventilation control) sensor to the Room Sensor port using a max. of 150 feet of Ethernet patch cable.

NOTE: See the **KMC Conquest Controller Application Guide** for information about switched commons (SC), using VDC power, and other issues.

NOTE: To use an **override board** instead of the default universal output, remove the jumper and insert a board in that slot. For more information, see the installation guide for the HPO-6700 output override board series.



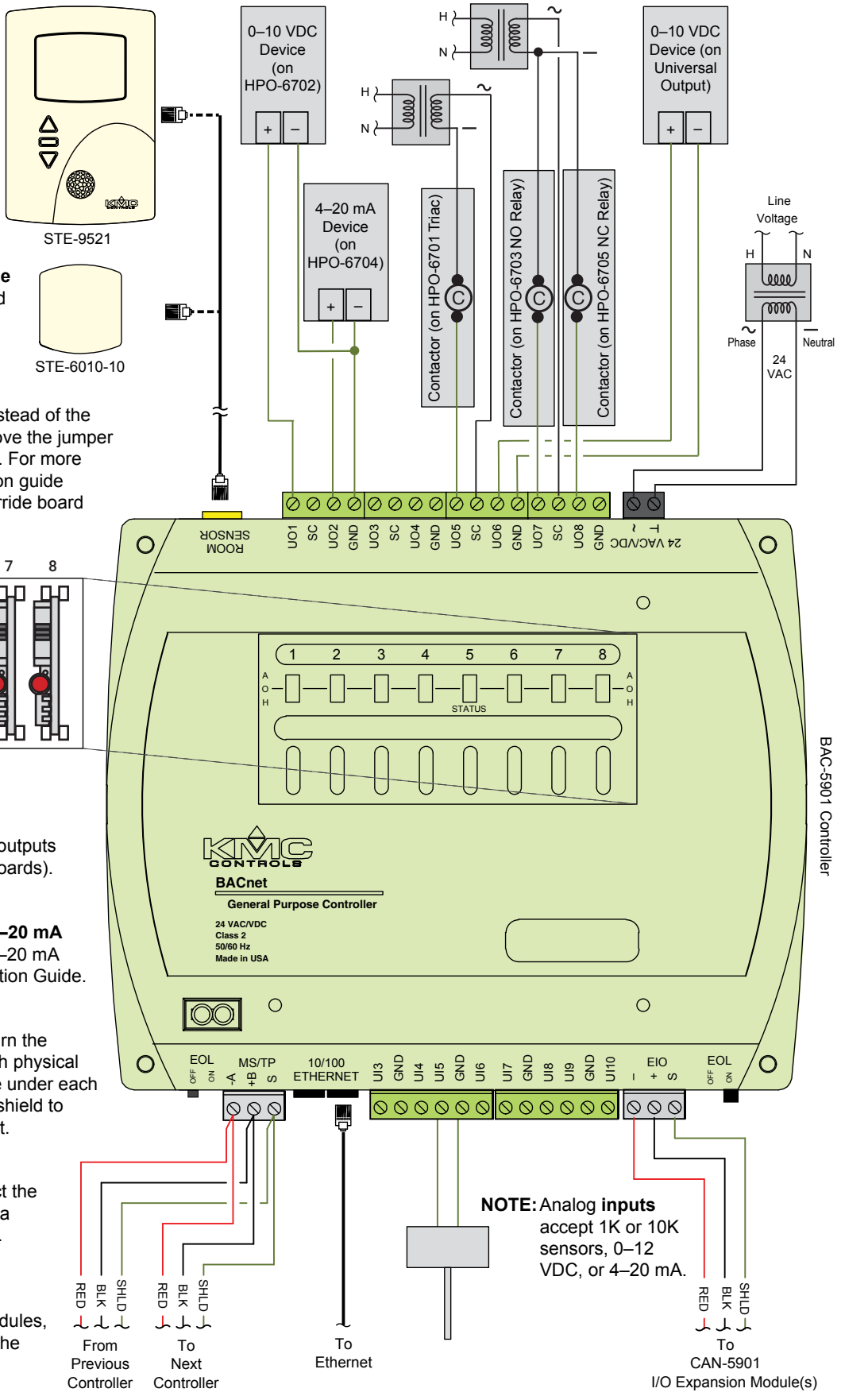
NOTE: Use 24 V**AC** (only) with triac outputs (HPO-6701 output override boards).

NOTE: For more information about **4–20 mA** inputs and outputs, see the 4–20 mA Wiring for Controllers Application Guide.

NOTE: For **EIO** and **MS/TP** wiring, turn the End Of Line switch ON at both physical ends of the network (one wire under each terminal). Connect the cable shield to earth ground at only one point.

NOTE: For **Ethernet** models, connect the controller to the network with a standard Ethernet patch cord.

NOTE: For more information about connections to expansion modules, see the installation guide for the **CAN-5901**.



NOTE: Analog **inputs** accept 1K or 10K sensors, 0–12 VDC, or 4–20 mA.

REPLACEMENT PARTS

HPO-0055	Replacement Network Bulb Module for Conquest Controllers, Pack of 5
HPO-9901	Conquest Hardware Replacement Parts Kit

NOTE: HPO-9901 includes the following:

Terminal Blocks	DIN Clips
(1) Black 2 Position	(2) Small
(2) Grey 3 Position	(1) Large
(2) Green 3 Position	
(4) Green 4 Position	
(2) Green 5 Position	
(2) Green 6 Position	

NOTE: See the **Conquest Selection Guide** for more information about replacement parts and accessories.

IMPORTANT NOTICES

The material in this document is for information purposes only. The contents and the product it describes are subject to change without notice.

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The KMC Connect Lite™ app for NFC configuration is protected under United States Patent Number 10,006,654. Pat. https://www.kmccontrols.com/patents/

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BAC-9300A Series

BACnet Unitary Controllers (B-AAC)

DESCRIPTION

KMC Conquest™ BAC-9300A series controllers are designed to operate unitary and terminal equipment. The integrated alarming, scheduling, and trending enable these BACnet Advanced Application Controllers to be powerful edge devices for the modern smart building ecosystem.

The factory-supplied programming covers common unitary applications. The controllers feature simple, menu-driven setup choices using an STE-9000 series digital sensor, which can be installed permanently as the room sensor or used temporarily as a technician's service tool.

Alternately, quick configuration of controller properties can be done using NFC (Near Field Communication) from a smart phone, tablet, or computer (using the KMC Connect Lite™ app) while the controller is unpowered.

The Ethernet-enabled BAC-93x1AC***E*** models can also be configured by connecting an HTML5-compatible web browser to the built-in configuration web pages.

To meet the most demanding building automation custom requirements, these controllers are also fully programmable. Custom configuration and programming, with wizards for application programming selection/configuration, are enabled by KMC Connect™ software and the KMC Converge™ module for Niagara Workbench.

KMC Converge and TotalControl™ software additionally provide the capability of creating custom graphical web pages (hosted on a remote web server) to use as a custom user-interface for the controllers.

(BAC-9301ACE Shown)



KMC Conquest™ Automation Hardware

USA MADE · BTL · FC · c UL US LISTED · RoHS COMPLIANT LEAD FREE

APPLICATIONS

Can be used with the following types of unitary equipment:

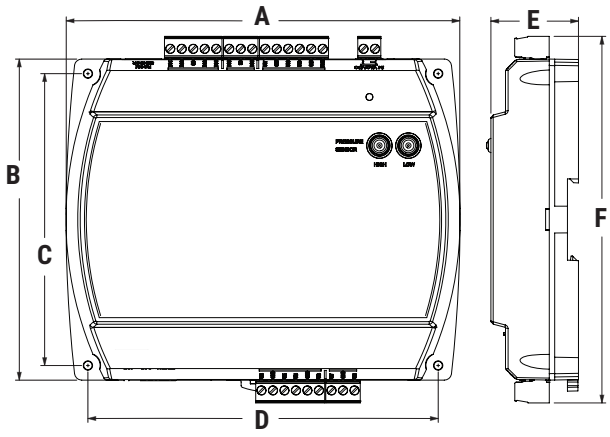
- Air handling units (AHU)
- Chilled beams
- Constant air volume (CAV) with external actuator
- Fan coil units (FCU)
- Heat pump units (HPU)
- Roof top units (RTU)
- Unit ventilators
- Variable air volume (VAV) with external actuator

(Some applications require custom programming. See also **Sample Installation on page 6**.)

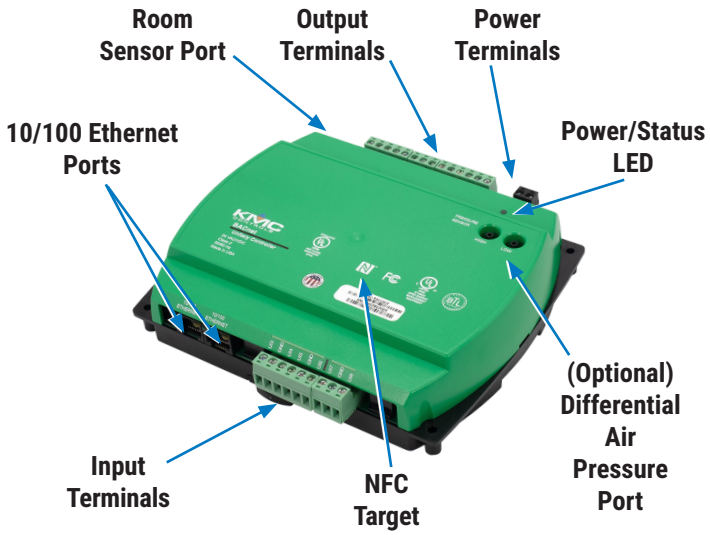
MODELS

APPLICATIONS	INPUTS	OUTPUTS	FEATURES				MODEL
			Air Pressure Sensor (Input)	Real Time Clock (RTC)	Ethernet Port	MS/TP Port	
RTU, HPU, FCU, AHU, and unit ventilator	1 opt. air pressure sensor and 8 (total) standard: • 2 analog (temp. sensor port) • 6 universal inputs (software configurable as analog, binary, or accumulator on terminals)	10 total: • 6 triacs (binary) • 4 universal (software configurable as analog or binary)				✓	**BAC-9301A**
VAV/CAV (with external tri-state actuator), RTU/ HPU static pressure monitoring/control				✓		✓	**BAC-9301AC**
				✓	✓		**BAC-9301ACE**
			✓			✓	**BAC-9311A**
			✓	✓		✓	**BAC-9311AC**
			✓	✓	✓		**BAC-9311ACE**

SPECIFICATIONS



DIMENSIONS					
A	6.744 inches	171 mm	**D**	6.000 inches	152 mm
B	5.500 inches	140 mm	**E**	1.500 inches	38 mm
C	5.000 inches	127 mm	**F**	6.279 inches	159 mm



TERMINAL COLOR CODE	
Black	24 VAC/VDC Power
Green	Inputs and Outputs

Inputs and Outputs

Inputs, Universal (6 on Terminal Blocks)

Universal inputs	Configurable as analog, binary, or accumulator objects
Termination	1K and 10K ohm sensors, 0–12 VDC, or 0–20 mA (without need for an external resistor)
Resolution	16-bit analog-to-digital conversion
Protection	Overvoltage protection (24 VAC, continuous)
Wire size	12–24 AWG, copper, in removable screw terminal blocks

Input, Dedicated Room Sensor Port

Connector	Modular connector for STE-9xx1 series digital wall sensors or STE-6010/6014/6017 analog temperature sensors
Cable	Uses standard Ethernet patch cable up to 150 feet (45 meters)

Input, Integrated Air Pressure Sensor (BAC-9311ACE)

D pressure range	0 to 2" wc (0 to 500 Pa)
Sensor accuracy	±4.5% of the reading or (when near zero) 0.0008" wc (0.2 Pa), whichever is greater (@ 25° C); internally linearized and temperature compensated
Connections	Barbed for 1/4 inch FR (Flame Retardant) tubing

Outputs, Universal (4 on Terminal Blocks)

Universal outputs	Configurable as an analog (0 to 12 VDC) or binary object (0 or 12 VDC, on/off)
Power/protection	Each short-circuit protected universal output capable of driving up to 100 mA (at 0–12 VDC) or 100 mA total for all outputs
Resolution	12-bit digital-to-analog conversion
Wire size	12–24 AWG, copper, in removable screw terminal blocks

Outputs, Triac (6 Binary)

Triac outputs	Optically isolated zero-crossing triac output configured as a binary object
Power	Maximum switching 24 VAC at 1.0 A for each output; maximum total for controller is 3.0 A
Wire size	12–24 AWG, copper, in removable screw terminal blocks

Communication Ports

MS/TP (optional)	One EIA-485 port (removable terminal block) for BACnet MS/TP, operating at 9.6, 19.2, 38.4, 57.6, 76.8, or 115.2 kilobaud; max. length of up to 4,000 feet (1,200 meters) of 18 AWG shielded, twisted-pair, no more than 51 pf/ft (167 pf/m); use repeaters for longer distances
Ethernet (optional)	Two 10/100BaseT Ethernet connectors for BACnet IP, Foreign Device, and Ethernet 802.3 (ISO 8802-3); segmentation supported; up to 328 ft (100 m) between controllers (using T568B Category 5 or better cable)
NFC	NFC (Near Field Communication) up to 1 inch (2.54 cm) from the top of the enclosure
Room sensor	Modular STE connection jack for STE-9000 series digital sensors and STE-6010/6014/6017 analog sensors

Configurability

OBJECTS*	MAXIMUM #	
Inputs and Outputs		
Analog, binary, or accumulator input	8 for BAC-9301	9 for BAC-9311
Analog or binary output	10	
Values		
Analog value	120	
Binary value	80	
Multi-state value	40	
Program and Control		
Program (Control Basic)	10	
PID loop	10	
Schedules		
Schedule	2	
Calendar	1	
Logs		
Trend log	20	
Trend log multiple (must be created)	4 (default 0)	
Alarms and Events		
Notification class	5	
Event enrollment	40	
Tables		
Input tables	20	
Control Basic tables	20	

*Configuration allows creation and deletion of objects (maximum number of objects shown). The number and configuration of default objects depends on the selected application. For lists of default objects, see the **KMC Conquest Controller Application Guide**. See also the PIC statement for all supported BACnet objects.

Configuring, Programming, and Designing

SETUP PROCESS			KMC CONTROLS TOOL
Config-uration	Programming (Control Basic)	Web Page Graphics*	
✓			Conquest NetSensor
✓			Internal configuration web pages in Conquest Ethernet "E" models**
✓			KMC Connect Lite™ (NFC) app***
✓	✓		KMC Connect™ software
✓****	✓****		TotalControl™ software
✓	✓		KMC Converge™ module for Niagara WorkBench
		✓	KMC Converge **GFX** module for Niagara WorkBench

*Custom graphical user-interface web pages can be hosted on a remote web server, but not in the controller.

Conquest Ethernet-enabled "E" models with the latest firmware can be configured with an HTML5 compatible web browser from pages served from within the controller. For information, see the **Conquest Ethernet Controller Configuration Web Pages Application Guide.

***Near Field Communication via enabled smart phone or tablet running the KMC Connect Lite app.

****Full configuration and programming of KMC Conquest controllers is supported starting with TotalControl ver. 4.0.

Hardware Features

Processor, Memory, and Clock

Processor	32-bit ARM® Cortex-M4
Memory	Programs and configuration parameters are stored in nonvolatile memory; auto restart on power failure
RTC	Real time clock with (capacitor) power backup for 72 hours ("C" model only) for network time synchronization or full stand-alone operation

Indicators and Isolation

LED indicators	Power/status and Ethernet status

Installation

Power

Supply voltage	24 VAC (50/60 Hz) or 24 VDC; –15%, +20%; Class 2 only; non-supervised (all circuits, including supply voltage, are power limited circuits)
Required power	8 VA, plus external loads
Wire size	12–24 AWG, copper, in a removable screw terminal block

Enclosure and Mounting

Weight	14 ounces (0.4 kg)
Case material	Green and black flame retardant plastic
Mounting	Direct mounting to panels or on DIN rails

Environmental Limits

Operating	32 to 120° F (0 to 49° C)
Shipping	–40 to 160° F (–40 to 71° C)
Humidity	0 to 95% relative humidity (non-condensing)

Warranty, Protocol, and Approvals

Warranty

KMC Limited Warranty	5 years (from mfg. date code)

BACnet Protocol

Standard	Meets or exceeds the specifications in ANSI/ASHRAE BACnet Standard 135-2010 for Advanced Application Controllers
Type	BTL-certified as a B-AAC controller type

Regulatory Approvals

UL	UL 916 Energy Management Equipment listed
	UL 864 Smoke Control Equipment listed (UUKL), 10th edition—for smoke control applications, see **Smoke Control Manual for KMC Conquest Systems**, P/N 000-035-18)
BTL	BACnet Testing Laboratory listed as Advanced Application Controller (B-AAC)
RoHS 2	RoHS 2 compliant
FCC	FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A*

*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. (NFC operation meets FCC compliance while the controller is in an unpowered state.)

ACCESSORIES

NOTE: For accessory details, see the respective product data sheets and installation guides.

Actuators

NOTE: See also the selection chart in the Connecting a Remote Actuator to a BAC-9311 section of the **KMC Conquest Controller Application Guide**.

MEP-4xxx	Actuators, 25 to 90 in-lb., fail-safe and non-fail-safe
MEP-7xxx	Actuators, 180 and 320 in-lb., fail-safe and non-fail-safe

Differential Air Pressure Sensors

SSS-1012	Sensor, 3-5/32 inches (80 mm) length
SSS-1013	Sensor, 5-13/32 in. (137 mm) length
SSS-1014	Sensor, 7-21/32 in. (194 mm) length
SSS-1015	Sensor, 9-29/32 in. (252 mm) length

Miscellaneous Hardware

HCO-1103	Steel control enclosure with DIN rail mounting, 10 x 7.5 x 2.5 inches (257 x 67 x 193 mm)
HCO-1035	Steel control enclosure, 20 x 24 x 6 inches (508 x 610 x 152 mm)*
HCO-1036	Steel control enclosure, 24 x 36 x 6 inches (610 x 914 x 152 mm)*
SP-001	Screwdriver (KMC branded) with a hex end (for NetSensor cover screws) and a flat blade end (for controller terminals)
HPO-9901	Controller replacement parts kit with terminal blocks (1 gray, 1 black, 2 green 3-terminal, 4 green 4-terminal, 2 green 5-terminal, 2 green 6-terminal) and DIN clips (2 small for router and 1 large for controllers)

***NOTE:** For smoke control applications, the controller must be mounted in a UL Listed FSCS enclosure or listed enclosure with minimum dimensions. The HCO-1035 and HCO-1036 are approved for such applications.

Network Communications

BAC-5051AE	BACnet router with single MS/TP and IP/Ethernet ports
HPO-0055	Replacement network bulb assembly (pack of 5)
HPO-5551	Router technician cable kit
HPO-9003	NFC Bluetooth/USB module (fob)
HSO-9001	Ethernet patch cable, 50 feet
HSO-9011	Ethernet patch cable, 50 feet, plenum rated
HSO-9012	Ethernet patch cable, 75 feet, plenum rated

Room Sensors, Analog

STE-6010W10	Temperature sensor, white
STE-6014W10	Sensor with rotary setpoint dial, white
STE-6017W10	Sensor with rotary setpoint dial and override button, white
HPO-9005	Room sensor adapter allows the use of other sensors and optional setpoint potentiometers (with wire leads or terminal blocks) to be used instead of STE-601x sensor models with modular jacks

NOTE: Other STE-6000 series sensors are not fully compatible with the dedicated sensor port. However, various other models can be used with an HPO-9005 adapter or with the controller screw terminals. See the STE-6000 series data sheet for more information. For digital sensor information, see the STE-9000 series.

NOTE: To order the STE-601x sensor with light almond color instead of white, drop the W on the end of the model number (e.g., STE-6010W is white and STE-6010 is light almond).

Room Sensors, Digital (LCD Display)

STE-9000 Series	KMC Conquest NetSensor digital room temperature sensors for viewing, configuring, and optional humidity, occupancy, and CO_2 sensing
HPO-9001	NetSensor distribution module

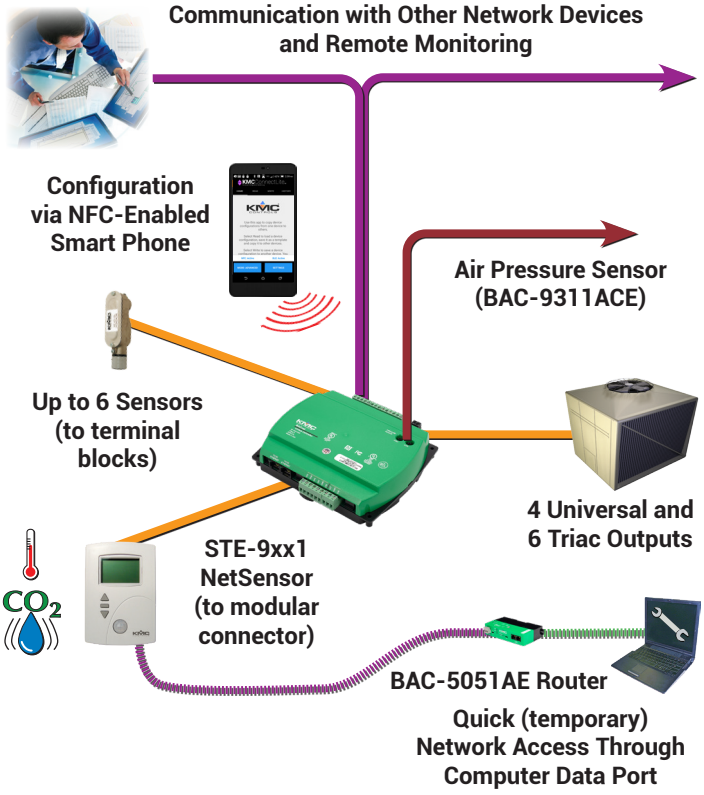
Sensors, Miscellaneous

STE-1405	DAT sensor with plenum-rated cable
STE-1451	OAT sensor

Transformers, 120 to 24 VAC

XEE-6111-050	50 VA, single-hub
XEE-6112-050	50 VA, dual-hub
XEE-6112-100	96 VA, dual-hub (approved for smoke control applications)

SAMPLE INSTALLATION



For more information about installation and operation, see:

- **BAC-9300 Series Controller Installation Guide**
- **KMC Conquest Controller Application Guide**
- **KMC Conquest Wiring: BAC-9300 Series Controllers (Video)**
- **Smoke Control Manual for KMC Conquest Systems**

SUPPORT

Additional resources for installation, configuration, application, operation, programming, upgrading, and much more are available on the web at **www.kmccontrols.com**. Log-in to see all available files.



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CAN-5900 Series Expansion Module

Installation Guide

CONTENTS

Introduction 1
Mount the Module 1
Connect the BAC-5900 Controller 2
Address the Modules 3
Set End Of Line (EOL) Switch 3
Connect Equipment 4
Install (Opt.) Override Boards 4
Connect Power 5
Power and Communication Status 6
Network Isolation Bulbs 7
Module Configuration 7
Replacement Parts 8
Important Notices 8
Sample Module Wiring 9

INTRODUCTION

Complete the following steps to install a KMC Conquest™ CAN-5900 Series Expansion Module that will be connected to a Conquest BAC-5900 Series Controller.

The **CAN-5901** has **8** inputs and **8** outputs. The **CAN-5902** has **16** inputs and no outputs.

NOTE: A CAN-5902 requires a BAC-5900 series controller with firmware version R1.2.0.9 or later.

For expansion module specifications, see the **data sheet** at **kmccontrols.com**. For additional information, see the **KMC Conquest Controller Application Guide**.

MOUNT THE MODULE

NOTE: Install the module in a metal enclosure for RF shielding and physical protection.

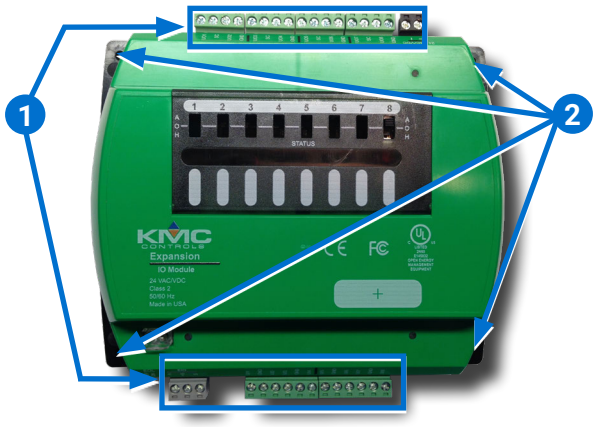
NOTE: To mount the module with **screws** on a flat surface, complete the steps in **On a Flat Surface on page 1**. Or to mount the module on a 35 mm **DIN rail** (such as integrated in an **HCO-1103** enclosure), complete the steps in **On a DIN Rail on page 1**.

On a Flat Surface

1. Position the module so that the color-coded **terminal blocks** (1) are easy to access for wiring.

   NOTE: The black terminals are for power. The green terminals are for inputs and outputs. The gray terminals are for communication.

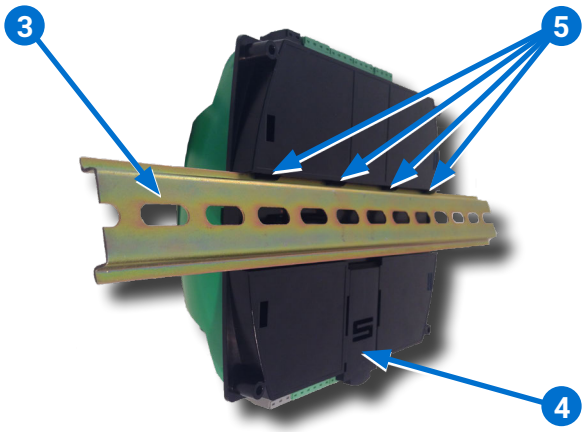
2. Screw a #6 sheet metal screw through each **corner** (2) of the module.



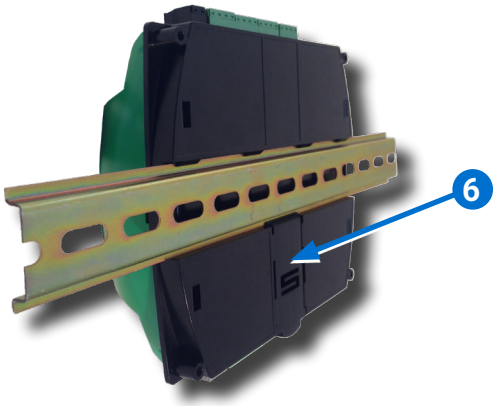
On a DIN Rail

1. Position the **DIN rail** (3) so that when the module is installed the color-coded terminal blocks are easy to access for wiring.
2. Pull out the **DIN Latch** (4) until it clicks once.
3. Position the module so that the top **four tabs** (5) of the back channel rest on the DIN rail.
4. Lower the module against the DIN rail.

5. Push in the **DIN Latch** 6 to engage the DIN rail.



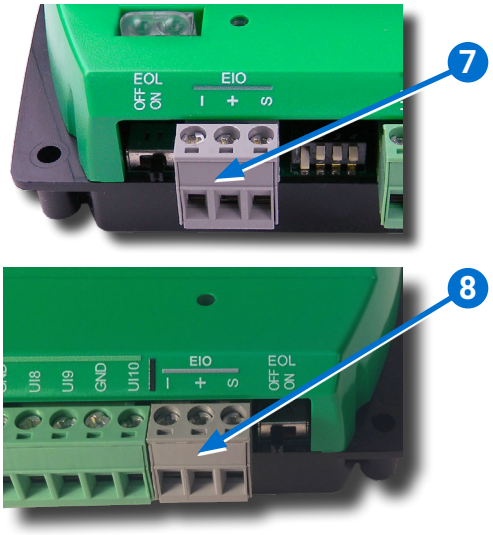
NOTE: To remove the module, pull the DIN Latch out until it clicks once and lift the module off the DIN rail.



CONNECT THE BAC-5900 CONTROLLER

NOTE: Four expansion modules can be connected in series (daisy chained) to a BAC-5900 series controller to add additional inputs and outputs.

1. Wire the **gray EIO (Expansion Input Output) terminal block** 7 of the module to the **gray EIO terminal block** 8 of the BAC-5900 series controller. See **Sample Module Wiring on page 9**.



NOTE: The module can be installed up to 200 feet (61 meters) away from the BAC-5900 controller. Up to four modules can be used.

NOTE: Use 18 gauge AWG shielded twisted pair cable with maximum capacitance of 51 picofarads per foot (0.3 meters) for all network wiring (Belden cable #82760 or equivalent).

A. Connect the **–** terminals in parallel with all other **–** terminals on the EIO network.

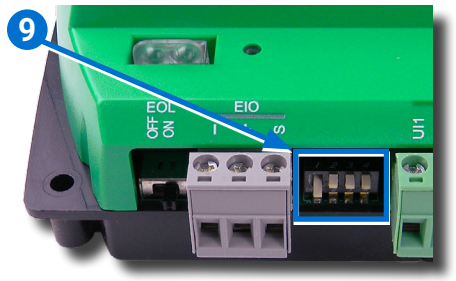
B. Connect the **+** terminals in parallel with all other **+** terminals on the EIO network.

C. Connect the **shields** of the cable together at each device using a wire nut or the S terminal on the controllers or modules.

2. Connect the cable shield to a good earth ground at **one end only**.

ADDRESS THE MODULES

The **address switches** 9 are used to identify the module's inputs and outputs.

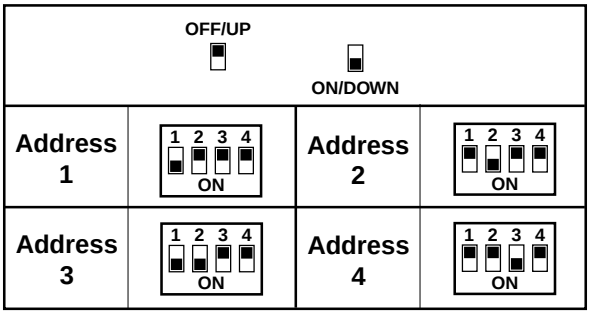


NOTE: When only one module is used, the address 1 (factory default) does not need to be changed. See the table below.

INPUT/OUTPUT ADDRESSES (CAN-5901)			
Module	**Inputs**	**Outputs**	**Address**
Controller	3–10	1–8	0
EIO_1	11–18	9–16	1 (default)
EIO_2	19–26	17–24	2
EIO_3	27–34	25–32	3
EIO_4	35–42	33–40	4

INPUT ADDRESSES (CAN-5902)			
Module	**Inputs**	**Outputs**	**Address**
Controller	3–10	NA	0
EIO_1	43–58		1 (default)
EIO_2	59–74		2
EIO_3	75–90		3
EIO_4	91–106		4

NOTE: Switch 4 should always be up (Off). Switches 1 through 3 should be configured for the appropriate address as shown in the graphic below.



NOTE: Input and output numbers must correspond with the appropriate module number set by the address switches. For example, if Inputs 19–26 and Outputs 17–24 are desired for a module, use the Address 2 switch positions.

NOTE: Address the modules in consecutive order if more than one module is used. If the modules are not addressed in consecutive order, gaps will exist between the input and output objects.

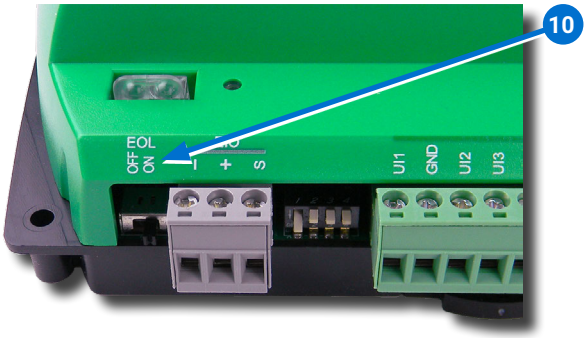
NOTE: One or more CAN-5901s can be mixed with one or more CAN-5902s. The addressing allows existing CAN-5901 input objects to remain the same if a CAN-5902 module is added later or even if a CAN-5902 replaces a CAN-5901.

MIXED MODULE EXAMPLE			
Module	**Inputs**	**Outputs**	**Address**
Controller	3–10	1–8	0
EIO_1 (CAN-590**2**)	43–58		1
EIO_2 (CAN-590**1**)	19–26	17–24	2
EIO_3 (CAN-590**2**)	75–90		3
EIO_4 (CAN-590**1**)	35–42	33–40	4

SET END OF LINE (EOL) SWITCH

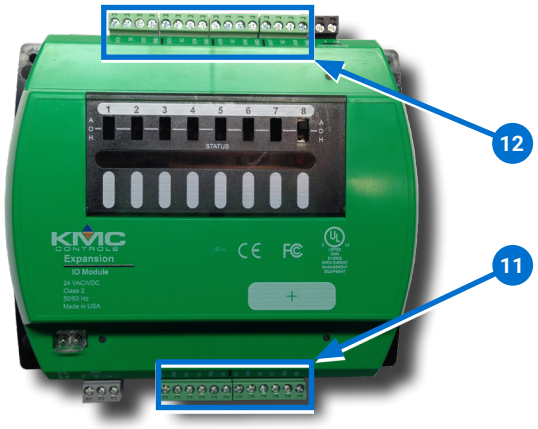
NOTE: The EOL switch is shipped from KMC in the OFF position.

1. If the module or controller is at either end of the EIO network (only one wire under the terminals), turn the **EOL switch** 10 to **ON**.



CONNECT EQUIPMENT

1. Verify the module is not connected to power.
2. Connect sensors to the **green (input) terminals** 11. See **Sample Module Wiring on page 9**.



NOTE: Wire sizes 12–24 AWG can be clamped in each terminal.

NOTE: No more than two 16 AWG wires can be joined at a common point.

3. Connect equipment (such as fans, heaters, and valves) to the **green (output) terminals** 12 (on CAN-5901 only).

NOTE: A CAN-590**2** has eight additional input terminals instead of output terminals.

⚠ CAUTION

Do NOT connect 24 VAC to any output without first installing an HPO-6701, HPO-6703, or HPO-6705 output override board!

INSTALL (OPT.) OVERRIDE BOARDS

NOTE: Install (optional) output override boards for enhanced output options, such as manual control, using large relays, or for devices that cannot be powered directly from a standard CAN-5901 output.

1. Verify the CAN-5901 is **not** connected to power.

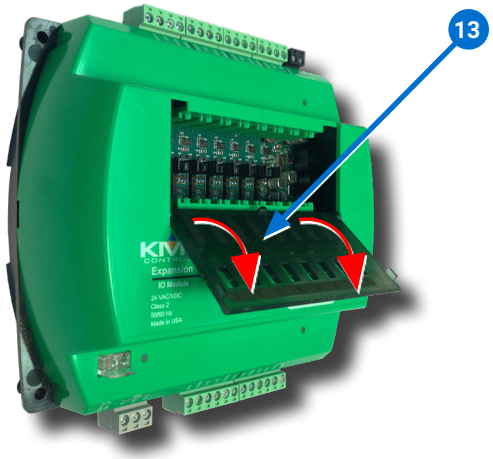
⚠ CAUTION

Connecting 24 VAC to an output before the appropriate override board is installed will damage the CAN-5901.

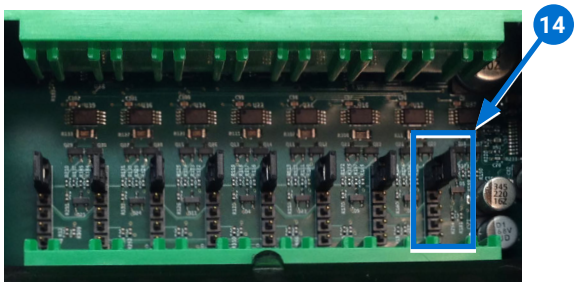
⚠ CAUTION

Connecting signals that exceed the operation specifications of the CAN-5901 may damage it.

