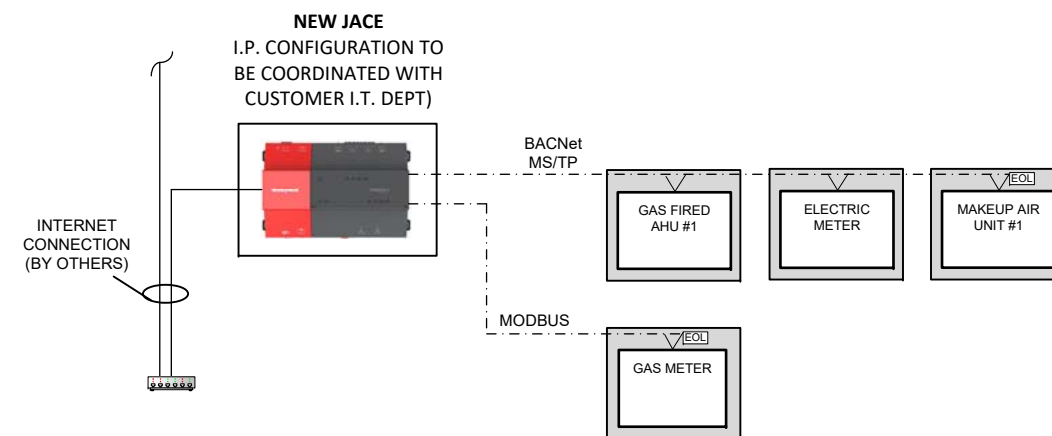


NETWORK RISER

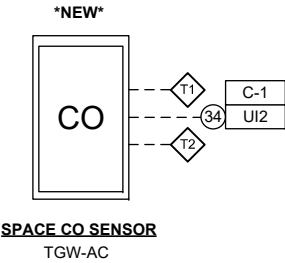
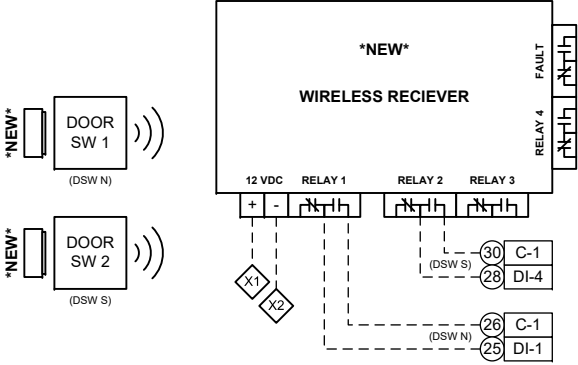
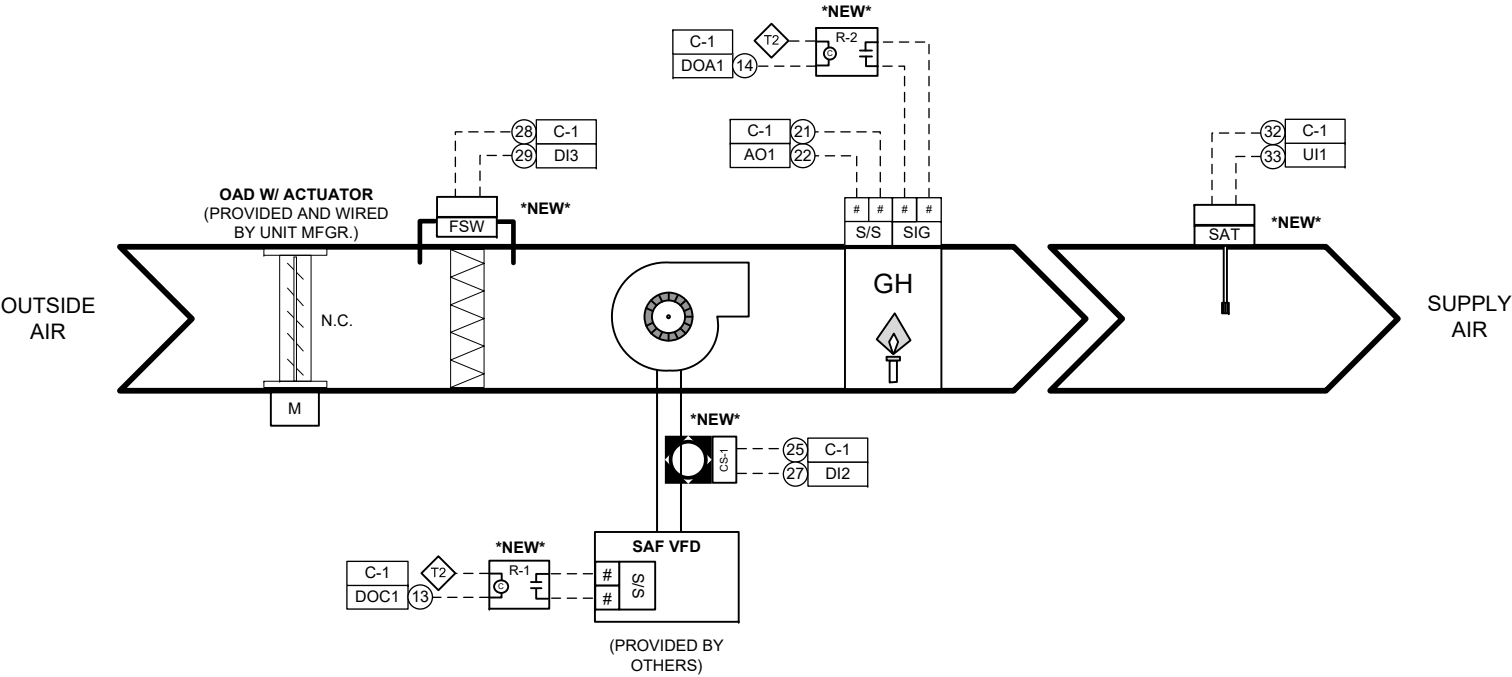


NOTE: 1) 120VAC POWER TO ALL CONTROL PANELS BY OTHERS

[illegible]

MAKE-UP AIR UNIT (MAU-1) FLOW DIAGRAM

WIRELESS DOOR SWITCH RECIEVER DIAGRAM



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

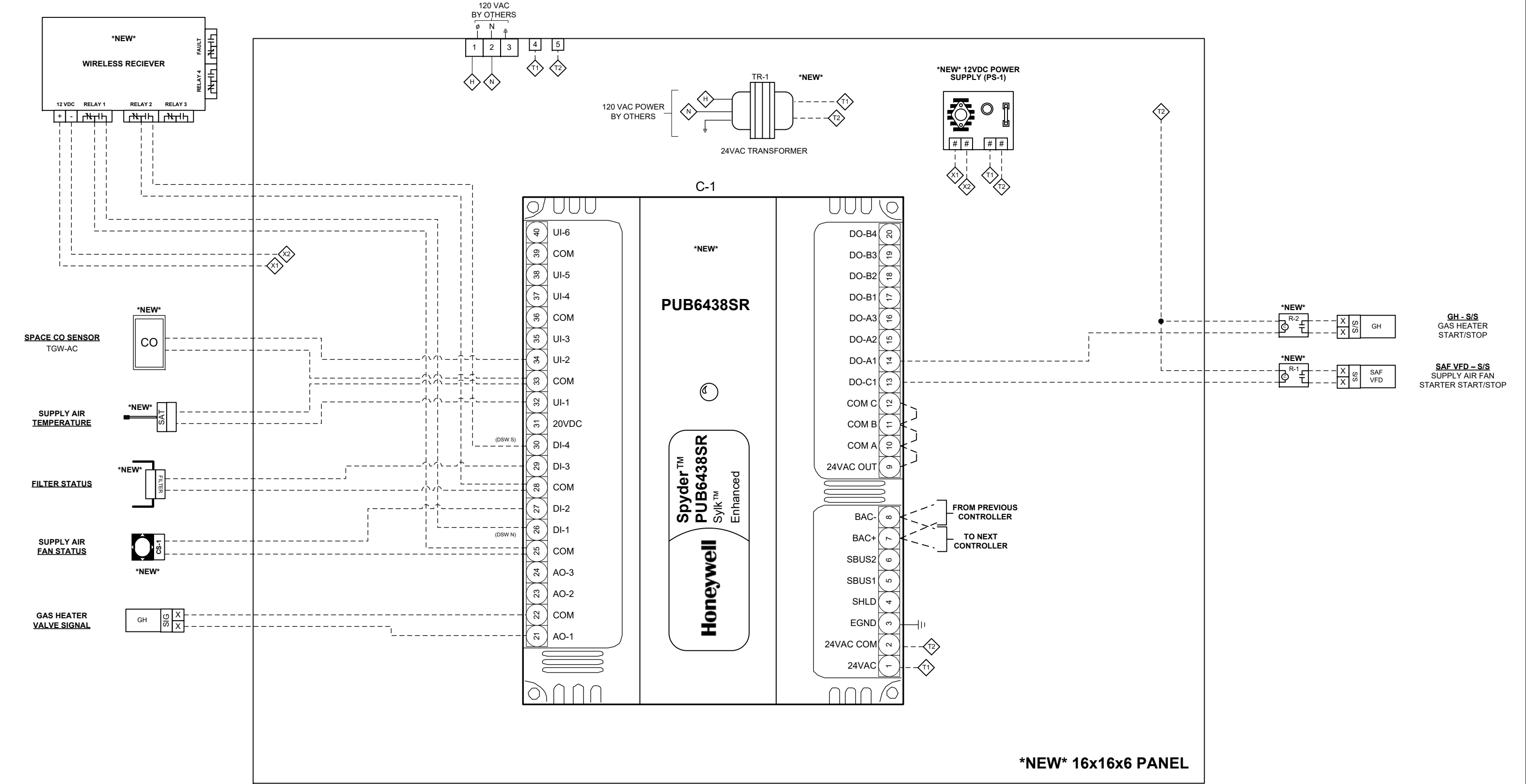
FACILITY	NJDOT Fernwood Building 23, 1035 Parkway Ave, Ewing, NJ 08625				
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	
		1	11-03-2017	ADDED DOOR SWITCHES	
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.
		NO.	DATE	REVISION	BY

Project: NJ DOT FERNWOOD GARAGE BUILDING 23

MAKE-UP AIR UNIT (MAU-1) FLOW DIAGRAM

Job No. #17-03253Page 4 of 11

MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 23, 1035 Parkway Ave, Ewing, NJ 08625						Project: NJ DOT FERNWOOD GARAGE BUILDING 23
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS			MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC
		1	11-03-2017	ADDED DOOR SWITCHES			
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.		
		NO.	DATE	REVISION	BY		Job No. #17-03253 Page 5 of 11

MAU SEQUENCE OF OPERATIONS

ENABLED MODE:

- 1 – The Make-up Air Unit and its associated Exhaust Fans shall be indexed into the Enabled Mode as per the BMS schedule, or whenever CO levels exceed 10 ppm (adj.).
- 2 – Upon initial startup, the Outside Air Damper shall open.
- 3 – Once the Outside Air Damper has proved open via the End Switch, the Supply Air Fan shall start.
- 4 – If the Supply Air Fan fails to start as sensed by its current sensor, an alarm shall be generated and the Outside Air Damper shall close.
- 5 – Once the Supply Air Fan has proved on, the Make-up Air Unit shall calculate its mode of operation.
- 6 – If the Outside Air Temperature is below 50 deg. F. (adj.), the Make-up Air Unit will enter it’s heating mode.
- 7 – Upon a call for heating, the Gas Heating Signal shall begin to modulate to maintain a Discharge Air Set-point of 60 deg. F..

AIR FILTER MONITORING:

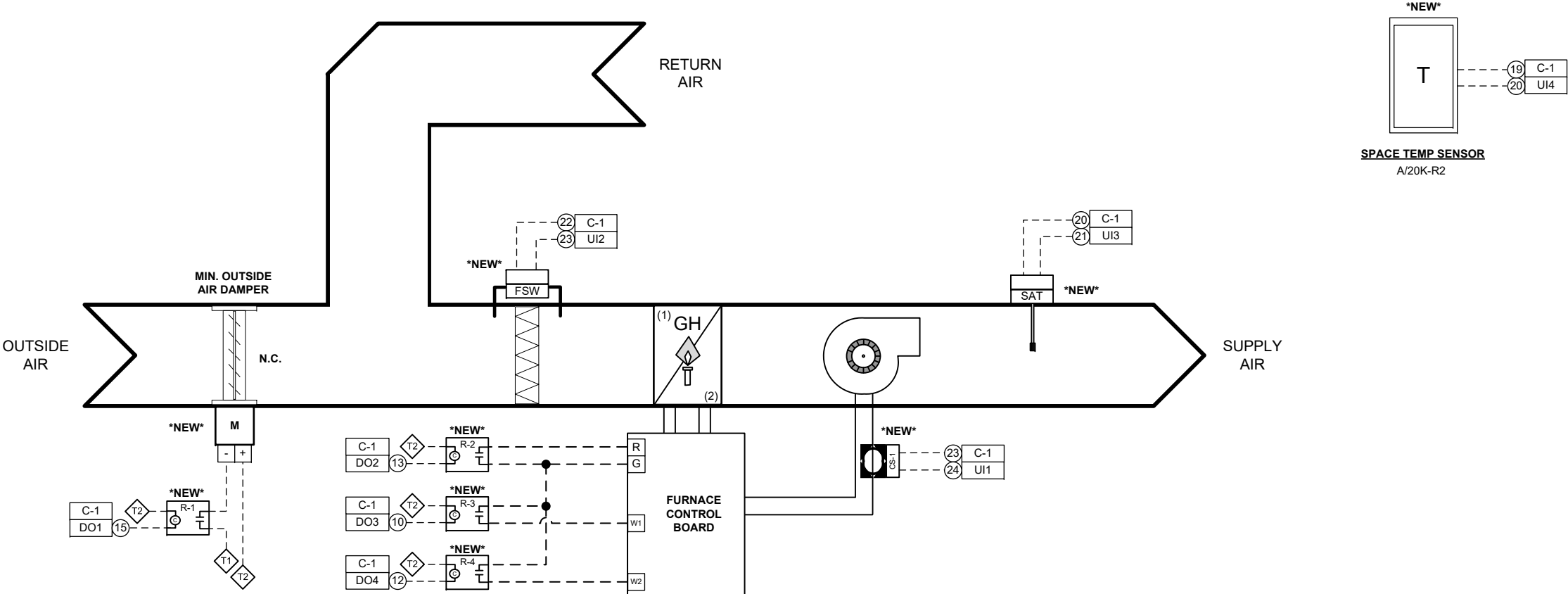
- 1 – The DDC controller shall monitor the filter switch and generate an alarm when it is tripped at the manufacturers dirty filter rating.

SENSOR ALARMING:

- 1 – If the Space Temperature is above 95 deg. F or below 45 deg. F an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 35 deg. F an alarm shall be generated.
- 3 – If the Discharge Air Temperature remains within 4 deg. F below of the Heating Set-point and the Heating Signal is more than 10% for longer than 10 minutes, an alarm shall be generated.
- 4 – All set-points shall be user adjustable from the graphical user interface.
- 5 – If a door switch has been open and the MAU’ heating has been operational for longer than 15 minutes, a critical alarm will be enunciated in the BMS.

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MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS			MAU SEQUENCE OF OPERATIONS	
		1	11-03-2017	ADDED DOOR SWITCHES				
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.			
		NO.	DATE	REVISION	BY		Job No.	#17-03253
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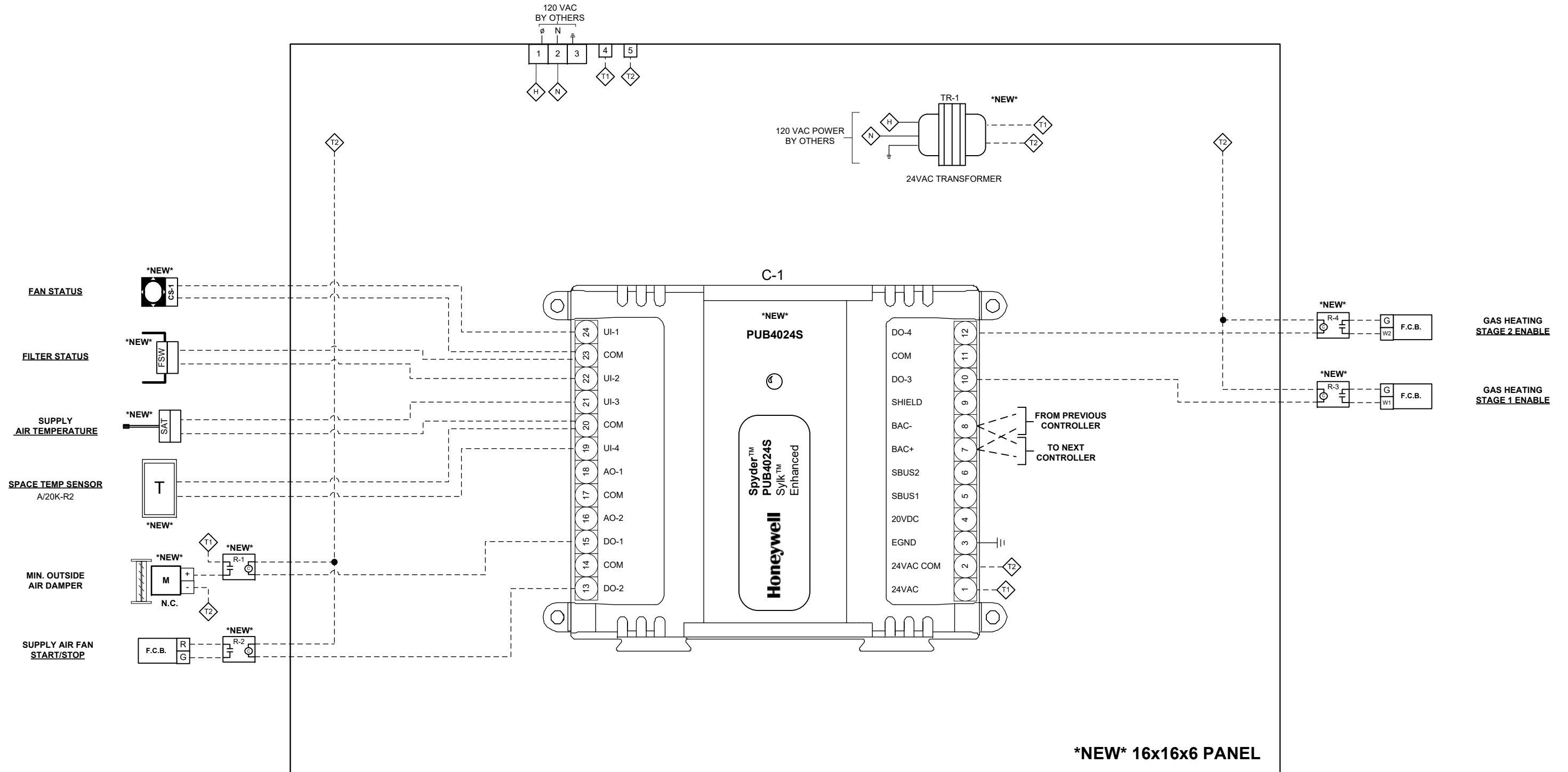
AIR HANDLING UNIT (AHU-1) FLOW DIAGRAM



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 23, 1035 Parkway Ave, Ewing, NJ 08625						Project: NJ DOT FERNWOOD GARAGE BUILDING 23			
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS				AIR HANDLING UNIT (AHU-1) FLOW DIAGRAM		
		1	11-03-2017	ADDED DOOR SWITCHES						
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.					
		NO.	DATE	REVISION	BY					
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AIR HANDLING UNIT (AHU-1) WIRING SCHEMATIC



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 23, 1035 Parkway Ave, Ewing, NJ 08625					Project: NJ DOT FERNWOOD GARAGE BUILDING 23		
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS			AIR HANDLING UNIT (AHU-1) WIRING SCHEMATIC	
		1	11-03-2017	ADDED DOOR SWITCHES				
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL		A.V.	Job No. #17-03253Page 8 of 11	
		NO.	DATE	REVISION		BY		

AIR HANDLING UNIT SEQUENCE OF OPERATIONS

WARM-UP MODE:

- 1 – One hour prior to the occupied mode, the Air Handler Unit shall be placed in Warm-up Mode when that Space Temperature is more than 10 Degr F. below the Space Heating Set-point.
- 2 – The Outside Air Dampers shall be closed and the Return Air Damper shall be opened, the stage 1 gas heating signal shall be enabled.
- 3 – The Air Handler Unit shall be released from Warm-up Mode when the Space Temperature is less than 3 Degr F. below the Space Heating Set-point or when the unit enters its scheduled occupied mode.
- 4 – When the Air Handler Unit is released from warm-up mode the Outside and Return Air Dampers and the Hot Water Valve shall revert to their scheduled modes.

OCCUPIED MODE:

- 1 – The Air Handler Unit shall be indexed into the occupied mode via the BMS schedule.
- 2 - Upon initial startup, the Outside and Return Air Damper shall open to their Minimum Outside Air setting.
- 3 - The supply fan shall start and slowly ramp up to its preset speed as determined by the balancing contractor.
- 4 - If the supply fan fails to start, an alarm shall be generated and the outside air damper shall close.
- 5 – Once the supply fan has proven on, the Air Handler Unit shall calculate its mode of operation.
- 6 - If the space temperature is 2 Degr F. below the space temperature set-point (72 Degr F. adj.) and the outside air temperature is below 55 Degr F., the Air Handler Unit will enter it's heating mode.
- 7 - Upon a call for heating, the Outside Air Damper shall remain at its minimum position and the stage 1 gas heating signal shall be enabled.
- 8 – When the Space Temperature is below 45 Degr F., both gas heating stages shall be enabled.
- 9 – If the space temperature is 2 Degr F. above the space temperature set-point (72 Degr F. adj.) and the outside air temperature is above 51 Degr F., but below 62 Degr F., the Air Handler Unit will enter its economizer mode.
- 10 - Upon a call for economizer cooling, the Outside Air Damper shall modulate open to maintain the discharge air set-point.
- 11- If the discharge air temperature goes below 45 Degr F., the economizer mode shall be overridden and the outside air damper shall modulate back to its minimum position.
- 12 – If the space temperature is 2 Degr F. above the space temperature set-point (72 Degr F. adj.) and the outside air temperature is above 65 Degr F., the Air Handler Unit will enter it's cooling mode.
- 13 - Upon a call for cooling, the Outside Air Damper shall remain at its minimum position, the DX coils and the ACCU's shall be toggled on, and the heating signals shall remain off.

UNOCCUPIED MODE:

- 1 – The Air Handler Unit's Supply Air Fan shall be off, the Outside Air Damper shall be closed, and the Return Air Damper shall be open.
- 2 – When any Space Temperature Sensor is below an Unoccupied Heating Set-point of 60 deg. F, the Air Handler Unit's Supply Air Fan shall start. The outside air damper shall remain closed and the gas heating stage 1 shall be enabled.
- 3 – When the Space Temperature rises above the Unoccupied Heating Set-point, the Air Handler Unit's Supply Air Fan shall stop.

AIR FILTER MONITORING:

- 1 – When the filter exceeds the manufacturer's rating for a dirty filter, an alarm shall be generated.

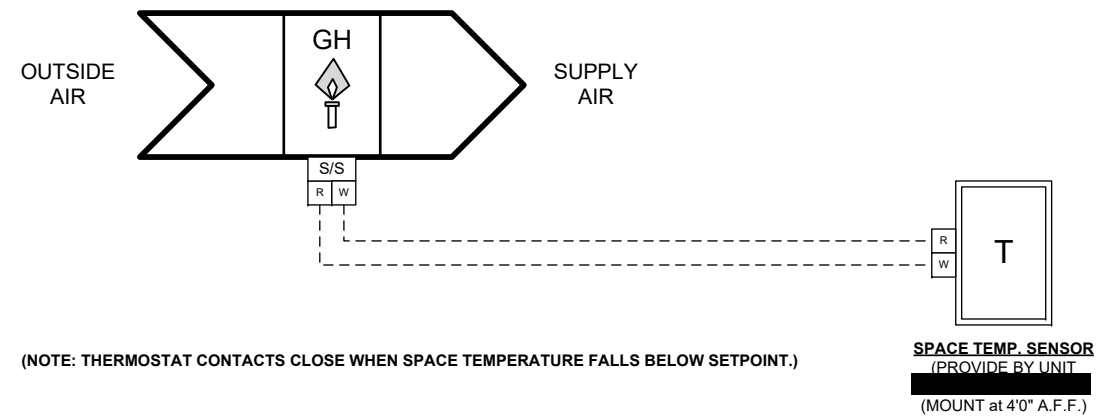
SENSOR ALARMING:

- 1 – If the Space Temperature is above 85 deg. F or below 55 deg. F an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 45 deg. F an alarm shall be generated.
- 3 - All set-points shall be user adjustable from the graphical user interface. Occupied space temperature set-points shall be limited between 70 Degr. F. and 74 Degr. F.

[illegible]

GAS UNIT HEATER (UH-1 TO 8) FLOW & WIRING DIAGRAM

(TYPICAL OF 8)

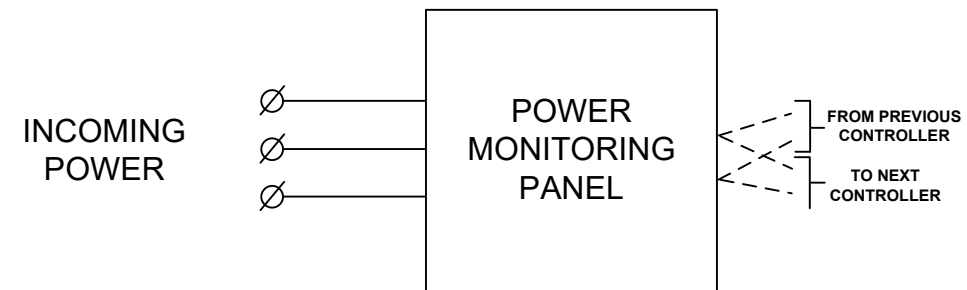


NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 23, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD GARAGE BUILDING 23	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS					GAS UNIT HEATER (UH-1 TO 8) FLOW & WIRING DIAGRAM
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				
		NO.	DATE	REVISION	BY			Job No. #17-03253 Page 10 of 11	

Diagram illustrating the connection of the Gas Monitoring Panel to the Main Gas Line and the JACE system.

- The **MAIN GAS LINE** is connected to the **GAS MONITORING PANEL**.
- The **GAS MONITORING PANEL** is connected to the **JACE** system via **MODBUS**.



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MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	
		1	11-03-2017	ADDED DOOR SWITCHES	
		0	09-13-2017	SUBMITTAL	A.V.
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	NO.	DATE	REVISION	BY

Project: NJ DOT FERNWOOD GARAGE BUILDING 23	
POWER AND GAS MONITORING FLOW DIAGRAM	
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PAGE	QTY	PRODUCT #	MFGR.	DESCRIPTION
PG 3 RISER	1	WEB-8000-CSE	Honeywell	JACE Web Controller
PG 3 RISER	1	NC-8010	Honeywell	JACE License Up to 10 Devices
PG 4 & 5 MAU	1	TGW-AC	Senva	Space Carbon Monoxide Sensor
PG 4 & 5 MAU	1	A/20K-D-8"	ACI	8-inch Duct Temperature Probe
PG 4 & 5 MAU	1	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 4 & 5 MAU	1	C-2200	Senva	On/Off Status Current Transducer
PG 4 & 5 MAU	1	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 4 & 5 MAU	1	EN4202R	Inovonics	Wireless Reciever w/ 4 Relays
PG 4 & 5 MAU	2	EN1210W	Inovonics	Wireless Magnetic Door Switch
PG 5 MAU	1	PUB6438SR	Honeywell	Spyder BACnet Prog. Controller
PG 5 MAU	1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 5 MAU	1	DCP-1.5-W-12VDC	Kele	24VAC/12VDC Power Supply
PG 5 MAU	1	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 5 MAU	1	SCE-16N16MP	Saginaw	16x16 Subpanel
PG 7 & 8 AHU	1	A/20K-R2	ACI	Space Temperature Sensor
PG 7 & 8 AHU	1	A/20K-D-8"	Dwyer	8-inch Duct Temperature Probe
PG 7 & 8 AHU	1	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 7 & 8 AHU	1	C-2200	Senva	On/Off Status Current Transducer
PG 7 & 8 AHU	4	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 7 & 8 AHU	1	MS8105A1030	Honeywell	24Vac On/Off 44lb-in Actuator
PG 8 AHU	1	PUB4024S	Honeywell	Spyder BACnet Prog. Controller
PG 8 AHU	1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 8 AHU	1	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 8 AHU	1	SCE-16N16MP	Saginaw	16x16 Subpanel
PG 11 GAS/PWR	1	PS3037-S-N	Dent Inst.	1-pt. Rev. Grade Power Meter
PG 11 GAS/PWR	1	CT-R16-A4-U	Dent Inst.	Flexible Current Transformer
PG 11 GAS/PWR	1	620S-BT-L06-M1-EN2-V4-NR-9-MB	Sierra Inst.	BoilerTrak Immersible Thermal Gas Mass Flow Meter

NJ DOT FERNWOOD GARAGE BUILDING 24 (AS-BUILTS)

ENERGY SAVINGS IMPROVEMENT PROJECT

BUILDING AUTOMATION SYSTEM

SHEET NUMBER	CONTENTS	REVISION
1	TITLE PAGE	
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4	MAKE-UP AIR UNIT (MAU-1) FLOW DIARAM	
5	MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC	
6	MAU SEQUENCE OF OPERATIONS	
7	AIR HANDLING UNIT (AHU-1 TO 6) FLOW DIAGRAM	
8	AIR HANDLING UNIT (AHU-1 TO 6) WIRING SCHEMATIC	
9	AIR HANDLING UNIT SEQUENCE OF OPERATIONS	
10	PACKAGED ROOFTOP UNIT (RTU-1) FLOW DIAGRAM	
11	GAS UNIT HEATER (UH-1 TO 8) FLOW & WIRING DIAGRAM	
12	POWER AND GAS MONITORING FLOW DIAGRAM	

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625								Project: NJ DOT FERNWOOD GARAGE BUILDING 24
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS					TITLE PAGE
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				Job No. #17-03253
		NO.	DATE	REVISION	BY				Page 1 of 12

LEGEND & SYMBOLS

GENERAL NOTES

1. ALL POWER WIRING 120 VAC AND ABOVE BY ELECTRICAL CONTRACTOR.

TEMPERATURE CONTROL LEGEND:

 MOUNTED ON PANEL FACE

 MOUNTED INSIDE PANEL

 CONTROL TUBE #3

 PNEUMATIC TUBING

 WIRING

 TERMINAL BLOCK #6

 SOLENOID VALVE

 CONTROL VALVE, 2-WAY

 CONTROL VALVE, 3-WAY

 PARALLEL BLADED DAMPER

 OPPOSED BLADED DAMPER

 SIGNAL LINE INSIDE PANEL

ABBREVIATIONS:

AFMS- AIR FLOW MEASURING STATION

C- COMMON PORT

CCP- CENTRAL CONTROL PANEL

CR- CONTROL RELAY

CS- CURRENT SWITCH

DA-DAMPER ACTUATOR

DPRO- DAMPER OUTPUT

DPRS- DAMPER STATUS

DPS- DIFFERENTIAL PRESSURE SWITCH

DPT- DIFFERENTIAL PRESSURE TRANS

EA- EXHAUST AIR

ES- END SWITCH, POSITION SWITCH

FS- FLOW SWITCH

FSD- FIRE & SMOKE DAMPER

H- HUMIDISTAT

HC- MOTOR STARTER HOLDING COIL

HI- HUMIDITY INDICATOR

HL- HIGH LIMIT HUMIDISTAT

HS- HIGH SIGNAL SELECTOR

HT- HUMIDITY TRANSMITTER

LCP- LOCAL CONTROL PANEL

LS- LOW SIGNAL SELECTOR

MA- MIXED AIR

MOD-MOTER OPERATED DAMPER

NC- NORMALLY CLOSED

NCP- NETWORK CONTROL PANEL

NO- NORMALLY OPEN

OA -OUTSIDE AIR

OL'S- MOTOR STARTER OVERLOADS

PC- PRESSURE CONTROLLER

PE- PRESSURE TOGGLE SWITCH

PI- PRESSURE INDICATOR

PL- PILOT LIGHT

PR- PNEUMATIC RELAY

PT- PRESSURE TRANSMITTER

RC- RECEIVER CONTROLLER

RR- REVERSING RELAY

RT- ROOM THERMOSTAT

S- SWITCH

SD- SMOKE DETECTOR

S/W- SUMMER/ WINTER SIGNAL

T- THERMOSTAT

TS- TEMPERATURE SENSOR

TC- TIME CLOCK

TDR- TIME DELAY RELAY

THL- TEMPERATURE HIGH LIMIT THERMOSTAT

TI- TEMPERATURE INDICATOR

TLL- TEMPERATURE LOW LIMIT THERMOSTAT

TR- TRANSDUCER

TT- TEMPERATURE TRANSMITTER

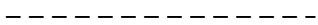
TX- TRANSFORMER

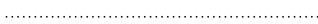
V- VALVE

WB- WET BULB

WU- WARM-UP SIGNAL

WIRING LEGEND

 Low Voltage, 18 AWG, Copper Wire

 Low Voltage Communication Wiring 22/2 AWG, CL2P, Shielded Copper Wire, Low Capacitance

 Line Voltage, THHN Field Wiring

HVAC SYSTEM LEGEND:

 MOTOR OPERATED DAMPER

 PREHEAT COIL

 COOLING COIL

 REHEAT COIL

 HEATING COIL

 DIRECT EXPANSION COIL

 FAN

 MANUAL VALVE

 ZONE CO2 SENSOR

 WATER FLOW METER

 AVERAGING TYPE TEMPERATURE SENSOR

 FILTER

 FIRE & SMOKE DAMPER (BY OTHERS)

 OUTSIDE AIR TEMPERATURE SENSOR

 FREEZESTAT (D.P. CONTACT)

 DUCT MOUNTED TEMPERATURE SENSOR

 IMMERSION TYPE TEMPERATURE SENSOR

 DUCT MOUNTED SMOKE DETECTOR

 STATIC PRESSURE TRANSMITTER

 STEAM PRESSURE SENSOR

 DUCT MOUNTED HUMIDITY SENSOR

 SPACE TEMPERATURE

 OUTSIDE AIR CO2 SENSOR

 AIR FLOW MEASURING STATION

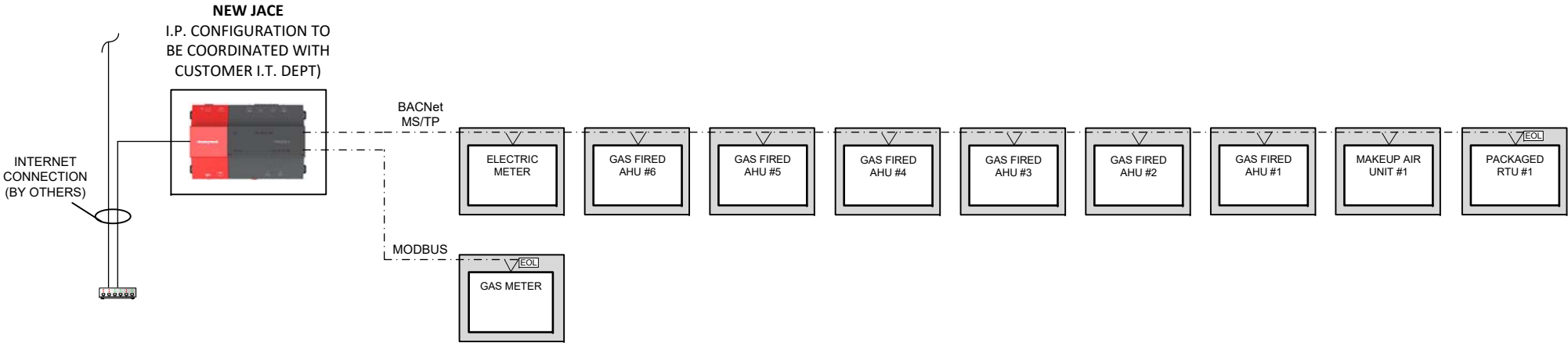
 CONTROL RELAY

 CURRENT SENSOR

 CO2 SENSOR

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD GARAGE BUILDING 24	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS				LEGEND & SYMBOLS	
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.			Job No. #17-03253	
		NO.	DATE	REVISION	BY			Page 2 of 12	

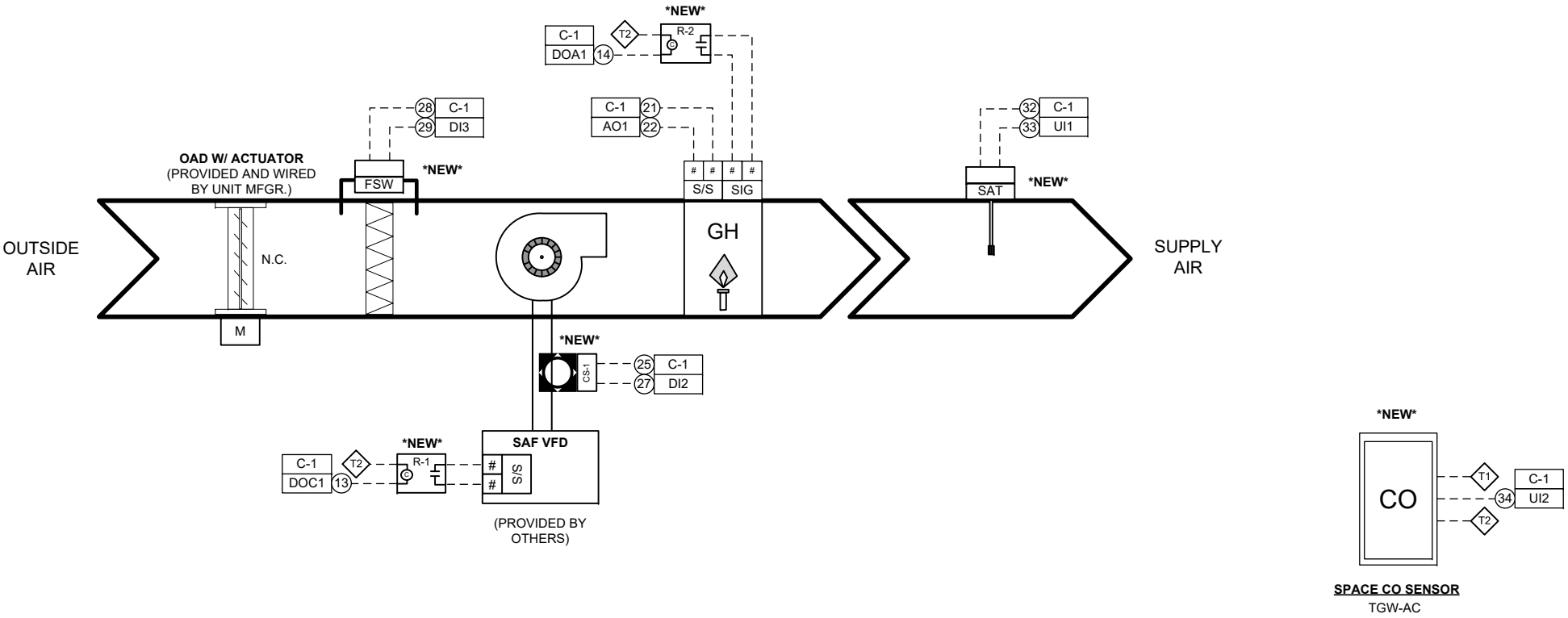
NETWORK RISER



NOTE: 1) 120VAC POWER TO ALL CONTROL PANELS BY OTHERS

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625					Project: NJ DOT FERNWOOD GARAGE BUILDING 24
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS		
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.	
		NO.	DATE	REVISION	BY	
						Job No. #17-03253
						Page 3 of 12

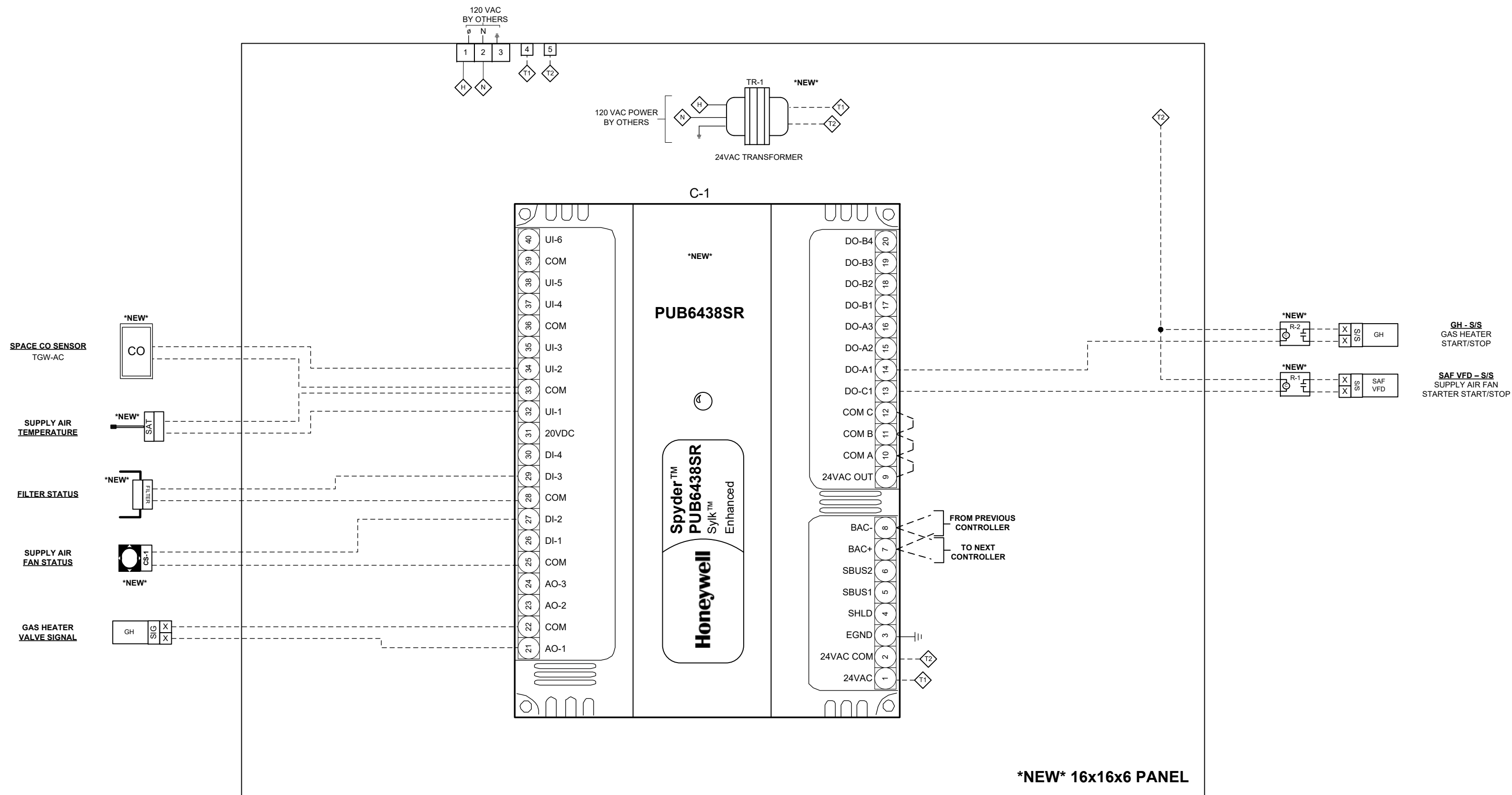
MAKE-UP AIR UNIT (MAU-1) FLOW DIAGRAM



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625								
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL					
		NO.	DATE	REVISION	BY				

MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

[illegible]

MAU SEQUENCE OF OPERATIONS

ENABLED MODE:

- 1 – The Make-up Air Unit and its associated Exhaust Fans shall be indexed into the Enabled Mode as per the BMS schedule, or whenever CO levels exceed 10 ppm (adj.).
- 2 – Upon initial startup, the Outside Air Damper shall open.
- 3 – Once the Outside Air Damper has proved open via the End Switch, the Supply Air Fan shall start.
- 4 – If the Supply Air Fan fails to start as sensed by its current sensor, an alarm shall be generated and the Outside Air Damper shall close.
- 5 – Once the Supply Air Fan has proved on, the Make-up Air Unit shall calculate its mode of operation.
- 6 – If the Space Temperature is below the Space Temperature Set-point (50 deg. F. adj.), the Make-up Air Unit will enter it’s heating mode.
- 7 – Upon a call for heating, the Gas Heating Signal shall begin to modulate to maintain a Discharge Air Set-point of 60 deg. F..

AIR FILTER MONITORING:

- 1 – The DDC controller shall monitor the filter switch and generate an alarm when it is tripped at the manufacturers dirty filter rating.

SENSOR ALARMING:

- 1 – If the Space Temperature is above 95 deg. F or below 45 deg. F an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 35 deg. F an alarm shall be generated.
- 3 – If the Discharge Air Temperature remains within 4 deg. F below of the Heating Set-point and the Heating Signal is more than 10% for longer than 10 minutes, an alarm shall be generated.
- 4 – All set-points shall be user adjustable from the graphical user interface.
- 5 – If the MAU has been operational for longer than 15 minutes, a critical alarm will be enunciated in the BMS.

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625						Project: NJ DOT FERNWOOD GARAGE BUILDING 24	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS			MAU SEQUENCE OF OPERATIONS	
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.		Job No.	#17-03253
		NO.	DATE	REVISION	BY		Page	6 of 12

(TYPICAL OF 6)

[illegible]

(TYPICAL OF 6 EXCEPT AS NOTED)

[illegible]

AIR HANDLING UNIT SEQUENCE OF OPERATIONS

MODE SELECTION:

- 1 – The Air Handler Unit shall be indexed into the Occupied and Unoccupied Modes via the BMS schedule (modes may be overridden by the Emergency Management System).
- 2 – The Air Handler Unit shall operate in Warm-up Mode instead of Unoccupied Mode whenever there is less than an hour left until the start of the next scheduled Occupied Mode.
- 3 – Should the controller lose communication with the BMS, an alarm shall be generated and the Air Handler Unit shall follow its local schedule until communication is restored.
- 4 – Should the Supply Air Fan fail whenever its called for, an alarm shall be generated and the unit (and all end-devices) shall remain inoperative until the alarm is cleared.

SET-POINT SELECTION:

- 1 – All set-points shall be user adjustable from the graphical user interface and Emergency Management System.
- 2 – The Occupied Space Temperature Set-point shall default to 72 deg. F. and be limited between 70 deg. F. and 74 deg. F.

OPERATIONAL MODES:

UNOCCUPIED MODE:

- 1 – The Gas Heating, Supply Air Fan, and any DX Cooling shall be off (by default), and the Outside Air Damper shall be closed.
- 2 – The Supply Air Fan and Stage 1 Gas Heater shall be enabled whenever the Space Temperature Sensor is below an Unoccupied Heating Set-point of 60 deg. F.
- 3 – The Stage 2 Gas Heater shall be enabled whenever the Space Temperature Sensor is more than 5 deg. F. below the Unoccupied Heating Set-point.
- 4 – DX COOLING UNITS ONLY: The Supply Air Fan and DX Cooling shall be enabled whenever the Space Temperature Sensor is below an Unoccupied Cooling Set-point of 85 deg. F.

WARM-UP MODE:

- 1 – The Air Handler Unit shall operate identically as when in the Unoccupied Mode, however the Space Temperature Heating and Cooling Set-points shall be set to 68 deg. F. and 76 deg. F., respectively.

OCCUPIED MODE:

- 1 – The Outside Air Damper shall be opened to its Minimum Outside Air setting and the Supply Air Fan shall be enabled.
- 2 – The Stage 1 Gas Heater shall be enabled whenever the Space Temperature is 2 deg. F. or more below the Space Temperature Set-point (72 deg. F. adj.).
- 3 – The Stage 2 Gas Heater shall be enabled whenever the Space Temperature is 3 deg. F. or more below the Space Temperature Set-point (72 deg. F. adj.).
- 8 – DX COOLING UNITS ONLY: the DX Cooling shall be enabled whenever the Space Temperature is 2 deg. F. or more above the Space Temperature Set-point.

ADDITIONAL ALARMS:

AIR FILTER MONITORING:

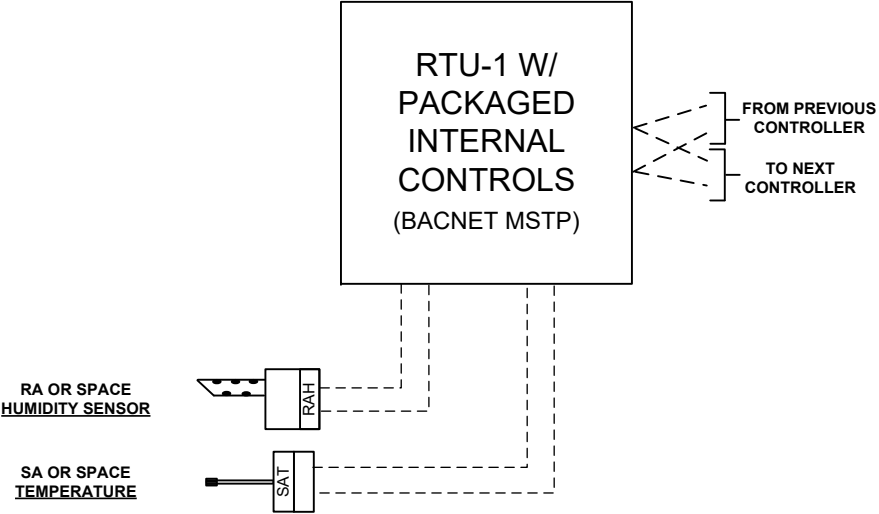
- 1 – When the filter exceeds the manufacturer’s rating for a dirty filter, an alarm shall be generated.

TEMPERATURE ALARMING:

- 1 – If the Space Temperature is above 90 deg. F. or below 55 deg. F. an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 45 deg. F an alarm shall be generated.

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625						Project: NJ DOT FERNWOOD GARAGE BUILDING 24	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS			AIR HANDLING UNIT SEQUENCE OF OPERATIONS	
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.		Job No.	#17-03253
		NO.	DATE	REVISION	BY		Page	9 of 12

PACKAGED ROOFTOP UNIT (RTU-1) FLOW DIAGRAM

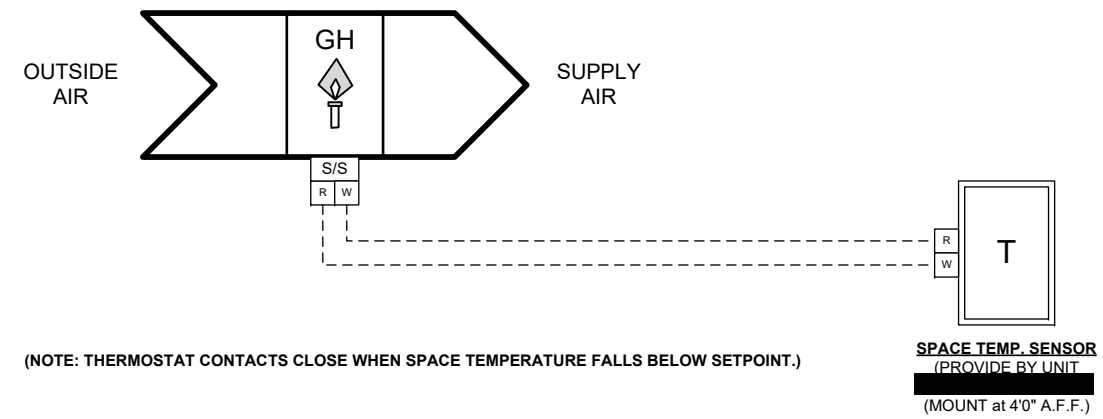


NOTE:
- ALL CONTROLS FURNISHED BY UNIT MANUFACTURER
(SEE DRAWING FERN 24, M-3)
- SENSOR MOUNT TYPES TO BE VERIFIED

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD GARAGE BUILDING 24	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS				PACKAGED ROOFTOP UNIT (RTU-1) FLOW DIAGRAM	
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.			Job No.	#17-03253
		NO.	DATE	REVISION	BY			Page	10 of 12

GAS UNIT HEATER (UH-1 TO 7) FLOW & WIRING DIAGRAM

(TYPICAL OF 7)

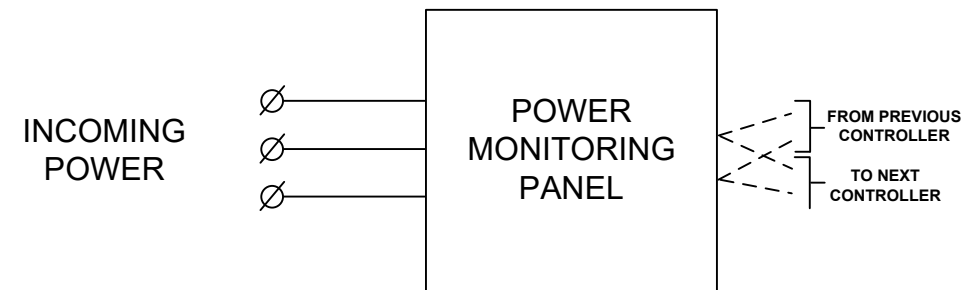


NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 24, 1035 Parkway Ave, Ewing, NJ 08625					Project: NJ DOT FERNWOOD GARAGE BUILDING 24	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	1	01-03-2018	AS-BUILTS		GAS UNIT HEATER (UH-1 TO 7) FLOW & WIRING DIAGRAM	
		0	09-13-2017	SUBMITTAL			
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	NO.	DATE	REVISION		BY	Job No. #17-03253

Diagram illustrating the connection of the JACE system to the gas monitoring panel:

- The **MAIN GAS LINE** is connected to the **GAS MONITORING PANEL** via a vertical pipe and a horizontal pipe.
- The **GAS MONITORING PANEL** is connected to the **JACE** system via a dashed line labeled **TO JACE (VIA MODBUS)**.

[illegible]

PAGE	QTY	PRODUCT #	MFGR.	DESCRIPTION
PG 3 RISER	1	WEB-8000-CSE	Honeywell	JACE Web Controller
PG 3 RISER	1	NC-8010	Honeywell	License for Up to 10 Devices
PG 4 & 5 MAU	1	TGW-AC	Senva	Space Carbon Monoxide Sensor
PG 4 & 5 MAU	1	A/20K-D-8"	ACI	8-inch Duct Temperature Probe
PG 4 & 5 MAU	1	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 4 & 5 MAU	1	C-2200	Senva	On/Off Status Current Transducer
PG 4 & 5 MAU	2	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 5 MAU	1	PUB6438SR	Honeywell	Spyder BACnet Prog. Controller
PG 5 MAU	1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 5 MAU	1	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 5 MAU	1	SCE-16N16MP	Saginaw	16x16 Subpanel
PG 7+8 AHU	6	A/20K-R2	ACI	Space Temperature Sensor
PG 7+8 AHU	6	A/20K-D-8"	ACI	8-inch Duct Temperature Probe
PG 7+8 AHU	6	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 7+8 AHU	12	C-2200	Senva	On/Off Status Current Transducer
PG 7+8 AHU	24	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 8 AHU	6	PUB6438SR	Honeywell	Spyder BACnet Prog. Controller
PG 8 AHU	6	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 8 AHU	6	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 8 AHU	6	SCE-16N16MP	Saginaw	16x16 Subpanel
PG 12 GAS/PWR	1	PS3037-S-N	Dent Inst.	1-pt. Rev. Grade Power Meter
PG 12 GAS/PWR	1	CT-R16-A4-U	Dent Inst.	Flexible Current Transformer
PG 12 GAS/PWR	1	620S-BT-L06-M1-EN2-V4-NR-9-MB	Sierra Inst.	BoilerTrak Immersible Thermal Gas Mass Flow Meter

TITLE PAGE

NJ DOT FERNWOOD GARAGE BUILDING 26 (AS-BUILTS)

ENERGY SAVINGS IMPROVEMENT PROJECT

BUILDING AUTOMATION SYSTEM

SHEET NUMBER	CONTENTS	REVISION
1	TITLE PAGE	
2	LEGEND & SYMBOLS	
3	NETWORK RISER	
4	MAKE-UP AIR UNIT (MAU-1) FLOW DIARAM	
5	MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC	
6	MAU SEQUENCE OF OPERATIONS	
7	ROOF TOP UNIT (RTU-1) FLOW DIAGRAM	
8	ROOF TOP UNIT (RTU-1) WIRING SCHEMATIC	
9	RTU SEQUENCE OF OPERATIONS	
10	GAS UNIT HEATER (UH-1 TO 4) FLOW & WIRING DIAGRAM	
11	POWER AND GAS MONITORING FLOW DIAGRAM	

[illegible]

LEGEND & SYMBOLS

GENERAL NOTES

1. ALL POWER WIRING 120 VAC AND ABOVE BY ELECTRICAL CONTRACTOR.

TEMPERATURE CONTROL LEGEND:

 MOUNTED ON PANEL FACE

 MOUNTED INSIDE PANEL

 CONTROL TUBE #3

 PNEUMATIC TUBING

 WIRING

 TERMINAL BLOCK #6

 SOLENOID VALVE

 CONTROL VALVE, 2-WAY

 CONTROL VALVE, 3-WAY

 PARALLEL BLADED DAMPER

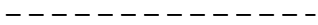
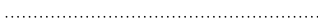
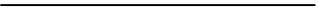
 OPPOSED BLADED DAMPER

 SIGNAL LINE INSIDE PANEL

ABBREVIATIONS:

AFMS- AIR FLOW MEASURING STATION	OA -OUTSIDE AIR
C- COMMON PORT	OL'S- MOTOR STARTER OVERLOADS
CCP- CENTRAL CONTROL PANEL	PC- PRESSURE CONTROLLER
CR- CONTROL RELAY	PE- PRESSURE TOGGLE SWITCH
CS- CURRENT SWITCH	PI- PRESSURE INDICATOR
DA-DAMPER ACTUATOR	PL- PILOT LIGHT
DPRO- DAMPER OUTPUT	PR- PNEUMATIC RELAY
DPRS- DAMPER STATUS	PT- PRESSURE TRANSMITTER
DPS- DIFFERENTIAL PRESSURE SWITCH	RC- RECEIVER CONTROLLER
DPT- DIFFERENTIAL PRESSURE TRANS	RR- REVERSING RELAY
EA- EXHAUST AIR	RT- ROOM THERMOSTAT
ES- END SWITCH, POSITION SWITCH	S- SWITCH
FS- FLOW SWITCH	SD- SMOKE DETECTOR
FSD- FIRE & SMOKE DAMPER	S/W- SUMMER/ WINTER SIGNAL
H- HUMIDISTAT	T- THERMOSTAT
HC- MOTOR STARTER HOLDING COIL	TS- TEMPERATURE SENSOR
HI- HUMIDITY INDICATOR	TC- TIME CLOCK
HL- HIGH LIMIT HUMIDISTAT	TDR- TIME DELAY RELAY
HS- HIGH SIGNAL SELECTOR	THL- TEMPERATURE HIGH LIMIT THERMOSTAT
HT- HUMIDITY TRANSMITTER	TI- TEMPERATURE INDICATOR
LCP- LOCAL CONTROL PANEL	TLL- TEMPERATURE LOW LIMIT THERMOSTAT
LS- LOW SIGNAL SELECTOR	TR- TRANSDUCER
MA- MIXED AIR	TT- TEMPERATURE TRANSMITTER
MOD-MOTER OPERATED DAMPER	TX- TRANSFORMER
NC- NORMALLY CLOSED	V- VALVE
NCP- NETWORK CONTROL PANEL	WB- WET BULB
NO- NORMALLY OPEN	WU- WARM-UP SIGNAL

WIRING LEGEND

	Low Voltage, 18 AWG, Copper Wire
	Low Voltage Communication Wiring 22/2 AWG, CL2P, Shielded Copper Wire, Low Capacitance
	Line Voltage, THHN Field Wiring

HVAC SYSTEM LEGEND:

 MOTOR OPERATED DAMPER

 PREHEAT COIL

 COOLING COIL

 REHEAT COIL

 HEATING COIL

 DIRECT EXPANSION COIL

 FAN

 MANUAL VALVE

 ZONE CO2 SENSOR

 WATER FLOW METER

 AVERAGING TYPE TEMPERATURE SENSOR

 FILTER

 FIRE & SMOKE DAMPER (BY OTHERS)

 OUTSIDE AIR TEMPERATURE SENSOR

 FREEZESTAT (D.P. CONTACT)

 DUCT MOUNTED TEMPERATURE SENSOR

 IMMERSION TYPE TEMPERATURE SENSOR

 DUCT MOUNTED SMOKE DETECTOR

 STATIC PRESSURE TRANSMITTER

 STEAM PRESSURE SENSOR

 DUCT MOUNTED HUMIDITY SENSOR

 SPACE TEMPERATURE

 OUTSIDE AIR CO2 SENSOR

 AIR FLOW MEASURING STATION

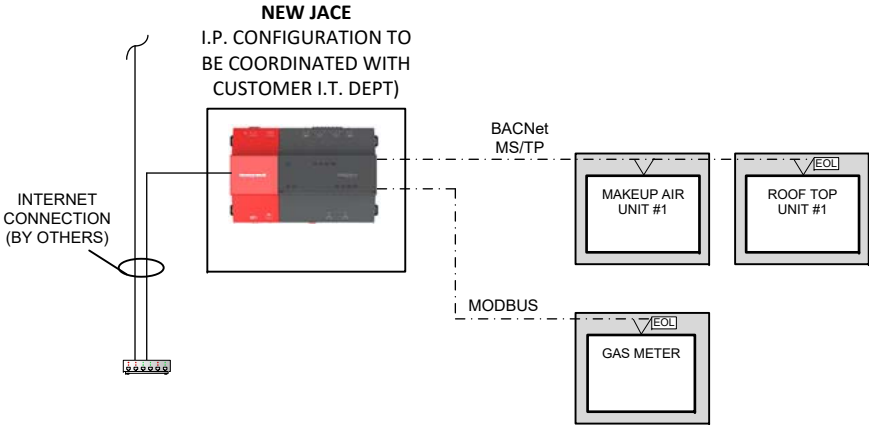
 CONTROL RELAY

 CURRENT SENSOR

 CO2 SENSOR

FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625								Project: NJ DOT FERNWOOD GARAGE BUILDING 26
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS					LEGEND & SYMBOLS
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL		A.V.			
		NO.	DATE	REVISION		BY			Job No. #17-03253Page 2 of 11

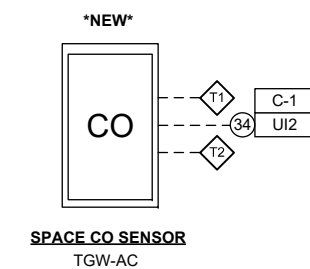
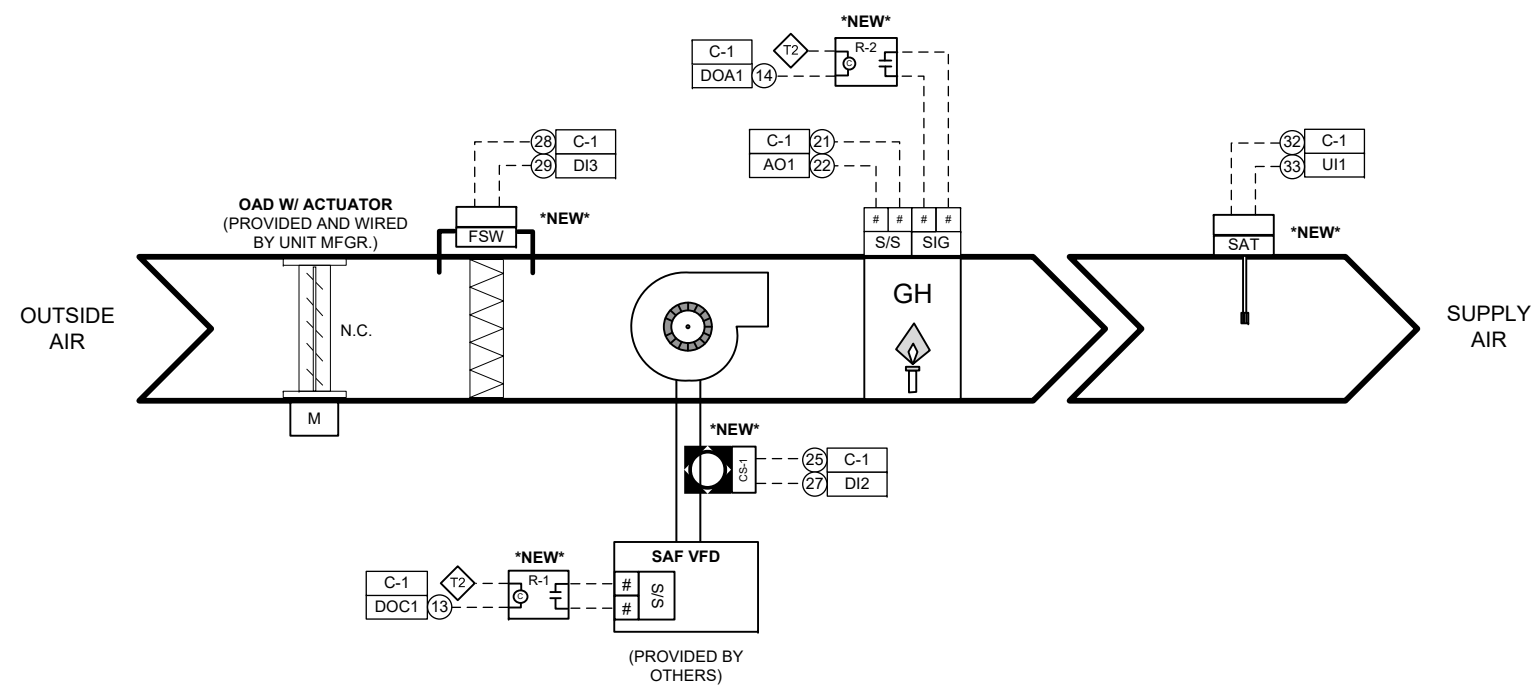
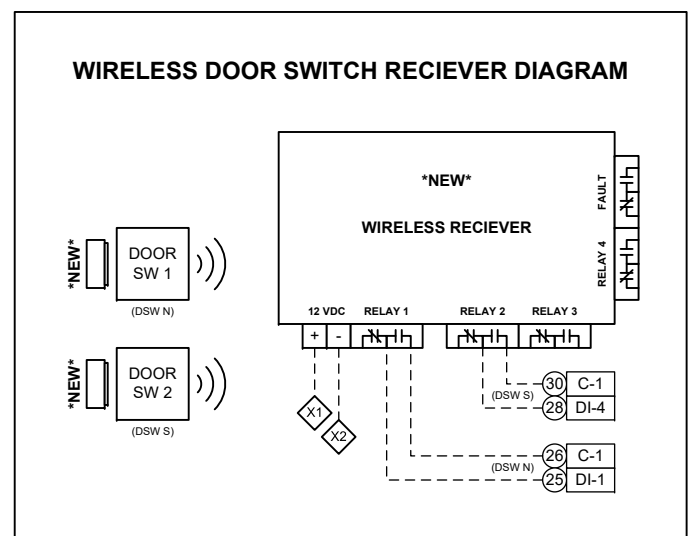
NETWORK RISER



NOTE: 1) 120VAC POWER TO ALL CONTROL PANELS BY OTHERS
2) ALL FINAL CONTROL PANEL LOCATIONS TO BE FIELD VERIFIED

FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625								Project: NJ DOT FERNWOOD GARAGE BUILDING 26
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS					NETWORK RISER
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				
		NO.	DATE	REVISION	BY				Job No. #17-03253Page 3 of 11

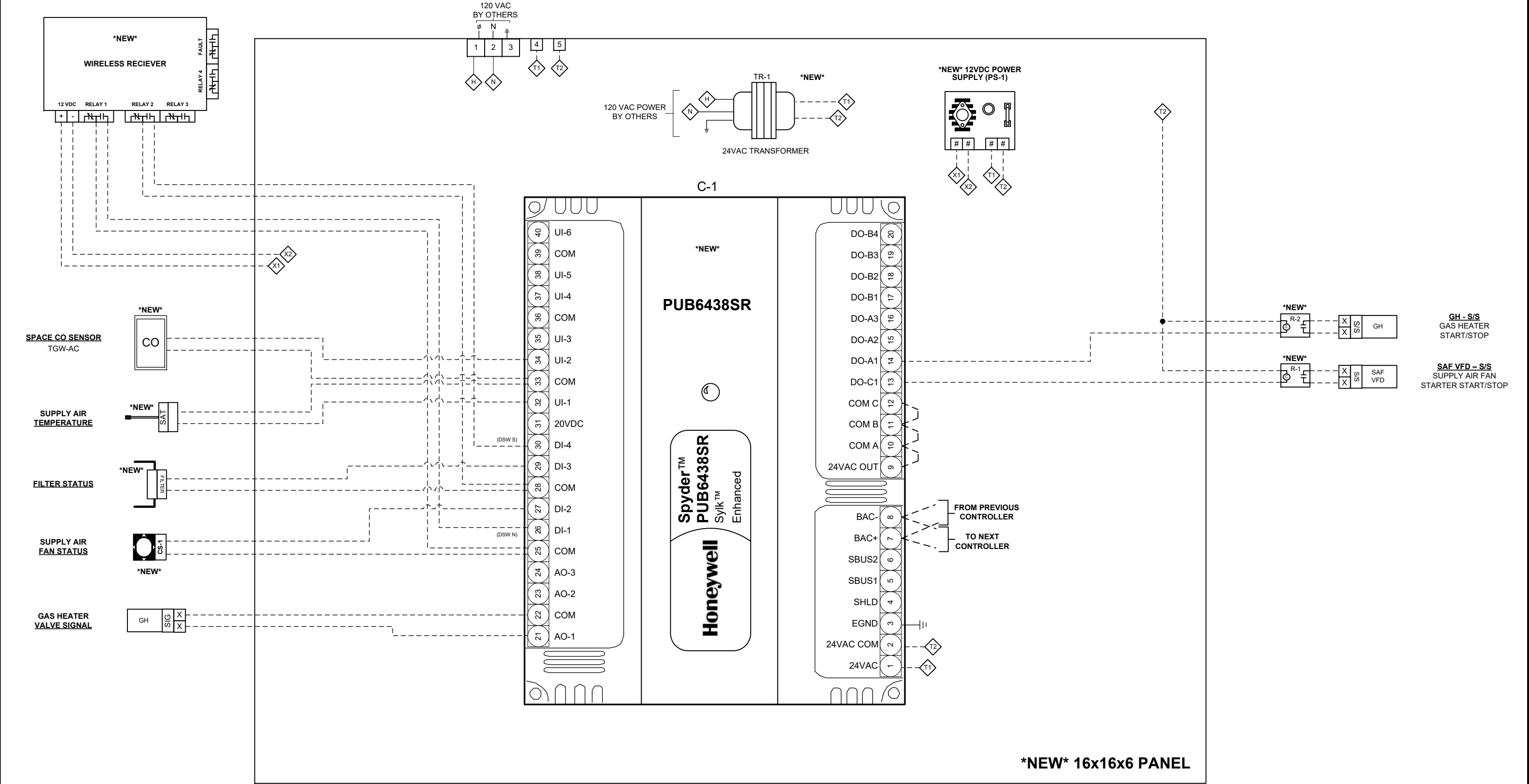
MAKE-UP AIR UNIT (MAU-1) FLOW DIAGRAM



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

[illegible]

MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625								
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS					
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				
		NO.	DATE	REVISION	BY				

Project: NJ DOT FERNWOOD GARAGE BUILDING 26

MAKE-UP AIR UNIT (MAU-1) WIRING SCHEMATIC

Job No. #17-03253

Page 5 of 11

MAU SEQUENCE OF OPERATIONS

ENABLED MODE:

- 1 – The Make-up Air Unit and its associated Exhaust Fans shall be indexed into the Enabled Mode as per the BMS schedule, or whenever CO levels exceed 10 ppm (adj.).
- 2 – Upon initial startup, the Outside Air Damper shall open.
- 3 – Once the Outside Air Damper has proved open via the End Switch, the Supply Air Fan shall start.
- 4 – If the Supply Air Fan fails to start as sensed by its current sensor, an alarm shall be generated and the Outside Air Damper shall close.
- 5 – Once the Supply Air Fan has proved on, the Make-up Air Unit shall calculate its mode of operation.
- 6 – If the Outside Air Temperature is below 50 deg. F. (adj.), the Make-up Air Unit will enter it’s heating mode.
- 7 – Upon a call for heating, the Gas Heating Signal shall begin to modulate to maintain a Discharge Air Set-point of 60 deg. F..