2. Open the **plastic cover** 13.

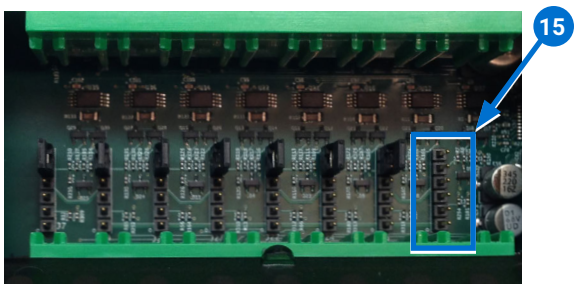


3. Remove the **jumper** 14 from the slot where the override board will be installed.

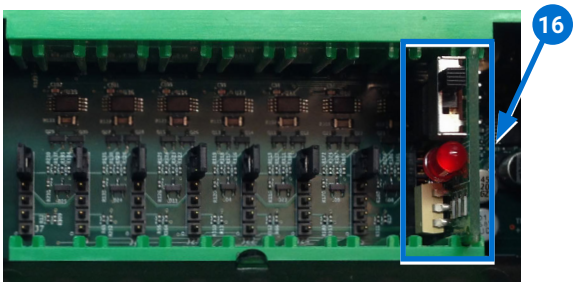


NOTE: Each of the eight override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Install the override board in the slot from which the jumper was removed 15.

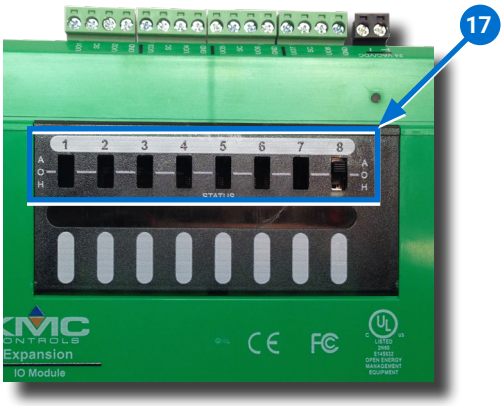


NOTE: Position the board with the **selection switch** 16 towards the top of the CAN-5901.



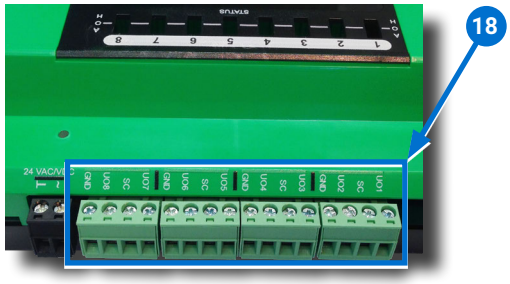
5. Close the plastic cover.
6. Move the **A-O-H selection switch** 17 on the override board to the appropriate position.

   NOTE: A = Automatic
   O = Off
   H = Hand (Manual On)



   NOTE: For more information about output override boards, see the **HPO-6700 Series.**

7. Wire the output device to the corresponding **green (output) terminal block** 18 of the override board.



NOTE: Wire the HPO-6701 triac and HPO-6703/6705 relay output override boards to the (Switched Common) **SC** terminal—**not** the (Ground Common) **GND** terminal.

CONNECT POWER

NOTE: Connect only one module to each 24 VAC, Class-2 transformer with 12–24 AWG copper wire.

NOTE: Modules are controlled by the BAC-5900 series controller. If they are on separate electrical circuits, the possibility exists that power could fail to the controller but remain on to the modules. Having the transformers for the controller and all modules on the same electrical circuit is recommended.

NOTE: If the **CAN-5901 loses EIO communication** with the BAC-5900 series controller, the CAN-5901 **retains the last present value for the outputs** until communication is restored or power is lost. When communication is restored, the outputs will go to whatever state the controller is commanding them to be at that time. (For CAN-5901 modules with firmware 0.0.0.1, about 30 seconds after communications loss, the module turns all of its outputs **off** until communication is restored.)

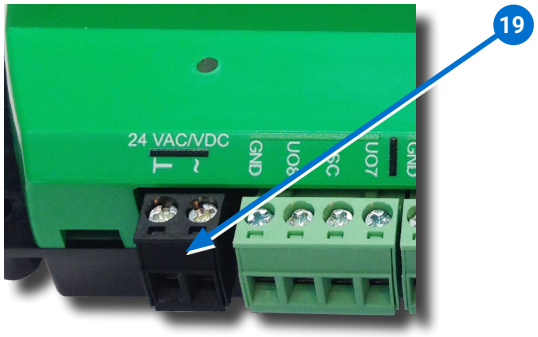
⚠ CAUTION

If the CAN-5901 will control a device that has a minimum required "off" time (e.g., a large compressor), for proper operation after a power failure, power the CAN-5901 from the same electrical circuit as the connected BAC-5900 series controller. The CAN-5901 should restart at the same time as the controller after a power failure.

NOTE: Follow all local regulations and wiring codes.

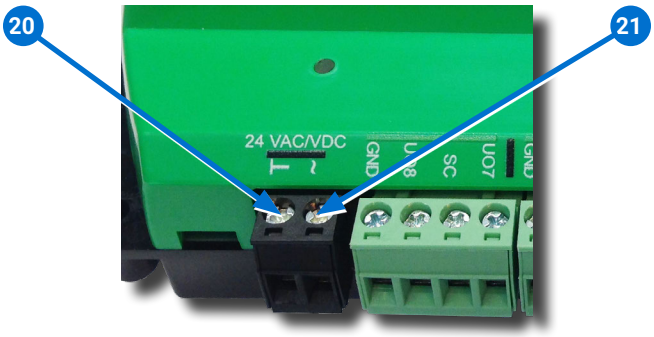
NOTE: Use either shielded connecting cables or enclose all cables in conduit to maintain RF emissions specifications.

8. Connect a 24 VAC, Class-2 transformer to the **black power terminal block** 19 of the module. See **Sample Module Wiring on page 9**.



   A. Connect the neutral side of the transformer to the **common terminal ⊥** 20.

   B. Connect the AC phase side of the transformer to the **phase terminal ~** 21.



POWER AND COMMUNICATION STATUS

The **status LEDs** indicate power connection and network communication.

NOTE: If both the READY and EIO LEDs remain OFF, check the power and connections to the controller.

READY LED 22

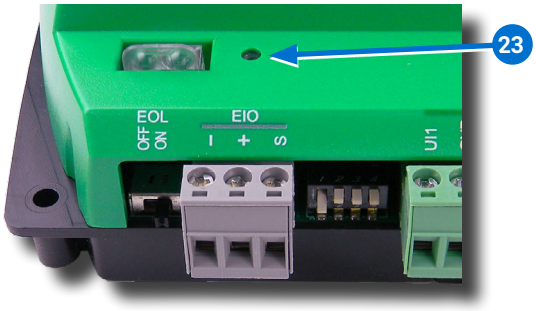
After module power-up or restart is complete, the READY LED flashes steadily about once per second, indicating normal operation.



EIO COMM LED 23

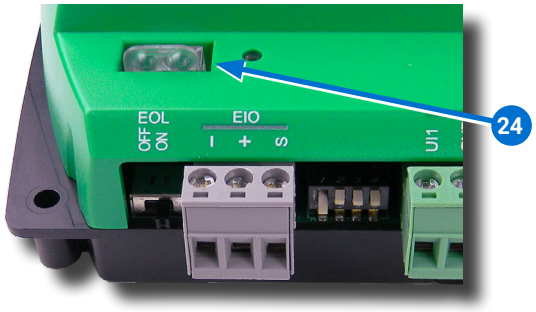
The **EIO communication status LED** next to the network bulb assembly indicates EIO network communication with the BAC-5900 series controller. The LED flickers as it receives and passes the token:

EIO COMM LED ON CAN-590X MODULE		
LED Activity	**Typical Status**	**Action**
Flashing rapidly	Connected and communicating with a controller and/or another module	None required
Flashing slowly	Connected but not communicating (silenced in [PRP140-x] EIO_0x proprietary object)	**Reset object**
Solid on	Not connected with an EIO network or a blown network isolation bulb (the LED might remain on or off, dependent on the timing of the interruption to the LED flashing cycle)	Check **wiring** and **bulb**
Off		
	No power to CAN-5901 if Ready LED is also off	**Check power**
EIO COMM LED ON BAC-590X CONTROLLER		
LED Activity	**Typical Status**	**Action**
Flashing	Communicating properly with expansion module(s)	None required
Off	Not communicating with any modules (possibly because of bad wiring, blown network isolation bulb, or silenced [PRP140-x] EIO_0x proprietary object)	Check **wiring**, **bulb**, and **object**
	No power if controller Ready LED is also off	**Check power**



NETWORK ISOLATION BULBS

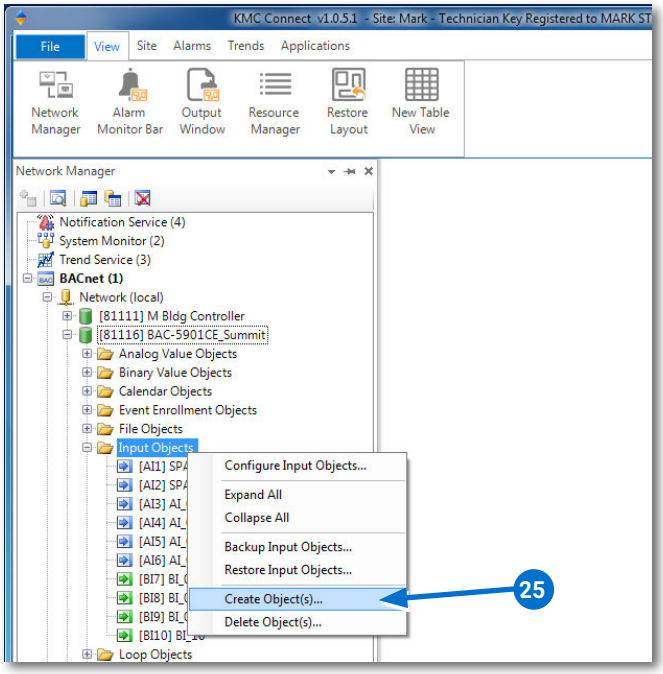
The two **network isolation bulbs** 24 serve three functions:



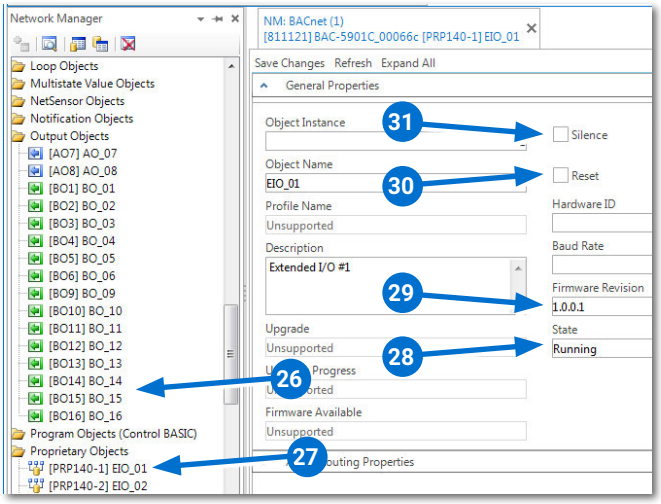
- Removing the (**HPO-0055**) bulb assembly opens the EIO circuit and isolates the module from the network.
- If one or both bulbs are ON, the network is improperly phased. This means the ground potential of the module is not the same as other modules or the controller on the network. If this happens, fix the wiring. (See **Connect the BAC-5900 Controller on page 2**.)
- If the voltage or current on the network exceeds safe levels, the bulbs blow, opening the circuit. If this happens, fix the problem and replace the bulb assembly.

MODULE CONFIGURATION

Input and output objects for the CAN-5900 series modules are **not** automatically created in the controller. Use KMC Connect, KMC Converge, or TotalControl to **create** 25 and configure input objects 11 and higher and output objects 9 and higher 26 (as needed) in the **connected BAC-5900 series controller**.



A CAN-5900 series module does not appear in the Network Manager of KMC Connect, KMC Converge, or TotalControl except as a proprietary object in the latest software.



With module firmware version 1.0.0.1 or later, the relevant **proprietary object** 27 **[PRP140-x] EIO_0x** (with x being the number of the addressed module) lets you:

- See the module's current **State** 28 (Running, Silent, or Inactive).
- See the module's installed **Firmware Revision** 29.
- **Reset** 30 the module remotely (rather than cycling power to it).
- **Silence** 31 the module for testing purposes (all inputs and outputs hold their last current value).

For more information, see the documents or help systems for the respective KMC software tool.

REPLACEMENT PARTS

HPO-0055	Replacement Network Bulb Module for Conquest Controllers, Pack of 5
HPO-9901	Conquest Hardware Replacement Parts Kit

NOTE: HPO-9901 includes the following:

Terminal Blocks	DIN Clips
(1) Black 2 Position	(2) Small
(2) Grey 3 Position	(1) Large
(2) Green 3 Position	
(4) Green 4 Position	
(2) Green 5 Position	
(2) Green 6 Position	

NOTE: See the **Conquest Selection Guide** for more information about replacement parts and accessories.

IMPORTANT NOTICES

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EMAIL: **info@kmccontrols.com**

SAMPLE MODULE WIRING

(General Purpose Applications with Input/Output Expansion)

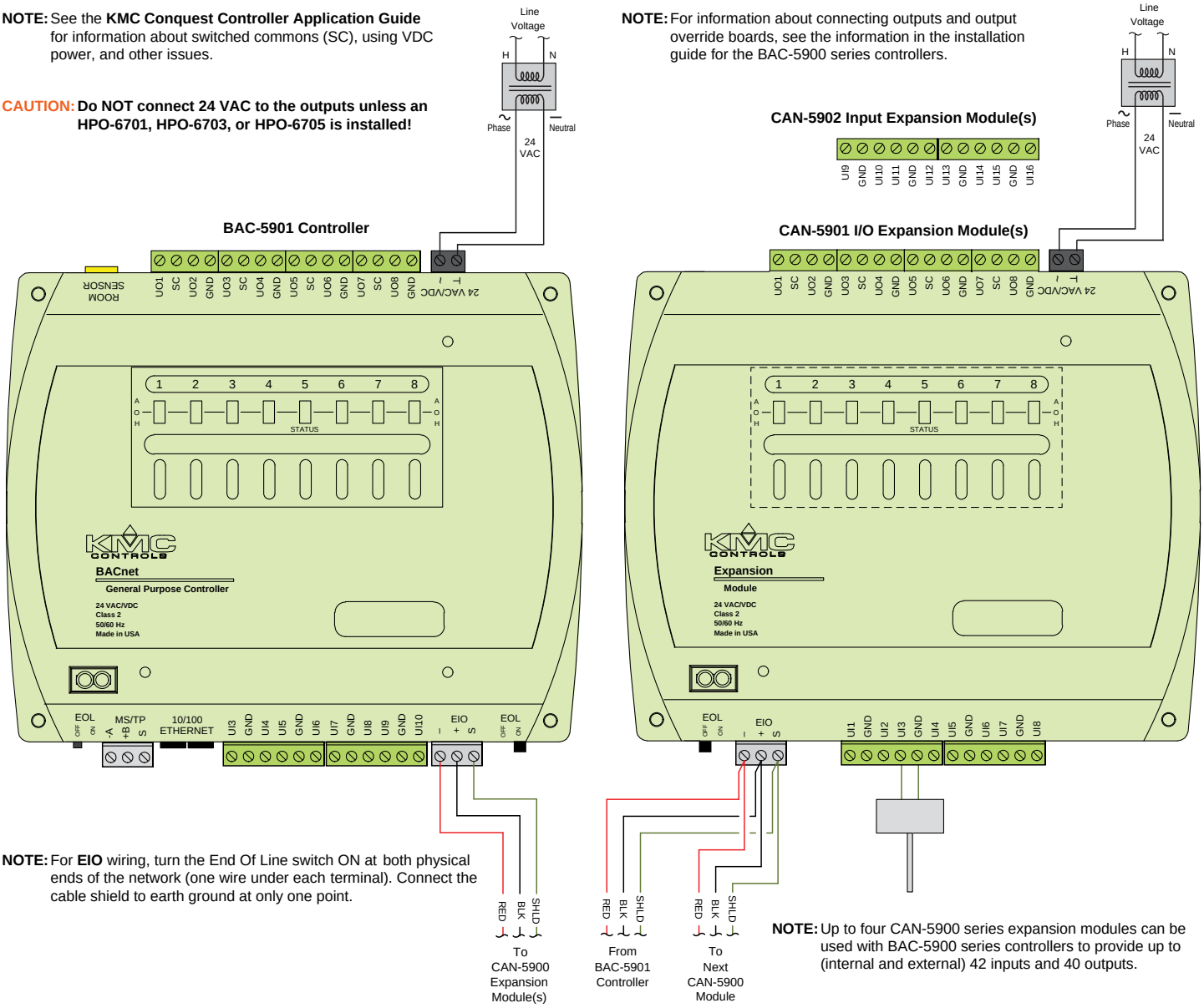
NOTE: For information on BAC-5900 connections, see the information in the installation guide for the BAC-5900 series controllers.

NOTE: See the **KMC Conquest Controller Application Guide** for information about switched commons (SC), using VDC power, and other issues.

CAUTION: **Do NOT connect 24 VAC to the outputs unless an HPO-6701, HPO-6703, or HPO-6705 is installed!**

NOTE: The CAN-5900 series modules do not have a Room Sensor port (unlike Conquest BAC-59xx/9xxx controllers). CAN-5902 modules have only inputs and no output override board slots.

NOTE: For information about connecting outputs and output override boards, see the information in the installation guide for the BAC-5900 series controllers.



NOTE: For **EIO** wiring, turn the End Of Line switch ON at both physical ends of the network (one wire under each terminal). Connect the cable shield to earth ground at only one point.

NOTE: Up to four CAN-5900 series expansion modules can be used with BAC-5900 series controllers to provide up to (internal and external) 42 inputs and 40 outputs.

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STE-9000 Series NetSensors

Digital Room Sensors

DESCRIPTION

KMC Conquest™ STE-9000 series NetSensors are wall-mounted digital space temperature sensors designed for use with KMC Conquest BAC-5900/9000/9300 series controllers. Key features include the following:

- Up to four sensors in a single package minimizes labor, wiring, and wall space, while optional humidity, motion, and CO_2 sensors allow expanded energy-efficient control of humidity, temperature setback, lighting, and ventilation.
- A user-friendly three-button integrated operator interface (on models with a display, i.e. **non**-NDL models) provides system and IAQ monitoring and adjusting for occupants.
- The upper (default) LCD display (on non-NDL models) shows room temperature and setpoints. A lower (default) display shows local time and can be enabled to show (dependent on sensors and controller configuration) % relative humidity, CO_2 ppm, and outside air temperature (°F or °C) in rotation. Both displays can be configured to show any controller default or calculated analog or binary values (such as airflow or energy consumption), and multiple values can show in rotation.
- It allows up to two separate passwords (on non-NDL models) for adjusting setpoints and configuring/commissioning/balancing.
- Up to 32 additional command points can be configured for user control and monitoring of a connected system (e.g., lighting, fan, or AHU control) from the display
- It connects to a controller via a modular jack connection using standard Ethernet patch cables.
- It installs permanently as a room sensor or (for models with a display) temporarily as a service tool; as a service tool, it commissions controllers without software, configures communication and application settings, and balances VAV air flow.





NDL (no display) models

MADE IN USA

KMC Conquest™ Automation Hardware

- An HPO-9001 NetSensor® distribution module allows up to eight STE-9000 series NetSensors to be linked to one controller or allows one STE-6010/6014/6017 analog temperature sensor to be connected with up to seven NetSensors.

APPLICATIONS

Temperature sensing to BAC-5900/9000/9300 series controllers for such applications as RTUs, HPUs, FCUs, AHUs, VAV terminal units, and unit ventilators.

Optional **humidity** sensing is for dehumidification and/or humidification sequences. Optional **motion** sensing (for models with a display) enhances occupancy-based control for lighting control, temperature setback, or self-learning schedules. Optional **CO_2** sensing enables demand-control ventilation (DCV) for optimizing ventilation and energy efficiency.

MODELS

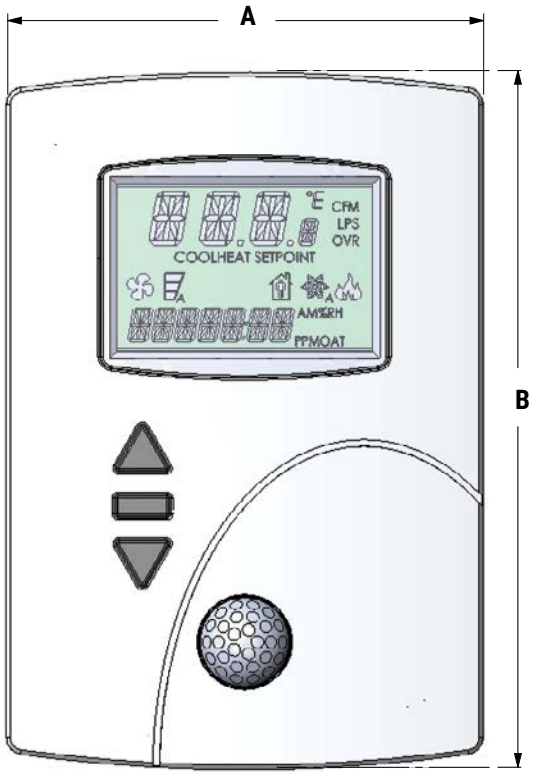
APPLICATIONS: TEMPERATURE CONTROL PLUS...	INTEGRATED SENSORS*					MODEL**
	Temp.	Humidity	Motion	CO_2	Display	
Temperature control only	✓				✓	STE-9001W
Temperature control only						STE-9001W-NDL
Humidity control for dehumidification/humidification		✓			✓	STE-9021W
Humidity control for dehumidification/humidification		✓				STE-9021W-NDL
Enhanced occupancy-based control (lighting/setback/self-learning)			✓		✓	STE-9201W
Humidity and occupancy control		✓	✓		✓	STE-9221W
DCV (Demand-Control Ventilation)				✓	✓	STE-9301W
DCV (Demand-Control Ventilation)				✓		STE-9301W-NDL
Humidity and ventilation control		✓		✓	✓	STE-9321W
Humidity and ventilation control		✓		✓		STE-9321W-NDL
Occupancy and ventilation control			✓	✓	✓	STE-9501W
Humidity, occupancy, and ventilation control		✓	✓	✓	✓	STE-9521W

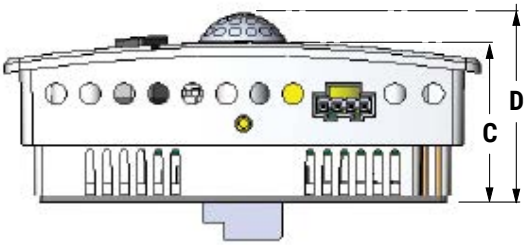
*All units have a temperature sensor (standard). See above for additional sensor options.

**A W at the end of the model number indicates a white case. To order the sensor with light almond color (for models with a display only) instead of white, drop the W on the end of the model number (e.g., STE-9001W is white and STE-9001 is light almond).

SPECIFICATIONS

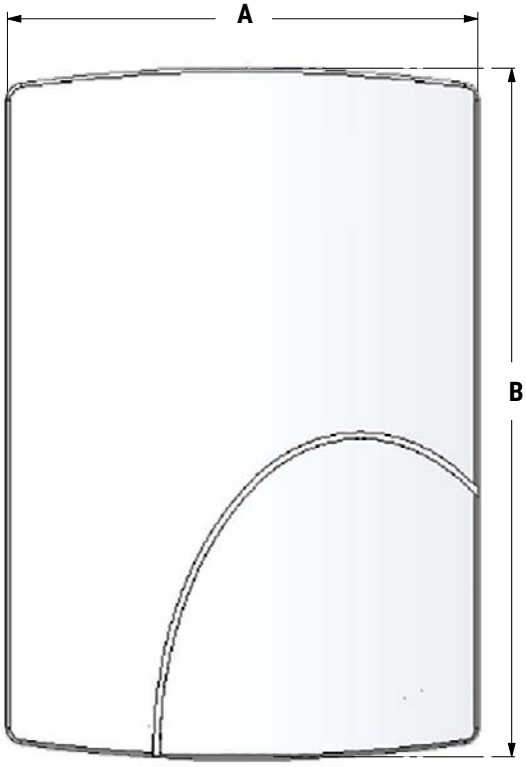
Models with a Display

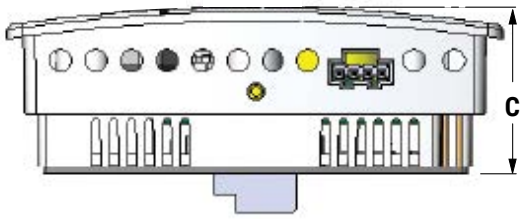




DIMENSIONS		
A	3.500 inches	89 mm
B	5.124 inches	130 mm
C	1.125 inches	29 mm
D	1.336 inches	34 mm

Models without a Display (NDL Models)





DIMENSIONS		
A	3.500 inches	89 mm
B	5.124 inches	130 mm
C	1.125 inches	29 mm

Sensors

Temperature Sensor (without humidity sensor)

Sensor type	Thermistor, 10K 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)

Humidity Sensor (optional)

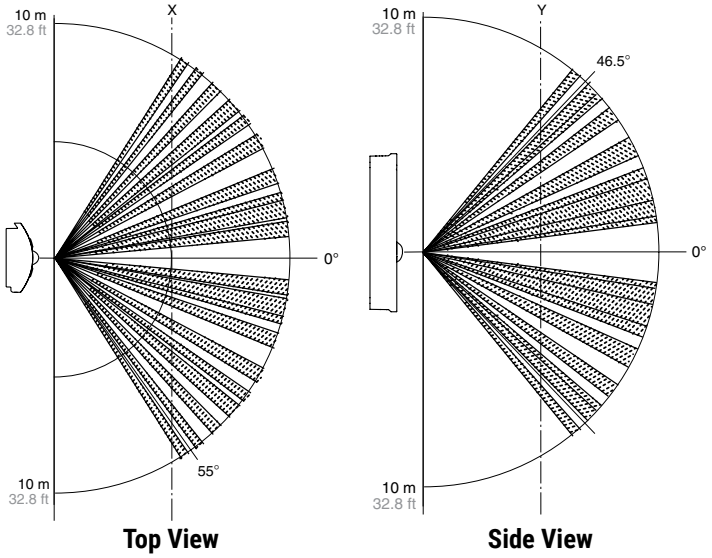
Sensor type	CMOS
Range	0 to 100% RH
Accuracy @ 25°C	±2% RH (10 to 90% RH)
Response time	Less than or equal to 4 seconds

CO_2 Sensor (optional)

Detector type	Non Dispersive Infrared (NDIR), with solid-state source and detector
Sample method	Diffusion
Rated life	15 years minimum
Operating limits	34° to 122° F (1.1 to 50° C)
Shipping limits	–22° to 140° F (–30°C to 60° C)
CO_2 range	0 to 2000 ppm, 0–1%
Accuracy	±50 ppm, ±3% of reading*
Non-linearity	< 1% of full scale
Calibration	Automatic calibration built-in*
Pressure dependence	0.13% of reading per mm Hg
Oper. pressure range	950 to 1050 bar
Warm-up time	10 seconds

***NOTE:** The CO_2 sensor uses a self-calibration technique designed to be used in applications where **CO_2 concentrations will periodically drop to outside ambient conditions** (approximately 400 ppm), typically during unoccupied periods. 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 CO_2. The sensor will maintain accuracy specifications if it is exposed to the reference value at least four times in 21 days.

Optional (for models with a display) Motion Sensing Coverage



Motion Sensor (optional for models with a display)

Detector type	Passive infrared
Range and Coverage	33 feet (10 meters)

Installation

Connections

Connector type	Eight-wire RJ-45 modular jack
Cable type	Standard T568B (Category 5 or better) Ethernet patch cable up to 150 feet (45 meters)
Power	Supplied by connected controller

Display (on non-NDL models)

Type	Multifunctional LCD with backlight
Size	1.88 x 1.25 inches (48 x 32 mm)
Icons	Language-independent symbols for mode and operating status
Features	Four-character upper display (with units of °F, °C, CFM, LPS, OVR, COOL, HEAT, and SETPOINT) for room temperature and setpoints (see the drawing under **Specifications on page 2**)
	Icons showing fan, speed, occupancy, heating, cooling, and auto
	Seven-character lower display (with units of AM, PM, PPM, %, RH, and OAT) for local time and optional analog or binary values

Enclosure and Mounting

Weight	2.8 ounces (80 grams)
Case material	Flame-retardant plastic
Mounting	Surface mount directly to any flat surface or to a 2 x 4 inch or 4 x 4 inch electrical box (mounting on a 4 x 4 box or a horizontal 2 x 4 box requires an HMO-10000/10000W mounting backplate)

Environmental Limits

Operating	34° to 125° F (1.1 to 51.6° C)*
Shipping	–40° to 140° F (–40°C to 60° C)*
Humidity	0 to 95% relative humidity non-condensing

***NOTE:** For models with the optional CO_2 sensor, see the reduced range in the operating and shipping limits in **CO_2 Sensor (optional) on page 3**.

Warranty, Protocol, and Approvals

Warranty

KMC Limited Warranty	5 years (from mfg. date code)

Controller Protocol Compatibility

BACnet	BAC-5900/9000/9300 series

Regulatory Approvals

UL	UL 916 Energy Management Equipment listed
CE	CE compliant
RoHS 2	RoHS 2 compliant
FCC	FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A*

*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.

HPO-9001 DISTRIBUTION MODULE

The HPO-9001 NetSensor distribution module allows up to eight STE-9000 series NetSensors to be linked to one BAC-5900/9000/9300 series controller (see **Sample Installation on page 6**).

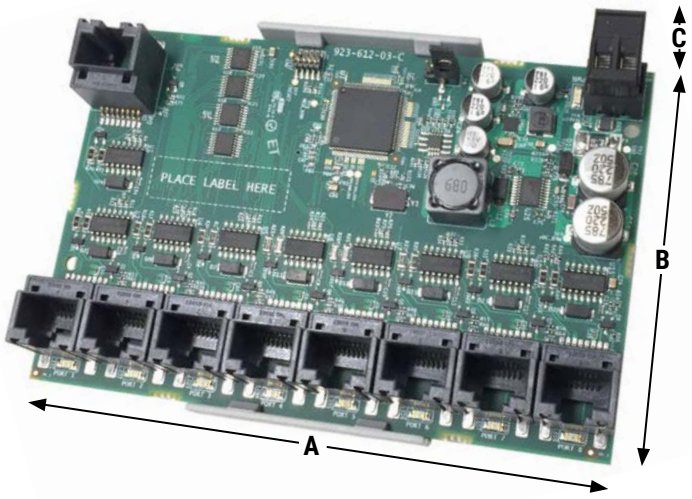
The module provides power (from a connected 24 VAC transformer) and addressing (according to the connected port) for each NetSensor. It also allows one STE-6010/6014/6017 analog temperature sensor to be connected to a controller along with up to seven NetSensors.

The module may be connected to a controller with an Ethernet patch cable up to 150 feet (45 meters) long. Cables from the module to any NetSensors may also be up to 150 feet (45 meters) long.

The module board is mounted via supplied Snap Track.

Using the HPO-9001 requires custom configuration of objects and custom Control Basic code. See the **HPO-9001 installation guide and sample programs** for more information. One sample application selects the average temperature, highest temperature, or lowest temperature among three NetSensors. Another sample application is for eight NetSensors in eight zones with eight individual (HW valves for baseboard) heating setpoints but a combined single setpoint for (RTU) cooling.

Installation



Dimensions		
A	5 inches	127 mm
B	3-1/2 inches	89 mm
C	1-3/8 inches	35 mm

MADE IN USA

RoHS COMPLIANT LEAD FREE

Connections

Connector type	Eight-wire RJ-45 modular jacks
Cable type	Standard (Category 5 or better) Ethernet patch cable up to 150 feet (45 meters)

Power

Supply voltage	24 VAC (–15%, +20%), 50/60 Hz, Class 2 only; non-supervised (all circuits, including supply voltage, are power limited circuits)
Required power	12 VA
Wire size	12–24 AWG, copper, in removable screw terminal block

Enclosure and Mounting

Weight	3.2 ounces (91 grams)
Mounting	Provided with 3.25 x 4 inch (83 x 102 mm) Snap Track
Enclosures	An **HCO-1034/1035/1036** or an **HCO-1101**

Environmental Limits

Operating	32 to 120° F (0 to 49° C)
Shipping	–40 to 160° F (–40 to 71° C)
Humidity	0 to 95% relative humidity (non-condensing)

Warranty, Protocol, and Approvals

Warranty

KMC Limited Warranty	5 years (from mfg. date code)

Controller Compatibility

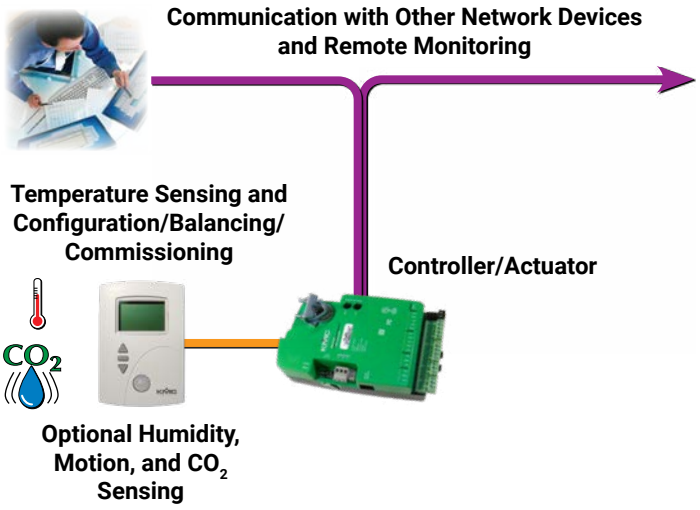
KMC Conquest	BAC-5900/9000/9300 series

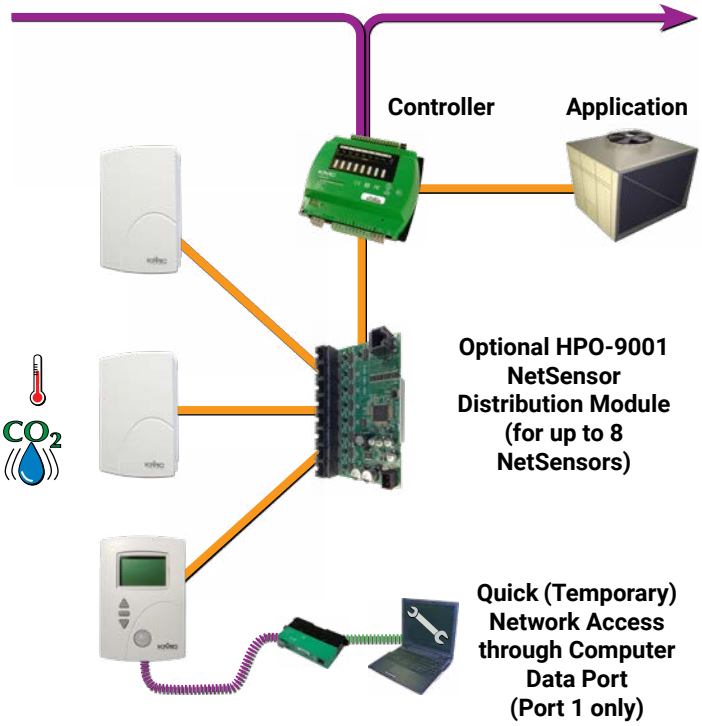
Regulatory

UL	UL Recognized, US and Canada
RoHS 2	RoHS 2 compliant
FCC	FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A*

*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.

SAMPLE INSTALLATION





For more information about installation and operation, see:

- **STE-9000 Series NetSensors Installation Guide**
- **Room Sensor and Thermostat Mounting and Maintenance Application Guide**
- **KMC Conquest Controller Application Guide**

ACCESSORIES

NOTE: For accessory details, see the respective product data sheets and installation guides.

HMO-10000	Light almond mounting plate, allows mounting to horizontal 2 x 4 or 4 x 4 inch electrical boxes
HMO-10000W	White version of HMO-10000
HPO-0044	Replacement cover hex screw
HPO-9001	NetSensor distribution module (see **HPO-9001 Distribution Module on page 5**)
HPO-9002	Foam insulating gasket (mounts between the black backplate and the electrical box)
HSO-9001	Ethernet patch cable, 50 feet
HSO-9011	Ethernet patch cable, 50 feet, plenum rated
HSO-9012	Ethernet patch cable, 75 feet, plenum rated
SP-001	Screwdriver (KMC branded) with hex end (for NetSensor cover screws) and flat blade end (for controller terminals)

SUPPORT

Additional resources for installation, configuration, application, operation, programming, upgrading, and much more are available on the web at **www.kmccontrols.com**. Log-in to see all available files.



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STE-9000 Series NetSensors

Installation Guide

INTRODUCTION

Complete the following steps to mount a KMC Conquest STE-9000 Series Digital NetSensor and connect it to a Conquest BAC-59xx/9xxx Controller.



STE-90xx/93xx | STE-92xx/95xx with Motion Sensor | STE-9xxxW-NDL (no display)

NOTE: See the **Conquest NetSensors STE-9000 Series Digital Room Sensors** data sheet and the **Conquest Selection Guide** at **kmccontrols.com** for specifications and other information.

SELECT MOUNTING LOCATION

See the **Room Sensor and Thermostat Mounting Location and Maintenance Application Guide** for cautions, troubleshooting, and best practices.

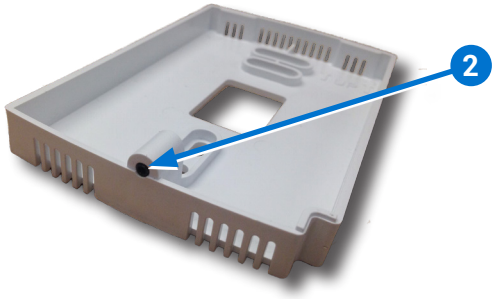
NOTE: Complete rough-in-wiring at each location before installing a sensor.

REMOVE BACKPLATE

1. Turn the **hex screw** 1 clockwise into the sensor until the screw clears the cover.



NOTE: The hex screw 2 should remain in the backplate.

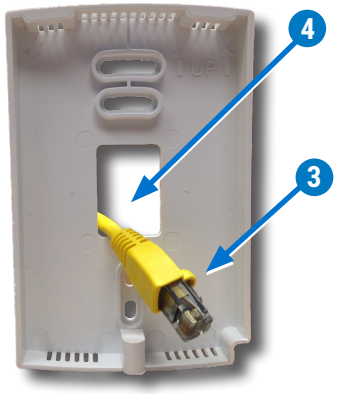


2. Pull the cover from the backplate.

CONNECT ETHERNET CABLE

3. Feed the **Ethernet patch cable** 3 from the Conquest controller through the center of the **backplate** 4.

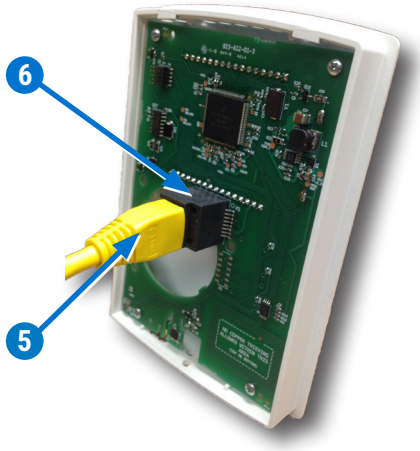
NOTE: The Ethernet patch cable should be a maximum of 150 feet (45 meters).



4. Mount the backplate on an electrical box using the screws provided.

NOTE: If additional thermal insulation is needed, install the optional **HPO-9002** gasket between the backplate and the electrical box. For more information, see the **Room Sensor and Thermostat Mounting Location and Maintenance Application Guide.**

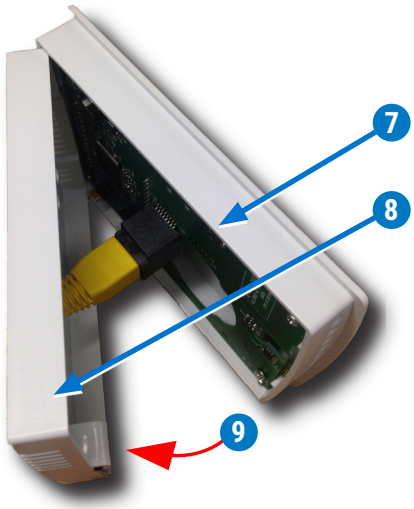
5. Plug the **Ethernet cable** 5 into the **modular jack** 6 of the sensor.



INSTALL SENSOR COVER

6. Place the **cover** 7 over the top of the **backplate** 8 ensuring that the tabs on the cover rest on top of the backplate.

7. Swing down the cover over the backplate 9, taking care not to pinch the Ethernet cable.



⚠ CAUTION

If any force seems to be needed to close the cover over the backplate, check the alignment of the tabs on the top of the backplate and/or the hex screw.

8. Turn the **hex screw** 10 counterclockwise until it engages the cover.



OPERATE

The STE-9000 Series NetSensor becomes operational after it is connected to a powered Conquest controller.

To change setpoints or configuration, see the **KMC Conquest Controller Application Guide**.

For continued maximum NetSensor efficiency, see the maintenance section in the **Room Sensor and Thermostat Mounting Location and Maintenance Application Guide.**

In CO_2 sensing models, the NetSensor must be continuously powered and exposed to fresh air through the HVAC system in order to self calibrate. The calibration technique is designed for use in applications where CO_2 concentrations periodically drop to outside ambient conditions (~400 ppm). The sensor typically reaches its operational accuracy after 25 hours of continuous operation if exposed to ambient reference levels of air 400 ±- 10 ppm CO_2. The sensor will maintain accuracy specifications if exposed to a reference value at least four times in 21 days.

IMPORTANT NOTICES

The material in this document is for information purposes only. The contents and the product it describes are subject to change without notice.

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FAX: 574.831.5252
e-mail: **info@kmccontrols.com**

Single Setpoint for STE-9xxx NetSensor

Application Guide



Contents

STE-9000 Series NetSensor Setpoints....1
Procedure....1
Control Basic Code (Reference)....7
NetSensor Menus....8
Handling Precautions....8
Support....8
Important Notices....8

STE-9000 Series NetSensor Setpoints

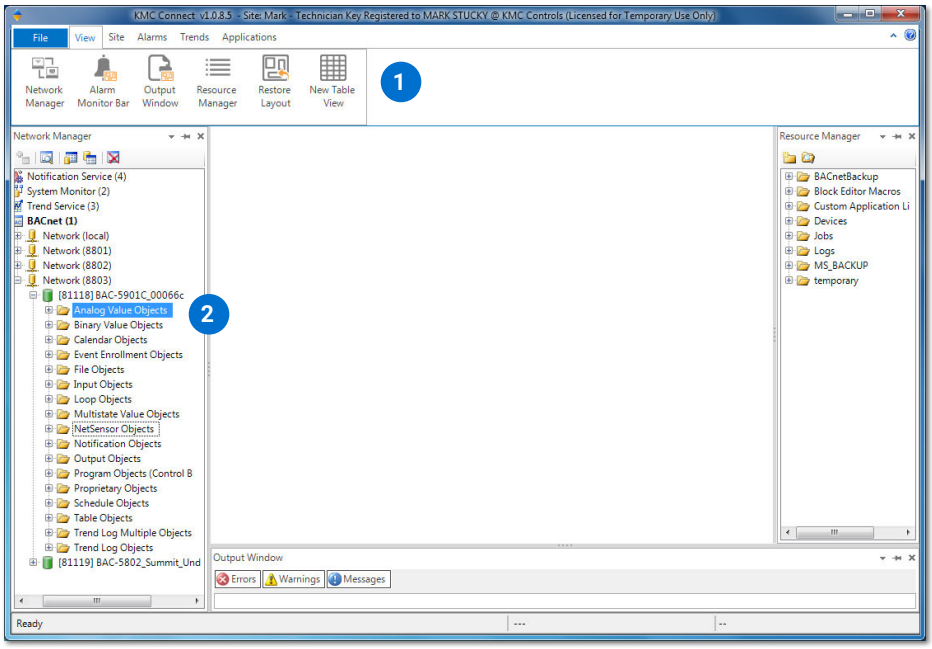
KMC Conquest NetSensors have **dual** (heating and cooling) setpoints. If a **single** occupied setpoint is desired:

- Configure AV5 and the NetSensor object to have AV5 be the only setpoint reference (instead of AV3 and AV4).
- Add custom Control Basic code.

NOTE: KMC provides a backup BND file that provides the custom Control Basic code. See the other file in the zipped file containing this bulletin.

Procedure

NOTE: All other controller application configuration should be performed (using the NetSensor, KMC Connect Lite, KMC Connect, KMC Converge, or TotalControl) before making the changes for a single setpoint. See other related documentation for additional information about configuration.



1. Start KMC Connect, KMC Converge, or TotalControl. (KMC Connect screens are shown here.)

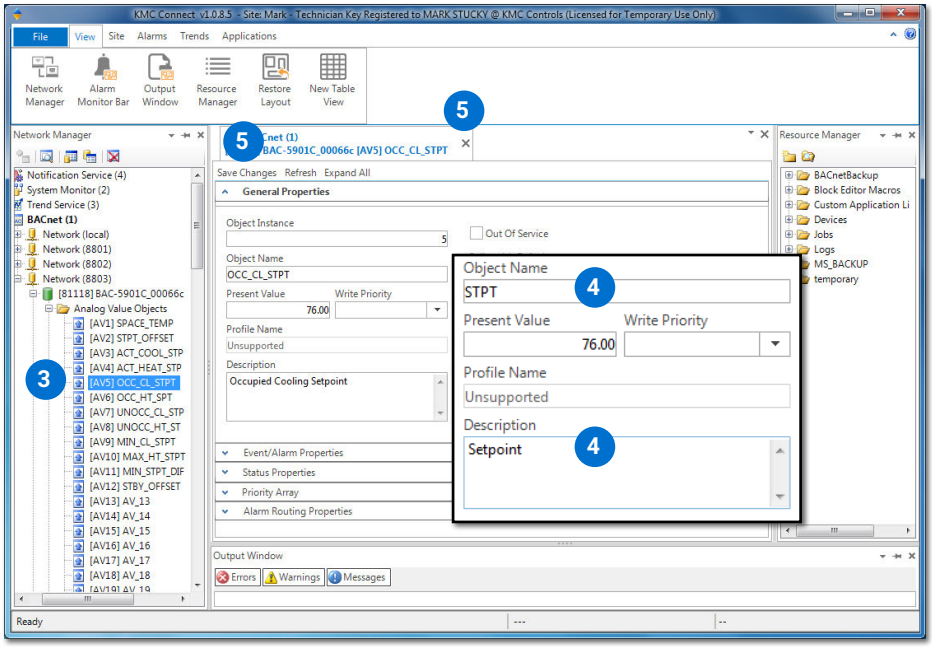
NOTE: Before modifying AV5, PRG7, and DS_01, backing up those objects (by dragging them from the Network Manager into a suitable folder in the Resource Manager) is recommended.

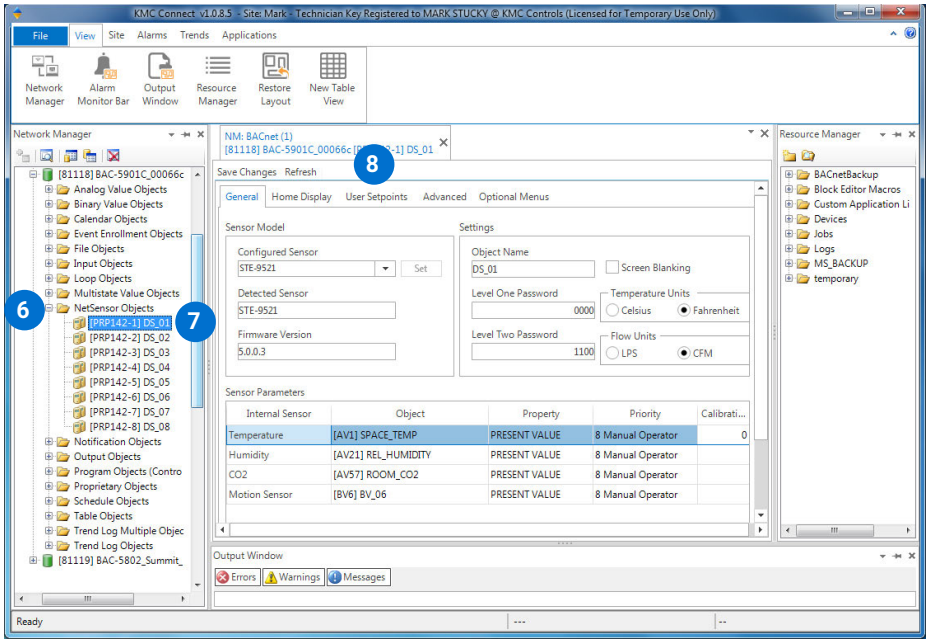
2. On the controller, click the **+** in front of Analog Value Objects to expand the folder.

3. Double-click **AV5** to open it.

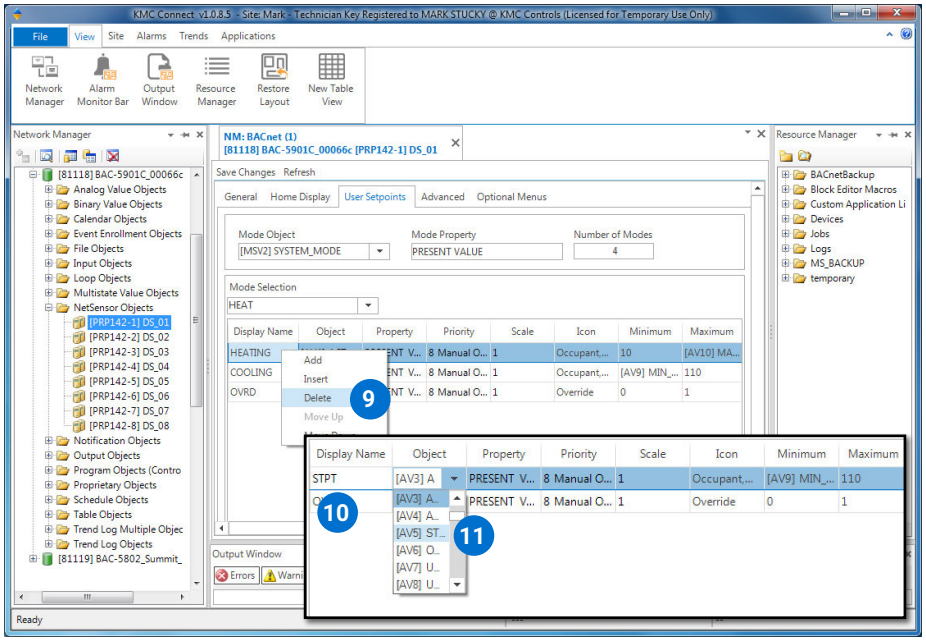
4. In the Object Name and Description fields, delete the references to Occupied Cooling—leaving **STPT** and **Setpoint**.

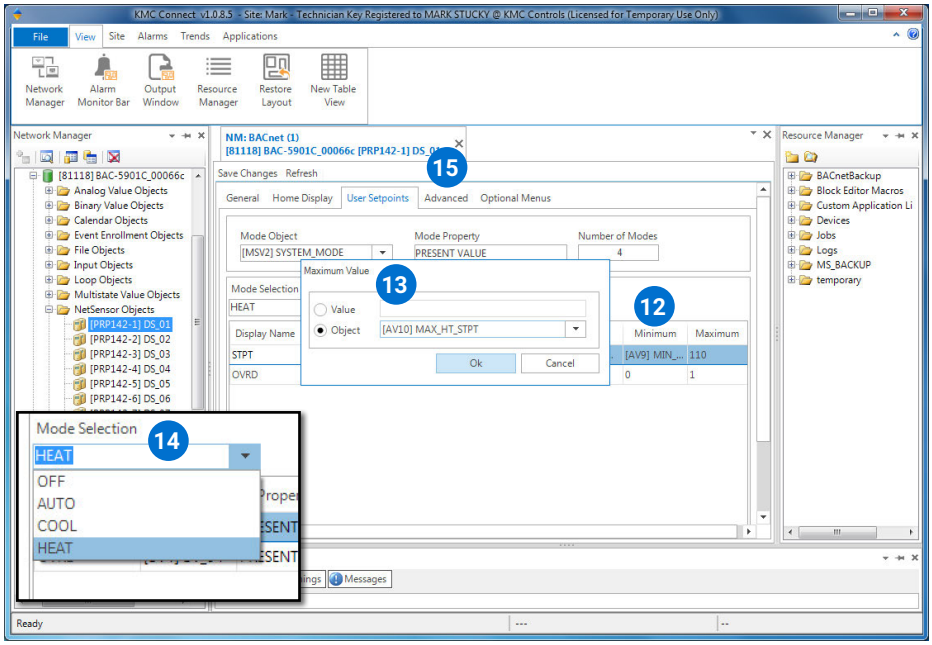
5. Click **Save Changes** and then the **X** in the tab to close it.



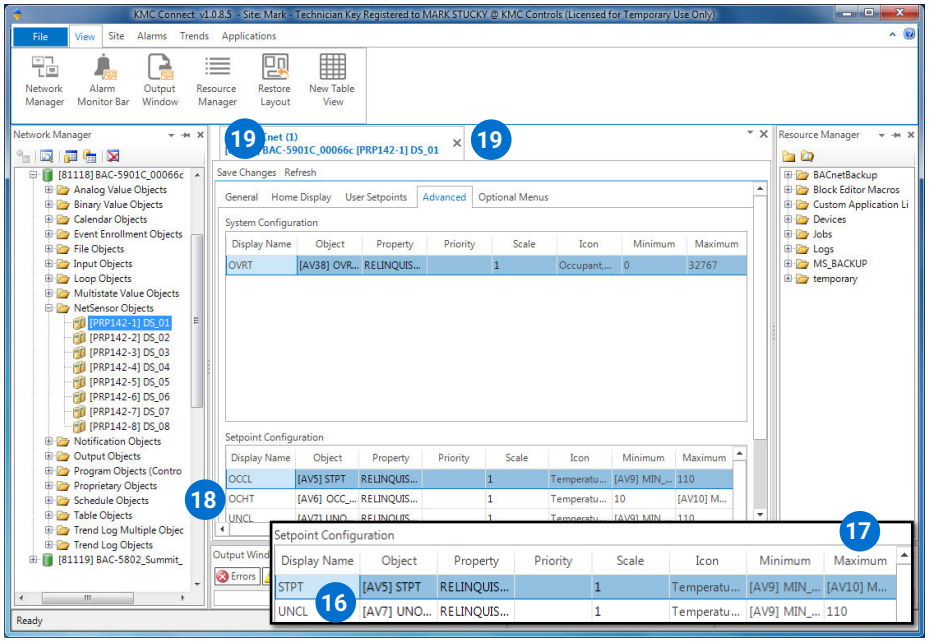


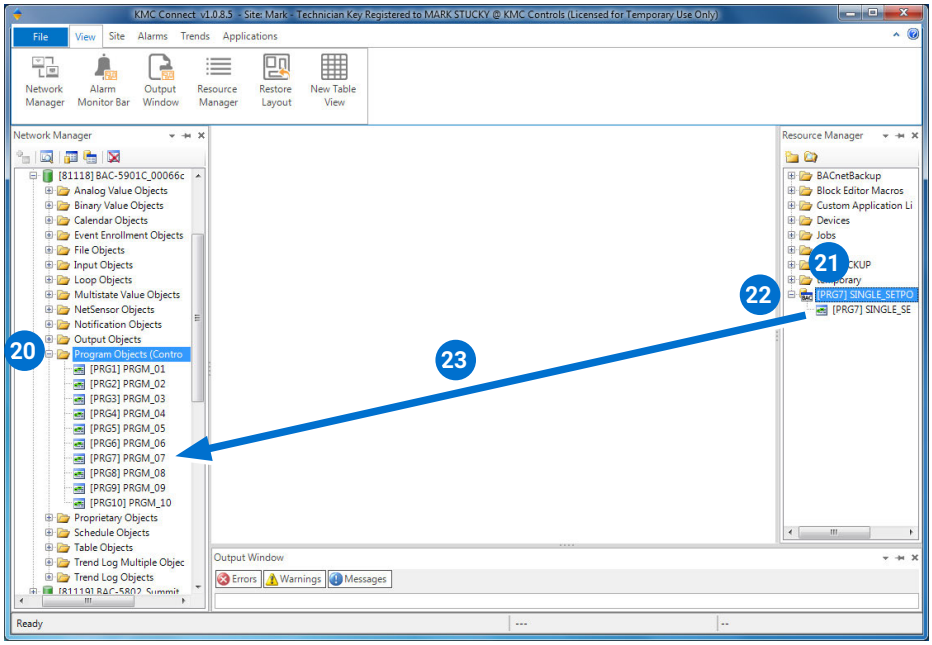
6. Click the **+** in front of NetSensor Objects to expand the folder.
7. Double-click **[PRP142-1] DS_01** to open it.
8. Click the **User Setpoints** tab.
9. Right-click in either the **HEATING** or **COOLING** line and select **Delete**.
10. On the remaining line, click under Display Name and enter **STPT** (or similar description up to 7 characters maximum).
11. Click under Object and select **AV5** from the drop-down box.





12. Click under Minimum and select **AV9** (if not already selected) from the Object drop-down box.
13. Click under Maximum and select **AV10** (if not already selected) from the Object drop-down box.
14. Under Mode Selection, select the other modes and modify the **HEATING** and **COOLING** lines as described in Steps 9 through 13.
15. Click the **Advanced** tab.
16. Click under Display Name of the line containing AV5 and change OCCL to **STPT**.
17. Click under Maximum and change the value to the object **AV10**.
18. Right-click in the OCHT line (containing AV6) and delete the line.
19. Click **Save Changes** and then the **X** in the tab to close it.





20. Under Network Manager, click the **+** sign in front of Program Objects to expand the folder.

NOTE: If preferred, copy and paste code from **Control Basic Code (Reference) on page 7** instead of using the BND file.

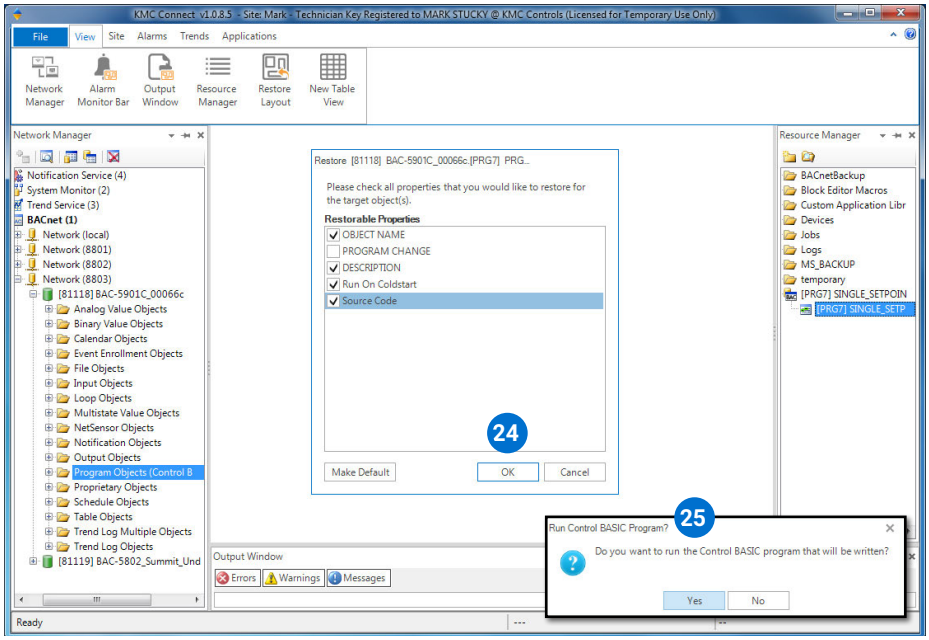
21. Drag the supplied **[PRG7] SINGLE_SETPOINT.bnd** file into Resource Manager.

22. Click the **+** sign in front of it to expand it.

23. Drag the **PRG7** file of the Resource Manager into **PRG7** of the Program Objects folder of the controller.

NOTE: Use a different unused program object if program 7 is already being used. The code in the supplied object can also be copied, modified, and pasted into other code as needed.

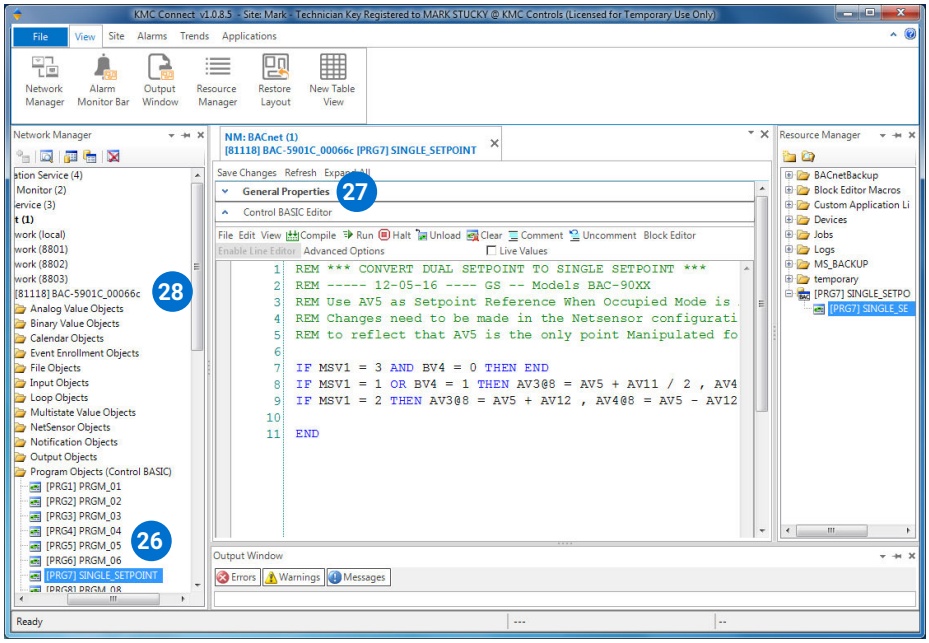
NOTE: KMC Controls is not responsible for custom code created or modified by customers.

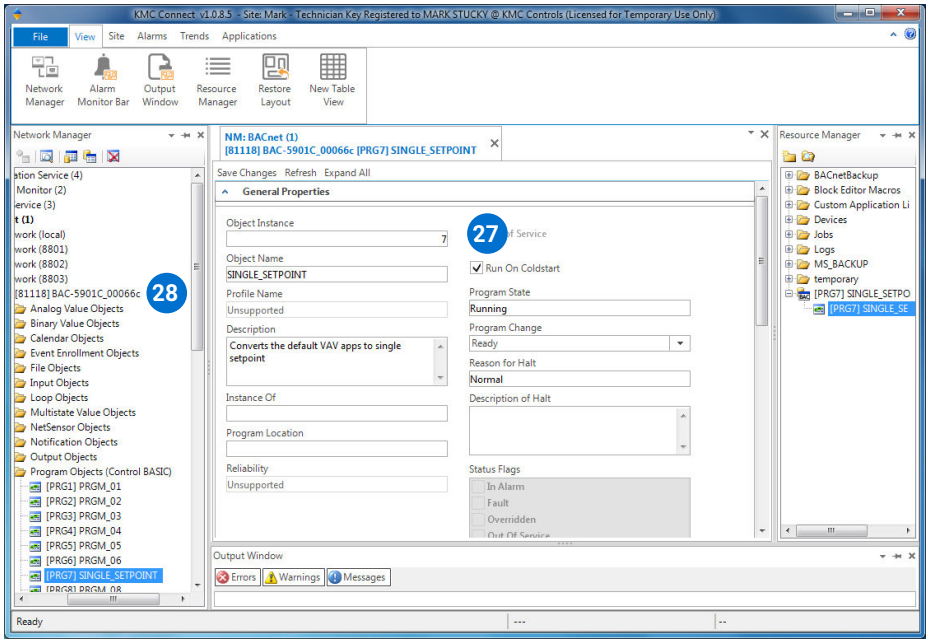


24. In the Restore dialogue box, click **OK**.

25. In the Run Control Basic Program dialogue box, click **Yes**.

26. Double-click to open the **[PRG7] SINGLE_SETPOINT** Program object.





27. Open the General Properties section and ensure that **Run On Coldstart** is checked.

28. Restart the controller:

    A. Right-click the controller device object in Network Manager.

    B. Select **Reinitialize Device...** from the menu.

    C. Click the **Reinitialize** button.

Control Basic Code (Reference)

NOTE: Below is the KMC Control Basic code in the BND file for Program 7. As an alternative method, this text can be copied and then pasted into an empty program (or section of a program) instead of doing the steps with the BND file.

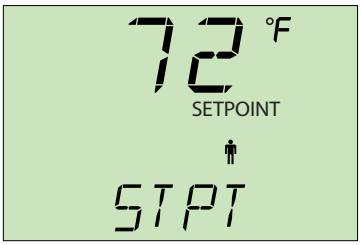
NOTE: Fix unintended line breaks after pasting. Ensure that **Run On Coldstart** for the program is checked.

```
REM *** CONVERT DUAL SETPOINT TO SINGLE SETPOINT ***
REM ----- 12-05-16 ---- GS -- Models BAC-90XX
REM Use AV5 as Setpoint Reference When Occupied Mode
is Active
REM Changes need to be made in the Netsensor
configuration under “User Setpoints” tab
REM to reflect that AV5 is the only point Manipulated
for Setpoint control

IF MSV1 = 3 AND BV4 = 0 THEN END
IF MSV1 = 1 OR BV4 = 1 THEN AV3@8 = AV5 + AV11 / 2 ,
AV4@8 = AV5 - AV11 / 2
IF MSV1 = 2 THEN AV3@8 = AV5 + AV12 , AV4@8 = AV5 -
AV12

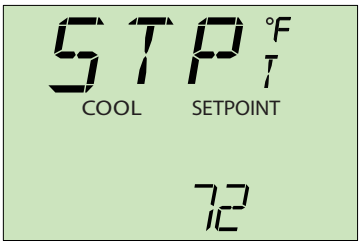
END
```

NetSensor Menus



Pushing the Enter button on the NetSensor will now show only a single setpoint (instead of separate heating and cooling setpoints) on the screen.

In the Setpoints section of the NetSensor's controller configuration menus, "Setpoint" controls both occupied heating and cooling even if it shows just COOL on the screen. **Un**occupied dual setpoints function as usual.



NOTE: For more information about the configuration menus, see the Controller Configuration with STE-9xx1 Menus section of the **KMC Conquest Controller Application Guide**.

Handling Precautions

For **digital and electronic** sensors, thermostats, and controllers, take reasonable precautions to prevent electrostatic discharges to the devices when installing, servicing, or operating them. Discharge accumulated static electricity by touching one's hand to a securely grounded object before working with each device.



Support

Additional KMC product information and resources are available on the web at **www.kmccontrols.com**. To see all available files, log-in to the KMC Partners site.



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CONDENSATE OVERFLOW SWITCHES
SS/SP SERIES

DESCRIPTION

The **Rectorseal SS/SP Series** condensate overflow switches detect rising water in A/C condensate drain pans and shut off the system to prevent overflow and water damage. Designed for installation on auxiliary drain pan outlets or inline on primary drains, models are available with a solid state electronic probe or magnetic reed switch. Switches include mounting adapters and hardware.

Model SG1 condensate overflow alarm is wired across the normally closed contacts of the condensate switch. As the water level rises, the switch opens allowing current to flow through the alarm which sounds a buzzer and flashes an LED indicating a possible overflow condition. The SG1 works with most 24-volt overflow switches and pumps and comes pre-wired with 4-foot 18 AWG lead wires and 2-sided tape.