AIR FILTER MONITORING:

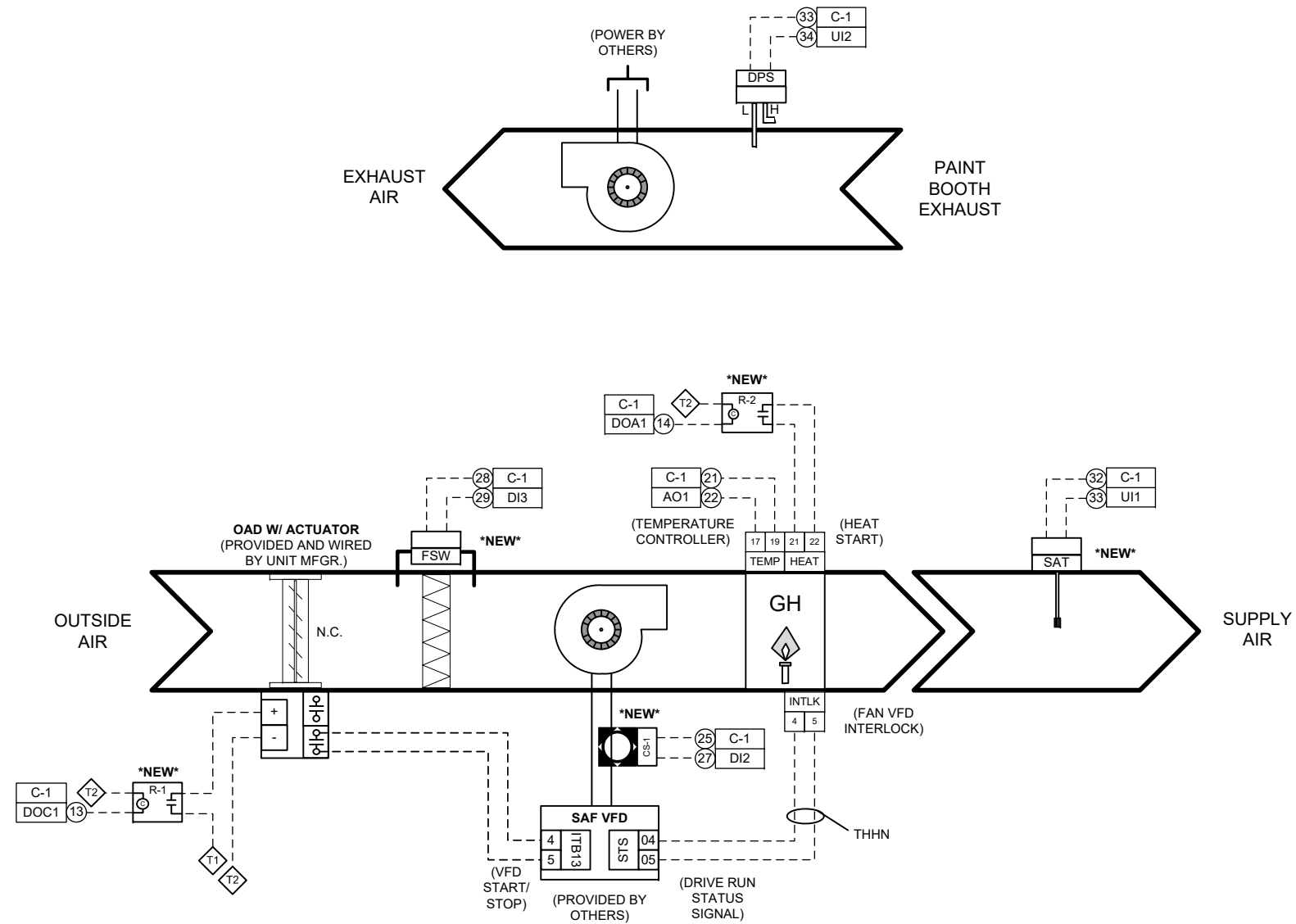
- 1 – The DDC controller shall monitor the filter switch and generate an alarm when it is tripped at the manufacturers dirty filter rating.

SENSOR ALARMING:

- 1 – If the Space Temperature is above 95 deg. F or below 45 deg. F an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 35 deg. F an alarm shall be generated.
- 3 – If the Discharge Air Temperature remains within 4 deg. F below of the Heating Set-point and the Heating Signal is more than 10% for longer than 10 minutes, an alarm shall be generated.
- 4 – All set-points shall be user adjustable from the graphical user interface.
- 5 – If a door switch has been open and the MAU’ heating has been operational for longer than 15 minutes, a critical alarm will be enunciated in the BMS.

FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD GARAGE BUILDING 26	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS					
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				
		NO.	DATE	REVISION	BY			Job No. #17-03253	Page 6 of 11

ROOF TOP UNIT (RTU-1) FLOW DIAGRAM

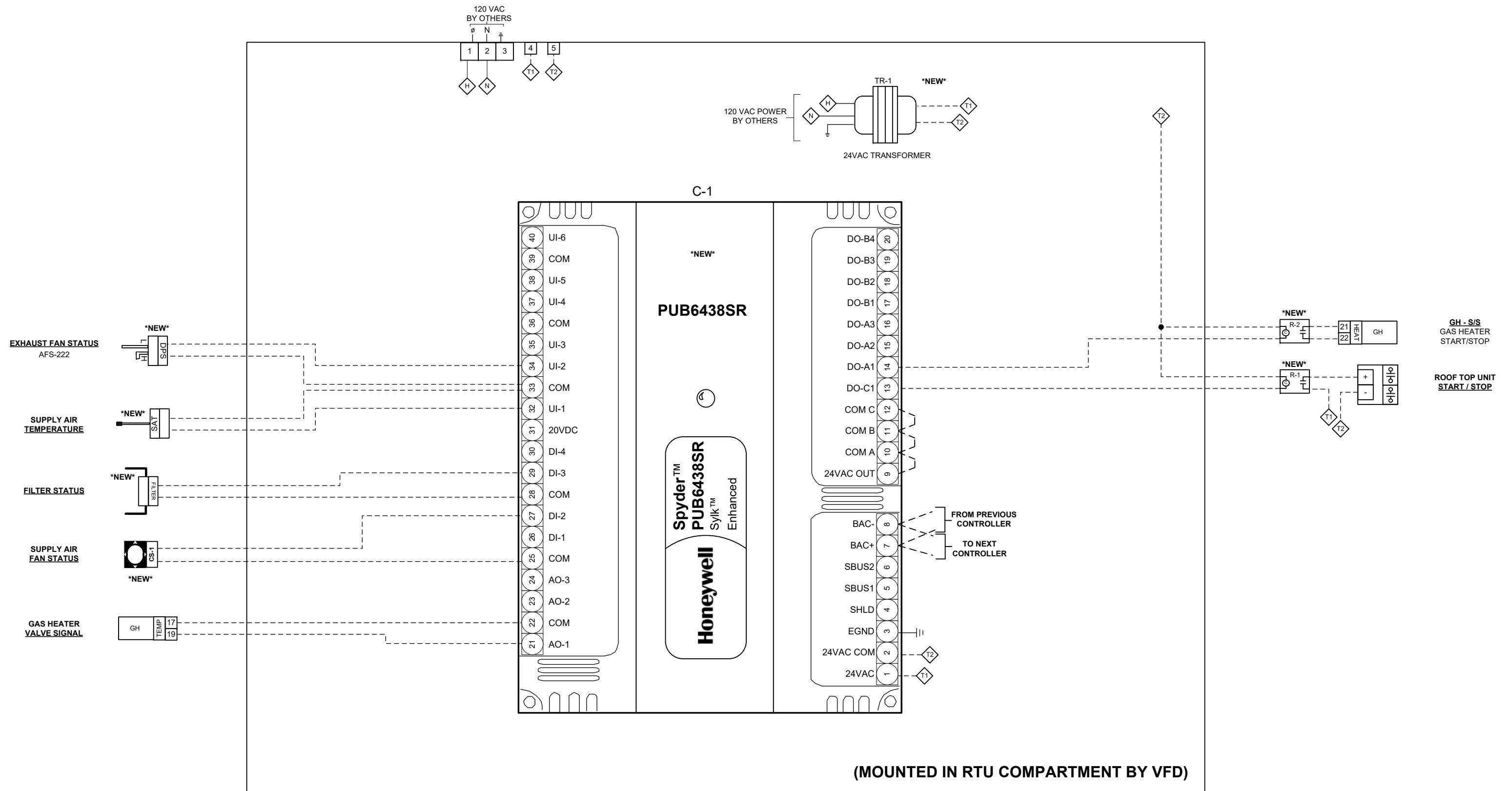


NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625					Project: NJ DOT FERNWOOD GARAGE BUILDING 26	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS			
		1	11-03-2017	ADDED DOOR SWITCHES			
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL			A.V.
		NO.	DATE	REVISION	BY		

ROOF TOP UNIT (RTU-1) FLOW DIAGRAM	
Job No. #17-03253	Page 7 of 11

ROOF TOP UNIT (RTU-1) WIRING DIAGRAM



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

[illegible]

RTU SEQUENCE OF OPERATIONS

ENABLED MODE:

- 1 – The Roof Top Unit and its associated Exhaust Fan shall be indexed into the Enabled Mode as per the BMS schedule or whenever its associated Exhaust Fan is on.
- 2 – Upon initial startup, the Outside Air Damper shall open.
- 3 – Once the Outside Air Damper has proved open via the End Switch, the Supply Air Fan shall start.
- 4 – If the Supply Air Fan fails to start as sensed by its current sensor, an alarm shall be generated and the Outside Air Damper shall close.
- 5 – Once the Supply Air Fan has proved on, the Roof Top Unit shall calculate its mode of operation.
- 6 – If the Outside Air Temperature is below 50 deg. F. (adj.), the Roof Top Unit will enter it's heating mode.
- 7 – Upon a call for heating, the Gas Heating Signal shall begin to modulate to maintain a Discharge Air Set-point of 60 deg. F..

AIR FILTER MONITORING:

- 1 – The DDC controller shall monitor the filter switch and generate an alarm when it is tripped at the manufacturers dirty filter rating.

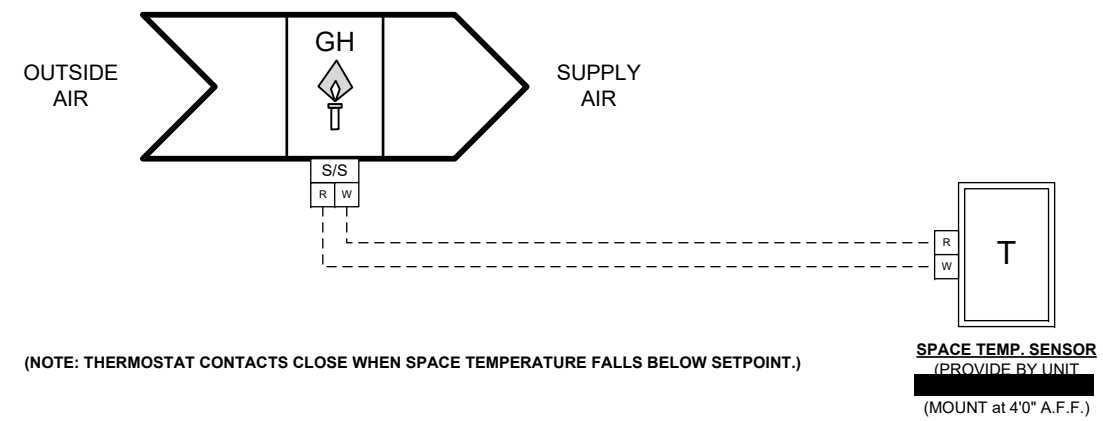
SENSOR ALARMING:

- 1 – If the Space Temperature is above 95 deg. F or below 45 deg. F an alarm shall be generated.
- 2 – If the Discharge Air Temperature is above 120 deg. F or below 35 deg. F an alarm shall be generated.
- 3 – If the Discharge Air Temperature remains within 4 deg. F below of the Heating Set-point and the Heating Signal is more than 10% for longer than 10 minutes, an alarm shall be generated.
- 4 – All set-points shall be user adjustable from the graphical user interface.

[illegible]

GAS UNIT HEATER (UH-1 TO 4) FLOW & WIRING DIAGRAM

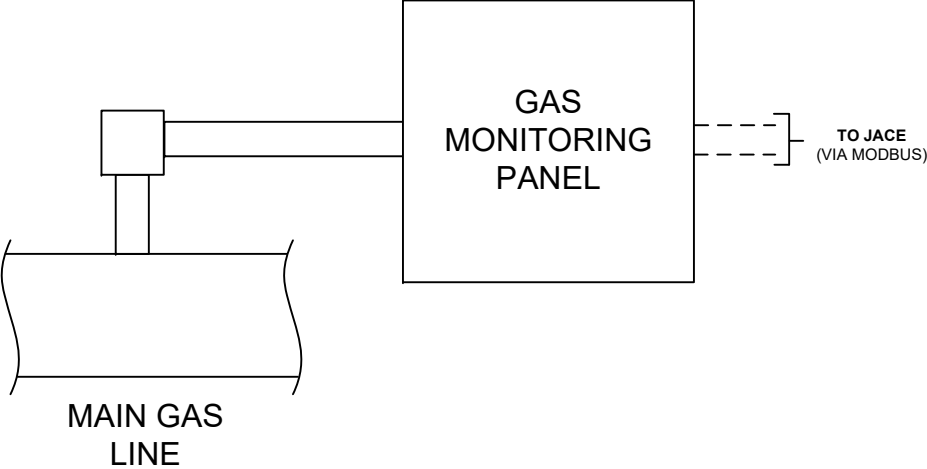
(TYPICAL OF 4)



NOTE:
PLEASE SEE MECHANICAL PLANS FOR UNIT SCHEDULE

[illegible]

POWER AND GAS MONITORING FLOW DIAGRAM



FACILITY	NJDOT Fernwood Building 26, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD GARAGE BUILDING 26	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS				POWER AND GAS MONITORING FLOW DIAGRAM	
		1	11-03-2017	ADDED DOOR SWITCHES					
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	09-13-2017	SUBMITTAL	A.V.				
		NO.	DATE	REVISION	BY				
		Job No.		#17-03253		Page		11 of 11	

PAGE	QTY	PRODUCT #	MFGR.	DESCRIPTION
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PG 4 & 5 MAU	1	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 4 & 5 MAU	1	C-2200	Senva	On/Off Status Current Transducer
PG 4 & 5 MAU	2	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 4 & 5 MAU	1	EN4202R	Inovonics	Wireless Reciever w/ 4 Relays
PG 4 & 5 MAU	1	EN1210W	Inovonics	Wireless Magnetic Door Switch
PG 5 MAU	1	PUB6438SR	Honeywell	Spyder BACnet Prog. Controller
PG 5 MAU	1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 5 MAU	1	DCP-1.5-W-12VDC	Kele	24VAC/12VDC Power Supply
PG 5 MAU	1	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 5 MAU	1	SCE-16N16MP	Saginaw	16x16 Subpanel
PG 7 & 8 RTU	1	A/20K-D-8"	ACI	8-inch Duct Temperature Probe
PG 7 & 8 RTU	1	AFS-222	ACI	Differential Pressure Switch
PG 7 & 8 RTU	1	ADPS-04-2-N	Dwyer	Differential Pressure Filter Switch
PG 7 & 8 RTU	1	C-2200	Senva	On/Off Status Current Transducer
PG 7 & 8 RTU	2	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 8 RTU	1	PUB6438SR	Honeywell	Spyder BACnet Prog. Controller
PG 8 RTU	1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 9 GAS/PWR	1	620S-BT-L06-M1-EN2-V4-NR-9-MB	Sierra Inst.	BoilerTrak Immersible Thermal Gas Mass Flow Meter

NJ DOT FERNWOOD / FORAN BUILDING 30 (AS-BUILTS)

ENERGY SAVINGS IMPROVEMENT PROJECT

BUILDING AUTOMATION SYSTEM

SHEET #	CONTENTS	REV.
1	TITLE PAGE	
2	LEGEND & SYMBOLS	
3	NETWORK RISER	
4	HOT WATE SYSTEM FLOW DIAGRAM	
5	HOT WATER SYSTEM C-1 WIRING SCHEMATIC	
6	HOT WATER SYSTEM C-1 WIRING SCHEMATIC	
7	HOT WATER SYSTEM SEQUENCE OF OPERATIONS	
8	UNIT HEATER FLOW & WIRING DIAGRAM	
9	POWER AND GAS MONITORING FLOW DIAGRAM	

LEGEND & SYMBOLS

GENERAL NOTES

1. ALL POWER WIRING 120 VAC AND ABOVE BY ELECTRICAL CONTRACTOR.

TEMPERATURE CONTROL LEGEND:

 MOUNTED ON PANEL FACE

 MOUNTED INSIDE PANEL

 CONTROL TUBE #3

 PNEUMATIC TUBING

 WIRING

 TERMINAL BLOCK #6

 SOLENOID VALVE

 CONTROL VALVE, 2-WAY

 CONTROL VALVE, 3-WAY

 PARALLEL BLADED DAMPER

 OPPOSED BLADED DAMPER

 SIGNAL LINE INSIDE PANEL

ABBREVIATIONS:

AFMS- AIR FLOW MEASURING STATION

C- COMMON PORT

CCP- CENTRAL CONTROL PANEL

CR- CONTROL RELAY

CS- CURRENT SWITCH

DA-DAMPER ACTUATOR

DPRO- DAMPER OUTPUT

DPRS- DAMPER STATUS

DPS- DIFFERENTIAL PRESSURE SWITCH

DPT- DIFFERENTIAL PRESSURE TRANS

EA- EXHAUST AIR

ES- END SWITCH, POSITION SWITCH

FS- FLOW SWITCH

FSD- FIRE & SMOKE DAMPER

H- HUMIDISTAT

HC- MOTOR STARTER HOLDING COIL

HI- HUMIDITY INDICATOR

HL- HIGH LIMIT HUMIDISTAT

HS- HIGH SIGNAL SELECTOR

HT- HUMIDITY TRANSMITTER

LCP- LOCAL CONTROL PANEL

LS- LOW SIGNAL SELECTOR

MA- MIXED AIR

MOD-MOTER OPERATED DAMPER

NC- NORMALLY CLOSED

NCP- NETWORK CONTROL PANEL

NO- NORMALLY OPEN

OA -OUTSIDE AIR

OL'S- MOTOR STARTER OVERLOADS

PC- PRESSURE CONTROLLER

PE- PRESSURE TOGGLE SWITCH

PI- PRESSURE INDICATOR

PL- PILOT LIGHT

PR- PNEUMATIC RELAY

PT- PRESSURE TRANSMITTER

RC- RECEIVER CONTROLLER

RR- REVERSING RELAY

RT- ROOM THERMOSTAT

S- SWITCH

SD- SMOKE DETECTOR

S/W- SUMMER/ WINTER SIGNAL

T- THERMOSTAT

TS- TEMPERATURE SENSOR

TC- TIME CLOCK

TDR- TIME DELAY RELAY

THL- TEMPERATURE HIGH LIMIT THERMOSTAT

TI- TEMPERATURE INDICATOR

TLL- TEMPERATURE LOW LIMIT THERMOSTAT

TR- TRANSDUCER

TT- TEMPERATURE TRANSMITTER

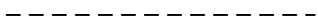
TX- TRANSFORMER

V- VALVE

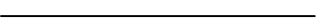
WB- WET BULB

WU- WARM-UP SIGNAL

WIRING LEGEND

 Low Voltage, 18 AWG, Copper Wire

 Low Voltage Communication Wiring 22/2 AWG, CL2P, Shielded Copper Wire, Low Capacitance

 Line Voltage, THHN Field Wiring

HVAC SYSTEM LEGEND:

 MOTOR OPERATED DAMPER

 PREHEAT COIL

 COOLING COIL

 REHEAT COIL

 HEATING COIL

 DIRECT EXPANSION COIL

 FAN

 MANUAL VALVE

 ZONE CO2 SENSOR

 WATER FLOW METER

 AVERAGING TYPE TEMPERATURE SENSOR

 FILTER

 FIRE & SMOKE DAMPER (BY OTHERS)

 OUTSIDE AIR TEMPERATURE SENSOR

 FREEZESTAT (D.P. CONTACT)

 DUCT MOUNTED TEMPERATURE SENSOR

 IMMERSION TYPE TEMPERATURE SENSOR

 DUCT MOUNTED SMOKE DETECTOR

 STATIC PRESSURE TRANSMITTER

 STEAM PRESSURE SENSOR

 DUCT MOUNTED HUMIDITY SENSOR

 SPACE TEMPERATURE

 OUTSIDE AIR CO2 SENSOR

 AIR FLOW MEASURING STATION

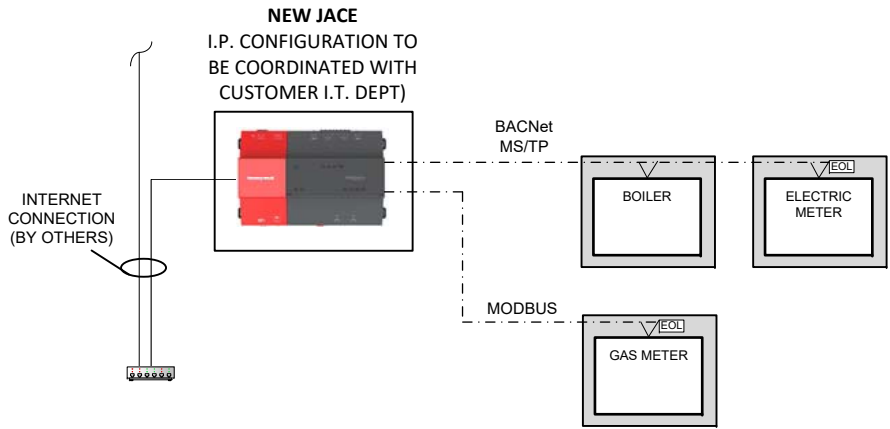
 CONTROL RELAY

 CURRENT SENSOR

 CO2 SENSOR

FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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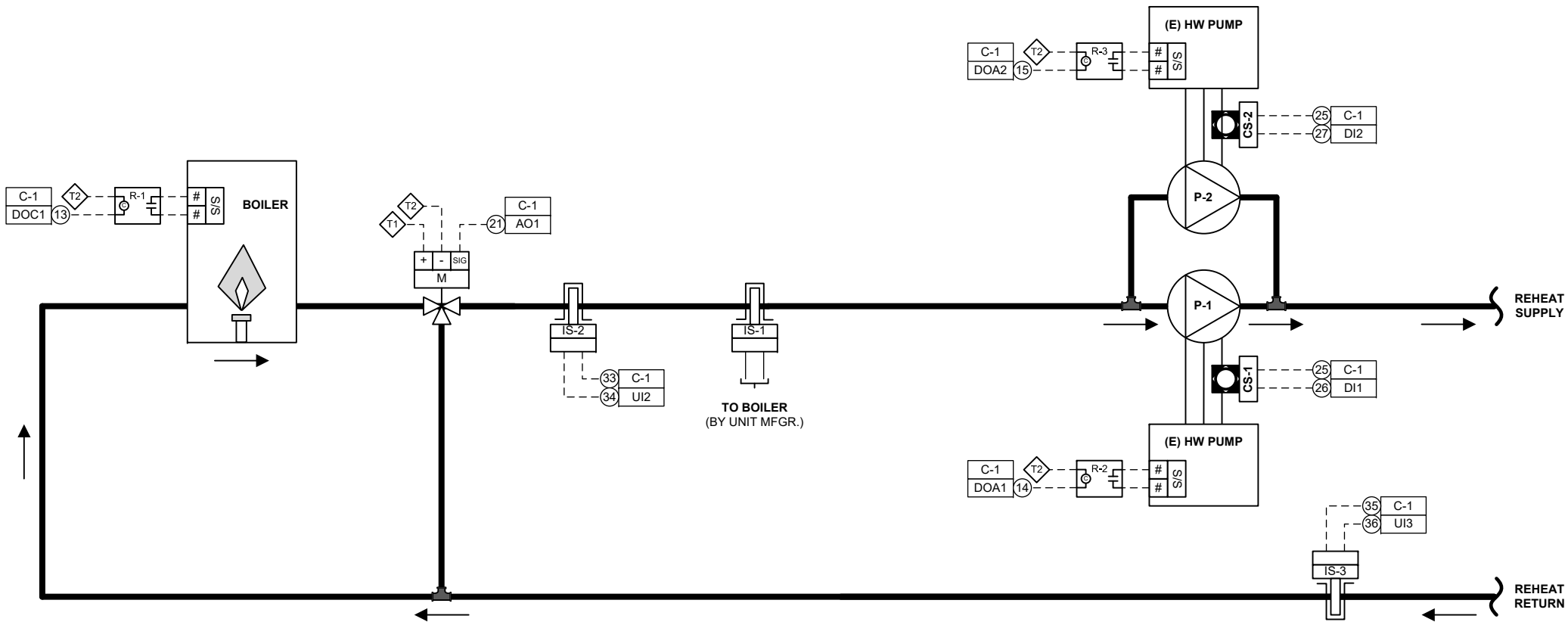
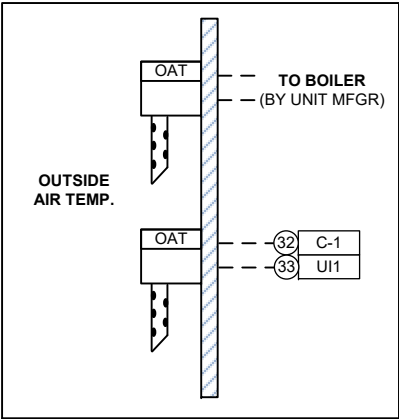
NETWORK RISER



NOTE: 1) 120VAC POWER TO ALL CONTROL PANELS BY OTHERS

FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625							Project: NJ DOT FERNWOOD / FORAN BUILDING 30	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	A.V.			NETWORK RISER	
		1	09-20-2017	ADDED HW SYSTEM AND MONITORS	A.V.				
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER				Job No. #17-04260	
		NO.	DATE	REVISION	BY			Page 3 of 8	

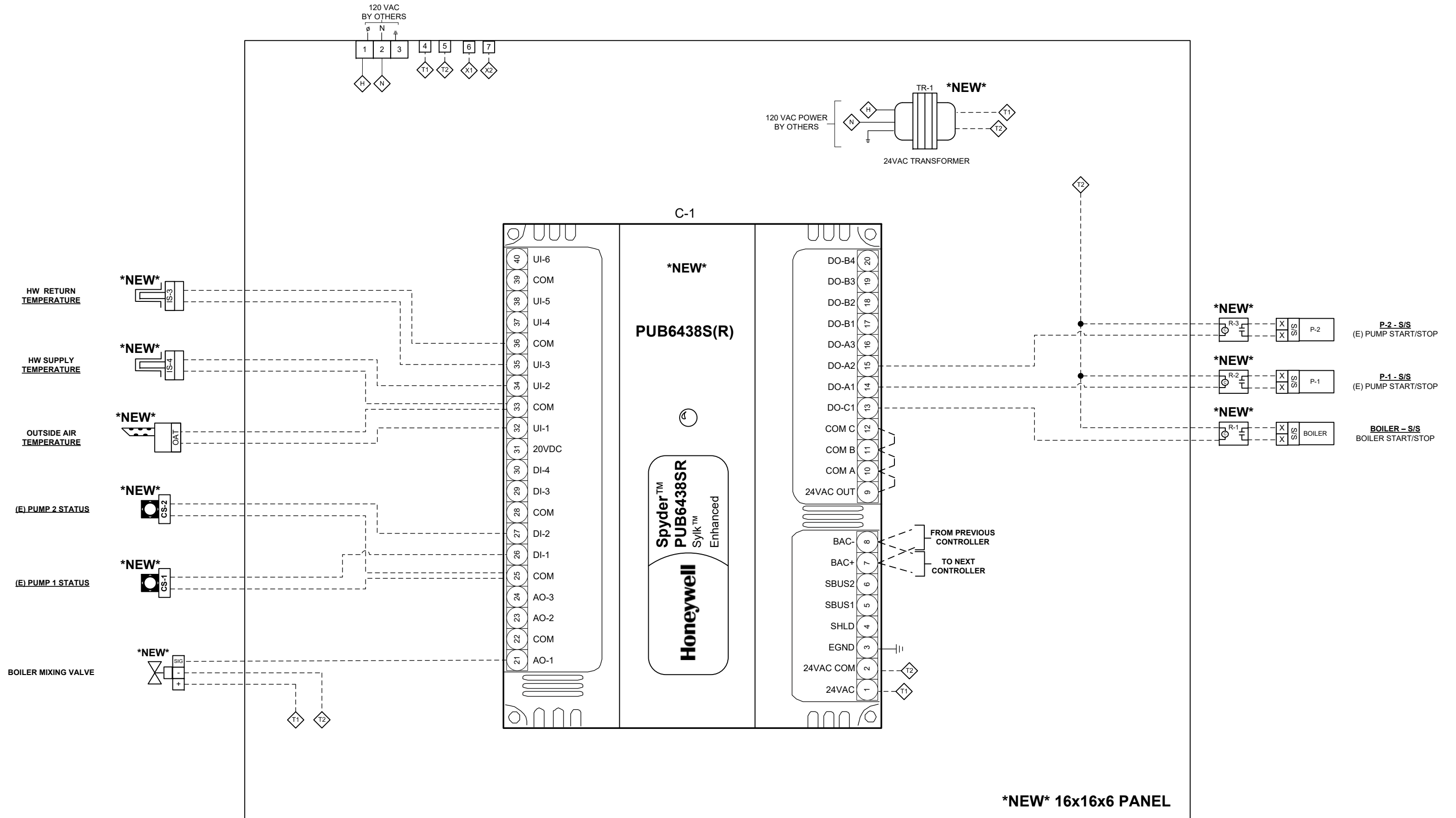
HOT WATER SYSTEM FLOW DIAGRAM



NOTES: SEE VALVE SCHEDULE FOR VALVE DATA

FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625						Project: NJ DOT FERNWOOD / FORAN BUILDING 30
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	A.V.		
		1	09-20-2017	ADDED HW SYSTEM AND MONITORS	A.V.		
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER			
		NO.	DATE	REVISION	BY		Job No. #17-04260
							Page 4 of 8

HOT WATER SYSTEM C-1 WIRING SCHEMATIC



NOTES: SEE VALVE SCHEDULE FOR VALVE DATA

FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625					Project: NJ DOT FERNWOOD / FORAN BUILDING 30	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS			A.V.
		1	09-20-2017	ADDED HW SYSTEM AND MONITORS			A.V.
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER			
		NO.	DATE	REVISION	BY		
						Job No. #17-04260Page 5 of 8	

HOT WATER SYSTEM SEQUENCE OF OPERATIONS

HW SYSTEM ENABLE:

- 1 – The hot water system shall be enabled whenever the outside air temperature is below 58 Deg F. (adj.)
- 2 - The hot water system shall be disabled whenever the outside air temperature is above 59 Deg F. (adj.)

OUTSIDE AIR TEMP/HW SUPPLY SETPOINT RESET:

- 1 – When the outside air temperature is 60 Deg F. or above the hot water supply set-point shall be 120 Deg F.
- 2 - When the outside air temperature is 30 Deg F. or below the hot water supply set-point shall be 180 Deg F.

INITIAL START-UP: HOT WATER PUMPS

- 1 – When the hot water system is enabled by the BMS, the lead hot water pump shall start.
- 2 – If the lead pump fails to start after 30 seconds as sensed by its respective current sensor then an alarm shall be generated.
- 3 – If the lead pump is in alarm then the lag pump shall start.
- 4 – Once hot water flow has been established, enable the boiler.

LEAD/LAG EQUIPMENT ROTATION:

- 1 – The BMS will rotate the equipment lead/lag schedule on a weekly basis in order to equalize equipment runtime.

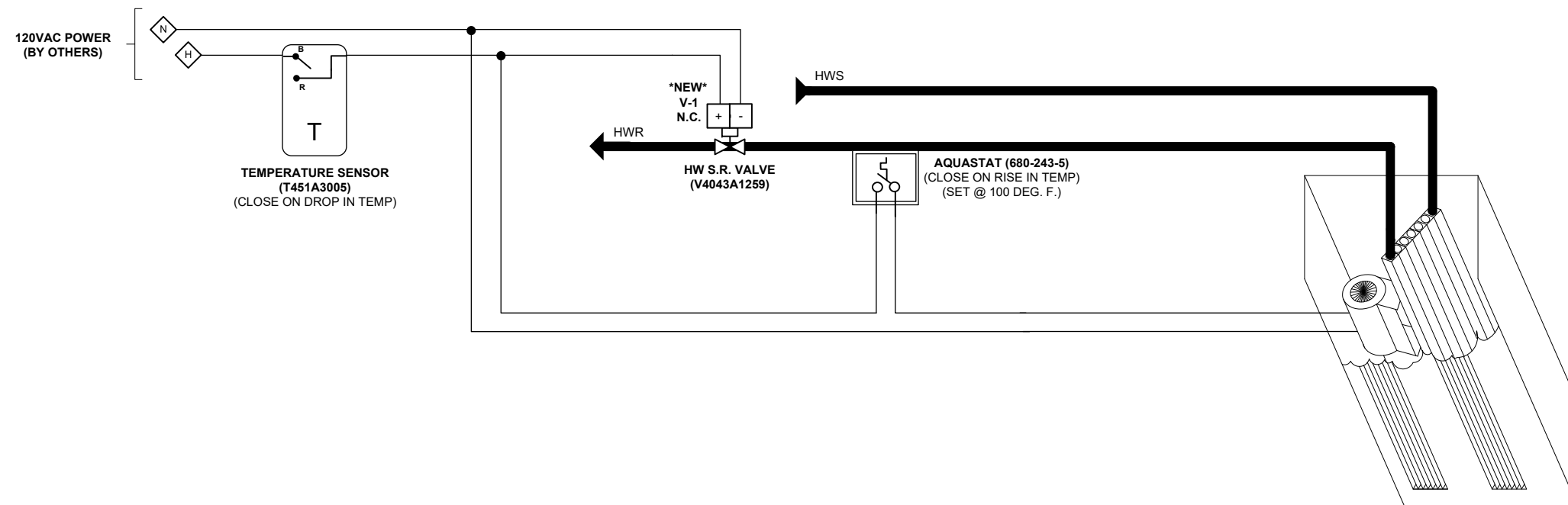
FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625				
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	A.V.
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ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER	
		NO.	DATE	REVISION	BY

Project: NJ DOT FERNWOOD / FORAN BUILDING 30

HOT WATER SYSTEM SEQUENCE OF OPERATIONS

Job No. #17-04260	Page 6 of 8
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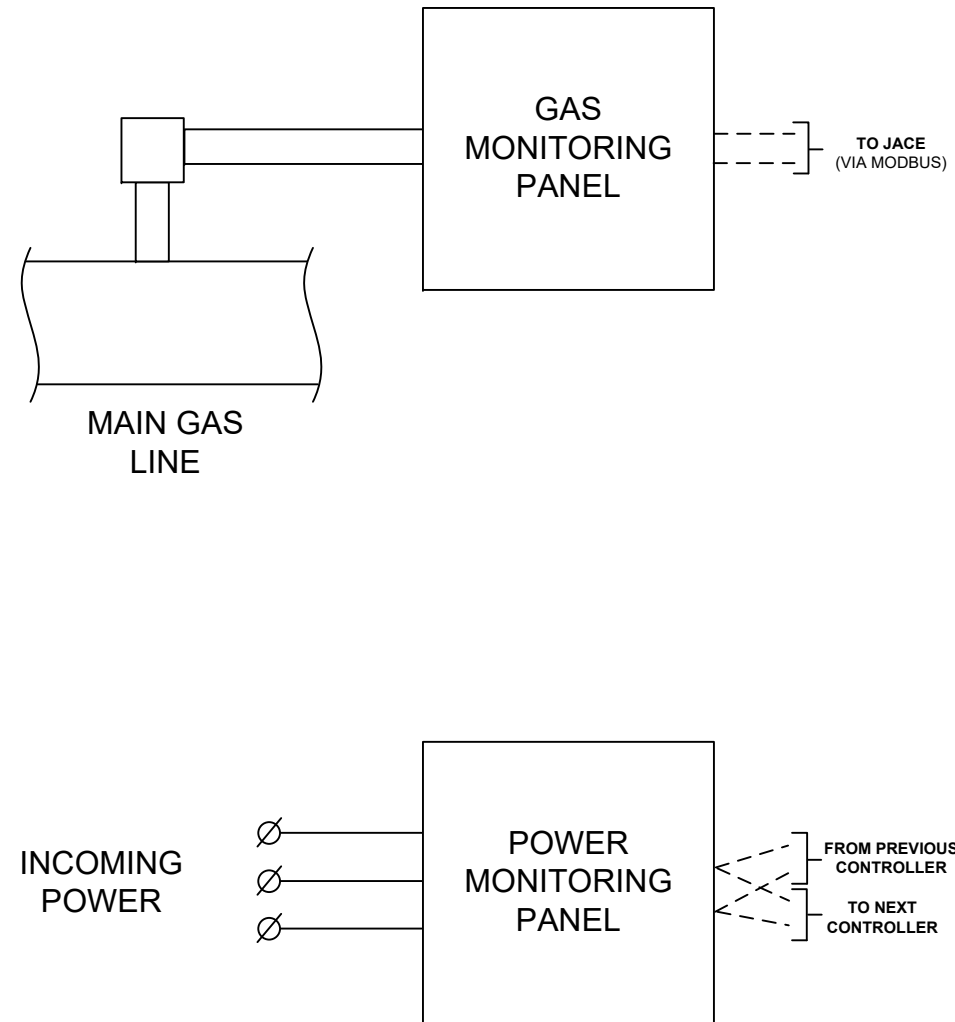
UNIT HEATER FLOW & WIRING DIAGRAM



**NOTE: SYSTEM IS SELF-CONTAINED
AND NOT TIED INTO THE BMS**

FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625									Project: NJ DOT FERNWOOD / FORAN BUILDING 30	
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	A.V.					UNIT HEATER FLOW & WIRING DIAGRAM	
		1	09-20-2017	ADDED HW SYSTEM AND MONITORS	A.V.						
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER						Job No. #17-04260	
		NO.	DATE	REVISION	BY						

POWER AND GAS MONITORING FLOW DIAGRAM



FACILITY	NJDOT Fernwood / Foran 30 Building, 1035 Parkway Ave, Ewing, NJ 08625				
MECHANICAL	DCO Energy, 5429 Harding Highway Building 500, Mays Landing, NJ 08330	2	01-05-2018	AS-BUILTS	A.V.
		1	09-20-2017	ADDED HW SYSTEM AND MONITORS	A.V.
ARCHITECTS	Concord Engineering, 520 South Burnt Mill Road, Voorhees, New Jersey 08043	0	06-18-2017	BACNET COMMUNICATIONS RISER	
		NO.	DATE	REVISION	BY

Project: NJ DOT FERNWOOD / FORAN BUILDING 30

POWER AND GAS MONITORING FLOW

DIAGRAM

Job No. #17-04260

Page 8 of 8

PROJECT: NJDOT - FORAN 30

JOB ID NUMBER: 17-04260

PAGE 1 OF 1

PAGE	SHIP	QTY	PRODUCT #	MFGR.	DESCRIPTION
PG 3 RISER		1	WEB-8000-CSE	Honeywell	JACE Web Controller w/ BACnet
PG 3 RISER		1	NC-8005	Honeywell	License for Up to 5 Devices
PG 4+5 HWS		1	A/20K-O	ACI	Outside Air Temp Sensor
PG 4+6 HWS		2	A/20K-I	ACI	Immersion + ½ Well 20K sensor
PG 4+5 HWS		2	C-2200	Senva	Current Transducer
PG 4+6 HWS		1	VGF31EM30 + MN7510A2001	Honeywell	3" Cv=115 3-way Valve + Modulating Actuator
PG 5 HWS		1	PUB6438SR	Honeywell	Spyder BACnet Programmable Controller
PG 5 HWS		1	TR75VA001	FD, Inc. (RIB)	120VAC/24VAC Transformer
PG 4+5 HWS		3	RIBU1C	FD, Inc. (RIB)	120 Vac / 10-30 Vac/dc Relay SPDT
PG 5 HWS		1	SCE-16N1606LP	Saginaw	Enviroline Series Control Panel
PG 5 HWS		1	SCE-16N16MP	Saginaw	Subpanel for Enviroline Panel
PG 8 GAS/PWR		1	PS3037-S-N	Dent Inst.	1-pt. Rev. Grade Power Meter
PG 8 GAS/PWR		1	CT-R16-A4-U	Dent Inst.	Flexible Current Transformer
PG 8 GAS/PWR		1	620S-BT-L06-M1- EN2-V4-NR-9-MB	Sierra Inst.	BoilerTrak Immersible Thermal Gas Mass Flow Meter



CENTRAL CHILLER PLANT



NJ DOT CENTRAL CHILLED WATER PLANT (AS-BUILTS)

ENERGY SAVINGS IMPROVEMENT PROJECT

BUILDING AUTOMATION SYSTEM

SHEET NUMBER	CONTENTS	REVISION
1	TITLE PAGE	
2	LEGEND & SYMBOLS	
3	NETWORK RISER	

LEGEND & SYMBOLS

GENERAL NOTES

1. ALL POWER WIRING 120 VAC AND ABOVE BY ELECTRICAL CONTRACTOR.

TEMPERATURE CONTROL LEGEND:

 MOUNTED ON PANEL FACE

 MOUNTED INSIDE PANEL

 CONTROL TUBE #3

 PNEUMATIC TUBING

 WIRING

 TERMINAL BLOCK #6

 SOLENOID VALVE

 CONTROL VALVE, 2-WAY

 CONTROL VALVE, 3-WAY

 PARALLEL BLADED DAMPER

 OPPOSED BLADED DAMPER

 SIGNAL LINE INSIDE PANEL

ABBREVIATIONS:

AFMS- AIR FLOW MEASURING STATION

C- COMMON PORT

CCP- CENTRAL CONTROL PANEL

CR- CONTROL RELAY

CS- CURRENT SWITCH

DA-DAMPER ACTUATOR

DPRO- DAMPER OUTPUT

DPRS- DAMPER STATUS

DPS- DIFFERENTIAL PRESSURE SWITCH

DPT- DIFFERENTIAL PRESSURE TRANS

EA- EXHAUST AIR

ES- END SWITCH, POSITION SWITCH

FS- FLOW SWITCH

FSD- FIRE & SMOKE DAMPER

H- HUMIDISTAT

HC- MOTOR STARTER HOLDING COIL

HI- HUMIDITY INDICATOR

HL- HIGH LIMIT HUMIDISTAT

HS- HIGH SIGNAL SELECTOR

HT- HUMIDITY TRANSMITTER

LCP- LOCAL CONTROL PANEL

LS- LOW SIGNAL SELECTOR

MA- MIXED AIR

MOD-MOTER OPERATED DAMPER

NC- NORMALLY CLOSED

NCP- NETWORK CONTROL PANEL

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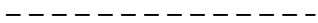
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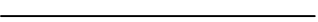
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WU- WARM-UP SIGNAL

WIRING LEGEND

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 Low Voltage Communication Wiring 22/2 AWG, CL2P, Shielded Copper Wire, Low Capacitance

 Line Voltage, THHN Field Wiring

HVAC SYSTEM LEGEND:

 MOTOR OPERATED DAMPER

 PREHEAT COIL

 COOLING COIL

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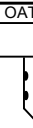
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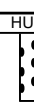
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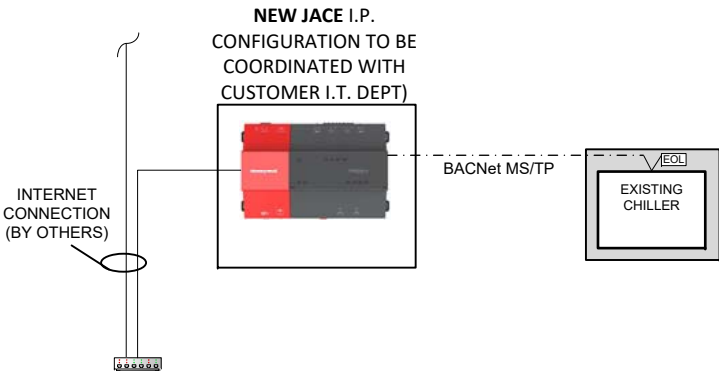
 CONTROL RELAY

 CURRENT SENSOR

 CO2 SENSOR

FACILITY								Project: NJ DOT CENTRAL CHILLED WATER PLANT
MECHANICAL		1	01-03-2018	AS-BUILTS				LEGEND & SYMBOLS
ARCHITECTS		0	05-22-2017	BACNET COMMUNICATIONS RISER	A.V.			Job No. #17-04260Page 2 of 3
		NO.	DATE	REVISION	BY			

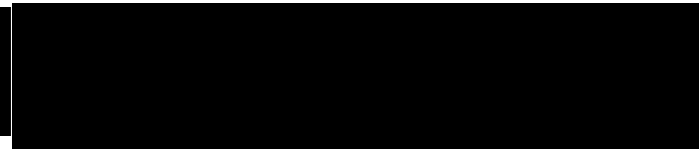
NETWORK RISER



NOTE: 1) 120VAC POWER TO ALL CONTROL PANELS BY OTHERS

[illegible]

PROJECT: NJDOT ESIP - CENTRAL CHILLER PLANT
JOB ID NUMBER: 17-04260



PAGE 1 OF 1

PAGE	QTY	PRODUCT #	MFGR.	DESCRIPTION
PG 3 RISER	1	WEB-8000-CSE	Honeywell	JACE Web Controller
PG 3 RISER	1	NC-8005	Honeywell	JACE License Up to 5 Devices



EQUIPMENT CUTSHEETS



WEB-8000 Controller

SPECIFICATION DATA



OVERVIEW

The WEB-8000 is a compact, embedded IoT (Internet of Things) controller and server platform for connecting multiple and diverse devices and sub-systems. With Internet connectivity and Webserving capability, the WEB-8000 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 or wireless LAN, or remotely over the Internet.

The licensing model for the WEB-8000 controller is simplified and features standard drivers along with optional IO and field bus expansion modules for ultimate flexibility and expandability. The WEB-8000 controller operates with WEBs-N4, the latest version of the Niagara Framework®, for optimum performance. In larger facilities, multibuilding applications and large-scale control system integrations, WEBs-N4 Supervisor can be used with WEB-8000 controllers to aggregate information, including real-time data, history and alarms, to create a single, unified application.

SPECIFICATIONS

TI AM3352: 1000MHz ARM® Cortex™-A8

1GB DDR3 SDRAM

**Removable micro-SD card with 4GB flash total storage/
2GB user storage**

Wi-Fi (Client or WAP)

IEEE802.11a/b/g/n

IEEE802.11n HT20 @ 2.4GHz

IEEE802.11n HT20/HT40 @ 5GHz

Configurable radio (Off, WAP, or Client)

WPAPSK/WPA2PSK supported

USB type A connector

Back-up and restore support

(2) isolated RS-485 with selectable bias and termination

(2) 10/100MB Ethernet ports

Secure boot

24VAC/DC power supply

Runs WEBs-4.1 and later

Real time clock

Batteryless



Expansion Module and IO Configurations

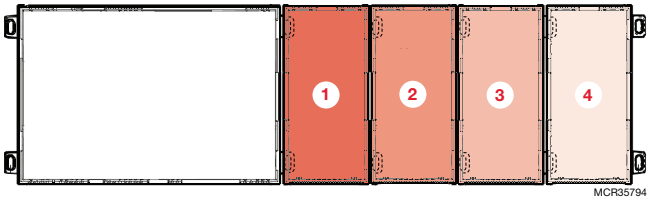
MAXIMUM EXPANSION MODULES SUPPORTED

NPB-8000-LON: 4
NPB-8000-232: 4
NPB-8000-2X-485: 2

MAXIMUM IO MODULES SUPPORTED

IO-16-REM-H: 16*
* Remote IO connection using RS-485 wiring

EXPANSION 1	EXPANSION 2	EXPANSION 3	EXPANSION 4
232 or LON	232 or LON	232 or LON	232 or LON
485 485	232 or LON	232 or LON	232 or LON
485 485	485 485	232 or LON	
485 485	485 485		



AGENCY CERTIFICATIONS

UL 916
CE EN 61326-1
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

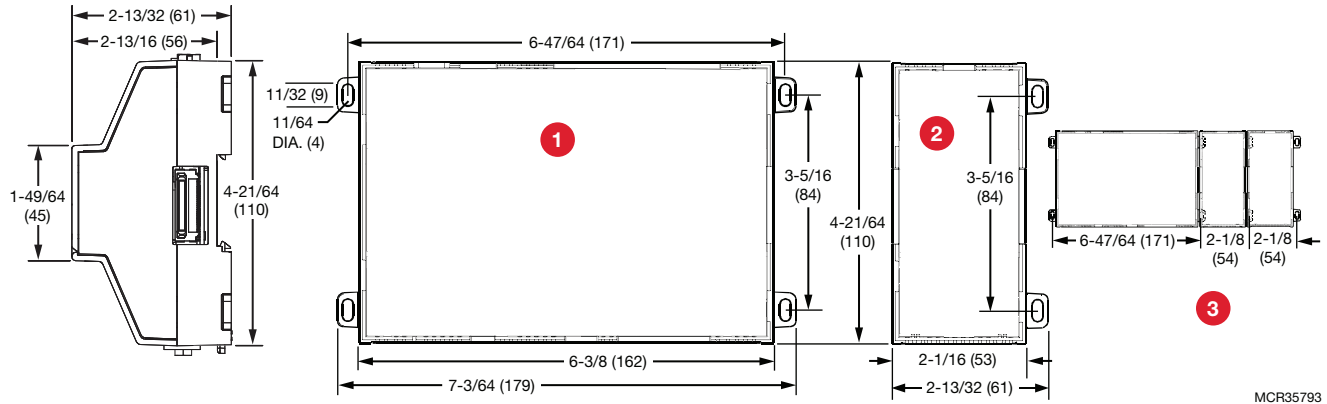
ENVIRONMENTAL SPECIFICATIONS

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+



WEB-8000 CONTROLLER MOUNTING & DIMENSIONS

1. WEB-8000 controller. Allow at least 1.5" (38mm) clearance around all sides and minimum 3" (76mm) at bottom for Wi-Fi antenna
2. Expansion module. Up to four (4) may be used.
3. See "Expansion Module and IO Configurations" Distances between center of tabs from one unit to another unit



Compatible with (DIN43880) enclosures

Suitable for mounting to a panel or to an EN50022 standard 35mm rail

ORDERING INFORMATION

Part Number	Description
WEB-8000	Base unit includes two isolated RS485 ports, two 10/100MB Ethernet ports, USB Backup & Restore and Wi-Fi connectivity
WEB-8000-DEMO	Base unit includes two isolated RS485 ports, two 10/100MB Ethernet ports, USB Backup & Restore, Wi-Fi connectivity, all available Tridium drivers and a 500 device license. Hardware Accessories purchased separately
NC-8005	Up to 5 devices/250 point core
NC-8010	Up to 10 devices/500 point core
NC-8025	Up to 25 devices/1,250 point core
NC-8100	Up to 100 devices/5,000 point core
NC-8200	Up to 200 devices/10,000 point core
DEVICE-10	Up to 10 devices/500 point upgrade (can be purchased during initial licensing)
DEVICE-25	Up to 25 devices/1,250 point upgrade (can be purchased during initial licensing)
DEVICE-50	Up to 50 devices/2,500 point upgrade (can be purchased during initial licensing)
DEVICE-UP-10	Up to 10 devices/500 point upgrade (can be purchased post initial licensing)
DEVICE-UP-25	Up to 25 devices/1,250 point upgrade (can be purchased post initial licensing)
DEVICE-UP-50	Up to 50 devices/2,500 point upgrade (can be purchased post initial licensing)
WEB-8000-AX	Enables WEB-8000 controller to run Webs-AX (3.8U). 3.8U Build with JACE 8000 controller support
NPB-8000-2X-485	WEB-8000 controller — add on dual port RS-485 module
NPB-8000-LON	WEB-8000 controller — add on single port LON FTT10A module
NPB-8000-232	WEB-8000 controller — add on single port RS-232 module
WPM-8000	Universal power supply for WEB-8000 controller
T-IO-16-485	Remote IO module, compatible with the WEB-8000 controller. Communication using RS 485, maximum IO supported IO-16-REM-H modules: 16
NPB-PWR-H	24V power supply for IO-16-REM-H
NPB-PWR-UN-H	Universal power supply for IO-16-REM-H

* All NC-8XXX parts include a WEBs-N4 license and Tridium's standard driver suite. Please see Tridium standard driver suite documentation for more details.

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FX80 Supervisory Controller Catalog Page

Code No. LIT-1901010

Issued April 2017

Refer to the [QuickLIT Web site](#) for the most up-to-date version of this document.

The FX80 Supervisory Controller is a web-based supervisory-class controller in the *Facility Explorer*® product family. The FX80 controller manages networks of field controllers using open communication protocols, such as BACnet®, LonWorks®, and N2 protocols. The FX80 controller supports a full set of building automation features, such as scheduling, alarming, historical data collection and management, data sharing, energy management, totalization, customized control routines, tagging, templates, search, and hierarchies, which are specifically designed for commercial facilities.

Each FX80 controller includes a graphical system user interface with an HTML5 web profile, a configuration tool that you can access with the web browser, and robust security. Remote access is easily achieved using a wired or wireless connection from the Internet or intranet. Multiple users can concurrently connect to the FX80 controller. You can manage security and presentation preferences through user profiles, login IDs, and passwords.

The FX80 Supervisory Controller is a compact DIN rail mountable controller with the capability for remote external input and output points.

In addition, the FX80 controller's hardware and software design is modular, so you can plug in accessories, such as communications option modules, if needed. Device and point licensing options allow you to select the device and point capacity most appropriate for the size of your facility and those options best needed to control it. And, in many cases, future expansions do not require the replacement of hardware.

Refer to the *FX80 Supervisory Controller Product Bulletin* (LIT-12012250) for important product applicationn.

If the FX80 Supervisory controller components (hardware and micro SD card) fail, it is required to place a call with Johnson Controls® Field Support Center (FSC) at 800-275-5676 (or email PSOTechSupport@jci.com) to determine if these components are field repairable or if one or both components need to be returned for a replacement. When the FSC has a qualified need for replacement, please contact Johnson Controls Product Sales at 800-275-5676 with your FSC Help Desk ticket number, QNX number, and serial number.

Figure 1: FX80 Supervisory Controller



FX80 Features and Benefits

- **Fully Commissioned and Licensed Out of the Box**—Power up, connect to a web browser, change default passwords, set up network parameters, and start adding your field controllers.
- **Web-Based User Interface**—Provides rich, graphical displays for system operation and analysis.
- **Adoption of Industry Standard Communication Protocols**—Allows for the integration of a wide variety of field controllers, including *Facility Explorer* field controllers and controllers provided by others without intermediate gateways or translators.
- **Embedded Configuration Tool**—Requires no proprietary or desktop software to configure the FX80 controller. You only need a web browser for basic configuration and monitoring.
- **Modular Design**—Allows you to select only those components needed to meet specific project requirements.
- **Small, Compact Design**—Installs easily.
- **FX Workbench**—Reduces engineering and installation time by easily and quickly creating the FX80 database from field controller configurations offline.
- **Niagara® Analytics**—Allows you to apply a variety of analytical algorithms and diagnostics to both historical and real-time data.

Table 1: FX80 Supervisory Controller Ordering Information

Product Code Number	Description
FX-SC8BASE-0	FX80 Supervisory Controller and micro Secure Digital (SD) card, licensing required and purchased separately
FX-SC8BASE-700	Replacement FX80 Supervisory Controller, no micro SD card, no licenses
FX-SC8BWW-0 ¹	FX80 Supervisory Controller Case, World Wide WLAN
FX-SC8DWIFI-0	FX80 Supervisory Controller Case, Disabled WLAN

1 The FX80 World Wide Controller is intended and only orderable outside of North America.

Table 2: FX80 Core Device Licenses Ordering Information

Product Code Number ¹	Description ²
FX-SC8CL005-0	FX80 Supervisory Controller core device license, 5 field devices, 250 points
FX-SC8CL010-0	FX80 Supervisory Controller core device license, 10 field devices, 500 points
FX-SC8CL025-0	FX80 Supervisory Controller core device license, 25 field devices, 1,250 points
FX-SC8CL100-0	FX80 Supervisory Controller core device license, 100 field devices, 5,000 points
FX-SC8CL200-0	FX80 Supervisory Controller core device license, 200 field devices, 10,000 points
FX-SC8CLDEMO-0	FX80 Supervisory Controller demo license, 500 field devices, 25,000 points. Enables all features needed to engineer and demonstrate FX Supervisory Controllers and FX Server stations. Intended for installing contractors. Requires annual support fee. Expires yearly.

1 Each FX80 controller requires the purchase of a single core device license.

2 Device licenses are also dependent on point (proxy) counts. For each device that is licensed, 50 points are licensed. A 5-device core license also licenses 250 points. This could satisfy five devices with 25 points each or three devices with 80 points each. For three devices with 90 points each, you need to purchase the 10-device core license (or add a 5-device additional license to the 5-device core license).

Table 3: New FX80 Controller Software Maintenance Ordering Information

Product Code Number	Description ^{1, 2}
FX-SC8D005M1-0	Initial 1 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D005M3-0	Initial 3 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D005M5-0	Initial 5 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D010M1-0	Initial 1 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity
FX-SC8D010M3-0	Initial 3 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity
FX-SC8D010M5-0	Initial 5 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity
FX-SC8D025M1-0	Initial 1 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D025M3-0	Initial 3 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D025M5-0	Initial 5 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D100M1-0	Initial 1 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D100M3-0	Initial 3 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D100M5-0	Initial 5 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D200M1-0	Initial 1 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity
FX-SC8D200M3-0	Initial 3 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity
FX-SC8D200M5-0	Initial 5 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity

1 Device capacity is equal to the sum of the **core device license** and **any additional device license** applied to the FX80 controller. Select the device capacity that is equal or lesser than the sum.

2 Maintenance cannot be purchased for any period beyond December 31, 2025.

Table 4: FX80 Controller Software Maintenance (Post Initial) Ordering Information

Product Code Number	Description ^{1, 2}
FX-SC8D005M1-6	1 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D005M3-6	3 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D005M5-6	5 year software maintenance for FX80 Supervisory Controller with 5–9 field device capacity
FX-SC8D010M1-6	1 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity
FX-SC8D010M3-6	3 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity
FX-SC8D010M5-6	5 year software maintenance for FX80 Supervisory Controller with 10–24 field device capacity

Table 4: FX80 Controller Software Maintenance (Post Initial) Ordering Information

Product Code Number	Description ^{1, 2}
FX-SC8D025M1-6	1 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D025M3-6	3 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D025M5-6	5 year software maintenance for FX80 Supervisory Controller with 25–99 field device capacity
FX-SC8D100M1-6	1 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D100M3-6	3 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D100M5-6	5 year software maintenance for FX80 Supervisory Controller with 100–199 field device capacity
FX-SC8D200M1-6	1 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity
FX-SC8D200M3-6	3 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity
FX-SC8D200M5-6	5 year software maintenance for FX80 Supervisory Controller with 200 and up field device capacity

1 Device capacity is equal to the sum of the **core device license** and **any additional device license** applied to the FX80 controller. Select the device capacity that is equal or lesser than the sum.

2 Maintenance cannot be purchased for any period beyond December 31, 2025.

Table 5: FX80 Controller Additional Field Device Licenses Ordering Information

Product Code Number ¹	Description
Initial Purchase	
FX-SC8DL10-0	License enabling an additional 10 field devices, 500 points for one FX80, initial purchase only
FX-SC8DL25-0	License enabling an additional 25 field devices, 1,250 points for one FX80, initial purchase only
FX-SC8DL50-0	License enabling an additional 50 field devices, 2,500 points for one FX80, initial purchase only
After Initial Purchase	
FX-SC8DL10-6	License enabling an additional 10 field devices, 500 points for one FX80; upgrade after initial purchase
FX-SC8DL25-6	License enabling an additional 25 field devices, 1,250 points for one FX80; upgrade after initial purchase
FX-SC8DL50-6	License enabling an additional 50 field devices, 2,500 points for one FX80; upgrade after initial purchase

1 Additional devices are used to expand capacity from the core device license. For example, you can order the FX-SC8DL25-0 with the FX-SC8CL025-0 for a total of 50 devices, 2,500 points.

Table 6: Niagara Analytics Licenses Ordering Information

Product Code Number ¹	Description
FX-ASCL100-0	License enabling 100 analytic points for Niagara Analytics on an FX80 Supervisory Controller at FX Supervisory Family Software Release 14.2 or greater
FX-ASCL250-0	License enabling 250 analytic points for Niagara Analytics on an FX80 Supervisory Controller at FX Supervisory Family Software Release 14.2 or greater
FX-ASCL500-0	License enabling 500 analytic points for Niagara Analytics on an FX80 Supervisory Controller at FX Supervisory Family Software Release 14.2 or greater
FX-ASCL1000-0	License enabling 1,000 analytic points for Niagara Analytics on an FX80 Supervisory Controller at FX Supervisory Family Software Release 14.2 or greater

1 Niagara Analytics products require Niagara Analytics N4 certification. Niagara Analytics certification training requires Niagara 4 TCP Certification.

Table 7: FX80 Supporting Software Ordering Information

Product Code Number	Description
FX-WBALM-0	License enabling Alarm Portal Client for FX Supervisory Family Software Release 14.2 or greater

Table 8: FX80 Controller Software Accessories Ordering Information

Product Code Number	Description
FX-SC8LCCN-0	License enabling Carrier® Communication/Comfort Network (CCN) driver for one FX80 Supervisory Controller; initial purchase
FX-SC8LAX-0	License enabling AX 3.8 downgrade for one FX80; initial purchase
FX-SC8LCCN-6	License enabling Carrier CCN driver for one FX80; upgrade after initial purchase
FX-SC8LAX-6	License enabling AX 3.8 downgrade for one FX80; upgrade after initial purchase
FX-SC8LAC-6 ¹	License enabling AC256 over RS-232 or RS-485 driver

Table 8: FX80 Controller Software Accessories Ordering Information

Product Code Number	Description
FX-SC8LAINF-6	License enabling Andover® Infinity driver
FX-SC8LAPHP-6	License enabling American Auto-Matrix™ PHP over RS-232 or RS-485 driver
FX-SC8LAPUP-6	License enabling American Auto-Matrix™ PUP over RS-232 or RS-485 driver
FX-SC8LFLEX-6	License enabling Flex™ driver over RS-232 or RS-485
FX-SC8LLOB-6 ²	License enabling control of IR AV equipment through an RS-232 to Global Cache FC module
FX-SC8LHELV-6 ²	License enabling Helvar lighting control driver
FX-SC8LHORT-6 ²	License enabling European Hortsmann meter driver
FX-SC8LJOS-6 ²	License enabling Josam® grease trap sensor driver
FX-SC8LLANG-6 ²	License enabling Lang™ oven RS-232 or RS-485 driver
FX-SC8LMCQ-6	License enabling McQuay® driver to OPM driver
FX-SC8LSMS-6 ²	License enabling SMS alarms through Global System for Mobile Communication (GSM)/General Packet Radio Services (GPRS) modem to RS-232 serial port driver
FX-SC8LVDRT-6 ²	License enabling Veeder-Root® RS-232 or RS-485 driver

1 Available in Beta version only.

2 Drivers supported at **FX Supervisory Family Software Release 6.3 only**. These drivers are **not** supported at FX Supervisory Family Software Release 14.x.

Table 9: FX80 Controller Hardware Accessories Ordering Information

Product Code Number	Description
FX-SC8SD-700	FX80 micro SD replacement (micro SD only); no licenses
FX-SC8XLON-0	LONWORKS FX80 expansion module for the FX80 Supervisory Controller
FX-SC8XD485-0	Dual port isolated RS-485 expansion module for the FX80 Supervisory Controller
FX-SC8X232-0	RS-232 expansion module for the FX80 Supervisory Controller
LP-FXRIO16-0	Remote input/output module for the FX Supervisory Controllers; includes 8 universal inputs, 4 relay outputs, and four 0-10 V analog outputs
FX-SC8AKIT-700	FX80 accessory kit including replacement connectors
FX-SC8XKIT-700	FX80 expansion module kit including one-size-fits-all replacement connector
FX-SC8XPS-0	FX80 universal wall mount power supply 100–240 VAC/24 V includes United States, Europe, United Kingdom, and Australia style plugs
FX-SC8WKIT-700	Extension cable and bracket for FX80 WLAN

Global Shipping

This section lists the FX80 parts that are used for each country.

Notes:

- Part number configuration cannot be changed after leaving the factory. For example, FX-SC8BDWIFI-0 (Wi-Fi disabled) is not field upgradeable to FX-SC8BWW-0 (World Wide Wi-Fi).
- Each part number referenced for a specific country complies with local safety regulations.

Table 10: Wi-Fi/WLAN Operation and Safety Certification Have Been Approved

Country	Country Code	Wi-Fi Enabled by FX Release ¹	FX80 Part Number with Wi-Fi	FX80 Part Number with Wi-Fi Disabled ²
Argentina	AR	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0
Australia	AU	14.2	FX-SC8BWW-0	FX-SC8BDWIFI-0
Austria	AT	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Belgium	BE	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Bulgaria	BG	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Canada	CA	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Chile	CL	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0
China	CN	14.2	Not Available	FX-SC8BDWIFI-0
Croatia	HR	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Cyprus	CY	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Czech Republic	CZ	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Denmark	DK	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Estonia	EE	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Finland	FI	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
France	FR	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Germany	DE	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Greece	GR	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Hong Kong	HK	14.2	FX-SC8BWW-0	FX-SC8BDWIFI-0
Hungary	HU	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Iceland	IS	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Ireland	IE	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Italy	IT	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Kuwait	KW	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0
Liechtenstein	LI	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Lithuania	LT	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Luxembourg	LU	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Malta	MT	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Netherlands	NL	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
New Zealand	NZ	14.2	FX-SC8BWW-0	FX-SC8BDWIFI-0
Norway	NO	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Poland	PL	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Portugal	PT	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Puerto Rico	PR	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Romania	RO	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Singapore	SG	14.2	FX-SC8BWW-0	FX-SC8BDWIFI-0
Slovakia	SK	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Slovenia	SI	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Spain	ES	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Saudi Arabia	SA	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0
Switzerland	CH	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Thailand	TH	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0

Table 10: Wi-Fi/WLAN Operation and Safety Certification Have Been Approved

Country	Country Code	Wi-Fi Enabled by FX Release ¹	FX80 Part Number with Wi-Fi	FX80 Part Number with Wi-Fi Disabled ²
United States	US	14.1	FX-SC8BASE-0	FX-SC8BDWIFI-0
United Kingdom	UK	14.1	FX-SC8BWW-0	FX-SC8BDWIFI-0
Vietnam	VN	14.3	FX-SC8BWW-0	FX-SC8BDWIFI-0

1 Wi-Fi Enabled by FX Release lists the minimum software version to support Wi-Fi.

2 Part numbers are not dependent on the FX Supervisory Software Release.

Table 11: Wi-Fi/WLAN Operation is Pending and Safety Certification is Approved

Country	Country Code	Wi-Fi Enabled by FX Release ¹	FX80 Part Number with Wi-Fi	FX80 Part Number with Wi-Fi Disabled ¹
Brazil	BR	14.3	Not Available	FX-SC8BDWIFI-0
Dominican Republic	DO	14.3	Not Available	FX-SC8BDWIFI-0
Egypt	EG	14.3	Not Available	FX-SC8BDWIFI-0
India	IN	14.3	Not Available	FX-SC8BDWIFI-0
Indonesia	ID	14.3	Not Available	FX-SC8BDWIFI-0
Iraq	IQ	14.3	Not Available	FX-SC8BDWIFI-0
Jordan	JO	14.3	Not Available	FX-SC8BDWIFI-0
Lebanon	LB	14.3	Not Available	FX-SC8BDWIFI-0
Malaysia	MY	14.3	Not Available	FX-SC8BDWIFI-0
Mexico	MX	14.3	Not Available	FX-SC8BDWIFI-0
Panama	PA	14.3	Not Available	FX-SC8BDWIFI-0
Peru	PE	14.3	Not Available	FX-SC8BDWIFI-0
Philippines	PH	14.3	Not Available	FX-SC8BDWIFI-0
Qatar	QA	14.3	Not Available	FX-SC8BDWIFI-0
South Africa	ZA	14.3	Not Available	FX-SC8BDWIFI-0
Taiwan	TW	14.3	Not Available	FX-SC8BDWIFI-0
Tunisia	TN	14.3	Not Available	FX-SC8BDWIFI-0
Turkey	TR	14.3	Not Available	FX-SC8BDWIFI-0
United Arab Emirates	AE	14.3	Not Available	FX-SC8BDWIFI-0
Israel IL	IL	14.3	Not Available	FX-SC8BDWIFI-0
Russian Federation	RU	14.3	Not Available	FX-SC8BDWIFI-0
Ukraine	UA	14.3	Not Available	FX-SC8BDWIFI-0

1 Wi-Fi Enabled by FX Release lists the minimum software version to support Wi-Fi.

2 Part numbers are not dependent on the FX Supervisory Software Release.

Table 12: Wi-Fi/WLAN Operation and Safety Certification is Pending

Country	Country Code	Wi-Fi Enabled by FX Release	FX80 Part Number with Wi-Fi	FX80 Part Number with Wi-Fi Disabled
Algeria	DZ	TBD	Not Available	Not Available
Azerbaijan	AZ	TBD	Not Available	Not Available
Bahrain	BH	TBD	Not Available	Not Available
Belarus	BY	TBD	Not Available	Not Available
Georgia	JP	TBD	Not Available	Not Available
Japan	IQ	TBD	Not Available	Not Available
Kazakhstan	KZ	TBD	Not Available	Not Available
Korea (South)	KR	TBD	Not Available	Not Available
Morocco MA	MA	TBD	Not Available	Not Available
Uzbekistan	TT	TBD	Not Available	Not Available
Not Otherwise Classified (NOC)	—	TBD	Not Available	Not Available

Table 13: FX80 is Restricted from Being Sold

Country	Country Code	FX80 Part Number with Wi-Fi	FX80 Part Number with Wi-Fi Disabled
Cuba	—	Restricted from Sale	Restricted from Sale
Iran	—	Restricted from Sale	Restricted from Sale
North Korea	—	Restricted from Sale	Restricted from Sale
Sudan	—	Restricted from Sale	Restricted from Sale
Syria	—	Restricted from Sale	Restricted from Sale

Technical Specifications

Table 14: FX80 Supervisory Controller

Enclosure/ Mounting	Plastic/DIN Rail
Dimension	8.5 x 6 x 2.625 in. (216 x 152 x 68 mm)
Power Supply	24 VAC/DC
Processor	TI AM3352: 1000MHz ARM® Cortex™ A8
RAM Memory	1 GB DDR3 SD RAM
Flash Memory	Removable micro-SD card with 4GB flash total storage, 2 GB user storage
Environment	Operating Temperature: -4 to 140°F (-20 to 60°C) Storage Temperature: -40 to 185°F (-40 to 85°C) Relative Humidity: 5 to 95%, noncondensing
Onboard	2 Ethernet 10/100 Mbps; 2 RS-485 (Isolated); 1 USB, 1 Micro USB, Fast USB Bus; Wi-Fi
	Plug-in options: Dual port RS-485 (Isolated); LON FT/TP-10; RS-232
Network Drivers	
Embedded	N2, BACnet, Niagara
Direct I/O	
Onboard	None
Optional	Up to 256 by using 16 Remote I/O Modules (FXRIO16)
Local (NDIO)	None
Remote I/O	Up to 256 I/O by using 16 Remote I/O Modules (FXRIO16)
Compliance	United States UL Listed, File E107041, CCN PAZX, under UL 916, Energy Management Equipment FCC compliant to CFR 47, part 15, subpart C, Class B
	Canada UL Listed, File E107041, CCN PAZX7, under CSA C22.2 No. 205, Signal Equipment Industry Canada compliant to ICES-003
	Europe CE Mark – Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive.
	

United States Emissions Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Emissions Compliance

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations. Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Table 15: Remote Input Output Modules

Product Codes	LP-FXRIO16-0: 8 universal inputs, 4 relay outputs, 4 analog outputs
Dimensions	4 x 3.625 x 2.625 in. (10.16 x 9.2 x 6.7 cm)

Table 15: Remote Input Output Modules

Universal Input Types Supported	10k ohm Type 3 thermistors. Thermistor Sensor Range: -10 to 240° F (-23.3 to 115.5° C). Input accuracy is in the range of $\pm 1\%$ of span. Characteristic curve is customizable. 0–10 V; accuracy is $\pm 2\%$ of span, without user calibration; uses an external resistor for current input (four provided, mounted by installer on terminal connections) 4–20 mA current loop; accuracy is $\pm 2\%$ of span, without user calibration; self-powered or board-powered sensors accepted Dry contact: V open circuit, 300- μA short-circuit current Pulsing dry contact at a rate of up to 20 Hz; 50% duty cycle
Digital Outputs	Form A relay contacts suitable for on/off control only; floating control not supported Maximum voltage 30 volts AC or DC, 1/2 A maximum current rating
Analog Outputs	0–10 V DC Minimum load supported per output is 2,500 ohms minimum or 4 mA drain maximum

Table 16: FX Workbench Requirements

Processor¹	Intel® Pentium® 4, 1 GHz or higher 4 x 3.625 x 2.625 in. (10.16 x 9.2 x 6.7 cm)
Operating System	32-bit: Windows® 10 Pro or Enterprise, Windows 8 Pro or Enterprise, Windows 7 Professional, Enterprise, or Ultimate, or Windows XP® Professional 64-bit: Windows® 10 Pro or Enterprise, Windows 8.1 Pro or Enterprise, Windows 8 Pro or Enterprise, Windows 7 Professional, Enterprise, or Ultimate, Windows Server 2012 Standard or Enterprise with SP2, or Windows Server® 2012 R2 Standard or Enterprise with SP2
Memory	1 GB minimum, 4 GB or more recommended for larger systems
Hard Disk	4 GB minimum, more recommended depending on archiving requirements
Network Support	Ethernet 10/100 Mbps with RJ-45 connector

¹ The information in this table applies to both the FX Supervisory Software Release 14.1 and FX Supervisory Software Release 6.x if using the AX license

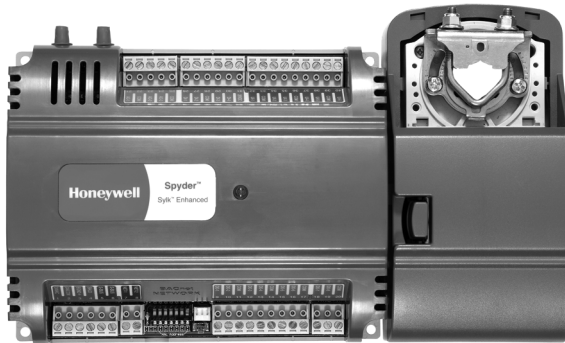


Building Technologies & Solutions
507 E. Michigan Street, Milwaukee, WI 53202

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Spyder® BACnet® Programmable Controllers

PRODUCT DATA



PRODUCT DESCRIPTION

The PUB and PVB controllers are part of the Spyder family. These controllers are BACnet MS/TP network devices designed to control HVAC equipment. These controllers provide many options and advanced system features that allow state-of-the-art commercial building control. Each controller is programmable and configurable through software.

The Spyder BACnet controllers require the Spyder BACnet Programmable Feature to be licensed in the WEBpro workbench tool and the WEBS AX JACE Controller for programming and downloading. The Spyder BACnet Models are also available as Individually Licensed Controllers (ILC). The ILC versions are identical in design and capability in every detail except for the licensing. The Individual Licensing of the Spyder ILCs (the License is built in) allows them to be programmed and downloaded with any brand of the Niagara Workbench or JACE controller. The Spyder ILCs are identified with a suffix on the Part Number of -ILC. Example: PUB6438S-ILC follows all the same Installation Instructions information as the PUB6438S.

These controllers are for use in VAV (Variable Air Volume), Unitary and advanced HVAC control applications. Each controller has flexible, universal inputs for external sensors, digital inputs, and a combination of analog and digital Triac outputs. All the models are described in Table 1. The photo to the left is the model PVB6436AS, which includes the actuator.

Table 1. Controller configurations.

Controller Model	Programmable Type	Universal Inputs (UI)	Digital Inputs (DI)	Analog Outputs (AO)	Digital Outputs (DO)	Velocity Pressure Sensor (Microbridge)	Series 60 Floating Actuator
PUB1012S	Unitary	1	0	1	2	NO	NO
PUB4024S	Unitary	4	0	2	4	NO	NO
PUB6438S	Unitary	6	4	3	8	NO	NO
PUB6438SR	Unitary	6	4	3	8 Relays	NO	NO
PVB0000AS	VAV	0	0	0	0	YES	YES
PVB4022AS	VAV	4	0	2	2	YES	YES
PVB4024NS	VAV	4	0	2	4	YES	NO
PVB6436AS	VAV	6	4	3	6	YES	YES
PVB6438NS	VAV	6	4	3	8	YES	NO

Each controller communicates via an EIA-485 BACnet MS/TP communications network, capable of baud rates between 9.6 and 115.2 kbits/s.

Controllers are field-mountable to either a panel or a DIN rail.



SPECIFICATIONS

General Specifications

Rated Voltage: 20–30 Vac; 50/60 Hz

Power Consumption:

100 VA for controller and all connected loads (including the actuator on models PVL0000AS, PVL4022AS and PVL6436AS).

Controller Only Load: 5 VA maximum; models PUB1012S, PUB4024S, PUB6438S, PVB4024NS and PVB6438NS.

Controller and Actuator Load: 9 VA maximum; models PVL0000AS, PVL4022AS and PVL6436AS.

External Sensors Power Output: 20 Vdc $\pm 10\%$ @ 75 mA maximum.

VAV Operating & Storage Temperature Ambient Rating (models PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS):

Minimum 32 °F (0 °C); Maximum 122 °F (50 °C)

Unitary Operating & Storage Temperature Ambient Rating (models PUB1012S, PUB4024S and PUB6438S):

Minimum -40 °F (-40 °C); Maximum 150 °F (65.5 °C)

Relative Humidity: 5% to 95% non-condensing

LED: Provides status for normal operation, controller down-load process, alarms, manual mode, and error conditions

Velocity Pressure Sensor (models PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)

Operating Range: 0 to 1.5 in. H₂O (0 to 374 Pa)

Series 60 Floating Actuator (models PVB0000AS, PVB4022AS and PVB6436AS)

Rotation Stroke: 95° $\pm$ 3° for CW or CCW opening dampers

Torque Rating: 44 lb-in. (5 Nm)

Run Time for 90° rotation: 90 seconds at 60 Hz

Operating Temperature: -4 °F to 140 °F (-20 to 60 °C)

Real Time Clock

Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic daylight savings time adjustment to occur at 2:00 a.m. local time on configured start and stop dates

Power Failure Backup: 24 hours at 32°F to 100°F (0°C to 38°C), 22 hours at 100°F to 122°F (38°C to 50°C)

Accuracy: ± 1 minute per month at 77 °F (25 °C)

Digital Input (DI) Circuits

Voltage Rating: 0 to 30 Vdc open circuit

Input Type: Dry contact to detect open and closed circuit

Operating Range: Open circuit = False; Closed circuit = True

Resistance: Open circuit > 3,000 Ohms;

Closed circuit < 500 Ohms

Digital Triac Output (DO) Circuits

Voltage Rating: 20 to 30 Vac @ 50/60Hz

Current Rating: 25 mA to 500 mA continuous, and 800 mA (AC rms) for 60 milliseconds

Digital Relay Output (DO) Circuits (PUB6438SR)

Voltage Rating: 20 to 30 Vac @ 50/60Hz

Current Rating: 0 mA to 1 A continuous, 3.5 A inrush (AC RMS) for 100 milliseconds

Analog Output (AO) Circuits

Analog outputs can be individually configured for current or voltage.

ANALOG CURRENT OUTPUTS:

Current Output Range: 4.0 to 20.0 mA

Output Load Resistance: 550 Ohms maximum

ANALOG VOLTAGE OUTPUTS:

Voltage Output Range: 0.0 to 10.0 Vdc

Maximum Output Current: 10.0 mA

Analog outputs may be configured as digital outputs and operate as follows:

- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc, (22 mA)

Universal Input (UI) Circuits

See Table 2 for the UI circuit specifications.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number. If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Environmental and Combustion Controls Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386
3. <http://customer.honeywell.com> or <http://customer.honeywell.ca>

International Sales and Service Offices in all principal cities of the world. Manufacturing in Belgium, Canada, China, Czech Republic, Germany, Hungary, Italy, Mexico, Netherlands, United Kingdom, and United States.

Table 2. Universal input circuit specifications.

Input Type	Sensor Type	Operating Range
Room/Zone Discharge Air Outdoor Air Temperature	20K Ohm NTC	-40 to 199 °F (-40 to 93 °C)
Outdoor Air Temperature	C7031G ^a	-40 to 120 °F (-40 to 49 °C)
	C7041F ^a	-40 to 250 °F (-40 to 121 °C)
	PT1000 (IEC751 3850)	-40 to 199 °F (-40 to 93 °C)
TR23 Setpoint Potentiometer	500 Ohm to 10,500 Ohm	-4° DDC to +4° DDC (-8° DDF to +7° DDF) or 50 F to 90 F (10 C to 32 C)
Resistive Input	Generic	100 Ohms to 100K Ohms
Voltage Input	Transducer, Controller	0–10 Vdc
Discrete Input	Dry Contact closure	Open Circuit > 3000 Ohms Closed Circuit < 3000 Ohms
Pulse Input ^b	Counter/Meter	Max. frequency: 15 Hz Min. pulse width: 20 ms

^a C7031G and C7041F are recommended for use with these controllers, due to improved resolution and accuracy when compared to the PT1000.

^b One Universal Input (UI-1*) on the PUB1012S, PUB4042S, PVB4022AS, and PVB4042NS is user selectable as a fast digital pulse meter.

BEFORE INSTALLATION

The controller is available in three models (see Table 1).

Review the power, input, and output specifications on page 2 before installing the controller.

- Hardware driven by Triac outputs must have a minimum current draw, when energized, of 25 mA and a maximum current draw of 500 mA.
- Hardware driven by the analog current outputs must have a maximum resistance of 550 Ohms, resulting in a maximum voltage of 11 volts when driven at 20 mA.
If resistance exceeds 550 Ohms, voltages up to 18 Vdc are possible at the analog output terminal.



WARNING

Electrical Shock Hazard.

Can cause severe injury, death or property damage.

Disconnect power supply before beginning wiring or making wiring connections to prevent electrical shock or equipment damage.

INSTALLATION

The controller must be mounted in a position that allows clearance for wiring, servicing, removal, connection of the BACnet MS/TP Molex connector and access to the MS/TP MAC address DIP switches (see Fig. 15 on page 13).

The controller may be mounted in any orientation.

IMPORTANT

Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the controller, or in areas where escaping gas or other explosive vapors are present. Fig. 6–Fig. 7 on page 6 for mounting dimensions.

For the PVB6436AS model, the actuator is mounted first and then the controller is mounted. For the other models, go to “Mount Controller” on page 5 to begin the installation.

Mount Actuator onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

PVB0000AS, PVB4022AS and PVB6436AS controllers include the direct-coupled actuator with Declutch mechanism, which is shipped hard-wired to the controller.

The actuator mounts directly onto the VAV box damper shaft and has up to 44 lb-in. (5 Nm) torque, 90-degree stroke, and 90 second timing at 60 Hz. The actuator is suitable for mounting onto a 3/8 to 1/2 in. (10 to 13 mm) square or round VAV box damper shaft. The minimum VAV box damper shaft length is 1-9/16 in. (40 mm).

The two mechanical end-limit set screws control the amount of rotation from 12° to 95°. These set screws must be securely fastened in place. To ensure tight closing of the damper, the shaft adapter has a total rotation stroke of 95° (see Fig. 1).

NOTES:

1. The actuator is shipped with the mechanical end-limit set screws set to 95 degrees of rotation. Adjust the two set screws closer together to reduce the rotation travel. Each “hash mark” indicator on the bracket represents approximately 6.5° of rotation per side.
2. The Declutch button, when pressed, allows you to rotate the universal shaft adapter (see Fig. 1).

IMPORTANT

Determine the damper rotation and opening angle prior to installation. See Fig. 2 below and Fig. 3 on page 4 for examples.

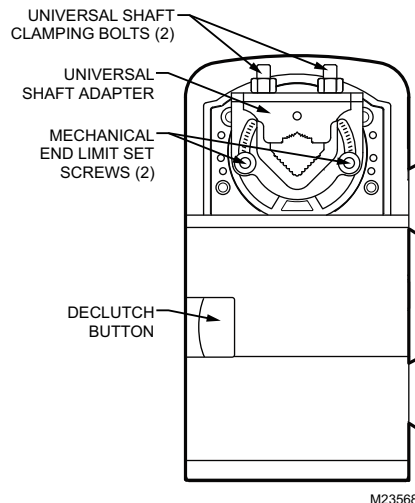


Fig. 1. Series 60 Floating Actuator.

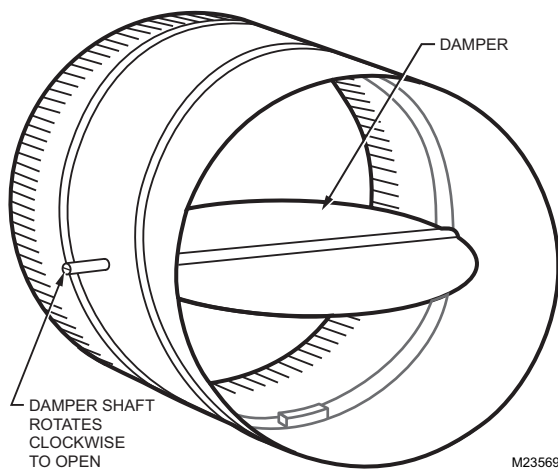


Fig. 2. Damper with 90 degree CW rotation to open.

IMPORTANT

Mount actuator flush with damper housing or add a spacer between the actuator mounting surface and damper box housing.

Before Mounting Actuator onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

Tools required:

- Phillips #2 screwdriver - end-limit set screw adjustment
- 8 mm wrench - centering clamp

Before mounting the actuator onto the VAV box damper shaft, determine the following:

1. Determine the damper shaft diameter. It must be between 3/8 in. to 1/2 in. (10 to 13 mm).
2. Determine the length of the damper shaft. If the length of the VAV box damper shaft is less than 1-9/16 in. (40 mm), the actuator cannot be used.

3. Determine the direction the damper shaft rotates to open the damper (CW or CCW) (see Fig. 3). Typically, there is an etched line on the end of the damper shaft that indicates the position of the damper. In Fig. 2, the indicator shows the damper open in a CW direction.
4. Determine the damper full opening angle (45, 60, or 90 degrees). In Fig. 2, the damper is open to its full open position of 90 degrees.

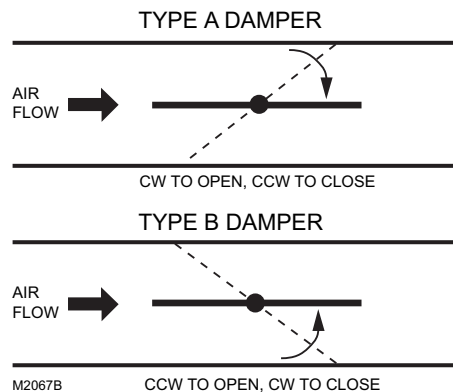


Fig. 3. Determining the rotation direction (CW or CCW) for damper opening.

Mounting Actuator onto Damper Shaft (PVB0000AS, PVB4022AS and PVB6436AS)

The unit is shipped with the actuator set to rotate open in the clockwise (CW) direction to a full 95 degrees. The extra 5 degrees ensures a full opening range for a 90 degree damper. The installation procedure varies depending on the damper opening direction and angle:

1. If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 90 degrees:
 - a. Manually open the damper fully (rotate clockwise).
 - b. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
 - c. Mount the actuator to the VAV damper box and shaft.
 - d. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque). When the actuator closes, the damper rotates CCW 90 degrees to fully close.
2. If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 45 or 60 degrees:
 - a. Manually open the damper fully (rotate clockwise).
 - b. The actuator is shipped with the mechanical end-limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
 - c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; 26.5–31 lb-in. [3.0–3.5 Nm] torque).
 - d. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
 - e. Mount the actuator to the VAV damper box and shaft.
 - f. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque).
 - g. When the actuator closes, the damper rotates CCW either 45 or 60 degrees to fully close.
3. If the damper rotates counterclockwise (CCW) to open, and the angle of the damper open-to-closed is 90 degrees:
 - a. Manually open the damper fully (rotate counterclockwise).
 - b. Using the Declutch button, rotate the universal shaft adapter fully counterclockwise.

- c. Mount the actuator to the damper box and shaft.
- d. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque). When the actuator closes, the damper rotates CW 90 degrees to fully close.
4. If the damper rotates counterclockwise to open, and the angle of the damper open-to-closed is 45 or 60 degrees:
 - a. Manually open the damper fully (rotate counterclockwise).
 - b. The actuator is shipped with the mechanical end-limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
 - c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; (26.5–31 lb-in. [3.0–3.5 Nm] torque).
 - d. Using the Declutch button, rotate the universal shaft adapter fully counter-clockwise.
 - e. Mount the actuator to the VAV damper box and shaft.
 - f. Tighten the two bolts on the centering clamp (8 mm wrench; 70.8–88.5 lb-in. [8–10 Nm] torque).
 - g. When the actuator closes, the damper rotates CW either 45 or 60 degrees to fully close.

IMPORTANT

Special precautions must be taken for dampers that open in a CCW direction. The actuator is shipped with its rotation direction set to CW to Open, which applies to the damper direction in steps 1 and 2 above. If the damper shaft rotates in the CCW direction to open, the controller software must be programmed to change the rotation to “Reverse to Open,” which applies to the damper direction in steps 3 and 4 above.

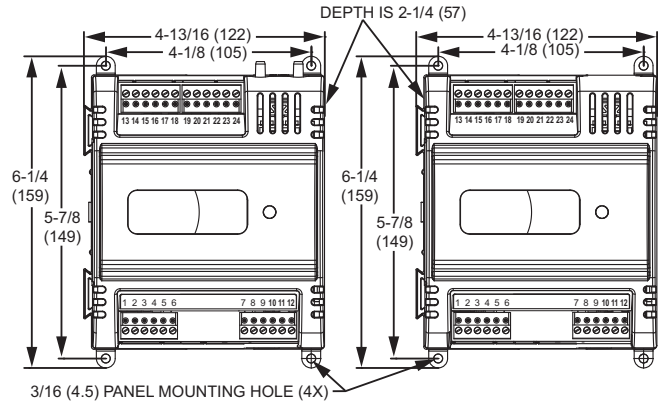
IMPORTANT

It is advisable to leave the dampers in an open position after installation to avoid the possibility of over-pressurizing the duct work on fan startup. Use the Declutch button (see Fig. 1 on page 4) to open the box damper on controllers that are powered down, to prevent over-pressurization in the duct work on fan startup. To Declutch, press and hold the button to disengage the motor. Turn the damper shaft until the damper is open and release the button. When power is restored to the controller, the controller synchronizes the damper actuator, so that the damper is in the correct position upon startup.

Mount Controller

NOTE: The controller may be wired before mounting to a panel or DIN rail.

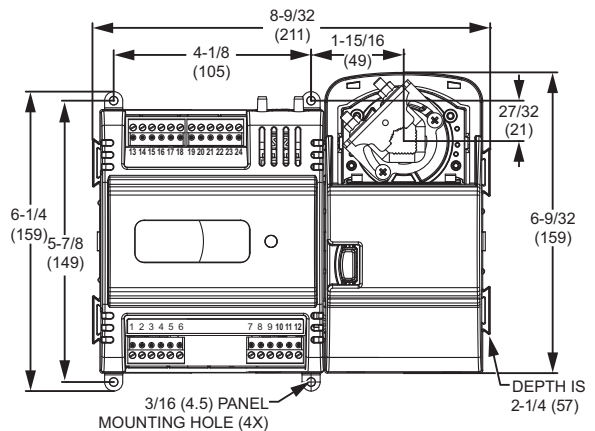
Terminal blocks are used to make all wiring connections to the controller. Attach all wiring to the appropriate terminal blocks (see “Wiring” on page 9).



NOTE: CONTROLLER CAN BE MOUNTED IN ANY ORIENTATION.

M31531

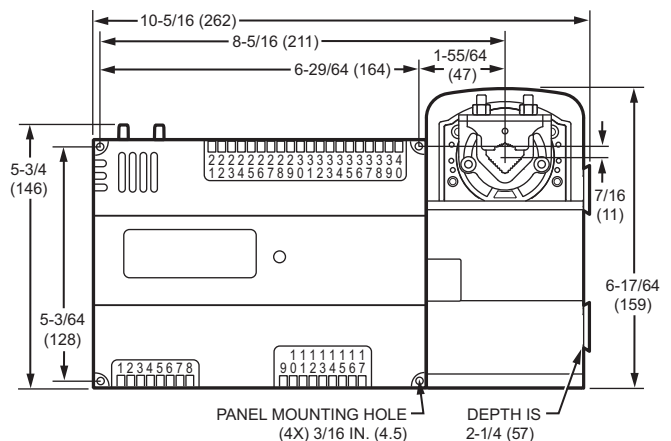
Fig. 4. Panel mounting - controller dimensions in inches (mm) for PUB1012S, PUB4024S and PVB4024NS only (PUB4024S and PVB4024NS shown).



NOTE: CONTROLLER CAN BE MOUNTED IN ANY ORIENTATION.

M31532

Fig. 5. Panel mounting - controller and actuator dimensions in inches (mm) for PVB0000AS and PVB4022AS only (PVB4022AS shown).



NOTE: CONTROLLER CAN BE MOUNTED IN ANY ORIENTATION.

M29329

Fig. 6. Panel mounting - controller and actuator dimensions in inches (mm) for PVB6436AS.

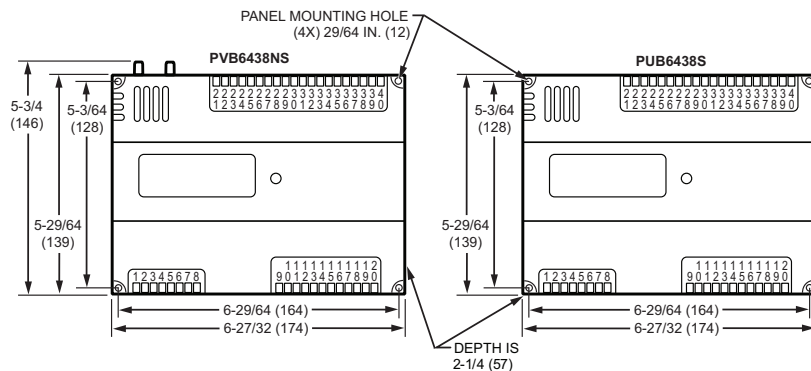


Fig. 7. Panel mounting - controller dimensions in inches (mm) for models PUB6438S, PVB6438NS and PUB6438SR.

Panel Mounting

The controller enclosure is constructed of a plastic base plate and a plastic factory-snap-on cover.

NOTE: The controller is designed so that the cover does not need to be removed from the base plate for either mounting or wiring.

The controller mounts using four screws inserted through the corners of the base plate. Fasten securely with four No. 6 or No. 8 machine or sheet metal screws.

The controller can be mounted in any orientation. Ventilation openings are designed into the cover to allow proper heat dissipation, regardless of the mounting orientation.

DIN Rail Mounting (PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS)

To mount the PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS controllers on a DIN rail [standard EN50022; 1-3/8 in. x 9/32 in. (7.5 mm x 35 mm)], refer to Fig. 8 and perform the following steps:

1. Holding the controller with its top tilted in towards the DIN rail, hook the two top tabs on the back of the controller onto the top of the DIN rail.
2. Push down and in to snap the two bottom flex connectors of the controller onto the DIN rail.

IMPORTANT

To remove the controller from the DIN rail, perform the following:

1. Push straight up from the bottom to release the top tabs.
2. Rotate the top of the controller out towards you and pull the controller down and away from the DIN rail to release the bottom flex connectors.

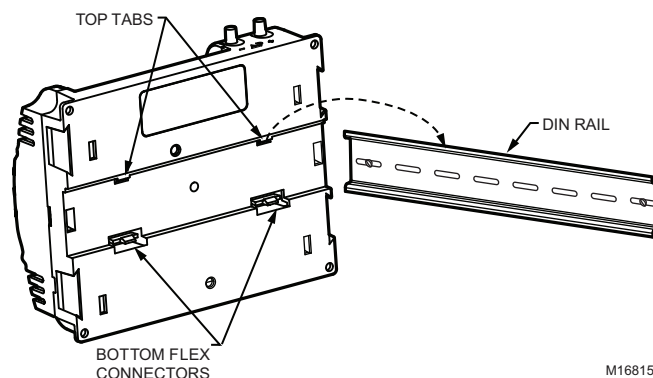


Fig. 8. Controller DIN rail mounting (models PUB1012S, PUB4024S, PUB6438S, PUB6438SR, PVB4024NS and PVB6438NS).

Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)

Air flow Pickup

For PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS, connect the air flow pickup to the two restrictor ports on the controller (see Fig. 9).

NOTES:

- Use 1/4 inch (6 mm) outside diameter, with a 0.040 in. (1 mm) wall thickness, plenum-rated 1219 FR (94V-2) tubing.
- Always use a fresh cut on the end of the tubing that connects to the air flow pickups and the restrictor ports on the controller.

Connect the high pressure or upstream tube to the plastic restrictor port labeled (+), and the low pressure or downstream tube to the restrictor port labeled (-). See labeling in Fig. 9. When twin tubing is used from the pickup, split the pickup tubing a short length to accommodate the connections.

NOTES:

- If controllers are mounted in unusually dusty or dirty environments, an inline, 5-micron disposable air filter (use 5-micron filters compatible with

pneumatic controls) is recommended for the high pressure line (marked as +) connected to the air flow pickup.

- The tubing from the air flow pickup to the controller should not exceed three feet (0.914 m). Any length greater than this will degrade the flow sensing accuracy.
- Use caution when removing tubing from a connector. Always pull straight away from the connector or use diagonal cutters to cut the edge of the tubing attached to the connector. Never remove by pulling at an angle.

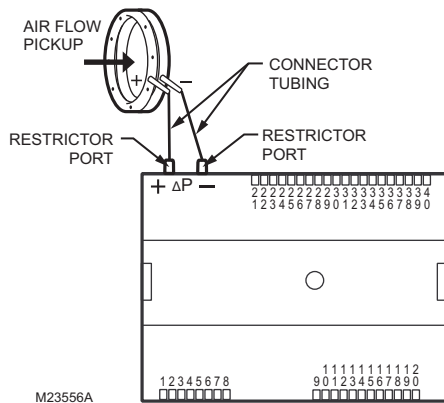


Fig. 9. Air flow pickup connections (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS).

Power

Before wiring the controller, determine the input and output device requirements for each controller used in the system. Select input and output devices compatible with the controller and the application. Consider the operating range, wiring requirements, and the environment conditions when selecting input/output devices. When selecting actuators for modulating applications consider using floating control. In direct digital control applications, floating actuators will generally provide control action equal to or better than an analog input actuator for lower cost.

Determine the location of controllers, sensors, actuators and other input/output devices and create wiring diagrams. Refer to Fig. 17–Fig. 23 beginning on page 15 for illustrations of typical controller wiring for various configurations.

The application engineer must review the control job requirements. This includes the sequences of operation for the controller, and for the system as a whole. Usually, there are variables that must be passed between the controller and other Spyder BACnet controller(s) that are required for optimum system wide operation. Typical examples are the TOD, Occ/Unocc signal, the outdoor air temperature, the demand limit control signal, and the smoke control mode signal.

It is important to understand these interrelationships early in the job engineering process, to ensure proper implementation when configuring the controllers. Refer to the controller Application Guides.

Power Budget

A power budget must be calculated for each device to determine the required transformer size for proper operation. A power budget is simply the summing of the maximum power

draw ratings (in VA) of all the devices to be controlled. This includes the controller itself and any devices powered from the controller, such as equipment actuators (ML6161 or other motors) and various contactors and transducers.

IMPORTANT

- When multiple controllers operate from a single transformer, connect the same side of the transformer secondary to the same power input terminal in each device. The earth ground terminal (terminal 3) must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10).
- Half-wave devices and full-wave devices must not use the same AC transformer. If a Spyder controller will share its power supply with another device, make sure the other device utilizes a half-wave rectifier and that the polarity of the wiring is maintained.

POWER BUDGET CALCULATION EXAMPLE

Table 3 is an example of a power budget calculation for a typical PVB6436AS controller. While the example is shown for only this model, the process is applicable for all controller models.

Table 3. Power budget calculation example.

Device	VA Information	Obtained From
PVB6436AS controllers (include Series 60 Floating Damper Actuator)	9.0	See “Specifications” on page 2.
R8242A Contactor fan rating	21.0	TRADELINE® Catalog inrush rating
D/X Stages	0.0	For example, assume cooling stage outputs are wired into a compressor control circuit and have no impact on the budget.
M6410A Steam Heating Coil Valve	0.7	TRADELINE® Catalog, 0.32A 24 Vac
TOTAL	30.7	

The system example above requires 30.7 VA of peak power. Therefore, a 100 VA AT92A transformer could be used to power one controller of this type. Because the total peak power is less than 33 VA, this same transformer could be used to power three of these controllers and meet NEC Class 2 restrictions (no greater than 100 VA).

See Fig. 11–Fig. 12 beginning on page 9 for illustrations of controller power wiring. See Table 4 for VA ratings of various devices.

Table 4. VA ratings for transformer sizing.

Device	Description	VA
PVB6436AS controllers and Series 60 Floating Damper Actuator	Controller and Actuator	9.0
PUB6438S or PVB6438NS	Controller	5.0
ML684	Versadrive Valve Actuator	12.0
ML6161	Damper Actuator, 35 lb-in.	2.2

Device	Description	VA
ML6185	Damper Actuator SR 50 lb-in	12.0
ML6464	Damper Actuator, 66 lb-in.	3.0
ML6474	Damper Actuator, 132 lb-in.	3.0
R6410A	Valve Actuator	0.7
R8242A	Contactor	21.0

For contactors and similar devices, the in-rush power ratings should be used as the worst case values when performing power budget calculations. Also, the application engineer must consider the possible combinations of simultaneously energized outputs and calculate the VA ratings accordingly. The worst case, which uses the largest possible VA load, should be determined when sizing the transformer.

Each controller requires 24 Vac power from an energy-limited Class II power source. To conform to Class II restrictions (U.S. only), transformers must not be larger than 100 VA. A single transformer can power more than one controller.

GUIDELINES FOR POWER WIRING ARE AS FOLLOWS:

- For multiple controllers operating from a single transformer, the same side of the transformer secondary must be connected to the same power input terminal in each device. The earth ground terminal must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10). Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only).
- See Fig. 11 on page 9 for controller power wiring used in UL 1995 equipment (U.S. only).
- Many controllers require all loads to be powered by the same transformer that powers the controller.
- Keep the earth ground connection wire run as short as possible (refer to Fig. 11–Fig. 12 beginning on page 9).
- Do not connect earth ground to the controller's digital or analog ground terminals (refer to Fig. 11 and Fig. 12).
- Unswitched 24 Vac power wiring can be run in the same conduit as the LONWORKS® Bus cable.

Line-Loss

Controllers must receive a minimum supply voltage of 20 Vac. If long power or output wire runs are required, a voltage drop due to Ohms Law ($I \times R$) line-loss must be considered. This line-loss can result in a significant increase in total power required and thereby affect transformer sizing. The following example is an $I \times R$ line-loss calculation for a 200 ft. (61m) run from the transformer to a controller drawing 37 VA and using two 18 AWG (1.0 sq mm) wires.

The formula is:

$$\text{Loss} = [\text{length of round-trip wire run (ft.)}] \times [\text{resistance in wire (ohms per ft.)}] \times [\text{current in wire (amperes)}]$$

From specification data:

18 AWG twisted pair wire has a resistance of 6.52 ohms per 1000 feet.

$$\text{Loss} = [(400 \text{ ft.}) \times (6.52/1000 \text{ ohms per ft.})] \times [(37 \text{ VA})/(24\text{V})] = 4.02 \text{ volts}$$

This means that four volts are going to be lost between the transformer and the controller. To assure the controller receives at least 20 volts, the transformer must output more than 24 volts. Because all transformer output voltage levels depend on the size of the connected load, a larger transformer outputs a higher voltage than a smaller one for a given load. Fig. 10 shows this voltage load dependence.

In the preceding $I \times R$ loss example, even though the controller load is only 37 VA, a standard 40 VA transformer is not sufficient due to the line-loss. Looking at Fig. 10, a 40 VA transformer is just under 100 percent loaded (for the 37 VA controller) and has a secondary voltage of 22.9 volts. (Use the lower edge of the shaded zone in Fig. 10 that represents the worst case conditions.) When the $I \times R$ loss of four volts is subtracted, only 18.9 volts reaches the controller. This is not enough voltage for proper operation.

In this situation, the engineer has three alternatives:

1. Use a larger transformer. For example, if an 80 VA model is used, an output of 24.4 volts, minus the four volt line-loss, supplies 20.4V to the controller (see Fig. 10). Although acceptable, the four-volt line-loss in this example is higher than recommended.

IMPORTANT

No installation should be designed where the line-loss is greater than two volts. This allows for nominal operation if the primary voltage drops to 102 Vac (120 Vac minus 15 percent).

2. Use heavier gauge wire for the power run. 14 AWG (2.0 sq mm) wire has a resistance of 2.57 ohms per 1,000 ft. Using the preceding formula results in a line-loss of only 1.58 volts (compared with 4.02 volts). This would allow a 40 VA transformer to be used. 14 AWG (2.0 sq mm) wire is the recommended wire size for 24 Vac wiring.
3. Locate the transformer closer to the controller. This reduces the length of the wire run, and the line-loss.

The issue of line-loss is also important in the case of the output wiring connected to the Triac digital outputs. The same formula and method are used. Keep all power and output wire runs as short as practical. When necessary, use heavier gauge wire, a bigger transformer, or install the transformer closer to the controller.

To meet the National Electrical Manufacturers Association (NEMA) standards, a transformer must stay within the NEMA limits. The chart in Fig. 10 shows the required limits at various loads.

With 100 percent load, the transformer secondary must supply between 23 and 25 volts to meet the NEMA standard. When a purchased transformer meets the NEMA standard DC20-1986, the transformer voltage regulating ability can be considered reliable. Compliance with the NEMA standard is voluntary.

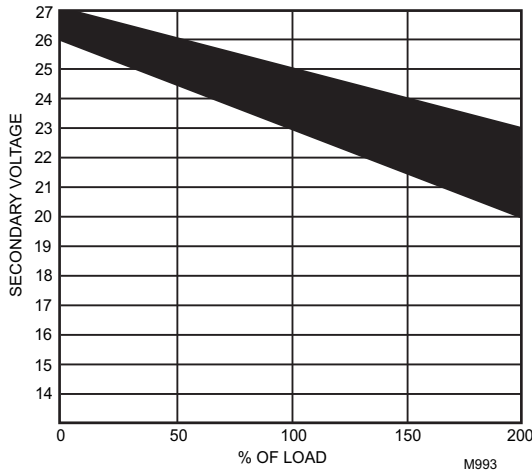


Fig. 10. NEMA Class 2 transformer voltage output limits.

The Honeywell transformers listed in Table 5 meet the NEMA standard DC20-1986.

Table 5. Honeywell transformers that meet NEMA standard DC20-1986.

Transformer Type	VA Rating
AT40A	40
AT72D	40
AT87A	50
AK3310 Assembly	100

NOTE: The AT88A and AT92A transformers do not meet the voluntary NEMA standard DC20-1986.

Wiring

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located on the top and the bottom of the device.



WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning wiring or making wiring connections, to prevent electrical shock or equipment damage.

NOTES:

- For multiple controllers operating from a single transformer, the same side of the transformer secondary must be connected to the same power input terminal in each controller. Controller configurations will not necessarily be limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only). For power and wiring recommendations, See "Power" on page 7. The earth ground terminal (terminal 3) must be connected to a verified earth ground for each controller in the group (see Fig. 12 on page 10).

- All loads on the controller must be powered by the same transformer that powers the controller itself. A controller can use separate transformers for controller power and output power.
- Keep the earth ground connection (terminal 3) wire run as short as possible.
- Do not connect the universal input COM terminals, analog output COM terminals or the digital input/output COM terminals to earth ground. Refer to Fig. 16–Fig. 21 beginning on page 14 for wiring examples.

The 24 Vac power from an energy limited Class II power source must be provided to the controller. To conform to Class II restrictions (U.S. only), the transformer must not be larger than 100 VA.

Fig. 11 depicts a single controller using one transformer.

IMPORTANT

Power must be off prior to connecting to or removing connections from the 24 Vac power (24 Vac/24 Vac COM), earth ground (EGND), and 20 Vdc power (20 Vdc) terminals.

IMPORTANT

Use the heaviest gauge wire available, up to 14 AWG (2.0 sq mm), with a minimum of 18 AWG (1.0 sq mm), for all power and earth ground wiring.

Screw-type terminal blocks are designed to accept up to one 14 AWG (2.0 sq mm) conductor or up to two 18 AWG (1.0 sq mm) conductors. More than two wires that are 18 AWG (2.0 sq mm) can be connected with a wire nut. Include a pigtail with this wire group and attach the pigtail to the terminal block.

IMPORTANT

Connect terminal 2, (the 24 Vac common [24 VAC COM] terminal) to earth ground (see Fig. 11).

NOTE: Unswitched 24 Vac power wiring can be run in the same conduit as the LONWORKS® cable.

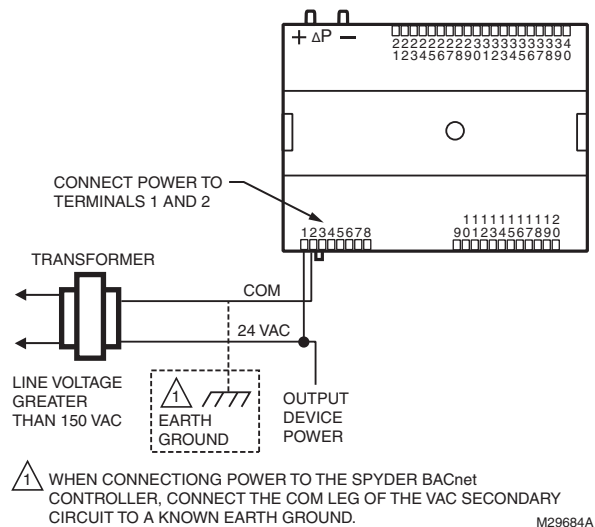


Fig. 11. Power wiring details for one controller per transformer.

More than one controller can be powered by a single transformer. Fig. 12 shows power wiring details for multiple controllers.

NOTE: Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only). For power wiring recommendations, see “Power” on page 7.

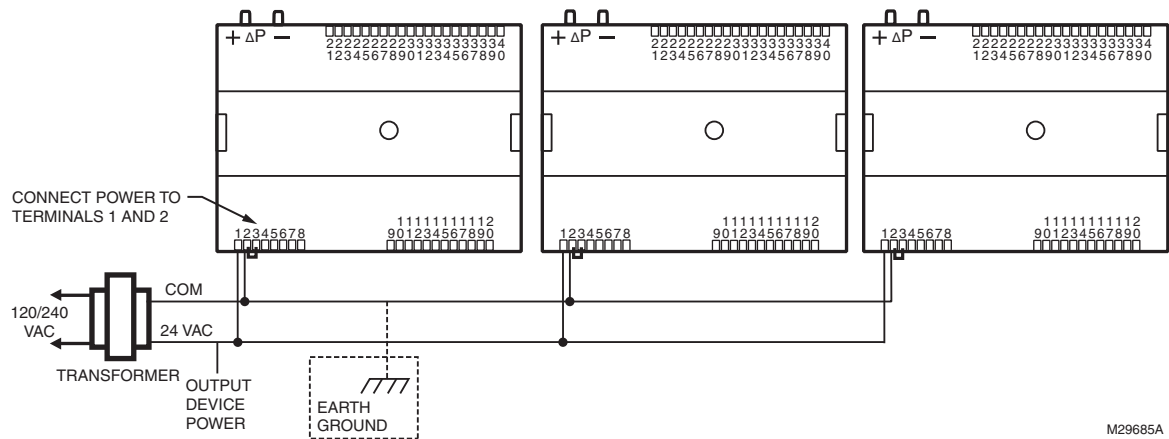


Fig. 12. Power wiring details for two or more controllers per transformer.

Communications

Each controller uses a BACnet MS/TP communications port. The controller’s data is presented to other controllers over a twisted-pair MS/TP network, which uses the EIA-485 signaling standard capable of the following baud rates: 9.6, 19.2, 38.4, 76.8 or 115.2 kilobits per second (configured at global controller). The Spyder BACnet controllers are master devices on the MS/TP network. Each Spyder BACnet controller uses a high-quality EIA-485 transceiver and exerts 1/4 unit load on the MS/TP network.

Cabling should be selected that meets or exceeds the BACnet Standard which specifies the following: An MS/TP EIA-485 network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 130 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot). Distributed capacitance between conductors and shield shall be less than 200 pF per meter (60 pF per foot). Foil or braided shields are acceptable. The Honeywell tested and recommended MS/TP cable is Honeywell Cable 3322 (18 AWG, 1-Pair, Shielded, Plenum cable), alternatively Honeywell Cable 3251 (22 AWG, 1-Pair, Shielded, Plenum cable) is available and meets the BACnet Standard requirements (www.honeywellcable.com).

The maximum BACnet MS/TP network Bus segment length is 4,000 ft. (1,219 m) using recommended wire. Repeaters must be used when making runs longer than 4,000 ft. (1,219 m). A maximum of three repeaters can be used between any two devices.

Setting the MS/TP MAC address

The MS/TP MAC address for each device must be set to a unique value in the range of 0-127 on an MS/TP network segment (address 0, 1, 2, & 3 should be avoided as they are commonly used for the router, diagnostic tools, and as spare addresses). DIP switches on the Spyder BACnet controller are used to set the controller’s MAC address.

To set the MS/TP MAC address of a Spyder BACnet controller:

- 1. Find an unused MAC address on the MS/TP network to which the Spyder BACnet controller connects.
- 2. Locate the DIP switch bank on the Spyder BACnet for addressing. This is labeled MAC Address
- 3. With the Spyder BACnet Controller powered down, set the DIP switches for the MAC Address you want. Add the value of DIP switches set to ON to determine the MAC address. See Table 6. Example, if only DIP switches 1, 3, 5, and 7 are enabled the MAC address would be 85 (1 + 4 + 16 + 64 = 85).

NOTE: See Fig. 15 on page 13 for DIP switch orientation and arrangement.

Table 6. DIP Switch Values For MS/TP MAC Address.

DIP	7	6	5	4	3	2	1
VALUE	64	32	16	8	4	2	1

Setting the Device Instance Number

The Device Instance Number must be unique across the entire BACnet system network because it is used to uniquely identify the BACnet devices. It may be used to conveniently identify the BACnet device from other devices during installation. The Spyder BACnet Controllers Device Instance Number is automatically set when it is added to a WEBStation-AX project. The Device Instance Number can be changed by the user, which may be necessary when integrating with a third party or when attempting to replace an existing controller and it is desired to maintain the existing Device Instance Number.

To edit the Device Instance Number using WEBs AX:

- 1. Identify an unused Device Instance Number on the BACnet Network, in the range of 0 - 4194302.
- 2. Open the Spyder Bacnet Device Mgr View
 - a. Double click on the BacnetNetwork located in the Nav tree.
 - b. Select the Spyder Controller to be modified.

- c. Click on the Edit button.
- d. Enter an unused value in the Device Id field.
- e. Select OK
3. Right Click on the Spyder Controller and select Actions > Write Device Instance to complete the update

Termination Resistors

Matched terminating resistors are required at each end of a segment bus wired across (+) and (-). Use matched precision resistors rated $1/4W \pm 1\% / 80 - 130 \text{ Ohms}$. Ideally, the value of the terminating resistors should match the rated characteristic impedance of the installed cable. For example, if the installed MS/TP cable has a listed characteristic impedance of 120 Ohm, install 120 Ohm matched precision resistors.

NOTE: The controller does not provide any network biasing.

Shield Terminating

Following proper MS/TP cabling shield grounding procedures is important to minimize the risk of communication problems and equipment damage caused by capacitive coupling. Capacitive coupling is caused by placing MS/TP cabling close to lines carrying higher voltage. The shield should be grounded on only one end of the MS/TP segment (typically the router end). Tie the shield through using the SHLD (terminal 4) on the Spyder BACnet Controller.

Sylk™ Bus

Sylk is a two wire, polarity insensitive bus that provides both 18 VDC power and communications between a Sylk-enabled sensor and a Sylk-enabled controller. Using Sylk-enabled sensors saves I/O on the controller and is faster and cheaper to install since only two wires are needed and the bus is polarity insensitive. Sylk sensors are configured using the latest release of the Spyder Tool for WEBPro and WEBStation.

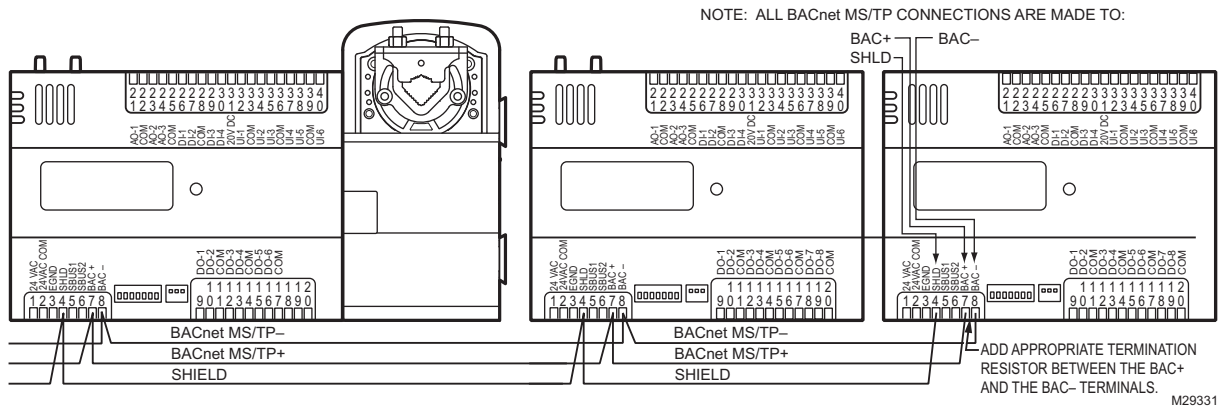


Fig. 13. Termination modules.

Wiring Method

! WARNING

Electrical Shock Hazard.

Can cause severe injury, death or property damage. Disconnect power supply before beginning wiring, or making wiring connections, to prevent electrical shock or equipment damage.

NOTE: When attaching two or more wires to the same terminal, other than 14 AWG (2.0 sq mm), be sure to twist them together. Deviation from this rule can result in improper electrical contact (see Fig. 14).

Each terminal can accommodate the following gauges of wire:

- Single wire: from 22 AWG to 14 AWG solid or stranded
- Multiple wires: up to two 18 AWG stranded, with 1/4 watt wire-wound resistor

Prepare wiring for the terminal blocks, as follows:

1. Strip 1/2 in. (13 mm) insulation from the conductor.
2. Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
3. If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them (see Fig. 14).
4. Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
5. Pull on each wire in all terminals to check for good mechanical connection.

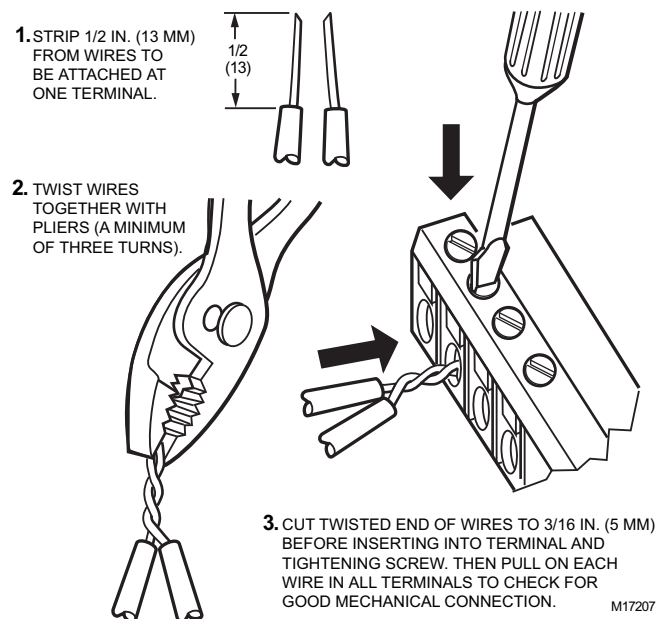


Fig. 14. Attaching two or more wires at terminal blocks.

Wiring Details

Each controller is shipped with the digital outputs, which switch the 24 Vac to the load (High Side).

The three analog outputs (AO) are used to control modulating heating, cooling and economizer equipment. Any AO may be used as a digital output, as follows:

- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc (22 mA)

The wiring connection terminals described in Table 7 are shown in Fig. 15 starting on page 13.

Table 7. Description of wiring terminal connections for PUB6438S, PUB6438SR, PVB6436AS, and PVB6438NS.

Terminal	Label	Connection
INPUT POWER & GROUND		
1	24 Vac	24 Vac Power
2	24 Vac COM	24 Vac Power
3	EGND	Earth Ground
4	SHLD	MS/TP Shield
5	SBUS 1	Sylk
6	SBUS 2	Sylk
NETWORK CONNECTIONS		
7	BAC +	LONWORKS® communications
8	BAC -	LONWORKS® communications
DIGITAL OUTPUTS ^a		
9	DO-1	Digital Output
10	DO-2	Digital Output
11	COM	Common
12	DO-3	Digital Output
13	DO-4	Digital Output
14	COM	Common
15	DO-5	Digital Output
16	DO-6	Digital Output
17	COM	Common
18	DO-7	Digital Output
19	DO-8	Digital Output
20	COM	Common
ANALOG OUTPUTS ^b		
21	AO-1	Analog Output
22	COM	Common
23	AO-2	Analog Output
24	AO-3	Analog Output
25	COM	Common
DIGITAL INPUTS ^c		
26	DI-1	Digital Input
27	DI-2	Digital Input
28	COM	Common
29	DI-3	Digital Input
30	DI-4	Digital Input
ATTACHED DEVICE(S) POWER		
31	20 Vdc	20 Vdc Power
UNIVERSAL INPUTS		
32	UI-1	Universal Input
33	COM	Common
34	UI-2	Universal Input
35	UI-3	Universal Input
36	COM	Common
37	UI-4	Universal Input
38	UI-5	Universal Input
39	COM	Common
40	UI-6	Universal Input

^a For the PVB6436AS controller ONLY, terminals 18, 19, and 20 (DO7, DO8, & COM) are not present. The actuator is internally hardwired to these terminals.

^b Analog outputs may be configured as digital outputs and operate as follows:

- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc (22 mA)

^c Digital inputs: Open circuit = False; Closed circuit = True

IMPORTANT

If the controller is not connected to a good earth ground, the controller's internal transient protection circuitry is compromised and the function of protecting the controller from noise and power line spikes cannot be fulfilled. This could result in a damaged circuit board and require replacement of the controller. Refer to installation diagrams for specific wiring.

All controllers have the terminal arrangements similar to the examples shown in Fig. 15 as described in Table 7 on page 12.

MS/TP MAC ADDRESS DIP SWITCHES

The MS/TP MAC address DIP switches are used to set the unit's MAC address. Each Spyder BACnet on an MS/TP network must have a unique MAC address in the range of 0-127 (address 0 should be avoided as it is the Honeywell factory default MAC address for all MS/TP devices).

MS/TP SERVICE CONNECTOR PINS

Local device MS/TP network connection is provided via the molex connector pins (0.100-in. molex connector—part number: 22-01-2035).

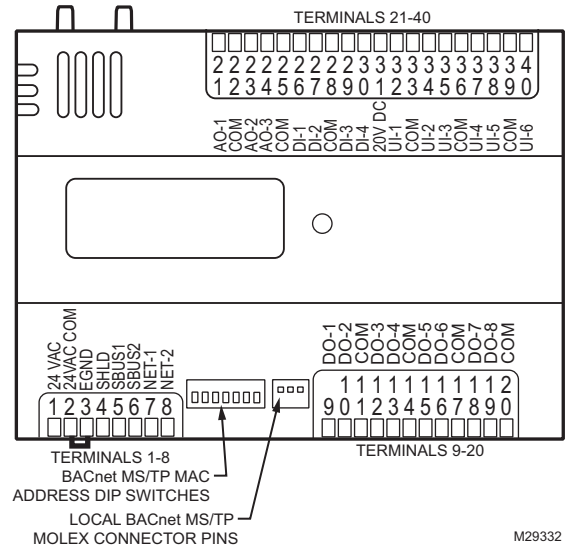
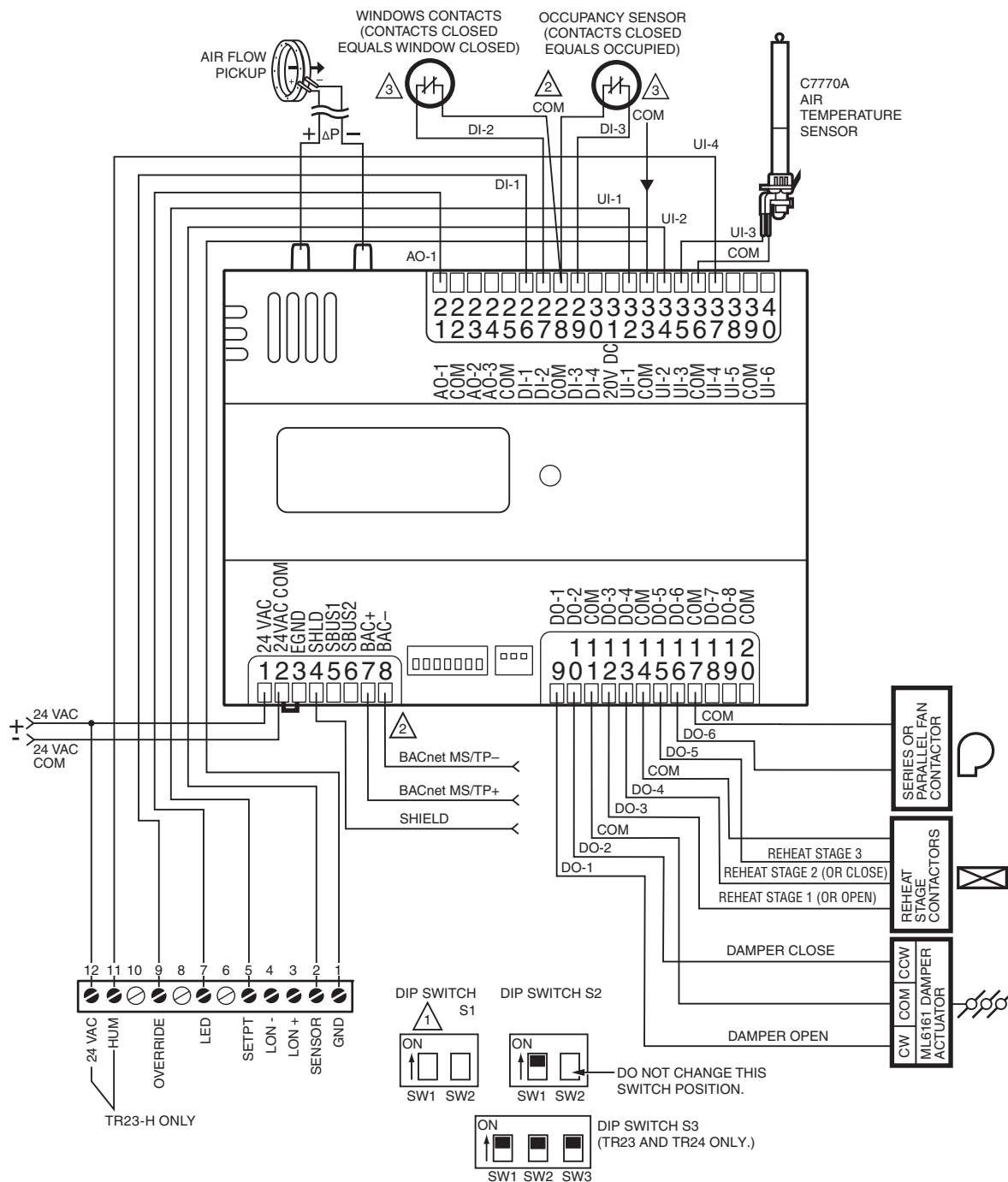


Fig. 15. Controller Terminal Connections, MS/TP MAC address DIP switches, MS/TP service connector pins, and BACnet Status LED for the PUB's and PVB's (PVB6438NS shown).

Wiring Applications (Examples)

Fig. 16–Fig. 22, beginning on page 14, illustrate controller wiring for the following configurations.

- Typical controller wiring for VAV application using the TR23 Wall Module and a C7770A Air Temperature Sensor (see Fig. 16 on page 14).
- Typical controller wiring for VAV application with staged reheat (see Fig. 17 on page 15).
- Typical controller wiring for PWM reheat and PWM peripheral heat valve actuator (see Fig. 18 on page 16).
- Typical controller wiring for AHU application (see Fig. 19 on page 17).
- Typical controller wiring for 4 to 20 mA enthalpy sensors and digital inputs (see Fig. 20 on page 18).
- Typical controller wiring for 4 to 20 mA heating, cooling, and model ML6161 floating motor control (see Fig. 21 on page 19).
- Typical controller wiring for a pneumatic transducer, model RP7517B (see Fig. 22 on page 20).



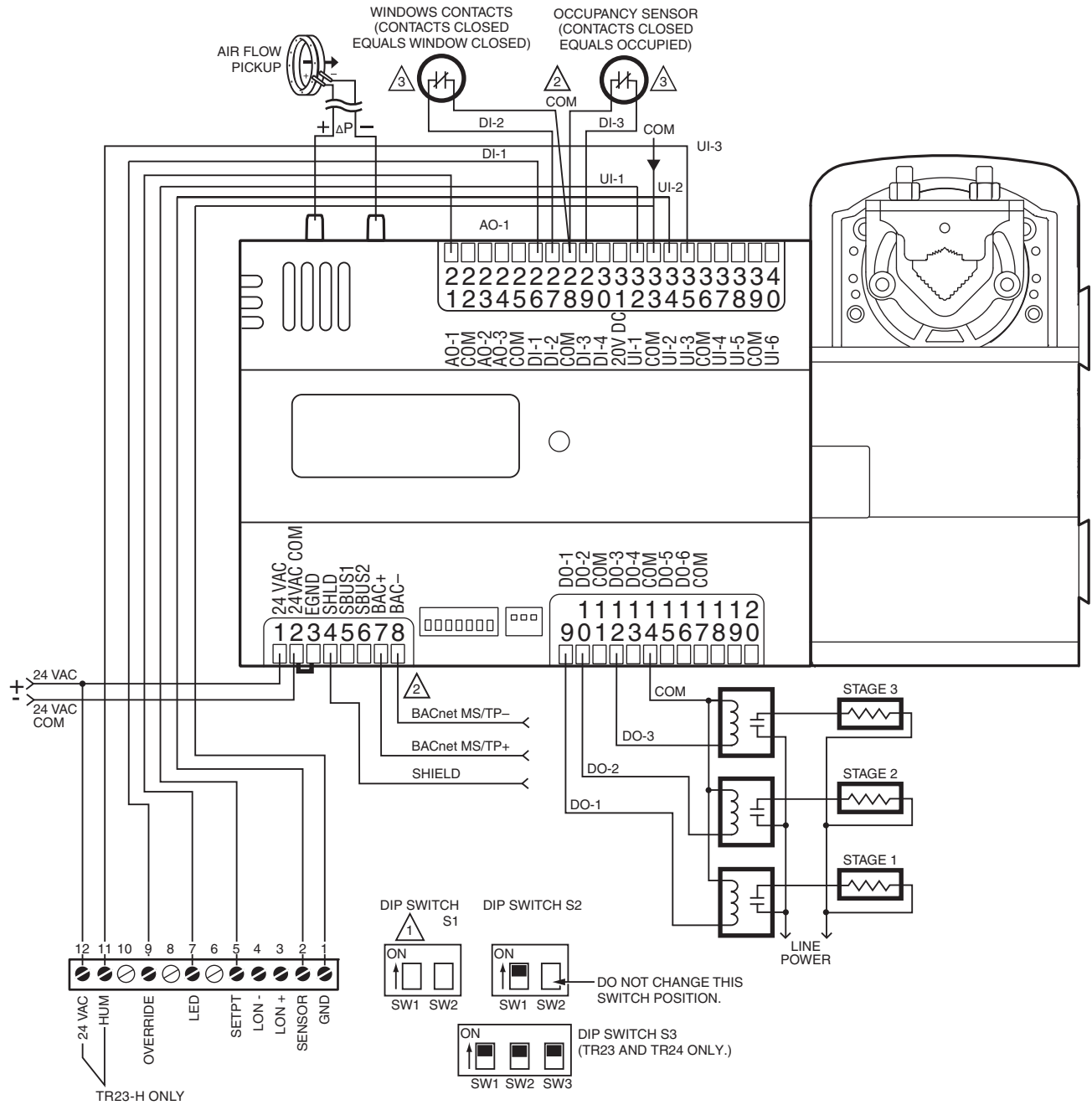
1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.

2 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.

3 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

M31 169C

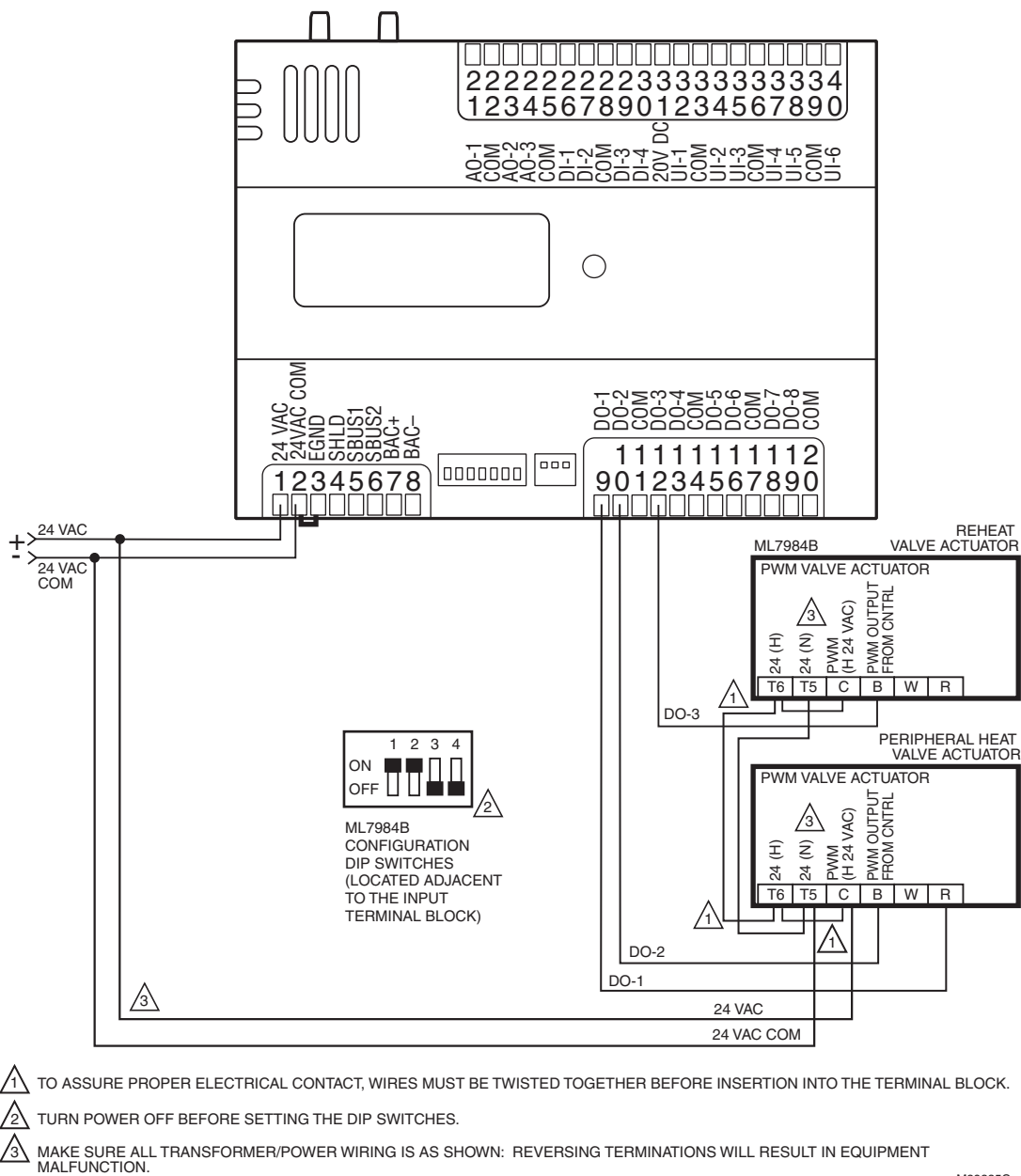
Fig. 16. Controller wiring diagram (model PVB6438NS shown) for typical VAV application, using the TR23 wall module and a C7770A air temperature sensor. (For note 2, refer to Fig. 14.)



- 1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.
- 2 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.
- 3 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

M31172C

Fig. 17. Controller wiring diagram (model PVB6436AS shown) for typical VAV application with staged reheat. (For note 2, refer to Fig. 14.)

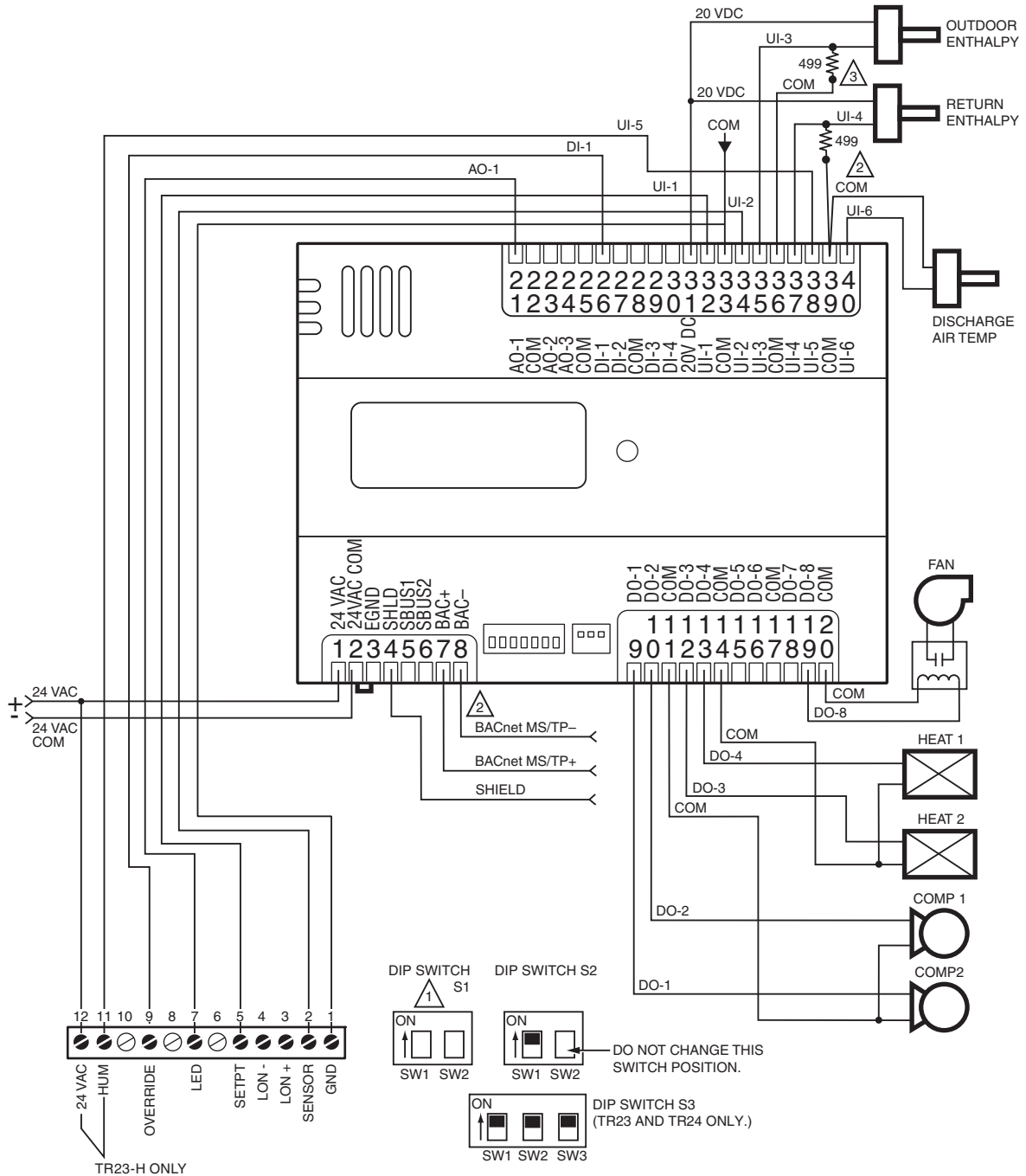


M29335C

Fig. 18. Controller wiring diagram (model PUB6438S shown) for typical PWM reheat and PWM peripheral heat valve actuator. (For note 2, refer to Fig. 14.)

NOTE: Make sure to set the Configuration DIP Switch as shown in Fig. 18. Switches 1 through 3 set the timing of the ML7984B valve actuator to match the controller outputs (0.1 second minimum with a

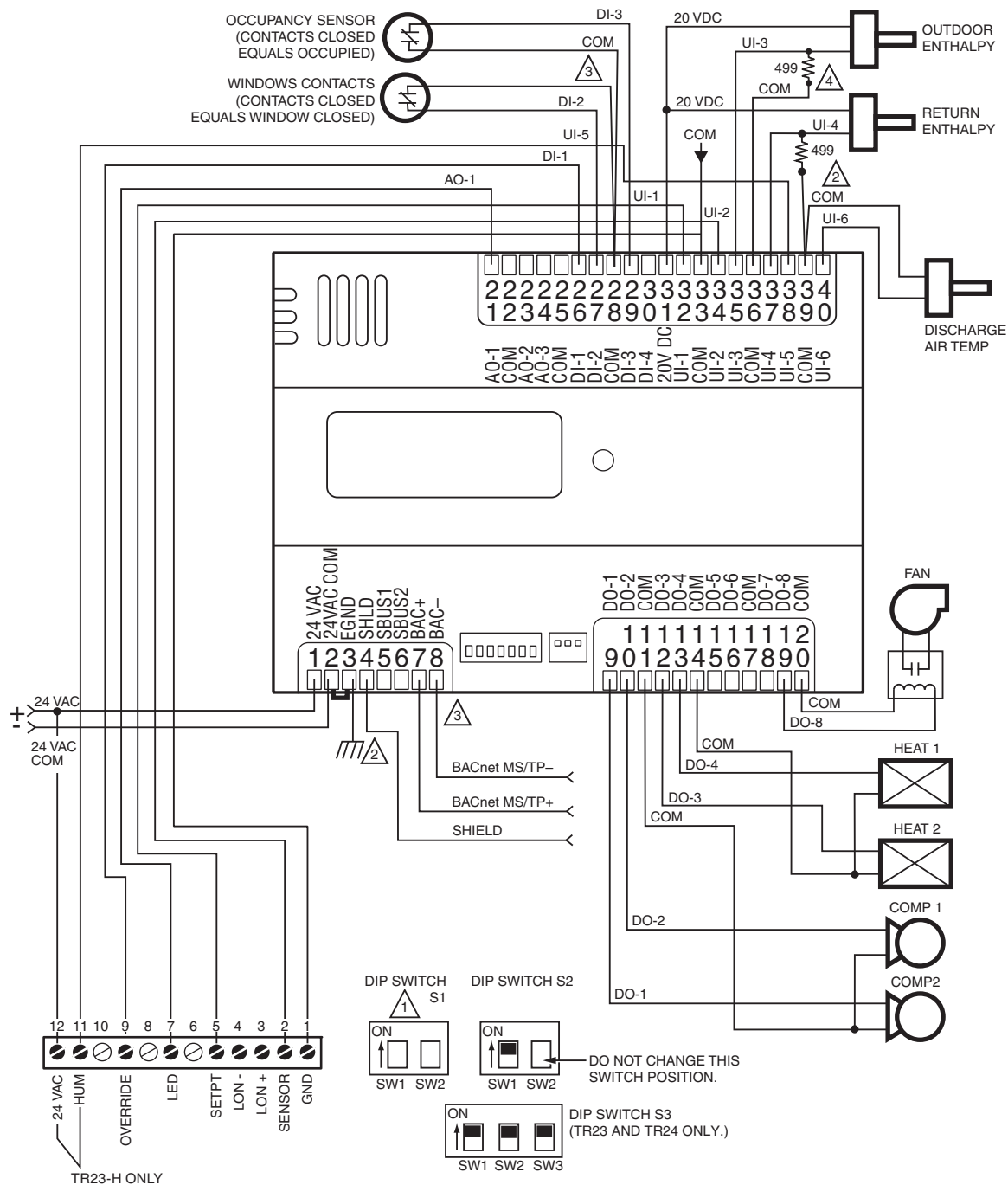
maximum time of 25.6 seconds). Switch 4 determines the action of the actuator (Off = Direct Acting, On = Reverse Acting).