SS1


SS2AP


SS3



SG1

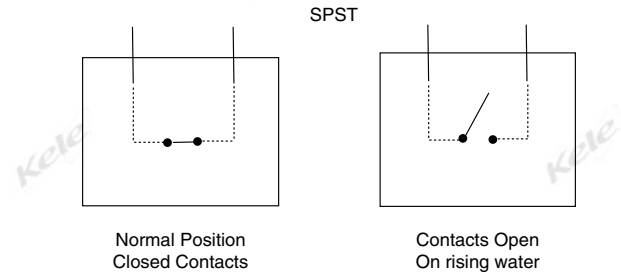
FEATURES

- ***Waterproof***
- ***Primary or auxiliary installation***
- ***Easy to install and service***
- ***Low voltage***
- ***UL 508 listed***
- ***Plenum rated models***
- ***One year warranty***

SPECIFICATIONS

Supply Voltage	24 VAC
Relay Type	Magnetic, Solid state
Switching Capability	1.25A, 2.3A
Plenum Rating	No, Yes
Mounting	3/4" adapter, NA
Mounting Orientation	Primary (inline) or auxillary, Auxillary, Drain Pan
Wire Length	6 ft (1.8m), 18 AWG, 4 ft (1.2m), 18 AWG
Weight	0.2 lb (0.09 kg), 0.09 lb (0.04 kg)
Warranty	1 year

WIRING



SPECIFICATIONS

Model	Switch Type	Supply Voltage	Switching Capability	Installation	Plenum Rated	Mounting Adapter	Lead Length	Weight
SS1	Magnetic	24 VAC	1.25A	Primary (inline) or auxillary	No	3/4” adapter	6 ft (1.8m), 18 AWG	0.2 lb (0.09 kg)
SS2AP	Magnetic	24 VAC	1.25A	Auxillary	Yes	3/4” adapter	4 ft (1.2m), 18 AWG	0.2 lb (0.09 kg)
SS3	Magnetic	24 VAC	1.25A	Drain Pan	No	NA	6 ft (1.8m), 18 AWG	0.09 lb (0.04 kg)

ORDERING INFORMATION

MODEL	DESCRIPTION
SS1	Inline magnetic reed condensate overflow switch
SS2AP	Auxiliary condensate overflow switch
SS3	Auxiliary condensate pan overflow switch
SP1P	Inline solid state condensate overflow switch

RELATED PRODUCTS

SG1	Condensate overflow alarm

Butterfly Valve with Lug types

- Disc 304 stainless steel
- Bubble tight shut-off
- Resilient seat
- Valve face-to-face dimensions comply with API 609 & MSS-SP-67
- Completely assembled and tested, ready for installation



5-year warranty

Type overview

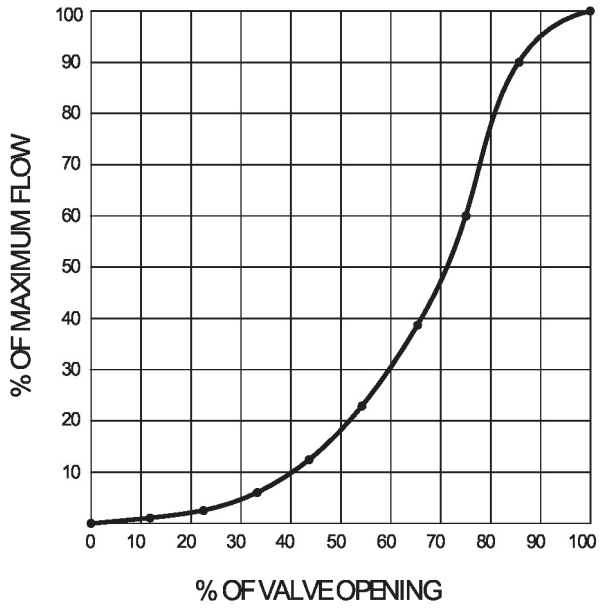
Type	DN
F650HD	50

Technical data

Functional data	Valve size [mm]	2" [50]
	Fluid	chilled or hot water, up to 60% glycol
	Fluid Temp Range (water)	-22...250°F [-30...120°C]
	Body Pressure Rating	ANSI Class Consistent with 125, 232 psi CWP
	Close-off pressure Δps	200 psi
	Flow characteristic	modified equal percentage
	Leakage rate	0% leakage, leakage rateA
	Pipe connection	Flange for use with ASME/ANSI class 125/150
	Servicing	maintenance-free
	Flow Pattern	2-way
	Controllable flow range	90° rotation
	Cv	115
	Maximum Velocity	12 FPS
	Lug threads	5/8-11 UNC
Materials	Valve body	Ductile cast iron ASTM A536
	Body finish	epoxy powder coating (blue RAL 5002)
	Stem	416 stainless steel
	Stem seal	EPDM (lubricated)
	Seat	EPDM
	Bearing	RPTFE
	Disc	304 stainless steel
Suitable actuators	Non Fail-Safe	ARB(X) GRB(X)
	Spring	AFRB(X)

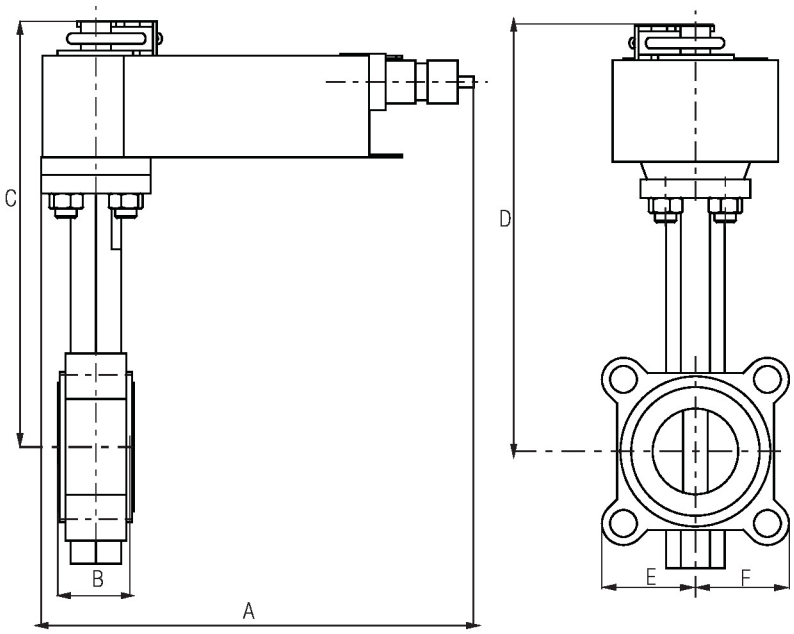
Product features

Flow/Mounting details



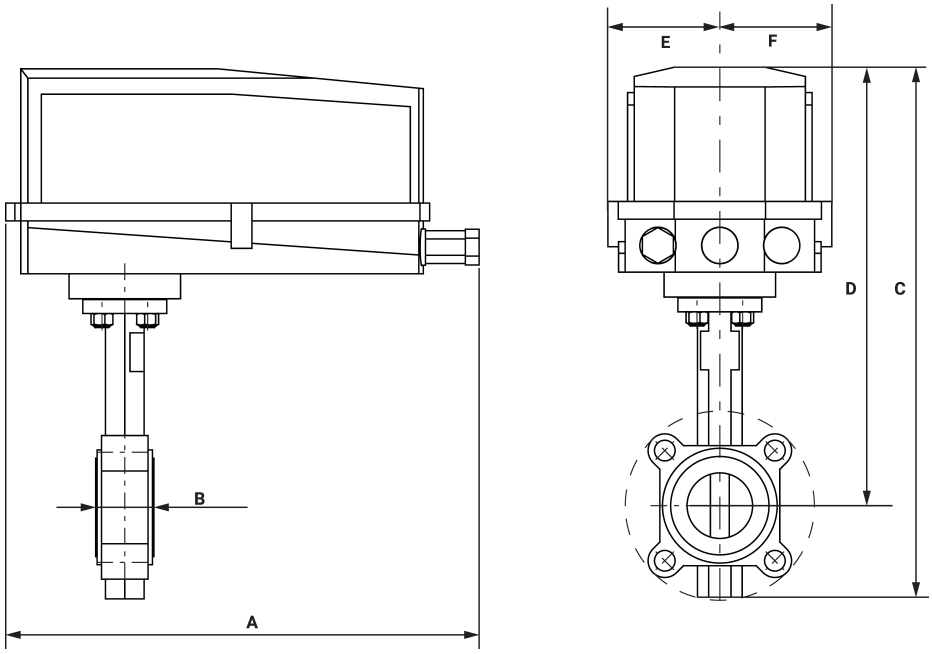
Dimensions

Type	DN	Weight
F650HD	50	12 lb [5.3 kg]



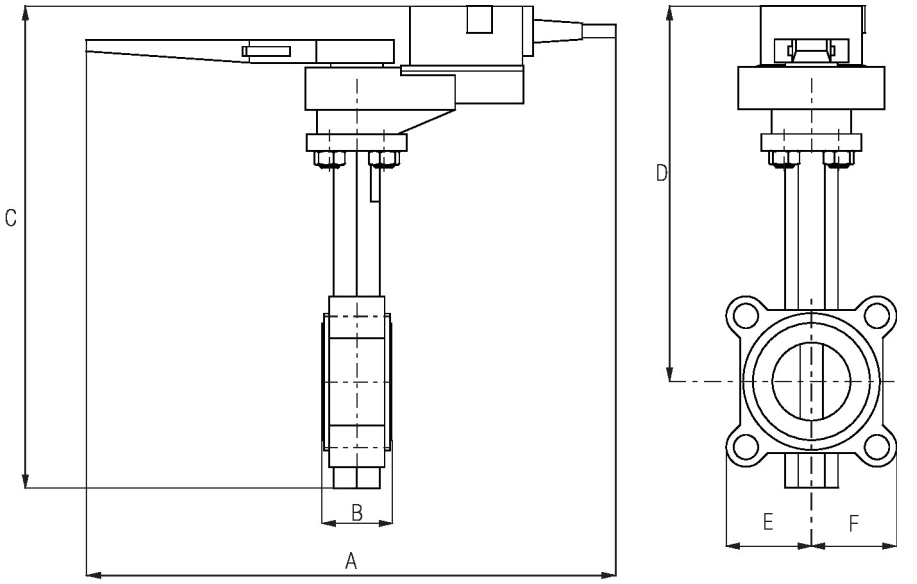
Valve with AFR Actuator

A	B	C	D	E	F	Number of Bolt Holes
10.1" [257]	1.8" [45]	12.3" [312]	9.5" [241]	2.9" [73]	2.9" [73]	4



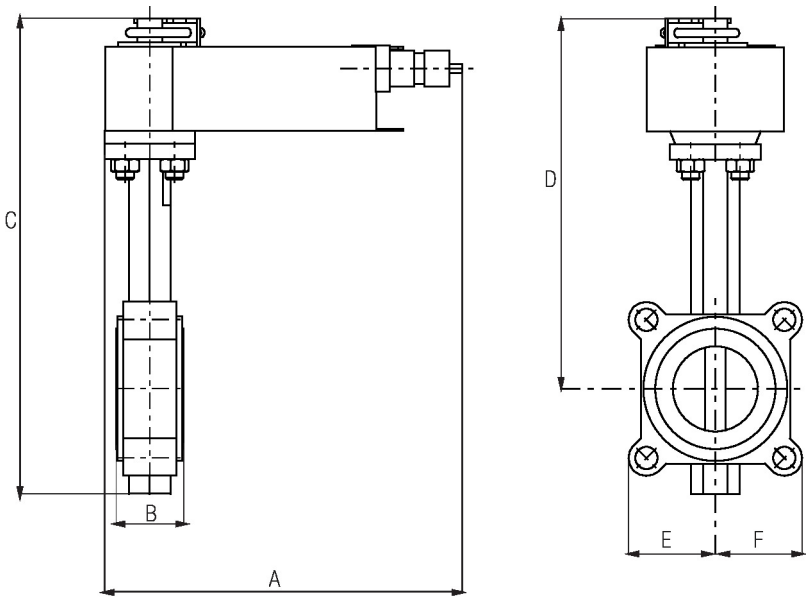
Valve with AF/GR N4 Actuator

A	B	C	D	E	F	Number of Bolt Holes
14.5" [368]	1.8" [45]	16.1" [409]	13.3" [338]	3.4" [86]	3.4" [86]	4



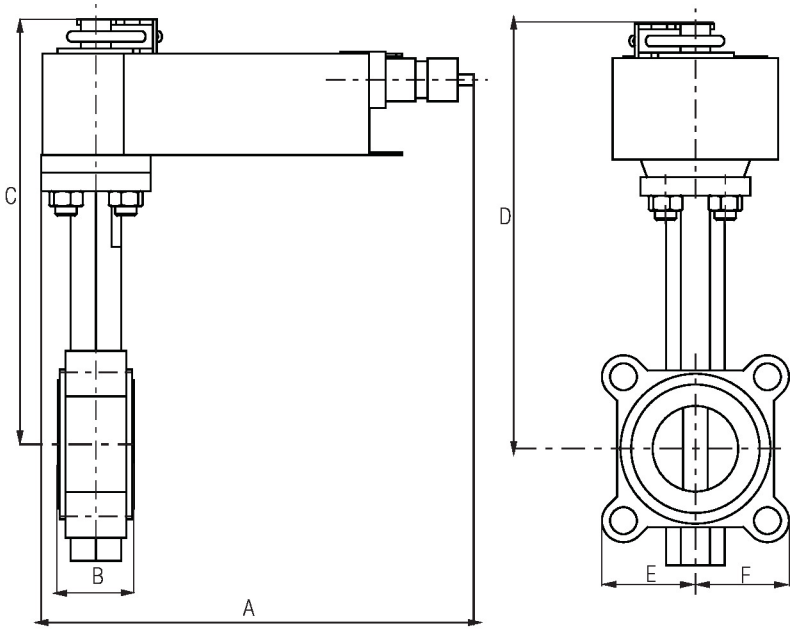
Valve with ARB/GRB Actuator

A	B	C	D	E	F	Number of Bolt Holes
14.6" [370]	1.8" [45]	12.4" [314]	9.7" [246]	2.9" [73]	2.9" [73]	4



Valve with AFB/AFX Actuator

A	B	C	D	E	F	Number of Bolt Holes
10.1" [257]	1.8" [45]	15.1" [384]	12.4" [315]	2.9" [73]	2.9" [73]	4

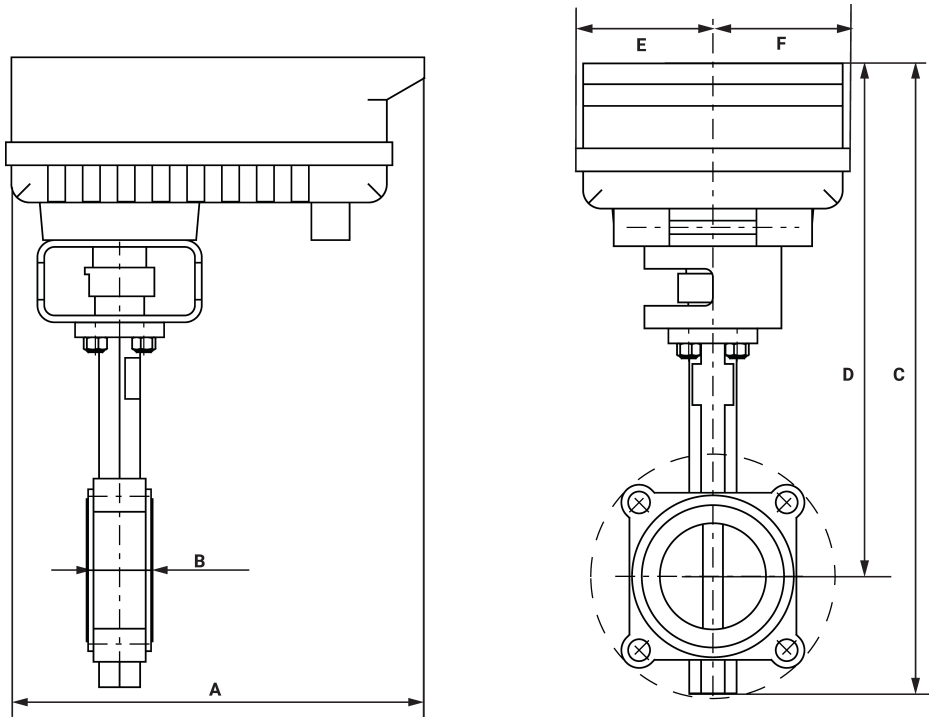


Valve with AMB/AMX Actuator

A	B	C	D	E	F	Number of Bolt Holes
8.3" [211]	1.8" [45]	15.1" [384]	12.4" [315]	2.9" [73]	2.9" [73]	4

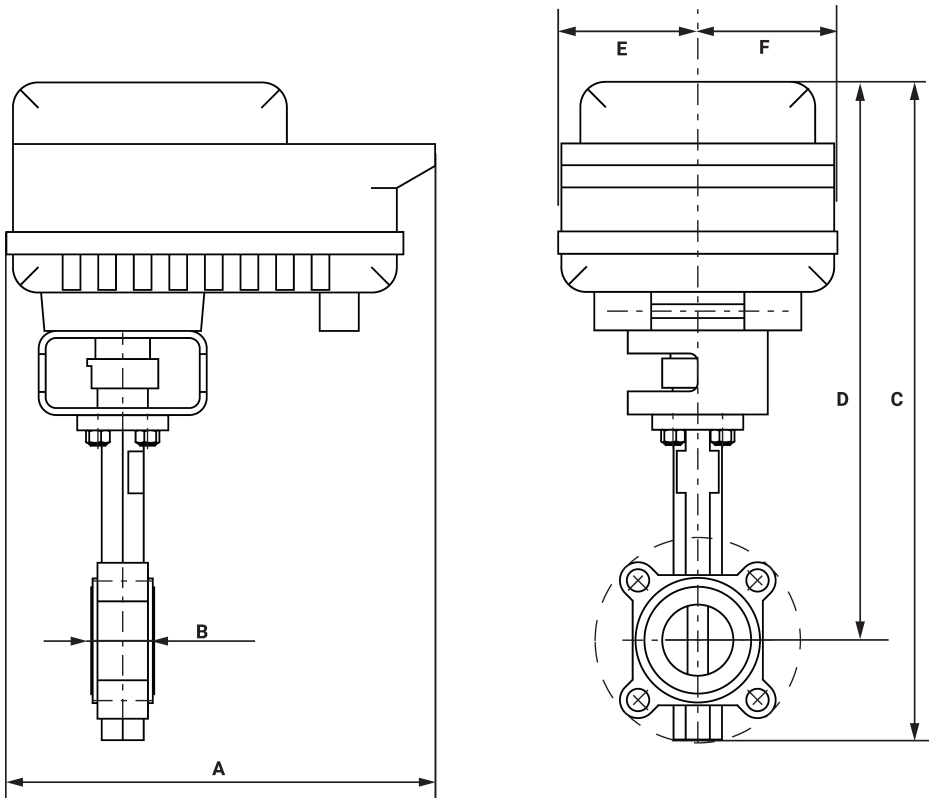
Dimensions

Valve with PR Actuator



A	B	C	D	E	F	Number of Bolt Holes
12.0" [304]	1.8" [45]	16.7" [425]	13.9" [354]	3.9" [100]	3.9" [100]	4

Valve with PK Actuator



A	B	C	D	E	F	Number of Bolt Holes
12.0" [304]	1.8" [45]	18.5" [470]	15.7" [399]	3.9" [100]	3.9" [100]	4

A	B	C	D	E	F	Number of Bolt Holes
10.8" [275]	1.8" [45]	13.0" [330]	10.2" [260]	2.9" [73]	2.9" [73]	4

MFT/programmable, Spring return, 24 V



5-year warranty

MFT

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	7.5 W
	Power consumption in rest position	3 W
	Transformer sizing	10 VA
	Electrical Connection	18 GA appliance cable, 1 m, 3 m, or 5 m with 1/2" NPT conduit connector, degree of protection NEMA 2 / IP54
	Overload Protection	electronic throughout 0...95° rotation
Functional data	Torque motor	20 Nm
	Operating range Y	2...10 V
	Operating range Y note	4...20 mA w/ ZG-R01 (500 Ω, 1/4 W resistor)
	Operating range Y variable	Start point 0.5...30 V End point 2.5...32 V
	Operating modes optional	variable (VDC, PWM, on/off, floating point)
	Position feedback U	2...10 V
	Position feedback U note	Max. 0.5 mA
	Position feedback U variable	VDC variable
	Direction of motion motor	selectable with switch 0/1
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Manual override	5 mm hex crank (3/16" Allen), supplied
	Angle of rotation	95°
	Angle of rotation note	adjustable with mechanical end stop, 35...95°
	Running Time (Motor)	150 s / 90°
	Running time motor variable	70...220 s
	Running time fail-safe	<20 s
	Override control	MIN (minimum position) = 0% MID (intermediate position) = 50% MAX (maximum position) = 100%
	Noise level, motor	40 dB(A)
	Noise level, fail-safe	62 dB(A)
	Position indication	Mechanical
Safety data	Power source UL	Class 2 Supply
	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2

Technical data

Safety data	Enclosure	UL Enclosure Type 2
	Agency Listing	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2014/30/EU
	Quality Standard	ISO 9001
	UL 2043 Compliant	Suitable for use in air plenums per Section 300.22(C) of the NEC and Section 602 of the IMC
	Ambient humidity	Max. 95% RH, non-condensing
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Servicing	maintenance-free
Weight	Weight	4.6 lb [2.1 kg]
Materials	Housing material	Galvanized steel and plastic housing

Footnotes *Variable when configured with MFT options.

Accessories

Electrical accessories	Description	Type
	Service tool, with ZIP-USB function, for programmable and communicative Belimo actuators, VAV controller and HVAC performance devices	ZTH US

Electrical installation

Warning! Live electrical components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Meets cULus requirements without the need of an electrical ground connection.

A Actuators with appliance cables are numbered.

1 Provide overload protection and disconnect as required.

3 Actuators may also be powered by DC 24 V.

5 Only connect common to negative (-) leg of control circuits.

7 A 500 Ω resistor (ZG-R01) converts the 4...20 mA control signal to 2...10 V.

8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 V line.

10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a triac sink controller; the actuator internal common reference is not compatible.

12 IN4004 or IN4007 diode. (IN4007 supplied, Belimo part number 40155).

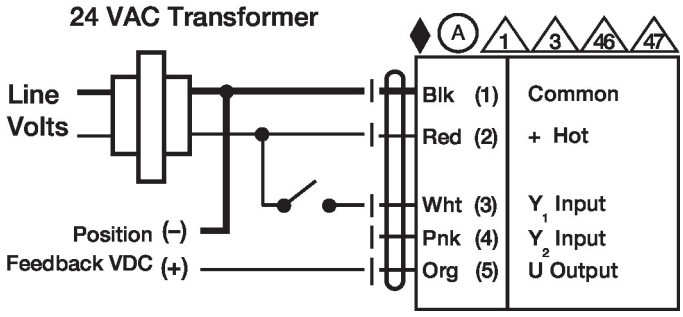
46 Actuators may be controlled in parallel. Current draw and input impedance must be observed.

47 Master-Slave wiring required for piggy-back applications. Feedback from Master to control input(s) of Slave(s).

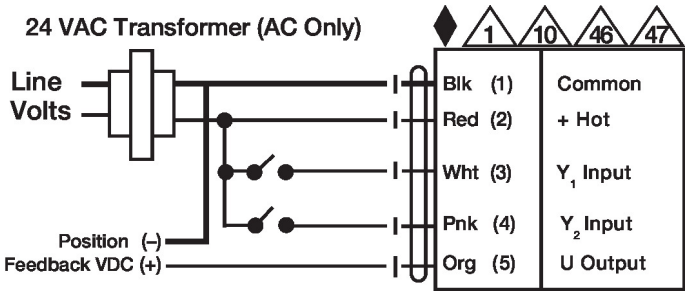
Electrical installation

Wiring diagrams

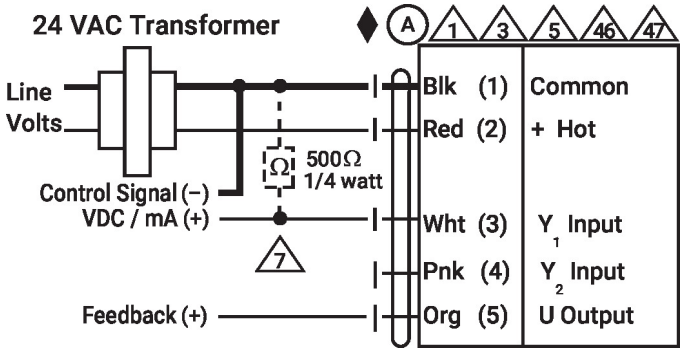
On/Off



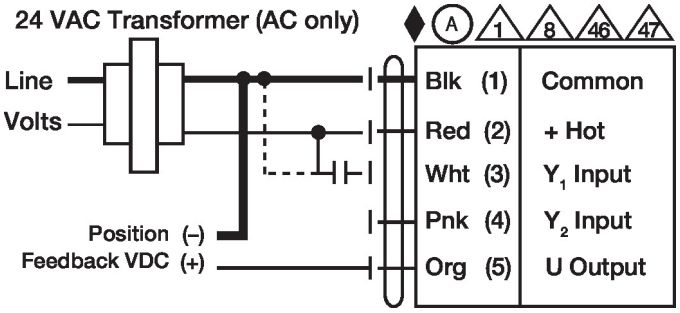
Floating Point



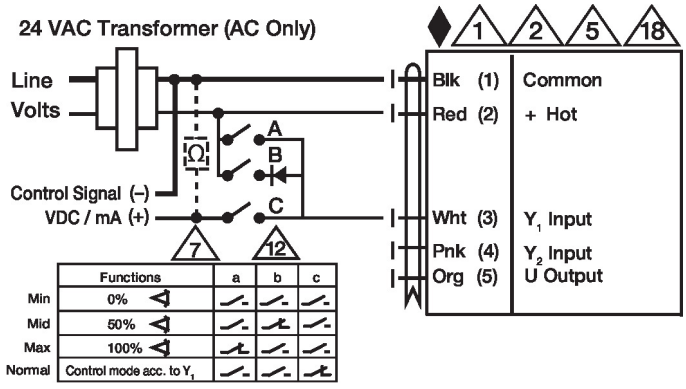
VDC/mA Control



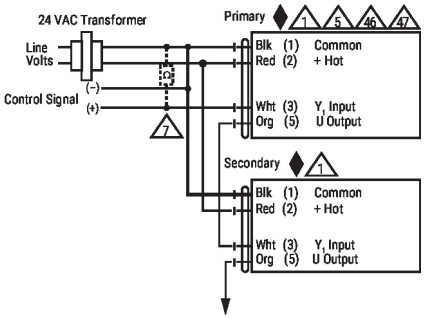
PWM Control



Override Control

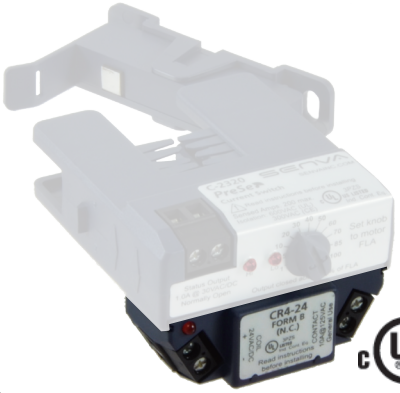


Primary - Secondary



INSTALLATION INSTRUCTIONS

CR3-24V Relay Module, 1 x N.O. Fits C23xx series



3PZS
c UL US LISTED

DANGER

Failure to follow these instructions will result in death or serious injury.

Hazard of electrical shock, explosion, and arc flash

- Follow ALL requirements in NFPA 70E for safe work practices and for Personal Protective Equipment (USA) and other applicable local codes when installing this product
- Only qualified electrical personnel should install this product.
- Read, understand, and follow all instructions thoroughly
- Install only on insulated conductors
- Lock out and tag out all power sources prior to installation. Use properly rated voltage sensing instrument to determine no voltage is present

WARNING

Failure to follow these instructions could result in death or serious injury.

Automated equipment may start without warnng

- Equipment monitored/operated by this device may start without warning. Keep clear of apparatus at all times

IMPORTANT WARNINGS

- Only qualified trade installers should install this product
- This product is not intended for life-safety applications
- Do not install in hazardous or classified locations
- The installer is responsible for all applicable codes
- This product must be installed in a suitable electrical enclosure

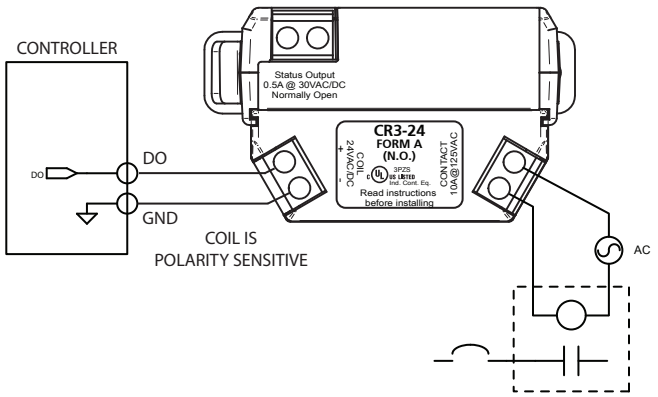
PRODUCT APPLICATION LIMITATION:
Senva products are not designed for life or safety applications. Senva products are not intended for use in critical applications such as nuclear facilities, human implantable device or life support. Senva is not liable, in whole or in part, for any claims or damages arising from such uses.

INSTALLATION

Disconnect, lock out and tag out all power supplies during installation

1. Slide relay module onto any C23xx series mini split-core sensor.
2. Wire relay module to control panel and to motor starter. Tighten terminals to 3.5 in-lb.
3. Observe polarity of relay coil terminals.

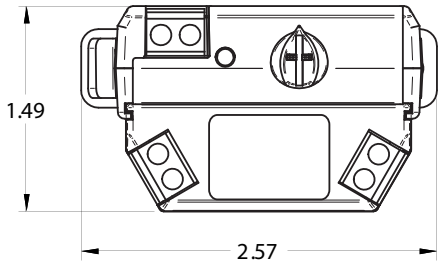
WIRING EXAMPLES



OPERATION

The CR3 command relay module slides onto any C23xx series sensor, providing a convenient means of controlling line-voltage devices such as motor starters from low-voltage control signals.

DIMENSIONS



Troubleshooting

Symptom	Causes	Remedy
LED not lit, relay not energized	Coil wiring incorrect	Check polarity
	Coil voltage too low	Check coil voltage

Maximum surrounding air ambient, 60 ° C.

For use in Pollution Degree 2 Environment.

Part Number	CR3-12	CR3-24
Coil	9-12VDC, 30mA nom.	24VAC/DC, 15mA nom.
Contact Arrangement	N.O. (1 form A)	
Contact Rating	10A@125VAC (UL C300 RATED)	
Temperature Rating	-15~60 ° C	
Dimensions (LxWxH)	2.94" x 2.23" x 0.82" (1.4" H with relay module)	

AutoSet Series

Self-calibrating Current Switch

Self-calibrating for proof of flow
Works flawlessly on VFDs and constant volume applcations
0.5-135A range
N.O. 30VAC/DC output
Optional command relay with LED



DESCRIPTION

The AutoSet™ VFD self-calibrates to detect proof of flow on both variable frequency driven and constant volume motors on fans or pumps. The C-2350VFD automatically sets the proper threshold, eliminating false alarms associated with varying frequencies. Detects motor undercurrent conditions such as belt loss, coupling shear, and mechanical failure on fans and pumps while reducing installation time. New super-low 0.5A turn-on--totally self-powered!

APPLICATIONS

- Detecting belt loss, coupling shear, and mechanical failure on variable frequency drives and constant volume fans and pumps.
- Great for data center current switch sensing



Optional CR-XX command relay for stop/start/status in one labor saving device.



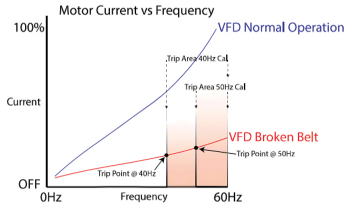
Low turn-on of 0.5A for proof of flow status on VFDs. No calibration typically required.



Never clibrate in live enclosures again. Redicing risk of an arc flash.



Proven 1/2 hour savings per install over manually calibrated devices.



Utilizes a algorithm to detect belt loss on motors operated by variable frequency drives



Buy American Act Certified

FEATURES

- Self-calibration for proof of flow on both VFD and constant volume (CV) fans and pump applications
- Works without costly 'training' of sensor - our sensors are just plain smarter!
- No need to open energized enclosures - save on labor as well as improves safety
- Only sensor line capable of functioning on VFDs to 0.5A
- Sensor is always properly adjusted—no callbacks
- Push-button and LED for fast learn and go/no modes
- Optional command relay for stop/start/status in unitary device—saves component and installation space/cost
- Solid-state-more reliable than mechanical pressure switches for proof of flow
- Quality backed by 7 year limited warranty!

ORDERING

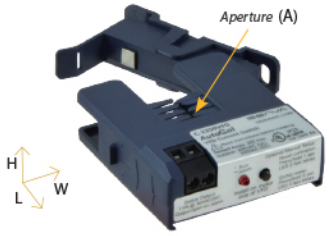
SPLIT CORE	Min (on)	Max Amps	Output	Run/Alarm LED	Sensor Power
C-2350VFD	0.5A @ 60Hz 1.5A @ 20Hz 2.5A @ 10Hz	135A	1.0A@30VAC/DC	•	Induced

COMMAND RELAY - DIRECT MOUNT (MOUNTS ON ALL 2300 SERIES CURRENT DEVICES)	Contact rating	Coil
CR3-24	N.O. 10A @ 125VAC	24VAC/DC 15mA nominal
CR4-24	N.C. 10A @ 125VAC	24VAC/DC 15mA nominal
CR3-12	N.O. 10A @ 125VAC	9-12VDC 30mA nominal
CR4-12	N.C. 10A @ 125VAC	9-12VDC 30mA nominal

Other coil voltages available—consult factory

DIMENSIONS

SPLIT CORE
C-2350VFD



L: 2.5" H: 0.57" W: 2.23"
A: 0.75"x 0.75"

- Mount sensor without removing conductor for installation savings
- Clamp on conductor with iris, or use detachable base to screw or DIN mount
- Larger 0.75" aperture accomodates oversize conductors

OPTIONAL RELAY



L: 0.84" H: 0.72" W: 2.06"

- Add to 2350VFD series to get start, stop, status in a single device
- Reduces the number of installed components… saves time and space
- Removable relay facilitates service

Warning: The datasheet is designed for reference only. Refer to installation instructions that accompany the product and heed all safety instructions. Product improvement is a continuing process at Senva. Changes may occur to products without prior notice.

SPECIFICATIONS

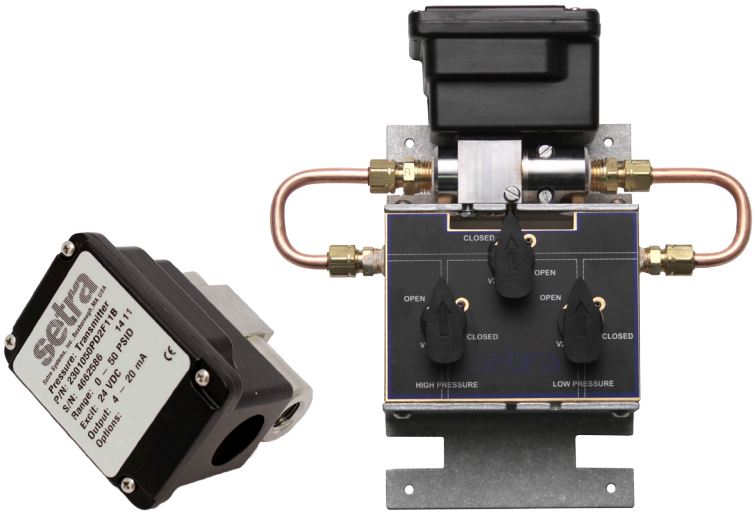
Split Core	Min (on)	Max A	Output*	Sensor P
C-2350VFD	0.5A	135A	1.0A@30VAC/DC	Induced

Command Relay	Contact rating	Coil
CR3-24	N.O. 10A@125VAC	24VAC/DC, 15mA nom.
CR4-24	N.C. 10A@125VAC	24VAC/DC, 15mA nom.
CR3-12	N.O. 10A@125VAC	9-12VDC, 30mA nom.
CR4-12	N.C. 10A@125VAC	9-12VDC, 30mA nom.

** Product improvement is a continual process at Senva and product features and specification may change without prior notice. Refer to instructions that accompany the product for installation and wiring.*

Model 230

True Wet-to-Wet Differential Pressure Transducer



The Model 230 is Setra's highest accuracy solution for monitoring differential pressure in wet-to-wet applications. Its single diaphragm design enables a true wet-to-wet differential pressure measurement with superior ±0.25% FS accuracy compared to competitive units which calculate differential pressure using two single point pressure sensors. The stainless steel capacitive sensor provides a highly accurate, linear analog output proportional to the pressure over a wide temperature range. The 230 is offered with an optional 3 or 5 valve machined brass manifold for ease of installation and maintenance.

Avoid Line Pressure w/ Single Diaphragm Sensor

Unlike the competition, the 230 is a true wet-to-wet sensor with a single diaphragm construction. The differential pressure range of a single diaphragm is not impacted by line pressure whereas dual differential pressure sensors require the individual sensors to measure gauge pressure, comparing the outputs to determine the differential pressure.

Increase the Sensors Response Time

The 230 utilizes an all stainless steel capacitive sensor which responds 20x faster than oil filled sensors and provides conditioned electronic circuitry with a highly accurate, linear analog output proportional to the pressure over a wide temperature range.

Save Time on Money & Installation

When time and project costs are a priority, the 230 is offered with an optional 3 or 5 valve machined brass manifold for ease of installation and maintenance. The brass body has no internal process connections, therefore eliminating the risk of internal leaks.

- **Single Diaphragm Design**
- **All Stainless Steel Capacitive Sensor**
- **3 or 5 Valve Manifold Assembly Options**

Model 230 Features:

- Only true wet-to-wet differential pressure transducer on the market
- ±0.25% FS Accuracy
- Available to 1 PSID with 350 PSI Line Pressure
- No Liquid Fill Diaphragm
- NEMA 4 Rated Housing
- Low Line Pressure Effect
- Fast Response Time
- Gas & Liquid Compatible
- CE & RoHS Compliant

Applications:

- Energy Management Systems
- Process Control Systems
- Flow Measurement of Various Gases or Liquids
- Liquid Level Measurement or Pressurized Vessels
- Pressure Drop Across Filters

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Model 230

True Wet-to-Wet Differential Pressure Transducer

PROOF PRESSURE

Unidirectional		
Pressure Range PSID	Proof Pressure High Side PSI	Proof Pressure Low Side PSI
0 to 1.0	50	2.5
0 to 2.0	50	5
0 to 5.0	100	12.5
0 to 10.0	100	25
0 to 25.0	350	62.5
0 to 30.0	350	75
0 to 50.0	350	125
0 to 100.0	350	250

Bidirectional		
Pressure Range PSID	Proof Pressure High Side PSI	Proof Pressure Low Side PSI
0 to ±0.5	50	1.25
0 to ±1.0	50	2.5
0 to ±2.5	100	6.35
0 to ±5.0	100	12.5
0 to ±10.0	200	25
0 to ±25.0	350	62.5
0 to ±50.0	350	125

GENERAL SPECIFICATIONS

Performance Data	
Accuracy RSS[1] (at constant temp)	±0.25% FS
Non-Linearity, BFSL	±0.20% FS
Hysteresis	0.10% FS
Non-Repeatability	0.05% FS
Thermal Effects[2]	
Compensated Range °F(°C)	+30 to +150 (-1 to +65)
Zero Shift %FS/100°F(%FS/50°C)	2.0 (1.8)
Span Shift %FS/100°F(%FS/50°C)	2.0 (1.8)
Line Pressure Effect	Zero shift ±0.004% FS/PSIG line pressure
Resolution	Infinite, limited only by output noise level (0.02%FS)
Static Acceleration Effect	2%FS/g (most sensitive axis)
Natural Frequency	500 Hz (gaseous media)
Warm-up Shift	±0.1% FS total
Response Time	30 to 50 milliseconds
Long Term Stability	0.5%FS/1 YR
Maximum Line Pressure	350 PSIG
Environmental Data	
Operating[3] Temperature °F (°C)	0 to +175 (-18 to +80)
Storage Temperature °F (°C)	-65 to +250 (-54 to +121)
Vibration	5 g from 5 Hz to 500 Hz
Acceleration	10g
Shock	50g
Pressure Media	
Model 230	
Gases or liquids compatible with 17-4 PH Stainless Steel, 300 Series Viton O-Rings. Note: Hydrogen not recommended for use with 17-4 PH stainless steel. Optional Buna-N O'rings are recommended for hydrocarbon applications.	
3 & 5 Valve Manifold	
Gases or liquids compatible with 360 brass, Copper 122, Acetal plug valves and Nitrile O-rings.	