- 1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.
- 2 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.
- 3 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

M31176B

**Fig. 19. Controller wiring diagram (model PUB6438S shown) for typical AHU application.
(For note 2, refer to Fig. 14.)**



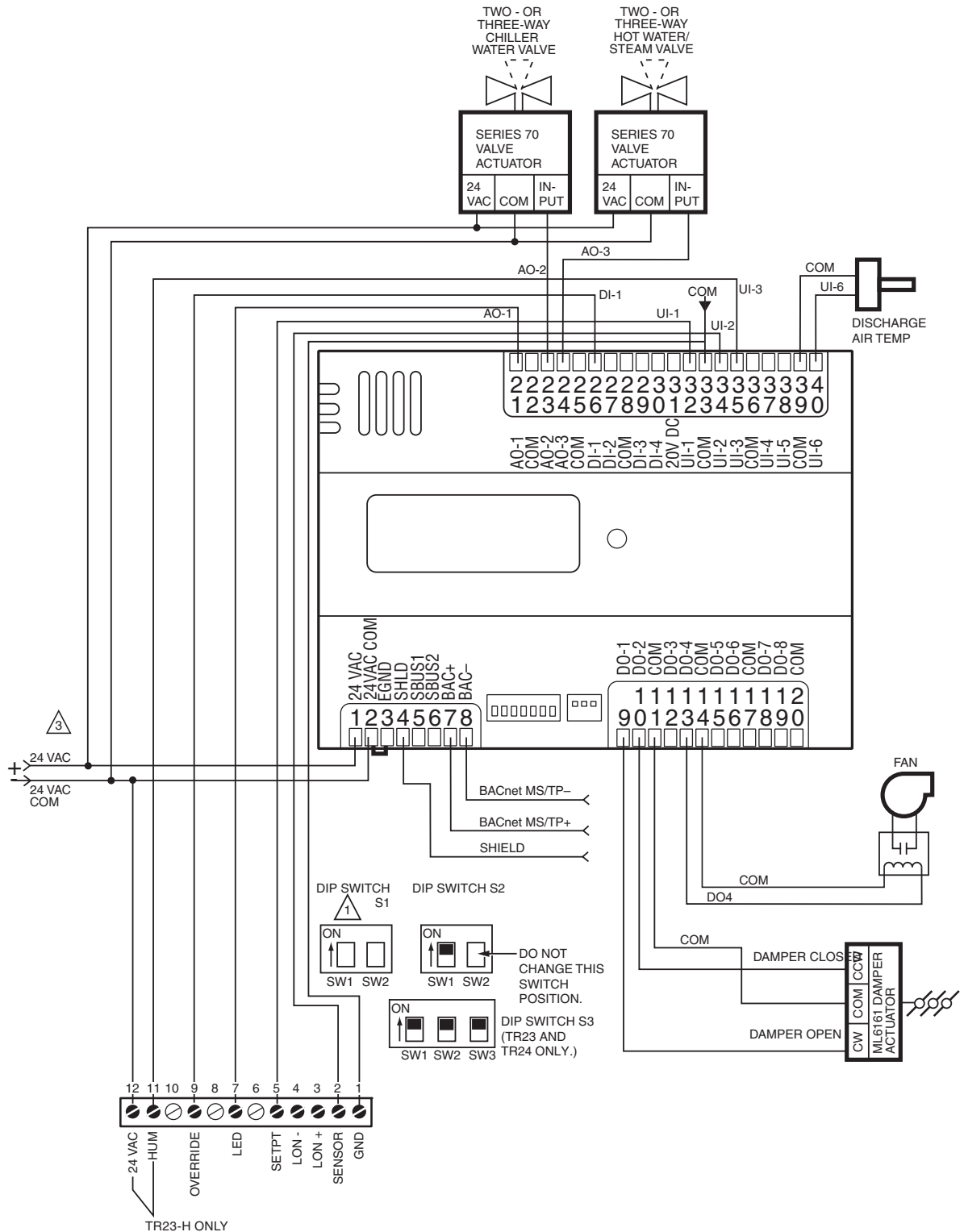
1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.

2 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.

3 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

M31177B

Fig. 20. Controller wiring diagram (model PUB6438S shown) with 4 to 20 mA enthalpy sensors and digital inputs.
(For note 2, refer to Fig. 14.)



- 1 DIP SWITCH S1 FOR HUMIDITY MODELS ONLY. SEE TR23 INSTALLATION INSTRUCTIONS, FORM NO. 62-0267, FOR CONFIGURATION DETAILS.
- 2 EARTH GROUND WIRE LENGTH SHOULD BE HELD TO A MINIMUM. USE THE HEAVIEST GAUGE WIRE AVAILABLE, UP TO 14 AWG (2.0 MM²) WITH A MINIMUM OF 18 AWG (1.0 MM²), FOR EARTH GROUND WIRE.
- 3 TO ASSURE PROPER ELECTRICAL CONTACT, WIRES MUST BE TWISTED TOGETHER BEFORE INSERTION INTO THE TERMINAL BLOCK.
- 4 CONTACTS MUST BE SUITABLE FOR DRY SWITCHING, 5V AT 10 mA. USE SEALED TYPE, GOLD FLASHED OR PIMPLED CONTACTS.

M31178A

Fig. 21. Controller wiring diagram (model PUB6438S shown) with 4 to 20 mA heating, cooling, and model ML6161 damper actuator. (For note 2, refer to Fig. 14.)

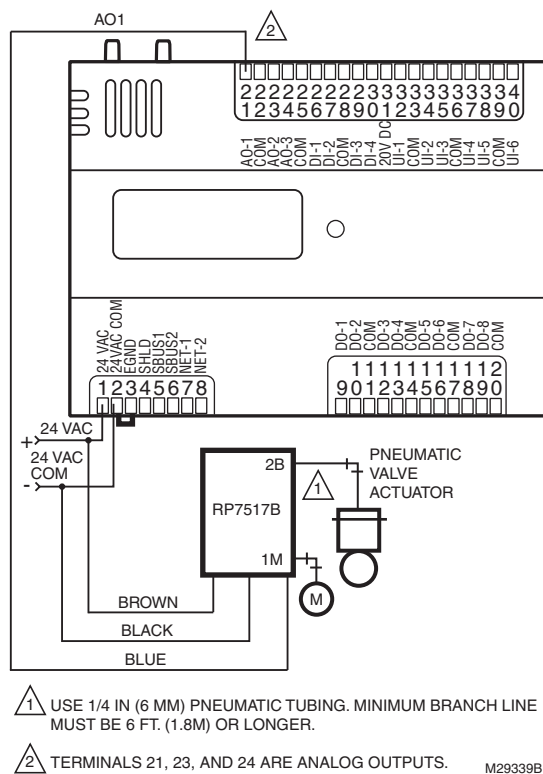


Fig. 22. Controller wiring diagram (model PUB6438S shown) for RP7517B pneumatic transducer.

CHECKOUT

Step 1. Check Installation and Wiring

Inspect all wiring connections at the controller terminals, and verify compliance with installation wiring diagrams. If any wiring changes are required, *first* be sure to remove power from the controller *before* starting work. Pay particular attention to:

- 24 Vac power connections. Verify that multiple controllers being powered by the same transformer are wired with the transformer secondary connected to the same input terminal numbers on each controller. Use a meter to measure 24 Vac at the appropriate terminals (see Fig. 12 on page 10). Controller configurations are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (U.S. only).
- Be sure that each controller has terminal 3 wired to a verified earth ground, using a wire run as short as possible with the heaviest gauge wire available, up to 14 AWG (2.0 sq mm) with a minimum of 18 AWG (1.0 sq mm) for each controller in the group (see Fig. 12 on page 10).
- Check that the MS/TP network polarity has been connected properly on each controller. BACnet MS/TP is polarity sensitive; communication will be lost for the entire segment

if one controller is connected improperly (see Fig. 13 on page 11).

- Verify that Triac wiring of the digital outputs to external devices uses the proper load power and 24 Vac common terminal (digital output common terminals) for High-Side switching.

NOTE: All wiring must comply with applicable electrical codes and ordinances or as specified on installation wiring diagrams.

For guidelines for wiring run lengths and power budget, see “Power” on page 7.

VERIFY END-OF-LINE TERMINATION RESISTOR PLACEMENT

The installation wiring diagrams should indicate the locations for placement of the end of line termination resistors. See Fig. 13 on page 11.

Correct placement of the end-of-line termination resistors is required for proper LONWORKS® Bus communications.

Step 2. Startup

Refer to Fig. 23 and the following text for startup information.

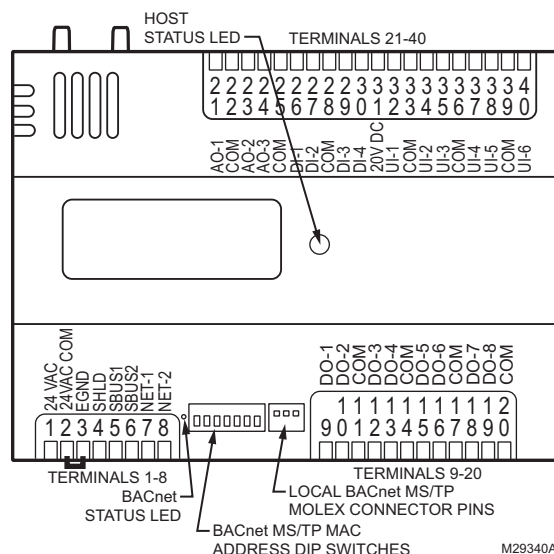


Fig. 23. LED, service, and network connection locations.

SET THE MS/TP MAC ADDRESS

The MS/TP MAC address DIP switches are used to set the unit's MAC address. Each Spyder BACnet on an MS/TP network must have a unique MAC address in the range of 0-127 (address 0 should be avoided as it is the Honeywell factory default MAC address for all MS/TP devices).

CONTROLLER STATUS LED:

The LED on the front of the controller provides a visual indication of the status of the device. When the controller receives power, the LED appears in one of the following allowable states, as described in Table 8.

Table 8. Status LED States.

LED State	Blink Rate	Status or Condition
OFF	Not applicable	No power to processor, LED damaged, low voltage to board, first second of power up or loader damaged.
ON	ON steady; not blinking	Processor not operating. Application Program CRC being checked. This takes 1-2 seconds and occurs on each restart (power up, reset and reflash, and following configuration file download).
Very Slow Blink (continuous)	1 second ON, 1 second OFF	Controller is operating normally.
Slow Blink (continuous)	0.5 second ON, 0.5 second OFF	Controller alarm is active or controller in process of configuration file download.
Medium Blink (continuous)	0.3 second ON, 0.3 second OFF	Controller is in reflash mode or awaiting/ receiving reflash data via the BACnet network.

BACNET STATUS LED:

The LED on the front of the controller, between the BACnet MS/TP terminals and MAC Address DIP Switches, provides a visual indication of the BACnet MS/TP communication status. When the controller receives power, the LED appears in one of the following allowable states, as described in Table 9.

Table 9. BACnet Status LED States.

BACnet LED Status	Status or Condition
Solid on	Controller has power, loader is not running.
Solid on, blinking off once in 2.5 sec.	Controller is in reflash mode, no MS/TP communication.
Solid on, blinking off twice in 2.5 sec.	Controller is in reflash mode, MS/TP communication present.
Solid on, blinking off thrice in 2.5 sec	Controller is in reflash mode, MS/TP communication data transfer in progress.
Solid off, there is no power	No power to processor, LED damaged, low voltage to board, or loader damaged.
Solid off, blinking on once in 2.5 sec.	Controller is running, no MS/TP communication.
Solid off, blinking on twice in 2.5 sec.	Controller is running, MS/TP communication present.
Solid off, blinking on thrice in 2.5 sec	Controller is running, MS/TP communication data transfer in progress.

Step 3. Checkout Completion

At this point the controller is installed and powered. To complete the checkout, the NIAGARA FRAMEWORK® application (run on a PC) is used to configure the I/O and functions of the controller. Refer to the Programming Tool User Guide, form no. 63-2662, for controller configuration and programming details.

CONTROLLER REPLACEMENT

There are no serviceable or repairable parts inside the controller.



WARNING

Fire, Explosion, or Electrical Shock Hazard.

Can cause severe injury, death or property damage.

Do not attempt to modify the physical or electrical characteristics of this device in any way. Replace the controller if troubleshooting indicates a malfunction.



WARNING

Electrical Shock Hazard.

Can cause severe injury, death or property damage.

Disconnect power supply before beginning controller replacement to prevent electrical shock or equipment damage.

Terminal Block Removal

To simplify controller replacement, all terminal blocks are designed to be removed with the wiring connections intact and then re-installed on the new controller. See Fig. 24 and refer to the following procedure:

IMPORTANT

To prevent bending or breaking the alignment pins on longer terminal blocks, insert the screwdriver at several points to evenly and gradually lift up the terminal block.

Insert the screwdriver blade no more than 1/8 in. (3 mm) to prevent damage to the terminal block alignment pins on the controller circuit board.

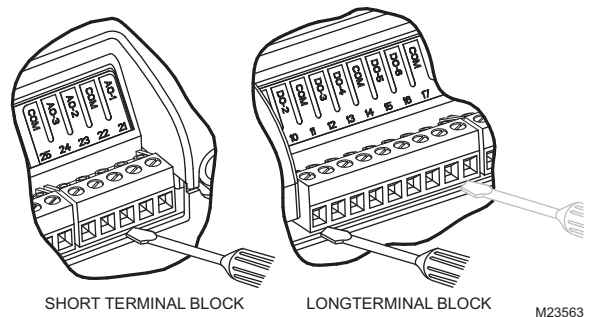


Fig. 24. Removing Terminal Blocks.

- Use a thin-bladed screwdriver to evenly raise the terminal block from its alignment pins:
 - For short terminal blocks (1 to 5 terminals), insert screwdriver blade in the center of the terminal block and use a back and forth twisting motion to gently raise the terminal block from its alignment pins 1/4 in. (6.35 mm).
 - For long terminal blocks (6 or more terminals), insert screwdriver blade on one side of the terminal block and gently rotate the blade 1/4 turn. Then, move to the other side of the terminal block and do the same. Repeat until the terminal block is evenly raised 1/4 in. (6.35 mm) from its alignment pins.

2. Once the terminal block is raised 1/4 in. (6.35 mm) from its alignment pins, grasp the terminal block at its center (for long terminal blocks grasp it at each end) and pull it straight up.

Controller Replacement (PVB0000AS, PVB4022AS and PVB6436AS)

For PVB0000AS, PVB4022AS and PVB6436AS controllers, which are hard-wired to an actuator, perform the following actions to replace the complete assembly (controller and actuator):

1. Remove all power from the controller.
2. Remove the two air flow pickup connections from the pressure sensor.
3. Remove the terminal blocks (See “Terminal Block Removal”).
4. Remove the old controller and actuator assembly from its mounting.
 - Loosen the two bolts on the actuator clamp to release the actuator from the shaft.
 - Remove the controller's mounting screws.
 - Gently pull the controller and actuator assembly straight out, until the assembly is clear of the actuator shaft.
5. Mount the new controller and actuator assembly (See “Installation” on page 3.).
6. Reconnect the two air flow pickup tubes to the pressure sensor (See “Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)” on page 6.).
7. Replace the terminal blocks:
 - Insert each terminal block onto its alignment pins.
 - Press straight down to firmly seat it.
 - Repeat for each terminal block.
8. Restore power to the controller.
9. Perform “Checkout” on page 20.

Controller Replacement (PVB4024NS and PVB6438NS)

Perform the following to replace the PVB4024NS and PVB6438NS controllers:

1. Remove all power from the controller.
2. Remove the two air flow pickup connections from the pressure sensor.
3. Remove the terminal blocks.
 - See “Terminal Block Removal” on page 21.

4. Remove the old controller from its mounting.

IMPORTANT

(FOR CONTROLLERS MOUNTED TO A DIN RAIL):

1. Push straight up from the bottom to release the top pins.
 2. Rotate the top of the controller outwards to release the bottom flex connectors (see Fig. 8 on page 6).
5. Mount the new controller.
 - See “Installation” on page 3.
 6. Reconnect the two air flow pickup tubes to the pressure sensor (See “Piping (PVB0000AS, PVB4022AS, PVB4024NS, PVB6436AS and PVB6438NS)” on page 6.).
 7. Replace the terminal blocks:
 - Insert each terminal block onto its alignment pins.
 - Press straight down to firmly seat it.
 - Repeat for each terminal block.
 8. Restore power to the controller.
 9. Perform “Checkout” on page 20.

Controller Replacement (PUB1012S, PUB4024S, PUB6438S and PUB6438SR)

Perform the following to replace the PUB1012S, PUB4024S, PUB6438S and PUB6438SR controllers:

1. Remove all power from the controller.
2. Remove the terminal blocks (See “Terminal Block Removal” on page 21.).
3. Remove the old controller from its mounting.

IMPORTANT

(FOR CONTROLLERS MOUNTED TO A DIN RAIL):

1. Push straight up from the bottom to release the top pins.
 2. Rotate the top of the controller outwards to release the bottom flex connectors (see Fig. 8 on page 6).
4. Mount the new controller. (See “Installation” on page 3.)
 5. Replace the terminal blocks:
 - Insert each terminal block onto its alignment pins.
 - Press straight down to firmly seat it.
 - Repeat for each terminal block.
 6. Restore power to the controller.
 7. Perform “Checkout” on page 20.

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Sylk™ I/O Devices

SPECIFICATION DATA

APPLICATION

The Sylk IO devices are part of the Spyder family. The three IO devices are designed to seamlessly integrate with Spyder with relay controllers using only Sylk™ for communication. These devices expand the footprint of a single Spyder, increasing the controller's ability to be applied in applications that require a large amount of physical I/O. The Sylk IO devices are programmable using existing Spyder wire sheets through the Niagara Framework® software. Since the Sylk IO devices are extensions of the Spyder LON and Spyder BACnet controllers, the same Spyder feature will be leveraged in the WebPro workbench tool and the WEBs-AX JACE controller.

The Sylk IO devices are intended for use in HVAC applications that require a programmable controller where the IO count is more than the full sized Spyder point count. All devices provide flexible, universal inputs for external sensors while SIO6042 and SIO4022 provide a combination of analog and digital outputs.

FEATURES

- Expands a single Spyder controller's IO count by 8-12 IO per device.
- Up to three devices for Lon Spydres and up to two devices for BACnet Spydres can be applied.
- Communicates through Sylk™ bus freeing up IO for more applications.
- Program logic resides in a single controller and uses the existing Spyder wire sheet.
- Programming is built directly into the Spyder tool.
- Installation can be done locally or remotely.
- Field configurable and programmable for control, input, and output functions using the Niagara Framework® software.
- All wiring connections are made to removable terminal blocks to simplify device installation and replacement.
- The device housing is UL plenum rated.



DESCRIPTION

The Sylk IO devices are available in three models, as described in Table 1.

Table 1. Device Configurations.

Devices	UI (Universal Input)	DI (Digital Input)	AO (Analog Output)	DO (Digital Output)
SI06042	6	0	4	2
SI04022	4	0	2	2
SI012000	12	0	0	0

Each device is programmable because the user chooses which function blocks to use and how to connect them. It is configurable because each function block has user-defined behavior.

SPECIFICATIONS

Electrical

Rated Voltage: 20-30 Vac; 50/60 Hz

Power Consumption:

100 VA for Sylk IO device and all connected loads

Sylk IO Device only Load: 3 VA maximum (SI012000), 4 VA maximum (SI04022), 5 VA maximum (SI06042)

External Sensors Power Output: 20 Vdc $\pm$ 10% @ 75 mA maximum

Environmental

Operating & Storage Temperature Ambient Rating:
Minimum -40° F (-40° C); Maximum 150° F (65.5° C)

Relative Humidity: 5% to 95% non-condensing

Dimensions (H/W/D)

See Fig. 1 on page 3 for dimensioned drawings.

Dimensions: 6.266 x 4.750 x 2.26 in.
(159 x 120.6 x 57.4 mm)

Approval Bodies

UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.

Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.

Meets Canadian standard C108.8 (radiated emissions).

Conforms to the following requirements per European Consortium standards:

- EN 61000-6-1; 2001 (EU Immunity).
- EN 61000-6-3; 2001 (EU Emissions).

Inputs and Outputs

Each device has a combination of digital outputs (DO), analog outputs (AO), and universal input (UI) circuits.

Digital Triac Output (DO) Circuits

Voltage Rating: 20 to 30 Vac @ 50-60Hz

Current Rating: 25 mA to 500 mA continuous, 800 mA (AC rms) for 60 milliseconds

Analog Output (AO) Circuits

Analog outputs are individually configurable for current or voltage.

ANALOG CURRENT OUTPUTS:

Current Output Range: 4.0 to 20.0 mA

Output Load Resistance: 550 Ohms maximum

ANALOG VOLTAGE OUTPUTS:

Voltage Output Range: 0.0 to 10.0 Vdc

Maximum Output Current: 10.0 mA

Analog outputs may be configured as digital outputs and operate as follows:

- False (0%) produces 0 Vdc, (0 mA)
- True (100%) produces the maximum 11 Vdc, (22 mA)

Universal Input (UI) Circuits

See Table 2 for the UI specifications.

Table 2. Universal Input Circuit Specifications.

Input Type	Sensor Type	Operating Range
Room/Zone Discharge Air Outdoor Air Temperature	20K Ohm NTC	-40° F to 199° F (-40° C to 93° C)
Outdoor Air Temperature	C7031G ^a	-40° to 120°F (-40° to 49°C)
	C7041F ^a	-40° to 250°F (-40° to 121°C)
	PT1000 (IEC751 3850)	-40° F to 199° F (-40° C to 93° C)
TR23 Setpoint Potentiometer	500 Ohm to 10,500 Ohm	-4° DDC to 4° DDC (-8° DDF to 7° DDF) or 50° F to 90° F (10° C to 32° C)
Resistive Input	Generic	100 Ohms to 100K Ohms
Voltage Input	Transducer, Controller	0 - 10 Vdc
Discrete Input	Dry Contact closure	OpenCircuit $\geq$ 3000Ohms ClosedCircuit < 3000Ohms

^a C7031G and C7041F are recommended for use with these controllers, due to improved resolution and accuracy when compared to the PT1000.

CPU

Each device uses a 32 bit ATMEL ARM 7 microprocessor.

Memory Capacity

Flash Memory: 512 kilobytes. The device is able to retain Flash memory settings for up to ten (10) years.

RAM: 128 kilobytes

Device Status LED

The LED on the front of the device provides a visual indication of the status of the device. When the device receives power, the LED appears in one of the following allowable states, as described in Table 3.

Table 3. Status LED States.

LED State	Blink Rate	Status or Condition
OFF	not applicable	No power to processor, LED damaged, low voltage to board, first second of power up, or loader damaged.
ON	ON steady; not blinking	Processor not operating. Application Program CRC being checked. This takes 1-2 seconds and occurs on each restart (power up, reset and reflash, and following configuration file download).
Very Slow Blink (continuous)	1 second ON, 1 second OFF	Device is operating normally.
Slow Blink (continuous)	0.5 second ON, 0.5 second OFF	Device alarm is active or device in process of configuration file download.

Sylk™ Bus

Sylk is a two wire, polarity insensitive bus that provides both 18 VDC power and communications between a Sylk-enabled sensor and a Sylk-enabled controller. Using Sylk-enabled sensors saves I/O on the controller and is faster and cheaper to install since only two wires are needed and the bus is polarity insensitive. Sylk sensors are configured using the latest release of the Spyder Tool for WEBPro and WEBStation.

Mounting

The Sylk IO device enclosure is constructed of a plastic base plate and a plastic factory-snap-on cover. The cover does not need to be removed from the base plate for either mounting or wiring. Removable terminal blocks are used for all wiring connections, which allow the device to be wired before or after mounting.

The Sylk IO device can be mounted in any orientation. Ventilation openings are designed into the cover to allow proper heat dissipation, regardless of the mounting orientation.

The device mounts to either a panel or a DIN rail [standard EN50022; 1-3/8 in. x 9/32 in. (7.5 mm x 35 mm)].

- For panel mounting, use four No. 6 or No. 8 machine sheet metal screws inserted through the corners of the base plate.
- For DIN rail mounting, refer to the Installation Instructions, form 62-0310.

NOTE: The Sylk IO device must be mounted in a position that allows clearance for wiring, servicing, and removal.

NOTE: For complete mounting information, refer to the Installation Instructions, form 62-0310.

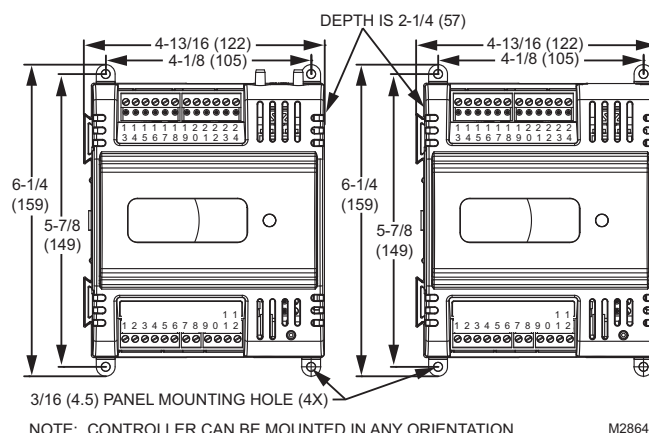


Fig. 1. Device dimensions in in. (mm).

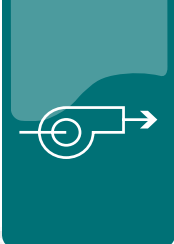
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Honeywell

**BTU METER AND FLOW MONITOR**
3050 SERIES**DESCRIPTION**

The **Badger Meter 3050 Series flow and energy monitor** is economical, full-featured, compact unit designed for flow and BTU measurement applications. Outputs include one mechanical relay and one solid state pulse output, featuring unit/pulse and set-point control independently based on flow or total readings.

OPTIONAL FEATURES

An analog 4-20 mA or 0-20 mA output is optional and USB, RS-485 Modbus, and BACnet/MSTP provide high-level communication. A two-line by 16-character, 3/8" high backlit LCD display is configured by the user to display flow rate and flow total. Custom units can be created during field setup. The flow sensor input features flexible scaling options and signal type selections that permit the use of most Data Industrial meter sensors, or other frequency (sine/pulse) or linear devices. Matched 10 k Ω thermistors (ordered separately) provide temperature differential for BTU calculations.

One mechanical relay and one solid state relay output
Optional 0/4-20 mA output
USB, RS-485, Modbus, and BACnet/MSTP all in one unit

**3050-1-0****FEATURES**

- *Menu-driven programming or Windows based programming*
- *NEMA 4X rated enclosure*
- *Two-line x 16-character display*
- *Password-restricted access*
- *Non-volatile memory*
- *Temperature sensor zeroing*

SPECIFICATIONS

Supply Voltage	8 to 28 VAC, 5 VA; 8-35 VDC, 280 mA	Zero Adjustments	any predefined or custom unit Compensation for variances between input sensors by adjusting T2 to match T1
Input	Data Industrial flow sensor or other frequency (sine/pulse) device	Communication Interface	USB 2.0A to mini-B 5-pin cable required, provides access to all programming and operation features
Sensor Input	Two 2-wire 10 k Ω type II thermistors or 100 Ω 3-wire platinum RTDs or field-defined custom temperature inputs	Communication Protocol	RS485 supports Modbus and BACnet/MSTP
Maximum Output Impedance	1 k Ω @ 24 VDC	Display	Backlit LCD, 16 characters/line, 0.31"H (0.79 cm), two lines
Output	Solid state pulse output rated at 1A @ 30 VAC or 35 VDC; closed 0.5 Ω @ 1A; open >10 M Ω	Engineering Units	Flow and Total in gal, liters, ft ³ , acre-ft, or bbl; Energy rate kBTU/hr, BTU/min, KW, Tons, J/sec or field-programmed custom; energy total units can be MBTU, kBTU, kWh, MWh, kJ, or field-programmed custom
Relay Output	Relay and pulse output are fully functional as either totalizing or setpoint outputs	Operating Temperature	-4° to 158°F (-20° to 70°C)
Relay Output Rating	5A @ 120 VAC or 30 VDC resistive; 1A @ 120 VAC or 30 VDC inductive	Enclosure Rating	NEMA 4X
Analog Output	4-20 mA, 0-20 mA (isolated, sinking or sourcing); loop powered (sinking) 30 VDC @ 0 mA maximum, 3 VDC @ 20 mA minimum; self powered (sourcing) 600 Ω maximum load	Weight	Panel mount 0.8 lb (0.34 kg) Wall mount 1.2 lb (0.54 kg)
Pulse Rate	1 pulse per 1.0000000 to 99999999 units; any predefined or custom unit can be used for flow or BTU totalizing; contact time 1 to 9999 milliseconds	Approvals	CE
Setpoints	Setpoint alarm for flow rate, BTU rate, Temp1, Temp2, DeltaT using	Warranty	1 year



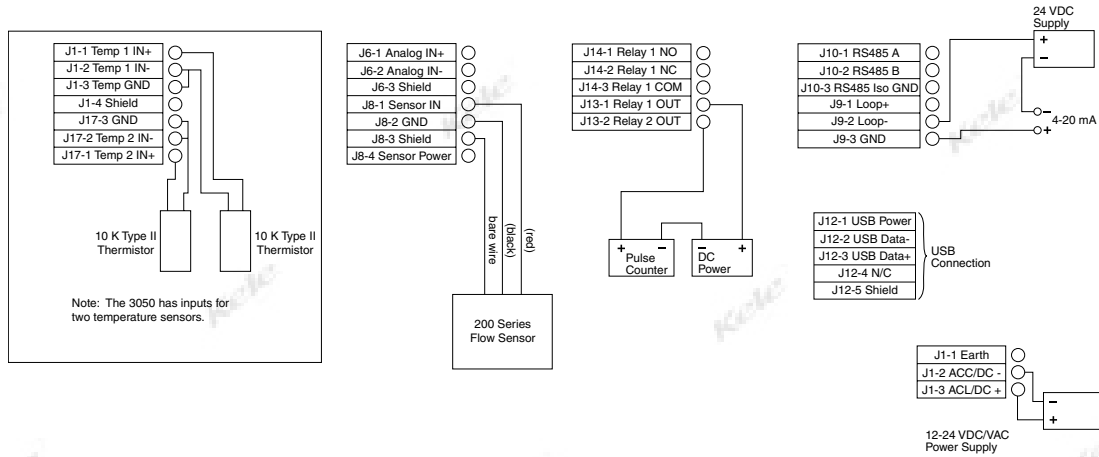
BTU METER AND FLOW MONITOR 3050 SERIES

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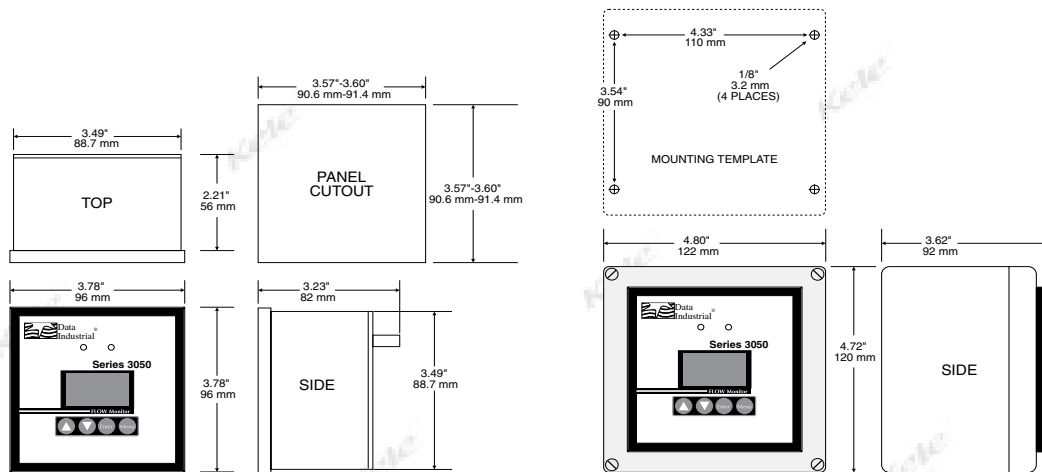
FLOW

WIRING

Badger 30XX BTU Monitor



DIMENSIONS



ORDERING INFORMATION

MODEL	DESCRIPTION
3050	BTU monitor with display
ANALOG OUTPUTS	
0	No analog output
1	Analog output, RS485 (BACnet/Modbus), and USB
MOUNTING	
0	Panel mount
1	Wall mount

RELATED PRODUCTS

200 Series
ST-U24B-XP
ST-U24S-XP

Data Industrial impeller type flow sensors with pulse output
Temperature sensors, matched $\pm 0.1^\circ\text{F}$, brass wells
Temperature sensors, matched $\pm 0.1^\circ\text{F}$, stainless steel wells



Impeller
Data Industrial®

BTU Monitor

Series 3050

DESCRIPTION

The Badger Meter® Series 3050 BTU monitor is an economical, full-featured, compact unit designed for HVAC sub-metering applications, and general hydronic thermal transfer systems.

Outputs include one mechanical relay and one solid-state pulse output, both featuring unit/pulse and setpoint control independently based on flow or energy rate/total, supply return, or delta temperature readings. Also driven by the same variables, an optional analog 4...20 mA or 0...20 mA output is provided. Additionally, the optional USB, RS-485 Modbus, and BACnet/MSTP provide high-level communication.

A two-line by 16-character 3/8 in. (9.5 mm) high backlit LCD display is configured by the user to display flow rate, flow total, energy rate, energy total, supply and return temperatures or delta T. In addition to many pre-programmed units of measure, many custom units can be created during field setup.

The two required temperature inputs can be standard Badger Meter two wire 10k thermistors, or three wire 100 Ω platinum RTDs. A unique programming feature permits custom RTD or thermistors to be accommodated.

The flow sensor input features flexible scaling options and signal type selections that permit the use of most Badger Meter sensors, or other frequency sine/pulse or linear analog devices.

OPTIONS

NEMA 4X panel mount conforms to DIN standard 96 mm x 96 mm for meter size and cutouts. NEMA 4X wall mount is available as an option.

Advanced features include:

- Infinite Impulse Response Filter (IIRF) smooths the flow rate, temperature, and energy rate calculations. This proprietary smoothing software provides accurate energy calculations by compensating for a wide variety of flow and temperature signal variables.
- Temperature sensor zeroing effectively makes any two similar sensors a matched pair at the actual operating temperature.
- Password restricted access to programming, reset total, or both.
- Non-volatile memory of totals and field configuration, without need for battery backup.
- Efficient switching power supply permits 12...24V AC/DC operations.

PROGRAMMING

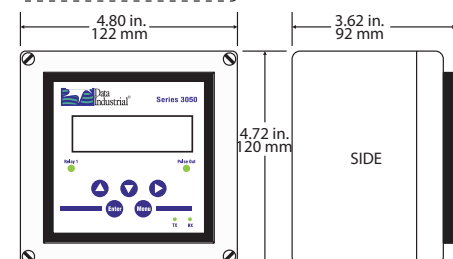
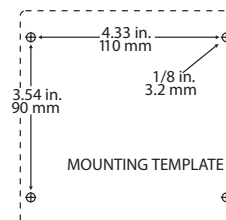
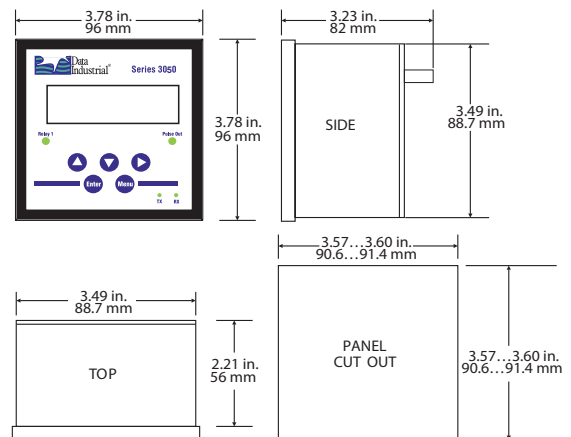
Programming is very easy and can be done using the five front panel push buttons, or optionally by using Windows® based software via a USB port.



PART NUMBER CONFIGURATION

		Example:	3050	-	x	x
Series	Flow Monitor		3050			
Option - Analog Output, RS485 (BACnet / Modbus), and USB						
	No Option				0	
	Analog Output, RS485 with BACnet and Modbus, and USB				1	
Option - Mounting						
	Panel Mount				0	
	Wall Mount				1	

DIMENSIONS



Badger Meter

DSY-DS-01684-EN-05 (February 2016)

Product Data Sheet

FLOW SENSOR INPUTS

Type	Threshold	Signal Input	Frequency	Pull-up	Impedance	Aux. Power	Calibration
Pulse-DI	2.5V DC	30V DC	0.4 Hz...10 kHz	1K...12V DC	—	12V DC @30mA	K + Offset
Pulse K-factor	2.5V DC	30V DC	0.4 Hz...10 kHz	—	—	12V DC @30mA	Pulse/Gal
Pull-up K-factor	2.5V DC	30V DC	0.4 Hz...10 kHz	1K...12V DC	—	12V DC @30mA	Pulse/Gal
Analog 4...20mA	10mVPP	50 mA Fused	—	—	100 Ω	12V DC @30mA	Linear
Analog 0...20mA	—	50 mA Fused	—	—	100 Ω	12V DC @30mA	Linear
Analog 0...1V DC	—	30V DC	—	—	100 Ω	12V DC @30mA	Linear
Analog 0...5V DC	—	30V DC	—	—	100 Ω	12V DC @30mA	Linear
Analog 0...10V DC	—	30V DC	—	—	100 Ω	12V DC @30mA	Linear

SPECIFICATIONS

Voltage	12...24V DC/AC (limit: 8...35V DC); (limit: 8...28V AC)		DC current draw (~ 280 mA) AC Power rating (~5 VA)
Operating Temperature	-4...158° F (-20...70° C)		
Storage Temperature	-22...176° F (-30...80° C)		
Weight	Panel Mount: 12 oz		
Pulse and Relays	Both pulse and relay are fully functional as either totalizing or setpoint outputs		
Pulse Electrical	1 Amp at 35V DC/30V AC	Closed: 0.5 Ω at 1 Amp; Open: >10 ⁸ Ω	
Relay Electrical	Resistive Load: 5A @ 120V AC/30V DC	Inductive Load: 1A @ 120V AC/30V DC	
Pulse/Unit Volume (Totalizer)	Driving Source: flow total, Btu total	Rate: 1 pulse per 1.0000000...99999999 units	Contact Time: 1...9999 mS
Setpoint (Alarm)	Driving Source: flow rate, Btu rate, temperature 1, temperature 2, delta T	Units: Any predefined or custom unit	Setpoint: 1.0000000...999999999
	Delay to Set: 1...9999 sec	Release Point: 1.0000000...999999999	Delay to Release: 1...9999 sec
Optional Analog Output	Driving Source: flow rate, Btu rate, temperature 1, temperature 2, delta T, PID control	Range: 4...20 mA; 0...20 mA (isolated current sinking or sourcing)	Sinking: 30V DC @ 0 mA max.; 3V @ 20 mA min. Sourcing: 600 W max load
USB Communication	Provides complete access to all programming and operation features		Requirements: USB 2.0 A to Mini-B, five-pin cable
RS-485 Communication	Supports Modbus and BACnet/MSTP		
Accessories	Programming kit; wall mount kit		
Temperature Inputs	Two of 2-wire 10k type II thermistor; 25...170° F (-3.9...76.7° C) or custom field-defined		
	3-wire platinum 100Ω RTD; 25...250° F (-3.9...121.1° C) or custom field-defined		
	Unis of Measure: °F and °C	Energy Rate Units: kBtu/hr; Btu/min; kW; Tons; J/Sec; and field programmed custom units	Operating Mode: T1<T2; T1>T2; absolute; Defines how reverse energy flows are handled (T1 should be installed in the same pipe as the flow sensor)
	Zeroing: Compensate for variances between temperature elements by adjusting T2 reading to match T1 reading.	Constant: Single point correction for variances in specific heat of transfer liquid.	Energy Total units: kBtu; Mbtu; kWh; MWh; kJ; and field programmed custom units
Units of Measure	Rate	US gpm; US gal/sec; gal/hr; US mgal/day; lps; lpm; lph; ft³/Sec; ft³/min; ft³/hr; m³/sec; m³/min; m³/hr; acre-ft/sec; acre-ft/min; acre-ft/hr; bbl/sec; bbl/min; bbl/hr; and field programmed custom units 0.00...999999999	
	Total	US mgal; liters; ft³; m³; acre-ft; bbl; and field programmed custom units 0.00...999999999	

Control. Manage. Optimize.

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Legacy Documents: DTB-077-03

PRELIMINARY

POWERSCOUT™ SERIES

NETWORKED POWER METERS



HIGH PERFORMANCE INSTRUMENTS FOR ENERGY MEASUREMENT

INDUSTRY'S MOST DEPENDABLE & PRECISE ENERGY MEASUREMENT

The PowerScout series networked power meters are designed to provide timely and accurate consumption data to gain the upper hand on electrical costs in today's escalating energy market. PowerScout meters can capture kWh/kW energy and demand data as well as virtually all relevant energy parameters for diagnostics and monitoring on three-phase or single-phase circuit installations. The PowerScout's flexibility, size, and ease-of-use make them ideal tools for gathering detailed consumption data in commercial, industrial, government and retail environments.



MAXIMUM VERSATILITY & FLEXIBILITY

Every PowerScout features field-selectable Modbus or BACnet protocols, interchangeable split-core or flexible RoCoil CTs, and direct USB setup. **Connect via RS-485** or optional Ethernet and use the optional back-lit display (PS3037) to verify setup and check real time values. The PowerScout makes over 50 total electrical measurements, including energy and demand.



FEATURES

- PowerScout meters monitor voltage, current, power, energy, and many other electrical parameters on single and three-phase systems.
- The PowerScout uses either BACnet or Modbus protocol and features digital pulse outputs. Available with Serial-only or with Ethernet.
- Positive and negative Modbus registers/BACnet objects allow for the PowerScout to be used on net metering projects.
- Mix-and-match a full range of Split Core or RoCoil™ Rogowski-style CTs
- PhaseChek™ LED indicators confirm proper CT orientation.
- Line-Powered*: 80-600V Phase-to-Phase Power Supply.
- Data updates occur every 0.5 seconds (PS3037) or once every second (PS24).
- PS3037: Revenue grade. ANSI C12.20-2010 Class 0.2
- PS3037: DIN rail or panel mount
- PS3037: Optional back-lit display available for verifying setup and checking real time values.
- UL and CE Mark†

APPLICATIONS

- Tenant Submetering
- Net Metering
- Data Center Monitoring
- Commercial
- Retail
- Industrial

*Use on 120/240V, 480/277V, 580/355V, or 380/220V services. 50 or 60 Hz.

† PS3037 and PS24D (with enclosure) are UL Listed. PS24N (without enclosure) is UL Recognized. CE Mark on PS3037 and PS24 Serial models.

POWERSCOUT™ 3037

REVENUE-GRADE SINGLE-POINT POWER METER

Display & ethernet will not be on the models provided for NJ DOT

ADAPT TO ANY PROJECT

The PowerScout 3037 comes in four basic configurations depending on whether a display or Ethernet port are desired. Instead of having one specific meter for a single job, the PowerScout 3037 can adapt to nearly any project requirement.

All PowerScout 3037 models have a broadband power supply (80-600VAC) and can be paired with a variety of current transformers, from split cores that measure <1A up to large RoCoils designed for measuring 4000A. In addition, communication protocols are field-selectable. Easily toggle between Modbus or BACnet using ViewPoint software.

QUICK & EASY SETUP

Configuring the PowerScout 3037 for a new project is faster than ever before, thanks to the standard USB port. To configure, simply connect the meter to a PC using a USB cable, then use ViewPoint software to select CT type, communication protocol, and other parameters. The meter is powered by the USB port while connected to a PC. Have several meters that require the same configuration? Save your setup table in ViewPoint and use it over and over.

FASTEST & EASIEST INSTALLATION

The PowerScout 3037 is compact enough to facilitate in-panel mounting. Or, use the built-in DIN rail channel, which is compatible with TS35/7 rail for quick and easy mounting near the circuit panel.

PowerScout instruments are line-powered and do not require external power. Its power supply can accommodate service voltages ranging from 80-600V (phase-to-phase). DENT's patented PhaseChek™ circuitry includes a 3 bi-color LED indicator display that confirms proper CT-to-phase placement and orientation.

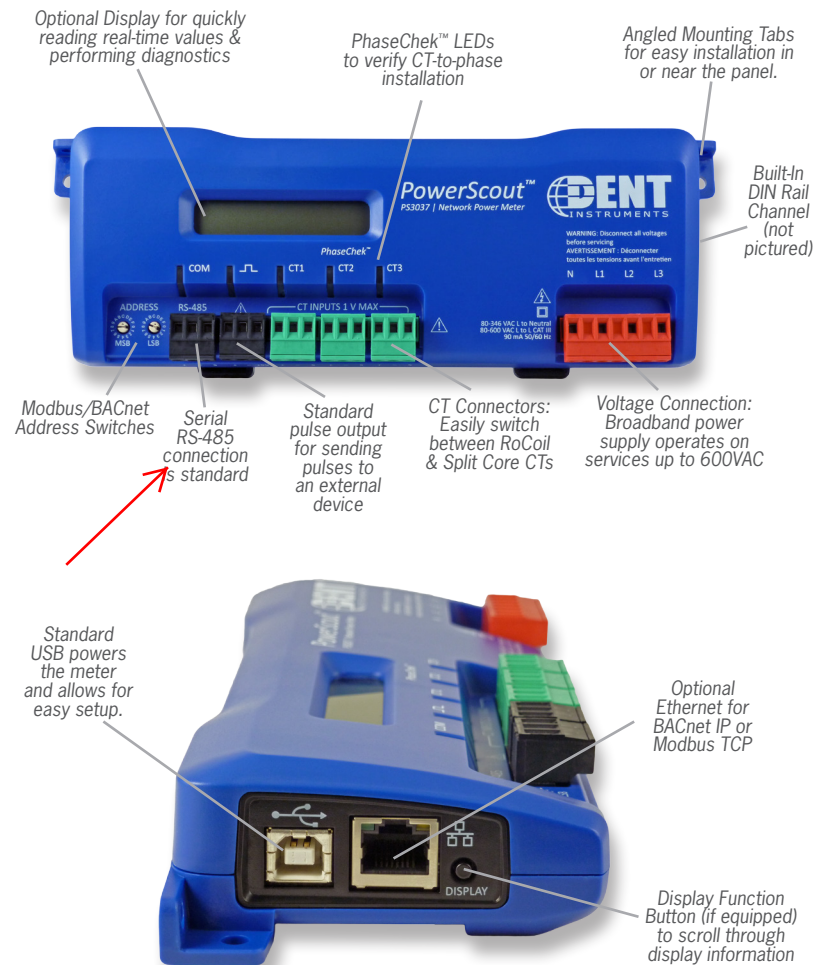


Use the standard USB connection to easily power and configure the PowerScout 3037 at your office or in the field. Once connected to the panel, USB can also be used to verify setup and check real-time values.



POWERSCOUT 3037 ANATOMY

PS3037-S-N PowerScout™ 3037 Serial Modbus/BACnet, No Display



REVENUE-GRADE PERFORMANCE

The PowerScout 3037 features revenue-grade ANSI C12.20-2010 qualified Class 0.2 performance. Paired with the appropriate DENT CTs, the PowerScout 3037 is ideal for high-accuracy applications like demand response or tenant submetering.

COMMUNICATIONS: INDUSTRY-STANDARD MODBUS OR BACNET

Communications interface to the PowerScout 3037 can be accomplished through serial RS-485 or USB, or optional Ethernet. The PowerScout can use either the BACnet IP or MS/TP protocol or Modbus TCP or RS-485 protocol for sending commands or retrieving data.

STANDARD PULSE OUTPUT

Send kWh or other pulses to an external device. The pulse output is used to generate system kWh pulses for devices, such as data loggers, that can accept pulses, but do not have BACnet or Modbus capability.

POWERSCOUT™ SPECIFICATIONS

TECHNICAL

SERVICE TYPE	Single Phase, 3 Phase - 4 Wire (WYE), 3 Phase - 3 Wire (Delta)
POWER	From L1 Phase to L2 Phase. 80-600VAC CAT III 50/60Hz, 70mA Max. Non-user replaceable .5 Amp internal fuse protection
POWER OUT	PS3037: Unregulated 5VDC output, 140 mA Max, resetting fuse
VOLTAGE CHANNELS*	80-346 Volts AC Line-to-Neutral, 600V Phase-to-Phase, CAT III
CURRENT CHANNELS	PS3037: 3 channels, 0.52 VA _{CT} max, 333 mV CTs, 0-4,000A
MAXIMUM CURRENT INPUT	PS3037: 158% of current transducer rating (mV CTs) to maintain accuracy. Measure up to 4000A with RoCoil CTs
MEASUREMENT TYPE	True RMS using high-speed digital signal processing (DSP)
LINE FREQUENCY	50/60 Hz
WAVEFORM SAMPLING	12 kHz
PARAMETER UPDATE RATE	PS3037: .5 seconds
MEASUREMENTS	Volts, Amps, kW, kWh, kVAR, kVARh, kVA, kVAh, aPF, dPF.
ACCURACY	PS3037: 0.2% (<0.1% typical) ANSI C12.20-2010 Class 0.2
RESOLUTION	0.01 Amp, 0.1 Volt, 0.01 watt, 0.01 VAR, 0.01 VA, 0.01 Power Factor depending on scalar setting
LED INDICATORS	Bi-color LEDs (red and green): 1 LED to indicate communication, 3 LEDs for correct CT-to-phase installation (per meter element).
PULSE OUTPUT	PS3037: Open Collector, 5mA max current, 30V max open voltage

COMMUNICATIONS

DIRECT	User selectable Modbus/BACnet Master Slave Token Passing protocol (MS/TP) or (optional) BACnet IP/Modbus TCP over Ethernet.
MAX DISTANCE	1200 meters with Data Range of 100K bits/second or less
BAUD RATE	9600 (Modbus default), 19200, 38400, 57600, 76800 (BACnet default), 115200
DATA BITS	8
PARITY	None, Even, Odd
STOP BIT	2, 1
DATA FORMATS	Modbus or BACnet

MECHANICAL

OPERATING TEMPERATURE	-20° to 60°C (-4° to 140°F)
HUMIDITY	5% to 95% non-condensing
ENCLOSURE	PS3037: ABS Plastic, 94-V0 flammability rating
WEIGHT (EXCLUDING CTS)	PS3037: 340 g (12 ounces)
DIMENSIONS	PS3037: 24.2 x 8.5 x 4.0 cm (9.5" x 3.3" x 1.6")

VIEWPOINT SOFTWARE

OPERATING SYSTEM	Windows® 8, Windows® 7 (32/64 bit), Windows® Vista (32/64 bit), or Windows® XP
COMMUNICATIONS	RS-485 & USB standard. One USB Port required on PC.

SAFETY

POWERSCOUT 3037 (All) PS3037-S-N, PS3037-S-D, PS3037-E-N, PS3037-E-D	UL Listed and CE Mark Conforms to UL Std 61010-1 Certified to CSA Std C22.2 No. 61010-1

MODBUS REGISTER/BACNET OBJECT DESCRIPTIONS (PARTIAL LIST)

System True Energy +/- (kWh)	Individual Phase to Phase Voltages
Instantaneous Total True Power +/- (kW)	Individual Phases True Energy +/- (kWh)
Peak Demand (Adjustable Window) (kW)	Individual Phases True Power +/- (kW)
Maximum Instantaneous Power +/- (kW)	Individual Phases Reactive Energy +/- (kVARh)
Minimum Instantaneous Power +/- (kW)	Individual Phases Reactive Power +/- (kVAR)
System Reactive Energy +/- (kVARh)	Individual Phases Apparent Energy kVAh)
System Apparent Energy (kVAh)	Individual Phases Apparent Power (kVA)
System Apparent Power (kVA)	Individual Phases Apparent Power Factor (aPF)
System Displacement Power Factor (dPF)	Individual Phases Displacement Power Factor (dPF)
System Apparent Power Factor (aPF)	Individual Phases Line to Neutral Voltages (Volts)
Average Line to Line Voltage (Volts)	Individual Phases Line to Line Voltages (Volts)
Average Line to Neutral Voltage (Volts)	PS3037: Net system true energy (kWh)

VIEWPOINT™ SOFTWARE: QUICK AND EASY SET-UP, CONFIGURATION, & DIAGNOSTICS

DENT's ViewPoint software utility allows you to easily configure the PowerScout for the connected CTs and to check real-time values to ensure that the meter is properly configured. ViewPoint is the quick and easy way to:

- Switch between communication protocols
- Verify meter installation
- Check real-time values before leaving the job site
- Read and write to specific registers
- Set the data scalar setting
- Update PowerScout firmware



DENT Instruments, Inc.
Energy & Power Measurement Solutions

An ISO 9001:2008 Certified Company

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without notice.
rev091914

Natural Gas & Propane Immersible Thermal Gas Mass Flow Meter

Features

- Fast response flow meter optimized for natural gas or propane measurement applications
- 200 millisecond response to changes in flow rate
- Programmable pulse output for remote totalization
- Optional Modbus communication
- Smart electronics permit field adjustment of critical flow meter settings
- Field validation of flow meter calibration
- Outstanding rangeability
- 2 x 12 backlit LCD display totalizer values along with instantaneous flow display
- Minimal flow blockage and low pressure drop
- CE approved

BoilerTrakTM-S-18



Description

Sierra Instruments' BoilerTrakTM Immersible Thermal Mass Flow Meter provides an optimized solution for natural gas or propane flow measurement applications. BoilerTrak is designed to provide an economical solution to new regulations for the burning of natural gas or propane in heaters and boilers. The meter's sensor offers long-term reliability and a 200 millisecond response to changes in flow rate.

The versatile microprocessor-based transmitter integrates the functions of flow-range adjustment, meter validation and diagnostics in a probe-mounted NEMA 4X (IP65) housing. Mass flow rate and totalized flow, as well as other configuration variables, are displayed on the meter's 2 x 12 backlit LCD panel.

The meter also provides an optical/galvanic isolated 4-20 mA output and two alarm outputs along with a programmable pulse output for remote totalization. An optional Modbus Communications package is also available. The programmable transmitter is easily configured via RS-232 and Sierra's Smart InterfaceTM WindowsTM based software (supplied with the meter) or three push buttons in the device. BoilerTrak is suitable for pipes or ducts from 1-inch to 6-inches.

Windows is a registered trademarks of Microsoft.



www.sierrainstruments.com



Performance Specifications

Accuracy of Point Velocity

+/- 1% of full scale (actual gas calibration)
 +/- 1% of full scale +/- 3% of reading (correlation)

Repeatability

+/- 0.2% of full scale

Temperature Coefficient

+/- 0.02% of reading per °F within +/- 50°F of customer specified conditions
 +/- 0.03% of reading per °F within +/- 50°F to 100°F of customer specified conditions
 +/- 0.04% of reading per °C within +/- 25°C of customer specified conditions
 +/- 0.06% of reading per °C within +/- 25°C to 50°C of customer specified conditions

Pressure Coefficient

0.2% of full scale per psi for natural gas / Methane / Propane

Response Time

200 milliseconds to 63% of final velocity value

Operating Specifications

Gases

Natural gas, Propane, Methane

Gas Pressure

0 psig to 120 psig (0 to 8 barg) Note: actual gas calibration limited to 30 psig (2 barg)

Pressure Drop

Negligible

Gas & Ambient Temperature

Gas . . . -40°F to 176°F (-40°C to 80°C)

Note: actual gas calibration limited to 50°F to 100°F (10°C to 38°C)

Ambient . . . -40°F to 120°F (-40°C to 50°C)

Power Requirements

15 to 18 VDC (regulated), 625 mA draw maximum

Note: BoilerTrak is not available in other power configurations due to safety concerns

Standard Calibrated Flow Rates

In various sizes of schedule 40 piping - STP = 70°F, 1atm (21°C, 101.3 kpa)

1.25"	80 SCFM (2.1 NM ³ /min)
1.5"	110 SCFM (2.9 NM ³ /min)
2"	185 SCFM (4.9 NM ³ /min)
2.5"	265 SCFM (7.0 NM ³ /min)
3"	410 SCFM (10.8 NM ³ /min)
4"	705 SCFM (18.5 NM ³ /min)
6"	1600 SCFM (42.1 NM ³ /min)

(L) DIMENSIONS

Code	L
L04	4.0 (101.6)
L06	6.0 (152.4)
L09	9.0 (228.6)
L13	13.0 (330.2)

Operating Specifications (cont.)

Output Signal

Linear 0–5 VDC and 4–20 mA proportional to mass flow rate.
 Modbus RTU Digital Communication ←

Alarms

Hard contact user-adjustable high and low
 Dead band adjustable with Smart Interface™ software
 Relay ratings Maximum 42 VAC or 42 VDC, 140 mA

Displays

Alphanumeric 2 x 12 digit backlit LCD
 Adjustable variables via on-board switches (password protected)
 or with Smart Interface™ software
 Adjustable variables Full scale (50 to 100 %)
 Time Response (1 to 7 seconds)
 Correction factor setting (0.5 to 5)
 Zero and span

Totalizer

Eight digits (9,999,999) in engineering units
 Resettable by software or on-board switches

Software

Smart Interface™ Windows™-based software
 Minimum 8 MB of RAM, preferred 16 MB of RAM
 RS-232 communication
 Additional features Alarm dead band adjustment
 Low flow cut-off adjustment
 Linearization adjustment
 Save / Load configurations
 Flow meter validation

Physical Specifications

Wetted Material

Probe 316SS
 Sensor. 304SS, glass coating epoxy

Enclosure

NEMA 4X (IP65) powder-coated cast aluminum

Electrical Connections

One 1/2-inch female NPT

Mounting

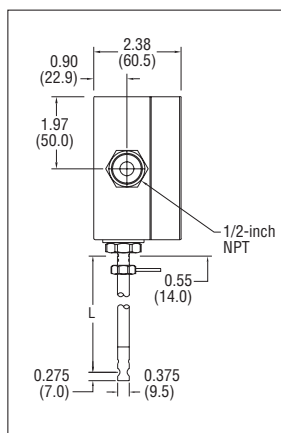
3/8-inch tube compression fitting with 1/2-inch male NPT

Certifications

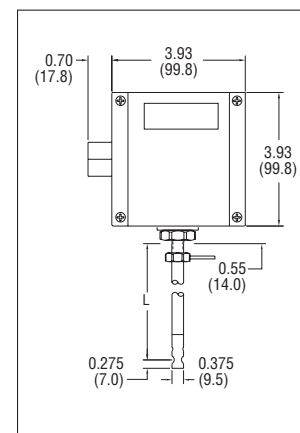
CE approved

Dimensional Specifications

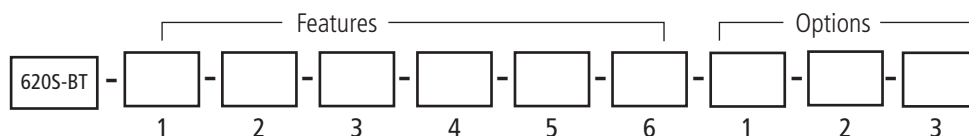
NEMA 4X—Side View (EN2)



NEMA 4X—Front View (EN2)



ORDERING INFORMATION



Instructions: To order a 620S-BT please fill in each number block by selecting the codes from the corresponding features below and following pages.

Parent Number	
620S-BT	BoilerTrak™ Insertion Mass Flow Meter optimized for natural gas and propane. 15-18 VDC input power with a 3/8-inch in diameter probe. Includes "Smart Electronics" with PC configuration software, calibrated temperatures up to 100F and pressures up to 30 psig (2.1 barg) real gas calibration and 120 psig (8.3 barg) correlation. 200 msec response. CE approved. 4-20 mA and 0-5 VDC linear output.

NOTE: ALL slpm flow ranges also available in nlpm. * Flow bodies are sized for nitrogen flow rates. Other gases must be converted to equivalent nitrogen flow. Use K-factor and size accordingly.

Feature 1: Probe Length	
L04	3.7-inches (9.5 cm)
L06	6-inch (15 cm)
L09	9-inch (23 cm)
L13	13-inch (33 cm)
L ()	Special Length - Specify length in parentheses. Maximum 24-inch (61 cm). Minimum 3.7-inches (9.5 cm)

Note: For Digital communication options, see Option 2.

Feature 3: Electronics Enclosure	
EN2	NEMA 4X (IP65) Enclosure. Mounted directly on probe.
EN4()	Remote NEMA 4X (IP65) Enclosure with Junction Box Mounted up to 200 feet (61m) away from the probe with junction box mounted on probe. Includes remote electronics enclosure mounting bracket and 1/2-inch Female NPT connection.

Feature 5: Display	
NR	No readout
DD	Digital display. 2 x 12 digit, backlit, LCD display indicates flow rate and totalized mass in engineering units. Simplifies configuration settings and provides system status information

Option 1: Digital Communications	
PULSE	Totalizer pulse output (1 Hz max)
MB	Modbus communications protocol

Option 2: Certificates	
MC	Material certificates--US Mill certs on all wetted parts
CC	Certificate of conformance
NACE	NACE certificate for sour gas
LT	Leak test certificate
PT	Pressure test certificate

Feature 2: Mounting Accessories	
M0	None. Customer to supply own mounting hardware
M1	Compression fitting for 3/8-inch probe feed through by x 1/2-inch Male NPT
M1-M2()	Compression fitting for 3/8-inch probe feed through by x 1/2-inch Male NPT including Weldolet. 1/2-inch Female NPT. Welds to pipe Specify pipe O.D. in parentheses
M3	Flat Duct Bracket. 3/8-inch tube compression fitting.
M4()	Curved duct Bracket with 3/8-inch tube compression fitting. Specify duct O.D. in parentheses.
M6	Conex (Viton® compression fitting) packing gland can be used with customer supplied ball valve for live insertion or removal up to product maximum pressures. Compression fitting for 3/8-inch probe feed through by x 1/2-inch Male NPT.

Feature 4: Output	
V1	0-5 VDC, linear
V3	0-10 VDC, linear
V4	4-20 mA, linear

Feature 6: Gas	
8	Methane (natural gas) calibration (1.0% full scale)
9	Methane (natural gas) correlation (3.0% reading plus 1% full scale)
12	Propane calibration (1.0% full scale)
13	Propane correlation (3.0% reading plus 1.0% full scale)
99	Other--consult factory

Option 3: Power Supplies	
900-T1	Power Supply, 15 VDC (for BoilerTrak only)



INSTALLATION INSTRUCTIONS

PW20

Wet-Wet Pressure Transmitter

Compatible with Senva 25, 50, 100, 250, 500psig pressure sensors



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
- De-energize power supply prior to installation or service

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.

IMPORTANT!

Do NOT exceed gage pressure rating of sensor.
Use ONLY Senva gage pressure sensors for PW transmitter.
Follow instructions step by step to ensure proper setup.

INSTALLATION

1. Plumb pressure gage sensors to media. Optional shutoff valves are available. No bypass valve manifold is necessary. Use only Senva gage pressure sensors.
2. Mount PW20 pressure transmitter such that provided cables can reach gage pressure sensors.
3. Plug custom length cables into installed gage pressure sensors.

4. Wire PW20 transmitter for voltage or current output as shown:

4-20mA wiring:

mA OUT = 4-20mA output return

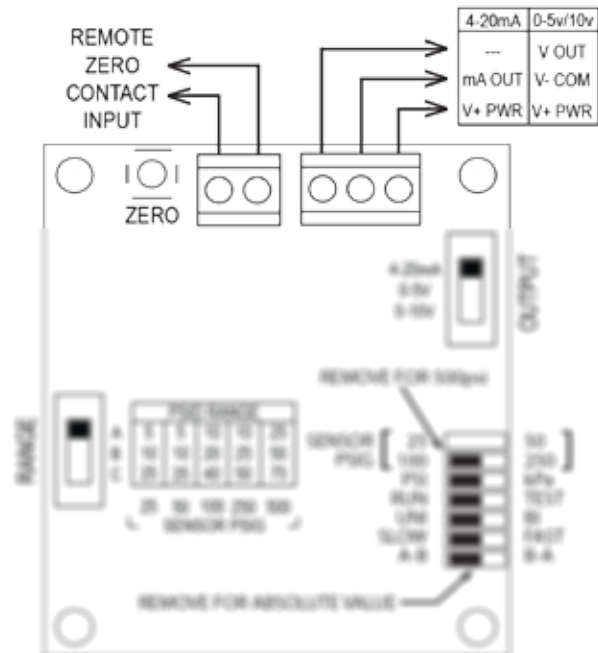
V+ PWR = Loop supply excitation voltage

0-5v/0-10v wiring:

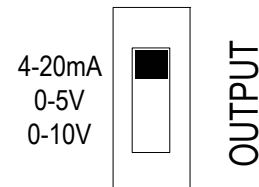
V OUT = Voltage output, 0-5 or 10vdc

V- COM = Ground/Common

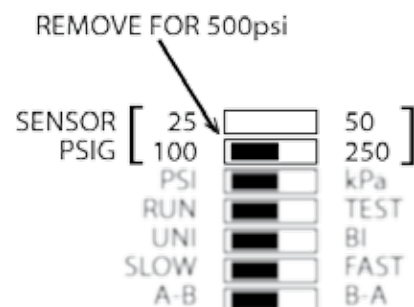
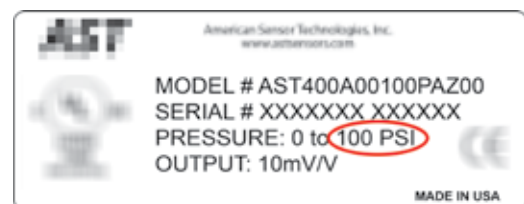
V+ PWR = Power supply excitation voltage



5. Select 20mA, 10v, or 5v output using OUTPUT switch based on wiring configuration.

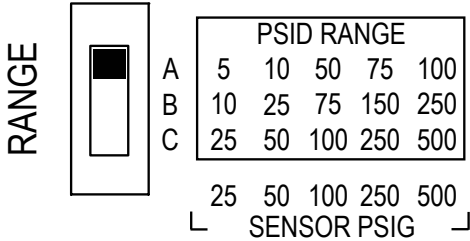


6. Configure PW20 transmitter with gage pressure sensor PSIG by setting jumper to PSI rating on sensors. ⁽¹⁾

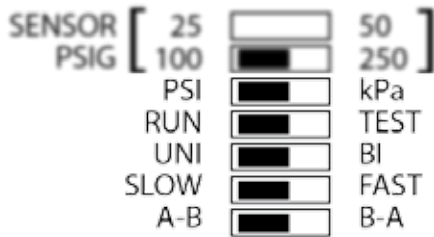


INSTALLATION CONTINUED

7. Select differential pressure range using RANGE switch. O/R symbol will flash if differential pressure is over range. Selectable PSID ranges are based on the gage sensor PSIG rating. (See 'PSID Range Selection Example' for further clarification).



8. Configure product by setting remaining jumpers as shown on diagram. (See 'Configuration Jumpers' section for details on each parameter)



REMOVE FOR ABSOLUTE VALUE

9. Apply power to sensor. With no pressure applied, press the ZERO button for 6-seconds⁽²⁾. Hold button for 10-seconds to restore factory setting. TEST MODE jumper may be used to force full-scale output for testing wiring and panel set up.

(1) PSI rating on Senva gage pressure sensors must be higher than maximum PSIG expected in application.

(2) Push ZERO button for full 6-seconds. LCD will indicated button is being pushed after 2 seconds. Continue holding to re-zero firmware.

CONFIGURATION JUMPERS

Sensor Select	Select FS range of pressure sensor.
Display Units	PSI or kPa
Test Mode	Forces outputs to full-scale
Direction Mode	Uni/Bi-Directional
Response Time	Slow or Fast
Port Swap	A-B or B-A
Absolute Mode	Absolute value (always positive)

Bi-Directional Mode Example:

A	B	DP	OUTPUT
100	0	+100	20mA/10V
100	50	+50	16mA/7.5V
50	50	0	12mA/5V
50	100	-50	8mA/2.5V
0	100	-100	4mA/0V

CALIBRATION

Senva PWS sensors are factory calibrated. No field calibration is necessary or recommended.

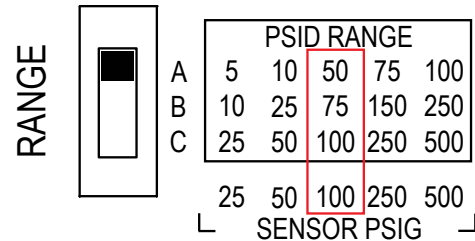
TROUBLESHOOTING

Symptom	Solution
No output	Check wiring. Ensure power supply meets requirements.
Pressure reading error	Verify control panel software is configured for correct output scaling. Verify switch and jumper settings.
Device will not zero	Hold ZERO button for full 6-seconds Continue holding ZERO button for 10-15 seconds to restore factory settings.

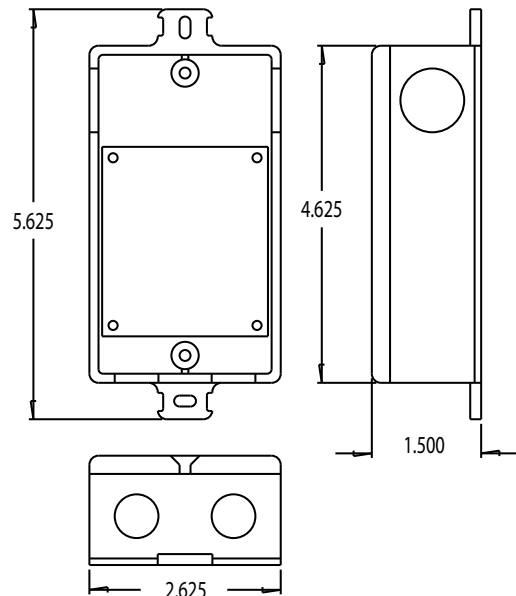
PSID RANGE SELECTION EXAMPLE

Each PWS gage pressure sensor element offers three ranges for PSID. The PSID range is selected via switch on the PW20 transmitter board. The PSID range options are in the column directly above the gage sensor PSIG rating.

This example shows the three ranges for the 100 PSIG elements. Installer can select the proper PSID range by moving the switch to the desired range. O/R symbol will flash if selected differential pressure is over range.



DIMENSIONS



SPECIFICATIONS

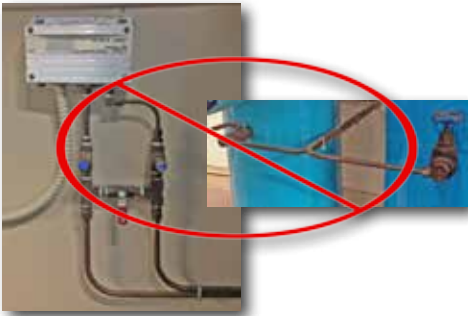
Power supply	Voltage output mode (0-5v)	12-30vdc/24vac ⁽¹⁾ , 20mA max.
	Voltage output mode (0-10v)	15-30vdc/24vac required for 10v f.s. output
	Current (4-20mA) output mode	12-30vdc, 20mA max.
Outputs	Switch selectable	2-wire 4-20mA, 3-wire 0-5v/10v
Pressure ranges (Switch selectable)	25psig sensor (PWS025)	5/10/25psid
	50psig sensor (PWS050)	10/25/50psid
	100psig sensor (PWS100)	50/75/100psid
	250psig sensor (PWS250)	75/150/250psid
	500psig sensor (PWS500)	100/250/500psid
Operating Temperature	Transmitter	32 to 140°F (0-60°C)
Media Compatibility	Sensor	Water, other 17-4 SS compatible media
Zero adjustment	Automatic	Pushbutton, terminal block switch input Press button for 6-seconds to re-zero Hold for 10-seconds to restore factory setting.
Sensor Type		Micro-machined silicon strain gauge
Sensor (PWS[xxx])Performance	Accuracy	< +/-0.5% BFSL
	Stability (1 year)	+/-0.25%FS, typ
	Over-range protection	2x rated pressure
	Burst pressure	5x or 20,000psi (whichever is less)
	Pressure Cycles	> 100 Million
	Compensated Range	30 to 130°F (0-55°C)
	Temperature Compensation	Zero, <+/-1.5% of FS Span, <+/-1.5% of FS
	Shock	100G, 11 msec, 1/2 sine
	Vibration	10G peak, 20 to 2000 Hz.
	EMI/RFI Protection	Yes
Enclosure, PW20 Transmitter	Construction	Powder coated steel
	Sealing	IP65 (Installed with water-tight fittings.)
Enclosure, PWS[xxx] Sensor	Construction	Stainless Steel, 17-4, 1/4" MNPT, Deutsch DT series connector

(1) One side of transformer secondary is connected to signal common. Dedicated transformer is recommended.



“ The install was great, no need for copper and a pipe fitter to finish it; plus it's the best instrument I have used in the last 20 years. ”

Eliminates costly plumbing and bypass assemblies



Standard LCD simplifies installation

Save time and money by eliminating costly plumbing with our new wet-wet pressure transducer!

Our PW Wet-Wet Series revolutionary design eliminates costly field plumbing. Simply run wires to sensors instead of costly plumbing! Also eliminates the need for costly bypass assemblies.

Each PW transmitter features a standard LCD for ease of installation and field replaceable PWS sensing elements to ensure your customer is getting a great value upfront and in the future. Startup time is also reduced since purging air out of the lines is not necessary. Project call for conduit? Order the PW Series with armored cable and save even more time! The PW Wet-Wet Series is a game changer, so what are you waiting for?



Wire leads--not pipe!



Remote mounted sensors

Wet-wet Differential Pressure

0 to 5~500 PSID (0 to 273~3447 kPa)

Revolutionary design eliminates plumbing

LCD display (PSID or kPa jumper selectable)

Dual 0-5/10VDC and 4-20mA outputs



DESCRIPTION

The PW Wet-Wet series remote sensors are installed directly into the pipe and electrical connection is made between the PWS remote sensors and the PW transmitter via cables. This dramatically reduces labor cost by eliminating plumbing/piping to a traditional transducer. Startup time is reduced since purging air out of the lines is not necessary. Traditional plumbed bypass assemblies are no longer required. Choose between the PW10 and PW20 model based on your anticipated PSID range.

APPLICATIONS

- Ideal for monitoring pumps and load differential pressures in HVAC systems and processes where local indication is needed.
- Process control systems
- Flow measurement of various gases or liquids
- Liquid level measurement of pressurized vessels

FEATURES

Versatile Universal Transmitter

- Three selectable PSID ranges per sensing element
- Low and standard PSID range transmitter models
- 500 PSIG is ideal for high rise applications
- User friendly LCD displays in PSID or kPa

Jumper selectable features for easy installation

- Absolute mode outputs absolute value of difference
- Port swap corrects plumbing errors
- Fast/slow to select desired response time
- Uni/bi directional
- Test mode—forces full-scale output
- Over range icon flashes if differential pressure is over-range, alerting technician to move range switch to next higher dp setting and rescale panel.
- Switch selectable outputs: 2-wire 4-20mA, 3-wire 0-5V or 0-10V

High Reliability

- MEMS sensor technology

Snap on deutsch sensor connection

- Allows for mounting sensor and quick connection of wire later
- Eliminates wire twisting when tightening sensors in pipe fitting

Save time and money--pull wires, not pipe!

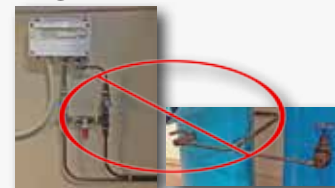


Pre-wired leads for fast snap connection to sensors



Revolutionary design eliminates costly field plumbing. Simply run wires to sensors instead of costly plumbing! Also eliminates the need for costly bypass assemblies.

Don't waste time and money on plumbing like this ever again!



Cables are prefabricated and snap onto sensors with industrial deutsch connectors. This eliminates wire twisting when tightening sensors. IP65 rated for outdoor use.

ORDERING
UNIVERSAL TRANSMITTER: PW
Transmitter Ranges

 10 = Low PSID selectable ranges
 20 = Standard PSID selectable ranges

Sensor Cable Length (feet)

 A = 3'
 B = 6'
 C = 9'
 D = 15'
 E = 20'
 F = 25'
 G = 30'
 H = 35'
 I = 40'
 J = 45"
 K = 50'
 L = 75'
 M = 100'

Sensor Cable Type

A = Armored Conduit None = Standard plenum rated cable

range length type


Ordering sensors: Order elements based on expected maximum PSIG. Order quantity of (2) PWSxxx sensors of same pressure range per (1) PW transmitter.
Need further explanation: Turn to page 34

element number

REMOTE SENSORS: PWS
Element Number

Element Number	Element Range	PW10 Selectable Ranges	PW20 Selectable Ranges
025	25 PSIG	5/10/25 PSID	5/10/25 PSID
050	50 PSIG	5/10/25 PSID	10/25/50 PSID
100	100 PSIG	10/20/40 PSID	50/75/100 PSID
250	250 PSIG	10/25/50 PSID	75/150/250 PSID
500	500 PSIG	25/50/75 PSID	100/250/500 PSID

PRESSURE SENSOR SERVICE VALVE: PWBV


Optional service valve PWBV for live sensor swap

SPECIFICATIONS

Power Supply	Voltage output mode 0-5V	12-30VDC/24VAC(1), 20mA max.
	Voltage output mode 0-10V	15-30VDC/24VAC required for 10V full scale output
	Current (4-20 mA) output mode	12-30VDC, 20mA max.
Output type	Switch selectable	3-wire 0-5/10VDC and 2-wire 4-20mA
	Model PWS025	25 PSIG (Select 5/10/25 PSID)
Pressure Ranges	Model PWS050	50 PSIG (Select 5/10/25 or 10/25/50 PSID based on PW Model)
	Model PWS100	100 PSIG (Select 10/20/40 or 50/75/100 PSID based on PW Model)
	Model PWS250	250 PSIG (Select 10/25/50 or 75/150/250 PSID based on PW Model)
	Model PWS500	500 PSIG (Select 25/50/75 or 100/250/500 PSID based on PW Model)
Operating Temperature	Transmitter	32 to 140F (0-60°C)
Media compatibility		Water; other 17-4 SS compatible media
Jumper Selectable Features	Absolute mode	Sensor outputs absolute value of difference
	Port swap	Corrects plumbing errors
	Response time	Fast/slow modes
	Test mode	Forced full-scale output
	Display units	PSI/kPa
	Direction mode	Uni/Bi
Zero Adjustment		Push-button, 1 sec to enable, 5 sec to restore factory settings
Sensor Type		Micro-machined silicon strain gauge
Sensor Performance	Accuracy	< ±0.5% BFS
	Stability (1 Year)	±0.25%FS, typ
	Overrange Protection	2X Rated Pressure
	Burst Pressure	5X or 20,000 psi (whichever is less)
	Pressure Cycles	> 100 Million
	Compensated Range	0 to 55°C (30 to 130°F)
	Temp. Comp. Zero	<±1.5% of FS
	Temp. Comp. Span	<±1.5% of FS
	Shock	100G, 11 msec, 1/2 sine
	Vibration	10G peak, 20 to 2000 Hz.
	EMI/RFI Protection	Yes
Enclosure, PW20 Transmitter	Construction	Powdered coated steel
	Sealing	IP65 (when installed with water-tight fittings)
Enclosure, PWS (xxx) Sensor	Construction	Stainless Steel 17-4, 1/4" MNPT, Deutsch DT series connector

(1) One side of transformer secondary is connected to signal common. Dedicated transformer is recommended.

(2) 15-30VDC/24VAC power supply voltage required for 10 volt output.



First time ordering our PW series? Let us help step by step!

Step 1

Tips for ordering the PW transmitter: Start by choosing your cable length and type. The range should be selected after you have decided which PWS remote sensors fit the application.



UNIVERSAL TRANSMITTER: PW Transmitter Ranges

10 = Low PSID selectable ranges
20 = Standard PSID selectable ranges

Sensor Cable Length (feet)

A = 3'
B = 6'
C = 9'
D = 15'
E = 20'
F = 25'
G = 30'
H = 35'
I = 40'
J = 45"
K = 50'
L = 75'
M = 100'

Sensor Cable Type

A = Armored Conduit None = Standard plenum rated cable

Step 2

Tips for ordering the PWS elements: Choose a pair of PWS elements that are rated above your max PSIG to ensure no clipping occurs. Order (2) PWS elements of the same PSIG rating per (1) PW transmitter.



REMOTE SENSORS: PWS

Element Number

Element Number	Element Range	PW10 Selectable Ranges	PW20 Selectable Ranges
025	25 PSIG	5/10/25 PSID	5/10/25 PSID
050	50 PSIG	5/10/25 PSID	10/25/50 PSID
100	100 PSIG	10/20/40 PSID	50/75/100 PSID
250	250 PSIG	10/25/50 PSID	75/150/250 PSID
500	500 PSIG	25/50/75 PSID	100/250/500 PSID

PRESSURE SENSOR SERVICE VALVE: PWBV



Optional service valve PWBV for live sensor swap

The PWBV is an optional service valve. Order (2) PWBV service valves per (1) PW transmitter.

Step 3

Deciding between a PW10 and PW20: After selecting the proper pair of PWS elements, select the PW10 or PW20 transmitter based on the PSID scale that fits your application. The PW10 has lower ranges for PSID than the PW20 transmitter. (Use the table under 'Step 2' to cross reference the PSID ranges associated with each PWS element)

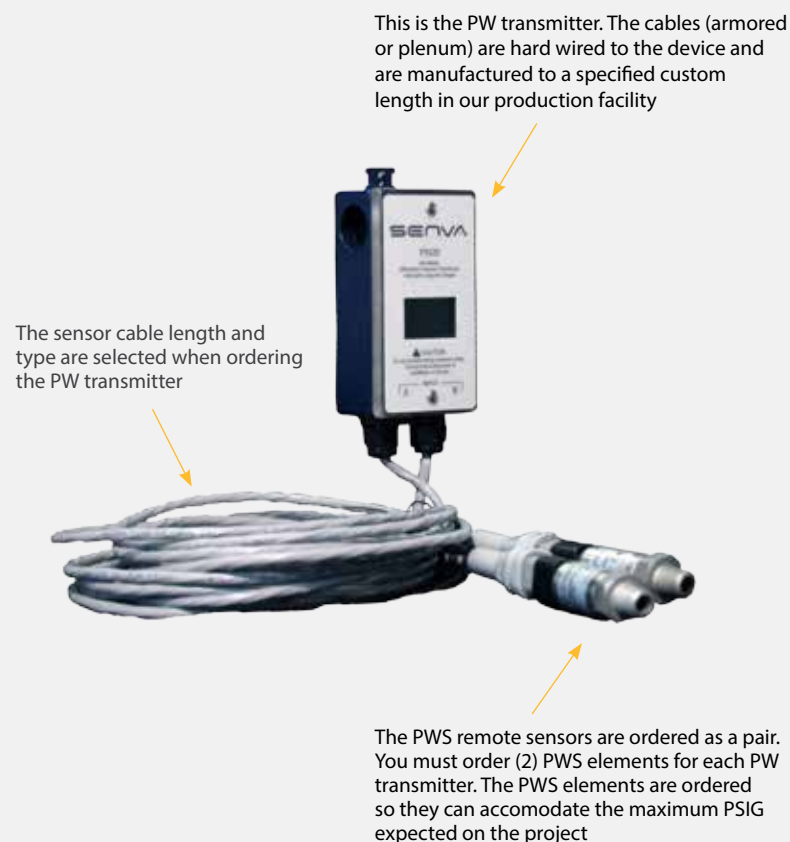
Examples

Example 1: Your project has a maximum of 80 PSIG with anticipated PSID between 10-15. For this application you would need (2) PWS-100 elements to accommodate the max gage pressure and (1) PW10 transmitter that will allow scaling the range between 10/20/40 PSID for the differential pressure.

Example 2: Your project has a maximum of 80 PSIG with anticipated PSID between 50-60. For this application you would need (2) PWS-100 elements to accommodate the max gage pressure and (1) PW20 transmitter that will allow scaling the range between 50/75/100 PSID for the differential pressure.

Example 3: Your project has a maximum of 400 PSIG with anticipated PSID between 15-20. For this application you would need (2) PWS-500 elements to accommodate the max gage pressure and (1) PW10 transmitter that will allow scaling the range between 25/50/75 PSID for the differential pressure.

PART NUMBER IDENTIFICATION





Series
PFT

Paddlewheel Flow Sensor

Non-Magnetic Sensing, Insertion Style for 1-1/2 to 40" Pipe,
Pulse or 4 to 20 mA



NEW!
4 to 20 mA Output Models

The Series PFT is a paddlewheel flow sensor used to monitor liquid flow rates in pipes from 1-1/2 to 40" with just one size adjustable sensor. Multiple wetted material choices offer application versatility. The PFT is ideal for monitoring water flow rates in irrigation systems and building automation cooling systems.

The PFT uses inductive sensing to sense the blades of the impeller as they rotate. Sensor technology does not use magnets allowing low flow rate monitoring and no concerns with magnetic material in the flow. Two output choices are available in the PFT, pulse or 4 to 20 mA. The pulse models are a square wave output signal with frequency proportional to the flow velocity. The 4 to 20 mA models have a linear output of the velocity with 4 mA equal to 0 ft/s and 20 mA equal to 25 ft/s. There are no external components needed to have the 4 to 20 mA output unlike other competitor products. Paddlewheel, shaft and bearings are easily field replaceable.

FEATURES

- Bearings and shaft offer excellent wear protection even in applications with particulate for long life
- Weatherproof and submersible rated for irrigation applications

APPLICATIONS

- Irrigation, ground water remediation, cooling systems, pump protection, leak detection, filtration systems

SPECIFICATIONS

Service: Water-based fluids.

Range: 1.2 to 25 ft/s (0.37 to 7.62 m/s).

Wetted Materials: Body and fitting: Brass or 316 SS; fitting O-ring: FKM standard, silicone or Buna-N optional; impeller: 316 SS; shaft: Tungsten carbide standard or 316 SS optional; bearing: PTFE standard, carbon graphite optional.

Linearity: $\pm 1.0\%$ of full range.

Repeatability: $\pm 0.5\%$ of full range.

Temperature Limits: -40 to 212°F (-40 to 100°C).

Pressure Limits: 400 psig (27.6 bar) @ 100°F (37.8°C), 325 psig (22.4 bar) @ 212°F (100°C).

Process Connection: 1-1/2" NPT male standard, 2" NPT male optional.

Output:

Pulse: NPN open collector with square wave output, rated 60 V @ 50 mA max. Frequency: 3.2 to 200 Hz. Pulse Width: 2.5 msec $\pm 25\%$.

4 to 20 mA: 4 mA is 0 ft/s, 20 mA is 25 ft/s.

Power Requirement: 10 to 35 VDC.

Power Consumption: 40 mA (max.).

Electrical Connection: 22 AWG shielded UL type PTLC rated 105°C, 20' (6.1 m) long with cable gland. Can be extended up to 2000' (609 m) with similar cable. Optional UL listed burial rated cable.

Enclosure Rating: NEMA 6P (IP67).

Housing Materials: Brass or 316 SS.

Weight: 3 lb.

Agency Approval: CE.

Model	Body Material	Output	Description
PFT-IAN-B111-S	Brass	4 to 20 mA	1-1/2" NPT connection, FKM seals, tungsten-carbide shaft, PTFE bearing, 20' of cable
PFT-IAN-S111-S	316 SS	4 to 20 mA	1-1/2" NPT connection, FKM seals, tungsten-carbide shaft, PTFE bearing, 20' of cable
PFT-IDN-B111-S	Brass	Pulse	1-1/2" NPT connection, FKM seals, tungsten-carbide shaft, PTFE bearing, 20' of cable
PFT-IDN-S111-S	316 SS	Pulse	1-1/2" NPT connection, FKM seals, tungsten-carbide shaft, PTFE bearing, 20' of cable

Consult factory for longer cable lengths, burial rated cable, 2" NPT connection, or other wetted materials.

For compatible installation fittings see Series SDF.

FLOW

Flow Transmitters, Paddlewheel, Adjustable Insertion

**R2 Enclosure**

Room with Setpoint & Override



Room



Room, Setpoint



Room, Override



Room (Infinity)



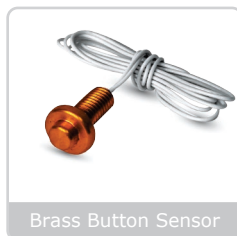
Room, Setpoint



Room, Override

Room, Setpoint,
Override

Stainless Plate

Stainless Plate,
Override

Brass Button Sensor



Stainless Button Sensor



Plastic Button Sensor

THERMISTORS

Wall Mounting

ACI offers a comprehensive list of wall mounting configurations for Thermistors (see list above). These sensors provide a predictable and accurate output over the specified temperature range. Each sensor configuration is designed and manufactured for long-term quality and performance. The most prominent of the series is the R2 wall mount enclosure which features a sleek and modern design. ACI wall mount enclosures offer the option of having a customized logo. Certain minimums, special part numbers, and specific artwork file types may be required. Please contact ACI for further details regarding custom labels. The ACI Button Series is an unobtrusive option for unique applications. This series is offered in brass, stainless steel, and plastic to blend into a wide array of decors.

The ACI Thermistor Series 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 web site, www.workaci.com.



SPECIFICATIONS

Accuracy (0-70°C)	Single Point: +/-0.2°C (+/-0.36°F)	Sensor Output [A/10KS]	10KΩ @77°F (25°C)
Stability	+/-0.13°C (+/-0.23°F)	Sensor Output [A/2252]	2252Ω @77°F (25°C)
Interchangeability	+/-0.2°C (+/-0.36°F)	Sensor Output [A/CSI]	10KΩ @77°F (25°C)
Operating Temperature Range	32 to 122°F (0 to 50°C)	Sensor Output [A/AN-BC]	10KΩ with 11K Shunt
PBS Housing Material	ABS Compound (low smoke)	Sensor Output [A/10K-E]	10KΩ @77°F (25°C)
Sensor Output [A/AN]	10KΩ @ 77°F (Type III)	Sensor Output [A/10K-E1]	10KΩ @77°F (25°C)
Sensor Output [A/CP]	10KΩ @ 77°F (Type II)	Setpoint Tolerance	+/- 10% of the range
Sensor Output [A/3K]	3KΩ @77°F (25°C)	Power Dissipation Constant	3 mW/°C
Sensor Output [A/1.8K]	1.8KΩ @77°F (25°C)	Operating Humidity Range	0 to 90% RH non-condensing
Sensor Output [A/20K]	20KΩ @77°F (25°C)	Product Dimensions	Please reference pages 7 & 8
Sensor Output [A/100KS]	100KΩ @77°F (25°C)		

ORDERING

Select one Series (A), one Enclosure (either Aries or Infinity) (B), & one Communication Jack (C). When selecting your Configuration (B) if "R2S", "RS", "RSO" or "R2SO" please choose a Pot Value (D), an Offset Resistor (E), Sticker (F) & a Pot Action (G). If "R2S", "RS", "RSO" or "R2SO" is not selected, your Part Number is finished after completing Communication (C). If a Stainless Plate or Button Sensor (1) is desired, please add a Stainless Plate (SP), Brass Button Sensor (BBS), Stainless Button Sensor (SBS), or a Plastic Button Sensor (PBS) to the separate Part Number below

NOTE: Sections (D) through (G) are for internal references and will not be displayed in your final part number. *Regarding the Sensor Series (1) and Additional Configuration (2), the A/10KS and A/AN-BC are not available as PBS.

A Room Sensor Series			B Aries Enclosure		Infinity Enclosure	C Communication	
☐ A/AN (Type III)	☐ A/20K	☐ A/CSI	☐ R2 (Room)		☐ R (Room)	☐ RJ4 (4 Pin/Conductor)	
☐ A/CP (Type II)	☐ A/100KS	☐ A/AN-BC	☐ R2S (Room, Setpoint)		☐ RS (Room, Setpoint)	☐ RJ6 (6 Pin/Conductor)	
☐ A/3K	☐ A/10KS	☐ A/10K-E	☐ R2O (Room, Override)		☐ RO (Room, Override)	☐ RS232 (Stereo Jack)	
☐ A/1.8K	☐ A/2252	☐ A/10K-E1	☐ R2SO (Room, Setpoint, Override)		☐ RSO (Room, Setpoint, Override)	☐ ---- (No Jack)	

D	Pot Value	E	Offset Resistor	F	Sticker	G	Pot Action						
☐	400	☐	8.5K	☐	0Ω (Default)	☐	1KΩ	☐	7.32K	☐	Blue/Red (R2 Only)	☐	DA (Direct)
☐	1K	☐	10K	☐	499Ω	☐	2KΩ	☐	8.25K	☐	Cool/Warm	☐	RA (Reverse)
☐	2K	☐	20K	☐	806Ω	☐	4.99K	☐	10K	☐	55 to 85°F		
☐	5K	☐	100K	☐	910Ω	☐	6.19K	☐	20K	☐	10 to 30°C		

1 Sensor Series	2 Additional Configuration
☐ A/AN ☐ A/20K ☐ A/CSI ☐ SP (Stainless Plate) ☐ BBS (Brass Button Sensor) ☐ PBS* (Plastic Button Sensor)	
☐ A/CP ☐ A/100KS ☐ A/AN-BC* ☐ SP-OR (Stainless Plate, Override) ☐ SBS (Stainless Button Sensor)	
☐ A/3K ☐ A/10KS* ☐ A/10KE	
☐ A/1.8K ☐ A/2252 ☐ A/10KE1	

BUILD PART NUMBER

After completing (A), (B), (C), (D), (E), (F) & (G) from the above table, fill in the "Part Number Table" below. (1) & (2) are additional configurations. An "example" part number is offered.

A	B	C	D	E	F	G
---	---	---	---	---	---	---

EXAMPLE: A/AN - R2 - RJ6

1	2
---	---

EXAMPLE: A/AN - SP

The R2 & R enclosures have a UL94-HB flammability rating.





Featured Thermistor Product

Duct



Duct w/o Box

Immersion, Two
Piece WellImmersion,
Machined Well

Immersion w/o Well



Copper Averaging



Flexible Averaging



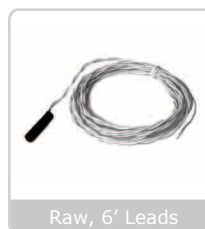
Strap



Outdoor Air



Raw Potted Sensor



Raw, 6' Leads



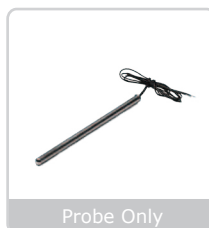
Bullet Probe



Bullet Probe, 20' Z



Rigid Averaging



Probe Only

THERMISTORS

General Mounting

ACI offers a comprehensive selection of general mounting configurations for Thermistors (see list above). These sensors provide a predictable and accurate output over the specified temperature range. Each sensor configuration is designed and manufactured for long-term quality and performance. ACI incorporates standard features such as double encapsulation and etched Teflon leads where applicable.

The ACI Thermistor Series is covered by ACI's Five (5) year limited warranty, which is located in the front of ACI's Sensors & Transmitters catalog or can be found on ACI's web site, which is www.workaci.com.



SPECIFICATIONS

Accuracy (0-70°C)	Single Point: +/-0.2°C (+/-0.36°F)	Sensor Output [A/10KS]	10KΩ @ 77°F (25°C)
Stability	+/-0.13°C (+/-0.23°F)	Sensor Output [A/2252]	2252Ω @ 77°F (25°C)
Interchangeability	+/-0.2°C (+/-0.36°F)	Sensor Output [A/CSI]	10KΩ @ 77°F (25°C)
Operating Temperature Range	-40 to 302°F (-40 to 150°C)	Sensor Output [A/AN-BC]	10KΩ with 11K Shunt
Sensor Output [A/AN]	10KΩ @ 77°F (Type III)	Sensor Output [A/10KE]	10KΩ @ 77°F (25°C)
Sensor Output [A/CP]	10KΩ @ 77°F (Type II)	Sensor Output [A/10KE1]	10KΩ @ 77°F (25°C)
Sensor Output [A/3K]	3KΩ @ 77°F (25°C)	Power Dissipation Constant	3 mW/°C
Sensor Output [A/1.8K]	1.8KΩ @ 77°F (25°C)	Operating Humidity	10 to 95% RH non-condensing
Sensor Output [A/20K]	20KΩ @ 77°F (25°C)	Product Dimensions	Please reference pages 5, 6, 7 & 8
Sensor Output [A/100KS]	100KΩ @ 77°F (25°C)		

ORDERING

Select one Series (A), one Configuration (B), one Length (C), one Enclosure (D) & one Lead Wire (E) (optional). **NOTE:** See Thermowell data sheet for proper well selection for all Immersion related sensors. Enclosure options (D) include Plastic Box (PB), Galvanized Box (GD), NEMA 3R (BB), NEMA 4X (4X), & Euro Housing (EH). The Plastic Box (PB) is rated from 0 to 203°F. Stay within the same row throughout the selection process for all General Mounting pages. ▶

A Sensor Series

- ☐ A/AN ☐ A/3K ☐ A/20K ☐ A/10KS ☐ A/CSI ☐ A/10KE
☐ A/CP ☐ A/1.8K ☐ A/100KS ☐ A/2252 ☐ A/AN-BC ☐ A/10KE1

B Configuration

C Length

D Enclosure

E Lead Wire

☐ D (Duct) ▶	☐ 4" ☐ 6" ☐ 8" ☐ 12" ☐ 18" ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ DO (Duct w/o Box) ▶	☐ 4" ☐ 6" ☐ 8" ☐ 12" ☐ 18" ▶	☐ ---- (No Enclosure) ▶	☐ ---- (N/A)
☐ PO (Probe Only) ▶	☐ 4" ☐ 6" ☐ 8" ☐ 12" ☐ 18" ▶	☐ ---- (No Enclosure) ▶	☐ 6'CL2P ☐ 10'CL2P ☐ 20'CL2P
☐ I (Immersion, Two Piece Well) ▶	☐ 2.5" ☐ 4" ☐ 6" ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ IM (Immersion, Machined Well) ▶	☐ 2.5" ☐ 4" ☐ 6" ☐ 12" ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ INW (Immersion w/o Well) ▶	☐ 2.5" ☐ 4" ☐ 6" ☐ 12" ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ A (Copper Averaging) ▶	☐ 8' ☐ 12' ☐ 24' ☐ 50' ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ FA (Flexible Cable Averaging) ▶	☐ 8' ☐ 12' ☐ 24' ☐ 50' ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ RA (Rigid Averaging) ▶	☐ 18" ☐ 24" ☐ 36" ▶	☐ PB ☐ GD ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ S (Strap) ▶	☐ ---- (No Length) ▶	☐ PB ☐ GD ☐ ---- ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ O (Outdoor Air) ▶	☐ ---- (No Length) ▶	☐ ---- ☐ ---- ☐ BB ☐ 4X ☐ EH ▶	☐ ---- (N/A)
☐ W (Raw Potted Sensor) ▶	☐ ---- (No Length) ▶	☐ ---- (No Enclosure) ▶	☐ ---- (N/A)
☐ W-6' (Raw w/6' Leads) ▶	☐ ---- (No Length) ▶	☐ ---- (No Enclosure) ▶	☐ ---- (N/A)
☐ BP (Bullet Probe, Plenum Cable) ▶	☐ ---- (No Length) ▶	☐ ---- (No Enclosure) ▶	☐ 6'CL2P ☐ 10'CL2P ☐ 20'CL2P
☐ BP (Bullet Probe, Teflon leads) ▶	☐ ---- (No Length) ▶	☐ ---- (No Enclosure) ▶	☐ ---- (N/A)
☐ BP-20'Z (BP, 20' Zip Wire) ▶	☐ ---- (No Length) ▶	☐ ---- (No Enclosure) ▶	☐ ---- (N/A)

BUILD PART NUMBER

After completing (A), (B), (C), (D) & (E) from the above table, fill in the "Part Number Table" below. An example part number is offered.

A	B	C	D	E
---	---	---	---	---

EXAMPLE: A/CP - D - 4" - PB

The Plastic Box has a UL94-HB rating. The NEMA 4X enclosure has a UL94-V2 flammability rating. The Euro Housing enclosure has a UL94-V0 flammability rating. CE exception: Averaging units and any other configuration with leads longer than 3 meters.





Featured Relative Humidity Resistive Product

Duct/Euro



Outside Air/Euro



Stainless Plate



Room 2



Room 2, Setpoint



Room 2, Override

Room 2, Setpoint,
Override

Room



Room, Setpoint



Room, Override

Room, Setpoint,
Override

RH RESISTIVE

RH with Resistive Temperature Output

The A/RH Series relative humidity transmitters (with resistive temperature output) utilize a capacitive sensing element to deliver a proportional analog output. This series features on board DIP switches which allow the user to select the desired output signal. In addition, field calibration can be performed by using the on board increment and decrement DIP switches. These enhancements provide increased flexibility and outstanding long-term performance. Duct and Outside Air configurations feature conformally coated circuit boards for moisture resistance. Several RTD and thermistor temperature sensing elements are available in this series.

The A/RH Series 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 web site, www.workaci.com.



SPECIFICATIONS

RH Supply Voltage (4 to 20 mA)	(250 Ohm Load): 15 to 40 VDC/18 to 28 VAC
RH Supply Voltage (4 to 20 mA)	(500 Ohm Load): 18 to 40 VDC/18 to 28 VAC
RH Supply Voltage (0-5 VDC)	12 to 40 VDC/18 to 28 VAC (4K Load minimum)
RH Supply Voltage (0-10 VDC)	0-10 VDC: 18 to 40 VDC/18 to 28 VAC (4K Load minimum)
Supply Current	Voltage Output: 8 mA maximum Current Output: 24 mA maximum
RH Measurement Range	0-100%
RH Output	2-wire: 4 to 20 mA (standard) 3-wire: 0-5 VDC, 0-10 VDC or 4 to 20 mA
RH Accuracy @ 77°F (25°C)	+/- 1% over 20% span (between 20 to 90%) +/- 2%, 3%, or 5% from 10 to 95%
Long Term Stability	Less than 2% drift/5 years
Repeatability	0.5% RH
Sensitivity	0.1% RH
Operating Environment, Duct/Outside	0 to 100% RH -40 to 140°F (-40 to 60°C)
Operating Environment, Room	0 to 95% RH (non-condensing) 32 to 122°F (0 to 50°C)
RH Sensor Type	Capacitive
Temperature Specifications	See corresponding Temp data sheets
Product Dimensions (Duct/Euro)	Enclosure: (W) 3.60" (D) 2.25" Probe: (L) 7.15"
Product Dimensions (Outside Air)	Cover: (H) 3.61" (W) 4.00" (D) 2.25" Stem: (H) 3.00" (W) 1.13"
Product Dimensions (Room 2)	(H) 4.50" (W) 2.75" (D) 1.12"
Product Dimensions (Room)	(H) 4.51" (W) 2.75" (D) 2.90"
Product Dimensions (Stainless Plate)	Plate: (H) 4.51" (W) 2.76" (D) 0.19" Filter: (L) 1.06"

ORDERING

Select one Series (A). If A/RH1 is selected, you must specify a 20% range. Choose a Temperature Sensor (B), one Configuration (C), & one RH Output (D). When selecting your Configuration (A), if "R2S", "RS", "RSO" or "R2SO," please choose a Pot Value (E), a Sticker (F) & a Pot Action (G). If "R2S", "RS", "RSO" or "R2SO" is not selected, your Part Number is finished after completing RH Output (D). **NOTE:** 4 to 20 mA output is not available for the SP configuration.

A Accuracy ☐ A/RH1 (+/-1%) (Specify 20% Range) ☐ A/RH2 (+/-2%) ☐ A/RH3 (+/-3%) ☐ A/RH5 (+/-5%)	B Temp Sensor ☐ 100-2W ☐ 1K-2W ☐ 1K-NI ☐ 100-3W ☐ 1K-3W ☐ 375 ☐ 3K ☐ 10KS ☐ 100KS ☐ AN (Type III) ☐ CP (Type II) ☐ CSI ☐ 20K ☐ 1.8K ☐ 10KE ☐ AN-BC ☐ 10KE1	C Configuration ☐ D (Duct/Euro) ☐ R2SO (Room, Setpoint, Override) ☐ O (Outside Air/Euro) ☐ R (Room) ☐ O-4X (Outside Air/NEMA 4X) ☐ RS (Room, Setpoint) ☐ SP (Stainless Plate) ☐ RO (Room, Override) ☐ R2 (Room) ☐ RSO (Room, Setpoint, Override) ☐ R2S (Room, Setpoint) ☐ R2O (Room, Override)
D RH Output ☐ ---- (4 to 20 mA) ☐ 5 (0-5 VDC) ☐ 10 (0-10 VDC)	E Setpoint Pot Value ☐ 400 ☐ 2K ☐ 100K ☐ 8.5 ☐ 20K ☐ 1K ☐ 3K ☐ 5K ☐ 10K ☐ Specify Pot Value	F Sticker G Pot Action ☐ Blue/Red ☐ DA (Direct) ☐ RA (Reverse)

BUILD PART NUMBER

After completing (A), (B), (C), (D), (E), (F) & (G) from the above table, fill in the Part Number Table below. An example part number is offered.

—	—	—	—	—	—	—
A	B	C	D	E	F	G

EXAMPLE: A/RH3 - CP - D

The Euro enclosure has a UL94-V0 flammability rating.





HUMIDITY

ROOM, DUCT, AND OSA 5% HUMIDITY TRANSMITTERS

A/RH5 SERIES

DESCRIPTION

The **ACI A/RH5 Series relative humidity transmitters** are specifically designed for HVAC/BAS applications and have proportional 4 to 20 mA, 0 to 5 VDC, or 0 to 10 VDC output for 5% measurement. It is available for room, duct, outside, and stainless steel wall plate applications. The **A/RH5 Series** has on board DIP switches which allow the user to select the desired output signal and can be powered by AC or DC power sources.

FEATURES

- Popular room housing
- Five-year warranty
- Duct and OSA twist-off NEMA 4 housing
- 24 VDC or 24 VAC power
- Field selectable current or voltage outputs
- Single point field calibration
- Optional temperature sensor



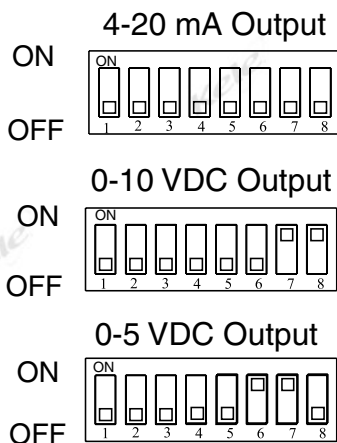
SPECIFICATIONS

Accuracy	±5% @ 77°F (25°C) from 10% to 95%
Stability	±2% RH/5 years
Supply Voltage	12-40 VDC or 18-28 VAC
Signal Output	4-20 mA @ 300Ω, 0-5/10 VDC @ 4kΩ min, (field selectable) except SP 0-5/10 VDC only
Measurement Range	0% to 100%
Sensing Technology	Capacitive
Operating Temperature	
Room	32° to 122°F (0° to 50°C)
Duct/OSA	-40° to 140°F (-40° to 60°C)
Dimensions	
Room	3.8"H x 2.8"W x 0.9"D (9.8 x 7 x 2.3 cm)

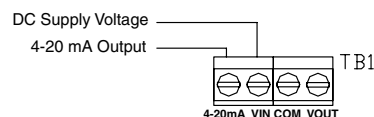
Duct	3.6" (9 cm) Ø head with 8.15"L (20 cm) probe 0.75" (1.9 cm) Ø
OSA	3.6" (9 cm) Ø head with 3.0"L (7.6 cm) probe 1.4" (3.6 cm) Ø
Enclosure	
Room	Plastic Delta-style
Duct/OSA	Plastic weatherproof
Weight	
Room	0.22 lb (0.1 Kg)
Duct	1.2 lb (0.54 Kg)
OSA	0.6 lb (0.27 Kg)
SP	0.2 lb (0.09 Kg)
Approvals	CE, RoHS
Warranty	5 years

WIRING

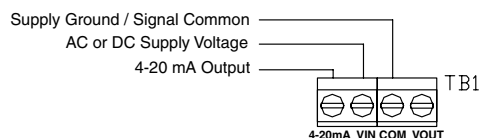
Output Selection Switches (SW 1)



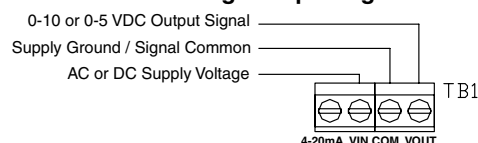
2 Wire Current Output Signal



3 Wire Current Output Signal

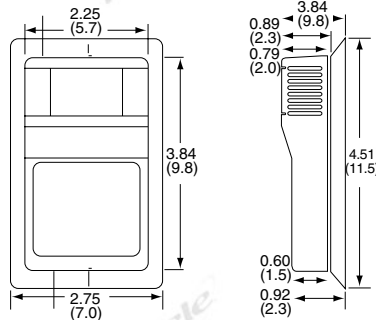


Voltage Output Signal

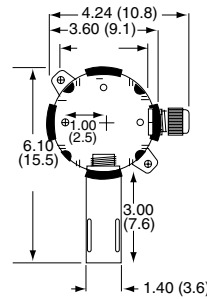




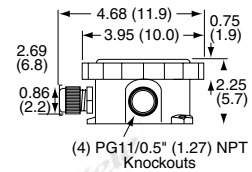
DIMENSIONS

in
(cm)


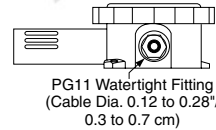
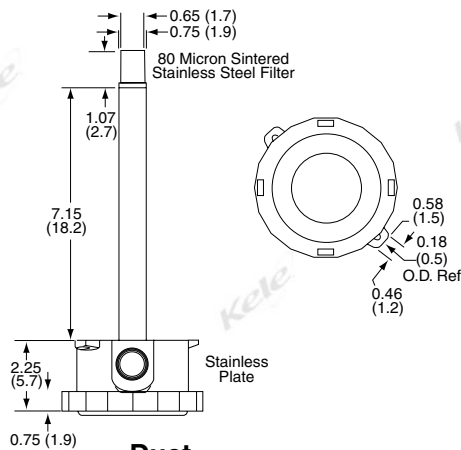
Room



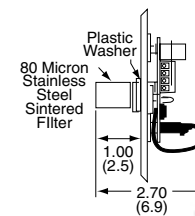
Outside



(4) PG11/0.5" (1.27) NPT Knockouts


PG11 Watertight Fitting
(Cable Dia. 0.12 to 0.28"/
0.3 to 0.7 cm)


Duct



Stainless Plate

Plastic Cover for
Stainless Steel Filter to
Protect Sensor during
Wash Down

ORDERING INFORMATION

MODEL	DESCRIPTION
A/RH5	5% accuracy humidity transmitter
OPTIONAL	
AN	Type III 10,000Ω thermistor
CP	Type II 10,000Ω thermistor
20K	20,000Ω thermistor
100	100Ω 385 PT RTD
1K	1,000Ω 385 PT RTD
REQUIRED	
R	Room
D	Duct
O	Outside air
SP	Stainless steel plate passive sensors only

A/RH5 - 100 - R Example: A/RH5-100-R A 5% accuracy room humidity transmitter with 100Ω RTD

RELATED PRODUCTS

DCP-1.5-W
DCPA-1.2
691-K0A

Power supply, 24 VAC IN to 24 VDC OUT
Power supply, 120 VAC IN to 24 VAC/24 VDC OUT
Control transformer, 120:24 VAC, 40 VA, Class 2

Wall & Duct CO & NO2 Sensor/Controller

Analog and BACnet/Modbus protocol options
Field replaceable sensing elements
Standard LCD with intuitive set up menu
Integrated LED indicators and audible alarm



DESCRIPTION

Senva TG Series sensors can be ordered as individual CO or NO2 sensors or as a combination CO/NO2 sensor in a shared enclosure.

The analog output model features 2 outputs that support daisy chain wiring - multiple sensors may be used in a parallel sequence (0-10V) for cost effective coverage of large areas. The unit can also act as a stand alone controller, utilizing the relay for exhaust fan operation or the output for direct control of a VFD.

The BACnet/Modbus model supports BACnet MS/TP & Modbus network communication in one unit. Standard features include network auto-configuration, a programmable fan relay, LED indicators, integrated display and audible alarm.

APPLICATIONS

- Ensure adequate air flow in occupied spaces
- Monitor multiple toxic gases with one mounted unit
- Alert occupants of elevated gas levels
- Directly control exhaust fans



7 year limited warranty

FEATURES

Cost-effective dual gas sensing and control

- Integrated display, LED indicators, audible alarm
- Order as individual CO or NO2 sensor, or specify both sensing elements in one enclosure

Flexibility of analog output model

- Menu selectable 0-5/10V, 1-5V and 4-20mA outputs (0-10V default)
- Dual outputs support daisy chain wiring to cost-effectively sense and control large areas

Versatility with BACnet/Modbus model

- Supports BACnet MS/TP and Modbus RTU networks
- Auto-configuration detects network baud rate, serial format, protocol type and self-addresses

High reliability reduces call backs

- Temperature compensated elements for maximum accuracy
- UL2034 recognized electrochemical CO sensing element
- 5 year life expectancy on CO and NO2 elements
- Warning indicators alert occupants when element's lifecycle is near end for replacement
- 7-year limited warranty on electronics; 2-year on elements

Easy to install

- Test mode speeds up field commissioning for verifying warning indicators and relay functions
- Push buttons and LCD to navigate setting parameters

Standard LCD and LED indicators

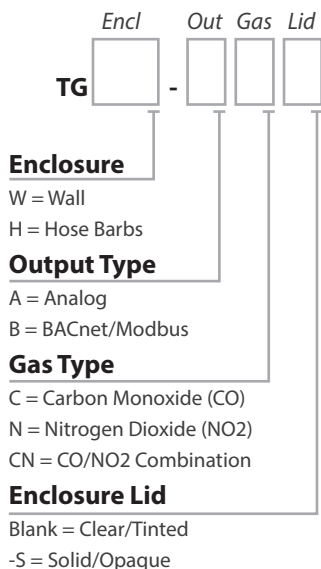
Removable terminal block

Field Replaceable Sensing Elements

Audible alarm

Push button menu for easy setup and programming

ORDERING



Replacement Elements

TGS-CO = Carbon Monoxide

TGS-NO2 = Nitrogen Dioxide



SPECIFICATIONS

Power Supply		15-30VDC/24VAC ⁽¹⁾ , 4W max, 120mA max.
Analog Outputs	2 programmable outputs	0-10V (default), 0-5V, 1-5V and 4-20mA (menu selectable)
	CO output scaling	0-200ppm (default), ranges below 200ppm (menu selectable)
	NO2 output scaling	0-10ppm (default), ranges below 10ppm (menu selectable)
	Temperature output scaling	-20 to 85°C
BACnet/Modbus	Baud Rates	9600, 19200, 38400, 57600, 76800, 115200
Fan Relay	Fan relay characteristics	N.C. 10A@125VAC, 5A@30VDC
	CO fan relay setpoint	25ppm (default), 0-200 ppm (menu selectable)
	NO2 fan relay setpoint	1ppm (default), 0-10ppm (menu selectable)
Alarm Relay (Analog model only)	Alarm relay characteristics	N.C. 0.5A@125VAC, 1A@30VDC
	CO alarm relay setpoint	100ppm (default), 0-200ppm (menu selectable)
	NO2 alarm relay setpoint	3ppm (default), 0-10ppm (menu selectable)
Display	3-1/2 digit LCD	Indicates CO ppm, NO2 ppm (menu selectable)
LEDs	Green, Yellow, Red	Green = Normal, Yellow = Relay, Red = Alarm
Audible Alarm Exposure	85dB Piezo transducer	30 minutes above alarm setpoint per UL2034 (menu selectable)
CO Sensor Performance	Type	Electrochemical
	Accuracy	+/-10% of full scale @ 20°C
	Reproducibility	<+/-2% of reading
	Response time	<15 seconds
	Certifications	UL2034 Recognized Component
	Long term stability	<+/-5% per year
	Life expectancy	>5 years
NO2 Sensor Performance	Type	Electrochemical
	Accuracy	+/-10% of full scale @ 20°C
	Reproducibility	<+/-3% of reading
	Response time	<15 seconds
	Long term stability	<+/-5% per year
	Life expectancy	>5 years
Operating Environment	Temperature, continuous	-20 to 40°C
	Temperature, intermittent	-30 to 55°C
	Humidity	15-95% continuous, 0-95% intermittent
Enclosure	Material	ABS/Polycarbonate
	Dimensions	4.0"h x 4.4"w x 2.1"d
	Conduit Opening	Tapped 1/2" NPT

(1) One side of transformer secondary is connected to signal common. Dedicated transformer is recommended.



AFS SERIES

Differential Pressure Switch

The AFS Series differential pressure switches are general purpose switches designed for both HVAC and Energy Management applications. These pressure switches can be used to sense positive, negative, or differential air pressures. All units contain a diaphragm, calibration spring, and a snap acting SPDT switch. The AFS-460's SPST output is configured for a normally closed action with a manual reset. The enclosure cover guards against accidental contact with the live switch terminal screws and the setpoint adjustment screw.

The AFS Series is covered by ACI's Two (2) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's web site, www.workaci.com.



SPECIFICATIONS

Input Pressure Range	AFS-222 (0.07" to 12" w.c.) AFS-262 (0.07" to 2" w.c.) AFS-460 (0.40 to 12" w.c.)
Output	AFS-222 (SPDT) AFS-262 (SPDT) AFS-460 (SPST-NC w/manual reset)
Operating Temperature Range	-40 to 180°F (-40 to 82°C)
Electrical Rating	300 VA pilot duty @ 115 to 277 VAC 15A non-inductive to 277 VAC, 60 HZ
Maximum Pressure	0.5 psi (0.03 Bar)
Switch Differential	Increasing from 0.02" +/- 0.01" w.c. to approx 0.8" w.c. @ maximum setpoint
Setpoint Range	0.05" + 0.02" w.c. to 12" w.c.
Measured Media	Air, or combustion by-products that will not degrade silicon
Mounting Direction	Any vertical plane
Fitting	Accepts a 0.25" O.D. rigid metallic tubing
Approvals	UL, FM, CSA
Product Dimensions	(H) 6.25" (W) 4.46" (D) 3.18"

ORDERING

Select one Differential Pressure Range (A).

A Differential Pressure Range

☒ AFS-222 (0.07"-12" w.c.) (with SPDT) ☐ AFS-262 (0.07"-2" w.c.) (with SPDT) ☐ AFS-460 (0.40"-12" w.c.) (with SPST-NC, Manual Reset)

BUILD PART NUMBER

After completing (A) from the above table, fill in the Part Number Table below. An example part number is offered.

A

EXAMPLE: AFS-262

L482A Low Limit Controller

INSTALLATION INSTRUCTIONS

BEFORE INSTALLATION

No special tools are required to install the L482A Low Limit Controller. Refer to the job drawings for specific wiring and installation information.

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

Mounting

IMPORTANT

1. The controller operates from the lowest temperature along the entire 20 feet of the sensing element.
2. Locate controller case and bellows where ambient temperature is always warmer than the set point.
3. For settings above the scale range midpoint it can be necessary to locate the controller case close to a steam pipe or other warm surface and make sure the element does not extend across a cold surface.

Controller

Surface mount the controller (Fig. 1) vertically on any convenient location (including the duct itself). Orient the case with the bellows positioned on the bottom.

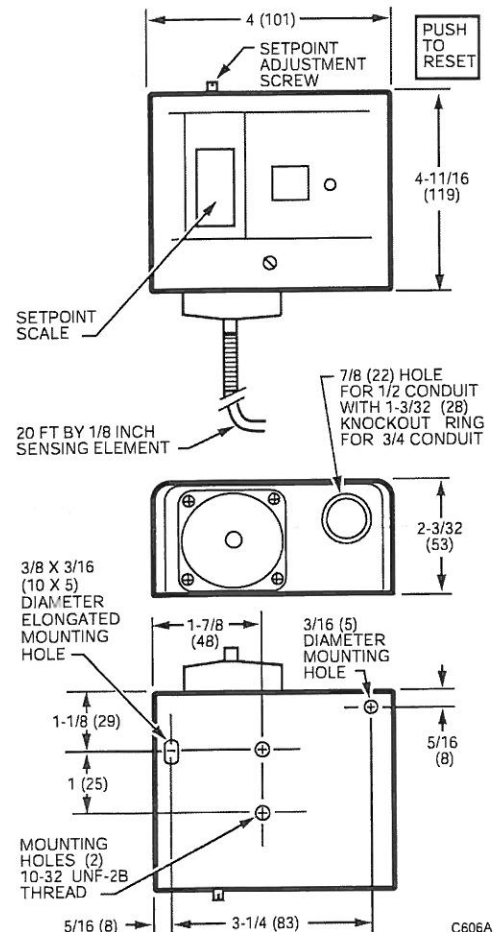


Fig. 1. L482A Low Limit Controller dimensions in in. (mm).



Sensing Element

IMPORTANT

- The maximum allowable sensing element temperature is 250°F (121°C).
- Uncoil only the amount of element required for the application.
- Bend element carefully and only as much as necessary. Bends require a minimum radius of one inch (25 mm).
- Bend only some distance from the controller.
- Pulling on the element damages it.
- For elements subject to vibration, provide protection from any surface which the element contacts.
- Mount element horizontally as shown in Fig. 2 and 3.

1. Locate the sensing element where it can sense the temperature of the air to be controlled.

NOTE: Locate the element away from hot or cold air inlets.

2. Punch or drill a 1/4 in. hole in the duct and install CCT1802 Grommet (Fig. 2) to protect the capillary.
3. Carefully insert the element through the grommet into the duct. Use as much element as possible to provide maximum protection.
4. Mount the element inside the duct or fasten to the coil if freezing can occur.
 - a. Duct mounting: Use CCT2600 Clip (Fig. 2).
 - b. Coil fastening: Use perforated metal straps (Fig. 3).

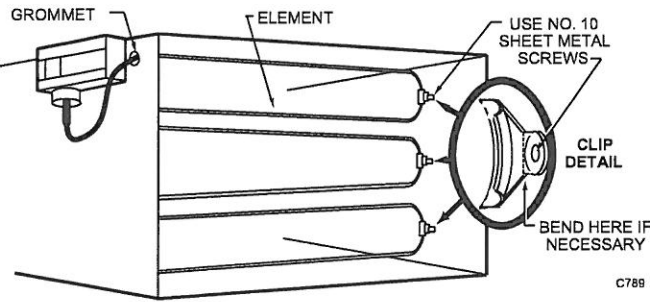


Fig. 2. Element mounted to duct with CCT2600 Clips.

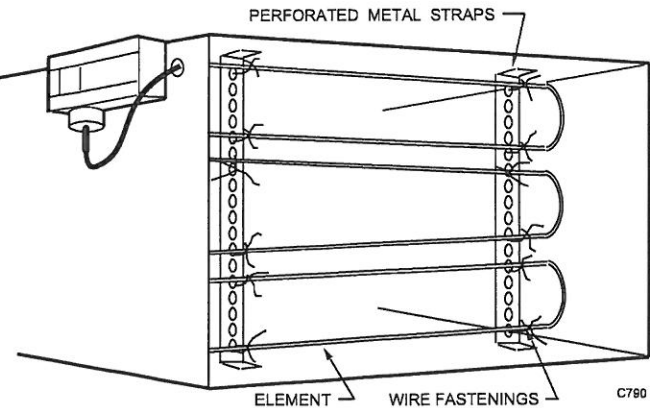


Fig. 3. Element mounted in duct with perforated metal straps.

OPERATION

On a temperature drop to setpoint, LINE 1 to M1 contacts close and LINE 2 to M2 contacts open. Reset to the normal state is manual.

WIRING

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or equipment damage.
Disconnect power supply before beginning installation to prevent electrical shock or equipment damage.

IMPORTANT

- All wiring must agree with applicable codes, ordinances and regulations.
- When switching both ac line voltage and an automation input (Fig. 4), the input wires must run no more than three feet in the same conduit. See Fig. 6.

For typical L482A wiring, see Fig. 4 and 5.

NOTES:

- Screw terminals are provided for wiring connections.
- Maximum wire size is 12 AWG.
- Use 8-32 x 1/4-inch screws for replacement if necessary. Longer screws can interfere with the switch mechanism and damage the switch.

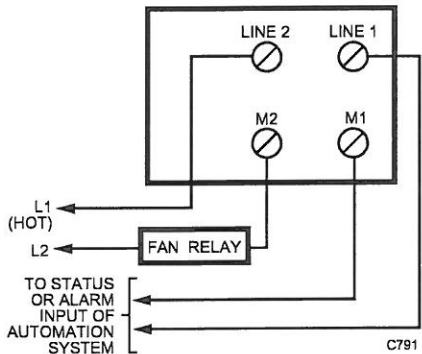


Fig. 4. Typical wiring diagram with automation input.

Adjustment

Turn the setpoint adjustment screw (Fig. 1) on the top of the controller case to the value called for on the job drawings.

NOTES:

1. The setpoint adjustment is limited to 35-55°F (2-13°C) by an internal physical stop.
2. The setpoint is factory set at 35°F. Setpoint is the temperature at which LINE 1 to M1 contacts close and LINE 2 to M2 contacts open on a temperature fall. The controller differential is fixed at 5°F (3°C) nominal and is additive to the setpoint.
3. The operating point drops for elevations above sea level. To compensate, increase the setpoint adjustment 1°F (0.6°C) above the required setpoint for each 1000 feet (305m) above sea level.

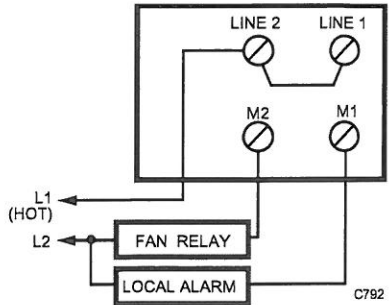


Fig. 5. Hookup providing freeze protection by shutting down fan with line powered local alarm.

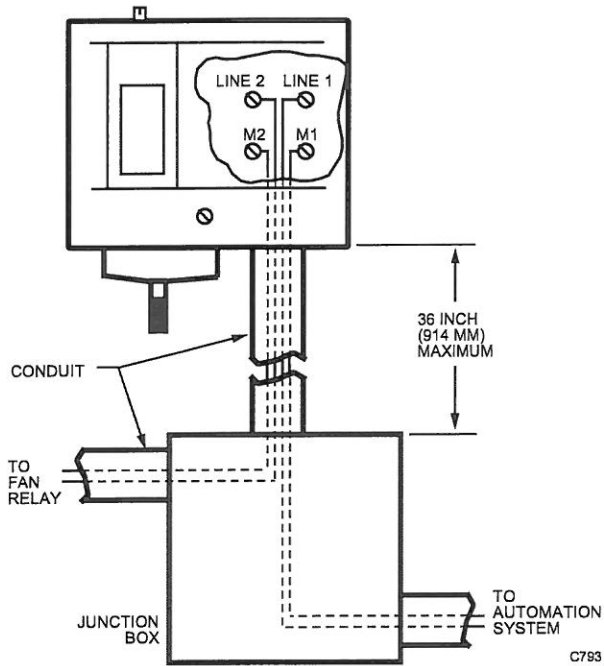


Fig. 6. Providing separate conduit for switched ac and automation input wiring.

CHECKOUT

Because of the L482A limited setpoint range, operational checkout can be difficult. Use one of the following methods to verify proper controller operation:

1. If the ambient temperature is below 50°F (10°C):
 - a. Turn the setpoint adjustment through the ambient temperature and note the switch action.
 - b. When the setpoint is increased to equal the ambient temperature:
 - (1) LINE 1 to M1 contacts should close.
 - (2) LINE 2 to M2 contacts should open.
 - c. Decreasing the setpoint to 5°F (3°C) below the ambient temperature should not affect the contact positions.
 - d. Pushing the manual reset button should:
 - (1) Open contacts LINE 1 to M1
 - (2) Close contacts LINE 2 to M2.
2. If the ambient temperature is above 50°F (10°C):
 - a. Immerse at least one foot of the element in ice water (or wrap same in ice).
 - b. As the element drops through the setpoint:
 - (1) LINE 1 to M1 contacts should close.
 - (2) LINE 2 to M2 contacts should open.
 - c. Remove the element from the ice water (or ice wrapping).
 - d. As ambient temperature rises to 5°F (3°C) the setpoint, there should be no effect on contact positions.
 - e. Pushing the manual reset button should:
 - (1) Open contacts LINE 1 to M1.
 - (2) Close contacts LINE 2 to M2.

Series
MS

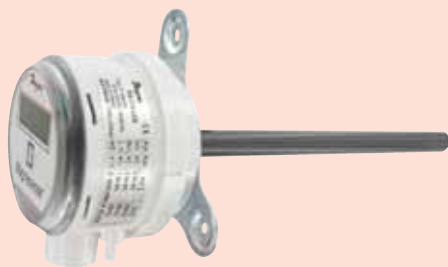
Magnesense® Differential Pressure Transmitter

Monitors Pressure & Air Velocity

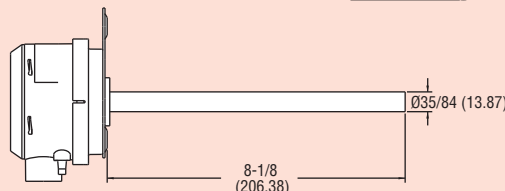
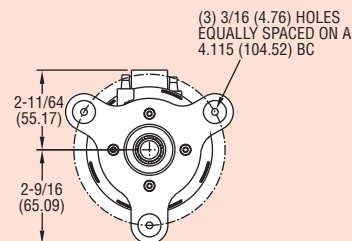
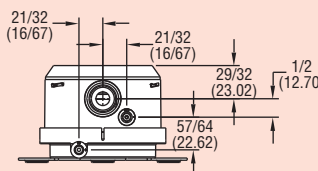
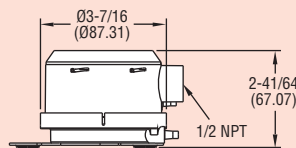
CE



Standard MS with optional LCD



Standard MS with optional and LCD static probe



The Series MS Magnesense® Differential Pressure Transmitter is an extremely versatile transmitter for monitoring pressure and air velocity. This compact package is loaded with features such as:

- Field Selectable English or Metric Ranges
- Field Upgradeable LCD Display
- Adjustable Dampening of Output Signal (with Optional Display)
- Ability to Select a Square Root Output for Use with Pitot Tubes and Other Similar Flow Sensors

Along with these features, the patented magnetic sensing technology provides exceptional long term performance and enables the Magnesense® Differential Pressure Transmitter to be the single solution for your pressure and flow applications.

Model	Output	Selectable Ranges
MS-121*	4-20 mA	0.1", 0.25", 0.5" w.c. (25, 50, 100 Pa)
MS-321*	0-10 V	0.1", 0.25", 0.5" w.c. (25, 50, 100 Pa)
MS-111*	4-20 mA	1", 2", 5" w.c. (250, 500, 1250 Pa)
MS-311*	0-10 V	1", 2", 5" w.c. (250, 500, 1250 Pa)
MS-131	4-20 mA	10" w.c. (2 KPa)
MS-141	4-20 mA	15" w.c. (3 KPa)
MS-151	4-20 mA	25" w.c. (5 KPa)
MS-331	0-10 V	10" w.c. (2 KPa)
MS-341	0-10 V	15" w.c. (3 KPa)
MS-351	0-10 V	25" w.c. (5 KPa)
MS-021	4-20 mA	±0.1", 0.25", 0.5" w.c. (±25, 50, 100 Pa)
MS-221	0-10 V	±0.1", 0.25", 0.5" w.c. (±25, 50, 100 Pa)

Note: Add -LCD to end of model for units with display.

*Models available with duct mount static pressure probe. Change last digit from 1 to 2. Ex. MS-122

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.

Wetted Materials: Consult factory.

Accuracy: ±1% for 0.25" (50 Pa), 0.5" (100 Pa), 2" (500 Pa), 5" (1250 Pa), 10" (2 kPa), 15" (3 kPa), 25" (5 kPa) ±2% for 0.1" (25 Pa), 1" (250 Pa) and all bi-directional ranges.

Stability: ±1% / year F.S.O.

Temperature Limits: 0 to 150°F (-18 to 66°C).

Pressure Limits: 1 psi maximum, operation; 10 psi, burst.

Power Requirements: 10 to 35 VDC (2-wire); 17 to 36 VDC or isolated 21.6 to 33 VAC (3-wire).

Output Signals: 4 to 20 mA (2-wire); 0 to 5 V, 0 to 10 V (3-wire).

Response Time: Adjustable 0.5 to 15 sec. time constant. Provides a 95% response time of 1.5 to 45 seconds.

Zero & Span Adjustments: Digital push button.

Loop Resistance: Current Output: 0-1250 Ω max; Voltage Output: min. load resistance 1 kΩ.

Current Consumption: 40 mA max.

Display (optional): 4 digit LCD.

Electrical Connections:

4-20 mA, 2-Wire: European Style Terminal Block for 16 to 26 AWG.

0-10 V, 3-Wire: European Style Terminal Block for 16 to 22 AWG.

Electrical Entry:

1/2" NPS Thread
Accessory (A-151): Cable Gland for 5 to 10 mm diameter cable.

Process Connections: 3/16" ID tubing (5 mm ID). Maximum OD 9 mm.

Enclosure Rating: NEMA 4X (IP65).

Mounting Orientation: Diaphragm in vertical position.

Weight: 8.0 oz (230 g).

Agency Approvals: CE.

ACCESSORIES

A-435, Field Upgradeable LCD

A-480, Plastic Static Pressure Tip

One Unit for all your Building Pressure Applications

The Industry Standard for Building Automation

• **Field Upgradable LCD.** No need to order two separate transmitters. Simply stock a transmitter and display and you can satisfy any customer's requests. Simply remove cover and snap the LCD onto the board.

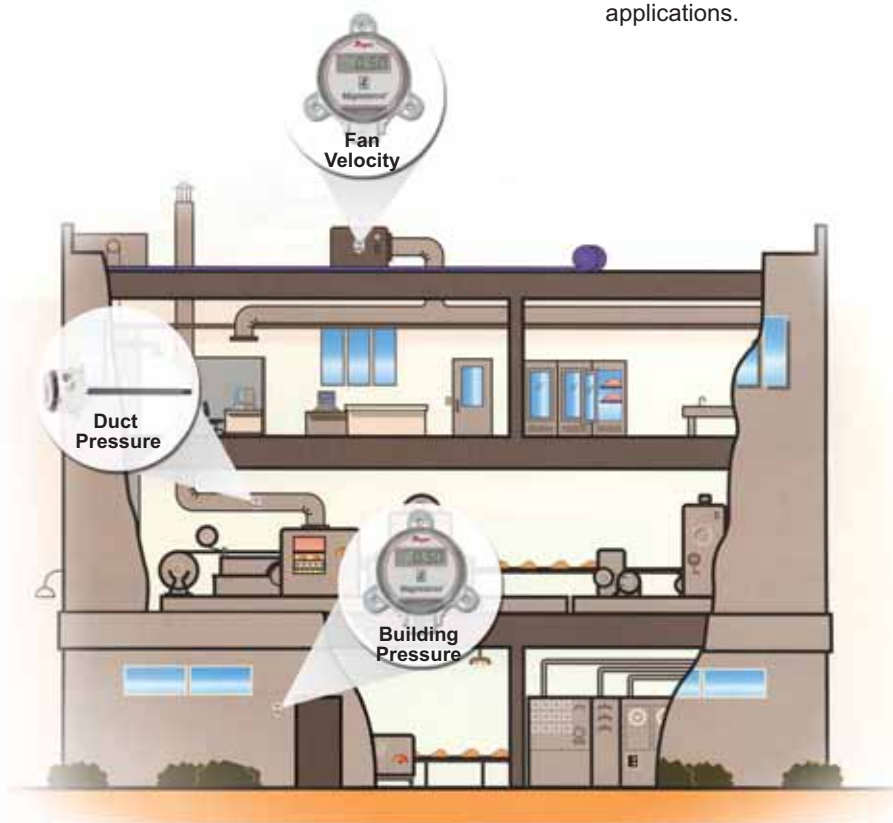
• **Field Selectable Ranges** in metric or English. Lowers stock and inventory requirements. You'll always have the right transmitter for every job.



• **Digital Push Button Zero and Span.** Reduces calibration time significantly over other transmitters that utilize potentiometers. Lowers maintenance time and costs.

• **Field Selectable Air Velocity Mode** for fan and blower applications. Unit provides square root output that accurately tracks fpm or m/s flow rate. No need for a smart programmable indicator or PLC to convert pressure to air flow. Reduces components and installation time lowering overall costs.

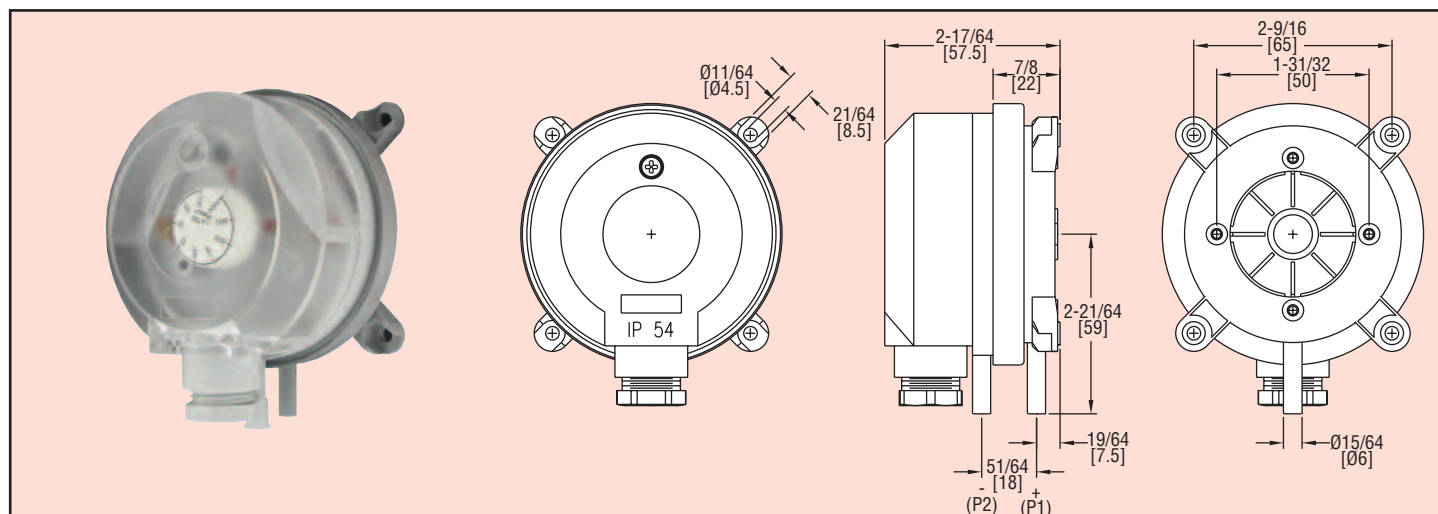
• **Adjustable Digital Dampening** smooths out unstable pressure fluctuations common in air flow applications.



Series
ADPS

H.V.A.C. Differential Pressure Switch

With Dual Scale Field Adjustable Set Point Knob



The Series ADPS Adjustable Differential Pressure Switch is 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 is 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. The compact size, adjustment knob and low cost make the ADPS the perfect choice for HVAC applications.

APPLICATIONS

- Monitoring air filters and ventilators
- Monitoring industrial cooling-air circuits
- Overheating protection for fan heaters
- Monitoring flows in ventilation ducts
- Controlling air and fire-protection dampers
- Frost protection for heat exchanges



Dual Scale
Field Adjustable
Set Point Knob

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.

Wetted Materials:

Diaphragm material: silicone; Housing material: POM switch body: PA 6.6; Cover: Polystyrene.

Temperature Limits: Process and ambient temperature from -4 to 185°F (-20 to 85°C).

Pressure Limits: Max. operating pressure: 40" 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 connection.

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 10⁶ switching operations.

Weight: 5.6 oz (160 g).

Agency Approvals: CE, RoHS.

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 (22)
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 below.

ACCESSORIES

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 and 7' (2.1 m) of PVC tubing

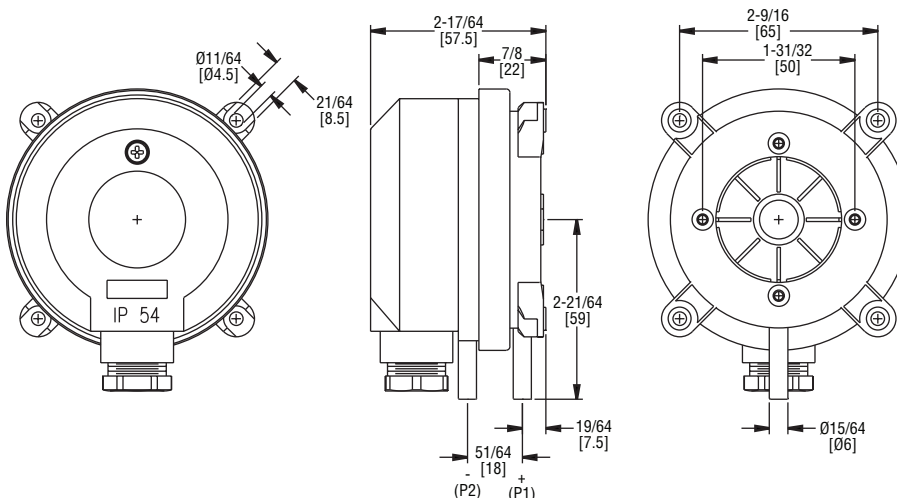
A-489, 4" Straight Static Pressure Tip with Flange

A-480



See page 587 for process tubing options.

Specifications - Installation and Operating Instructions



www.dwyer-inst.com
e-mail: info@dwyermail.com

Electrical Connection

Work on electrical installations must only be carried out by electricians who are specifically trained for this purpose.

CAUTION First make sure that there is no voltage on the connecting cable while you are working on the electrical connections. Otherwise, a possible electric shock may result and the connected equipment may be damaged. The connecting cable can be run to the pressure switch from three sides, according to choice. The screw cable connection has a plug-in design for this purpose. Rotate protective cover accordingly.

For cable gland models, the seal in the screw cable connection is designed for cables with alternative sheath diameters of 0.275" (7 mm) or 0.393" (10 mm). Only use these sizes – otherwise the screw cable connection cannot seal adequately.