Physical Description (Model 230)	
Case	Stainless Steel/Aluminum
Electrical Connection	Barrier strip terminal block with conduit enclosure & 0.875 DIA conduit opening.
Pressure Fittings	1/4"-18 NPT internal
Weight (approx.)	14.4 oz
Sensor Cavity Volume	0.27 in³ Positive Port, 0.08 in³ Negative Port
(With 1/4"NPT external fittings installed-does not include cavity volume of 1/4"NPT external fittings.)	
Physical Description (3-Valve Manifold Assembly)[4]	
Manifold Block	Brass
Valves (3)[5]	V1 for Connection to + port V2 for Connection to - port V3 for Equalizing Pressure
Valve Type	90° On/Off
Process Connections	1/4"-18 NPT Internal Thread
Dimensions	7.05"W x 6.25"H x 2.16"D
Weight	<2.5 lbs.
Physical Description (5-Valve Manifold Assembly)[6]	
Manifold Block	Brass
Valve (5)[5]	V1 for Connection to ± Port V2 for Connection to – Port V3 for Equalizing Pressure V4 & V5 for Connection to External Gauge or Alternate Plumbing Configuration
Process Connection	1/4"-18 NPT Internal Thread
Dimensions	7.05"W x 6.25"H x 2.16"D
Weight	<3.8 lbs.
Electrical Data (Voltage)	
Circuit	3-Wire (Exc, Out, Com)
Excitation	9 to 30 VDC for 0-5 VDC Output, 13 to 30 VDC for 0-10 VDC Output
Output[7]	0 to 5 VDC[8], 0 to 10 VDC[8]
Output Impedance	100 ohms
Electrical Data (Current)	
Circuit	2-Wire
Output[9]	4 to 20mA[10]
External Load	0 to 1000 ohms
Minimum supply voltage (VDC)	9+ 0.02 x (Resistance of receiver plus line).
Maximum supply voltage (VDC)	30+ 0.004 x (Resistance of receiver plus line).

[1] RSS of Non-Linearity, Hysteresis, and Non-Repeatability.
[2] Units calibrated at nominal 70° F. Maximum thermal error computed from this datum.
[3] Operating temperature limits of the electronics only. Pressure media temperatures may be considerably higher.
[4] Order assembled with the Model 230 (Code 3V) or separately as Option 891.
[5] Refer to drawings
[6] Order assembled with the Model 230 (Code 5V)
[7] Calibrated into a 50K ohm load, operable into a 5000 ohm load or greater.
[8] Zero output factory set to within ±25mV (for 5 VDC output) or ±50mV (for 10 VDC output)
Span (Full Scale) output factory set to ±25 mV (for 5 VDC output) or ± 50 mV (for 10 VDC output
[9] Calibrated at factory with a 24 VDC loop supply voltage and a 250 ohm load.
[10] Zero output factory set to within ±0.16mA. Span factory set to within ±0.16 mA

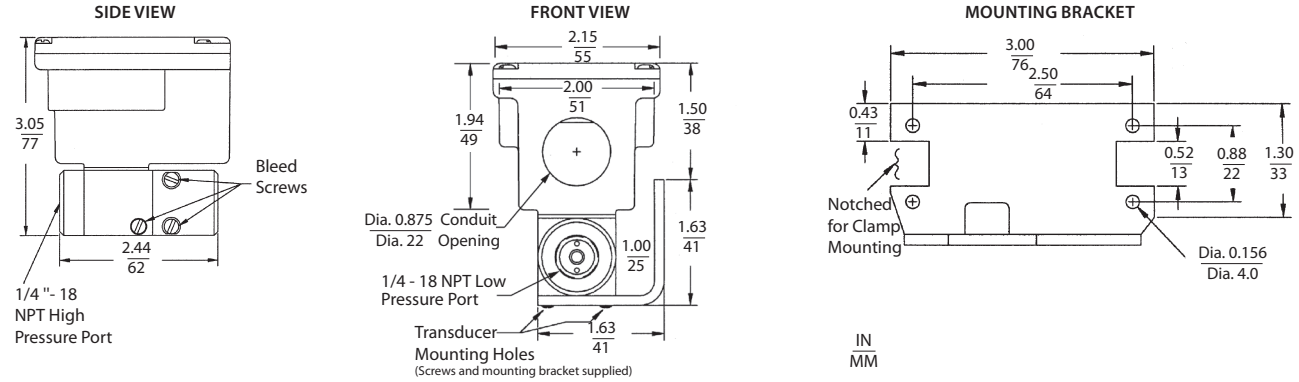
Specifications subject to change without notice.

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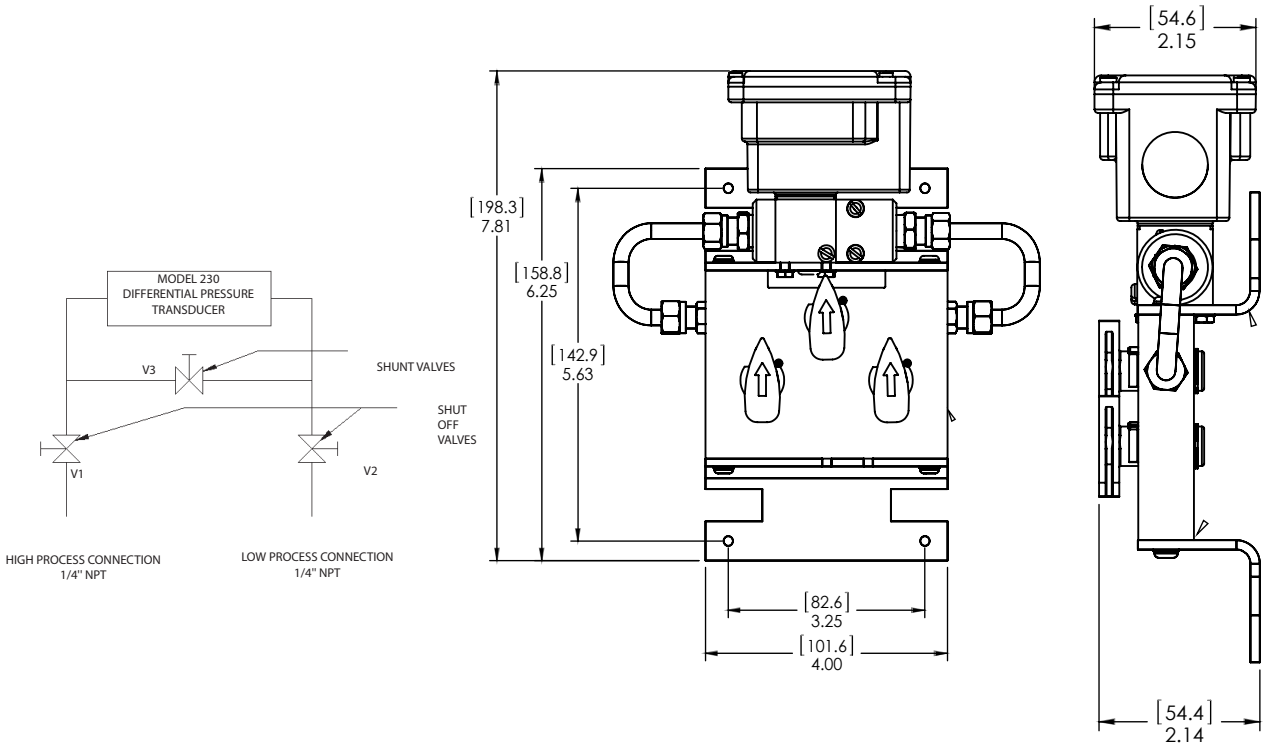
Model 230

True Wet-to-Wet Differential Pressure Transducer

MODEL 230 DIMENSIONS



DIMENSIONS W/ 3-VALVE MANIFOLD ASSEMBLY



For differential pressure measurements at high line pressure (350 PSIG max), it is recommended that the pressure sensor be installed with a valve in each line, plus a shunt valve across the high and low (reference) pressure ports as shown.

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Model 230

True Wet-to-Wet Differential Pressure Transducer

ORDERING INFORMATION

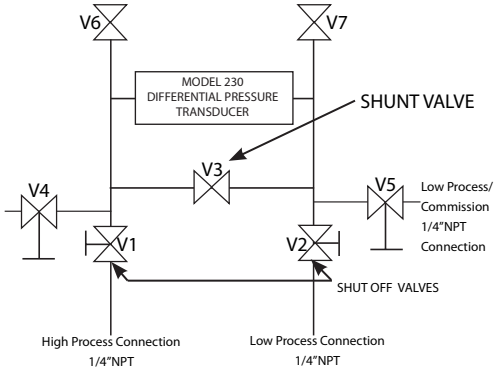
2	3	0	1	–						–			–			–		–	

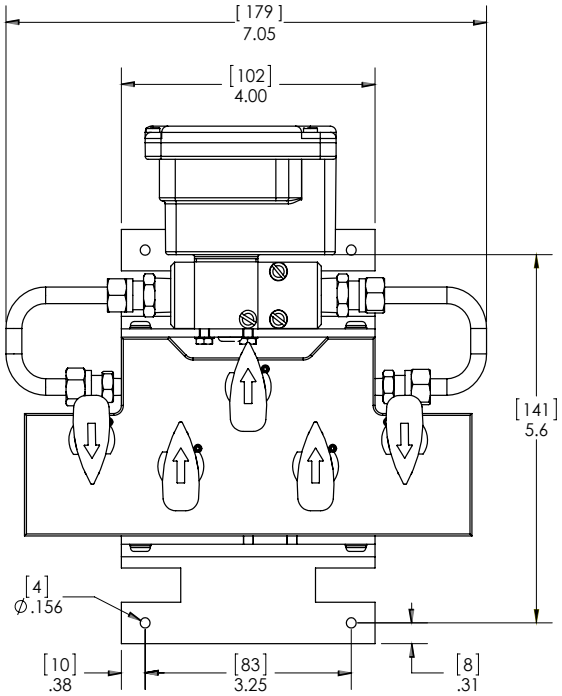
Model	Range				Pressure Fitting		Output		Bleed Screw Seals			Optional	
2301 = 230	Unidirectional		Bidirectional		2F	1/4" NPT (F)	11	4-20 mA	Std.	B	Viton	C	Calibration Certificate
	001PD	0 to 1 PSID	0R5PB	±0.5 PSID	3V	3-Valve Manifold	2D	0.05-5.05 VDC	Opt.	A	Buna-N		
	002PD	0 to 2 PSID	001PB	±1 PSID	5V	5-Valve Manifold	2E	0.05-10.05 VDC					
	005PD	0 to 5 PSID	2R5PB	±2.5 PSID									
	010PD	0 to 10 PSID	005PB	±5 PSID									
	025PD	0 to 25 PSID	010PB	±10 PSID									
	030PD	0 to 30 PSID	025PB	±25 PSID									
	050PD	0 to 50 PSID	050PB	±50 PSID									
	100PD	0 to 100 PSID											

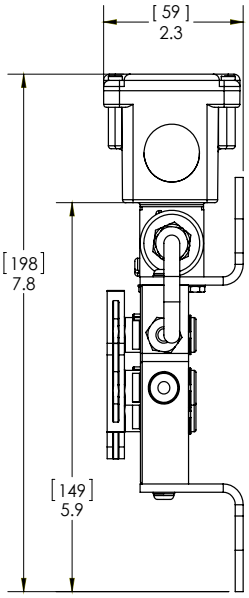
Please contact factory for versions not shown.

Ordering Example: 2301005PD2F11B = Model 230 0 to 5 PSID unidirectional, 1/4-18 NPT Ext. fitting, 4 to 20 mA Output, and Viton/Silicone Seals.
2301005PD3V11B = Model 230, 0 to 5 PSID unidirectional, 3-Valve Manifold, 4 to 20 mA, Output, and Viton/Silicone Seals (Assembled w/3- Valve Manifold).

DIMENSIONS W/ 5-VALVE MANIFOLD ASSEMBLY







For differential pressure measurements at high line pressure (350 PSIG max), it is recommended that the pressure sensor be installed with a valve in each line, plus a shunt valve across the high and low (reference) pressure ports as shown.
Note: V6 and V7 bleed valves are not required when used with a Setra Model 230. Use the bleed screws on Model 230 to bleed the lines of air.

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Code No. LIT-1900614
Issued October 2019

Expansion Panels - Heating, Ventilating, and Air Conditioning (HVAC) Catalog Page

Description

Expansion panels provide a platform for field built custom or standard panel solutions. Field assembly time is compressed by providing a pre-assembled panel containing a power supply, wire management hardware, DIN rails, a perforated sub-panel, and a 24 VAC distribution terminal block. Digital controllers and other required components are obtained and installed separately.

The components included with the expansion panel include a steel enclosure with perforated sub-panel, a pre-mounted DIN rail, power supply with convenience outlets (additional transformer with some models), wire ducts, and a 24 VAC distribution terminal block.

Features

- flexibility to customize the expansion panel assembly to a wide variety of solutions using basic panel components
- additional items, such as digital controllers, input/output modules, relays, and contactors, which are sourced locally and field mounted
- five available sizes, all in a consistent layout
- distribution terminal block, which provides additional points for 24-volt supply
- available in NEMA/UL Type 1, NEMA/UL Type 3R, and NEMA/UL Type 4/4x/12

Repair information

If the expansion panel fails to operate within its specifications, replace the unit. For a replacement expansion panel, contact the nearest Johnson Controls® representative.



Clockwise from top: Expansion Panels Type 1, Type 4/4x/12, and Type 3R

Selection charts

NEMA/UL Type 1 Expansion panels

Product code number	Description
PA0000004GC0	Expansion panel, 12 x 16 x 6.5 in. panel, 40 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001FH0	Expansion panel, 16 x 20 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001AH0	Expansion panel, 20 x 24 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000002AH0	Expansion panel, 20 x 24 x 6.5 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block, and additional 96 VA transformer
PA0000001EH0	Expansion panel, 24 x 24 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000002EH0	Expansion panel, 24 x 24 x 6.5 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer
PA0000001BH0	Expansion panel, 24 x 36 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000002BH0	Expansion panel, 24 x 36 x 6.5 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer
P2BBN-00001N00	Expansion panel, 20 in. x 24 in. x 9.25 in., 120/24 VAC power supply, wire duct, 5 point distribution block, Suitable for use with ring manager IP network system
P2DBN-00002N00	Expansion panel, 24 in. x 36 in. x 9.25 in., 120/24 VAC power supply, wire duct, 10 point distribution bloc, Additional 96 VA transformer, Suitable for use with ring manager IP network system
P2DBN-00001N00	Expansion panel, 24 in. x 36 in. x 9.25 in., 120/24 VAC power supply, wire duct, 5 point distribution block, Suitable for use with ring manager IP network system

NEMA/UL Type 3R Expansion panels

Product code number	Description
PA0000001FA0	Expansion panel, 16 x 20 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001AA0	Expansion panel, 20 x 24 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001EA0	Expansion panel, 24 x 24 x 8 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000002AA0	Expansion panel, 20 x 24 x 8 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer
PA0000002EA0	Expansion panel, 24 x 24 x 8 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer

NEMA/UL Type 4/4x/12 Expansion panels

Product code number (Part 1 of 2)	Description
PA0000001FB0	Expansion panel, 16 x 20 x 6.5 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001AB0	Expansion panel, 20 x 24 x 8 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001EB0	Expansion panel, 24 x 24 x 8 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block
PA0000001BB0	Expansion panel, 24 x 36 x 8 in. panel, 96 VA power supply, and a 5 point 24 VAC distribution terminal block

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products. © 2019 Johnson Controls.

Expansion Panels - Heating, Ventilating, and Air Conditioning (HVAC) Catalog Page

Product code number (Part 2 of 2)	Description
PA0000002AB0	Expansion panel, 20 x 24 x 8 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer
PA0000002EB0	Expansion panel, 24 x 24 x 8 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer
PA0000002BB0	Expansion panel, 24 x 36 x 8 in. panel, 96 VA power supply, 10 point 24 VAC distribution terminal block and additional 96 VA transformer

Technical specifications

Expansion panels	
Wire size	Ground wire: 14 AWG; Controller wires: 16 AWG
Ambient operating condition	32°F to 122°F (0°C to 50°C) 10% to 90% RH
Ambient storage condition	-40°F to 176°F (-40°C to 80°C) 5% to 95% RH
Agency compliance	Expansion Panel: UL508A Listed (cULus) Enclosure: UL50 Listed, CSA Approved
Material type	NEMA/UL Type 1: Steel NEMA/UL Type 3R: Steel NEMA/UL Type 4/4x/12: Aluminum
Enclosure finish	NEMA/UL Type 1: Grey powder coat paint NEMA/UL Type 3R: Grey powder coat paint NEMA/UL Type 4/4x/12: Brushed
Door type	NEMA/UL Type 1: Lift off NEMA/UL Type 3R: Lift off NEMA/UL Type 4/4x/12: Stainless steel hinge
Latch type	NEMA/UL Type 1: Keyed lock NEMA/UL Type 3R: Draw pull latches NEMA/UL Type 4/4x/12: Stainless steel door clamps and a hasp and staple for padlocking
Miscellaneous	NEMA/UL Type 4/4x/12: Oil resistant gasket and a door mounted data pocket

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products. © 2019 Johnson Controls.

Order Confirmation

No. 100413710 of 12/02/2025

Sold to:

HARRISON ENERGY PARTNERS
1501 WESTPARK DR
LITTLE ROCK AR 72204-2694

Ship to:

HARRISON ENERGY PARTNERS
1501 WESTPARK DR
LITTLE ROCK AR 72204-2694

Order date: 12/02/2025
Customer PO#: Bjc-MJH10502
Project Name: Ozark Medical
Ordered By: Brent Corn
Customer No.: 104589
Incoterms: DAP Delivered At Place

TRANE - ARKANSAS

Pos.	Item - Description	Quantity	Unit	Origin	List price	Multiplier	Net price	Total price
10	G665C+AFX24-MFT-X1 Reorder# G6GCC6+AFX600 AA1 A01 Globe Valve (GV), 2 1/2", 2-way, ANSI Class 125, Cv 65 Valve Actuator AC/DC 24 V, MFT/programmable Close-off pressure 140 psi assembled, NC/FC Carrier: PYLE Service: Less Than Truck Load Payment Type: Pre Paid **Approx.Receipt: 12/10/2025** Platinum Contrator	2	PC	US	5,396.00	0.291	1,570.24	3,140.47

Belimo Aircontrols (USA), Inc
33 Turner Road
Danbury, CT 06810
Tel: 800-543-9038
Fax: 800-228-8283
www.belimo.com

Order Confirmation

No. 100413710 of 12/02/2025

Pos.	Item - Description	Quantity	Unit	Origin	List price	Multiplier	Net price	Total price

Total net price	Freight	Taxable Sales	Tax %	Tax	Invoice-Total
3,140.47	414.64				**3,555.11 USD**

Terms of payment: 15 days 1 %, 45 days net

BELIMO Americas current Terms and Conditions apply exclusively

Terms and Conditions https://www.belimo.com/mam/americas/marketing_communication/brochures/Terms_and_Conditions_en-us.pdf

Belimo Aircontrols (USA), Inc
33 Turner Road
Danbury, CT 06810
Tel: 800-543-9038
Fax: 800-228-8283
www.belimo.com

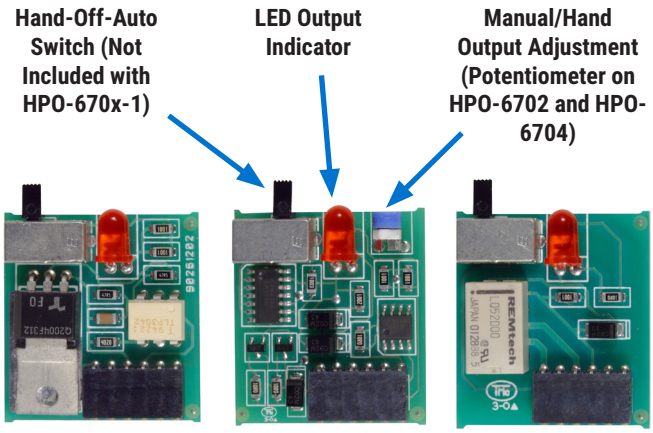
HPO-6700 Series Output Override Boards

Installation Guide

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Older "Plastic" Case Controllers 3
Older "Metal" Case Controllers 4
Wiring 4
Grounds Versus Switched Commons 6
Maintenance 6
Important Notices 6

INTRODUCTION



For enhanced controller output options (such as manual control, using large relays, or for devices that cannot be powered directly from a standard output), install output override boards (in compatible controllers). The following **types of override boards** are available:

- The **HPO-6702** enhances the analog **voltage output** with a **"Hand-Off-Auto" control** while providing an adjustable **potentiometer** for override settings while in the "Hand" position.
- The **HPO-6701/6703/6705** boards are designed to convert a binary/digital output to a **relay** contact or **triac** output and to provide "Hand-Off-Auto" control and feedback functions.
- The **HPO-6704** converts a standard analog voltage output to a **4–20 mA output** while providing an adjustable potentiometer for override settings while in the "Hand" position.

NOTE: The **HPO-6704 board supplies the power** and will not work with a 4–20 mA device that also supplies its own power.

Each output board has a red **LED** indicator that turns On when the board's output is turned **On either manually or automatically.**

Output boards have an accessible three-position **slide switch** for selecting the **"Hand-Off-Auto"** functions:

- While in the **H ("Hand" or manual On)** position, the output is manually energized, and the controller is provided with a feedback signal to indicate the output has been overridden.
- While in the **O (Off)** position, the output is manually de-energized, and the controller is provided with a feedback signal to indicate the output has been overridden.
- While in the **A (Auto)** position, the output is under the command of the controller.

NOTE: An HPO-670x**-1** is always in auto mode and does not have the manual slide switch.

NOTE: HPO-6701 **triac** and HPO-6703/6705 **relay** circuits use the Switched Common **SC** terminal—**not** the Ground Common **GND** terminal.

NOTE: HPO-6701 **triac** outputs are for 24 V**AC** only.

NOTE: Only the HPO-670**1** triac and HPO-670**4** 4–20 mA boards are approved for **smoke control** applications. For smoke control application information, see Smoke Control Manuals 000-035-08 (**BACnet**) and/or 000-035-09 (**KMDigital**).

⚠ CAUTION

Connecting 24 VAC or other signals that exceed the operation specifications of the controller before an override board is installed will damage the controller.

For HPO-6700 series **specifications**, see the **data sheet** at **kmccontrols.com**.

See the sections below for installation into the **particular type of controller.**

- For KMC **Conquest** BAC-5900 series controllers and CAN-5901 expansion modules, see **Conquest Controllers/Modules on page 2**.
- For older controllers with **"top-mounting" raised plastic cases** (BAC-5801/5802 and newer KMD-5801/5802s), see **Older "Plastic" Case Controllers on page 3**.
- For older controllers with **metal** (e.g., BAC-5831, BAC-A1616BC) and **older "side-mounting" plastic cases** (older KMD-5801/5802s), see **Older "Metal" Case Controllers on page 4**.

CONQUEST CONTROLLERS/MODULES

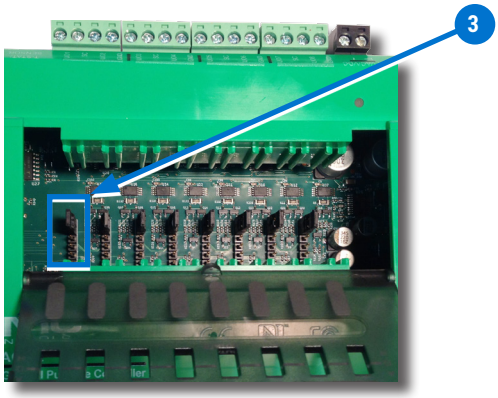
These instructions apply to KMC **Conquest** BAC-5900 series controllers and CAN-5901 expansion modules (with a flip-open lid).

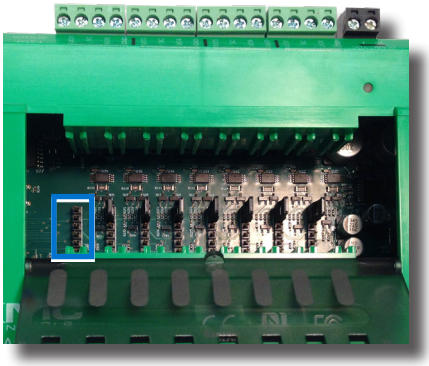
1. Disconnect the power by removing the **black power terminal block**.



2. Pull the top edge of the (translucent black) override board cover away from the case and flip open the **cover**.

3. Remove the **jumper** from the slot in which the override board will be installed.

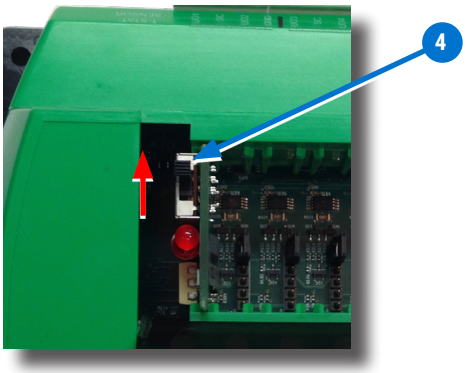




NOTE: Each of the eight override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Orient the override board with the HOA selection slide **switch toward the top** of the controller.

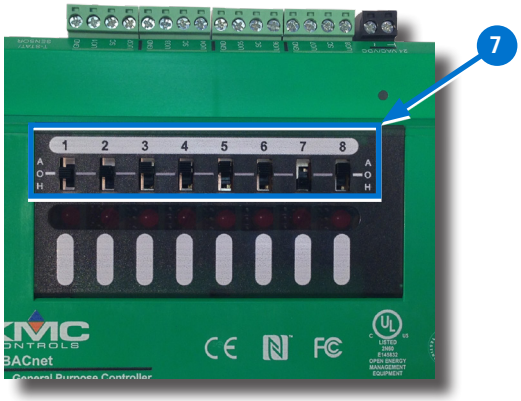
5. Slide the override **board into the slot** in which the jumper was removed.



6. Close the plastic cover.

7. Move the **A-O-H selection switch** on the override board to the appropriate position.

NOTE: **A** = Automatic (upper position).
O = Off (middle position).
H = Hand/On (lower position).



NOTE: For more information about output override boards, see the installation guide for the **HPO-6700 Series.**

8. Repeat Steps 3 through 7 for all other desired boards.

9. Wire the output device to the corresponding **green (output) terminal block** of the override board. (See **Wiring on page 4**.)



OLDER "PLASTIC" CASE CONTROLLERS



These instructions apply to controllers with **"top-mounting" raised plastic** cases (e.g., BAC-5801/5802 and newer KMD-5801/5802). After installation of the boards, the existing cover is reinstalled.

To install the HPO-6700 series override boards:

1. Disconnect the power by removing the **power jumper or terminal block**.

2. Remove the **cover** by squeezing on both sides of the cover and lifting it off.

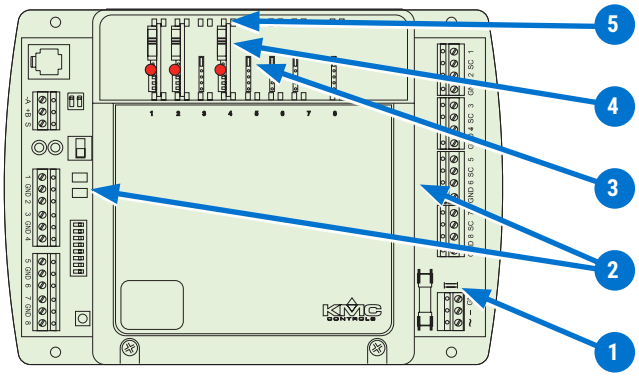
3. Remove the **jumper** from the slot in which the override board will be installed.

   NOTE: Each of the override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Orient the override board with the HOA selection slide **switch toward the top** of the controller.

5. Slide the override **board into the slot** in which the jumper was removed.

6. Set the selection switch on the override board to the

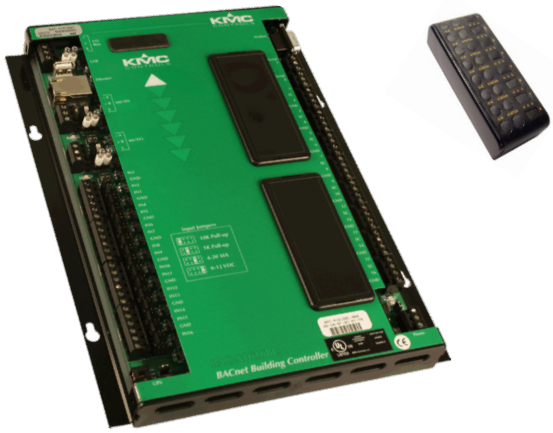


appropriate position.

NOTE: **A** = Automatic (upper position).
O = Off (middle position).
H = Hand/On (lower position).

7. Repeat steps 3 through 6 for all desired boards.
8. Reinstall the cover over the boards.
9. Connect output devices to the controller outputs. (See **Wiring on page 4**.)
10. Reinstall the power jumper that was removed in Step 1.

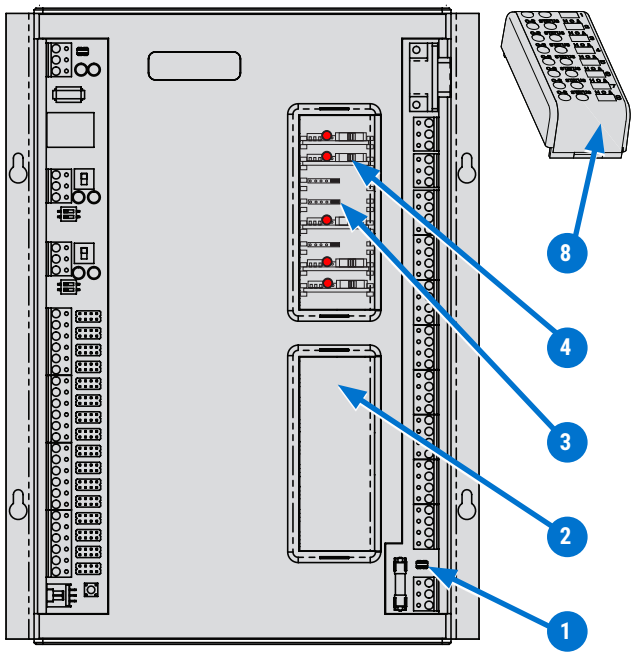
OLDER "METAL" CASE CONTROLLERS



These instructions apply to controllers with **metal** (e.g., BAC-5831, BAC-A1616BC) **and older "side-mounting" plastic cases** (e.g., older KMD-5801/5802). After installation of the boards, the existing slot cover needs to be replaced by a raised HPO-6802 output board cover.

To install the HPO-6700 series override boards:

1. Disconnect the power by removing the **power jumper or terminal block**.
2. Remove the relevant slot **cover**(s) by lifting the right-hand side of the cover (within the plastic frame) toward you.
3. Remove the **jumper** from the slot in which the override board will be installed.

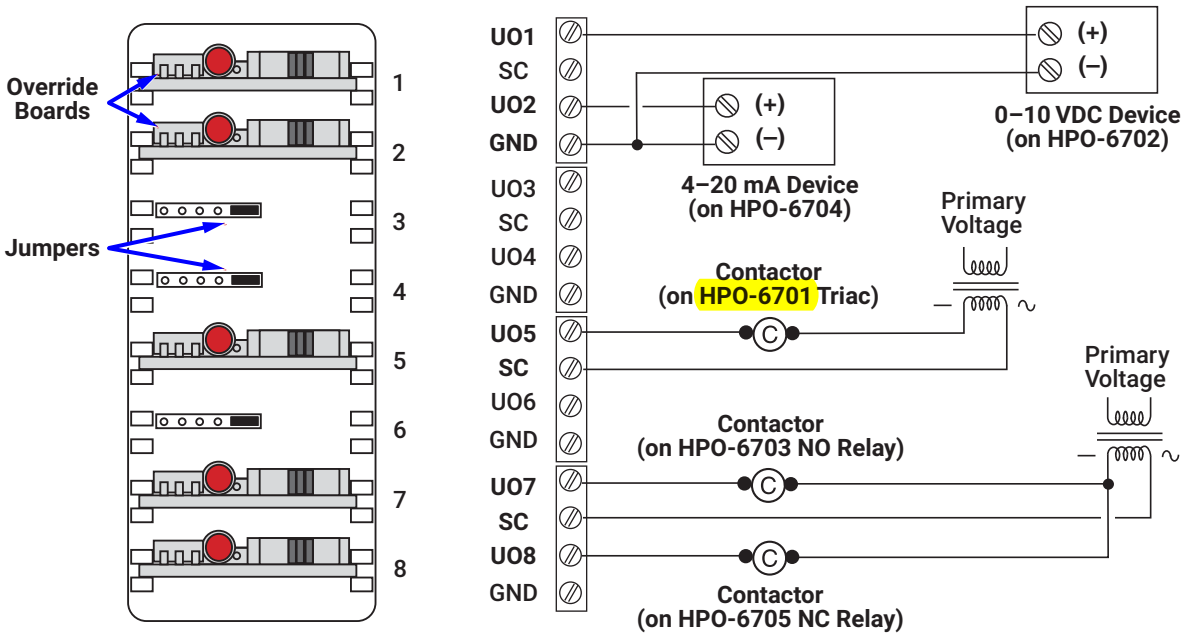


NOTE: Each of the override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

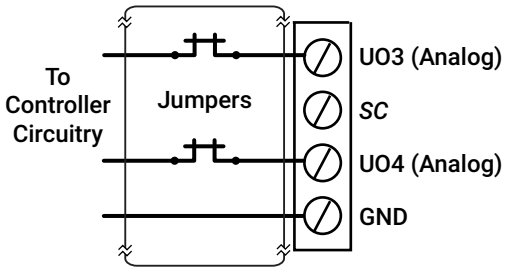
4. Orient the override board with the HOA selection slide **switch toward the outputs** of the controller.
5. Slide the override **board into the slot** in which the jumper was removed.
6. Move the **A-O-H selection switch** on the override board to the appropriate position.

NOTE: **H** = Hand/On.
O = Off.
A = Automatic.

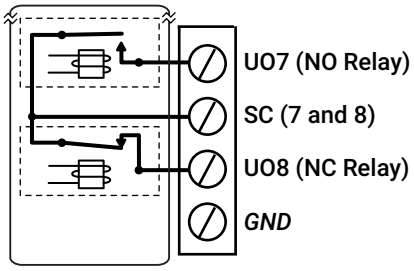
7. Repeat steps 3 through 6 for all desired boards.
8. Remove the necessary label slots for each board location in the **HPO-6802 output board cover** (purchased separately).
9. Snap the HPO-6802 cover over the boards.
10. Connect output devices to the controller outputs. (See **Wiring on page 4**.)
11. Reinstall the power jumper or terminal block that was removed in Step 1.



Simplified Schematic of Standard Analog (GND) Outputs



Simplified Schematic of Override Board Relay (SC) Outputs



HPO-6703/6705 Relay Boards
(Coils Controlled by Controller Circuitry)

⚠ CAUTION

Connecting 24 volts AC or other signals that exceed the operation specifications of the controller to the output before the output jumper is removed will damage the controller. Remove the jumper and install the override board before connecting AC or other voltage to the output of the controller.

NOTE: **Switched Common (SC)** output terminals are unconnected in these model controllers unless an appropriate override output board is installed. Use only the Switched Common instead of Ground with the HPO-6701 triac and HPO-6703/6705 relays. Use the SC terminal in the same output bank as the output terminal. See **Grounds Versus Switched Commons on page 6**.

NOTE: The **4–20 mA HPO-6704 board supplies the power** and will not work with a 4–20 mA device that also supplies its own power. For 4–20 ma applications, see also the **4–20 mA Wiring for Controllers Application Guide**.

NOTE: **If a board is removed from a slot, reinstall the (HPO-0063) jumper** (previously removed) on the two pins closest to the outputs. The jumper enables the analog voltage output on the terminals.

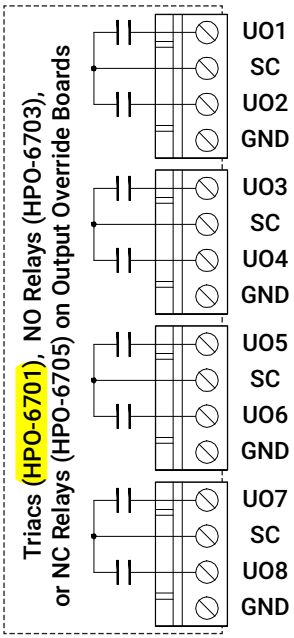
GROUNDS VERSUS SWITCHED COMMONS

Switched Common (SC) output terminals are unconnected in the controller unless the jumper is removed and an appropriate relay/triac override output board is installed.