1. If using a 0.275" (7 mm) connecting cable, you can line up the press nut, the plain washer and the sealing ring directly on the cable.
2. If using a 0.393" (10 mm) connecting cable, you must first break the inner rubber ring out of the sealing ring directly on the cable. Then line up the press nut, the plain washer and the sealing ring on the cable.

Wiring

The switching device in this pressure switch is designed as a change-over contact as can be seen from the wiring diagram (Figure 1). The rest position is shown in Figure 1 (pressure below the activation switch point on dial).

1. In the instance where pole 3 (COM) closes to Pole 2, the pressure is increasing (NO).
2. In the instance where pole 3 (COM) closes to Pole 1, the pressure is decreasing (NC).

Protect the feed line (to pole 3) by fuse, either in control system or along the line, and do so with:

1. Max. 1.5 A / 250 VAC, if you are loading the contact with an resistive load;
2. Max 0.4 A / 250 VAC, if you are loading the contact with an inductive load (such as relay);
3. Max. 0.1 A / 24 VDC, if you are using the pressure switch in the weak current version with gold-plated contacts.

The connections are intended for crimp-type sockets, 0.25 in (6.3 mm).

1. Make sure the crimp connection is perfect, and that the cable lugs fit properly on to the connections.
2. If you do not have any crimp-type sockets available, you can also use the cable lugs which are supplied with mounted screw terminals. However, these are only intended for rigid copper wire.
3. On flex, it is either necessary to crimp on strand end sleeves – and then you can also screw the strands on – or to crimp cable lugs on directly as previously described.

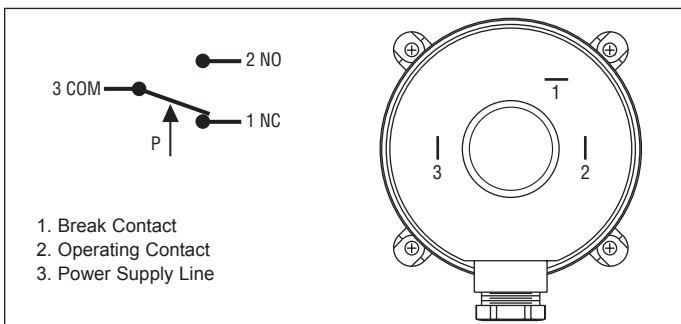


Figure 1

Setting the Pressure Range

Make absolutely certain that there is no voltage on the electrical connections before you carry out any setting on the pressure switch. Otherwise, it could be fatal if you accidentally touch the electrical connections or the metal adjusting screw while you are performing the settings.

a) Use the adjustment dial to set the pressure which should trip the switch on an increase of pressure.

1. The indications on the dial are only correct for the vertical mounting position.
2. When the pressure falls, the switch returns to its resting position as soon as the pressure falls below the dead band.

Attaching Cover

- a) Insert the screw cable connection into the recess provided for this purpose on the housing.
- b) Then place the housing cover in position and screw it down evenly on to the pressure switch.

Testing the Setting

Do not operate the system until the housing is closed. Otherwise there is the possibility of an electric shock if you accidentally touch live parts. Check the trip and reset pressures by slowly increasing the pressure and then allowing it to fall again.

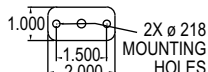
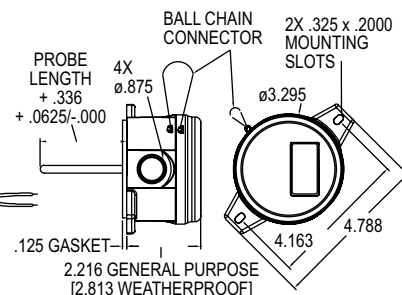
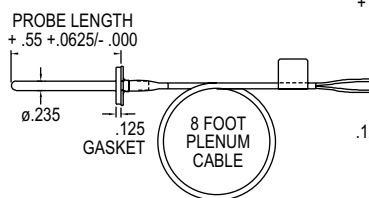
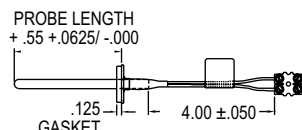
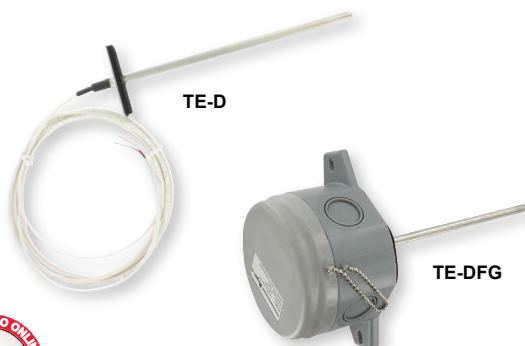
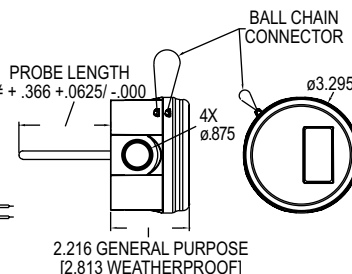
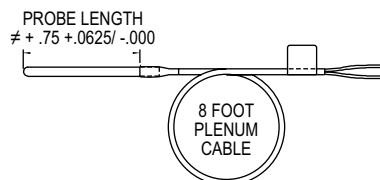
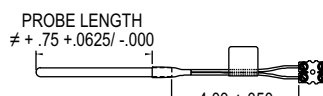
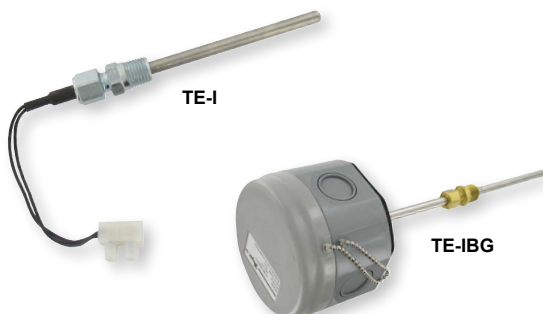
IMPORTANT: Observe the maximum permissible operating pressure of 40" w.c. (10 kPa) which is indicated in the data sheet. Otherwise the pressure switch may be damaged.

MAINTENANCE

Upon final installation of the Series ADPS Adjustable Differential Pressure Switch, no routine maintenance is required. A periodic check of system operation is recommended. The Series ADPS is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

DUCT AND IMMERSION BUILDING AUTOMATION TEMPERATURE SENSORS

Available up to 18" Probe Length, Thermistor or RTD Outputs



The **SERIES TE** Duct and Immersion Temperature Sensor can be used to monitor air or water temperature throughout a building management system or an air handler unit. Duct or immersion options available with or without an enclosure.

FEATURES/BENEFITS

- Easy to mount external tab housing and flange options for duct applications
- 1/4 turn housing cover with chain to prevent dropping
- Multiple conduit knockouts for easy installation positioning
- 8' plenum rated cable option
- Terminal connector eliminates need for wire nuts

APPLICATIONS

- Building automation
- VAV temperature sensing
- Chiller or boiler loops
- AHU monitoring

SPECIFICATIONS

Accuracy: Thermistor temperature sensor: $\pm 0.22^{\circ}\text{C}$ @ 25°C ($\pm 0.4^{\circ}\text{F}$ @ 77°F); RTD temperature sensor: DIN class A: $\pm 0.15^{\circ}\text{C}$ @ 0°C ($\pm 0.28^{\circ}\text{F}$ @ 32°F).
Temperature Limits: Operating: -40 to 302°F (-40 to 150°C).
Sensor Curves: See page reference 1 below.
Cable Rating: Plenum option includes UL listed plenum cable.
Housing Material: Meets UL, 94 V-0 polycarbonate plastic.
Housing Rating: NEMA 4X (IP66) (DFW, IBW only).
Weight: 5.3 oz (150.3 g).
Warranty: 5 year limited warranty.

MODEL CHART

Example	TE	-DFN	-A	04	4	8	-00	TE-DFN-A0448-00	Price
Series	TE							Temperature sensor	-
Mounting Configuration		DFN						Duct mount probe only	\$7.00
		DFG						Duct mount probe in general purpose housing	12.50
		DFW						Duct mount probe in NEMA 4X housing	15.00
		IBN						Immersion probe only	7.00
		IBG						Immersion probe in general purpose housing	12.50
		IBW						Immersion probe in NEMA 4X housing	15.00
Sensor Type			A					10k Ω type III thermistor	-
			B					10k Ω type II thermistor	-
			C					3k Ω thermistor	+1.50
			D					Pt100 Ω RTD	+3.00
			E					Pt1000 Ω RTD	+3.00
			F					20k Ω thermistor	-
			G					10k Ω type III with 11k Ω shunt	+2.00
Probe Length				25				2.5"	-
				04				4"	-
				06				6"	-
				08				8"	-
				12				12"	-
				18				18" (DFN/DFG only)	+3.00
Probe Diameter					4			1/4"	-
Termination						3		4" leads with spade connectors	+1.65
						4		4" leads	-
						7		8' plenum rated cable with spade connectors	+3.65
						8		8' plenum rated cable	+2.00
Fittings							00	None (probe only)	-
							12	1/2" NPT compression fitting	+4.00
							14	1/4" NPT compression fitting	+2.00

THERMOWELLS - MACHINED

Model	Material	Length	Connection (Internal/External) (NPT)	Price
TE-TNS-N044N-14	304 SS	4"	1/4" / 1/2"	\$17.00
TE-TNS-N044N-12	304 SS	4"	1/2" / 3/4"	15.25
TE-TNS-N064N-14	304 SS	6"	1/4" / 1/2"	18.25
TE-TNS-N064N-12	304 SS	6"	1/2" / 3/4"	18.25
TE-TNS-N094N-14	304 SS	9"	1/4" / 1/2"	31.25
TE-TNS-N094N-12	304 SS	9"	1/2" / 3/4"	29.50
TE-TNS-N124N-14	304 SS	12"	1/4" / 1/2"	45.25
TE-TNS-N124N-12	304 SS	12"	1/2" / 3/4"	43.25



Machined Thermowell

For Straight Thermowell Dimensions: See page 151 (Series W)

Resistance vs. Temperature Table: See page 156 (Series TE-OND/RND/OSA)



EN4204R Four Zone Add-On Receiver with Relay Outputs

Installation Instructions

1 Overview

The EN4204R four zone add-on receiver with relay outputs allows you to add up to four transmitters to any application. With diversity reception and advanced signal processing, Inovonics' EchoStream technology is designed to minimize dead spots in transmission areas.

The following add-on receivers are available from Inovonics:

Receiver	Alarm Output Relays	Fault Relays	Transmitters Supported
EN4204R	4	1	4
EN4216MR	5	1*	16
EN4232MR	11	1*	32

* At least one relay must be used for faults to ensure the system is supervised. More than one relay may be used, but that will deduct from the number of alarm output relays.

1.1 Installing an Inovonics Security System

An EchoStream survey kit should be used to establish an EchoStream system. The EchoStream survey kit measures the signal strength of high-power repeater and sensor messages to help optimize your EchoStream system.

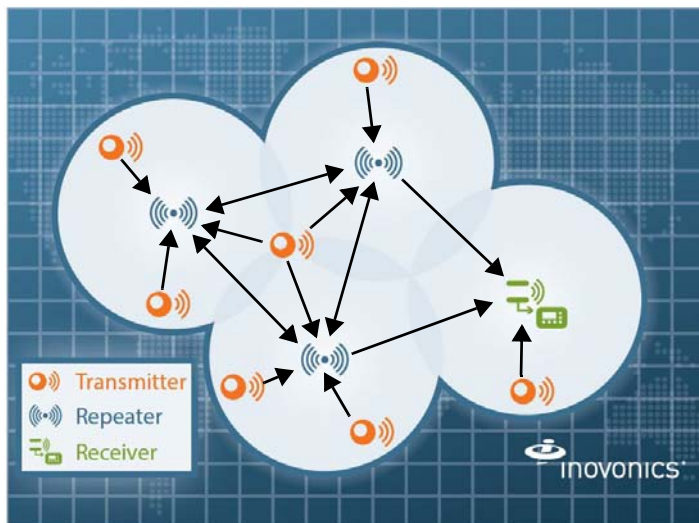


Figure 1 Sample EchoStream system

The EchoStream survey kit provides you with two signal strength measurements: signal level and signal margin.

Signal level

The signal level is the measurement of the overall decibel level of the message.

Signal margin

The signal margin is the measurement of the decibel level of the message, minus the decibel level of any interfering signals. Inovonics equipment should be placed within a facility such that all end-devices produce signal margin readings of at least 4 decibels.

Both the signal level and signal margin are measured in decibels. Because signal strength and signal margin are measured on a logarithmic scale, the difference between a decibel level of 3 (Weak) and a decibel level of 4 (Good) is a much larger difference than it would be on a linear scale.

Note: For more information about the EchoStream survey kit, see the EN7017 Survey Kit and App Installation and Site Survey Instructions.

Caution: The EchoStream system should be tested regularly to ensure operation. To test: place the system in test mode, activate an end device, and ensure an appropriate response.

1.2 RF Signal Propagation

While wood, drywall and glass usually let the RF signals pass, some materials may inhibit or attenuate radio frequency (RF) signal propagation by blocking, reflecting, deflecting or absorbing RF signals.

Consider anything between transmitters and repeaters and/or the receiver. Is there concrete and steel construction? Are there earthen berms or hills? Are there a lot of trees? Devices should be mounted such that they are least affected by these elements.

For best results, transmitters and repeaters should be mounted at the optimal height to achieve line of sight to repeaters and/or the receiver. Usually this means they will be mounted as high as possible.

Following are some typical obstacles to RF signal propagation:

Material	Affect	Recommendation
Metal construction, including ductwork; pipes; studs; stucco, plaster or concrete with wire mesh; satellite dishes, metal-lined rooms such as walk-in coolers or freezers; metal siding, safes, etc.	Can reflect, absorb and/or disrupt RF signals.	Perform a site survey using an Inovonics wireless survey kit to verify the RF signal is acceptable, and, when necessary, to determine where to locate repeaters.
Completely enclosed metal boxes/enclosures.	Can restrict RF signals.	
Solar panels, cinder block walls, windows with built-in solar tinting.	Can absorb and/or reflect RF signals.	
Vegetation.	Can attenuate RF signals. The RF environment can alter as trees shed or sprout leaves.	Add repeaters as issues arise.
Automobile and truck traffic.	Can disrupt RF signals.	Mount Inovonics devices at a height sufficient to achieve line of sight above traffic.

1.3 Inovonics Wireless Contact Information

If you have any problems with this procedure, contact Inovonics Wireless technical services:

- E-mail: support@inovonics.com.
- Phone: (800) 782-2709; (303) 939-9336.

1.4 EN4204R Four Zone Add-On Receiver with Relay Outputs Front Panel

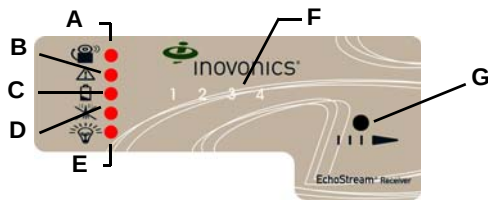


Figure 2 EN4204R receiver LEDs and buttons

A Alarm LED **B** Tamper Fault LED **C** Low Battery Fault LED
D Inactive Fault LED **E** Power LED **F** Transmitter Number LEDs
G Advance Button

1.5 EN4204R Four Zone Add-On Receiver with Relay Outputs LEDs

Most of the LEDs and buttons perform different function depending on which mode the receiver is in. By default the LEDs are in operation mode; to enter diagnostic mode, press the advance button.

Operation LEDs

Alarm LED: Lights when any transmitter is sending an alarm transmission.

Tamper Fault LED: Lights when any transmitter is sending a tamper transmission.

Low Battery Fault LED: Lit when any transmitter has a low battery.

Inactive Fault LED: Lit when any transmitter is inactive.

Power LED: Lit when receiving power.

Transmitter Number LEDs: Lit when the transmitter is in alarm.

Decode LED: Flashes when any recognizable transmission is received. This LED is only visible when the pry-out door or cover is removed.

Diagnostic LEDs

Alarm LED: Lights when the selected transmitter is sending an alarm transmission.

Tamper Fault LED: Lights when the selected transmitter is sending a tamper transmission.

Low Battery Fault LED: Lit when the selected transmitter has a low battery.

Inactive Fault LED: Lit when the selected transmitter is inactive.

Power LED: Lit when receiving power.

Transmitter Number LEDs: Shows status of the transmitter assigned to that number when lit. Use the advance button to scroll through transmitters.

Advance Button: Scrolls through transmitters to display status.

Decode LED: Flashes when any recognizable transmission is received. This LED is only visible when the pry-out door or cover is removed.

1.6 EN4204R Internal Components

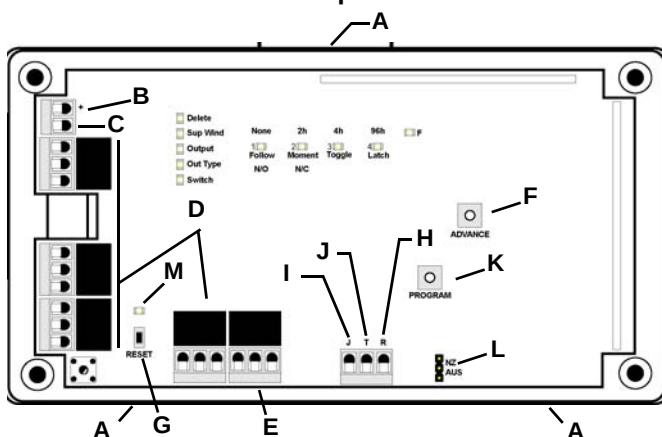


Figure 3 EN4204R internal components

A Housing release tabs **B** Power (11-14 VDC) **C** GND connection
D Output terminals **E** Fault output **F** Advance button
G Reset button **H** Reset input **I** Jam output
J Tamper output **K** Program button **L** Frequency band selection pins
M Decode LED

1.7 What's in the Carton

- Two drywall anchors.
- Two mounting screws.
- Three housing screws.
- Two pieces double-sided mounting tape.
- One frequency band selection jumper.

2 Installation and Startup

2.1 Installation Notes

- These products are designed to be maintained by professional security technicians.
- Products are tested for indoor use.
- All products should be manually tested weekly.

2.2 Connect Power Cabling

Caution: Incorrect connections may cause damage to the unit.

Before beginning startup, you will have to connect power to the receiver. To connect power to the receiver:

1. Use a small screwdriver to press the housing release tab on the top or bottom of the receiver; separate the housing.
2. Connect power cabling to the Power and GND connections.
 - Power source should be 11-14 VDC. Power supply must be unswitched, uninterrupted, and regulated.
 - Use 18 - 22 gauge wire for all cabling, and ensure torque on the screw terminals does not exceed 7 inch-pounds.
 - For UL installations, wire lengths must not exceed 300 feet.

2.3 Select the Frequency Band

EchoStream devices are able to use a range of radio frequencies, and must be configured for your geographic area. This device ships with a default frequency range of 902-928 MHz for use in North America. If you are using the device in North America, skip to section 3, "Registering a Transmitter"; if you are using the device in Australia or New Zealand, you will need to configure it.

1. Place a selection jumper on the appropriate frequency band selection pins.
 - Place the jumper on the top two pins, marked NZ, to set the frequency range to 921-928 MHz for New Zealand.
 - Place the jumper on the bottom two pins, marked AUS, to set the frequency range to 915-928 MHz for Australia.

Note: Only devices set for North America are configured for UL installations.

2. Cycle power source to reset.

3 Registering a Transmitter

3.1 Quick Setup

In many cases, the default settings are sufficient and the points don't need programming changes. To register transmitters without changing the settings:

First Transmitter

1. Press the advance button one time to select the first point.
2. Press the program button four times to select the default programming options.
3. The first point number will be flashing, indicating it is awaiting the transmitter's reset message; press the transmitter's reset button.

Second Transmitter

1. Press the advance button two times to select the second point.
2. Press the program button four times to select the default programming options.
3. The second point number will be flashing, indicating it is awaiting the transmitter's reset message; press the transmitter's reset button.

Third Transmitter

1. Press the advance button three times to select the third point.
2. Press the program button four times to select the default programming options.
3. The third point number will be flashing, indicating it is awaiting the transmitter's reset message; press the transmitter's reset button.

Fourth Transmitter

1. Press the advance button four times to select the fourth point.
2. Press the program button four times to select the default programming options.
3. The fourth point number will be flashing, indicating it is awaiting the transmitter's reset message; press the transmitter's reset button.

Note: After registering a transmitter, there is no need to exit programming mode. The receiver is normal operation once the transmitter's reset button has been pressed.

The default settings are:

Point	Supervision Window	Output	Type
1	4 hours	1	Follow
2	4 hours	2	Follow
3	4 hours	3	Follow
4	4 hours	4	Follow
F	N/A	Fault	Inactive is set to follow; low battery and tamper are set to latching.

3.2 Customize Transmitters

If the default settings are not sufficient, you will need to program the points individually.

Note: If changing programming for a point that already has a transmitter registered to it, there is no need to re-register the transmitter. Changes to point programming are automatically assigned to the transmitter registered to that point.

The following programming options available:

Supervision window

- None, 2h, 4h, or 96h. When you are choosing the supervision window, the "Sup Wind" LED will light, along with the LED that indicates the selected window.

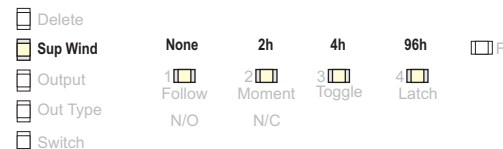


Figure 4 Select the supervision window

Output (relay)

- 1, 2, 3, 4. When you are choosing the output, the "Output" LED will light, along with the LED that indicates the selected output number.

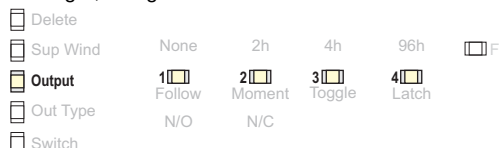


Figure 5 Select the output number

Output type

- Follow, Moment, Toggle, Latch. When you are choosing the output, the "Out Type" LED will light, along with the LED that indicates the selected output type.

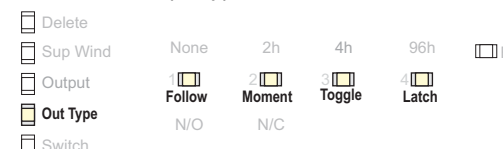


Figure 6 Select the output type

To program any of the four transmitter points:

1. Use the advance button to select any of the four transmitter points.
 - Press the advance button one time to select the first point; the first LED will light.
 - Press the advance button two times to select the second point; the second LED will light.
 - Press the advance button three times to select the third point; the third LED will light.

- Press the advance button four times to select the fourth point; the fourth LED will light.
2. Press the program button to begin programming the point.

Note: The program button should be pressed within a few seconds of selecting the point number. If not, the point number will not be lit, and you will need to select it again.

- If no transmitter has been registered to the chosen point, the receiver advances to the supervision window option.
 - If a transmitter has already been registered to the chosen point, the delete LED lights. Press advance to delete the point and return to normal operation; press program to advance to the supervision window option.
3. Use the advance button to choose a supervision window of None, 2h, 4h and 96h (Fig. 4).
 - Press the advance button one time to select none.
 - Press the advance button two times to select two hours.
 - Press the advance button three times to select four hours.
 - Press the advance button four times to select 96 hours.

When you have selected the supervision window, press program to complete and advance to the output option.

4. Use the advance button to select the output number (Fig. 5).
 - Press the advance button one time to select the first output.
 - Press the advance button two times to select the second output.
 - Press the advance button three times to select the third output.
 - Press the advance button four times to select the fourth output.

When you have selected the output number, press program to complete and advance to output type option

5. Use the advance button to select the output type (Fig. 6).
 - Press the advance button one time to select follower. In follower the output reflects the transmitter's alarm status.
 - Press the advance button two times to select momentary. In momentary the output turns on for seven seconds, then turns off, regardless of the device status.
 - Press the advance button three times to select toggle. In toggle the output changes state each time the device sends a new activation. A minimum of four seconds must elapse before the output can send a new activation.
 - Press the advance button four times to select latching. In latching the output turns on when activated and remains on until the receiver is reset.

When you have selected the output type, press program to complete and advance to the switch type option.

6. All the option LEDs will light and the point you've just programmed will flash. If you wish to register a transmitter to the point you've just programmed, press the transmitter's reset button; otherwise, press program to save programming changes without registering a transmitter.

Note: The registration is not complete until all LEDs turn off and the point number lights.

All of the alert LEDs will turn off when the receiver has received the transmitter's registration message, and the point number LED will light for two seconds. This indicates the receiver has received the transmitter's registration message. If this does not occur, press reset on the transmitter again.

3.3 Connect Input/Output Cabling

The tamper output, jam output and reset input are open collectors, not dry contacts.

1. Connect cabling to the tamper output. Must be configured for UL installations.
 - The tamper output is a normally open (N/O) open collector output that reports receiver case tamper to an external device.
2. Connect cabling to the jam output. Must be configured for UL installations.
 - The jam output is a normally closed (N/C) open collector output that opens when noise thresholds on all receive channels remain above a predetermined value for 10 seconds. The jam output is set to the follower output type.
3. Connect a momentary switch to the reset input and ground (Figure 7, "EN4204R terminals"). Must be configured for UL installations.
 - The reset input circuit permits installation of a remote momentary normally open (N/O) switch to clear faults, unlatch outputs, and reset the receiver to a normal state.

4. Connect cabling to the output terminals. Must be configured for UL installations.
 - The EN4204R provides five Form-C relays.

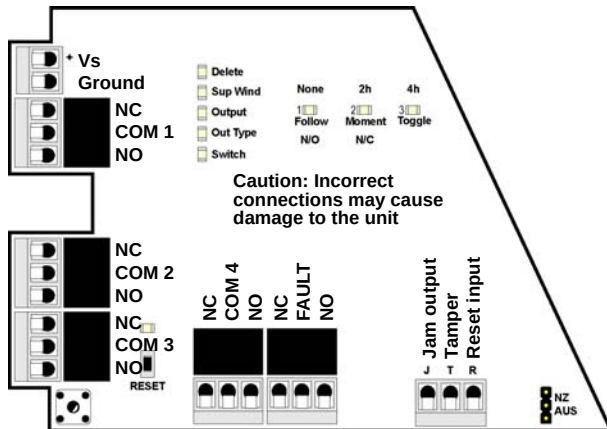


Figure 7 EN4204R terminals

3.4 Mount the Receiver

Caution: Mount the receiver in a location removed from metal. Metal objects (duct work, wire mesh screens, boxes) will reduce RF range.

Note: For UL listed systems containing a UL hold-up switch, the EN4204R must be located within three feet of a system keypad in a location out of sight from the protected premise.

Note: For UL installations, the EN4204R must be in the same room as the control panel.

1. Use the provided anchors and screws to mount the receiver in a location accessible for future maintenance, making sure the housing is flush with the wall and the back tamper switch is actuated.
2. After all transmitters have been registered, perform a walk test, activating each transmitter assigned to the receiver and ensuring a good signal.

4 Return to Factory Configuration

The EN4204R four zone add-on receiver with relay outputs can be returned to factory defaults using the following .

Caution: The factory config will erase all programmed point, output, and language information.

To restore the factory configuration defaults to the receiver:

1. Hold down the reset and advance buttons.
2. With the buttons held down, cycle power.

5 US Patent Numbers

- 7,154,866.
- 7,554,932.
- 7,746,804.
- Other patents pending.

6 Specifications

Compatible repeater, transmitters: EN5040-T, EN1215EOL, EN1215WEOL, EN1223D, EN1235SF, EN1235DF, EN1244, EN1249, EN1261HT.

Housing: 6.38" x 3.60" x 1.10" (162 mm x 92 mm x 28 mm).

Operating environment: 32°- 140°F (0°- 60°C), 90% relative humidity, non-condensing.

Power requirement: 11 - 14 VDC; 400 mA.

Current consumption: Approx. ~400 mA max with all five relays energized.

Output specifications: Form C relay 1A @ 28 VDC, 0.5A @ 30 VAC resistive load; N/O receiver case tamper contact closure, N/C receiver jam output indication.

Input specifications: A low is less than .5 V; a high is greater than 2.5 V.

Reset input: Contact closure, momentary low.

Receiver type: Frequency hopping spread spectrum.

Operating frequency: 915-928 MHz (Australia), 921-928 MHz (New Zealand), 902-928 MHz (USA).

Number of points/transmitters: Four.

Number of alarm outputs: Four Form C relay outputs.

Number of fault outputs: One Form C relay output.

UL listings: UL 365, UL 636, UL 985, UL 1023, ULC/ORD-C1023-74, UL 1610, UL 1076.

7 UL Requirements

- Due to the trouble output being shared by all transmitters, this receiver must be set up and programmed as either a commercial and residential burglary receiver or as a residential fire receiver. Burglary and fire devices cannot be intermixed in a single receiver. If both burglary and fire applications are required in a single system, two EN4204R receivers will be required, with one set up for burglary and the other set up for fire.
- The control panel must be programmed to indicate an alarm if the system is in an armed condition and an RF jamming signal occurs at the receiver.
- The receiver tamper and transmitter tamper cannot be combined in one loop.
- The control unit providing input power to the receiver must not have a range outside of 11-14 VDC.

8 Television and Radio Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

9 US Patent Numbers

- 7,154,866.
- 7,554,932.
- 7,746,804.
- Other patents pending.



EN1210W/EN1210W-60 EchoStream® Door/Window Transmitter with Reed Switch

1 Overview

The EN1210W and EN1210W-60 are universal transmitters with one internal contact magnetic reed switch. Inovonics multi-function add-on receivers will support both inputs as separate devices.

Note: The transmitter contains both a wired input and an input activated by a reed switch and magnet. The reed switch and magnet must be used unless the application (control panel) specifically supports both inputs as separate devices. Use of the wired input is optional.

Note: For UL 2560 installations, refer to the *EN6080 Area Control Gateway Installation Instructions*.

1.1 Maximum Number of Repeaters for a UL2560 Installation
To achieve the 99.99% alarm message reliability required for UL2560 compliance, system installations must operate within the following limits for end device and repeater counts.

End Devices	Maximum Repeaters
150	397
250	386
350	375
500	360
1000	313
2000	238
3000	184

1.2 Inovonics Wireless Contact Information

If you have any problems with this procedure, contact Inovonics Wireless technical services:

- E-mail: support@inovonics.com.
- Phone: (800) 782-2709.

1.3 Internal Components

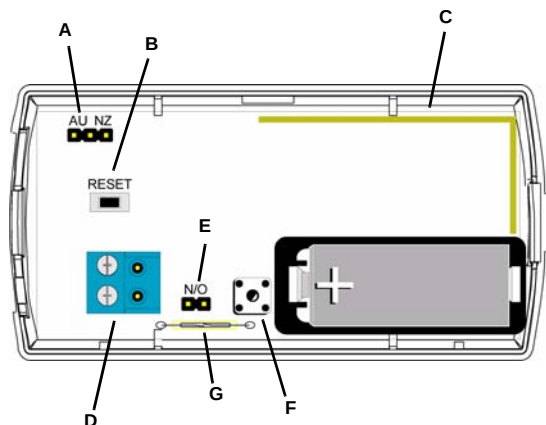


Figure 1 Components

- A Frequency band selection pins B Reset button
C Antenna D Input terminal
E N/O - N/C selection pins F Tamper button and spring
G Reed switch

1.4 What's In The Carton

- Three wall mount screws.
- Three wall mount anchors.
- Two selection jumpers.
- One 3.0V lithium battery.
- One magnet.

2 Installation and Startup

2.1 Installation Notes

- These products are designed to be installed and maintained by professional security technicians.
- Products are intended for indoor use.
- Manually test all products weekly.

2.2 Install the Battery

- Pry the top lip of the mounting bracket up, and lift the bracket off of the transmitter.
- Use your thumb to depress the housing release tab on the bottom of the transmitter; separate the housing.
- Install the new battery.
- Press the reset button to initialize the transmitter.

2.3 Select the Frequency Band

EchoStream products are able to use a range of radio frequencies, and must be configured for your geographic area. This product ships with a default frequency range of 902-928 MHz for use in North America. If you are using the product in North America, skip to section 2.4, "Select Input Type"; if you are using the product in Australia or New Zealand, you will need to configure the transmitter.

- Place a selection jumper on the appropriate frequency band selection pins.
 - Place the jumper on the right two pins, marked NZ, to set the frequency range to 921-928 MHz for New Zealand.
 - Place the jumper on the left two pins, marked AU, to set the frequency range to 915-928 MHz for Australia.
- Press the reset button to complete configuration.

Caution: When pressing the reset button, make sure you don't also touch the frequency band selection pins. Touching the frequency band selection pins while pressing the reset button can inadvertently set the transmitter to the wrong frequency band.

2.4 Select Input Type

The N/O-N/C selection pins allow the choice of a normally open or normally closed state for the contact circuit wired to the input terminal. The transmitter is shipped set for normally open, with a selection jumper on the N/O selections pins. If you are using the product in a normally open state, skip to section 2.5, "Register the Transmitter"; if you are using the product in a normally closed state, you will need to configure the transmitter:

- Remove the selection jumper from the selection pins to select normally closed.
- Press the reset button to complete configuration.

Caution: If only the reed switch and magnet are to be used, normally open should be selected.

2.5 Register the Transmitter

Transmitters must be registered with the system in order to be monitored and supervised. The EN1210W sends a check-in message every three minutes; the EN1210W-60 sends a check-in message every 60 minutes. Each transmitter has a unique factory-programmed identification number. Refer to the receiver installation instructions for details on registering a transmitter.

Note: For UL 2560 installations, transmitters must have a minimum check-in time of 60 minutes.

- When prompted by the receiver to reset transmitter, press the reset button.
- Replace the cover.
- Test the transmitter by activating each of the conditions and ensuring an appropriate response.

2.6 Mount the Transmitter

- Mount the bracket on the wall with the screws provided, ensuring room for the magnet where indicated by the mounting directions on the inside of the bracket.

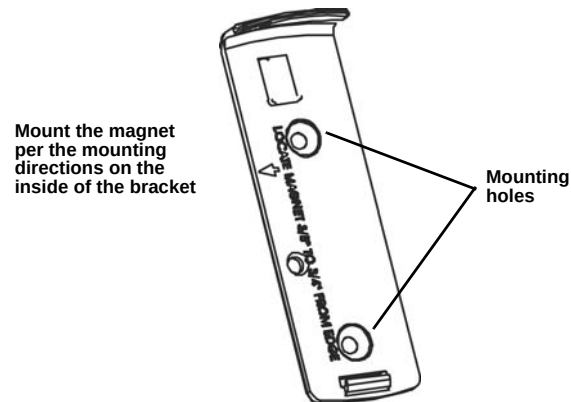


Figure 2 Mount the bracket

- Mount the magnet where indicated by the mounting arrow on the inside of the bracket.
- Clip the transmitter onto the bracket. Hook the bottom catch first, then press the top into place.
- As desired, use the third mounting screw to secure the housing through the screw hole located beneath the battery.

Note: Accessing this screw on an active transmitter requires opening the housing and removing the battery, causing a tamper condition.

16. Replace the housing lid.

3 Operate the Transmitter

The transmitter has one internal contact magnetic reed switch. The magnet should be parallel with the reed switch. The maximum operating gap between the magnet and the reed switch is 16mm (5/8"). The transmitter can monitor internal and external contacts at the same time.

4 US Patent Numbers

- 7,154,866.
- 7,554,932.
- 7,746,804.
- Other patents pending.

5 Specifications

External contacts: N/O or N/C.

Distance, external contact to transmitter: 3 meters (10 feet) maximum.

Typical battery life: 3-5 years.

Battery type (BAT604): Panasonic CR123A or equivalent.

Power requirement: 3VDC, 60 mA.

Operating environment: -20° to 60°C (-4° to 140°F), noncondensing.

Compatible receiver for UL 2560 installations with the EN1210W-60: EN6080.

Compatible repeater for UL 2560 installations with the EN1210W-60: EN5040-20T.

Note: The EN1210W-60 is a supplemental device that can be installed in a UL 2560 certified system. Specifications and data are subject to change without notice.

6 Television and Radio Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

7 FCC Part 15 and Industry Canada Compliance

This device complies with part 15 of the FCC Rules and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Note: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



RELAYS & CONTACTORS

RELAY IN A BOX

RIB, RIBT PILOT SERIES

DESCRIPTION

The **Relay In A Box (RIB) Pilot Series** controls most BAS, HVAC, low-horsepower motor, and lighting applications. The relays come mounted and prewired in a housing, which saves the installer the time, trouble, and expense of buying separate components (relay, socket, mounting rail, and enclosure) and assembling them on the job or at the shop.

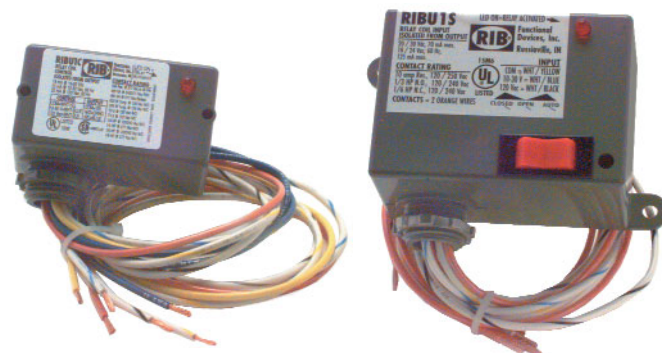
The **RIB Pilot Series** has a protruding 1/2" or 3/4" NPT nipple from which all wires exit (except **T Series**). To install, remove a conduit knockout in the equipment, insert the wires and nipple through the hole, tighten the locknut, and connect the wires.

RIB Pilot Series - 10A Relays

The **RIB Pilot Series** has relay contacts rated for 10A and is used to control light electrical loads, drive power relays/contactors, or sense the voltage being fed to electrical loads. The **RIB Pilot Series** requires a low coil drive current and is provided with circuitry to allow powering the relay coil from a wide range of AC or DC voltages.

RIBT Series - High/Low Voltage Separation

The **RIBT Series** is designed to provide physically separate entrances for connections to the relay input coil and output contacts. Relay contact wires exit the housing through a 1/2" or 3/4" NPT nipple. The cover of the **RIBT Series** is removable, and the coil drive wires can enter the housing through one of two convenient openings with star bushings or 1/2" conduit. The coil drive wires are secured to screw terminals within a separate wiring compartment in the **RIBT Series**. Most of the **RIBs** in the **Pilot Series** are also available in the **T Series**.



RIBU1C

RIBU1S



FEATURES

- **Convenient and economical to use**
- **Relay status indicator via LED**
- **Coil uses low current and accepts a wide range of AC and DC voltages**
- **Closed/Open/Auto switch option available**
- **Nipple- or screw-mountable**
- **Compact, gray plastic enclosure**
- **Color-coded wires for eliminating errors**
- **UL listed for UL916 Energy Management and UL864 Fire**
- **Made in the USA**

SPECIFICATIONS - GENERAL

Enclosure size

A	1.7"H x 2.8"W x 1.5"D 4.32 x 7.11 x 3.81 cm)
B	4.0"H x 4.0"W x 1.8"D (10.16 x 10.16 x 4.57 cm)
G	2.3"H x 3.2"W x 1.8"D (5.84 x 8.13 x 4.57 cm)

Operating temp

-30° to 140°F (-34° to 60°C)

Humidity

5% to 95% noncondensing

Life rating (all relays)

10 million cycles min
mechanical

Relay status

LED, ON - relay activated

Housing

Plenum rated, NEMA 1,
optional NEMA 4

Coil pull-in/drop-out (nominal values)

COIL DRIVE	PULL-IN		DROP-OUT	
	DC	AC	DC	AC
10-30 VAC/DC	10	9	2.8	2.1
24 VAC/DC	20	18	3.8	3
120 VAC	—	102	—	9
208-277 VAC	—	176	—	13

Wire length

16" (40.6 cm)

Agency approvals

UL listed, UL916 Energy
Management UL 864 Fire,
ULC listed, CSFM

Weight

Approx. 1.0 lb (0.45 kg)



RELAYS & CONTACTORS

RELAY IN A BOX

RIB, RIBT PILOT SERIES

SPECIFICATIONS - PILOT SERIES

MODEL	TYPE	COIL DRIVE	SIZE/HUB	OVR SW	RELAY CONTACT RATINGS		RELAY CONTACT WIRING	RELAY COIL DRIVE DATA	
RIBU1C* RIBU1C-N4†	1-SPDT	10-30 VAC/VDC 120 VAC 50/60 Hz	A-1/2	—	10A resistive 10A resistive 480 VA pilot duty 480 VA ballast 600W tungsten 240W tungsten	120/240/277 VAC 28 VDC 240/277 VAC 277 VAC 120 VAC N.O. 120 VAC N.C.	Relay #1 NC (blue) COM (yellow) NO (orange)	Wiring Relay #1 Common - White/Yellow wire 10-30 VAC/VDC - White/Blue wire 120 VAC - White/Black wire 208-277 VAC - White/Brown wire Relay #2 (if present) Common - White/Purple wire 10-30 VAC/VDC - Gray/White wire 120 VAC - White/Red wire 208-277 VAC - White/Orange wire	
RIBU2C*	2-SPDT		G-3/4	—	1/3 hp for N.O. 1/6 hp for N.C. 1/4 hp for N.O. 1/8 hp for N.C.	120/240 VAC 120/240 VAC 277 VAC 277 VAC	Relay #2 (if present) NC (gray) COM (purple) NO (brown)		
RIBH1C* RIBH1C-N4†	1-SPDT	10-30 VAC 208-277 VAC 50/60 Hz	A-1/2	—	10A resistive 480 VA pilot duty 480 VA ballast 600W tungsten 240W tungsten 1/3 hp for N.O. 1/6 hp for N.C. 1/4 hp for N.O. 1/8 hp for N.C.	277 VAC 277 VAC 277 VAC 120 VAC N.O. 120 VAC N.C. 120-240 VAC 277 VAC 277 VAC	 Relay #1 (orange) Closed (orange) Open (orange) Auto Relay #2 of RIBU2S2 Closed (brown) Open (brown) Auto Relay #2 of RIBU2SC NC (gray) COM (purple) NO (brown) STATUS = 2nd Pole of switch of RIBU1SM, RIBH1SM Closed (brown) Open (purple) Auto (gray)		
RIBH2C*	2-SPDT		G-3/4	—					
RIBU1SC*	1-SPDT	10-30 VAC/VDC 120 VAC 50/60 Hz	G-1/2	Yes-2				Status Contact on RIBU1SM and RIBH1SM: 5A max @ 277 VAC	12 mA @ 10 VDC 14 mA @ 12 VDC 16 mA @ 24 VDC 18 mA @ 30 VDC
RIBH1SC*	1-SPDT	10-30 VAC 208-277 VAC 50/60 Hz	G-1/2	Yes-2					
RIBU1S*	1-SPST-NO**	10-30 VAC/VDC 120 VAC 50/60 Hz	G-1/2	Yes					
RIBU2SC	1-SPST-NO** 1-SPDT		G-3/4	Yes					
RIBU2S2	2-SPST-NO**		B-3/4	Yes-2					
RIBU1SM	1-SPST-NO**		G-1/2	Yes + Status					
RIBH1S*	1-SPST-NO**	10-30 VAC/VDC 208-277 VAC 50/60 Hz	G-1/2	Yes	12 mA @ 10 VDC 14 mA @ 12 VDC 16 mA @ 24 VDC 18 mA @ 30 VDC				
RIBH1SM	1-SPST-NO**		G-1/2	Yes + Status					
RIB2401D* RIB2401D-N4†	1-DPDT	24 VAC/VDC 120 VAC 50/60- Hz	A-1/2	—	10A resistive 10A resistive 1/2 hp for N.O. 1/3 hp for N.C.	30 VDC 277 VAC 120/240 VAC 120/240 VAC	NC (blue) COM (yellow) NO (orange)	Wiring Common - White/Yellow wire 24 VAC/VDC - White/Blue wire 120 VAC - White/Black wire 208-277 VAC - White/Brown wire	
RIB2402D RIB2402D-N4†	1-DPDT	24 VAC/VDC 208-277 VAC 50/60 Hz	A-1/2	—	10A resistive 10A resistive 180 VA pilot duty 1/8 hp for N.C.	30 VDC 277 VAC 120 VAC 120 VAC	NC (gray) COM (purple) NO (brown)	Input Current 29 mA @ 24 VAC 22 mA @ 24 VDC 28 mA @ 120 VAC 32 mA @ 208-277 VAC	
RIBL3C	3-SPST-NO	10-30 VAC/VDC 50/60 Hz	B-1/2	—	10A resistive 10A resistive 480 VA pilot duty 480 VA ballast 600W tungsten 240W tungsten	120-277 VAC 28 VDC 240-277 VAC 277 VAC 120 VAC N.O. 120 VAC N.C.	Relay #1 (black) (black) Relay #2 (blue) (blue) Relay #3 (yellow) (yellow)	Wiring Common - White/Red wire Relay#1 - White/Black wire Relay#2 - White/Blue wire Relay#3 - White/Yellow wire Relay#4 - White/Brown wire (if present) Input Current 30 mA @ 10 VAC 12 mA @ 10 VDC 32 mA @ 12 VAC 14 mA @ 12 VDC 42 mA @ 24 VAC 16 mA @ 24 VDC 50 mA @ 30 VAC 18 mA @ 30 VDC	
RIBL4C	3-SPST-NO 1-SPDT		B-1/2	—	1/3 hp for N.O. 1/6 hp for N.C. 1/4 hp for N.O. 1/8 hp for N.C.	120-240 VAC 120-240 VAC 277 VAC 277 VAC	Relay #4 (if present) NC (gray) COM (purple) NO (brown)		
SIB02S	SPDT Manual Switch	—	A-1/2	Yes	Switch ratings 20A	277 VAC	(blue) (yellow) (orange)	No Relay Switch Only	

ORDERING INFORMATION

Order by model number

* Models may be ordered in **RIBT Series** with high/low voltage separation.

Can be ordered normally closed by adding - **NC after the model number. Contact Kele.

†N4 has NEMA 4 housing

78 Series Electromechanical Relay Selection Guide



Specification	781 Series	782 Series	783 Series	784 Series
Coil Voltages	120VAC, 240VAC, 12VAC, 12VDC, 24VAC, 24VDC	120VAC, 240VAC, 12VAC, 12VDC, 24VAC, 24VDC	120VAC, 240VAC, 12VAC, 12VDC, 24VAC, 24VDC	120VAC, 240VAC, 12VAC, 12VDC, 24VAC, 24VDC
Configuration	SPDT	DPDT	3PDT	4PDT
Contact Rating	15A	15A	15A	15A
Base Socket	5 pin spade terminal	8 pin spade terminal	11 pin spade terminal	14 pin spade terminal
Agency Approvals	UL Recognized (E191059), CE, IEC Std 947-4-1 and 947-5-1, CSA 244610	UL Recognized (E191059), CE, IEC Std 947-4-1 and 947-5-1, CSA 244610	UL Recognized (E191059), CE, IEC Std 947-4-1 and 947-5-1, CSA 244610	UL Recognized (E191059), CE, CSA 244610
Prices starting at	\$4.50	\$5.50	\$5.75	\$7.25



Features

- Small package design
- Silver alloy gold flashed contact
- High open contact dielectric strength (up to 2500V rms)
- High reliability and long life
- High vibration and shock resistance
- LED indicator on all models, so you can easily see if the relay is working properly without using a voltmeter
- Flag indicator shows relay status in manual or powered condition
- A pushbutton allows manual operation of the relay without the need for power to the coil
- Lock-Down door, when activated, holds pushbutton and contacts in the "operate" position, allowing circuits to be analyzed.
- SPDT, DPDT, 3PDT and 4PDT models
- Finger grip cover allows easier removal of relays from sockets than conventional relays
- I.D. tag/write labels for identifying relays in multi-relay circuits

These ice cube style relays are power relays designed for applications demanding high power control in various factory machines and control panels. They are ideal for electrical control panels requiring stable and reliable relays.

78 Series Relays Selection Guide

NOTE: Not recommended for low current switching. Find contacts' Minimum Switching Requirement on following page.
For low current switching, please see the QM4N1 and QM4X1 series.

Part Number	Price	Coil Voltage	Configuration	Dimensions	Relay Socket Part Number	Price	Dimensions
781-1C-12D	\$4.75	12VDC	SPDT	Figure 1	781-1C-SKT	\$4.00	Figure 5
781-1C-12A	\$4.75	12VAC					
781-1C-24D	\$4.50	24VDC					
781-1C-24A	\$4.75	24VAC					
781-1C-120A	\$4.75	120VAC					
781-1C-240A	\$5.25	240VAC					
782-2C-12D	\$5.50	12VDC	DPDT	Figure 2	782-2C-SKT	\$4.00	Figure 6
782-2C-12A	\$5.50	12VAC					
782-2C-24D	\$5.50	24VDC					
782-2C-24A	\$5.75	24VAC					
782-2C-120A	\$5.75	120VAC					
782-2C-240A	\$6.25	240VAC					
783-3C-12D	\$5.75	12VDC	3PDT	Figure 3	783-3C-SKT	\$4.50	Figure 7
783-3C-12A	\$7.75	12VAC					
783-3C-24D	\$8.25	24VDC					
783-3C-24A	\$8.25	24VAC					
783-3C-120A	\$8.25	120VAC					
783-3C-240A	\$8.25	240VAC					
784-4C-12D	\$7.25	12VDC	4PDT	Figure 4	784-4C-SKT-1	\$4.75	Figure 8
784-4C-12A	\$9.50	12VAC					
784-4C-24D	\$7.50	24VDC					
784-4C-24A	\$7.50	24VAC					
784-4C-120A	\$7.50	120VAC					
784-4C-240A	\$7.50	240VAC					

78 Series Electromechanical Relay Specifications

78 Series Relay Specification Table												
Part Numbers	781-1C-12D	781-1C-12A	781-1C-24D	781-1C-24A	781-1C-120A	781-1C-240A	782-2C-12D	782-2C-12A	782-2C-24D	782-2C-24A	782-2C-120A	782-2C-240A
General Specifications												
*Service Life: Mechanical / Electrical Operations	Mechanical: 10,000,000 operations unpowered											
	Electrical: 100,000 operations @ rated resistive load											
Operating Temperature	-40°C to 55°C (-40°F to 131°F)											
Response Time	20ms											
Vibration Resistance	± 1mm (10-35 Hz) and 3gn (35-50Hz)											
Shock Resistance	15gn											
Weight	26g (0.92 oz)						36g (1.27 oz)					
**Agency Approvals and Standards	UL Recognized File E191059, CE, CSA											
Environmental Protection	IP40											
NEMA B300 Pilot Duty Rated	Yes											
Coil Specifications												
Standard	Mechanical flag indicator, LED Indicator, lockable push to test button											
Coil Input Voltage	12VDC	12VAC	24VDC	24VAC	120VAC	240VAC	12VDC	12VAC	24VDC	24VAC	120VAC	240VAC
Coil Resistance	115Ω	44Ω	450Ω	177Ω	4.43kΩ	17.72kΩ	177Ω	44Ω	640Ω	177Ω	4.43 kΩ	17.72 kΩ
Power Consumption	1.4 W DC, 1.9 VAC						1.15 W DC, 1.4 VAC					
Dropout Voltage (% of nominal voltage or more)	10%	15%	10%	15%			10%	15%	10%	15%		
Pull-in Voltage (% of nominal voltage or less)	85%	85%	85%	85%			80%	85%	80%	85%		
Max. Voltage (Max. continuous voltage)	110% of the rated coil voltage											
Contact Specifications												
Contact Type	SPDT						DPDT					
Contact Material	Silver alloy, gold flashed											
Minimum Switching Requirement	10mA @ 17VDC											
Max. Contact Rating	Refer to Contact Ratings charts.											
Dielectric Strength Between Contacts	Between coil contact: 2000V rms; Between poles 2000V rms; Between contacts 1500V rms											

*Note: These devices are rated for 1,000 cycles when used in a motor application. (Per Table 45.1, UL 508).

**Note: UL listed when used with sockets 781-1C-SKT, 782-2C-SKT, 783-3C-SKT, 784-4C-SKT, or 784-4C-SKT-1.

Current limited to rating of relay or socket, whichever is less.

NEMA Mechanical Switching Ratings and Test Values for AC Control Circuit Contacts											
Contact Rating Designation	Thermal Continuous Test Current (A)	Maximum AC Current, 50/60Hz (A)								Voltamperes	
		120 Volts		240 Volts		480 Volts		600 Volts			
		Make	Break	Make	Break	Make	Break	Make	Break	Make	Break
B300	5	30	3.00	15	1.50	---	---	---	---	3600	360
This chart is provided as a guideline only, and the ratings and values are not guaranteed to be accurate. It is the users' responsibility to properly size their control circuit devices. The chart values are from NEMA Standard ICS 5-2000, Table 1-4-1.											

781 Series Contact Ratings (current)				
Resistive				*Motor Load
Voltage	Nominal	UL	CSA	UL
28VDC	15A	15A	12A	---
120VAC	15A	15A	15A	1/2Hp
277VAC	15A	12A	12A	1Hp

782 Series Contact Ratings (current)				
Resistive				*Motor Load
Voltage	Nominal	UL	CSA	UL
28VDC	15A	15A	12A	---
120VAC	15A	15A	15A	1/2Hp
277VAC	15A	12A	12A	1Hp

78 Series Electromechanical Relay Specifications

78 Series Relay Specification Table												
Part Numbers	783-3C-12D	783-3C-12A	783-3C-24D	783-3C-24A	783-3C-120A	783-3C-240A	784-4C-12D	784-4C-12A	784-4C-24D	784-4C-24A	784-4C-120A	784-4C-240A
General Specifications												
*Service Life: Mechanical / Electrical Operations	Mechanical: 10,000,000 operations unpowered											
	Electrical: 100,000 operations @ rated resistive load											
Operating Temperature	-40°C to 55°C (-40°F to 131°F)											
Response Time	20ms											
Vibration Resistance	± 1mm (10-35 Hz) and 3gn (35-100 Hz)											
Shock Resistance	15gn											
Weight	60g (2.12 oz)						80g (2.82 oz)					
**Agency Approvals and Standards	UL Recognized File E191059, CE, CSA											
Environmental Protection	IP40											
NEMA B300 Pilot Duty Rated	Yes											
Coil Specifications												
Standard	Mechanical flag indicator, LED Indicator, lockable push to test button											
Coil Input Voltage	12VDC	12VAC	24VDC	24VAC	120VAC	240VAC	12VDC	12VAC	24VDC	24VAC	120VAC	240VAC
Coil Resistance	80Ω	30Ω	320Ω	110Ω	2.88 kΩ	11.3 kΩ	76Ω	20Ω	303Ω	80Ω	2.1 kΩ	8kΩ
Power Consumption	1.85 W DC, 2.05 VAC						1.5 W DC, 1.5 VAC					
Dropout Voltage (% of nominal voltage or more)	10%	15%	10%	15%			10%	15%	10%	15%		
Pull-in Voltage (% of nominal voltage or less)	80%	85%	80%	85%			80%	85%	80%	85%		
Max. Voltage (Max. continuous voltage)	110% of the rated coil voltage											
Contact Specifications												
Contact Type	3PDT						4PDT					
Contact Material	Silver alloy, gold flashed											
Minimum Switching Requirement	10mA @ 17VDC											
Max. Contact Rating	Refer to Contact Ratings charts.											
Dielectric Strength Between Contacts	Between coil and contacts: 2000V rms; Between poles: 2000V rms; Between contacts: 1500V rms											

*Note: These devices are rated for 1,000 cycles when used in a motor application. (Per Table 45.1, UL 508).

**Note: UL listed when used with sockets 781-1C-SKT, 782-2C-SKT, 783-3C-SKT, 784-4C-SKT, or 784-4C-SKT-1. Current limited to rating of relay or socket, whichever is less.

783 Series Contact Ratings (current)				
Resistive				*Motor Load
Voltage	Nominal	UL	CSA	UL
28VDC	15A	15A	15A @ 28VDC 30A max total	—
120VAC	15A	—	15A	1/2 hp
277VAC	15A	15A	15A @ 150VAC 30A max total	1hp 2hp max total

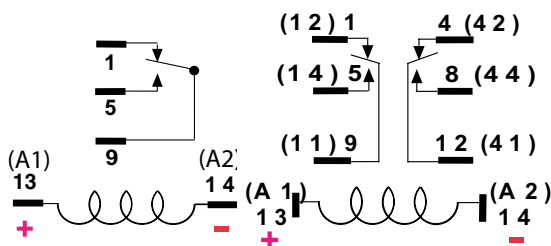
784 Series Contact Ratings (current)				
Resistive				*Motor Load
Voltage	Nominal	UL	CSA	UL
28VDC	15A	15A	15A @ 28VDC 30A max total	—
120VAC	15A	—	15A	1/2Hp
277VAC	15A	15A	15A @ 150VAC 30A max total	1hp 2hp max total

*Note: These devices are rated for 1,000 cycles when applied to a motor application. (Per Table 46.1` UL 508)

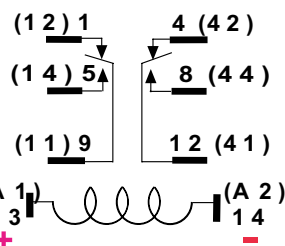
78 Series Wiring Diagrams and Dimensions

Wiring Diagrams (viewed from pin end)

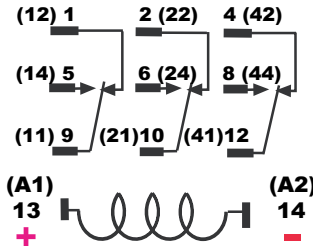
781-1C-XXX



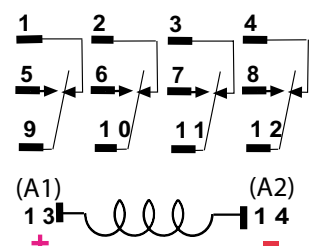
782-2C-XXX



783-3C-XXX



784-4C-XXX



ALTERNATE NEMA OR IEC () NUMBERS, VIEWED FROM PIN SIDE

Dimensions

inches [mm]

Figure 1: 781-1C

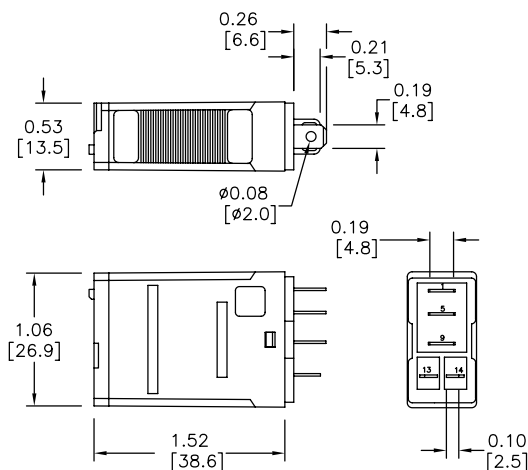


Figure 2: 782-2C

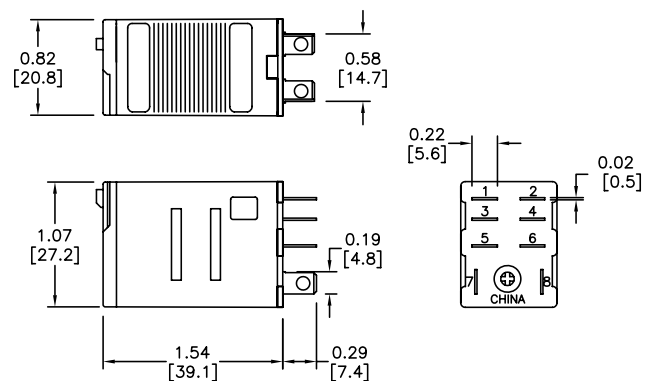


Figure 3: 783-3C

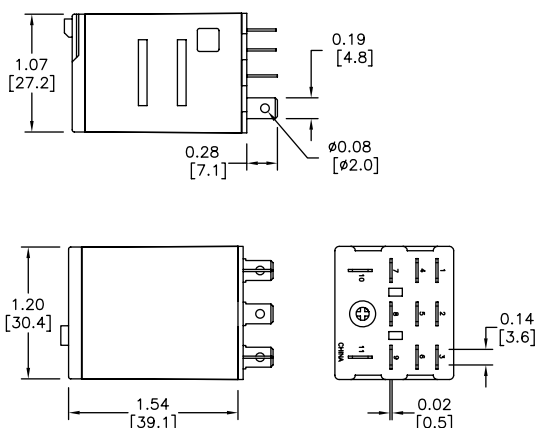
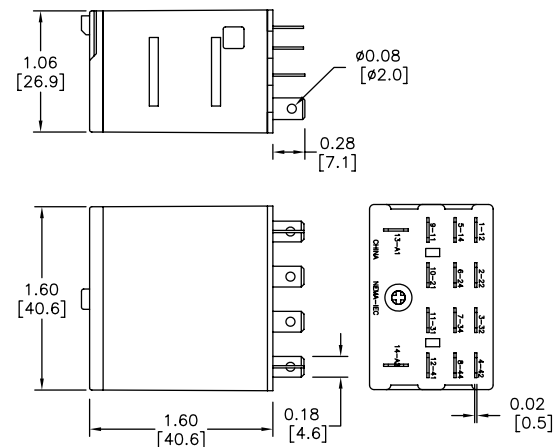


Figure 4: 784-4C



78 Series Relay Socket Dimensions

Dimensions

inches [mm]

Figure 5: 781-1C-SKT

DIN-rail mounting, SPDT, for use with 781 series relays

Note: See Table on next page for maximum screw torques and wire sizes

UL Recognized

file number: E225080

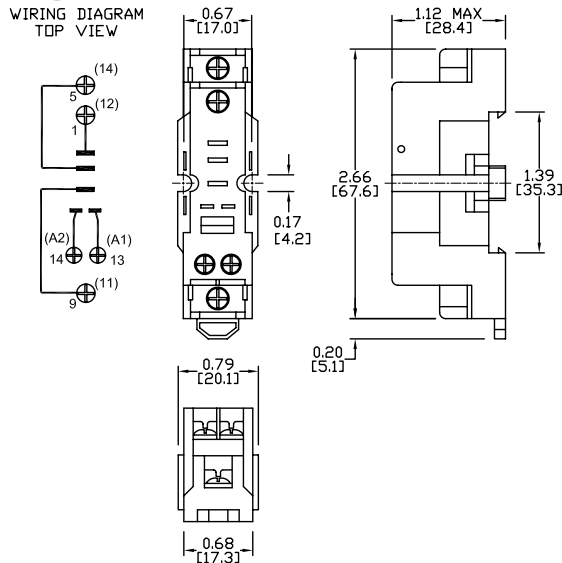


Figure 6: 782-2C-SKT

DIN-rail mounting, DPDT, for use with 782 series and AD-70S2 relays

Note: See Table on next page for maximum screw torques and wire sizes

UL Recognized

file number: E225080

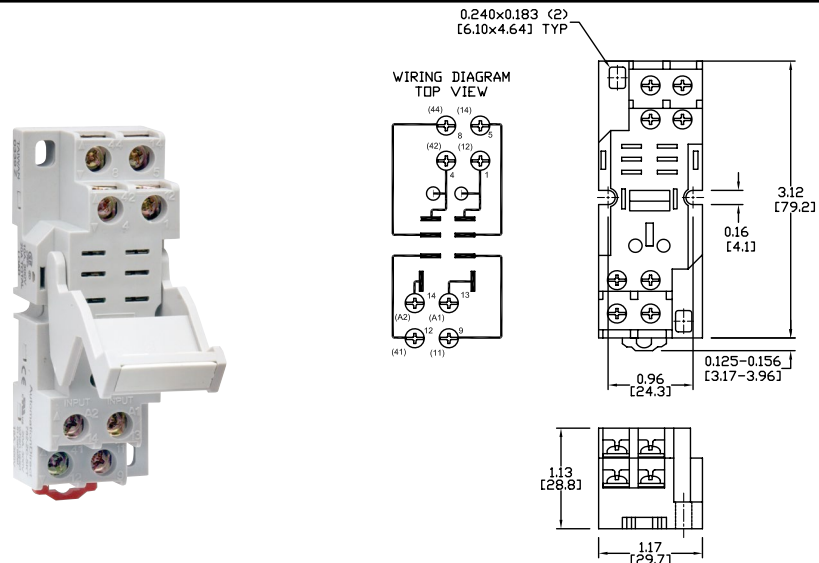


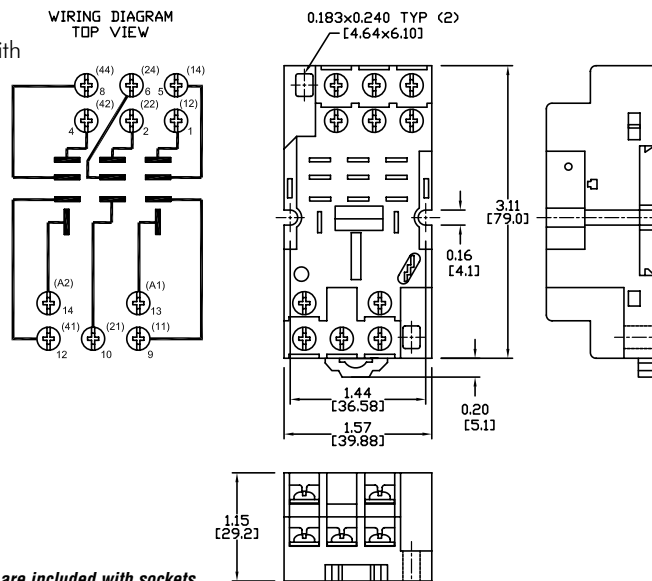
Figure 7: 783-3C-SKT

DIN-rail mounting, 3PDT, for use with 783 series relays.

Note: See Table on next page for maximum screw torques and wire sizes

UL Recognized

file number: E225080



Note: Order sockets separately; holding clips are included with sockets.

78 Series Relay Socket Dimensions



Dimensions

inches [mm]

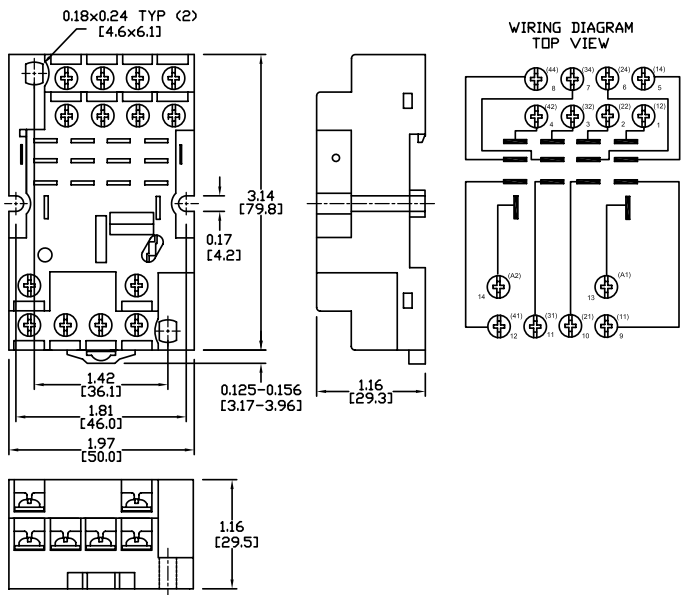


Figure 8: 784-4C-SKT-1

DIN-rail mounting, 4PDT,
for use with 784 series relays.

Note: Order sockets separately;
holding clips are included with sockets.

Note: See table below for maximum screw
torques and wire sizes

UL Recognized
file number: E225080

Part Number	Price	Maximum Screw Torques	Maximum Wire Sizes
781-1C-SKT	\$4.00	Terminals 13, 14: 7 in-lbs/0.8 N-m Terminals 1, 5, 9: 9 in-lbs/1.0 N-m	Terminals 13, 14: 18 to 20 AWG, solid or stranded, one or two identical wires Terminals 1, 5, 9: 12 to 20 AWG, solid or stranded, one or two identical wires
782-2C-SKT	\$4.00	All terminals: 9 in-lbs/1.0 N-m	All terminals: 12 to 20 AWG, solid or stranded, one or two identical wires
783-3C-SKT	\$4.50		
784-4C-SKT-1	\$4.75		

Packaged M.O.V.s and Diodes

Overview

Metal Oxide Varistors (MOV) and Diode circuits are offered as convenient plug-in modules. Plugging a module into the relay socket connects the circuit in parallel with the relay coil. No additional wiring is required.

Modules fit within the maximum dimensions of the relay and socket.

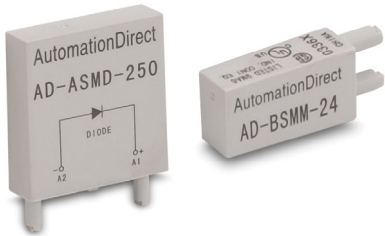
Features

- MOVs protect by shunting potentially damaging electrical spikes away from the relay coil. Ideal for AC and DC applications.
- Diodes protect external drive circuitry from inductive voltages generated when removing coil voltage. Ideal for DC applications. Polarity sensitive.

Application

Many PLC systems control one or more inductive load devices. These inductive loads (devices with a coil) generate transient voltages when they are de-energized with a relay contact. When a relay contact is closed it “bounces”, which causes the coil to energize and de-energize until the “bouncing” stops. The transient voltage which is generated is much larger in amplitude than the supply voltage, especially with a DC supply voltage.

When switching a DC-supplied inductive load the full supply voltage is always present when the relay contact opens (or “bounces”). When switching an AC-supplied inductive load, if the voltage is not zero when the relay contact opens, there is energy stored in the inductor that is released when the voltage to the inductor is suddenly removed. This release of energy is what produces transient voltages.



When inductive load devices (motors, motor starters, interposing relays, solenoids, valves, etc.) are controlled with relay contacts, it is recommended that a surge suppression device be connected directly across the coil of the field device. If the inductive device has plug-type connectors, the suppression device can be installed on the terminal block of the relay output.

Metal oxide varistors (MOV) and diodes are devices which provide good surge and transient suppression of AC and DC powered coils.

Protection Device Selection Guide					
Part Number	Price	Description	Nominal Input Voltage	Dimensions & Package	Mating Socket
AD-ASMD-250	\$9.75	Protection diode module for 784 and 75 series relays. Plug-in modules come in package of 5.	6-250VDC	Figure 1	783-3C-SKT 784-4C-SKT-1 750-2C-SKT 750-3C-SKT
AD-ASMM-24	\$8.00	MOV module for 784 and 75 series relays that operate at 24VAC coil voltage. Package includes 5 modules.	24VAC/VDC		
AD-ASMM-120	\$8.00	MOV module for 784 and 75 series relays that operate at 120VAC coil voltage. Package includes 5 modules.	120VAC/VDC		
AD-ASMM-240	\$8.00	MOV module for 784 and 75 series relays that operate at 240VAC coil voltage. Package includes 5 modules.	240VAC/VDC		
AD-BSMD-250	\$8.00	Protection diode module for 782 series relays. Plug-in modules come in package of 5.	6-250VDC	Figure 2	782-2C-SKT
AD-BSMM-24	\$8.00	MOV module for 782 series relays that operate at 24VAC coil voltage. Package includes 5 modules.	24VAC/VDC		
AD-BSMM-120	\$8.00	MOV module for 782 series relays that operate at 120VAC coil voltage. Package includes 5 modules.	120VAC/VDC		
AD-BSMM-240	\$8.00	MOV module for 782 series relays that operate at 240VAC coil voltage. Package includes 5 modules.	240VAC/VDC		

Accessory dimensions

inches [mm]

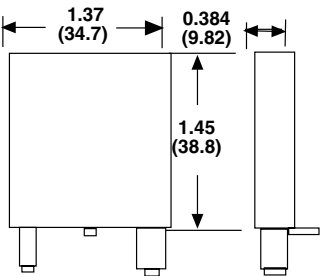


Figure 1

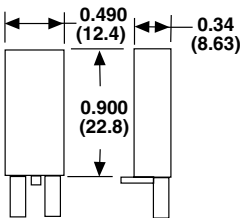
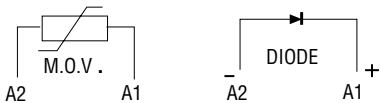


Figure 2



INSTALLATION INSTRUCTIONS

C-2200, Go/No Tiny Split-Core Digital Output



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 warning

- 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



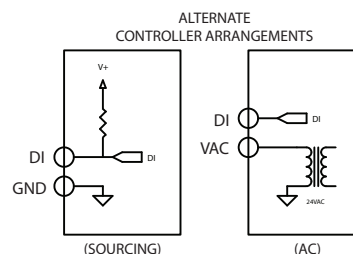
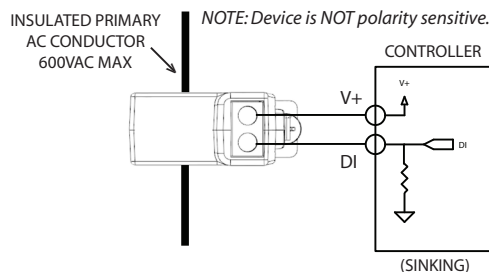
INSTALLATION

1. Determine mounting location for the sensor near the conductor to be monitored. The sensor should be located AT LEAST 1/2" from any uninsulated conductor.
2. Sensor features a flexible iris which allows the sensor to hang on the conductor if local codes permit. A mounting tab is included for screw mounting.
3. Clamp sensor around INSULATED CONDUCTOR ONLY, 600VAC MAX to be monitored.
4. Wire the output of the sensor to a control panel digital input loop not to exceed 30VAC/DC wetting voltage. Tighten terminals to 3.5 in-lb.