Use only the **SC instead of Ground** with the HPO-6701 **triac** and HPO-6703/6705 **relays!**

Use the **SC terminal in the same output bank** (individual terminal block) **as its output terminal**. The switched common terminals are isolated from the circuit grounds used for the universal output analog circuitry in controllers.

For samples of wiring to output devices, see **Wiring on page 4**.



BAC-5901/CAN-5901

MAINTENANCE

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance.

IMPORTANT NOTICES

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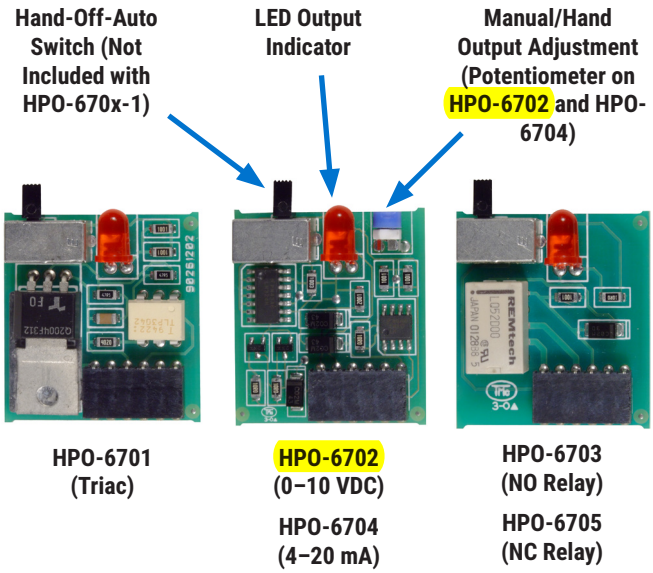
HPO-6700 Series Output Override Boards

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INTRODUCTION



For enhanced controller output options (such as manual control, using large relays, or for devices that cannot be powered directly from a standard output), install output override boards (in compatible controllers). The following **types of override boards** are available:

- The **HPO-6702** enhances the analog **voltage output** with a **"Hand-Off-Auto" control** while providing an adjustable **potentiometer** for override settings while in the "Hand" position.
- The **HPO-6701/6703/6705** boards are designed to convert a binary/digital output to a **relay** contact or **triac** output and to provide "Hand-Off-Auto" control and feedback functions.
- The **HPO-6704** converts a standard analog voltage output to a **4–20 mA output** while providing an adjustable potentiometer for override settings while in the "Hand" position.

NOTE: The **HPO-6704 board supplies the power** and will not work with a 4–20 mA device that also supplies its own power.

Each output board has a red **LED** indicator that turns On when the board's output is turned **On either manually or automatically.**

Output boards have an accessible three-position **slide switch** for selecting the **"Hand-Off-Auto"** functions:

- While in the **H ("Hand" or manual On)** position, the output is manually energized, and the controller is provided with a feedback signal to indicate the output has been overridden.
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- While in the **A (Auto)** position, the output is under the command of the controller.

NOTE: An HPO-670x**-1** is always in auto mode and does not have the manual slide switch.

NOTE: HPO-6701 **triac** and HPO-6703/6705 **relay** circuits use the Switched Common **SC** terminal—**not** the Ground Common **GND** terminal.

NOTE: HPO-6701 **triac** outputs are for 24 V**AC** only.

NOTE: Only the HPO-670**1** triac and HPO-670**4** 4–20 mA boards are approved for **smoke control** applications. For smoke control application information, see Smoke Control Manuals 000-035-08 (**BACnet**) and/or 000-035-09 (**KMDigital**).

⚠ CAUTION

Connecting 24 VAC or other signals that exceed the operation specifications of the controller before an override board is installed will damage the controller.

For HPO-6700 series **specifications**, see the **data sheet** at **kmccontrols.com**.

See the sections below for installation into the **particular type of controller.**

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- For older controllers with **metal** (e.g., BAC-5831, BAC-A1616BC) and **older "side-mounting" plastic cases** (older KMD-5801/5802s), see **Older "Metal" Case Controllers on page 4**.

CONQUEST CONTROLLERS/MODULES

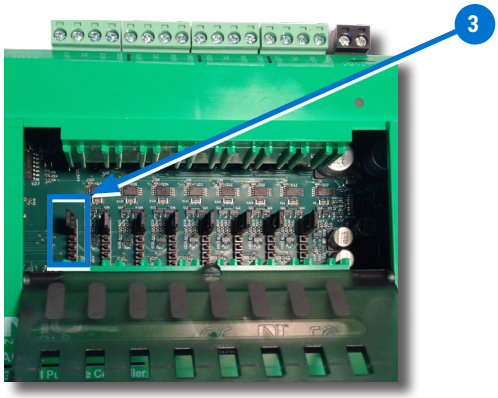
These instructions apply to KMC **Conquest** BAC-5900 series controllers and CAN-5901 expansion modules (with a flip-open lid).

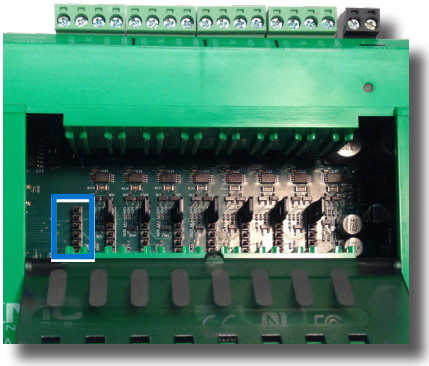
1. Disconnect the power by removing the **black power terminal block**.



2. Pull the top edge of the (translucent black) override board cover away from the case and flip open the **cover**.

3. Remove the **jumper** from the slot in which the override board will be installed.

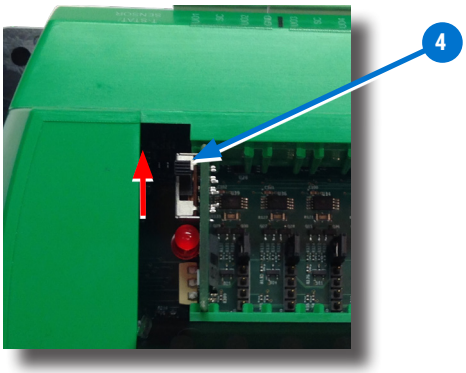




NOTE: Each of the eight override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Orient the override board with the HOA selection slide **switch toward the top** of the controller.

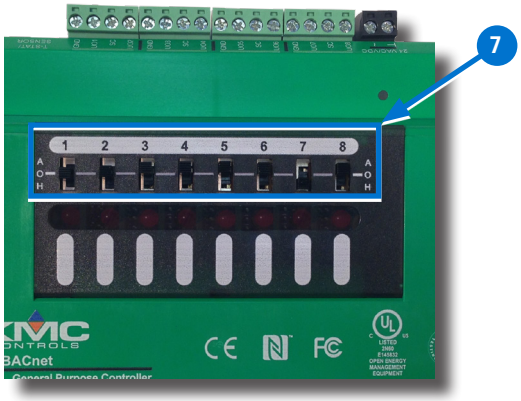
5. Slide the override **board into the slot** in which the jumper was removed.



6. Close the plastic cover.

7. Move the **A-O-H selection switch** on the override board to the appropriate position.

NOTE: **A** = Automatic (upper position).
O = Off (middle position).
H = Hand/On (lower position).



NOTE: For more information about output override boards, see the installation guide for the **HPO-6700 Series.**

8. Repeat Steps 3 through 7 for all other desired boards.

9. Wire the output device to the corresponding **green (output) terminal block** of the override board. (See **Wiring on page 4**.)



OLDER "PLASTIC" CASE CONTROLLERS



These instructions apply to controllers with **"top-mounting" raised plastic** cases (e.g., BAC-5801/5802 and newer KMD-5801/5802). After installation of the boards, the existing cover is reinstalled.

To install the HPO-6700 series override boards:

1. Disconnect the power by removing the **power jumper or terminal block**.

2. Remove the **cover** by squeezing on both sides of the cover and lifting it off.

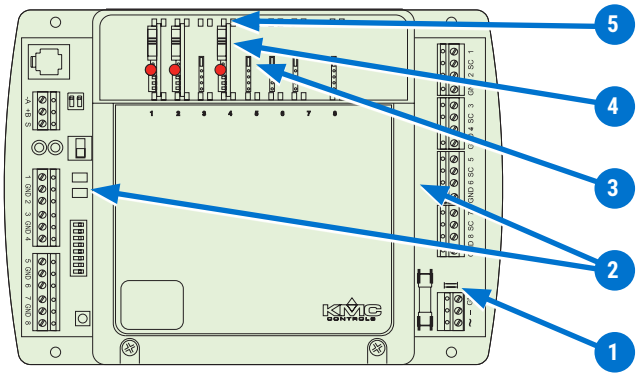
3. Remove the **jumper** from the slot in which the override board will be installed.

   NOTE: Each of the override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

4. Orient the override board with the HOA selection slide **switch toward the top** of the controller.

5. Slide the override **board into the slot** in which the jumper was removed.

6. Set the selection switch on the override board to the

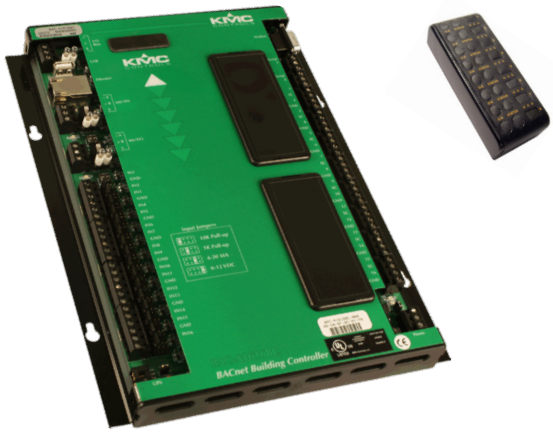


appropriate position.

NOTE: **A** = Automatic (upper position).
O = Off (middle position).
H = Hand/On (lower position).

7. Repeat steps 3 through 6 for all desired boards.
8. Reinstall the cover over the boards.
9. Connect output devices to the controller outputs. (See **Wiring on page 4**.)
10. Reinstall the power jumper that was removed in Step 1.

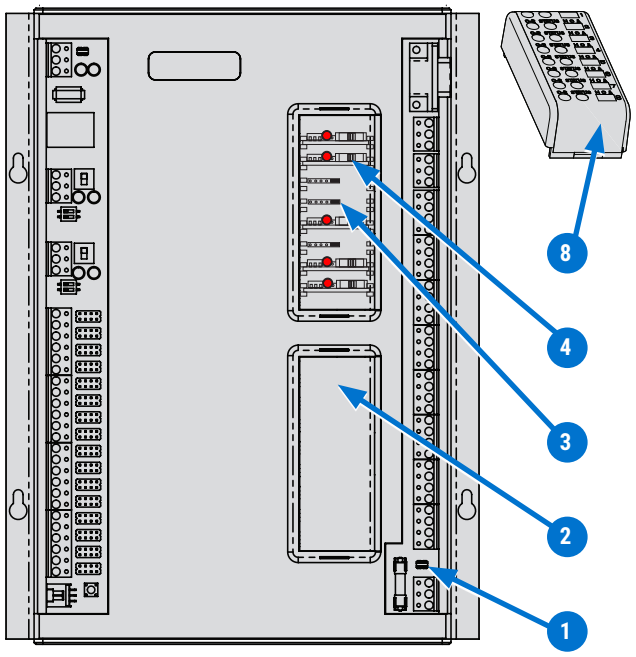
OLDER "METAL" CASE CONTROLLERS



These instructions apply to controllers with **metal** (e.g., BAC-5831, BAC-A1616BC) **and older "side-mounting" plastic cases** (e.g., older KMD-5801/5802). After installation of the boards, the existing slot cover needs to be replaced by a raised HPO-6802 output board cover.

To install the HPO-6700 series override boards:

1. Disconnect the power by removing the **power jumper or terminal block**.
2. Remove the relevant slot **cover**(s) by lifting the right-hand side of the cover (within the plastic frame) toward you.
3. Remove the **jumper** from the slot in which the override board will be installed.

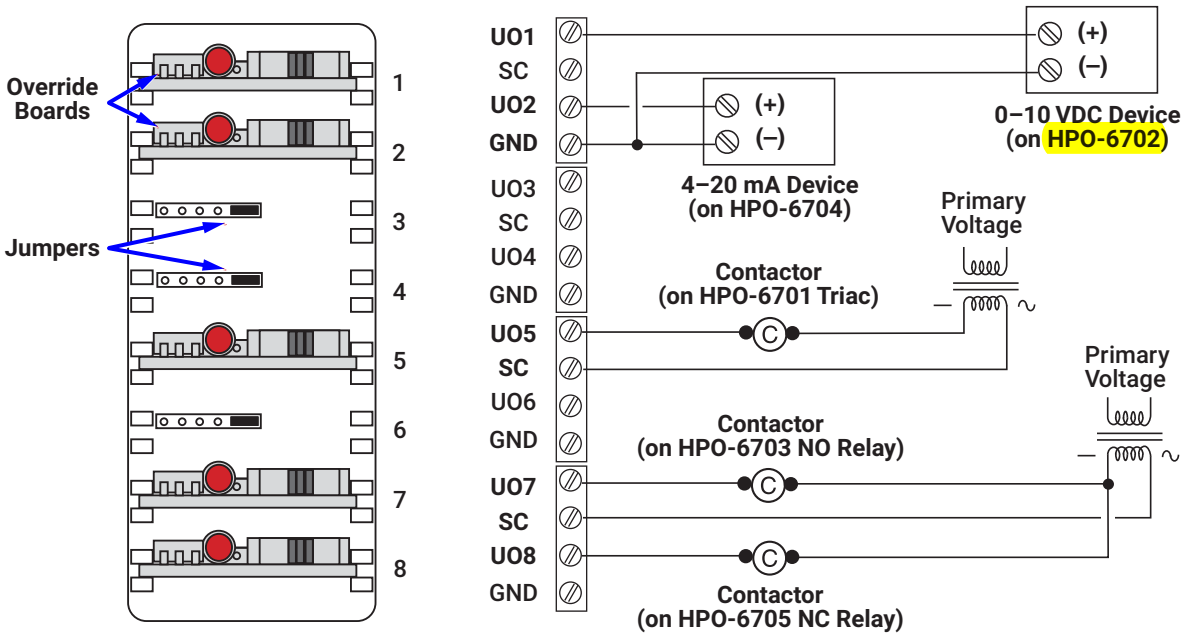


NOTE: Each of the override slots ships from KMC with a jumper installed on the two pins closest to the output terminal blocks. Only remove a jumper if an override board will be installed.

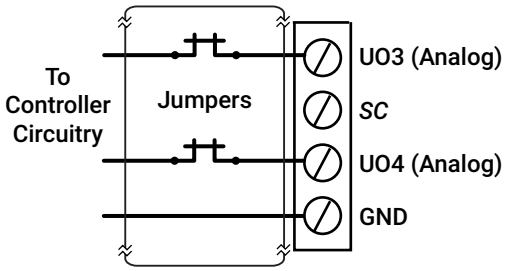
4. Orient the override board with the HOA selection slide **switch toward the outputs** of the controller.
5. Slide the override **board into the slot** in which the jumper was removed.
6. Move the **A-O-H selection switch** on the override board to the appropriate position.

NOTE: **H** = Hand/On.
O = Off.
A = Automatic.

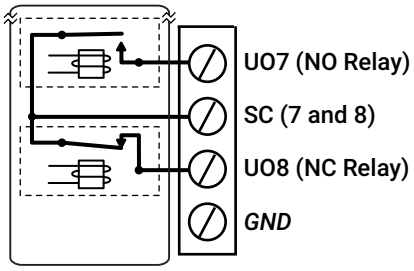
7. Repeat steps 3 through 6 for all desired boards.
8. Remove the necessary label slots for each board location in the **HPO-6802 output board cover** (purchased separately).
9. Snap the HPO-6802 cover over the boards.
10. Connect output devices to the controller outputs. (See **Wiring on page 4**.)
11. Reinstall the power jumper or terminal block that was removed in Step 1.



Simplified Schematic of Standard Analog (GND) Outputs



Simplified Schematic of Override Board Relay (SC) Outputs



HPO-6703/6705 Relay Boards
(Coils Controlled by Controller Circuitry)

⚠ CAUTION

Connecting 24 volts AC or other signals that exceed the operation specifications of the controller to the output before the output jumper is removed will damage the controller. Remove the jumper and install the override board before connecting AC or other voltage to the output of the controller.

NOTE: **Switched Common (SC)** output terminals are unconnected in these model controllers unless an appropriate override output board is installed. Use only the Switched Common instead of Ground with the HPO-6701 triac and HPO-6703/6705 relays. Use the SC terminal in the same output bank as the output terminal. See **Grounds Versus Switched Commons on page 6**.

NOTE: The **4–20 mA HPO-6704 board supplies the power** and will not work with a 4–20 mA device that also supplies its own power. For 4–20 ma applications, see also the **4–20 mA Wiring for Controllers Application Guide**.

NOTE: **If a board is removed from a slot, reinstall the (HPO-0063) jumper** (previously removed) on the two pins closest to the outputs. The jumper enables the analog voltage output on the terminals.

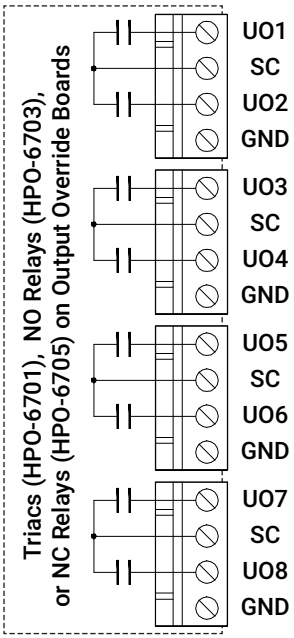
GROUNDS VERSUS SWITCHED COMMONS

Switched Common (SC) output terminals are unconnected in the controller unless the jumper is removed and an appropriate relay/triac override output board is installed.

Use only the **SC instead of Ground** with the HPO-6701 **triac** and HPO-6703/6705 **relays!**

Use the **SC terminal in the same output bank** (individual terminal block) **as its output terminal**. The switched common terminals are isolated from the circuit grounds used for the universal output analog circuitry in controllers.

For samples of wiring to output devices, see **Wiring on page 4**.



BAC-5901/CAN-5901

MAINTENANCE

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance.

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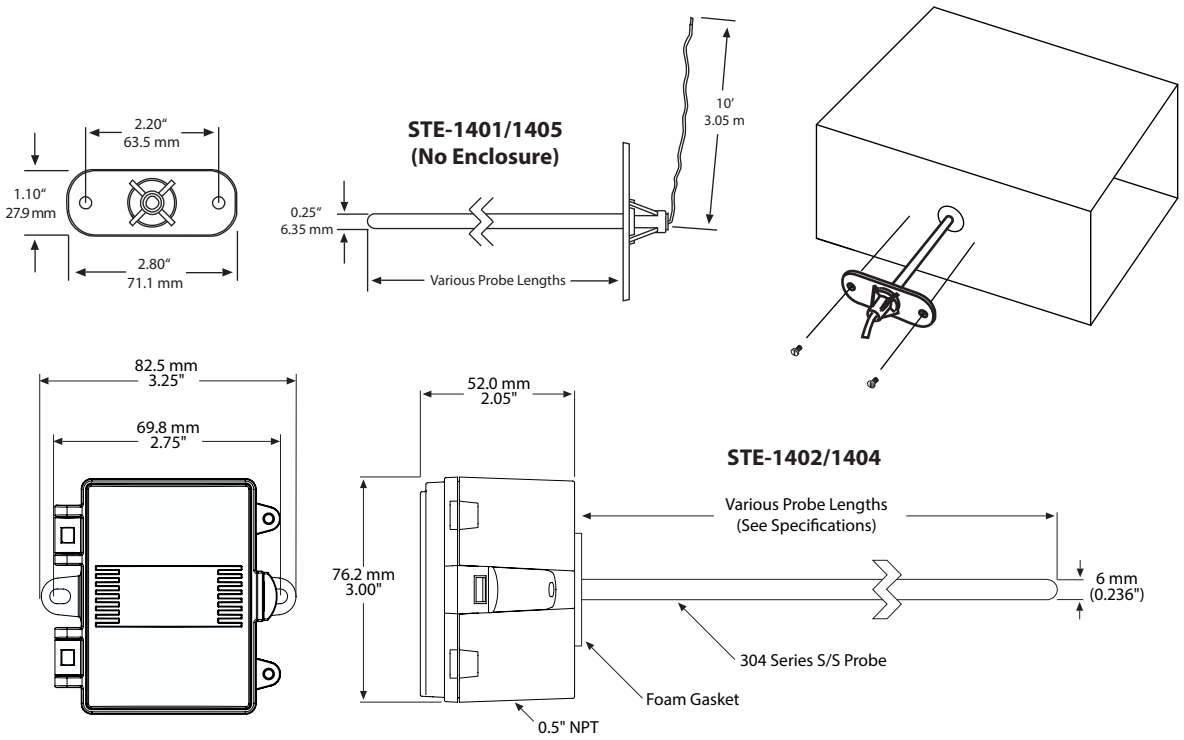
TEL: 574.831.5250
FAX: 574.831.5252
EMAIL: **info@kmccontrols.com**

Duct Temperature Sensor, Rigid

STE-1401/1402/1404/1405

Installation Guide

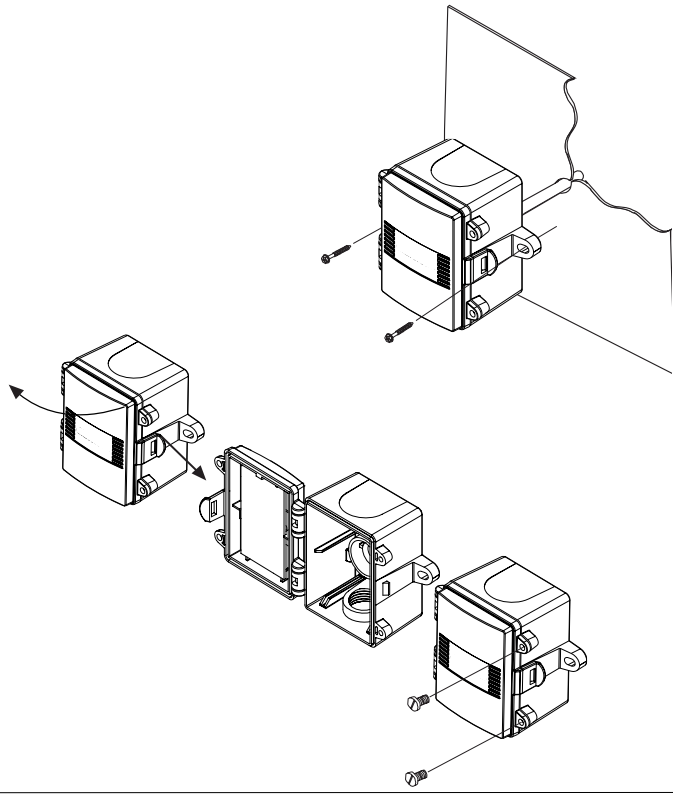
Mounting



Designed for single-point monitoring, these sensors are available in various stainless-steel probe lengths of 4, 8, and 12 inches (100, 200, and 300 mm).

NOTE: Select a probe length that places the sensor in the middle of the duct to avoid errors due to laminar flow.

1. Locate the sensor in a straight section of duct away from heating, cooling, or humidifier elements.
2. Cut a 1/4-inch hole for the probe in the side of the duct as well as smaller holes for screws at the appropriate locations.
3. Insert the probe and fasten the assembly to the duct using screws threaded through the mounting holes in the housing.
4. Open the sensor cover (STE-1402/1404 only) by pulling slightly on the latch on the right side of the enclosure while pulling on the cover.
5. For the cable leading to the building automation system controller, attach conduit to the 1/2" NPT threaded connection hole that is provided in the bottom of the enclosure as needed.



Connections and Wiring

NOTE: Use 18 to 24 AWG shielded wiring for all connections. Do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Make all connections in accordance with national and local codes.

1. Bring the cable from the controller through the bottom hole (if applicable).
2. Make connections to the two wire leads with either butt-splices or solder. Using wire nuts is **not** recommended.

NOTE: The two-wire sensor is not polarity sensitive.

NOTE: Plug the conduit with sealant to prevent air infiltration.

3. Swing the door (if applicable) closed until securely latched.
4. If desired for added security (if applicable), install the two (provided) screws in the door's integrated screw tabs.

Configuration

For controller configuration, see the **Type III Sensors Applications Guide** on the KMC web site.

Specifications

Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Probe Sensing Range	–40 to 212° F (–40 to 100° C)
Ambient Operating Range	–40 to 122° F (–40 to 50° C), 5 to 95 % RH noncondensing
Enclosure	(STE-1402/1404 only) UL94-V0, IP65 (NEMA 4X), ABS
Wiring	10-ft. FT-6 plenum-rated, 22 AWG cable for STE-1401/1405; PVC insulated, 22 AWG leads for STE-1402/1404
Probe Lengths	
STE-1405	4 inches (100 mm)
STE-1401/1402	8 inches (200 mm)
STE-1404	12 inches (300 mm)

Maintenance

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance.

More Information

For **troubleshooting, controller configuration, and other information**, see the **Type III Sensors Applications Guide** on the KMC web site. For **additional information**, see the **STE-1400 Series Data Sheet** on the KMC web site.

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STE-1400 Series

Temperature Sensors

DESCRIPTION AND APPLICATION

STE-1400 Series, 10,000 ohm, Type III thermistor, temperature sensors are available for duct, immersion, strap-on, room, and outside air applications. See also **Models on page 2**. Applicable probes are constructed to provide good heat transfer and fast response.

The **STE-1430 room** sensor, designed for inconspicuous and tamper-resistant temperature measurement of occupied spaces, can be mounted on an interior hollow wall in a standard single-gang electrical box. The sensor is mounted to the back of a flat, brushed stainless-steel plate.

The **STE-1451 outside** air sensor is mounted in a gasketed weatherproof LB-style aluminum enclosure for protection against the outdoor elements. It comes with an c/w 1/2" NPT fitting for connection to conduit.

An **STE-1411/1412/1413/1414/1415/1416/1417 averaging duct** sensor incorporates numerous sensors and is available in a 5/16-inch OD bendable copper probe or in a flexible plenum-rated cable. The completed assembly acts as a single sensor and any temperature change is averaged across the sensor. The probes can flex to fit any size duct.

Each **STE-1401/1402/1404/1405 duct** sensor is encapsulated in a rigid 1/4-inch OD stainless-steel probe. The probe protrudes from the sensor housing (if included). The probe can be inserted directly into the duct for single-point monitoring, and mounting holes are provided to rigidly support the assembly.

An **STE-1423/1424 immersion/duct** sensor is encapsulated in a rigid 1/4-inch OD 304 stainless-steel probe. The probe protrudes from the sensor housing for insertion into an HMO-4545/4546 stainless-steel thermowell for immersion applications. (See **Accessories on page 3** for thermowells and thermal compound.) These sensors can also be used (without thermowells) as a rigid-probe duct sensors for small ducts.

The **STE-1455 strap-on** sensor is encapsulated in a two-inch-long, 1/4-inch OD stainless-steel probe. The probe has a five-foot lead wire. The **STE-1454** strap-on sensor also comes with an enclosure. A strap-on sensor is typically used if an immersion sensor is impractical.



FEATURES

- Type III 10,000 ohm thermistor encapsulated temperature sensors.
- Available in a number of models to accommodate various installation applications.
- Models are available with and without enclosures and with different length leads.

SPECIFICATIONS

Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Accuracy	±0.36° F (±0.20° C)
Temperature Limits	See installation guides for the different models
Wiring	Wire leads pigtail or cable, dependent on model
Mfg. Process	ISO 9001 registered quality system
Approvals	CE and RoHS compliant

NOTE: These specifications are for models that started shipping May 2020. For specifications of earlier models, see Rev. Q of this document.

MODELS

MODEL	SENSOR TYPE	PROBE TYPE	PROBE LENGTH	ENCLOSURE	CONNECTIONS*
STE-1405	Duct, Rigid	1/4-inch OD stain-less-steel	4 inches (100 mm)	None (mounting bracket only)	10-ft. FT-6 plenum-rated, 22 AWG cable
STE-1401			8 inches (200 mm)		
STE-1402			8 inches (200 mm)	Plastic, UL94-V0, IP65 (NEMA 4X) ABS	PVC insulated, 22 AWG, wire leads
STE-1404			12 inches (300 mm)		
STE-1411	Duct, Averaging	Copper, bend-able	6 feet (1.8 m)		FT-6 plenum-rated, 22 AWG wire leads
STE-1412			12 feet (3.6 m)		
STE-1414			20 feet (6.1 m)		
STE-1413			24 feet (7.3 m)		
STE-1415		Flexible, FT-6 plenum-rated cable	6 feet (1.8 m)		
STE-1416			12 feet (3.6 m)		
STE-1417			24 feet (7.3 m)		
STE-1423	Immersion** or Rigid Duct	1/4-inch OD stain-less-steel (w/o well)	4 inches (100 mm)		PVC insulated, 22 AWG, wire leads
STE-1424			6 inches (150 mm		
STE-1454	Strap On	1/4-inch OD stain-less-steel	2 inches (50 mm)		5-ft. non-plenum-rated, PVC insulated, 22 AWG cable (between sensor and enclosure for STE-1454)
STE-1455				None	
STE-1430	Room	Sensor is behind a blank, flat, stainless steel plate for mounting on a (not supplied) single-gang electrical box			Wire leads
STE-1451	Outside Air	Inside an LB-type aluminum, IP65 (NEMA 4X), enclosure			

***NOTE**: All sensors have short leads except for those with five-foot or ten-foot cables.

****NOTE**: For immersion applications, the STE-1423 sensor requires an HMO-4545 thermowell, and the STE-1424 requires an HMO-4546. See **Accessories on page 3**.

ENCLOSURES

The STE-1401, STE-1405, and STE-1455 have no enclosures.

The STE-1430 sensor is behind a blank, flat, brushed stainless steel plate for mounting on a (not supplied) single gang electrical box. It has an IP50 (NEMA 1) rating after mounting.

The STE-1451 outside air temperature sensor has an aluminum LB enclosure with an IP65 (NEMA 4X) rating.

All others have a UL94-V0, IP65 (NEMA 4X) ABS plastic utility box, with a hinged and gasketed cover.





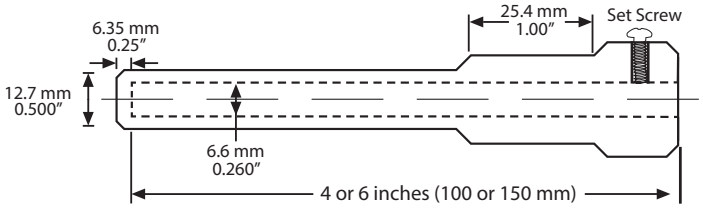




ACCESSORIES

For the STE-1421 and STE-1422 **immersion sensors,** these thermowells and thermal compound are available:

HMO-4532	Thermal compound for thermowells, 1 oz.
HMO-4545	4" 304 stainless-steel well (for the STE-1423)
HMO-4546	6" 304 stainless-steel well (for the STE-1424)



NOTE: STE-1423/1424 sensor probe is secured inside the thermowell with a set screw. Using HMO-4532 thermal compound inside the well ensures optimal heat transfer.

NOTE: STE-1423/1424 immersions sensors replace older STE-1421/1422 sensors used with (threaded) HMO-4534/4544 thermowells. When replacing an STE-1421/1422 sensor with an STE-1423/1424, the thermowell also needs to be replaced with an HMO-4545/4546.

SUPPORT

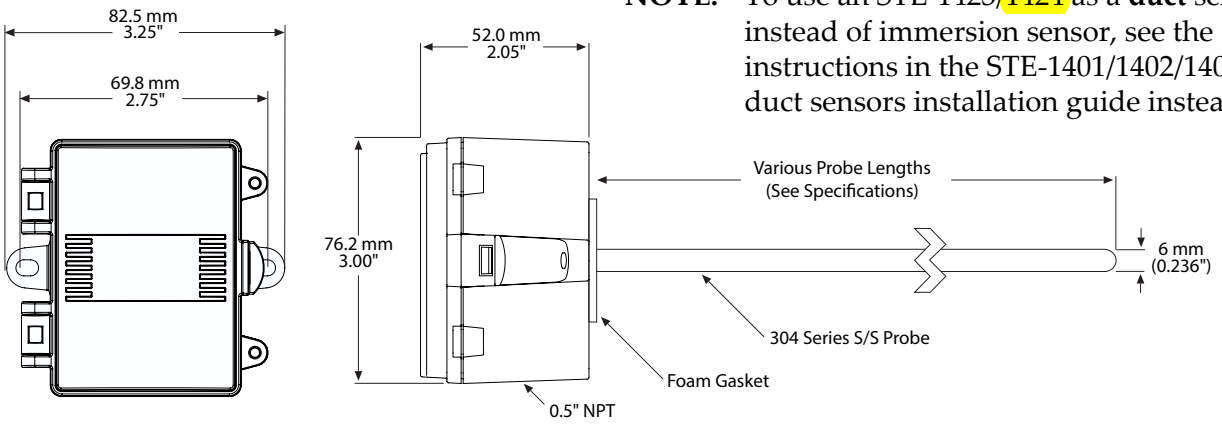
Additional product and other resources are available on the web at **www.kmccontrols.com**.

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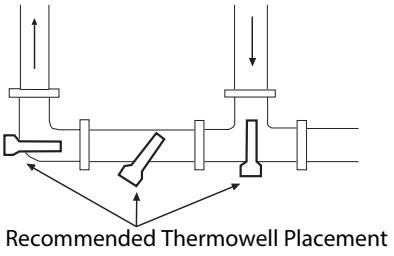
Installation Guide

Mounting

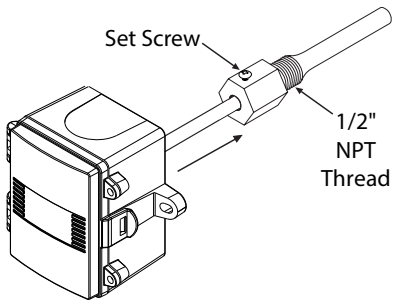


NOTE: To use an STE-1423/1424 as a **duct** sensor instead of immersion sensor, see the instructions in the STE-1401/1402/1404/1405 duct sensors installation guide instead.

Immersion probes measure the temperature inside pipes carrying liquid or steam and are installed in a 304 stainless-steel thermowell. Mount the thermowell horizontally or with the open end facing down (to allow any condensation to drain). Select an appropriate length (4 or 6 inches of sensor probe and thermowell) and position the thermowell to prevent contact with the inner surface of the opposite side of the pipe.

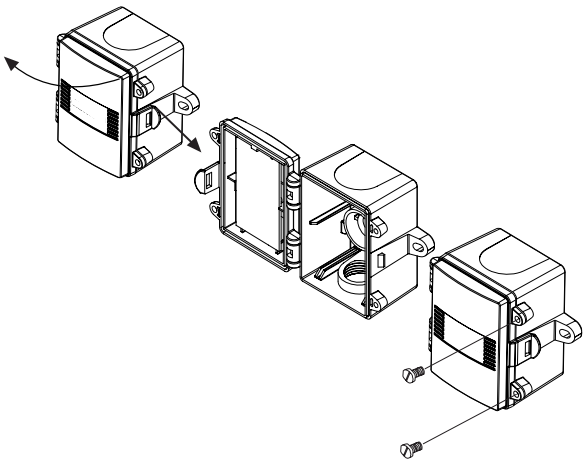

Recommended Thermowell Placement

1. Install the pipe fittings required, by local code, for a 1/2" NPT thermowell into the dry/drained pipe. If the system is pressured, use a hot tap.
2. Install the thermowell. (See the Accessories section.)
3. Fill the thermowell with thermal compound to ensure complete conductivity from well to probe.
4. Open the sensor cover by pulling slightly on the latch on the right side of the enclosure while pulling on the cover.
5. From inside the enclosure, push the probe as far as it will go into the thermowell.