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

WIRING EXAMPLES

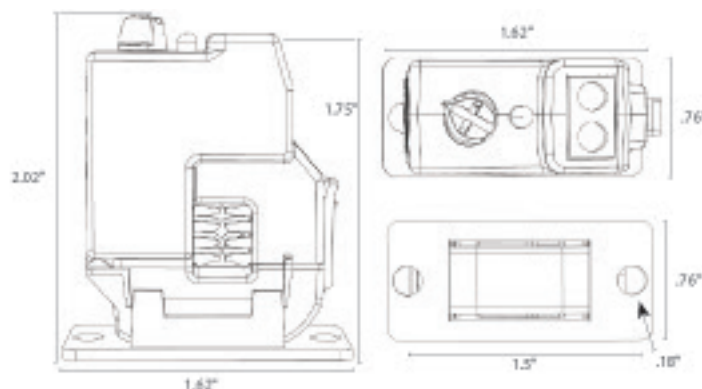


PRODUCT APPLICATION LIMITATION:

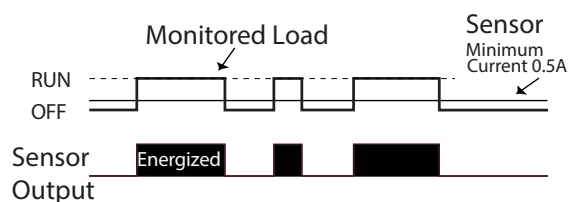
Senva products are not designed for life or safety applications. Senva products are not intended for use in critical applications such as nuclear facilities, human implantable device or life support. Senva is not liable, in whole or in part, for any claims or damages arising from such uses.



DIMENSIONS



OPERATION



The C-2200 output changes state whenever current above 0.5A is present. This provides "go/no" status on loads that are not subject to mechanical failures.

Typical on/off status applications include:

- Lighting circuits
- Heater elements
- Direct drive fans (e.g. exhaust fans)
- Process motors

Specification

C-2200

Amperage Range	0.5A (on)-50A (50A Max)
Output Type	NO, solid-state FET
Output Rating	1.0A@30VAC/DC Max.
Temperature Rating	-15 to 60 ° C
Insulation Class	600V RMS. For use on insulated conductors only! Use minimum 75 ° C insulated conductor
Sensor Power	Induced
Frequency Range	50/60Hz
Dimensions (LxWxH)	1.9" x 1.35" x 0.6" (2.0" x 1.6" x 0.6" with bracket)
Sensor Aperture	0.375"

Maximum surrounding air ambient, 60 ° C.

For use in Pollution Degree 2 Environment.

Troubleshooting

Symptom	Causes	Remedy
Sensor output does not change state	Amperage is below sensor minimum threshold	Wrap monitored conductor turns through sensor.
	Testing with ohm meter yields incorrect results	Solid state output may show approx. 1 ohm or less.
	Incorrect control wiring	Ensure control loop voltage is present

RōCoil™

Flexible CTs

The DENT RōCoil™ Current Transformers have been designed for accurate non-intrusive measurement of AC current, pulsed DC or distorted waveforms where conventional rigid core CTs are unsuitable. This type of sensor may be used to measure AC current over a wide dynamic range and from 20 Hz to 5 kHz. Note: Some applications may require use of integrator/amplifier. See also RōCoil mV™.

KEY SPECIFICATIONS

Four Lengths	40 cm (16"), 60 cm (24"), 90 cm (35"), 120 cm (47")
Window Size	11.5 cm (4.5"), 17.9 cm (7.0"), 27.5 cm (10.8"), 37 cm (14.6")
Output Signal (di/dt)	131 mVAC/1000A @ 60 Hz 109.2 mV/1000A @ 50 Hz
Current Range	5 - 5000A AC*
Accuracy (typical)	< 0.6%**

ELECTRICAL

All accuracies specified at 20°C (±2°C) with RōCoil™ centered on conductor.

Output Signal	131 mV/1000A @ 60 Hz 109.2 mV/1000A @ 50 Hz
Wire Colors	White = (+) positive Brown = (-) negative Bare wire = shield
Phasing	Arrow Points Towards Load
Phase Shift	< 0.2° at 50/60 Hz
Frequency Range	20 Hz to 5 kHz*
Useful Current Range	5 - 5000A AC*
Linearity	± 0.2%
Temperature Sensitivity	0.07% per °C

MECHANICAL

Coil Materials	Blue thermoplastic rubber, flame retardant UL 94 V-0 rated
Coupling Materials	PA6 UL 94 V-0 rated
Shielding	100% transducer, 100% output lead
Working Temp	-20 °C to +70 °C (-4° to +158 °F)

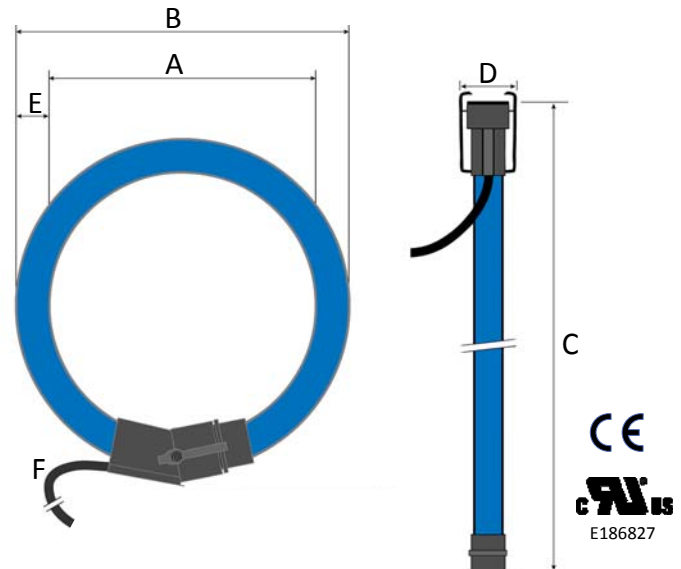
SAFETY

Working Voltage	1000 Vrms maximum
Dielectric Strength	7400 VAC around coil 1000 VAC rated leads
Certifications	 Conforms to UL STD 61010-1 Certified to CAN/CSA STD C22.2 No. 61010

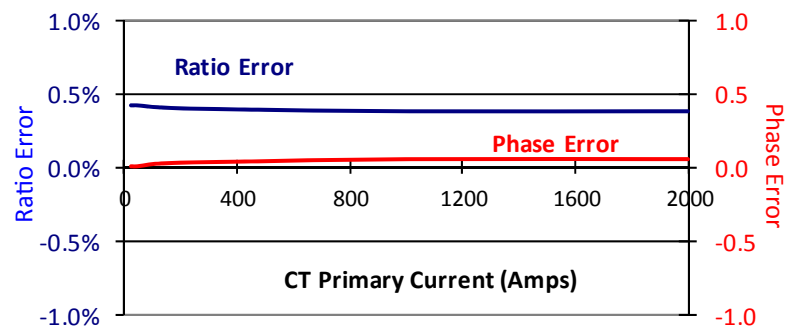
*Depending on meter compatibility. RōCoil CTs UL Rated to 100KA AC. ELITEpro SP/XC (v. 212 or newer firmware) and PowerScout™ 3 and 24 (v. 3.16 or newer firmware) rated for 5-5000A. Meters with earlier firmware versions rated from 50-5000A AC. PowerScout™ 18 rated for 50-3500A.

**Installed using best practices with conductor centered in the CT window and ensure any external conductors are a minimum distance of > 2X the diameter of the RōCoil. Accuracy below 20A rated at 1.5% +/- 0.5A when used with DENT ELITEpro/PowerScout meters. RōCoil have been 100% verified to meet the C57.13-2008 Class 1.2 Standard.

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All specifications subject to change without notice.



DIMENSIONS		R16 40 cm (16")	R24 60 cm (24")	R36 90 cm (35")	R47 120 cm (47")
A	Window Size	11.5 cm (4.5")	17.9 cm (7.0")	27.5 cm (10.8")	37 cm (14.6")
B	Transformer Coil O.D.	13.9 cm (5.5")	20.3 cm (8.0")	29.9 cm (11.8")	39.4 cm (15.5")
C	Transformer Length	40 cm (15.8")	60 cm (23.6")	90 cm (35.4")	120 cm (47.2")
D	Locking Connector O.D.	2.0 cm (0.8")			
E	Transformer Coil Diameter	1.2 cm (0.5")			
F	Wire Lead Total Length	2 m (80")			



CT testing performed with 16"RōCoil. Conductor used filled 90% of RōCoil window.

RōCoil™ PART NUMBERS

40 cm (16") RōCoil™	CT-R16-A4-U
60 cm (24") RōCoil™	CT-R24-A4-U
90 cm (35") RōCoil™	CT-R36-A4-U
120 cm (47") RōCoil™	CT-R47-A4-U

CONTACT US

DENT Instruments, Inc.
Energy & Power Measurement Solutions
An ISO 9001:2008 Certified Company

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CONTROL TRANSFORMERS

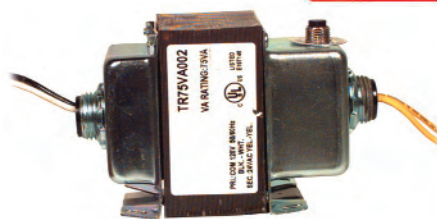
RIB TR SERIES

DESCRIPTION

The **RIB TR Series** offers a complete line of control transformers for use in building automation and temperature control systems. The Series includes transformer VA ratings from 20 VA through 375 VA and primary voltages of 120, 208, 240, 277, and 480 VAC. Isolation transformers for 24 VAC circuits are also included. All **RIB TR Series** transformers are UL listed and feature split-bobbin construction. Some also have a secondary circuit breaker.

FEATURES

- Complete line of control transformers from 20 VA to 375 VA
- Foot and hub mounting on most models
- All models UL listed; many are Class 2 rated
- Color-coded wire leads
- Ambient temp 32° to 104°F (0° to 40°C)
- One-year warranty



TR75VA002



TR40VA001



SPECIFICATIONS

MODEL	VA RATING	PRIMARY: SECONDARY VOLTAGE (VAC)	FREQ (Hz)	CIRCUIT BREAKER	MOUNTING H = Hub	AGENCY APPROVALS
TR20VA001	20	120:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR20VA002	20	208:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR20VA003	20	24:24 (isolation)	50/60	No	1H + Foot	UL506 listed US/Canada, E197147
TR20VA007	20	277:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA001	40	120:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA002	40	120:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA003	40	24:24 (isolation)	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA004	40	120/208/240/277:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA015	40	120/208/240:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR40VA040	40	120/208/240:24 (terminals)	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA001	50	120:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA002	50	120:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA003	50	208/240:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA004	50	120/240/277/480:24	50/60	Yes	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA005	50	120:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA006	50	277:24	50/60	No	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA007	50	277:24	50/60	No	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA009	50	120/208/240	50/60	Yes	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA014	50	277:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA015	50	120/208/240/277/480:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA016	50	120/208/240:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR50VA017	50	208/277/480:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR75VA001	75	120:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR75VA002	75	120:24	50/60	Yes	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR75VA003	75	277:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR75VA004	75	120/208/240/480:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR75VA005	75	120/208/240/480:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR85VA002	85	120:24	50/60	No	1H + Foot	UL506 listed US/Canada, E197147
TR100VA001	96	120:24	50/60	Yes	1H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR100VA002	96	120:24	50/60	Yes	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR100VA004	96	120/240/277/480:24	50/60	Yes	2H + Foot	Class 2 UL1585 listed US/Canada, E197146
TR150VA001	150	120:24	50/60	Yes	1H + Foot	UL506 listed US/Canada, E197147
TR175VA001	175	208/240:24	50/60	No	Foot	UL506 listed US/Canada, E197147
TR175VA002	175	120:24	50/60	No	2H + Foot	UL506 listed US/Canada, E197147
TR240VA001	240	120:24	50/60	No	1H + Foot	UL506 listed US/Canada, E197147
TR300VA002	300	120/208/240/480:24	50/60	Yes	Foot	UL506 listed US/Canada, E197147
TR375VA001	375	120:24	50/60	No	Foot	UL506 listed US/Canada, E197147

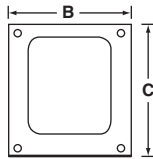
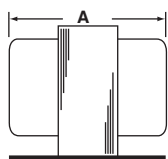
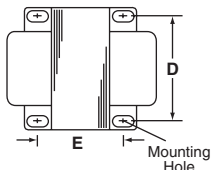


CONTROL TRANSFORMERS

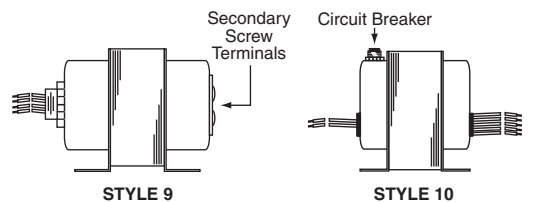
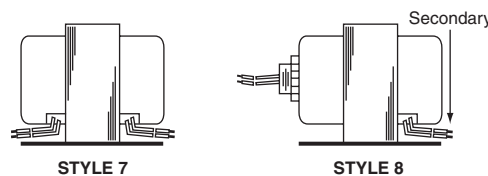
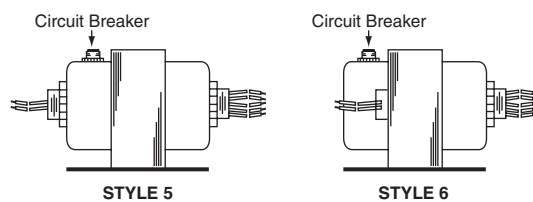
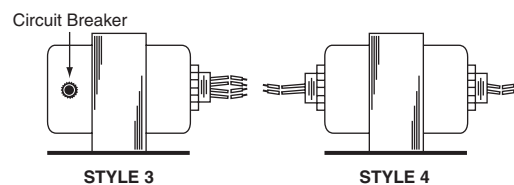
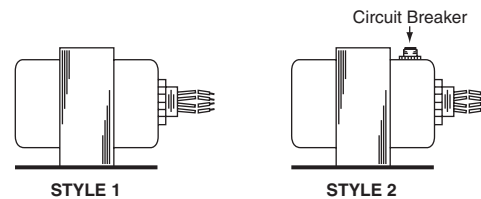
RIB TR SERIES

DIMENSIONS

in
(cm)



MODEL	DIMENSIONS					WIRES	WEIGHT lb (kg)	STYLE
	A	B	C	D	E			
TR20VA001	2.13 (5.4)	1.90 (4.8)	2.6 (6.6)	1.63 (4.1)	1.54 (3.9)	8.0 (20.3)	1.35 (0.61)	1
TR20VA002	2.31 (5.86)	1.89 (4.80)	2.63 (6.68)	1.63 (4.1)	1.54 (3.9)	8.0 (20.3)	1.32 (0.61)	4
TR20VA003	2.13 (5.4)	1.90 (4.8)	2.6 (6.6)	1.63 (4.1)	1.54 (3.9)	8.0 (20.3)	1.39 (0.63)	1
TR20VA007	2.13 (5.4)	1.90 (4.8)	2.6 (6.6)	1.63 (4.1)	1.54 (3.9)	8.0 (20.3)	1.38 (0.63)	1
TR40VA001	2.7 (6.9)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	1.93 (4.9)	8.0 (20.3)	2.02 (0.92)	1
TR40VA002	2.7 (6.9)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	1.93 (4.9)	8.0 (20.3)	2.05 (0.93)	4
TR40VA003	2.7 (6.9)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	1.93 (4.9)	8.0 (20.3)	2.05 (0.93)	1
TR40VA004	2.75 (7.0)	2.2 (5.6)	2.88 (7.31)	1.75 (4.4)	2.06 (5.23)	8.0 (20.3)	2.02 (0.92)	4
TR40VA015	2.7 (6.9)	2.2 (5.6)	2.88 (7.31)	1.75 (4.4)	1.95 (4.95)	8.0 (20.3)	1.96 (0.89)	1
TR40VA040	2.7 (6.9)	2.2 (5.6)	2.88 (7.31)	1.75 (4.4)	1.95 (4.95)	8.0 (20.3)	1.96 (0.89)	9
TR50VA001	2.75 (7.0)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	1.93 (4.9)	8.0 (20.3)	2.14 (0.97)	1
TR50VA002	2.75 (7.0)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	1.93 (4.9)	8.0 (20.3)	2.18 (0.99)	4
TR50VA003	2.75 (7.0)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	2.01 (5.1)	8.0 (20.3)	2.17 (0.98)	4
TR50VA004	3.48 (8.8)	2.52 (6.4)	3.0 (7.6)	2.0 (5.1)	1.95 (5.0)	9.5 (24.1)	3.04 (1.38)	5
TR50VA005	3.5 (8.9)	2.52 (6.4)	3.0 (7.6)	2.0 (5.1)	2.0 (5.1)	9.0 (22.9)	2.6 (1.18)	2
TR50VA006	2.79 (7.1)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	2.01 (5.1)	8.0 (20.3)	2.16 (0.98)	1
TR50VA007	2.79 (7.1)	2.2 (5.6)	2.9 (7.4)	1.75 (4.4)	2.01 (5.1)	8.0 (20.3)	2.17 (0.98)	4
TR50VA009	3.48 (8.8)	2.52 (6.4)	3.0 (7.6)	2.0 (5.1)	1.95 (5.0)	9.5 (24.1)	3.04 (1.38)	5
TR50VA014	3.45 (8.76)	2.5 (6.4)	3.05 (7.74)	2.0 (5.1)	1.95 (4.95)	9.0 (22.9)	2.8 (1.27)	2
TR50VA015	3.475 (8.82)	2.53 (6.42)	3.04 (7.72)	2.0 (5.1)	1.95 (4.95)	9.5 (24.1)	2.98 (1.35)	2
TR50VA016	3.475 (8.82)	2.53 (6.42)	3.06 (7.77)	2.0 (5.1)	1.95 (4.95)	9.5 (24.1)	2.90 (1.32)	2
TR50VA017	3.475 (8.82)	2.53 (6.42)	3.05 (7.74)	2.0 (5.1)	1.95 (4.95)	9.5 (24.1)	2.86 (1.29)	2
TR75VA001, 005	3.9 (9.9)	2.5 (6.4)	3.0 (7.6)	2.0 (5.1)	2.4 (6.1)	9.5 (24.1)	3.66 (1.66)	2
TR75VA002	3.9 (9.9)	2.5 (6.4)	3.0 (7.6)	2.0 (5.1)	2.4 (6.1)	9.5 (24.1)	3.70 (1.68)	5
TR75VA003	3.875 (9.84)	2.5 (6.4)	3.06 (7.77)	2.0 (5.1)	2.4 (6.1)	9.5 (24.1)	3.60 (1.63)	2
TR75VA004	3.9 (9.9)	2.5 (6.4)	3.0 (7.6)	2.0 (5.1)	2.4 (6.1)	9.5 (24.1)	3.78 (1.71)	6
TR85VA002	2.80 (7.1)	3.75 (9.5)	3.18 (8.1)	3.10 (7.9)	2.0 (5.1)	9.5 (24.1)	4.35 (1.97)	1
TR100VA001	4.0 (10.2)	2.5 (6.4)	3.0 (7.6)	2.0 (5.1)	2.55 (6.4)	9.5 (24.1)	4.06 (1.84)	2
TR100VA002	4.0 (10.2)	2.5 (6.4)	3.0 (7.6)	2.0 (5.1)	2.55 (6.5)	9.5 (24.1)	4.13 (1.87)	5
TR100VA004	4.25 (10.8)	2.5 (6.4)	3.0 (7.6)	1.97 (5.0)	2.75 (7.0)	9.5 (24.1)	4.60 (2.08)	5
TR150VA001	3.5 (8.9)	3.75 (9.5)	3.25 (8.3)	3.23 (8.2)	2.0 (5.1)	9.5 (24.1)	4.92 (2.23)	3
TR175VA001	3.8 (9.7)	3.8 (9.7)	3.2 (8.1)	3.1 (7.9)	3.0 (7.6)	9.5 (24.1)	7.05 (3.19)	7
TR175VA002	3.9 (9.9)	3.75 (9.5)	3.18 (8.1)	3.1 (7.9)	3.0 (7.6)	9.5 (24.1)	7.10 (3.22)	4
TR240VA001	3.75 (9.5)	3.75 (9.5)	4.5 (11.4)	3.13 (8.0)	3.23 (8.2)	9.5 (24.1)	9.12 (4.13)	8
TR300VA002	5.4 (13.7)	3.75 (9.5)	4.5 (11.4)	3.18 (8.07)	3.84 (9.75)	8.5 (21.6)	12.1 (5.49)	10
TR375VA001	4.33 (11.0)	3.75 (9.5)	4.5 (11.4)	3.15 (8.0)	3.83 (9.7)	7.0 (17.8)	11.44 (5.18)	7



TRANSFORMER STYLES

WIRING

Primary Wires

480 VAC	Gray	120 VAC	White
277 VAC	Brown	24 VAC	Black
240 VAC	Orange	Common	Black
208 VAC	Red		

Secondary Wires*

24 VAC	Yellow
24 VAC	Yellow or Yellow/White

*Transformer Style 9 has secondary screw terminals.

ORDERING INFORMATION

Order by transformer model as listed under Specifications on the previous page.



DESCRIPTION

The **Kele DCP-1.5-W** is a regulated 1.5A power supply that accepts 24 VAC at the input and provides 24 VDC at the output. The **DCP-1.5-W** can be ordered with any output voltage from 1.5V to 27 VDC. Field voltage adjustments may also be made using only a screwdriver. The power supply is provided with a mounting track for easy field application. This low cost power supply features good regulation and has full overcurrent protection.

FEATURES

- **Low cost**
- **Regulated DC output**
- **Snap-track mounted**
- **Screw terminals with pressure plates**
- **Adjustable DC output**
- **Full-wave rectified**



DCP-1.5-W

APPLICATION

In general, the output current rating will be reduced by the ratio of the output voltage divided by the input voltage. For example, a 6 VDC supply powered by a 24 VAC transformer will have a reduced-rated output current of 375 mA. $(6/24) \times 1.5 = 0.375$

To obtain the full-rated output current at reduced output voltages, the standard power supply input voltage must be reduced. It is a good practice to maintain the same AC input voltage as the desired DC output voltage.

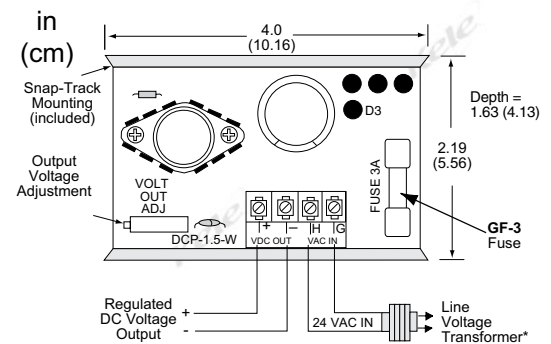
A grounded DC minus terminal and a grounded secondary 24 VAC input transformer will blow the unit's fuse. If this is a problem, there are three possible solutions:

Option 1: Remove the ground on the transformer secondary to float the voltage output, or use a separate ungrounded transformer.

Option 2: Add a Model Y65G13-0 40 VA isolation transformer. This option reduces the power supply capacity to 920 mA.

Option 3: Remove diode D3 (marked on board). Jumper the VDC OUT (-) terminal to the VAC IN (G) terminal. The grounded side of the AC supply should be wired to the VAC IN (G) terminal. This option reduces the power supply capacity to 400 mA. (Sometimes call "1/2 wave" option)

DIMENSIONS / WIRING



* Input Transformer Required VA Rating @ 24 VAC = $43.2 \times \text{Desired DC Output Current}$
For full 1.5A capacity, use a 75 VA transformer.

SPECIFICATIONS

Supply Voltage	24 VAC
Output Voltage	24 VDC (full wave rectified and regulated), Adjustable 1.5 - 27 VDC (full wave rectified and regulated)
Supply Frequency	50/60 Hz
Regulation	1.5% at full rated current
Output Current	1.5A (with 75 VA transformer)
Over Current Protection	3A fuse (GF-3)
Mounting	Snap track (included)
Temperature Stability	1%
Operating Temperature	32° to 130°F (0° to 55°C)
Operating Humidity	95% RH non-condensing
Dimensions	1.63"H x 2.19"W x 4.0"D (4.13 x 5.56 x 10.16 cm)
Weight	0.4 lb (0.18 Kg)
Warranty	1 year

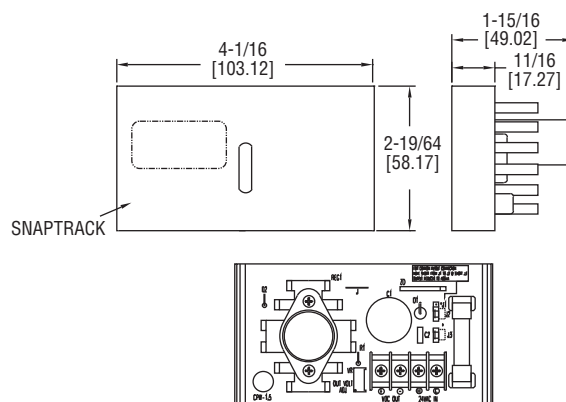
ORDERING INFORMATION

MODEL	DESCRIPTION
DCP-1.5-W	Power supply, 24 VAC IN to 24 VDC OUT
DCP-1.5-W-C	Power supply, 24 VAC In to special DC output (Specify output voltage when ordering, 1.5-27 VDC)



Model BPS-015 Low Cost DC Power Supply

Specifications - Installation and Operating Instructions



The Series BPS Building Automation Power Supply is used to convert 24 VAC to a regulated DC power source for transmitters with 4 to 20 mA outputs. The output voltage can be field adjusted from 1.5V to 27V using a potentiometer. The 3A fuse protects the power supply from over-current conditions. The snap-on bracket can be quickly surface mounted to any flat surface.

SPECIFICATIONS

Input: 24 VAC/VDC 50/60 Hz.

Output: 24 VDC (full wave rectified and regulated) adjustable 1.5 to 27 VDC.

Maximum Current Output: 1.5A (de-rated to 400 mA for non-isolated circuits).

Operating Temperature: 32 to 130°F (0 to 55°C).

Humidity Limits: 95% (non-condensing).

Weight: 0.4 lb.



CAUTION: TO PREVENT OVERHEATING, THE OUTPUT CURRENT MUST NOT EXCEED THE RATIO OF THE OUTPUT VOLTAGE TO THE INPUT VOLTAGE TIMES THE RATED CURRENT.

Example:

For output voltage set at 5 VDC, the output current should not exceed 313 mA.

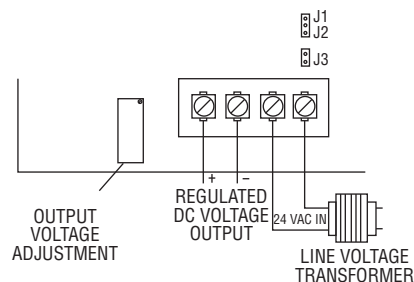
$$(5V/24V) \times 1.5A = 0.313A$$

Isolation:

If the DC ground is connected to the AC ground, the fuse will open.

If the AC and DC circuit grounds cannot be isolated, move the shorting jumper from J1 to J2 and add a shorting jumper to J3. In this case the output current is limited to 400 mA.

WIRING DIAGRAM





POWER SUPPLIES

FUNCTIONAL DEVICES ENCLOSED 24 VAC CLASS 2 POWER SOURCE

PSH SERIES

DESCRIPTION

The **PSH Series** power sources from Functional Devices include one or two transformers, pre-packaged in a metal enclosure. The transformers are available in 40VA, 75VA and 100VA sizes. A switch/circuit breaker is provided for switching the output of each transformer. An optional switch/circuit breaker is available for controlling power to the entire unit. Other handy features include an LED to indicate the presence of 24VAC at the Class 2 output terminals or wires, an internal high-voltage wiring compartment, and two optional 120VAC grounded convenience outlets.



PSH,
Single Transformer
Model with Options



PSH,
Two Transformer Model
with Options

FEATURES

- One or two transformers in pre-packaged metal enclosure
- 40, 75 and 100 VA Class 2 transformers
- Output switch/circuit breaker and LED indication
- Optional primary switch/circuit breaker
- Optional 120 VAC convenience outlets
- To order UL508 add 1C to the end



SPECIFICATIONS

Supply Voltage 120 VAC, 50/60 Hz, 120 VAC, 50/60 Hz (40 VA), 480/277/240/208/120 VAC 50/60 Hz (75VA) , 480/277/240/208/120 VAC 50/60 Hz (75 VA), 120 VAC, 50/60 Hz (100 VA)

Output Voltage Class 2
PSH40A 24 VAC, 40VA
PSH75A 24 VAC, 75VA
PSH100A 24 VAC, 100VA
PSH40A40A Dual 40 24 VAC, 40 VA
PSH40A75A Dual 24 VAC, 40VA and 75 VA
PSH40A100A Dual 24 VAC, 40VA and 100 VA
PSH75A75A Dual 24 VAC, 75 VA
PSH75A100A Dual 24 VAC, 75VA and 100VA
PSH100A100A Dual 24 VAC, 100VA

Note for dual power supplies:

Output derating may exceed 20% due to elevated ambient temperature or heat buildup in device over time
Input Control Combination on/off switch and 10A circuit breaker

Convenience Outlet

120 VAC, 15A maximum.

Output Control

Combination of on/off switch and circuit breaker. Controls 24 VAC output only.

Output Indication Red LED, one for each 24 VAC output

Dimensions

Single Transformer Models

4.50"H x 8.25"W x 4.50"D
(11.4 x 20.96 x 11.4 cm)

Two Transformer Models

4.50"H x 8.25"W x 4.50"D
(11.4 x 20.96 x 11.4 cm)

Weight

PSH40A 3.1 lb (1.41 Kg)
PSH75A 4.5 lb (2.04 Kg)
PSH100A 4.6 lb (2.09 Kg)
PSH40A40A 5.4 lb (2.45 Kg)
PSH40A75A 6.8 lb (3.09 Kg)
PSH40A100A 6.9 lb (3.13 Kg)
PSH75A75A 8.4 lb (3.86 Kg)
PSH75A100A 8.5 lb (3.86 Kg)
PSH100A100A 8.6 lb (3.90 Kg)

Approvals

UL, Class 2, UL916, File E190394
CE, RoHS

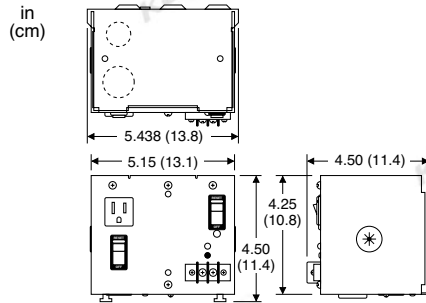
Warranty

1 Year

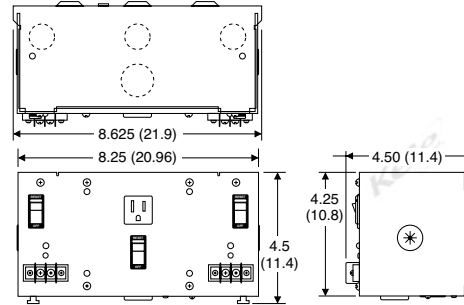
FUNCTIONAL DEVICES ENCLOSED 24 VAC CLASS 2 POWER SOURCE PSH SERIES



DIMENSIONS



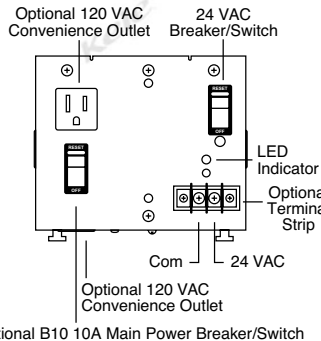
Single Transformer Models
(PSH40A, PSH75A, PSH100A)



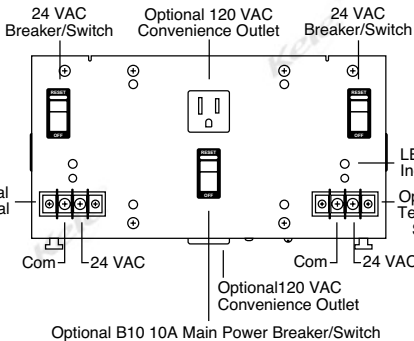
Two Transformer Models
(PSH40A40A, PSH40A75A, PSH40A100A,
PSH75A75A, PSH75A100A, PSH100A100A)

WIRING

Single Transformer



Dual Transformer



INPUT:
Transformer Primary Wires
40 VA or 100 VA
Black: 120 VAC
White: Common
75 VA
Gray: 480 VAC
Brown: 277 VAC
Orange: 240 VAC
Red: 208 VAC
White: 120 VAC
Black: Common

"B10" Option Models Only
40 VA, 75 VA, or 100 VA
Black: 120 VAC
White: Neutral
Green: Ground

OUTPUT:
Models with Terminals
HOT: 24 VAC
COM: Common

"W" Option Models
Internal Leads**
Yellow/White: 24 VAC
White/Blue: Common

"B10" Option Models
Internal Leads**
Blue: 120 VAC
auxiliary output

"EXT2" Option Models Only
AC Power Supply Cord

*Output derating may exceed 20% due to elevated ambient temperature or heat buildup in device over time.

**Remove cover to wire to flying leads.

ORDERING INFORMATION

MODEL	DESCRIPTION
PSH40A	Enclosed single 40 VA power source, 120 to 24 VAC
PSH75A	Enclosed single 75 VA power source, 480/277/240/208/120 to 24 VAC
PSH100A	Enclosed single 100 VA power source, 120 to 24 VAC
PSH40A40A	Enclosed dual 40 VA power sources, 120 to 24 VAC
PSH40A75A	Enclosed dual (40 VA, 120 to 24 VAC, and 75 VA, multi-tap to 24 VAC power sources)
PSH40A100A	Enclosed dual (40 VA and 100 VA power sources, 120 to 24 VAC)
PSH75A75A	Enclosed dual 75 VA power sources, 480/277/240/208/120 to 24 VAC
PSH75A100A	Enclosed dual (75 VA, 480/277/240/208/120 to 24 VAC and 100 VA, 120 to 24 VAC sources)
PSH100A100A	Enclosed dual 100 VA power sources, 120 to 24 VAC
OPTIONS	
-	External secondary terminals, 120 VAC convenience outlets***
N	External secondary terminals, without 120 VAC convenience outlets
W	Internal 24 VAC secondary flying lead wires, 120 VAC convenience outlets***
NW	Internal 24 VAC secondary flying lead wires, without 120 VAC convenience outlets
-	Without 10A main power switch/breaker and without 120 VAC auxiliary output wire
B10	10A main power switch/breaker and Internal 120 VAC Flying Lead auxiliary output wires (75 VA transformers are 120 VAC input only with "B10" option)
1C	UL508
EXT2	With 36" power cord and 3 prong plug

*** Multi-tap input (75A), other than 120 VAC, will disable convenience outlet

TRM0018-K

ACCESSORIES

Terminal Block Cover (Replacement)

Type 1 Enclosures

Type 1 Enclosures

Saginaw Control & Engineering's Type 1 Enclosures are designed for control and instrumentation applications.

They are a general-purpose enclosure intended for indoor use or locations where unusual service conditions do not exist.

Type 1 Enclosures primarily provide protection against accidental contact with live parts and against a limited amount of falling dirt.

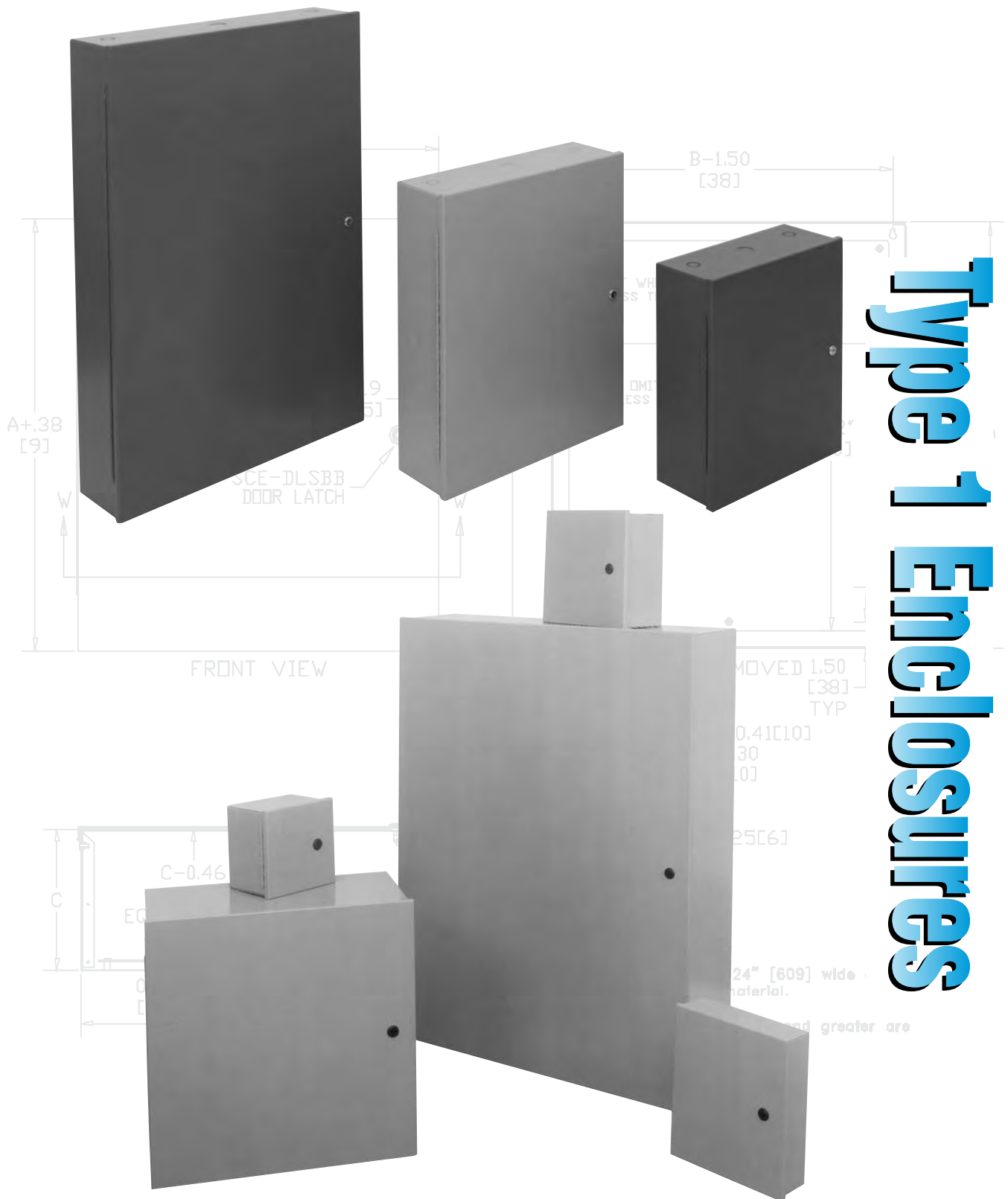
Product Attributes

- The SCE design incorporates an exclusive sub-panel design, which maximizes available space for all size enclosures.
- Any of the standard SCE quarter turn replacement latches and handles can be used in the Type 1 products.
- Type 1 Enclosures with knockouts have keylocking latches.
- Continuously hinged doors are easily removed from enclosure body.
- Type 1 Enclosures have ANSI-61 gray powder coat finish.
- Type 1 Enclosures with knockouts are available in precaution blue, safety orange or taupe tan textured powder coat finish.

Product Overview

- Hinged Cover Type 1 Enclosures
- Type 1 Enclosures with knockouts

Type 1 Enclosures



TYPE 1 Single-Door Enclosures

Application -

Designed to house electrical controls, instruments and components in areas that do not require oil, water and dust tight protection.

Construction -

- 0.060" & 0.075" carbon steel depending on its size.
- Spot weld construction.
- Standoffs provided for mounting optional panels.
- Continuous hinge.
- Doors open 180 degrees.
- Black quarter turn latches.
- Latches are opened or closed with a screwdriver.
- Ground stud on door.
- Mounting holes in back of enclosure.
- Subpanel mounting hardware.

Options -

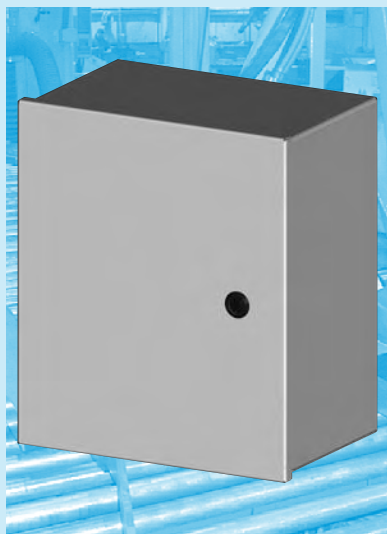
- Tamper-resistant inserts available.
- Optional mounting straps available

Finish -

ANSI-61 gray powder coat inside and out over phosphatized surface. Optional panels are powder coated white.

Industry Standards -

NEMA Type 1
UL Listed Type 1
CSA Type 1
IEC 60529 IP 30



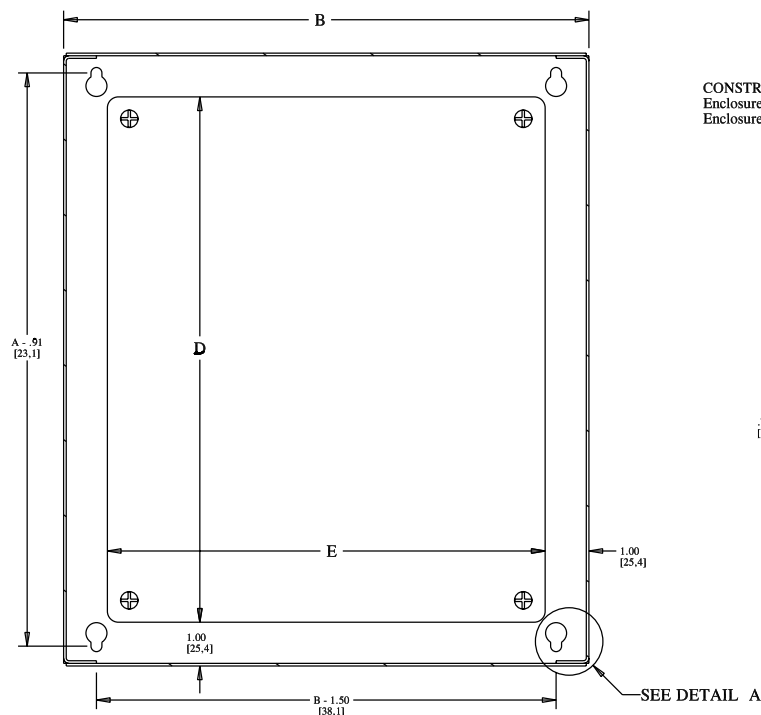
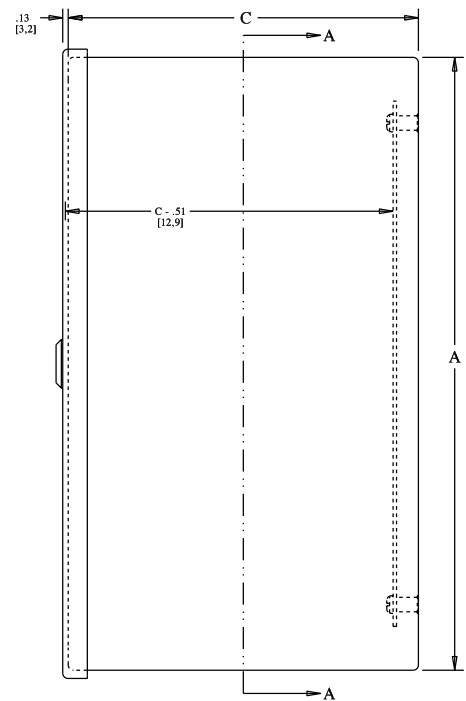
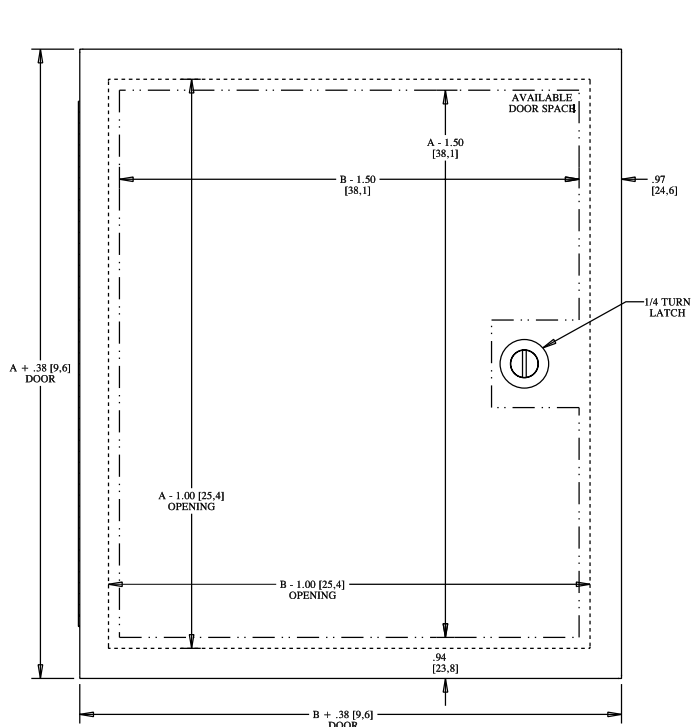
TYPE 1 SINGLE-DOOR ENCLOSURES

ENCLOSURES						SUB-PANEL				
Catalog No.	Height (A)	Width (B)	Depth (C)	Product Code	List Price	Catalog No.	Panel Height (D)	Panel Width (E)	Product Code	List Price
SCE-6N604LP	6.00	6.00	4.00	N1	27.03	SCE-6N6MP	4.00	4.00	N1	2.32
SCE-8N604LP	8.00	6.00	4.00	N1	29.50	SCE-8N6MP	6.00	4.00	N1	2.74
SCE-8N804LP	8.00	8.00	4.00	N1	32.75	SCE-8N8MP	6.00	6.00	N1	3.21
SCE-8N806LP	8.00	8.00	6.00	N1	36.86	SCE-8N8MP	6.00	6.00	N1	3.21
SCE-10N804LP	10.00	8.00	4.00	N1	35.97	SCE-10N8MP	8.00	6.00	N1	3.78
SCE-10N806LP	10.00	8.00	6.00	N1	40.64	SCE-10N8MP	8.00	6.00	N1	3.78
SCE-10N1004LP	10.00	10.00	4.00	N1	39.54	SCE-10N10MP	8.00	8.00	N1	4.40
SCE-10N1006LP	10.00	10.00	6.00	N1	44.85	SCE-10N10MP	8.00	8.00	N1	4.40
SCE-12N1004LP	12.00	10.00	4.00	N1	43.25	SCE-12N10MP	10.00	8.00	N1	5.12
SCE-12N1006LP	12.00	10.00	6.00	N1	48.93	SCE-12N10MP	10.00	8.00	N1	5.12
SCE-12N1204LP	12.00	12.00	4.00	N1	47.37	SCE-12N12MP	10.00	10.00	N1	6.11
SCE-12N1206LP	12.00	12.00	6.00	N1	53.69	SCE-12N12MP	10.00	10.00	N1	6.11
SCE-12N1208LP	12.00	12.00	8.00	N1	59.95	SCE-12N12MP	10.00	10.00	N1	6.11
SCE-14N1204LP	14.00	12.00	4.00	N1	51.60	SCE-14N12MP	12.00	10.00	N1	6.86
SCE-14N1206LP	14.00	12.00	6.00	N1	58.45	SCE-14N12MP	12.00	10.00	N1	6.86
SCE-14N1208LP	14.00	12.00	8.00	N1	65.25	SCE-14N12MP	12.00	10.00	N1	6.86
SCE-16N1206LP	16.00	12.00	6.00	N1	98.04	SCE-16N12MP	14.00	10.00	N1	7.71
SCE-16N1208LP	16.00	12.00	8.00	N1	106.84	SCE-16N12MP	14.00	10.00	N1	7.71
SCE-16N1606LP	16.00	16.00	6.00	N1	109.57	SCE-16N16MP	14.00	14.00	N1	9.47
SCE-16N1608LP	16.00	16.00	8.00	N1	119.19	SCE-16N16MP	14.00	14.00	N1	9.47
SCE-16N2006LP	16.00	20.00	6.00	N1	121.09	SCE-20N16MP	18.00	14.00	N1	11.65
SCE-20N1606LP	20.00	16.00	6.00	N1	121.09	SCE-20N16MP	18.00	14.00	N1	11.65
SCE-20N1608LP	20.00	16.00	8.00	N1	132.41	SCE-20N16MP	18.00	14.00	N1	11.65
SCE-20N2006LP	20.00	20.00	6.00	N1	132.99	SCE-20N20MP	18.00	18.00	N1	15.83
SCE-20N2008LP	20.00	20.00	8.00	N1	145.52	SCE-20N20MP	18.00	18.00	N1	15.83
SCE-20N2010LP	20.00	20.00	10.00	N1	158.06	SCE-20N20MP	18.00	18.00	N1	15.83
SCE-24N1606LP	24.00	16.00	6.00	N1	131.91	SCE-24N16MP	22.00	14.00	N1	14.33
SCE-24N2006LP	24.00	20.00	6.00	N1	147.17	SCE-24N20MP	22.00	18.00	N1	17.87
SCE-24N2008LP	24.00	20.00	8.00	N1	161.03	SCE-24N20MP	22.00	18.00	N1	17.87
SCE-24N2010LP	24.00	20.00	10.00	N1	174.83	SCE-24N20MP	22.00	18.00	N1	17.87
SCE-24N2406LP	24.00	24.00	6.00	N1	149.12	SCE-24N24MP	22.00	22.00	N1	33.63
SCE-24N2408LP	24.00	24.00	8.00	N1	164.32	SCE-24N24MP	22.00	22.00	N1	33.63
SCE-24N2412LP	24.00	24.00	12.00	N1	194.33	SCE-24N24MP	22.00	22.00	N1	33.63
SCE-30N2406LP	30.00	24.00	6.00	N1	165.84	SCE-30N24MP	28.00	22.00	N1	44.46
SCE-30N2408LP	30.00	24.00	8.00	N1	184.23	SCE-30N24MP	28.00	22.00	N1	44.46
SCE-30N2412LP	30.00	24.00	12.00	N1	216.79	SCE-30N24MP	28.00	22.00	N1	44.46
SCE-30N3008LP	30.00	30.00	8.00	N1	207.99	SCE-30N30MP	28.00	28.00	N1	55.55
SCE-36N2406LP	36.00	24.00	6.00	N1	192.87	SCE-36N24MP	34.00	22.00	N1	45.70
SCE-36N2408LP	36.00	24.00	8.00	N1	211.73	SCE-36N24MP	34.00	22.00	N1	45.70
SCE-36N2412LP	36.00	24.00	12.00	N1	245.16	SCE-36N24MP	34.00	22.00	N1	45.70
SCE-36N3006LP	36.00	30.00	6.00	N1	211.16	SCE-36N30MP	34.00	28.00	N1	55.55
SCE-36N3008LP	36.00	30.00	8.00	N1	231.98	SCE-36N30MP	34.00	28.00	N1	55.55
SCE-36N3012LP	36.00	30.00	12.00	N1	273.50	SCE-36N30MP	34.00	28.00	N1	55.55

**Perforated subpanels available in the accessory section.*

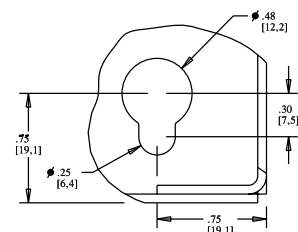
TYPE 1 SINGLE DOOR ENCLOSURES

TECHNICAL DATA



SECTION A-A

CONSTRUCTION NOTES:
Enclosures < 24.00" [609.6] wide are made of 0.060" [1.5] material.
Enclosures = > 24.00" [609.6] wide are made of 0.075" [1.9] material



DETAIL A

TYPE 1

Enclosures with Knockouts

Application-

Designed to house electrical controls, instruments and components in areas that do not require oil, water and dust tight protection.

Construction -

- 0.063 & 0.075 carbon steel depending on its size.
- Spot weld construction.
- Knockouts provided in the top, bottom, right and left side.
- Standoffs provided for mounting optional panels.
- Continuous hinge.
- Doors open 180 degrees.
- Key locking quarter turn latches.
- Ground stud on door.
- Mounting holes in back of enclosure.
- Subpanel with mounting grid pattern included.

Finish -

Optional Precaution Blue texture, Safety Orange or Taupe Tan textured powder coat finish inside and out over phosphatized surface. Panels are powder coated to match the enclosure.

Options -

Optional mounting feet available.

Industry Standards -

NEMA Type 1
UL Listed Type 1
CSA Type 1
IEC 60529 IP 30

TYPE 1 ENCLOSURES WITH KNOCKOUTS

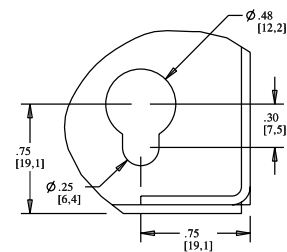
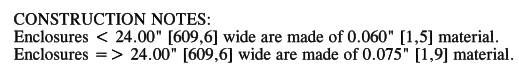
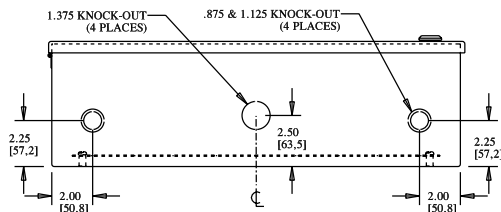
ENCLOSURES						SUB-PANEL		
Catalog No.	Height (A)	Width (B)	Depth (C)	Product Code	List Price	Panel Height (D)	Panel Width (E)	List Price
SCE-18N1606NK-T	18.00	16.00	6.00	N1	128.86	16.00	14.00	Included
SCE-18N1606NK-B	18.00	16.00	6.00	N1	128.86	16.00	14.00	Included
SCE-18N1606NK-O	18.00	16.00	6.00	N1	128.86	16.00	14.00	Included
SCE-24N2006NK-T	24.00	20.00	6.00	N1	152.30	22.00	18.00	Included
SCE-24N2006NK-B	24.00	20.00	6.00	N1	152.30	22.00	18.00	Included
SCE-24N2006NK-O	24.00	20.00	6.00	N1	152.30	22.00	18.00	Included
SCE-36N2406NK-T	36.00	24.00	6.00	N1	234.30	34.00	22.00	Included
SCE-36N2406NK-B	36.00	24.00	6.00	N1	234.30	34.00	22.00	Included
SCE-36N2406NK-O	36.00	24.00	6.00	N1	234.30	34.00	22.00	Included
*SCE36N24NL-T	36.00	24.00	6.00	N1	201.28	34.00	22.00	Included
*SCE36N24NL-B	36.00	24.00	6.00	N1	201.28	34.00	22.00	Included
*SCE36N24NL-O	36.00	24.00	6.00	N1	201.28	34.00	22.00	Included

*NL-Non UL Listed 16 ga enclosures.

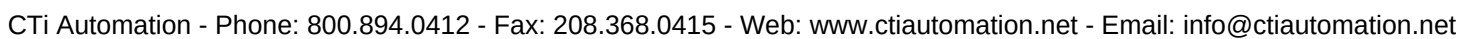
Note: Part Numbers ending in the letter:
(B) are Precaution Blue textured
(O) are Safety Orange textured
(T) are Taupe Tan textured



Type 1 Enclosures



SECTION A-A



VRW2 Dynamic Pressure-Regulating Flanged Control Valves

PRODUCT DATA



APPLICATION

The VRW2 two-way dynamic pressure-regulating control valves maintain constant flow of hot and chilled water in closed-loop heating, ventilating, and air conditioning (HVAC) systems regardless of head pressure fluctuations above minimum specified pressure drop. These valves come complete with proportional, stay-in-place or electronic fail-safe actuators.

The built-in differential pressure regulator maintains fluid flow through the valve independent of changes in supply pressure, eliminating “hunting” by the control system, even at low coil flow. The pressure regulator virtually eliminates cavitation in the valve, and decouples the control valve from the effects of piping components such as reducers and elbows.

Pressure independent control valves are sized to match design coil flow regardless of coil size. VRW2 valves eliminate the need to balance the system for proper flow, and allow chillers to be operated at design temperature differential for maximum efficiency at every load condition. When used in a system with variable speed pump drives, 3-way valves and coil bypass lines are not required.

FEATURES

- 2-1/2 to 6-inch pipes with wafer-flanged connections.
- Combination ANSI/ASME Class 150/300 pressure rating.
- Controls hot or chilled water with up to 50% glycol.
- Regulated flow rates available from 39 to 469 gpm.
- Stainless steel pressure regulator maintains constant pressure drop across valve seat.
- Positive pressure, rolling diaphragm regulator design for long service life provides flow control accuracy of $\pm 5\%$.
- Equal percentage flow characteristic using multi-turn, non-rising, characterized plug.
- High close-off rating.
- 50 discrete, selectable flow rates available per valve size.
- Stainless steel trim.
- Six-turn actuator with floating or modulating inputs available with stay-in-place or electronic fail-safe action.
- Fail-safe actuators field-configurable for normally open or normally closed power failure return position.
- Two Test Ports for venting or pressure gauge attachment.

Contents

Application	1
Features	1
Specifications	2
Ordering Information	2
Installation	4
Typical Specifications	13



SPECIFICATIONS

Models: See Table 3.

Dimensions: See Fig. 1.

Body Style: Two-way, multi-turn, non-rising stem valve, straight-through flow.

Pipe Size: 2-1/2 to 6 inches with multi-size, wafer flange pipe fittings.

Test Ports: 1/4 in. ISO

Flow Capacity: See Table 1.

Body Pressure Rating (maximum): 580 psig (40 bar) at 248°F (120 C).

Controlled Medium: Water or Glycol solutions up to 50%. Not suitable for combustible gases, oil or steam.

Fluid Temperature Range: -4 to +248°F (-20 to +120 C).

Minimum Differential Pressure: See Table 1.

Maximum Differential Pressure: 58 psid (400 kPa).

Close-off Pressure: 101 psid (700 kPa), maximum 0.2% leakage.

Flow Characteristics: Equal Percentage.

Materials

Body: Ductile iron (ASTM A536-65T, Class 60-45-18).

Flow Regulation Unit: Stainless steel.

Stem Seals: EPDM and Nitrile O-rings.

Ball Seals: Reinforced Teflon™ seals, with EPDM O-rings.

Regulator: EPDM rolling diaphragm in 316 stainless steel housing.

Power Supply:

Voltage: 24 Vac/Vdc

Frequency: 50/60 Hz

Power: 12 VA

Approvals Standards

Actuators: Safety Extra-Low Voltage, Class II wiring only.

Table 1. VRW2 Flow Ratings.

VRW2...		...X...	...V...				...W...			
Size ^a			Flow		Differential Pressure		Flow		Differential Pressure	
In.	S.I.	Code	Minimum gpm (L/s)	Maximum gpm (L/s)	Minimum psid (kPa)	Maximum psid (kPa)	Minimum gpm (L/s)	Maximum gpm (L/s)	Minimum psid (kPa)	Maximum psid (kPa)
2-1/2 & 3	DN65 DN80	J	39 (2.5)	112 (7.1)	5.1 (35)	58 (400)	56 (3.5)	155 (9.8)	11.6 (80)	58 (400)
3 & 4	DN80 DN100	K	55 (3.5)	147 (9.3)			73 (4.6)	222 (14.0)	8.6 (60)	
5 & 6	DN125 DN150	L	103 (6.5)	370 (23.3)			118 (7.4)	469 (29.6)		

^a Wafer-style flanges for each model fit between 2 pipe flange sizes, of either ANSI/ASME Class 150 or Class 300.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number. If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Environmental and Combustion Controls Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386
3. <http://customer.honeywell.com> or <http://customer.honeywell.ca>

International Sales and Service Offices in all principal cities of the world. Manufacturing in Belgium, Canada, China, Czech Republic, Germany, Hungary, Italy, Mexico, Netherlands, United Kingdom, and United States.

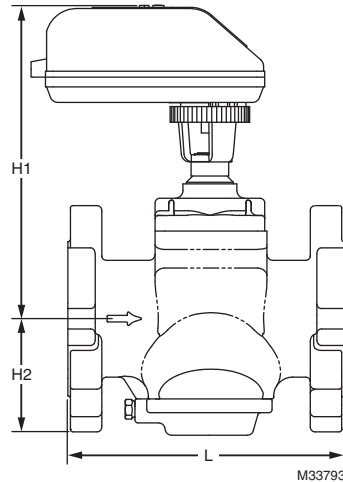


Fig. 1. Dimensions in in. (mm).

Table 2. Dimensions.

Model	Size ^a		L	H ₁	H ₂	Weight
	In.	S.I.	in. (mm)	in. (mm)	in. (mm)	lbs. (kg)
VRW2J...	2-1/2 & 3	DN65, DN80	8 3/4 (224)	9 3/4 (246)	3 3/4 (95)	27.8 (10.0)
VRW2K...	3 & 4	DN80, DN100	12 5/8 (320)	11 3/8 (290)	5 1/4 (135)	75.0 (30.0)
VRW2L...	5 & 6	DN125, DN150	16 5/8 (422)	13 1/4 (338)	7 1/8 (180)	148.0 (70.0)

^aWafer-style flanges for each model fit between 2 pipe flange sizes, of either ANSI/ASME Class 150 or Class 300. Valve is suspended from the rods joining the flanges attached to the pipes.

Table 3. Model Selection.

Valve, Regulated	Pipe fitting	Body Pattern	Valve Size	Flow Rating	Pressure Rating	Valve Trim	Actuator Secondary Spec	Actuator Control Form	Description
VR									Dynamic pressure regulated control valve
	W								Combination-size wafer flange
		2							2-way
			J						Valve size, 2-1/2 and 3 in. (DN65 and DN80)
			K						Valve size, 3 and 4 in. (DN80 and DN100)
			L						Valve size, 5 and 6 in. (DN125 and DN150)
				V					Adjustable, low minimum differential pressure
				W					Adjustable, high minimum differential pressure
					4				ANSI/ASME 150/300
						S			Stainless steel trim, dual Test Ports
							M		Multi-turn valve
								B	Modulating actuator
								D	Modulating fail-safe actuator
VR	W	2	K	V	4	S	M	B	= 2-way, 3 & 4" wafer flanged dynamic pressure-regulated valve, SS trim, 55~147 gpm, modulating electronic fail safe.

NOTE: This is a guide to the meaning of the product nomenclature, and is not intended to indicate all legal combinations of bodies and actuators.

Application Notes

Accurate valve sizing and adjustment is crucial for efficient

system operation. Pressure regulated control valves optimize hydronic HVAC systems at all load conditions as well as balancing the system at design conditions.

Low flow rates maximize coil efficiency, but require pressure regulated valves for stable operation.

High temperature change (ΔT) is needed to maintain thermal transfer at low flow rates, and maximizes efficiencies in chillers and condensing boilers.

In new construction, low flow rates at high ΔT reduce the size requirements for pumps, chillers, boilers, and piping components. In retrofit applications, lower flow rates reduce pump energy consumption and peak power requirements.

Pressure regulated control valves work as effectively as reverse return piping designs, but use less material.

If a system balancing report is required, coil flow must be verified by measuring pressure drop across the coil, not the control valve, using the coil manufacturer's specifications. Bubble-tight close-off will require use of a resilient-seat butterfly valve in series with the load.

Proper Use

These valves are only for use in cold, warm, and hot water systems applications with ethylene glycol or propylene glycol up to 50% concentration. They are designed for a medium temperature range of from -4°F (-20°C) to 228°F (120°C) at a maximum pressure of 580 psig (40 bar). VRW2 valves are to be operated with supplied multi-turn actuators only.

IMPORTANT

Water should be properly filtered, treated and conditioned according to local conditions and the recommendations of the boiler or chiller manufacturers. The installation of strainers and side-stream filters is strongly recommended to protect the pressure regulator cartridge

The presence of excessive iron oxide (red rust) in the system voids the valve warranty. Rust is highly abrasive.

EPDM rubber used in this valve absorbs oil. Do not use petroleum-based additives and thoroughly flush system to remove petroleum-based cutting oil, solder flux, etc. Do not use solvents that will dissolve silicon grease

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. Installer must be a trained, experienced, licensed service technician.
4. After installation is complete, check out product operation as provided in these instructions

Preparation



CAUTION

Equipment Damage Hazard

- Foreign particles like sand and metal chips can damage valve seals and regulator diaphragm.
- For trouble-free operation of the product, good installation practice must include initial system flushing, and chemical water treatment.
- Use of a 50 micron (or finer) system side stream filter is recommended and in-line Y-strainers are suggested. Remove all sieves before flushing the system to avoid trapping dirt in the filters.
- Acceptable antifreeze solutions, with minimum 50% water dilution, are diethylene glycol, ethylene glycol, and propylene glycol.
- Do not use boiler additives, solder flux and wetted materials which are petroleum based or contain mineral oil, hydrocarbons, or ethylene glycol acetate. If in doubt, consult an HVAC water treatment specialist.
- If installing these valves in a new addition, or if retrofitting an existing building, do not assume that the fluid in the existing piping meets these criteria.

1. Clean the lines upstream of particles larger than 1/16 in. diameter (welding slag, pipe scale and other contaminants).
2. Proceed with installation once the system specifics (expansion/contraction of the system and its medium as well as operating pressures) are within tolerances.
3. Eliminate air from system. Free oxygen will corrode iron parts.

IMPORTANT

- Ensure that the valve is not in the fully closed position when filling the system with water. **TURN OFF POWER** and open manually if necessary.
 - Do not exceed maximum pressure differential control range for valve.
 - Install valve indoors. If valve is installed outdoors, water tight protection is required for the actuator.
 - If the valve is to be installed in vertical pipe on a chilled water system, ensure that the covered electronics are upwards above the valve spindle, to prevent condensation from entering the electronics. If necessary use a socket and ratchet to remove the brass nut attaching the mounting bracket to the valve body, re-position the Actuator and replace the brass nut.
 - Even torque on all flange bolts and connecting rods is critical to pipe seals.
 - Flow arrows must point in the direction of the flow for proper operation.
4. Stem rotation as viewed from above:
 - a. Clockwise to close.
 - b. Counterclockwise to open
 5. Valve must be mounted with the actuator/bracket above pipe center line. Do not install the valve with the stem below horizontal or upside down without NEMA 3, 4, or 4X actuator enclosure to prevent actuator damage due to condensation or leaks. See Fig. 2 and 3.

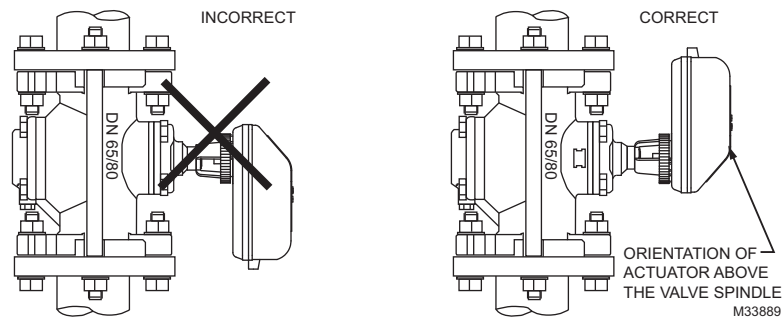


Fig. 2. Vertical pipe installation.

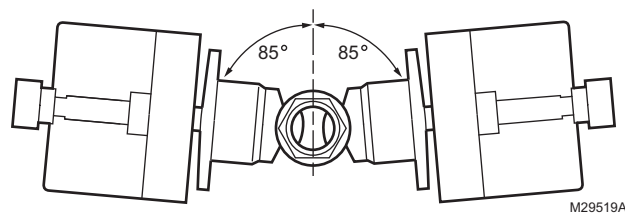


Fig. 3. Acceptable valve angle from vertical.

General Information

1. Clean the lines upstream of valve particles larger than 1/16 in. diameter (welding slag, pipe scale and other contaminants). Honeywell recommends the use of a strainer upstream to prevent damage or blockage.
2. Air should be eliminated from the system so valves remain full of fluid during operation. All PI valves trap air in the regulator section of the valve. If the air is not removed, one of the effects is a valve that may pulsate with a mild or violent shaking force. The normal process of bleeding air from a system will not remove this air because the air is trapped within a chamber. A convenient way to bleed the air is to cycle the valve closed, wait 10-15 seconds, then open it. This exhausts air out of the diaphragm chamber and into the pipe where it can later rise to a high point for extraction. In a building with several valves, it is most convenient to perform this from a central building automation control. Honeywell recommends sequentially closing one valve at a time to minimize the disruption to occupants. If the building is not occupied it is acceptable to cycle all the valves at once as long as there is a method in place to keep the system pressure differential to within the valve differential pressure range. In the event that vibration persists, the VRW products have a pressure response valve (PRV) for additional control over the regulator response time. It's a small needle valve located on the bottom of the valve at the center of a hex nut designed to control the response time of the valve as it corrects for pressure fluctuations. Screw the small needle valve clockwise to close. DO NOT over tighten as it is a small brass screw and can easily be damaged. Then open it about 1/4 turn. This will slow down the response and should further suppress vibration.
3. All styles of Honeywell 2-way flow control valves are marked to show the direction of flow. THE FLOW ARROW MUST POINT IN THE DIRECTION OF FLOW FOR PROPER OPERATION.
4. Do not use boiler additives, chemicals which are petroleum based or contain mineral oil, hydrocarbons, azole compounds or ethylene glycol acetate. Compounds which can be used, with minimum 50% water dilution, are diethylene glycol, ethylene glycol, and propylene glycol. If installing these valves in an addition or retrofitting an existing building, do not assume that the fluid in the existing piping meets these criteria.
5. Do not install valves at pump discharge. Minimum of 8 pipe diameters (or 8 feet) is required before the valve.

Mechanical Installation

Union Connections

1. When soldering union sweat-end ball valves, remove the union nut and slide over the pipe. Then sweat the tail-piece to the pipe. If there are sweat ends on both sides, repeat the same steps for each end. Next, install the valve body assembly between the tailpieces and tighten the union nuts. This will prevent damage to the O-rings.

O-Ring Replacement

1. Assembly must be made with care to protect the O-ring from damage during installation. Some of the most important features to ensure this are:
 - Cleanliness is important for proper seal action and long O-ring life. Foreign particles like dirt, metal chips, etc. in the O-ring groove may cause O-ring leakage and can damage the O-ring thus reducing its life.

- Using silicon oil or grease lubricant at assembly helps protect the O-ring from damage by abrasion, pinching or cutting. Do not use aerosol products or petroleum-based lubricants. The lubricant should not excessively soften or harden.
- The O-ring should be placed in the groove.

Flange Connections

1. O-rings are supplied with the valve and are used to seal the connections. Place the O-ring in the grooves in the inlet and outlet of the valve body.
2. Using silicon oil or grease lubricant at assembly helps protect the O-ring.
3. 2-1/2"-3": 4 hole flanges require (4) 5/8" X 2-3/4" bolts and (2) 5/8" X 12-1/2" studs. Valves are not compatible with slip-on flanges.
4. All other sizes: 8 hole flanges require (8) 5/8" X 2-3/4" bolts and (4) 5/8" X 12-1/2" studs. 2-1/2" to 4" valves are compatible with both Class 150 and Class 300 flanges. 5"/6" valve is compatible with Class 150 flanges and/or Class 300, 5" flanges.