NOTE: As it is inserted into the thermowell, the probe can slide within its collar on the enclosure.

6. Tighten the set screw on the thermowell to secure the probe.
7. For the cable leading to the building automation system controller, attach conduit to the 1/2" NPT threaded connection hole that is provided in the bottom of the enclosure as needed.



Connections and Wiring

NOTE: Use 18 to 24 AWG shielded wiring for all connections. Do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Make all connections in accordance with national and local codes.

1. Bring the cable from the controller through the bottom hole.
2. Make connections to the two wire leads with either butt-splices or solder. Using wire nuts is **not** recommended.

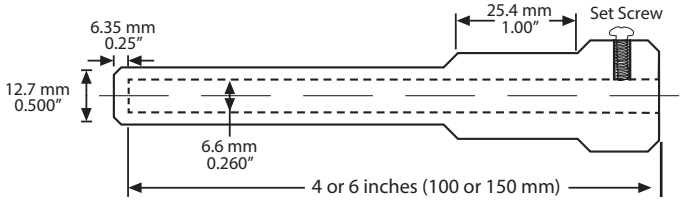
NOTE: The two-wire sensor is not polarity sensitive.

NOTE: Plug the conduit with sealant to prevent air infiltration.

3. Swing the door closed until securely latched.
4. If desired for added security, install the two (provided) screws in the door's integrated screw tabs.

Accessories

HMO-4532	Thermal compound (1 oz.) for thermowells
HMO-4545	4-inch 304 stainless-steel thermowell (for the STE-1423)
HMO-4546	6-inch 304 stainless-steel thermowell (for the STE-1424)



NOTE: STE-1423/1424 immersion sensors replace older STE-1421/1422 sensors used with (threaded) HMO-4534/4544 thermowells. When replacing an STE-1421/1422 sensor with an STE-1423/1424, replace the thermowell with an HMO-4545/4546.

Specifications

Probe Lengths	
STE-1423	4 inches (100 mm)
STE-1424	6 inches (150 mm)
Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Probe Sensing Range	–40 to 212° F (–40 to 100° C)
Ambient Operating Range	–40 to 122° F (–40 to 50° C), 5 to 95 % RH noncondensing
Enclosure	UL94-V0, IP65 (NEMA 4X), ABS
Wiring	PVC insulated, 22 AWG, wire leads

Maintenance

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance.

More Information

For **troubleshooting, controller configuration, and other information**, see the **Type III Sensors Applications Guide** on the KMC web site. For **additional information**, see the **STE-1400 Series Data Sheet** on the KMC web site.

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STE-1400 Series

Temperature Sensors

DESCRIPTION AND APPLICATION

STE-1400 Series, 10,000 ohm, Type III thermistor, temperature sensors are available for duct, immersion, strap-on, room, and outside air applications. See also **Models on page 2**. Applicable probes are constructed to provide good heat transfer and fast response.

The **STE-1430 room** sensor, designed for inconspicuous and tamper-resistant temperature measurement of occupied spaces, can be mounted on an interior hollow wall in a standard single-gang electrical box. The sensor is mounted to the back of a flat, brushed stainless-steel plate.

The **STE-1451 outside** air sensor is mounted in a gasketed weatherproof LB-style aluminum enclosure for protection against the outdoor elements. It comes with an c/w 1/2" NPT fitting for connection to conduit.

An **STE-1411/1412/1413/1414/1415/1416/1417 averaging duct** sensor incorporates numerous sensors and is available in a 5/16-inch OD bendable copper probe or in a flexible plenum-rated cable. The completed assembly acts as a single sensor and any temperature change is averaged across the sensor. The probes can flex to fit any size duct.

Each **STE-1401/1402/1404/1405 duct** sensor is encapsulated in a rigid 1/4-inch OD stainless-steel probe. The probe protrudes from the sensor housing (if included). The probe can be inserted directly into the duct for single-point monitoring, and mounting holes are provided to rigidly support the assembly.

An **STE-1423/1424 immersion/duct** sensor is encapsulated in a rigid 1/4-inch OD 304 stainless-steel probe. The probe protrudes from the sensor housing for insertion into an HMO-4545/4546 stainless-steel thermowell for immersion applications. (See **Accessories on page 3** for thermowells and thermal compound.) These sensors can also be used (without thermowells) as a rigid-probe duct sensors for small ducts.

The **STE-1455 strap-on** sensor is encapsulated in a two-inch-long, 1/4-inch OD stainless-steel probe. The probe has a five-foot lead wire. The **STE-1454** strap-on sensor also comes with an enclosure. A strap-on sensor is typically used if an immersion sensor is impractical.



FEATURES

- Type III 10,000 ohm thermistor encapsulated temperature sensors.
- Available in a number of models to accommodate various installation applications.
- Models are available with and without enclosures and with different length leads.

SPECIFICATIONS

Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Accuracy	±0.36° F (±0.20° C)
Temperature Limits	See installation guides for the different models
Wiring	Wire leads pigtail or cable, dependent on model
Mfg. Process	ISO 9001 registered quality system
Approvals	CE and RoHS compliant

NOTE: These specifications are for models that started shipping May 2020. For specifications of earlier models, see Rev. Q of this document.

MODELS

MODEL	SENSOR TYPE	PROBE TYPE	PROBE LENGTH	ENCLOSURE	CONNECTIONS*
STE-1405	Duct, Rigid	1/4-inch OD stain-less-steel	4 inches (100 mm)	None (mounting bracket only)	10-ft. FT-6 plenum-rated, 22 AWG cable
STE-1401			8 inches (200 mm)		
STE-1402			8 inches (200 mm)	Plastic, UL94-V0, IP65 (NEMA 4X) ABS	PVC insulated, 22 AWG, wire leads
STE-1404			12 inches (300 mm)		
STE-1411	Duct, Averaging	Copper, bend-able	6 feet (1.8 m)		FT-6 plenum-rated, 22 AWG wire leads
STE-1412			12 feet (3.6 m)		
STE-1414			20 feet (6.1 m)		
STE-1413			24 feet (7.3 m)		
STE-1415		Flexible, FT-6 plenum-rated cable	6 feet (1.8 m)		
STE-1416			12 feet (3.6 m)		
STE-1417			24 feet (7.3 m)		
STE-1423	Immersion** or Rigid Duct	1/4-inch OD stain-less-steel (w/o well)	4 inches (100 mm)		PVC insulated, 22 AWG, wire leads
STE-1424			6 inches (150 mm		
STE-1454	Strap On	1/4-inch OD stain-less-steel	2 inches (50 mm)		5-ft. non-plenum-rated, PVC insulated, 22 AWG cable (between sensor and enclosure for STE-1454)
STE-1455				None	
STE-1430	Room	Sensor is behind a blank, flat, stainless steel plate for mounting on a (not supplied) single-gang electrical box			Wire leads
STE-1451	Outside Air	Inside an LB-type aluminum, IP65 (NEMA 4X), enclosure			

***NOTE**: All sensors have short leads except for those with five-foot or ten-foot cables.

****NOTE**: For immersion applications, the STE-1423 sensor requires an HMO-4545 thermowell, and the STE-1424 requires an HMO-4546. See **Accessories on page 3**.

ENCLOSURES

The STE-1401, STE-1405, and STE-1455 have no enclosures.

The STE-1430 sensor is behind a blank, flat, brushed stainless steel plate for mounting on a (not supplied) single gang electrical box. It has an IP50 (NEMA 1) rating after mounting.

The STE-1451 outside air temperature sensor has an aluminum LB enclosure with an IP65 (NEMA 4X) rating.

All others have a UL94-V0, IP65 (NEMA 4X) ABS plastic utility box, with a hinged and gasketed cover.





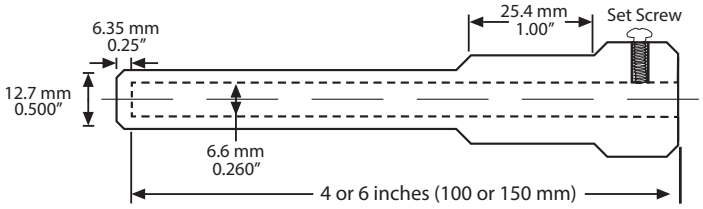




ACCESSORIES

For the STE-1421 and STE-1422 **immersion sensors,** these thermowells and thermal compound are available:

HMO-4532	Thermal compound for thermowells, 1 oz.
HMO-4545	4" 304 stainless-steel well (for the STE-1423)
HMO-4546	6" 304 stainless-steel well (for the STE-1424)



NOTE: STE-1423/1424 sensor probe is secured inside the thermowell with a set screw. Using HMO-4532 thermal compound inside the well ensures optimal heat transfer.

NOTE: STE-1423/1424 immersions sensors replace older STE-1421/1422 sensors used with (threaded) HMO-4534/4544 thermowells. When replacing an STE-1421/1422 sensor with an STE-1423/1424, the thermowell also needs to be replaced with an HMO-4545/4546.

SUPPORT

Additional product and other resources are available on the web at **www.kmccontrols.com**.

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Outside Air Temperature Sensor

STE-1451

Installation Guide

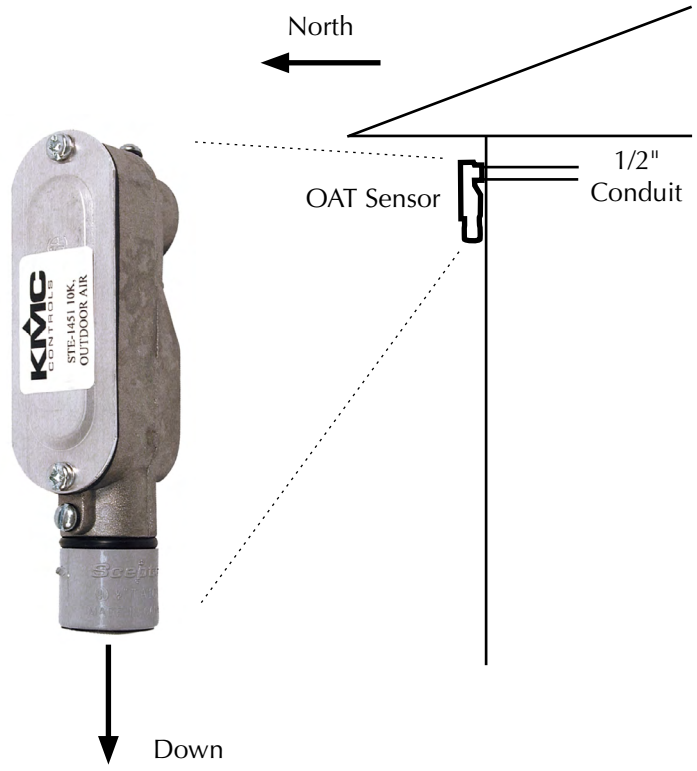
Mounting

Designed specifically for outside air temperature measurement, this device comes in an aluminum LB-style enclosure.

For best results, locate the sensor on the north side of the structure (when located north of the equator) high under the eaves or another protected area to prevent incorrect readings from direct sunlight and damage due to the elements. Also, avoid proximity to other heat sources, vents, power wires, or a large thermal mass.

1. Run 1/2" conduit through the wall.
2. Attach the conduit to the sensor enclosure's CW 1/2" NPT fitting with a suitable coupler (such as a Chase closed nipple).

NOTE: The sensor air holes must face down to prevent the accumulation of dirt or water.



Connections and Wiring

1. Remove the two cover screws and cover.

NOTE: Removal of only one screw is required. The other screw can be loosened, and the cover can be swung out of the way.

2. Feed wires through the conduit opening.

NOTE: Use 18 to 24 AWG shielded wiring for all connections. Do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Make all connections in accordance with national and local codes.

3. Make connections to the two wire leads with either butt-splices or solder. (Using wire nuts is **not** recommended.) The two-wire sensor is not polarity sensitive.
4. Plug the conduit with sealant to prevent air infiltration.
5. Check that the rubber weather gasket is placed correctly between the enclosure and cover.
6. Reinstall the cover and tighten the screws to create a weather-resistant seal.

Specifications

Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Temperature Limits	–40 to 122° F (–40 to 50° C); 5 to 95 % RH non-condensing
Wiring	22 AWG wire leads
Case	Aluminum LB-style, IP65 (NEMA 4X)

Maintenance

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance. If dirt clogs the air holes at the bottom, remove it.

Configuration

For controller configuration, see the **Type III Sensors Applications Guide** on the KMC web site.

More Information

For **troubleshooting, controller configuration, and other information**, see the **Type III Sensors Applications Guide** on the KMC web site. For **additional information**, see the **STE-1400 Series Data Sheet** on the KMC web site.

Important Notices

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KELE WATER DETECTOR

WD-1B

DESCRIPTION

The **Kele WD-1B** water detector features gold-plated probes and microchip technology for dependable detection of conductive liquids. The **Model WD-1B** can be operated from 11-27 VAC/VDC. For application flexibility, SPDT contacts are provided to connect to a monitoring system. A height-adjustable, cast-aluminum, weatherproof enclosure is standard. A green LED visible outside the box indicates power. A red LED indicates water detected. The **Model WD-1B** is also available with an external tape style sensor, the Model WD-2-T.



WD-1B

FEATURES

- ***Weather resistant enclosure***
- ***Easy to install***
- ***SPDT alarm contacts***
- ***11-27 VAC/DC(50/60 Hz)***
- ***Reliable operation***
- ***LEDs for power and alarm indication (green, red)***
- ***Adjustable detection level***

OPERATION

The **Model WD-1B** can be used with any contact-closure monitoring panel. The SPDT contacts may be wired normally open or normally closed, allowing wiring flexibility to handle most installations.

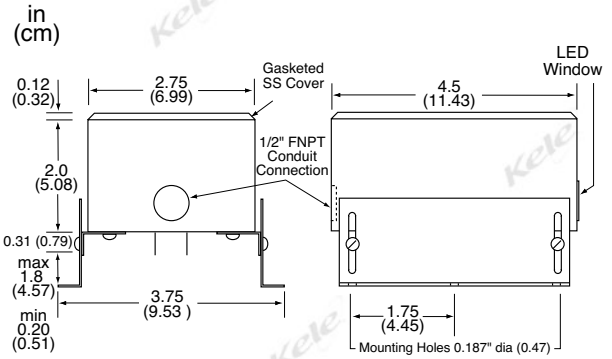
MOUNTING

Secure by applying a silicone adhesive to the mounting feet and placing the sensor in the area to be protected. For more permanent installations, fasten the sensor using the 0.19" (0.48 cm) holes provided in the mounting feet with #6 or #8 screws. The legs are adjustable 1.5" (3.81 cm) for precise water level signaling.

SPECIFICATIONS

Supply Voltage	11-27 VAC @ 1.7 VA; 11-27 VDC @ 30 mA
Relay Type	SPDT
Relay Rating	1 A @ 24 VAC/VDC, 1/2 A @ 120 VAC
Display	Green LED = Power Red LED = Alarm
Probe	Gold plated, 1.5" adjustable
Operating Temperature	32° to 158°F (0° to 70°C)
Enclosure Rating	NEMA 4, Cast aluminum, weather resistant with adjustable legs
Dimensions	4.3"H X 3.75"W X 4.5"L (10.7 X 9.5 X 11.4 cm)
Weight	0.98 lb (0.4445 Kg)
Approvals	CE
Warranty	1 year

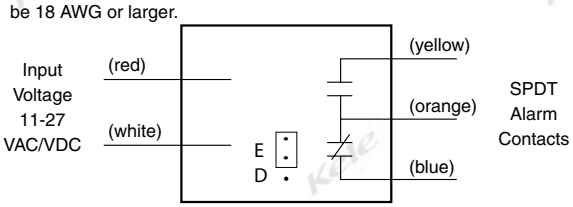
DIMENSIONS



Probe height adjustable 0" to 1.5" (0 to 3.8 cm)

WIRING

The **WD-1B** is provided with a 1/2" FNPT conduit connection in the end of the enclosure. Terminations are made to the color-coded wires with field-supplied connectors. All interconnect wiring should be 18 AWG or larger.



E/D Option Jumper*

If grounded AC power is used, the grounded power supply lead must be connected to the white lead on the **WD-1B**, or the unit may fail to operate.

*E/D Option Jumper:

E = Output relay is energized when water is detected. (No alarm on power loss)

D = Output relay is de-energized when water is detected or when power is lost. (Alarm on when water is present or power loss)

ORDERING INFORMATION

MODEL	DESCRIPTION
WD-1B	Water detector
WD-1B-C	Water detector with normally-energized relay (alarms when power is lost or water is detected)

RELATED PRODUCTS

WD-2-T	Water detector (tape style sensor)

LOW & HIGH TEMPERATURE LIMIT CONTROLS

A70 SERIES

DESCRIPTION

The **Johnson Controls A70 Series** heavy-duty temperature-limit controls incorporate a vapor charged sensing element. **A70G, A70H**, and **A70K** have a four-wire, two-circuit contact block that contains two isolated sets of contacts. The contacts are designed to transfer at set point so that when the main contact opens, the auxiliary contact closes simultaneously. Typical applications include shutdown of a ventilation system and BAS alarm indication upon low or high temperature.

FEATURES

- ***Automatic or manual reset models***
- ***Long-life, snap-acting contacts***
- ***Easy set point adjust***
- ***One-year warranty***



A70HA-1

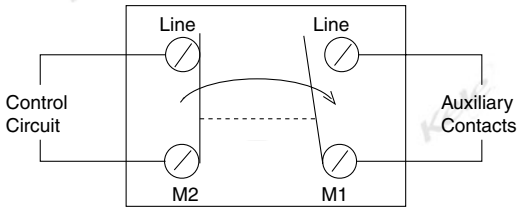
SPECIFICATIONS

MODEL	SWITCH ACTION (Main contacts) LINE-M2	TEMP RANGE °F (°C)	RESET °F (°C)	BULB/ CAPILLARY	MAX BULB TEMP °F (°C)	RANGE ADJUSTER
A70GA-1* Low Limit	Open Low	15 to 55* (-10 to 13)	Auto 5 (2.8)	20' of 1/8" (6m of 0.32 cm) OD tubing	400 (260)	Screwdriver Slot
A70HA-1* Low Limit	Open Low	15 to 55* (-10 to 13)	Manual Reset	20' of 1/8" (6m of 0.32 cm) OD tubing	400 (260)	Screwdriver Slot
A70HA-2 Low Limit	Open Low	35 to 80 (1.7 to 27)	Manual Reset	3/8" x 3" (0.95 x 7.6 cm) 6' (1.9m)cap	250 (121)	Screwdriver Slot
A70KA-1 High Limit	Open High	100 to 170 (38 to 77)	Manual Reset	3/8" x 10" (0.95 x 25.4 cm) 6' (1.9m) cap	240 (116)	Screwdriver Slot

ELECTRICAL RATING								
MOTOR RATINGS (VAC)	LINE-M2 (Main)				LINE-M1 (Auxiliary)			
	120	208	240	277	120	208	240	277
AC Full Load Amp	16.0	9.2	8.0	–	6.0	3.3	3.0	–
AC Non-Inductive Amp	16.0	9.2	8.0	7.2	6.0	6.0	6.0	6.0
Pilot Duty	125 VA, 24-600 VAC 57.5 VA, 120-300 VDC							
Approvals	UL Listed File #SA516							

*The low cut-out stop is set and sealed at 35°F (1.6°C). The control responds to the lowest temperature along any 1' (30.5 cm) section of the 20' (6m) element.

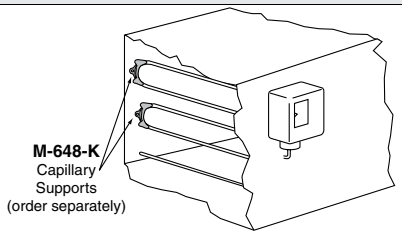
WIRING



A70 Series

Low Limit - Action on temperature decrease
High Limit - Action on temperature increase

INSTALLATION



Mount sensor horizontally for proper measurement.Typically mounted downstream of a coil with capillary exposed to all areas likely to encounter low or high temperatures as required.

ORDERING INFORMATION

MODEL	DESCRIPTION
A70GA-1	Low-limit temperature control, automatic reset, 20' (6m) element
A70HA-1	Low-limit temperature control, manual reset, 20' (6m) element
A70HA-2	Low-limit temperature control, manual reset, 3" (7.6 cm) element, 6' (1.9m) capillary
A70KA-1	High-limit temperature control, manual reset, 10" (25.4 cm) element, 6' (1.9m) capillary

RELATED PRODUCTS

CC-1G-K	Plastic capillary and sensor holder mounting clip
ES1051	Freeze spray, 8 fl oz
M-648-K	Copper-clad capillary mounting clip

HVAC DIFFERENTIAL PRESSURE SWITCHES

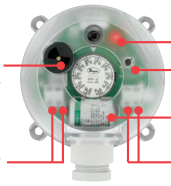
With Dual Scale Field Adjustable Set Point Knob



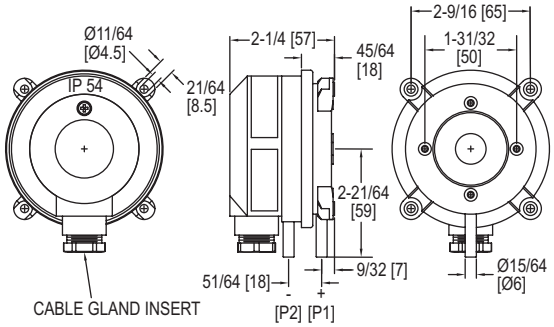
ADPS



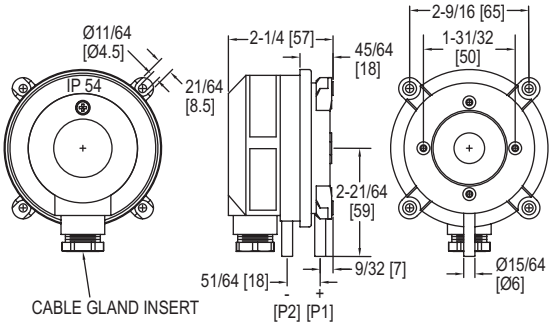
EDPS



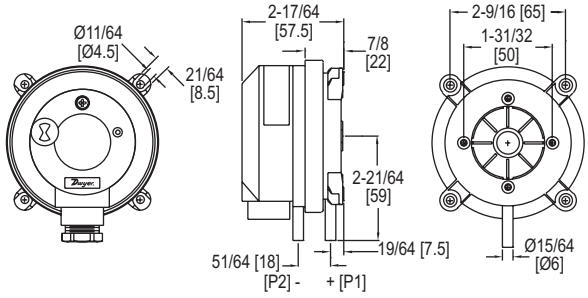
BDPA



ADPS



EDPS



BDPA

VIDEO ONLINE

The **Series ADPS/EDPS/BDPA HVAC Differential Pressure Switches** are designed for pressure, vacuum, and differential pressures. The dual scaled adjustment knob in inches water column and pascals allows changes to the switching pressure to be made without a pressure gage. The ADPS/EDPS/BDPA are available with settings from 0.08 in w.c. (20 Pa) up to 20 in w.c. (5000 Pa). The silicone diaphragm and PA 6.6 body make the series ADPS ideal for use with air and other noncombustible gases. Series EDPS models meet UL508 and are constructed of plenum rated plastics. The series BDPA Adjustable Differential Pressure Alarms offer a versatile range of configurations allowing utilization of their many features including buzzer and LED notification, and battery or line powered. The compact size, adjustment knob and low cost make the ADPS/EDPS/BDPA the perfect choice for HVAC applications.

FEATURES/BENEFITS

- Adjustment knob changes switching pressure easily with a pressure gage reducing components for application
- Low cost device makes it an excellent solution in BAS and HVAC applications requiring duct control and monitoring
- Relay contact allows simple integration with DDC or building systems

APPLICATIONS

- Air filter and ventilator monitoring
- Industrial cooling circuits
- Fire-protection damper control
- Ventilation duct monitoring
- Fan heater overheating protection
- Heat exchanger frost protection

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: ADPS: Diaphragm material: Silicone; Housing material: POM; Switch body: PA 6.6; Cover: Polystyrene; EDPS: Diaphragm material: Silicone; Housing material: Switch body: PA 6.6; Cover: Polystyrene; Materials UL 94 V-0 rated.
Temperature Limits: Process and ambient temperature from -4 to 185°F (-20 to 85°C).
Storage: -40 to 185°F (-40 to 85°C).
Pressure Limits: Max. operating pressure: 40 in w.c. (10 kPa) for all pressure ranges.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: Max. 1.5 A res./0.4 A ind./250 VAC, 50/60 Hz; Max. switching rate: 6 cycles/min.
Electrical Connections: Push-on screw terminals. M20x1.5 with cable strain relief or optional 1/2″ NPT.
Process Connections: 5/16″ (7.94 mm) outside diameter tubing, 1/4″ (6.0 mm) inside diameter tubing.
Enclosure Rating: NEMA 13 (IP54).
Mounting Orientation: Vertically, with pressure connections pointing downwards.
Mechanical Working Life: Over 10^6 switching operations.
Weight: 4.4 oz (125 g).
Agency Approvals: ETL approved to UL508 and CSA C22.2#14 (EDPS only).

MODEL CHART - ADPS

Model	Set Point Range in w.c. (Pa)	Approx. Dead Band @ Min Set Point in w.c. (Pa)	Approx. Deadband @ Max Set Point in w.c. (Pa)
ADPS-08-2-N	0.08 to 1.20 (20-300)	0.04 (10)	0.05 (12)
ADPS-04-2-N	0.12 to 1.60 (30-400)	0.06 (15)	0.09 (23)
ADPS-03-2-N	0.20 to 2.00 (50-500)	0.08 (20)	0.09 (23)
ADPS-05-2-N	0.80 to 4.00 (200-1000)	0.4 (100)	0.5 (130)
ADPS-06-2-N	2.00 to 10.00 (500-2500)	0.6 (150)	0.8 (200)
ADPS-07-2-N	4.00 to 20.00 (1000-5000)	1.0 (250)	1.4 (350)

Note: For optional 1/2″ NPT conduit connection, change -2-N to-1-N. Models that include installer kit add -C to the end of the model number (-2-N cable gland models only). Installer kit includes two static tips and 7 ft of PVC tubing. Order installer kit separately with 1/2″ NPT conduit connection models. See A-481 in the accessories list. Consult factory for bulk packaging option.

MODEL CHART - EDPS

Model	Set Point Range in w.c. (Pa)	Approx. Dead Band @ Min Set Point in w.c. (Pa)	Approx. Dead Band @ Max Set Point in w.c. (Pa)
EDPS-08-1-N	0.08 to 1.20 (20-300)	0.04 (10)	0.05 (12)
EDPS-04-1-N	0.12 to 1.60 (30-400)	0.06 (15)	0.09 (23)
EDPS-03-1-N	0.20 to 2.00 (50-500)	0.08 (20)	0.09 (23)
EDPS-05-1-N	0.80 to 4.00 (200-1000)	0.4 (100)	0.5 (130)
EDPS-06-1-N	2.00 to 10.00 (500-2500)	0.6 (150)	0.8 (200)
EDPS-07-1-N	4.00 to 20.00 (1000-5000)	1.0 (250)	1.4 (350)

Note: For optional M20 cable gland connection, change -1-N to-2-N.

MODEL CHART - BDPA

Model	Set Point Range in w.c. (Pa)	Approx. Dead Band @ Min Set Point in w.c. (Pa)	Approx. Dead Band @ Max Set Point in w.c. (Pa)
BDPA-08-2-N	0.08 to 1.20 (20 to 300)	0.04 (10)	0.05 (12)
BDPA-04-2-N	0.12 to 1.60 (30 to 400)	0.06 (15)	0.09 (23)
BDPA-03-2-N	0.20 to 2.00 (50 to 500)	0.08 (20)	0.09 (23)
BDPA-05-2-N	0.80 to 4.00 (200 to 1000)	0.4 (100)	0.5 (130)
BDPA-06-2-N	2.00 to 10.00 (500 to 2500)	0.6 (150)	0.8 (200)
BDPA-07-2-N	4.00 to 20.00 (1000 to 5000)	1.0 (250)	1.4 (350)

ACCESSORIES

Model	Description
A-288	"L" type metal mounting bracket with screws
A-289	"S" type metal mounting bracket with screws
A-480	Plastic static pressure tip
A-481	Installer kit, includes 2 plastic static pressure tips & 7′ (2.1 m) of PVC tubing
A-489	4″ straight static pressure tip with flange



A-480

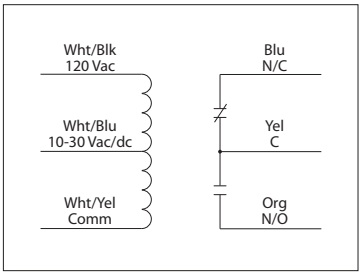
Process Tubing Options: See page 455 (Gage Tubing Accessories)

RIB Functional Devices, Inc.
(800) 888-5538
sales@functionaldevices.com
www.functionaldevices.com

10 AMP PILOT CONTROL RELAY

RIBU1C

Enclosed Relay 10 Amp SPDT with
10-30 Vac/dc/120 Vac Coil





RIBU1C-RD
- Red housing



RIBU1C-N4
- NEMA 4X housing, UL508 only

SPECIFICATIONS

Relays & Contact Type: One (1) SPDT Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Operate Time: 20ms
Relay Status: LED On = Activated
Dimensions: 1.70˝ x 2.80˝ x 1.50˝ with .50˝ NPT nipple
Wires: 16˝, 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL
California State Fire Marshal, CE, RoHS
Housing Rating: UL Accepted for Use in Plenum, NEMA 1
Gold Flash: Yes
Override Switch: No

Contact Ratings:
10 Amp Resistive @ 277 Vac
10 Amp Resistive @ 28 Vdc
480 VA Pilot Duty @ 240-277 Vac
480 VA Ballast @ 277 Vac
Not rated for Electronic Ballast
600 Watt Tungsten @ 120 Vac (N/O)
240 Watt Tungsten @ 120 Vac (N/C)
1/3 HP @ 120-240 Vac (N/O)
1/6 HP @ 120-240 Vac (N/C)
1/4 HP @ 277 Vac (N/O)
1/8 HP @ 277 Vac (N/C)

Coil Current:

33 mA @ 10 Vac	13 mA @ 10 Vdc
35 mA @ 12 Vac	15 mA @ 12 Vdc
46 mA @ 24 Vac	18 mA @ 24 Vdc
55 mA @ 30 Vac	20 mA @ 30 Vdc
28 mA @ 120 Vac	

Coil Voltage Input:
10-30 Vac/dc ; 120 Vac ; 50-60 Hz
Drop Out = 2.1 Vac / 2.8 Vdc
Pull In = 9 Vac / 10 Vdc

Functional Devices, Inc.
101 Commerce Drive
Sharpsville, IN 46068

Toll-free: (800) 888-5538
Office: (765) 883-5538
Fax: (765) 883-7505

Email: sales@functionaldevices.com
Website: www.functionaldevices.com

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A. All prices quoted for products are Ex-Works (Incoterms 2010) at a shipping facility determined by Seller, unless otherwise noted by Seller ("**Seller's Shipping Facility**"). Risk of loss or damage, and beneficial ownership, of the Products are transferred to Buyer when the Products are made available to Buyer at Seller's Shipping Facility. All delivery dates are approximate.

B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

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The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

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For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

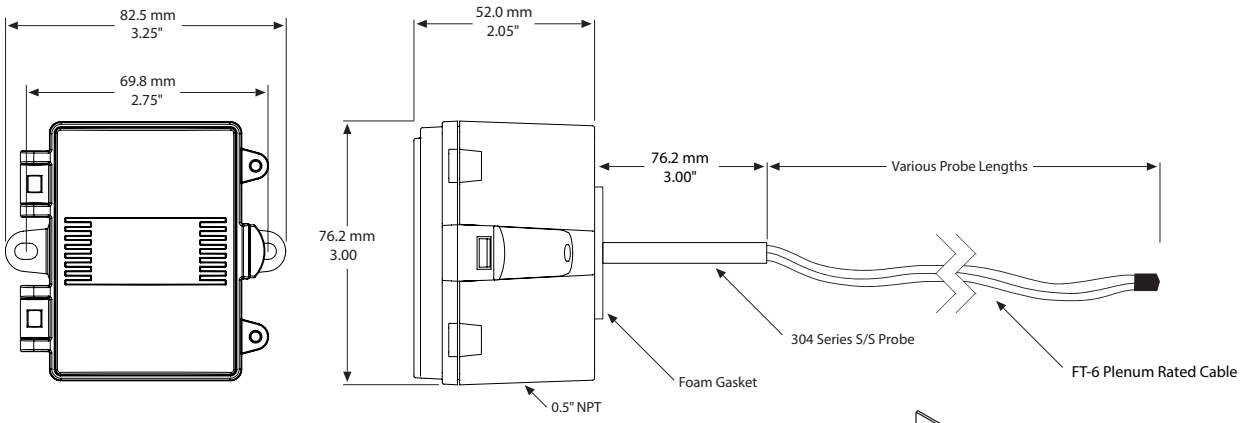
11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

Duct Temperature Sensor, Averaging (Flexible)

STE-1415/1416/1417

Installation Guide

Mounting



The averaging temperature sensor incorporates several discrete sensors encapsulated at equal distances across the length of the probe. The complete assembly acts as a single sensor to monitor the average temperature in a duct. (Averaging elements are not recommended for high humidity applications.)

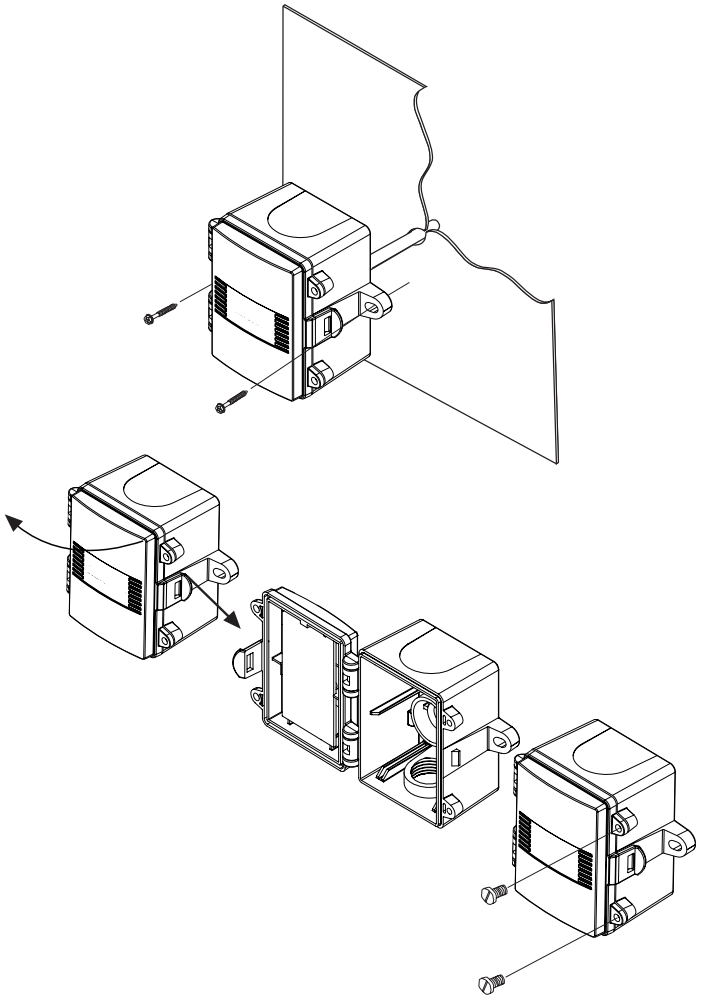
The sensors can be installed onto hangers in the duct using tube clamps or wire ties. They should be located in a straight section of duct away from heating, cooling, or humidifier elements.

Temperature sensors can be affected by air stratification in the duct, air leakage through the conduit or other duct holes, and nearness to exterior walls, a large thermal mass (e.g., concrete blocks), heat sources, or wires with power.

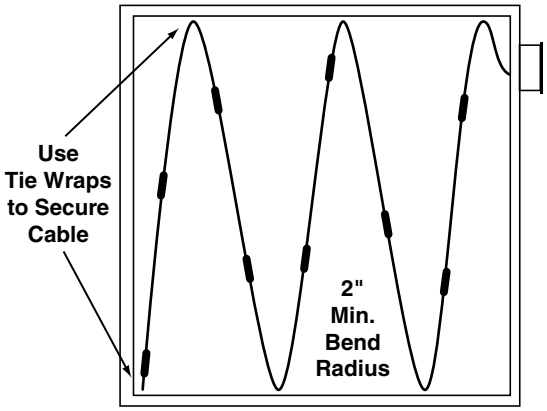
Because of air stratification, the coldest air tends to be toward the bottom of the duct. Hence, one of the sensors should be near the bottom of the duct.

The flexible cable can be easily shaped to fit any duct size but observe a **minimum bend radius of two inches** to prevent damage to wires or sensors.

1. Cut a hole in the duct large enough to feed the sensor cable from the back of the sensor enclosure.
2. Insert the sensor cable into the duct, stringing the cable to cover the air path, and secure as needed.
3. Fasten the enclosure to the duct by drilling holes in the duct and threading screws through the mounting holes in the case.



4. For the cable leading to the building automation system controller, attach conduit to the 1/2" NPT threaded connection hole that is provided in the bottom of the enclosure as needed.



5. Open the cover by pulling slightly on the latch on the right side of the enclosure while pulling on the cover.

Connections and Wiring

NOTE: Use 18 to 24 AWG shielded wiring for all connections. Do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors. Make all connections in accordance with national and local codes.

1. Bring the cable from the controller through the bottom hole.
2. Make connections to the two wire leads with either butt-splices or solder. Using wire nuts is **not** recommended.

NOTE: The two-wire sensor is not polarity sensitive.

NOTE: Plug the conduit with sealant to prevent air infiltration.

3. Swing the door closed until securely latched.
4. If desired for added security, install the two (provided) screws in the door's integrated screw tabs.

Specifications

Sensor	Type III thermistor, 10K ohm @ 77° F (25° C)
Probe Sensing Range	–40 to 140° F (–40 to 60° C)
Ambient Operating Range	–40 to 122° F (–40 to 50° C), 5 to 95% RH noncondensing
Enclosure	UL94-V0, IP65 (NEMA 4X), ABS
Wiring	FT-6 plenum-rated, 22 AWG wire leads
Cable Lengths	STE-1415 6 feet (1.8 m), STE-1416 12 feet (3.6 m), STE-1417 24 feet (7.3 m)

Configuration

For controller configuration, see the **Type III Sensors Applications Guide** on the KMC web site.

Maintenance

No routine maintenance is required. Each component is designed for dependable, long-term reliability and performance. Careful installation will also ensure long-term reliability and performance.

More Information

For **controller configuration, troubleshooting, and other information**, see the **Type III Sensors Applications Guide** on the KMC web site. For **additional information**, see the **STE-1400 Series Data Sheet** on the KMC web site.

Important Notices

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RH DUCT

Relative Humidity, Duct, Thermistor

The ACI Relative Humidity with Thermistor Duct Series utilizes a thermoset polymer capacitive sensing element with a factory fitted hydrophobic filter to improve its moisture resistance. The sensing elements multilayer construction also provides excellent resistance in applications where dust, dirt, oils and common environmental chemicals are found. The RH duct sensors include on board DIP switches which allow the user to select the desired output signal and can be powered by AC or DC power sources. Each unit also contains 0%, 50%, and 100% test options to verify that the transmitter is both working and wired properly. Field calibration can be performed by using the increment and decrement calibration DIP switches without the need to replace the sensing element. These enhancements provide increased flexibility and outstanding long-term reliability without the need to replace the sensors in the field. Duct configurations feature a weatherproof Euro style enclosure with a gasketed cover and conformally coated circuit boards for increased moisture resistance in high humidity environments. The sensor is protected by a stainless-steel sintered filter. Three and Five-point NIST Calibration Certificates are available and must be ordered separately when placing your order.

Applications: Humidification, Dehumidification, Supply / Discharge / Return Air, Economizers, Clean Rooms, Data Centers, Process Control, Schools, Hospitals, Office Buildings

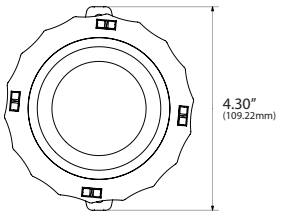
The ACI RH Thermistor Duct is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

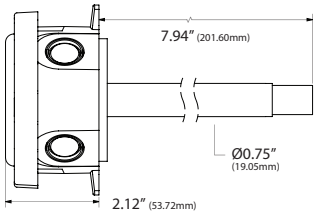
PRODUCT SPECIFICATIONS

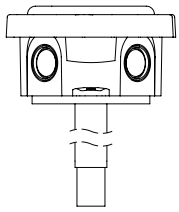
RH Supply Voltage (Reverse Polarity Protected):	**4-20 mA:** 250 Ohm Load: 15 - 40 VDC / 18 - 28 VAC | **500 Ohm Load:** 18 - 40 VDC / 18 - 28 VAC **0-5 VDC:** 12 - 40 VDC / 18 - 28 VAC | **0-10 VDC:** 18 - 40 VDC / 18 - 28 VAC	
RH Supply Current (VA):	**Voltage Output:** 8 mA maximum (0.32 VA) | **Current Output:** 24 mA maximum (0.83 VA)	
RH Output Load Resistance:	**4-20 mA:** 700 Ohms maximum | **0-5 VDC or 0-10 VDC:** 4K Ohms Minimum	
RH Output Signal:	**2-wire:** 4 - 20 mA (Factory Default) | **3-wire:** 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable)	
RH Accuracy @ 77°F (25°C):	+/- 1% over 20% RH Range between 20 to 90% | +/- 2%, 3%, or 5% from 10 to 95%	
RH Measurement Range	0-100%	
Operating RH Range:	0 to 95% RH, non-condensing (Conformally Coated PCB's)	
Operating Temperature Range:	-40 to 140°F (-40 to 60°C)	
Storage Temperature Range:	-40 to 149°F (-40 to 65°C)	
RH Stability | Repeatability | Sensitivity:	Less than 2% drift / 5 years | 0.5% RH | 0.1% RH	
RH Response Time (T63):	20 Seconds Typical	
RH Sensor Type:	Capacitive with Hydrophobic Filter	
RH Transmitter Stabilization Time:	30 Minutes (Recommended time before doing accuracy verification)	
RH Connections | Wire Size:	Screw Terminal Blocks (Polarity Sensitive) | 16 (1.31 mm^2) to 26 AWG (0.129 mm^2)	
RH Terminal Block Torque Rating:	4.43 to 5.31 lb-in (0.5 to 0.6 Nm)	
RH NIST Test Points:	**Default Test Points:** 3 Points (20%, 50% & 80%) or 5 Points (20%, 35%, 50%, 65% & 80%) **1% NIST Test Points:** 5 Points within selected 20% Range (ie. 30%-50% are 30, 35, 40, 45 & 50)	
Nominal Thermistor Resistive Output @ 77°F (25°C) (Lead Wire Colors) Non-Linear NTC (Negative Temperature Coefficient):	**RHx-1.8K Series:** 1.8KΩ (Red/Yellow) **RHx-3K Series:** 3KΩ (White/Brown) **RHx-AN Series (Type III):** 10KΩ (White/White) **RHx-AN-BC Series:** 5.238KΩ (White/Yellow) **RHx-CP Series (Type II):** 10KΩ (White/Green) **RHx-CSI Series:** 10KΩ (Green/Yellow)	**RHx-10KS Series:** 10KΩ (White/Blue) **RHx-10K-E1 Series:** 10KΩ (Gray/Orange) **RHx-20K Series:** 20KΩ (Brown/Blue) **RHx-50K Series:** 50KΩ nominal (Brown/Yellow) **RHx-100KS Series:** 100KΩ (Black/Yellow)
Thermistor Accuracy 32-158°F (0-70°C):	+/- 0.36°F (0.2°C) except 10K-E1 Series: +/- 0.54°F (0.3°C) **1.8K Series:** +/- 0.9°F (0.5°C) @ 77°F (25°C) & +/- 1.8°F (1.0°C) from 32 to 158°F (0 to 70°C)	
Thermistor Power Dissipation Constant:	3 mW/°C except 1.8K Series: 1 mW/°C; 10K-E1 Series: 2 mW/°C	
Thermistor Sensor Response Time (T63):	10 Seconds nominal	
Lead Wire Length | Conductor Size:	14" (35.6 cm) | 22 AWG (0.65 mm)	
Insulation | Rating:	Etched Teflon (PTFE) Colored Leads | Mil Spec 16878/4 Type E	
Enclosure Specifications (Material, Flammability, Temperature, NEMA/IP Rating):	**"-EH" Enclosure:** ABS Plastic; UL94-V0; -40 to 140°F (-40 to 60°C) **"-4X" Enclosure:** Polystyrene Plastic; UL94-V2; -40 to 158°F (-40 to 70°C); NEMA 4X (IP 66)	
Sensing Tube Material | Filter Material:	**"EH" Enclosure:** 304 Series Stainless Steel | 304 Series Stainless Steel **"-4X" Enclosure:** Schedule 40 PVC (White) | Slotted PVC without filter	
Sensing Tube Dimensions (Length x Diameter):	**"-EH" Models with Sintered Filters:** 7.75" (196.85 mm) x 0.75" (19.05 mm) **"-4X" Models:** 7.20" (182.88 mm) x 0.84" (21.34 mm)	
Product Dimensions (L x W x D):	See drawings on back of data sheet	
Product Weight:	**A/RHx-xx-D Series:** 1.22 lbs. (0.55 kg) | **A/RHx-xx-D-4X Series:** 0.50 lbs. (0.227 kg)	
Agency Approvals:	CE, RoHS2, WEEE	

DIMENSIONAL DRAWING

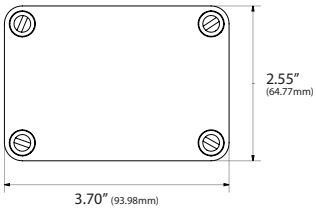
Euro Enclosure [EH]

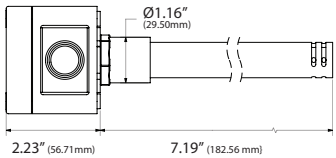


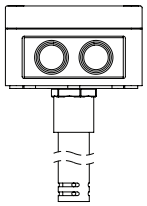




NEMA 4X Enclosure [4X]







Front View | **Right View** | **Top View**

CUSTOM ORDERING

Model # Example: A/ - RH2 - CP - D - [ ] - NIST
(A. B. C. D. E. F.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/** →	**A/**
B. Accuracy *Select One (1)*	**RH1** = +/-1% (Specify a 20% Range between 20 to 90% RH) **RH2** = +/-2% | **RH3** = +/-3% | **RH5** = +/-5%	
C. Temperature Sensor *Select One (1)*	**1.8K** | **3K** | **10KS** | **AN** (Type III) | **AN-BC** | **CP** (Type II) | **CSI** | **10K-E1** | **20K** | **50K** | **100KS**	
D. Configuration *Select One (1)*	**D** = Duct (Euro Enclosure) | **D-4X** (NEMA 4X Enclosure)	
E. Output Signal *Select One (1)*	**----** = 4 to 20 mA (Default) | 0 to 10 VDC (Field Selectable) | 0 to 5 VDC (Field Selectable)	
F. NIST (Temperature) *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (Must Specify 1, 3 or 5 Points)	

Note: Outputs are field selectable between 4-20 mA, 0-5 VDC & 0-10 VDC

ACCESSORIES ORDERING

Model # Example: A/SINTERED FILTER

Model #	Item #	Description
A/SINTERED FILTER	143433	3/8″ Sintered Filter for RH Duct/Stainless Plate/Remote Probe

ACCESSORIES ORDERING [NIST]

Model # Example: NIST RH CERT

Model #	Description
NIST RH CERT	RH Calibration Certificate (Specify 3 Point or 5 Point NIST)

Note: When ordering NIST certificates, please add an additional line item under the corresponding A/RHx-xx-D Model Number

Basic Fail-Safe modulating actuator for controlling dampers in typical commercial HVAC applications.

- **Torque motor 180 in-lb [20 Nm]**
- **Nominal voltage AC/DC 24 V**
- **Control Modulating**
- **Position feedback 2...10 V**



Picture may differ from product

5-year warranty

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	5.5 W
	Power consumption in rest position	3 W
	Transformer sizing	8.5 VA
	Electrical Connection	18 AWG appliance cable, 3 ft [1 m], with 1/2" NPT conduit connector
	Overload Protection	electronic throughout 0...95° rotation
	Electrical Protection	actuators are double insulated
Functional data	Torque motor	180 in-lb [20 Nm]
	Operating range Y	2...10 V
	Operating range Y note	4...20 mA w/ ZG-R01 (500 Ω, 1/4 W resistor)
	Input impedance	100 kΩ for 2...10 V (0.1 mA), 500 Ω for 4...20 mA
	Position feedback U	2...10 V
	Position feedback U note	Max. 0.5 mA
	Direction of motion motor	selectable with switch 0/1
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Manual override	5 mm hex crank (3/16" Allen), supplied
	Angle of rotation	95°
	Angle of rotation note	adjustable with mechanical end stop, 35...95°
	Running Time (Motor)	95 s / 90°
	Running time fail-safe	<20 s @ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Noise level, motor	40 dB(A)
	Noise level, fail-safe	62 dB(A)
	Position indication	Mechanical
Safety data	Power source UL	Class 2 Supply
	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2
	Housing	UL Enclosure Type 2

Technical data

Safety data	Agency Listing	cULus listed to UL60730-1A:02; UL 60730-2-14:02 and CAN/CSA-E60730-1:02
	Quality Standard	ISO 9001
	UL 2043 Compliant	Suitable for use in air plenums per Section 300.22(C) of the NEC and Section 602 of the IMC
	Ambient humidity	Max. 95% RH, non-condensing
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Servicing	maintenance-free
Weight	Weight	5.3 lb [2.4 kg]
Materials	Housing material	UL94-5VA

Footnotes †Rated Impulse Voltage 800V, Type of action 1.AA, Control Pollution Degree 3

Product features

Application

For fail-safe, modulating control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The actuator operates in response to a DC 2...10 Vor, with the addition of a 500Ω resistor, a 4...20 mA control input from an electronic controller or positioner. A DC 2...10 V feedback signal is provided for position indication.

A common installation technique for control of multi-section dampers is to use the U5 position feedback of one actuator (Primary) to control multiple actuators (Secondary). Belimo refers to this as primary and secondary control. The only requirement is that the actuators are installed on MECHANICALLY SEPARATE damper shafts.

Operation

The AF..24-SR series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AF..24-SR series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The AF..24-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. The AF..24-SR actuator is shipped at 5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

ATTENTION: AF..24-SR cannot be tandem mounted on the same damper or valve shaft. Only On/Off and MFT AF.. models can be used for tandem mount applications.

Product features

Typical specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05” diameter. The actuator must provide modulating damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counter clockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Parts included

Description	Type
Cable conduit connector 1/2"	TF-CC US
Wrench 0.32 in and 0.39 in [8 mm and 10 mm]	TOOL-06
Mounting bracket for AF..	ZG-100
Mounting bracket for AF / NF	ZG-101
Mounting bracket for AF / NF	ZG-118
Mounting kit for foot mount installation	ZG-AFB118
Weather shield 13x8x6" [330x203x152 mm] (LxWxH)	ZS-100
Weather shield 406x213x102 mm [16x8-3/8x4"] (LxWxH)	ZS-150
Explosion proof housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations	ZS-260
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300

Accessories

Electrical accessories

Description	Type
DC Voltage Input Rescaling Module	IRM-100
Auxiliary switch, mercury-free	P475
Auxiliary switch, mercury-free	P475-1
Signal simulator, Power supply AC 120 V	PS-100
Convert Pulse Width Modulated Signal to a 2...10 V Signal for Belimo Proportional Actuators	PTA-250
Positioner for wall mounting	SGA24
Positioner for front-panel mounting	SGF24
Cable conduit connector 1/2"	TF-CC US
Resistor, 500 Ω, 1/4" wire resistor with 6" pigtail wires	ZG-R01
Resistor kit, 50% voltage divider	ZG-R02
Transformer, AC 120 V to AC 24 V, 40 VA	ZG-X40

Mechanical accessories

Description	Type
Anti-rotation bracket, for AF / NF	AF-P
Shaft extension 240 mm ø20 mm for damper shaft ø8...22.7 mm	AV8-25
End stop indicator	IND-AFB
Shaft clamp reversible, for central mounting, for damper shafts ø12.7 / 19.0 / 25.4 mm	K7-2
Ball joint suitable for damper crank arm KH8 / KH10	KG10A
Ball joint suitable for damper crank arm KH8	KG8
Damper crank arm Slot width 8.2 mm, clamping range ø14...25 mm	KH10
Damper crank arm Slot width 8.2 mm, for ø1.05"	KH12

Accessories

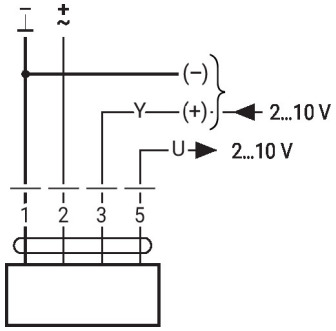
Description	Type
Damper crank arm Slot width 8.2 mm, clamping range ø10...18 mm	KH8
Actuator arm, for 3/4" shafts, clamping range ø10...22 mm, Slot width 8.2 mm	KH-AFB
Push rod for KG10A ball joint L 36", 3/8" diameter	SH10
	SH8
Wrench 0.32 in and 0.39 in [8 mm and 10 mm]	TOOL-06
Baseplate extension	Z-AF
Mounting bracket for AF..	ZG-100
Mounting bracket for AF / NF	ZG-101
Dual actuator mounting bracket.	ZG-102
Mounting bracket	ZG-109
Linkage kit	ZG-110
Mounting bracket for AF / NF	ZG-118
Jackshaft mounting bracket.	ZG-120
Mounting kit for linkage operation for flat and side installation	ZG-AFB
Mounting kit for foot mount installation	ZG-AFB118
	ZG-DC1
	ZG-DC2
1" diameter jackshaft adaptor (11" L).	ZG-JSA-1
1-5/16" diameter jackshaft adaptor (12" L).	ZG-JSA-2
1.05" diameter jackshaft adaptor (12" L).	ZG-JSA-3
Weather shield 13x8x6" [330x203x152 mm] (LxWxH)	ZS-100
Baseplate, for ZS-100	ZS-101
Weather shield 406x213x102 mm [16x8-3/8x4"] (LxWxH)	ZS-150
Explosion proof housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations	ZS-260
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300-5
Shaft extension 1/2"	ZS-300-C1
Shaft extension 3/4"	ZS-300-C2
Shaft extension 1"	ZS-300-C3
Baseplate extension	Z-SF
Linkage kit	ZG-JSL
Jackshaft RetroFIT+ Linkage with Belimo Rotary Actuators	

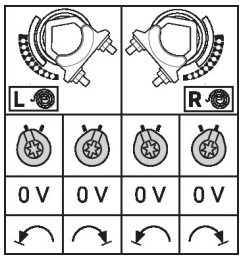
Electrical installation

Wire colors:
1 = black
2 = red
3 = white
5 = orange

Electrical installation

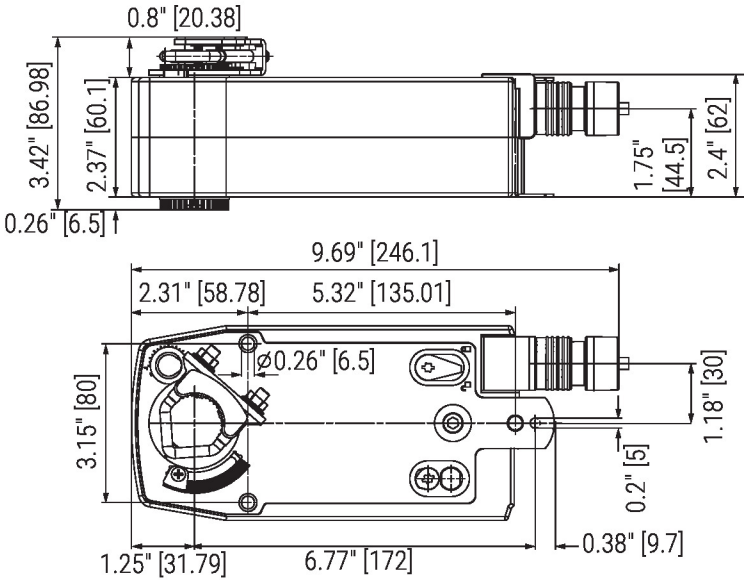
AC/DC 24 V, modulating





Dimensions

PC



2-way, Characterized Control Valve, Stainless Steel Ball and Stem



Picture may differ from product

5-year warranty

Type overview

Type	DN
B239	1 1/2" [40]

Technical data

Functional data	Valve size [mm]	1.5" [40]
	Fluid	chilled or hot water, up to 60% glycol
	Fluid Temp Range (water)	0...250°F [-18...120°C]
	Body Pressure Rating	400 psi
	Close-off pressure Δps	200 psi
	Flow characteristic	equal percentage
	Leakage rate	0% for A – AB
	Pipe connection	Internal thread NPT (female)
	Servicing	maintenance-free
	Flow Pattern	2-way
	Controllable flow range	75°
	Cv	29
Materials	Valve body	nickel-plated brass body
	Stem	stainless steel
	Stem seal	EPDM (lubricated)
	Seat	PTFE
	Characterized disc	TEFZEL®
	O-ring	EPDM (lubricated)
	Ball	stainless steel
Suitable actuators	Non Fail-Safe	ARB(X) ARQB(X) NRQB(X) ARB(X) N4
	Spring	AFRB(X)

Safety notes

- WARNING: This product can expose you to lead which is known to the State of California to cause cancer and reproductive harm. For more information go to www.p65warnings.ca.gov

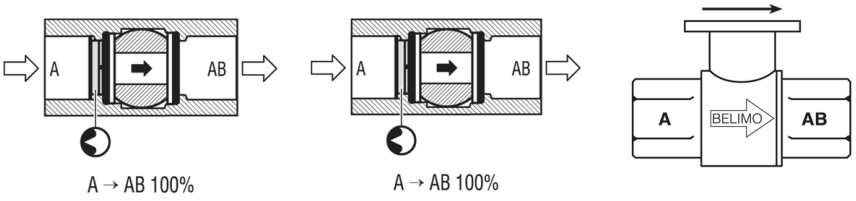
Product features

Application

This valve is typically used in air handling units on heating or cooling coils, and fan coil unit heating or cooling coils. Some other common applications include Unit Ventilators, VAV box re-heat coils and bypass loops. This valve is suitable for use in a hydronic system with variable flow.

Flow/Mounting details

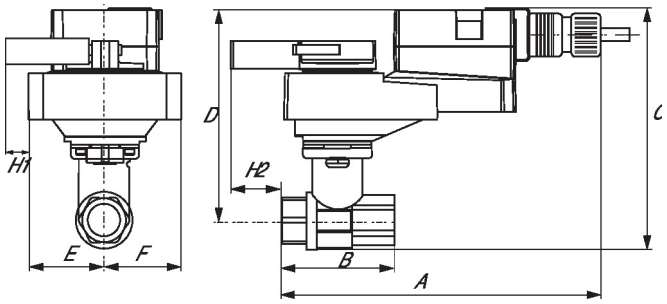
Two-way valves should be installed with the disc upstream.



Dimensions

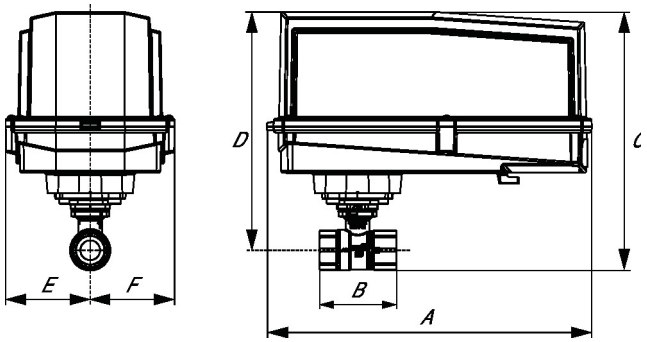
Type	DN	Weight
B239	1 1/2" [40]	1.9 lb [0.86 kg]

ARCB, ARCX, ARB, ARX



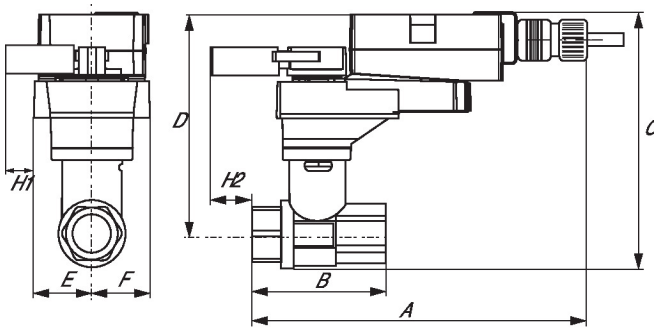
A	B	C	D	E	F	H1	H2
11.0" [280]	3.9" [100]	6.4" [163]	5.3" [135]	1.77" [44]	1.7" [44]	0.8" [20]	1.2" [30]

ARB N4, ARX N4, NRB N4, NRX N4



A	B	C	D	E	F
11.4" [289]	3.9" [100]	8.5" [217]	7.3" [185]	3.1" [80]	3.1" [80]

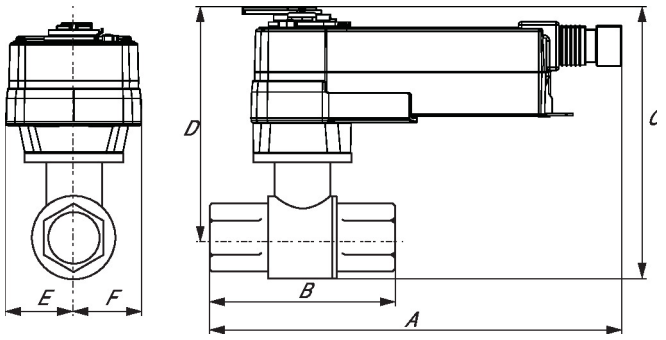
NRQB, NRQX



Dimensions

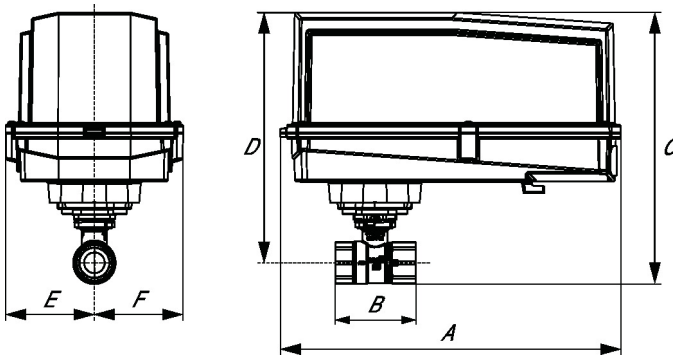
A	B	C	D	E	F	H1	H2
11.0" [280]	3.9" [100]	7.1" [181]	6.0" [153]	1.77" [44]	1.7" [44]	1.4" [34]	0.6" [15]

AFRB, AFRX



A	B	C	D	E	F
10.8" [275]	3.9" [100]	9.0" [229]	7.8" [198]	2.0" [51]	2.0" [51]

AFRB N4, AFRX N4



A	B	C	D	E	F
13.0" [330]	3.9" [100]	10.3" [262]	8.5" [216]	3.4" [86]	3.4" [86]

2-way, Characterized Control Valve, Stainless Steel Ball and Stem



5-year warranty

Type overview

Type	DN
B248	50

Technical data

Functional data	Valve size [mm]	2" [50]
	Fluid	chilled or hot water, up to 60% glycol
	Fluid Temp Range (water)	0...250°F [-18...120°C]
	Body Pressure Rating	400 psi
	Close-off pressure Δps	200 psi
	Flow characteristic	equal percentage
	Leakage rate	0% for A – AB
	Pipe connection	Internal thread NPT (female)
	Servicing	maintenance-free
	Flow Pattern	2-way
	Controllable flow range	75°
	Cv	29
Materials	Valve body	Nickel-plated brass body
	Stem	stainless steel
	Stem seal	EPDM (lubricated)
	Seat	PTFE
	Characterized disc	TEFZEL®
	O-ring	EPDM (lubricated)
	Ball	stainless steel
Suitable actuators	Non Fail-Safe	ARB(X) ARQB(X) ARB(X) N4
	Spring	AFRB(X)

Safety notes

- WARNING: This product can expose you to lead which is known to the State of California to cause cancer and reproductive harm. For more information go to www.p65warnings.ca.gov

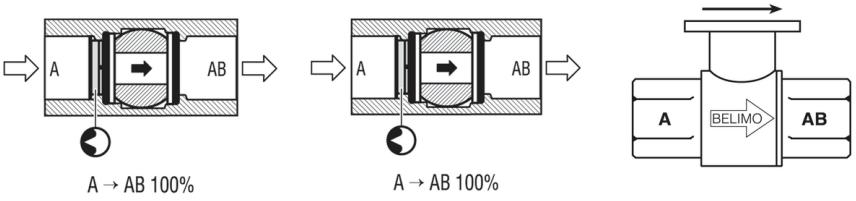
Product features

Application

This valve is typically used in air handling units on heating or cooling coils, and fan coil unit heating or cooling coils. Some other common applications include Unit Ventilators, VAV box re-heat coils and bypass loops. This valve is suitable for use in a hydronic system with variable flow.

Flow/Mounting details

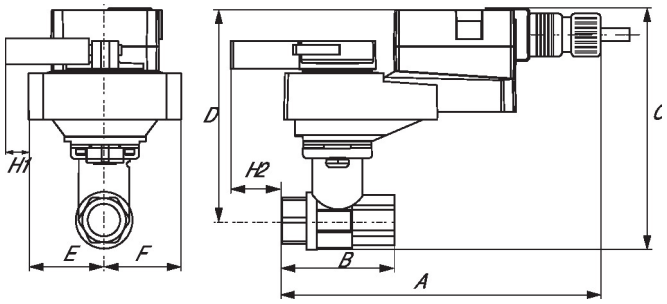
Two-way valves should be installed with the disc upstream.



Dimensions

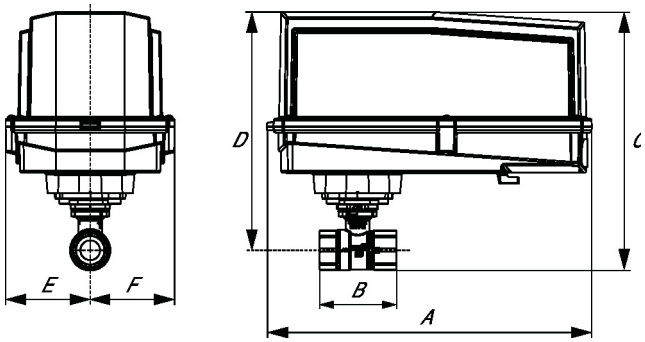
Type	DN	Weight
B248	50	2.8 lb [1.3 kg]

ARB, ARX



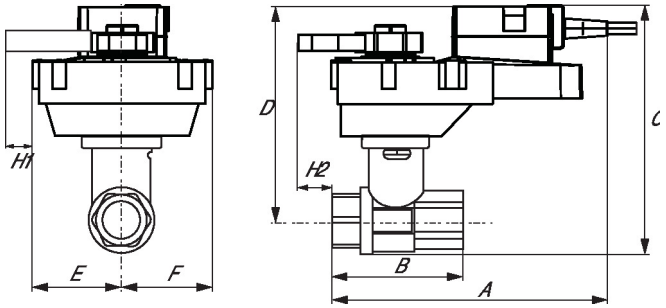
A	B	C	D	E	F	H1	H2
11.0" [280]	4.2" [107]	6.9" [175]	5.5" [140]	1.7" [44]	1.7" [44]	1.2" [30]	0.6" [15]

ARB N4, ARX N4, NRB N4, NRX N4



A	B	C	D	E	F
11.4" [289]	4.2" [107]	9.8" [249]	7.6" [194]	3.1" [80]	3.1" [80]

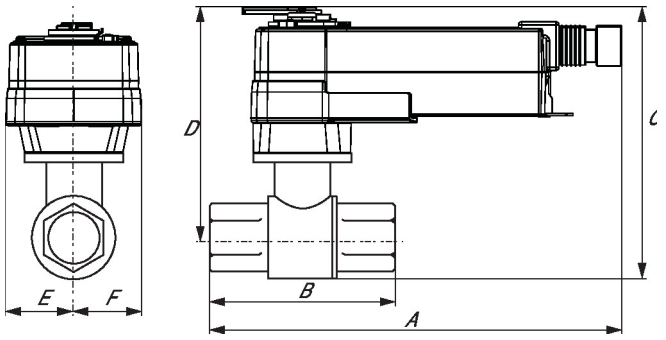
ARQB, ARQX



Dimensions

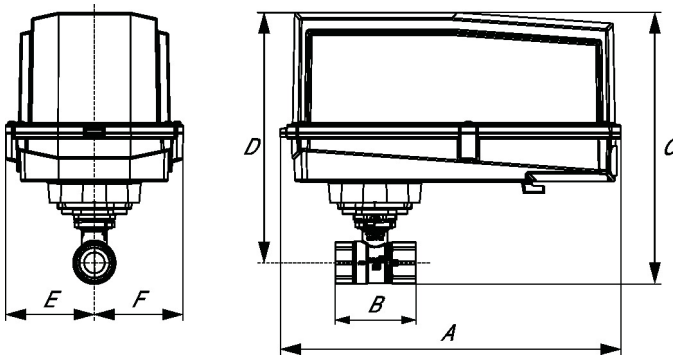
A	B	C	D	E	F	H1	H2
11.0" [280]	4.2" [107]	7.5" [191]	6.1" [155]	2.3" [58]	2.3" [58]	0.8" [20]	0.6" [15]

AFRB, AFRX



A	B	C	D	E	F
10.8" [275]	4.2" [107]	9.5" [241]	8.1" [206]	2.0" [51]	2.0" [51]

AFRB N4, AFRX N4



A	B	C	D	E	F
13.0" [330]	4.9" [125]	10.3" [262]	9.3" [235]	3.4" [86]	3.4" [86]

BELIMO

Modulating, Spring return, 24 V

Technical data sheet AFRB24-SR



5-year warranty

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	5.5 W
	Power consumption in rest position	3 W
	Transformer sizing	8.5 VA
	Electrical Connection	18 GA appliance cable, 1 m, with 1/2" NPT conduit connector
	Overload Protection	electronic throughout 0...95° rotation
Functional data	Operating range Y	2...10 V
	Operating range Y note	4...20 mA w/ ZG-R01 (500 Ω, 1/4 W resistor)
	Input impedance	100 kΩ for 2...10 V (0.1 mA), 500 Ω for 4...20 mA
	Position feedback U	2...10 V
	Position feedback U note	Max. 0.5 mA
	Direction of motion motor	selectable with switch
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Manual override	5 mm hex crank (3/16" Allen), supplied
	Angle of rotation	90°
	Running Time (Motor)	95 s / 90°
	Running time fail-safe	<20 s
	Noise level, motor	45 dB(A)
	Noise level, fail-safe	62 dB(A)
	Position indication	Mechanical
Safety data	Power source UL	Class 2 Supply
	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2
	Enclosure	UL Enclosure Type 2
	Agency Listing	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02 CE acc. to 2014/30/EU and 2014/35/EU
	Quality Standard	ISO 9001
	UL 2043 Compliant	Suitable for use in air plenums per Section 300.22(C) of the NEC and Section 602 of the IMC
	Ambient humidity	Max. 95% RH, non-condensing
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Servicing	maintenance-free
Weight	Weight	5.4 lb [2.4 kg]

Materials	Housing material	Galvanized steel and plastic housing

Footnotes †Rated Impulse Voltage 800V, Type of action 1.AA, Control Pollution Degree 3

Electrical installation

INSTALLATION NOTES

A Actuators with appliance cables are numbered.

1 Provide overload protection and disconnect as required.

3 Actuators may also be powered by DC 24 V.

5 Only connect common to negative (-) leg of control circuits.

7 A 500 Ω resistor (ZG-R01) converts the 4...20 mA control signal to 2...10 V.

11 Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

Meets cULus requirements without the need of an electrical ground connection.

Warning! Live electrical components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Wiring diagrams

2...10 V / 4...20 mA Control