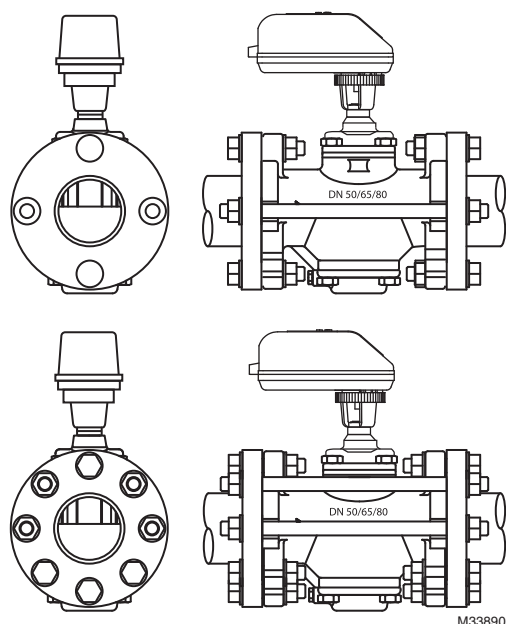


Fig. 4. 4-hole and 8-hole flanges.

Electrical Installation

Fitting and Orientation of the Actuator

1. To fit the actuator on the valve body, grease the o-ring on the spindle adaptor and place the spindle adaptor on the valve spindle.
2. Place the actuator on the spindle adaptor and place the three actuator "legs" into the three holes in the mounting bracket. Make sure that the snap ring is clicked onto the mounting bracket, so that the snap ring is locked at the top of the mounting bracket, but is able to rotate.

3. Turn the snap ring counter clockwise (upside view) approximately 1/6 of a turn until its stop points touch the actuator "legs" and the mounting is locked with a (small) click.
4. See Fig. 5 for wiring. If feedback signal is not required, leave green wire detached.

To remove the actuator, please reverse the procedure, i.e. turn the snap ring clockwise until the actuator is loosened and lift the actuator up. To ease removal of actuator, make sure that the valve is not fully closed.

Symbols on the bottom side of the actuator also indicate how to lock and unlock the actuator with the snap ring.

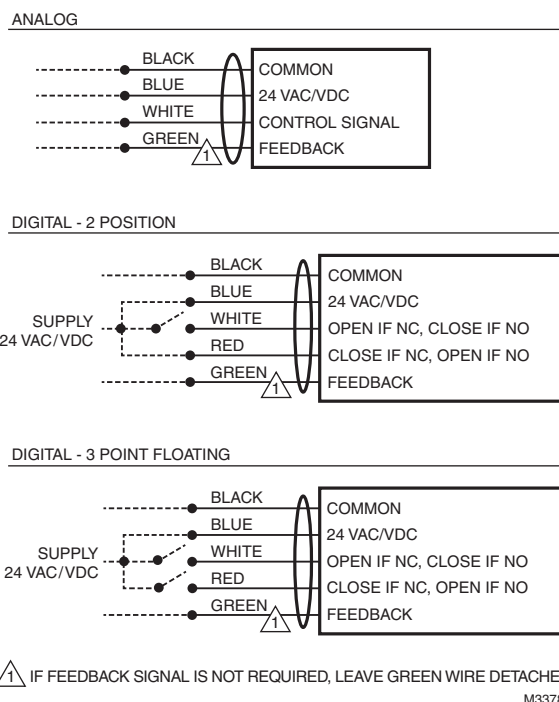


Fig. 5. Wiring Diagram

Fitting and Orientation of the Actuator

When power to the actuator is turned on, the actuator will automatically calibrate:

- Valve is calibrating to determine closing point. This calibration can take up to 10 minutes depending on the valve's position at start-up. During calibration lower part of display will show "CAL".
 - If no control signal is detected, flush is started if enabled in programming menu (enabled by default), opening valve to 5/6 of fully open. Lower part of display will show "FLUSH" until control signal is detected.
 - When control signal is present, actuator will adjust to current control signal and proceed with normal operation.
- At first start-up please enter programming menu to adjust actuator settings.

Actuator Wiring and Programming



Fig. 6. Actuator Display

The programming menu is always accessible. To enter the programming menu, please simultaneously press the two arrow buttons (→ and ←) for 6 seconds, until bottom line blinks.

Generally, press → button to accept value and go to next step and press ← button to go to previous step. To change the value, press ▼ or ▲ keys, for quick scroll through values hold down the button.

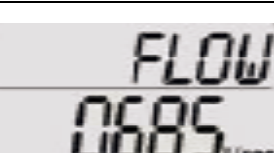
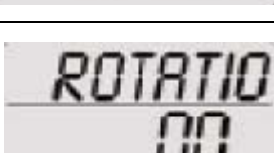
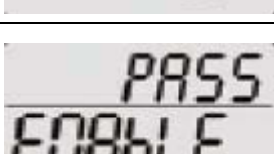
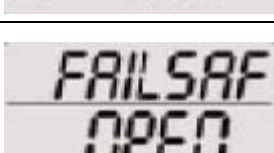
Press and simultaneously for 6 sec. to exit programming menu. Actuator will automatically return to operation mode if no action is detected on arrow keys for 1 minute.

All values selected in the programming menu are stored in non-volatile memory.

Table 4. Actuator Steps.

Step	Display	Description	Values
0	ENTER 00000000	Password. *scrolling top: ENTER PASS WORD	Disabled by default Password: 3569266. Only if Enabled (in step 11). Change one digit at a time, press → and ← to move between digits. At last digit, press → to go to next step.
1	LANG EnGLI S	Select Language. *scrolling top: SELECT LANGUAG	Default: English. Possibility to choose other languages later on (not currently an option).
2	VALVE SP7 00	Select valve model onto which the actuator is installed. *scrolling top: SELECT VALVE MODEL	Default: SM.0.0 Select from the available valve models using this cross reference. VRW2J_B=SM.3.1; VRW2J_D=SM.3.2; VRW2K_B=SM.4.1; VRW2K_D=SM.4.2; VRW2L_B=SM.5.1; VRW2L_D=SM.5.2
3	UNIT L/sec	Choose unit scale for flow rate. *scrolling top: SELECT UNIT SCALE	Default: l/sec. Options: l/sec or l/hr or GPM.
4	FLUSH EnABLE	Activate Flush mode at startup. *scrolling top: SELECT FLUSH MODE	Default: Enable. Options: Enable or Disable. When no control signal (analog) is detected at start up, flush mode is started (5/6 of fully opened). It will be dismissed when control signal is detected.
5	SIGNAL 2-10 Vdc	Select type of control signal. *scrolling top: SELECT CONTROL SIGNAL	Default: 2-10VDC. Options: 2-10VDC or 4-20mA or digital. Choose: • 2-10VDC for VDC • 4-20mA for mA • Digital for 2 position or 3 point floating.

Table 4. Actuator Steps. (Continued)

Step	Display	Description	Values
6		Select minimum control value. *scrolling top: SET MINIMUM LIMIT	<u>Volt default: 2.</u> Options: from 0-7. Increment: 0.1. <u>mA default: 4.</u> Options: from 0-14. Increment: 0.2. NA if Digital (in step 5).
7		Select maximum control value. *scrolling top: SET MAXIMUM LIMIT	<u>Volt default: 10.</u> Options: from 3-10 and at least 3 VDC greater than the selected minimum limit. Increment: 0.1. <u>mA default: 20.</u> Options: from 6-20 and at least 6 mA greater than the selected minimum limit. Increment: 0.2. NA if Digital (in step 5).
8		Select feedback signal. *scrolling top: SELECT FEEDBACK SIGNAL	Default: AU; Automatic match of control signal if analog. Options: 0-10 VDC, 2-10 VDC or 4-20 mA or AU. If Digital (in step 5) AU is not an option.
9		Set the designed maximum flow. Accuracy: Greatest of either $\pm 5\%$ of designed max. flow or $\pm 2\%$ of max. valve flow. *scrolling top: SELECT MAXIMUM FLOW	Default: Maximum setting. Values depend on valve model and unit scale chosen in step 2 and 3.
10		Select direction of rotation. *scrolling top: SELECT ROTAT DIRECT	Default: Normally Closed (NC). Options: Normally Open (NO) or Normally Closed (NC).
11		Activation of password. *scrolling top: ACTIVAT PASS WORD	Default: Disable. Options: Enable or Disable. If Enabled password is required to access alarm and programming menu.
12		Select direction of rotation when Failsafe. *scrolling top: SELECT FAIL SAFE DIRECT	Default: Closed. Options: Open or Closed. <i>Only valid for failsafe model. Failsafe direction open means opening to max. flow chosen in step 9.</i>

Notes about Failsafe mode

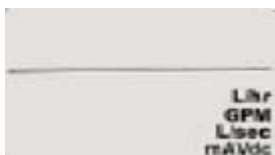
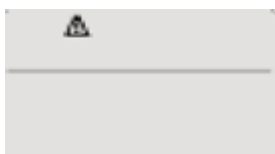
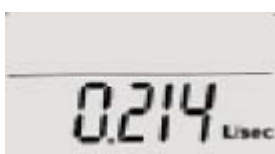
If power supply is out of range or lost, failsafe mode will be activated:

1. Approximately 80 second delay.
2. Actuator opens/closes valve (according to failsafe direction chosen in programming menu).
3. Actuator shuts off.

If power supply is restored during action 1 or 2, failsafe mode is deactivated.

In Operation

Table 5. In Operation.

Display	Description	Values
	Indicates unit scale system.	l/sec or l/min or GPM. mA or VDC.
	Alarm indicator.	Blinking if actuator is still functional (warning). Fully on if actuator is not working (critical).
	Current Flowrate ^a	Indicates current flow rate in l/sec, l/hr or GPM.

^a Note that the flow rate displayed on the actuator is a calculated value based upon differential pressure being within control range. If display shows “NA” instead of current flow rate, it indicates that the flow rate is below minimum defined flow rate according to tech note, or that valve model has not been chosen in programming menu step 2.

Alarm Menu

To enter the alarm menu, simultaneously press ▼ or ▲ for 6 seconds. You can access the alarm menu only if an alarm is present. Press → to go to the next alarm display, press ← to

return to previous step. Press ▼ or ▲ simultaneously for 6 seconds to exit alarm menu. Actuator will automatically return to operation mode if no action is detected on arrow keys during 1 minute.

Table 6. Alarm Menu.

Display	Description	Values
	Alarm	
	Enter password	If enabled in programming menu step 11 Disabled by default. Password: 3569266.

Table 7. Alarm Codes.

Code	Icon	Description	Details
01	 FULL ON	Valve/actuator is over torqued.	Operation is stopped. Actuator will retry operation every 4 minutes. If over torque condition disappears, error will convert to error code 02.
02	 BLINKING	Actuator has reached its torque limit in the past.	Actuator is functioning. To reset the alarm simultaneously press ▲ and ◀ for 6 seconds.
03	 FULL ON	Critical - over temperature.	Critical: Temperature in actuator is at least 70°C, motor operation is stopped. If temperature is decreasing, operation will resume.
04	 BLINKING	High temperature.	Actuator is still functioning. Temperature in actuator is at least 50°C/122 °F. If temperature is decreasing, operation will resume.
05	 FULL ON	No Failsafe: Power supply not in range.	Operation is stopped. Alarm will automatically reset when voltage is back in range.
	 BLINKING	With Failsafe: Power supply not detected / not in range.	Failsafe is activated. Alarm will automatically reset when voltage is back in range.
06	 FULL ON	Control signal not detected.	Operation is stopped. Alarm will automatically reset when control signal is back in range.
07	 BLINKING	Battery error.	Battery is not properly connected. Alarm will reset when battery is properly connected. <i>Only valid for failsafe model</i>

In Case of ERRORS or ALARM

If actuator is still functioning (error 02, 04, 05 with failsafe and 07 with failsafe) the ALARM icon will flash. Error codes can be found in the alarm menu.

If actuator is not functioning (error 01, 03, 05 without failsafe and 06) the ALARM icon is turned on. The error code will be available in the information in the upper part of the display and the alarm menu.

Auto Stroke Recalibration

In case the valve does not operate as expected, start the auto-stroke sequence to re-calibrate the closing point of the valve and to make sure that the actuator is able to open the valve fully. Press buttons ➡ and ▲ simultaneously for 6 seconds to start the autostroke.

Auto-stroke sequence. (display shows: "AUTO STROKE CYCLES"):

1. Valve is closed to determine closing point.
2. Valve is opened fully (independent of max. flow chosen).
3. System returns to normal operation.

If actuator is not able to open valve fully, an error will be displayed. An auto-stroke cannot be cancelled.

Manual Override

Manual override is used to temporarily set the position of the valve regardless of the settings and control signal for the actuator.

1. Turn off power to the actuator.
2. Remove actuator from valve as described.
3. Turn spindle to the relevant position (Clockwise to close valve, counter clockwise to open valve). Be sure not to use more than 10 Nm torque. Please protect actuator from water while not on valve.
4. Re-mount actuator on valve as described.
5. Turn on power to the actuator when normal operation is needed.

Flowrate Versus Valve Position

Table 8. Flowrate in GPM Versus Valve Position.

2-1/2" - 3" 5.1-58psid	2-1/2" - 3" 11.6 - 58psid	3" - 4" 5.1- 58psid	3" - 4" 8.6- 58psid	3" - 4" High 8.6-58psid	5" - 6" 5.1- 58psid	5" - 6" 8.6- 58psid	Position From Closed (In Stem Rotations)
39.0	55.5	54.7	73.4	58.3	103	118	1.0
43.2	60.1	60.5	82.0	70.0	115	131	1.1
47.4	64.7	66.3	90.6	81.3	126	143	1.2
51.6	69.4	72.1	99.1	92.3	137	156	1.3
55.9	74.0	77.9	108	103	148	168	1.4
60.1	78.6	83.7	116	113	160	181	1.5
62.7	82.3	88.4	123	123	170	193	1.6
65.3	86.0	93.1	130	133	180	205	1.7
67.9	89.6	97.7	137	142	190	218	1.8
70.5	93.3	102	143	152	200	230	1.9
73.1	97.0	107	150	160	210	242	2.0
74.8	99.3	110	155	169	218	252	2.1
76.6	102	113	159	177	227	262	2.2
78.4	104	115	164	185	235	271	2.3
80.2	106	118	168	193	243	281	2.4
81.9	108	121	173	200	251	291	2.5
83.4	111	123	176	207	257	301	2.6
84.8	113	125	179	214	263	310	2.7
86.2	115	126	181	221	269	320	2.8
87.7	117	128	184	227	276	329	2.9
89.1	119	130	187	233	282	339	3.0
90.0	121	131	189	239	287	344	3.1
90.9	122	132	191	245	293	350	3.2
91.7	124	134	193	250	298	355	3.3
92.6	125	135	195	255	304	360	3.4
93.5	127	136	198	260	309	366	3.5
94.4	128	137	200	265	315	371	3.6
95.3	129	138	202	269	320	376	3.7
96.2	131	140	204	274	326	381	3.8
97.1	132	141	206	278	331	387	3.9
98.0	134	142	208	281	337	392	4.0
98.7	135	142	209	285	339	396	4.1
99.3	136	143	210	288	342	401	4.2
100	137	143	212	292	344	405	4.3
101	138	144	213	295	346	409	4.4
101	139	144	214	297	349	414	4.5
102	141	144	215	300	351	418	4.6
103	142	145	216	303	353	422	4.7
104	143	145	218	305	355	426	4.8
104	144	146	219	307	358	431	4.9
105	145	146	220	309	360	435	5.0
106	146	146	220	311	361	438	5.1
106	147	146	220	312	362	442	5.2
107	148	146	221	314	363	445	5.3

Table 8. Flowrate in GPM Versus Valve Position. (Continued)

2-1/2" - 3" 5.1-58psid	2-1/2" - 3" 11.6 - 58psid	3" - 4" 5.1- 58psid	3" - 4" 8.6- 58psid	3" - 4" High 8.6-58psid	5" - 6" 5.1- 58psid	5" - 6" 8.6- 58psid	Position From Closed (In Stem Rotations)
108	149	146	221	315	364	448	5.4
108	150	147	221	316	365	452	5.5
109	151	147	221	317	366	455	5.6
110	153	147	221	318	367	458	5.7
111	154	147	222	319	368	461	5.8
111	155	147	222	320	369	465	5.9
112	156	147	222	320	370	468	6.0

OPERATION

1. Ensure that the valve is not in the fully closed position when filling the system with water.
2. Do not exceed maximum pressure differential control range for valve.
3. Install valve indoors. If valve is installed outdoors, water tight protection is required for the actuator.
4. If the valve is to be installed in vertical pipe on a chilled water system, ensure that the covered electronics are upwards above the valve spindle, to prevent condensation from entering the electronics. If necessary use a socket and ratchet to remove the brass nut attaching the mounting bracket to the valve body, re-position the Actuator and replace the brass nut.

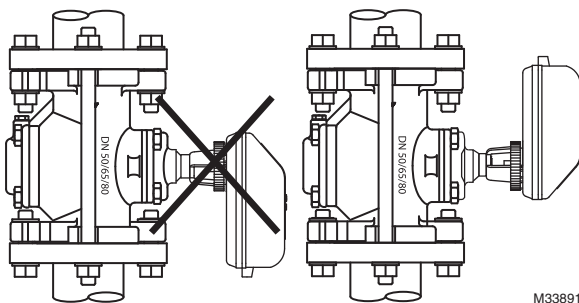


Fig. 7. Operation Diagram

The differential pressure regulator maintains constant pressure drop ($P_{IN} - P_{OUT}$) across the valve seat through a wide range of head pressures. At a given shaft position, flow through the valve will be constant as defined by the formula:

$$Q_{GPM} = C_V \times \frac{\sqrt{P_{IN} - P_{OUT}}}{\sqrt{\rho}}$$

where ρ is the density of the glycol mix.

P_{IN} changes constantly in a multi-zone system as other valves open and close, changing system flow and head pressure according to the characteristics of the supply pump curve. Reaction of the mechanical pressure regulator is instantaneous, eliminating changes in room temperature due to changes in fluid flow, and reducing the need for the control system to constantly operate the control portion of the valve to correct for the non-load related temperature changes that occur in a system with standard control valves.

At full flow in a 2-position control application, a VRW2 behaves as a flow limiter.

The pressure regulator takes a minimum pressure to operate, and has a maximum differential regulation capability. The pressure drop across a VRW Valve is comparable to the pressure drop across a control valve plus a balancing valve in a conventional system design.

SETTINGS AND ADJUSTMENTS

Under steady state operation, the control system will only require the valve to open enough to satisfy load conditions. During morning recovery from night setback, the controller will usually command the valve to 100%.

Coil flow can be confirmed by reading pressures at the supply inlet and return outlet, and using the system design data to calculate flow.

Note that the pressure regulator in this valve guarantees that the flow through the valve will not be affected by upstream changes in pressure. Unlike conventional balancing valves, it is not necessary to reconfirm flow after adjusting other valves. Any overflow during morning recovery due to oversized pressure regulated valves will not affect other valves in the system, provided pumps are capable of required flow.

TYPICAL SPECIFICATIONS

23 00 00 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 09 00 Instrumentation and Control for HVAC

23 09 13 Instrumentation and Control Devices for HVAC

23 09 13.33 Control Valves

Multi-Turn, Dynamic Pressure-Regulating Wafer-Flanged Control Valve

Mounting and Wiring

1. Valves shall be available with wafer-flanges for use with either ANSI/ASME 125/150 or ANSI/ASME 250/300 pipe flanges in sizes from 2-1/2 up to 6 inches (DN65 to DN150). Each wafer flange shall be usable with either of two successive pipe sizes.
2. The valve shall have an integral differential pressure regulator to maintain constant pressure drop across valve seat to decouple valve flow from system pressure changes. Regulator will be constructed from 316 stainless steel with a rolling diaphragm and operate under positive pressure. Regulator shall be located above axis of pipe with 1/4-in. ISO test port fittings to allow pressure measurement and venting. Control accuracy shall be +/- 5% or better.
3. Valves shall use a non-rising stem, characterized plug with equal percentage flow control characteristic. Valve trim shall be stainless steel.
4. Valve bodies shall have static pressure rating of 580 psig (4000 kPa) at 248°F (120 C).
5. Maximum operating differential pressure rating shall be no less than 58 psid. Close-off pressure shall be 100 psid minimum, at no more than 0.2% leakage.
6. Valve stem seals shall be a combination of EPDM and Nitrile O-rings.
7. Actuators shall be six turn rotary type requiring neither crank-arm nor linkage and direct mount to the valve actuator bracket.
8. Actuators shall provide screw terminal wiring connections with adapters for flexible conduit where mechanical protection is required by local codes.
9. Valve actuator shall be capable of operating on 24 Vac Class II power, in both electronic fail-safe and stay-in-place configurations. Actuator fail-safe action in the event of power failure shall be field-selectable normally open or normally closed.

Control

1. The actuator shall provide two-position, floating, analog or digital proportional control. Analog proportional control refers to direct acceptance of 2-10 Vdc or a 4-20 mA input signal. Digital proportional control refers to direct acceptance of 24 Vac pulse-width-modulated input signal. Floating control refers to direct acceptance of 24 Vac pulsed open and close commands from a tri-state (SP3T) controller. Two-position control of non-fail safe actuators shall be in the form of 24 Vac power controlled

by SPDT switch. Two-position control of fail safe actuators shall be in the form of 24 Vac power controlled by SPST switch.

2. Flow valve shall have minimum 50:1 rangeability with an equal percentage flow characteristic. Actuator shall have field-adjustable signal zero and span adjustments.
3. Flow settings shall be field-selectable from 50 unique settings.
4. Proportional and floating control actuators shall provide a 2-10 Vdc/4-20 mA feedback signal.
5. Actuators shall provide analog proportional, PWM, floating, or two-position control through wiring options.
6. Actuation will be available with electronic fail-safe operation.

Other

1. Valves may not be installed with stems below the horizontal plane to prevent actuator damage due to stem seal leakage, or accumulation of particulate in the stem packing.
2. A water filtration and treatment system shall be installed and operated according to the requirements of Division 23 25 13, Water Treatment for Closed-Loop Hydronic Systems. These requirements shall meet or exceed European Norm VDI 2035. The presence of excess rust in the system will void the manufacturer's warranty.
3. Run time shall be constant and independent of: load, temperature, and supply voltage (within specifications).
4. All valves and actuators shall be manufactured under ISO 9001 International Quality Control Standards.
5. Actuators shall have a one year warranty from date of installation.
6. Accessories Identification tags shall be available for all valves; tags shall be indelibly marked with gpm, model number, and tag location.
7. Valves and actuators shall be as supplied by Honeywell.

Balancing Valves (Mechanical section)

Balancing valve installation and commissioning shall not be required when dynamic pressure-regulating control valves are used throughout a building. The balancing report, as required, shall confirm design coil flow by direct measurement across (a representative sample of/all) coils in the building.

MAINTENANCE

1. If the system experiences large amounts of pipe scale due to poor water conditions, as sometimes found in older or retrofit pipe systems, provisions should be made to keep the system clean. Proper water treatment is also recommended by the use of a separator.
2. IF A SEPARATOR IS NOT USED FOR SYSTEM CLEANING, THE VALVES SHOULD BE CHECKED ANNUALLY.

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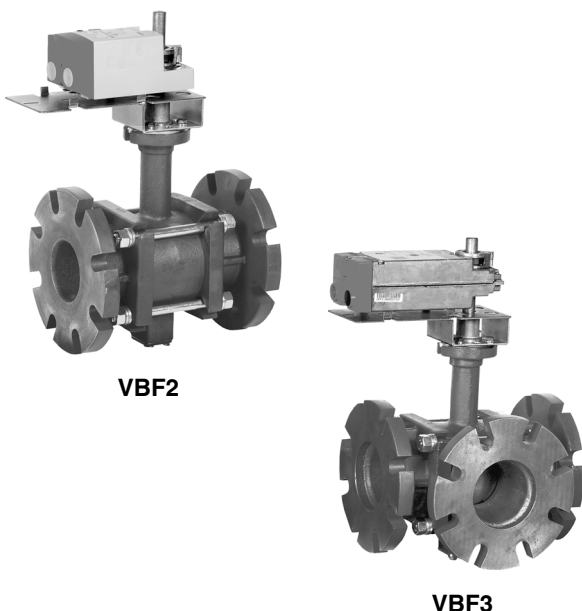
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VBF2, VBF3 Control Ball Valves With Flanged Connections

SPECIFICATION DATA



FEATURES

All Models

- Sizes from 4 to 6 inch with ANSI Class 125 flanged connections.
- Equal percentage or linear flow characteristics.
- Choice of four, factory-installed actuation control schemes: Floating, Modulating (2-10 V), Spring Return 24V 2-Position, Spring Return Modulating/Floating.
- Field configurable for normally open or normally closed fail-safe position.
- Optional NEMA 3R (IP54) rated enclosure for outdoor applications.
- Option of four actuator mounting positions on the valve.
- Wide range of C_v choices from 91 to 650.
- Valve ball and stem 316 stainless steel.

VBF2 (Two-way)

- ANSI Class IV leakage specification (0.01% of C_v).

VBF3 (Three-way)

- Mixing or Diverting control and ANSI Class IV leakage specification (.01% of C_v) for all sizes except as noted below.
- VBF3 4 inch with 327 C_v , 5 inch with 400 C_v , and 6 inch with 650 C_v .
 - Mixing control only.
 - Class IV (.01% of C_v) leakage A to AB.
 - Class III (.1% of C_v) leakage B to AB.
- Globe valve A-B-AB flow pattern (side B port).

APPLICATION

The VBF2 Two-Way and the VBF3 Three-Way Ball Valve Assemblies, with and without actuators, control hot and chilled water with glycol solutions up to 50% in heating, ventilating, and air conditioning (HVAC) systems to provide two-position or modulating functions.

These valve assemblies can be ordered with or without factory-mounted non-spring return or spring return direct-coupled actuators (DCA).



SPECIFICATIONS

Table 1. Model Selection.

Valve	Fitting	Body /Flow	Size	C _V	T/P	Trim	Enclosure	Actuator
VB = valve, ball								
F = Flanged								
2 = 2 way								
3 = 3 way								
inch S.I. metric								
J 4 DN100								
K 5 DN125								
L 6 DN150								
S								
T								
U								
1								
2								
3								
4								
5								
6								
7								
1 = ANSI Valve construction								
S = Stainless Steel								
0 = no enclosure								
R = NEMA 3R enclosure								
X = no actuator								
A = NSR, Floating								
B = NSR, Modulating								
C = SR, 2-Position, 24 Vac								
D = SR, Floating/Modulating								
VB	F	2	A	B	1	S	0	A

Dimensions: Refer to Figures 1 and 2.

Body Style: Two-way ball valve, straight-through flow, full or reduced port using laser-milled stainless steel control ball. Three-way ball valve, A-B-AB characterized flow, laser-milled stainless steel control ball. Combination ANSI 125/PN16 flanged connections.

Body Size: 4 to 6 inch (DN100, DN125, DN150).

Flow Capacity: See Table 2.

Body Pressure Rating (maximum):

240 psi (1655 kPa) at 250° F (121° C).

Controlled Medium: Water or Glycol solutions up to 50%.

Not suitable for combustible gases. For closed loop systems only. Not for use in open loop systems.

Fluid Temperature Range: -22 to +250° F (-30 to +121° C).

Maximum Differential Pressure: Refer to Table 3.

Flow Characteristics:

Two-way: Equal Percentage.

Linear with full port.

Three-way: Port A to AB: Equal Percentage.

Port B to AB: Linear with 20% reduced flow capacity.

Rangeability: 500:1 minimum.

Mounting: Bolt holes conform to ANSI B16.1.

Materials:

Body: Cast Iron ASTM A395, 60-40-18

Ball and Stem: 316 Stainless Steel.

Stem Seals: EPDM O-Rings.

Ball Seals: Teflon® Seals

Approvals/Standards:

Valves: ANSI close-off/leakage.

2-way - ANSI Class IV leakage

3-way - ANSI Class IV leakage (except as noted below)

3-way - A to AB; ANSI Class IV leakage.

B to AB; ANSI Class III leakage on 4 inch with

327 C_V, 5 inch with 400 C_V, and 6 inch with 650 C_V.

Actuators: Non-Spring Return, Floating or Modulating

UL/cUL.

UL873 Plenum Rating, File No. E4436; Guide No. XAPX.

CE

Spring Return 2-Position, 24 Vac or Floating/Modulating

UL/cUL

UL873 Plenum Rating, File No. E4436; Guide No. XAPX.

CE

C-TICK

Accessories:

7981-200 replacement mounting kit for Honeywell® direct coupled actuators.

SW2-US actuator auxiliary switch kit.

Table 2. Flanged Valves C_V Values.

Pipe Size	C _V Designator*									
	S	T	U	1	2	3	4	5	6	7
4 in.	91	118	152	197	254	327 ^a				
5 in.			144	185	240	309	400			
6 in.				208	268		346	441	577	650

^a For three-way valves only

* Maximum flow is 700 gpm (44 L/s)

Application Notes

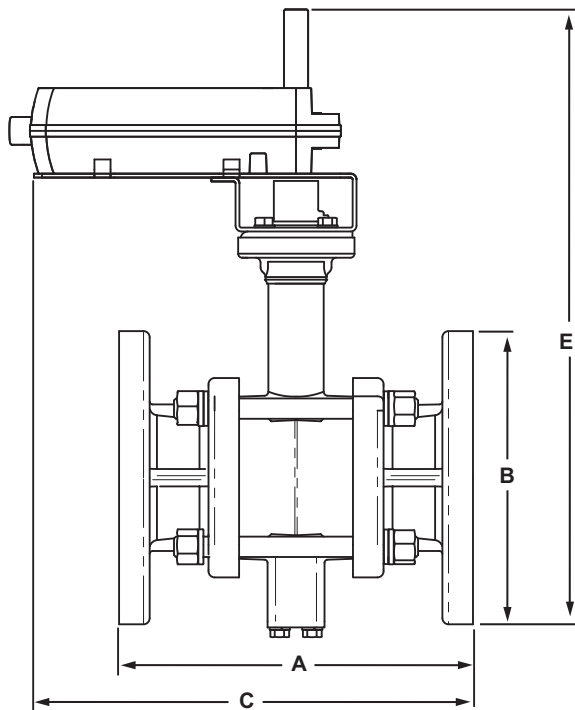
Required Torque

Both Honeywell non-spring return and spring return direct coupled actuators can be utilized with the VBF2 and VBF3 valves. See Table 3, which lists the close-off pressure rating for the valves with the different torque actuators. Larger torque actuators may be used, but there is no increase in close-off pressure rating.

Table 3. Close-off Pressure Ratings

Valve Size	Actuator Torque			
	88 in.-lb (10 Nm)	175 in.-lb (20 Nm)	175 in.-lb (20 Nm) 2-position	300 in.-lb (34 Nm)
Close Off Pressure Rating (psid)				
4 in.	70*	130	130	130
5 in.	70*	130	130	130
6 in.			70*	70*

* This is the factory-installed actuator rating.



Size (in.)	Model Number	A in. (mm)	B in. (mm)	C in. (mm)	D (depth) (not shown) in. (mm)	E in. (mm)	Wt. lb (kg)
4	VBF2J	11 (278)	9 (229)	13-1/4 (337)	9 (229)	18-3/4 (476)	65 (31)
5	VBF2K	12-3/8 (352)	10 (254)	14-1/4 (362)	10 (254)	19 (483)	75 (34)
6	VBF2L	13-7/8 (352)	11 (278)	15-1/8 (384)	11 (278)	19-7/8 (505)	90 (41)

M13732

Fig. 1. VBF2 Dimensions in inches (mm).

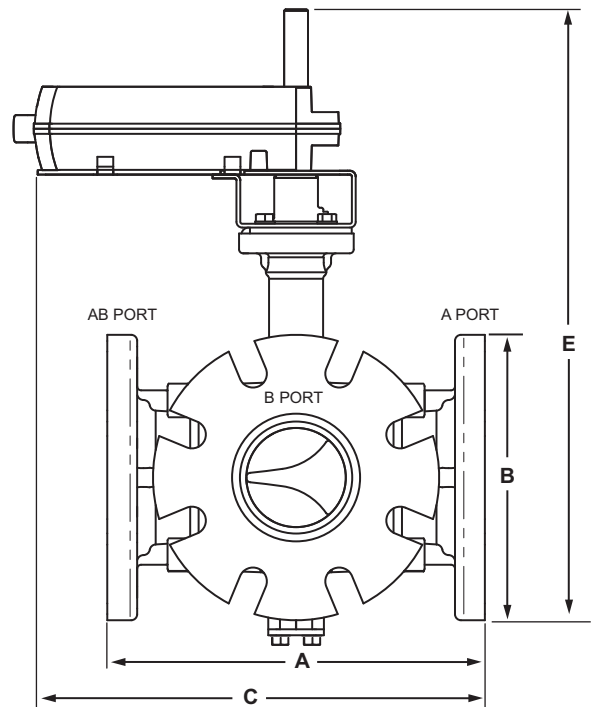
Flow Characteristics

VBF2 Two-Way Ball Valves have:

- an equal percentage flow characteristic.

VBF3 Three-Way Ball Valves have:

- between ports A and AB: an equal percentage flow characteristic.
- between ports B and AB: a linear flow characteristic.



Size (in.)	Model Number	A in. (mm)	B in. (mm)	C in. (mm)	D (depth) (not shown) in. (mm)	E in. (mm)	Wt. lb (kg)
4	VBF3J	11-7/8 (278)	9 (229)	14-1/8 (337)	10-3/8 (229)	18-1/2 (470)	75 (34)
5	VBF3K	13-7/8 (352)	10 (254)	15-1/8 (362)	12 (254)	19-3/8 (483)	90 (41)
6	VBF3L	15-7/8 (403)	11 (278)	16-1/8 (410)	13-3/8 (521)	20-1/2 (521)	105 (48)

M13733A

Fig. 2. VBF3 Dimensions in inches (mm).

TYPICAL SPECIFICATIONS

Actuated Ball Valve

Valve housing shall consist of cast iron, rated at no less than 240 psi at 250° F (121° C). Valve housing shall have ANSI Class 125 flanges. Valve ball shall consist of stainless steel with parabolic ports to make flow control equal percentage. Valve shall have a blow-out proof stem with two EPDM O-Rings. Valve shall have EPDM O-Rings behind ball seals to allow for a minimum close-off pressure of 70 psi with 88 in.-lbs of torque for 4 and 5 inch valves. Six inch valves shall require actuators with 140 in.-lbs of torque for flow rates under 700 gpm. Valve shall be available with a minimum of 5 unique C_v values for each size. 3-Way Valve: Bypass C_v shall be 80% of Through C_v .

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Valve Actuator

Control valve actuator shall accept analog modulating floating (tri-state), or two-position signal as indicated in the control sequence. Actuators shall be by Honeywell. Actuator shall provide minimum torque required for full valve shutoff position. Wiring terminals shall be provided for installation to control signal and power wiring.

ACCESSORIES

Identification tags shall be available for all valves; tags shall be indelibly marked with C_v , model number and location.

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DESCRIPTION

The VBN2 and VBN3 Series are Honeywell's characterized flow, low torque, two- and three-way ball valves. They are designed to provide Cv ratings that closely match industry standard globe valves and they have equal percentage flow characteristics. A single-style bracket maximizes simplicity and flexibility in mounting spring or non-spring return actuators. The valve bodies are 1/2" to 3" NPT sizes and use low torque, low cost actuators.

FEATURES

- Parabolic flow insert constructed into the ball
- Cv ratings similar to globe valves
- Three-way body pattern similar to globe valves
- Low torque means smaller, lower cost actuators
- Common mounting bracket
- Removable manual override handle
- Flexible bracket orientation
- Plenum rated
- Available with or without actuator
- Nema 3R option available



VBN2, VBN3 Series

3

CONTROL VALVES

SPECIFICATIONS			
Size	1/2" to 3" FNPT (three-way to 2-1/2")	Media Compatibility	Hot or chilled water, up to 50% glycol
Cv Range	0.38 to 266	Media Temperature Range	-22° to 250°F (-30° to 121°C)
Body Pattern	Two-way and three-way (mixing or diverting)	Compatible Actuators	Any Honeywell or Kele 44 in-lb non-spring return or spring return actuator will operate all VBN2, VBN3 assemblies up to 3"
Flow Characteristic		Pressure Rating	360 psig (2482 kPa) @ 250°F (121°C)
Two-way	Equal percentage for models with parabolic insert, linear for full port models	Operating Temperature with KA/MN actuators	-5° to 140°F (-20° to 60°C)
Three-way	Equal percentage ports A-to-AB and linear ports B-to-AB	with KAS/MS actuators	-40° to 150°F (-40° to 65°C)
Leakage Rating	ANSI Class IV (0.01% of Cv)	with MVN actuators	-4° to 131°F (-20° to 55°C)
Maximum Closeoff Pressure		Warranty	5 years
Two-way	Two-way 1/2" and 3/4": 130 psid (897 kPa)		
Three-way	1" to 3": 100 psid (690 kPa)		
Three-way	1/2" to 1": 50 psid (345 kPa)		
Three-way	1-1/4" to 2-1/2": 40 psid (276 kPa)		
Materials Of Construction	Forged brass body (ASTM B283), nickel-plated brass (or stainless steel) ball and stem, EPDM o-ring stem seals and EPDM with reinforced Teflon® ball seals		



CONTROL VALVES

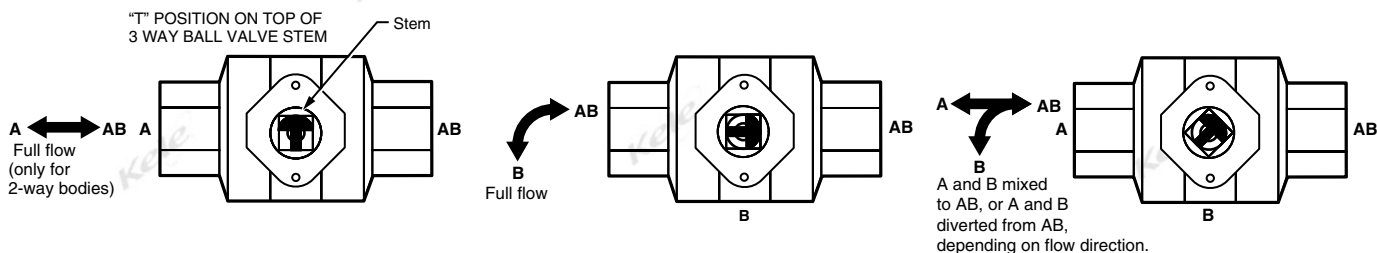
BALL VALVES

VBN2, VBN3 SERIES

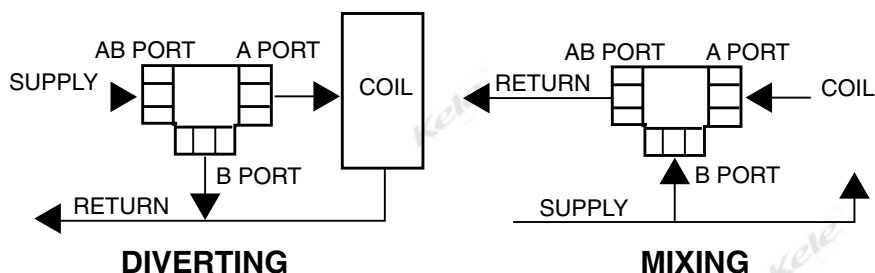
3

CONTROL VALVES

ORIENTATION OF BALL IN VALVE



FLOW ORIENTATION



Three-way ball valve flow for orientation (not to scale).

RANGEABILITY

Rangeability is a measure of a valve's controllability. It is a measured property and is expressed as the ratio of a valve's maximum flow rate to its minimum controllable flow rate.

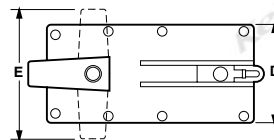
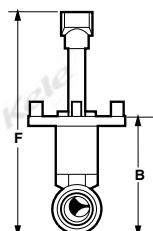
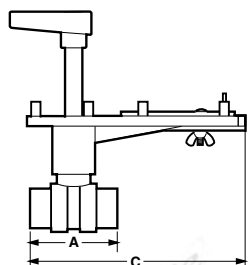
2-WAY AVAILABLE CV AND RANGEABILITY

VBN2A	CV	0.38	0.68	1.30	2.00	2.30	4.70	8.00	11.70	
	Rangeability	17	41	52	*	321	159	390	251	
VBN2B	CV	0.31	0.63	1.20	2.50	4.30	7.40	10.10	14.70	29.00
	Rangeability	17	41	52	321	159	*	390	251	1503
VBN2C	CV	4.40	9.00	15.30	26.00	44.00	54.00			
	Rangeability	159	390	1040	484	1263	1207			
VBN2D	CV	4.40	8.30	14.90	25.00	37.00	41.00	102.00		
	Rangeability	159	390	1040	*	484	1207	1263		
VBN2E	CV	23.00	30.00	41.00	74.00	172.00				
	Rangeability	484	*	603	1263	558				
VBN2F	CV	42.00	57.00	71.00	100.00	108.00	210.00	266.00		
	Rangeability	603	*	287	*	558	750	877		
VBN2G	Cv	45.00	55.00	72.00	101.00	162.00	202.00			
	Rangeability	250	*	287	558	750	877			
VBN2H	Cv	49.00	63.00	82.00	124.00	145.00				
	Rangeability	250	287	558	750	877				

* Data not available

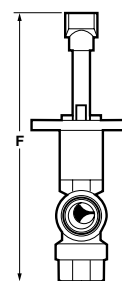
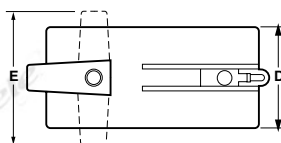
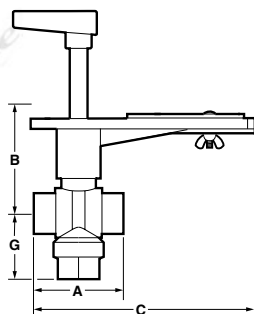


DIMENSIONS



Pipe Size	Model No.	Cv	Dimensions inches (mm)						Weight lb (kg)
			A	B	C	D	E	F	
1/2"	VBN2A	0.38, 0.68, 1.3, 2.0, 2.6, 4.7, 11.7	2-3/8 (60)	3-7/16 (87)	6-5/8 (168)	3 (76)	4 (102)	8-1/8 (206)	1 (0.5)
		8.0	2-5/8 (67)	3-11/16 (94)	6-1/2 (165)	3 (76)	4 (102)	8-5/16 (211)	1 (0.5)
3/4"	VBN2B	0.31, 0.63, 1.2, 2.5, 4.3, 7.4, 14.7	2-3/8 (60)	3-7/16 (87)	6-7/16 (164)	3 (76)	4 (102)	8-1/8 (206)	1 (0.5)
		10.1, 29	2-5/8 (67)	3-11/16 (94)	6-1/2 (165)	3 (76)	4 (102)	8-5/16 (211)	1 (0.5)
1"	VBN2C	9.0	3-3/4 (95)	3-11/16 (94)	7-1/16 (179)	3 (76)	4 (102)	8-5/16 (211)	1 (0.5)
		4.4, 15.3, 54	3 (76)	3-15/16 (100)	6-3/4 (171)	3 (76)	4 (102)	8-11/16 (221)	1.4 (0.6)
		26, 44	4-3/8 (111)	4-7/16 (113)	7-3/8 (187)	3 (76)	4 (102)	8-7/8 (225)	2.4 (1.1)
1-1/4"	VBN2D	4.4, 8.3, 14.9, 25, 41	3 (76)	3-15/16 (100)	6-11/16 (170)	3 (76)	4 (102)	8-11/16 (221)	1.4 (0.6)
		37, 102	3-5/8 (92)	4-7/16 (113)	7 (178)	3 (76)	4 (102)	9-1/16 (231)	2.4 (1.1)
1-1/2"	VBN2E	23, 30, 74	3-3/8 (86)	3-15/16 (100)	6-15/16 (176)	3 (76)	4 (102)	9-1/16 (231)	2.4 (1.1)
		41, 172	3-3/4 (95)	5-3/16 (132)	7-1/16 (179)	3 (76)	4 (102)	8-7/8 (225)	3.2 (1.5)
2"	VBN2F	42, 108	4 (102)	5-3/16 (132)	7-3/16 (183)	3 (76)	4 (102)	8-7/8 (225)	3.2 (1.5)
		57, 71, 100, 210, 266	4-3/8 (111)	5-3/4 (146)	7-7/16 (189)	3 (76)	4 (102)	10-1/2 (267)	5 (2.3)
2-1/2"	VBN2G	45, 55, 72, 101, 162, 202	4-3/4 (121)	5-3/4 (146)	7-9/16 (192)	3 (76)	4 (102)	10-1/2 (267)	5.5 (2.5)
3"	VBN2H	49, 63, 82, 124, 145	5 (127)	5-7/8 (149)	7-11/16 (195)	3 (76)	4 (102)	10-11/16 (271)	5.9 (2.7)

VBN2 dimensions in inches (millimeters)



Pipe Size	Model No.	Cv	Dimensions inches (mm)						Weight lb (kg)
			A	B	C	D	E	F	
1/2"	VBN3A	0.33, 0.59, 1.0, 2.4, 4.3, 8.0	3-1/2 (90)	3-5/16 (84)	7 (178)	3 (76)	4 (102)	9-3/8 (238)	2.4 (1.1)
3/4"	VBN3B	0.40, 0.66, 1.3, 2.4, 3.8, 7.0, 11.0	2-13/16 (71)	3-5/16 (84)	6-1/2 (168)	3 (76)	4 (102)	8-13/16 (224)	2 (0.9)
1"	VBN3C	0.40, 0.65, 1.3, 2.3, 3.5	3-13/16 (97)	3-5/16 (84)	7-5/16 (186)	3 (76)	4 (102)	9-1/2 (241)	2.8 (1.3)
		8.6, 22	3 (76)	3-13/16	6-13/16 (173)	3 (76)	4 (102)	9-13/16 (249)	2.6 (1.2)
		4.5, 14.9, 31	4-1/2 (114)	4 (102)	7-13/16 (198)	3 (76)	4 (102)	10-13/16 (275)	3.3 (1.5)
1-1/4"	VBN3D	4.1, 8.7, 19.0	3 (76)	3-13/16	6-13/16 (173)	3 (76)	4 (102)	9-13/16 (249)	2.5 (1.1)
		12.7, 27, 34	3-5/8 (92)	4 (102)	7-5/16 (186)	3 (76)	4 (102)	10-5/16 (262)	2.8 (1.3)
1-1/2"	VBN3E	4.0, 8.3, 13.4, 32	4-1/2 (114)	4 (102)	7-13/16 (198)	3 (76)	4 (102)	10-13/16 (275)	3.3 (1.5)
		24, 61	4 (102)	4-1/2 (114)	7-5/16 (186)	3 (76)	4 (102)	11 (279)	3.3 (1.5)
2"	VBN3F	24, 38, 57	4 (102)	4-1/2 (114)	7-5/16 (186)	3 (76)	4 (102)	11 (279)	3.3 (1.5)
		83, 109	5 (127)	5-13/16	7-13/16 (198)	3 (76)	4 (102)	12-5/16 (313)	3.8 (1.7)
2-1/2"	VBN3G	38, 74, 100	5 (127)	5-13/16	7-13/16 (198)	3 (76)	4 (102)	12-5/16 (313)	3.8 (1.7)

VBN3 dimensions in inches (millimeters)



CONTROL VALVES

BALL VALVES

VBN2, VBN3 SERIES

3

CONTROL VALVES

TABLE 1: VBN2 2-WAY VALVE CV CODE SELECTION CHART

Ordering Code	Valve Size							
	Cv							
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
B	0.38	0.31						
D	0.68	0.63						
E	1.3	1.2						
F	2.0							
G	2.6	2.5						
H	4.7	4.3	4.4	4.4				
J	8.0	7.4	9.0	8.3				
K	11.7*	10.1		14.9				
L		14.7*	15.3	25.0	23.0			
M		29.0*	26.0	37.0	30.0			
N			44.0*	41.0*	41.0	42.0	45.0	49.0
P			54.0*			57.0	55.0	63.0
R					74.0	71.0	72.0	82.0
S				102.0*		100.0	101.0	
T						108.0*		124.0
U							162.0	145.0*
1					172.0*	210.0	202.0*	
2						266.0*		

* Denotes Full port

TABLE 2: VBN3 3-WAY VALVE CV CODE SELECTION CHART

Ordering Code	Valve Size						
	Cv						
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"
B	0.33						
C	0.59	0.4	0.4				
D		0.66	0.65				
E	1.0	1.3	1.3				
F	2.4	2.4	2.3				
G		3.8	3.5				
H	4.3		4.5	4.1	4.0		
J	8.0	7.0	8.6	8.7	8.3		
K		11.0*	14.9	12.7	13.4		
L			22.0	19.0*	24.0	24.0	
M			31.0	27.0	32.0*		
N				34.0*		38.0	38.0
P					61.0	57.0	
R						83.0	74.0
S							100.0*
T						109.0	

* Denotes Full port valve



ORDERING INFORMATION, VALVE BODY WITH ACTUATOR

MODEL	
VBN	VB Series Ball Valve with Female NPT threaded connections
CONFIGURATION	
2	2-Way
3	3-Way
CONNECTION SIZE	
A	1/2"
B	3/4"
C	1"
D	1-1/4"
E	1-1/2"
F	2"
G	2-1/2"
H	3" (2-Way valves only)
CODE for Cv SELECTION	
x	See Tables 1 and 2 for the Ordering Code to place here
3 ANSI 300 VALVE CONSTRUCTION	
P	Nickel chrome plate brass
S	316 stainless steel
ENCLOSURE	
A	MVN standard (1/2", 3/4", 1" and 1-1/4" valves)
L	MVN low profile (1/2", 3/4", 1" and 1-1/4" valves only)**
X	MN or MS
ACTUATOR	
0	No actuator (valve body only)
1	MVN613 On/Off or floating (90 second timing), Non-spring return
2	MVN643 On/Off or floating (30 second timing), Non-spring return
3	MVN713 Modulating, Non-spring return
4	MN6105A1011-Direct Coupled Actuator (DCA), floating On/Off (SPDT), Non-spring return
5	MN7505A2001-Direct Coupled Actuator (DCA), floating, modulation, On/Off (SPDT), Non-spring return
6	MS7505A2030- Direct Coupled Actuator (DCA), floating, modulation, On/Off (SPDT), Spring return
7	MS8105A1030- Direct Coupled Actuator (DCA), 2-Position (SPST), Spring return
FAIL SAFE POSITION	
0	Fail in place or No Actuator - Non-spring return actuators only
1	Fail safe open - Spring return actuators only
2	Fail safe closed - Spring return actuators only
3	Fail A to AB Open - Spring return actuators only
4	Fail B to AB Open - Spring return actuators only
OPTIONS	
00	Standard actuator- no options
01	1 meter cable
02	NEMA 3R Enclosure (DCA actuators only)

VBN 2 A B P A 1 1 00 **Example: VBN2ABPA1100**

*Standard base provides clearance between valve and actuator for insulation.

**Low profile base enables installation of valve and actuator in tight spaces.

NOTE: All functions and options are not available with all versions

NOTE: The part numbers selected are the Honeywell Short Order Codes. Ask your Kele rep for cross reference for complete factory assembly model number.

SSTAG
5112-3R
5112-11

RELATED PRODUCTS

Stainless steel tag on bead chain, 1" x 2" dogtag, custom engraved per order
NEMA 3R enclosure
Replacement mounting kit

VRN Pressure Independent Control Valves and Actuators

PRODUCT DATA



APPLICATION

The VRN2 two-way pressure independent control valves maintain constant flow of hot or chilled water with glycol solutions up to 50% in closed-loop heating, ventilating, and air conditioning (HVAC Division 23) systems regardless of head pressure fluctuations above the minimum specified pressure drop. These valve assemblies can be used with Honeywell non-spring return or spring return direct coupled actuators (DCA).

The built-in differential pressure regulator makes fluid flow through the valve independent of changes in supply pressure, eliminating “hunting” by the control system, even at low coil flow. The pressure regulator virtually eliminates cavitation in the valve, and decouples the control valve from the effects of piping components such as reducers and elbows.

Pressure independent control valves are sized to match design coil flow regardless of coil size. VRN2 valves eliminate the need to balance the system for proper flow, and allow chillers to be operated at design temperature differential for maximum efficiency at every load condition. When used in a system with variable speed pump drives, 3-way valves and coil bypass lines are not

required. In new construction, VRN2 valves perform better than reverse return piping designs without the extra materials these systems need.

Pressure-independent control requires less flow, enabling use of smaller piping, pumps, and chillers.

FEATURES

- **Sizes from 1/2 to 3 in. with internal (female) NPT connections.**
- **Controls hot or chilled water with up to 50% glycol.**
- **Regulated flow rates available from 1 to 95 gpm.**
- **Differential pressure regulator for constant pressure drop across valve seat.**
- **Positive pressure, rolling diaphragm regulator design for flow control accuracy of $\pm 5\%$.**
- **Equal percentage flow characteristic using patented flow control ball insert.**
- **Multiple maximum flow rates available per valve size.**
- **Patented ball seals for low operating torque.**
- **Nickel-chrome plated brass or stainless steel trim.**
- **Choice of factory-installed actuation using Honeywell MVN or MN/MS series direct coupled actuators: Floating, Modulating (2-10 V), Non-Spring Return and Spring Return.**
- **Spring return actuators field-configurable for normally open or normally closed fail-safe position.**
- **Removable, manual operating handle to control valve during installation or in an event of power failure.**
- **Upstream Test Port for venting or pressure gauge attachment.**
- **Three actuator orientations on the valve for cramped spaces.**
- **Integral snubber eliminates effect of system pressure fluctuations and entrapped air while improving flow performance.**

Contents

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Operation and Checkout	18



SPECIFICATIONS

Valve Type: Pressure Independent Control Valve

Body Style: Two-way ball valve, straight-through flow, full port with patented flow control insert.

Pipe Size: 1/2 to 3 inches with female NPT pipe fittings.

Body Pressure Rating (maximum): 360 psi (2500 kPa) at 250°F (121 C).

Controlled Medium: Water or Glycol solutions up to 50%. Not suitable for combustible gases, oil or steam.

Medium Temperature Range: -22 to +250°F (-30 to +121 C).

Maximum Differential Pressure: See Table 1.

Close-off pressure: 100 psid

Flow Characteristics

Equal Percentage with flow control insert. See Fig. 31.

Materials

Body: Forged Brass (ASTM B283).

Flow Optimizer: laser-milled, glass-reinforced Noryl®

Trim (ball and stem): Nickel-chrome plated brass, or stainless steel.

Stem Seals: EPDM O-ring and Teflon™ bearings.

Ball Seals: Reinforced Teflon™ seals, with EPDM O-rings.

Regulator: Hydrogenated acrylonitrile-butadiene rubber rolling diaphragm in stainless steel housing.

Compatible Actuators

Minimum Torque Required:

35 lb-in. (4 Nm) up to 3 in. (≤DN80).

27 lb-in. (3 Nm) up to 1-1/4 in. (≤DN32).

Fail Safe: MSXX05*

Non-Fail Safe: MVN & MNXX05*

* These actuators are available as factory-installed assemblies.

See Table 1 for all available options.

Approvals Standards

Actuators: See literature for the given actuator.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number. If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Environmental and Combustion Controls Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386
3. <http://customer.honeywell.com> or <http://customer.honeywell.ca>

International Sales and Service Offices in all principal cities of the world. Manufacturing in Belgium, Canada, China, Czech Republic, Germany, Hungary, Italy, Mexico, Netherlands, United Kingdom, and United States.

Table 1. VRN Model Selection.

Model Selection: Pressure Independent Control Valve								Actuator		Fail Position		Accessories
Valve	Fitting	Body/Flow Type	Size	Max flow rate	Trim	Profile						
VR - Pressure Independent Control Valve								MVN613A0000*		Leave blank = Fail in place		C1 - 1 meter cable
N- Female NPT threaded								MVN643A0000*				3R - NEMA Enclosure
2- 2 way								MVN713A0000*				FSO = Fail Safe Open FSC = Fail Safe Closed
								MN6105A1011				
								MN6105A1201				
								MN7505A2001				
								MN7505A2209				
								MS7505A2030				
								MS7505A2130				
								MS8105A1030				
								MS8105A1130				
								MS4105A1030				
								MS4105A1130				

Example part number: **VRN2A001.00PA+MVN613A0000+C1**

* Only compatible with valves 1-1/4" or smaller.

Table 2. Actuator Control Description.

Actuator	Control
MVN613A0000	Floating, Two-position (SPDT or SPST) (90 sec. timing), 24 V, Fail in Place
MVN643A0000	Floating, Two-position (SPDT) Fast Acting (30 sec. timing), 24 V, Fail in Place
MVN713A0000	Modulating, 24 V, Fail in Place
MN6105A1011	Floating, Two-position (SPDT), 24 V, Fail in Place
MN6105A1201	Floating, Two-Position (SPDT), 24 V, Fail in Place with end switches
MN7505A2001	Modulating, 24 V, Fail in Place
MN7505A2209	Modulating, 24 V, Fail in Place with end switches
MS7505A2030	Modulating, Floating, Two-position (SPDT), 24 V, Fail Safe
MS7505A2130	Modulating, Floating, Two-Position (SPDT), 24 V, Fail Safe with end switches
MS8105A1030	Two-Position (SPST), 24 V, Fail Safe
MS8105A1130	Two-Position (SPST), 24 V, Fail Safe with end switches
MS4105A1030	Two-Position (SPST), 120 V, Fail Safe
MS4105A1130	Two-Position (SPST), 120 V, Fail Safe with end switches

Table 3. Pressure Independent Valve Short Order Codes ½” – 3”.

Model Selection: Control Valve							Actuator		Fail Position		Accessories
Valve	Body Flow Type	Valve Size	Max Flow Rate	Trim	Actuator Adapter						
VRN - Pressure Independent Control Valve							0 - No Actuator (valve only)		0 - No Actuator or Fail in Place (FIP)		00 - None
2 - 2-way A---1/2 (DN15) B---3/4 (DN20) C---1 (DN25) D---1-1/4 (DN32) E---1-1/2 (DN40) F---2 (DN50) G---2-1/2 (DN65) H---3 (DN80) Flow Rate (GPM) Options range from B-9. See Table 4. P - Nickel Chrome Plated Brass S - 316 Stainless Steel (2-way only) A - Standard Base X - MN/MS DCA Actuator Bracket						1 - 24 Vac, Floating/2-Pos., 90 sec. (MVN613, Fail in place)*		1 - Fail Safe Open (FSO)	01 - 1 m Cable (C1)		
						2 - 24 Vac, Floating/2-Pos., 30 sec. (MVN643, Fail in place)*		2 - Fail Safe Closed (FSC)	02 - 3R - NEMA enclosure		
						3 - 24 Vac, Modulating 0(2)-10 Vdc (MVN713, Fail in place)*					
						4 - 24 Vac, Floating/2-Position (MN6105, Fail in place)					
						5 - 24 Vac, Mod. 0(2)-10 Vdc (MN7505, Fail in place)					
						6 - 24 Vac, Mod. 0(2)-10 Vdc/Floating (MS7505, Fail safe)					
						7 - 24 Vac, 2-Position (MS8105, Fail safe)					
						8 - 100-250 Vac, 2-Position (MS4105, Fail safe)					
						9 - 100-250 Vac, 2-Pos. w/ end switches (MS4105, Fail safe)					
						A - 24 Vac, 2-Position w/ end switches (MS8105, Fail safe)					
						B - 24 Vac, Mod 0(2)-10 Vdc/Floating w/ end switches (MS7505, Fail safe)					
						C - 24 Vac, Floating/2-Position w/ end switches (MN 6105, Fail in place)					
						D - 24 Vac, Mod. 0(2)-10Vdc w/ end switches (MN7505, Fail in place)					
						VRN					
A	B	P	A			1					

Example part number: **VRN2ABPA1000**

* Only compatible with valves 1-1/4” or smaller.

Table 4. VRN Flow Rate (GPM) and Differential Pressure with Short Order Code Indicator.

Model	Size	ΔP range		Head Loss	Short Order Code Indicator																									
		Min	Max		Maximum GPM																									
	(inch)	(psi)	(psi)	(psi)	B	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	1	2	3	4	5	6	7	8	9
VRN2A	0.5	3	35	3	1	2	3	4	5	6	7																			
VRN2B	0.75	3	35	3	1	2	3	4	5	6	7																			
		6	35	6								8	9	10*																
VRN2C	1	3	35	3	1	2	3	4	5	6	7																			
		6	35	6								8	9																	
		4	50	4										10	15	20														
VRN2D	1.25	4	50	4									10	15	20															
		5	50	5													25	30												
		6.5	58	6.5															35*											
VRN2E	1.5	4	50	4										10	15	20														
		5	50	5													25	30												
		4	58	4															35											
		6	58	6																40	45	50								
		7	58	7																			55	60	65	70	75	80	85	
		11	58	11																										95*
VRN2F	2	4	50	4										10	15	20														
		5	50	5													25	30												
		4	58	4															35											
		6	58	6																40	45	50								
		7	58	7																			55	60	65	70	75			
VRN2G	2.5	4	58	4													25	30	35											
		6	58	6																40	45	50								
		7	58	7																			55	60	65	70	75	80	85	
		11	58	11																										95*
VRN2H	3	4	58	4													25	30	35											
		6	58	6																40	45	50								
		7	58	7																			55	60	65	70	75	80	85	
		11	58	11																										95*

* Denotes full port valve (with no insert).

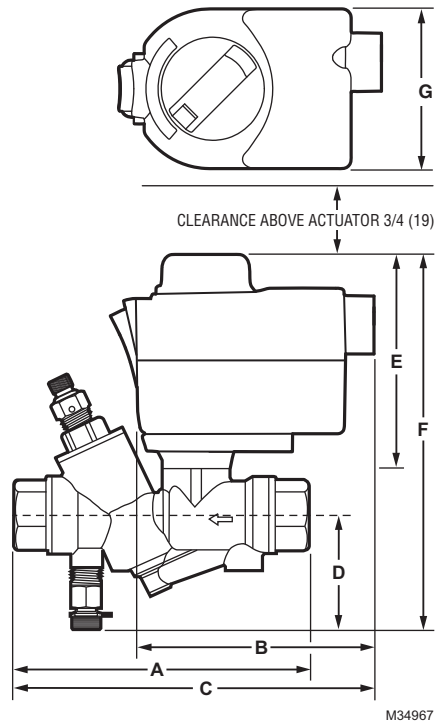


Fig. 1. Valve Dimensions with MVN Actuator; see Table 5.

Table 5. Valve Dimensions with MVN Actuator.

Model	Pipe Size		Flow, gpm (m3/h)			Dimensions in in. (mm)							Weight lb. (kg)	Service Replacement Parts
NPT	in.	S.I. metric	Min. Rating	Max. Rating	Full Port	A	B	C	D	E	F	G		
VRN2A	1/2	DN15	1.0 (0.23)	7.0 (1.6)		5.71 (145)	4.56 (116)	6.57 (167)	2.32 (59)	3.87 (98)	7.36 (187)	2.8 (71)	2.5 (1.1)	Stem: 5112-19 5112-22 (SS); Regulator: 8615-100 for 1-3 gpm; 8615-101 for 4-10 gpm
VRN2B	3/4	DN20		9.0 (2.0)	10 (2.3)			6.63 (168)						
VRN2C	1	DN25		15.0 (3.4)		5.83 (148)								
				20 (4.5)	20 (4.5)			9.65 (245)			9.13 (232)		2.41 (61)	
VRN2D	1-1/4	DN32	10 (2.3)	30 (6.8)	35 (7.9)	8.98 (228)	8.79 (223)							

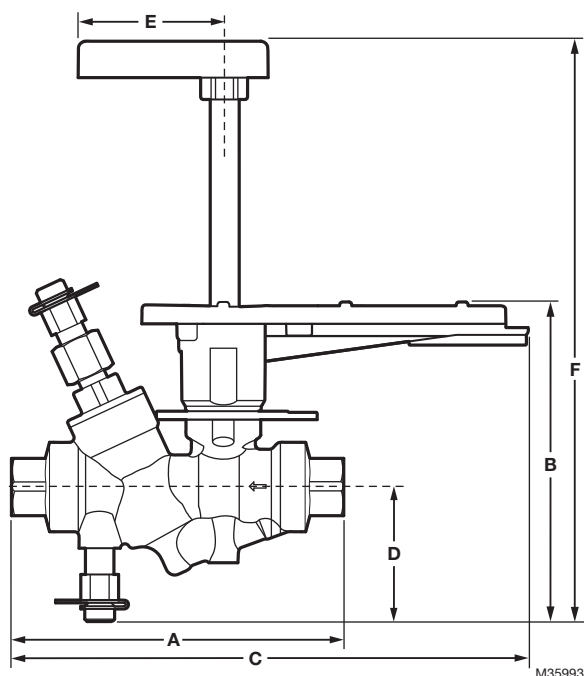


Fig. 2. Dimensions of valves used with MN/MS actuators; see Table 6. Actuator not shown. See Figures 4 and 5 for MN/MS actuator dimensions.

Table 6. Dimensions of valves used with MN/MS actuators; see Fig. 2. See Figures 4 and 5 for MN/MS actuator dimensions.

Model	Pipe Size		Flow, gpm (m ³ /h)			Dimensions ^c in in. (mm)							Weight lb. (kg)	Service Replacement Parts	
NPT	in.	S.I. metric	Min. Rating	Max. Rating	Full Port	A	B	C	D	E	Fz ^a	Fs ^a			
VRN2A	1/2	DN15	1.0 (0.23)	7.0 (1.6)		5.71 (145)	5.43 (138)	8.87 (225)	2.32 (59)	2.5 (64)	10.02 (255)	8.77 (223)	2.5 (1.1)	Stem: 5112-19 5112-22 (SSb); Regulator: 8615-100 for 1-3 gpm; 8615-101 for 4-10 gpm	
VRN2B	3/4	DN20		9.0 (2.0)	10 (2.3)			8.94 (227)							
VRN2C	1	DN25		15.0 (3.4)			5.83 (148)								
			20 (4.5)	20 (4.5)		9.65 (245)		11.44 (291)							
VRN2D	1-1/4	DN32	10 (2.3)	30 (6.8)	35 (7.9)	8.98 (228) (213)	6.10 (155)	11.10 (282)	2.41 (61)			10.68 (271)	9.43 (240)	7.1 (3.2)	Stem: 5112-20 5112-23 (SSb); Regulator: 8615-102
VRN2E	1-1/2	DN40		35 (7.9)				8.80 (224)			11.01 (280)				
			40 (9.1)	85 (19.3)	95 (21.6)	10.66 (271)		12.84 (326)							
VRN2F	2	DN50	25 (5.7)	75 (17.0)		10.97 (279)	6.95 (177)	13.00 (330)	2.93 (74)			11.55 (293)	10.30 (262)	13.7 (6.2)	Stem: 5112-21 5112-24 (SSb); Regulator: 8615-031
VRN2G	2-1/2	DN65		85 (19.3)	95 (21.6)	11.42 (290)		13.23 (336)							
VRN2H	3	DN80				11.80 (300)		13.41 (341)							

^a Long shaft supplied with “Zelix” direct coupled spring return actuators; short shaft supplied with MN series stay-in-place DCAs.

^b Do not use stainless steel replacement stem assemblies in valves with plated brass trim; galvanic reactions may occur.

^c Actuator dimensions fall within the envelope of the handle and mounting bracket. See actuator literature for detailed dimensions.

MVN Actuator



APPLICATION

MVN 3Nm (27 lb-in.) Control Valve Actuator is used with the VRN2 Pressure Independent Control Valves to control hot and chilled water with glycol solutions up to 50% in heating, ventilating, and air conditioning (HVAC) systems to provide two-position or modulating functions.

FEATURES

- Non-spring Return
- Floating and modulating
- Space saving, click-on installation – no tool required
- Extendable position indicator for easy commissioning
- Available with or without cable
- Compatible with control ball valves from 1/2 to 1-1/4 inches.
- Actuator can be mounted on the valve in any of four positions.

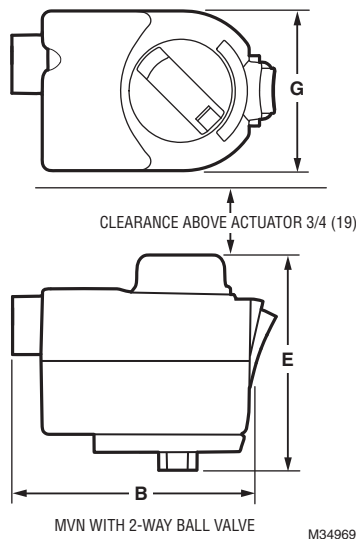


Fig. 3. Dimensions; see Table 5 on page 6.

SPECIFICATIONS

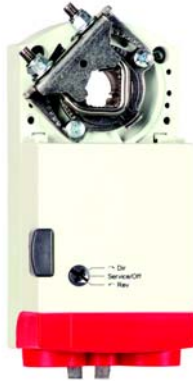
- Actuator Type:** Valve
- Rotational Stroke:** 90° ±3°.
- Fail Safe Mode:** Non-spring return, Fail in place
- Torque:** 27 lb-in. (3 Nm).
- External Auxiliary Switches Available:** No
- Supply Voltage:** 24 Vac +20%, -15%, 24 Vdc
- Power Consumption:** 5 VA- Modulating, 1.5 VA - Floating, 6 VA - Fast Acting SPDT
- Environmental Rating:** NEMA2
- Frequency:** 50 Hz; 60 Hz
- Mounting:** Click-on installation – no tool required
- Noise Rating at 1m (Maximum):** 35 dB(A) max at 1 m [50 dB(A) for MVN643].
- Materials:** Plenum rated plastic housing
- Operating Humidity Range (% RH):**
5 to 95% RH, non-condensing
- Ambient Temperature Range:**
-4°F to 131°F (-20°C to 55°C)
- Storage Temperature Range:**
-40°F to 176°F (-40°C to 80°C)
- Weight:** 0.6 lb. (0.27 kg)
- Dimensions:** See Fig. 1 and Table 5.
- Timing:** 90 sec. (+/-10%) for MVN613 and MVN713; 30 sec. (+/-10%) for MVN643
- Electrical Connections:** Field wiring 18 to 20 AWG to screw terminals, located under the removable access cover.
- Humidity Ratings:** 5% to 95% RH non-condensing.
- Design Life (at Rated Voltage):**
60,000 cycles; 1 cycle = 0°...90°...0°
- Cable Specification:**
18 AWG, Plenum Rated, 300 V, 10 A, 3 ft. length from end of access cover.
- Environmental Protection Ratings:** IP40.
- Approvals:**
UL/cUL
UL60730

Table 7. Actuators and Accessories

Actuator	Description	Accessory
MVN613A0000	Floating control ball valve actuator	C1- 1 meter cable
MVN643A0000	Fast acting SPDT control ball valve actuator	
MVN713A0000	Modulating control ball valve actuator	

To order actuator with accessories order actuator part number + accessory. For example: MVN613A0000 + C1

Non-Spring Return Direct Coupled Actuator



APPLICATION

This non-spring return direct-coupled damper actuator provides modulating and floating/2-position control for: air dampers, air handlers, ventilation flaps, louvers, and reliable control for air damper applications with up to 10 sq. ft./ 44lb.-in. (5 Nm) and 20 sq. ft./88 lb.-in. (10 Nm) (seal-less damper blades; air friction-dependent).

FEATURES:

- **Declutch for manual adjustment**
- **Adjustable mechanical end limits**
- **Access cover includes enclosed screw terminal strip (22 to 14 AWG) for electrical connections**
- **Models available with 3 foot 18 AWG color-coded cable**
- **Mountable in any orientation**
- **Function selection switch for selecting modulating or floating/2-position control**

SPECIFICATIONS

Actuator Type: Damper; Valve

Rotational Stroke: 95° ±3 degrees

Fail Safe Mode: Non-spring return

Torque: 44 lb.-in. (5 Nm)

External Auxiliary Switches Available: Yes, SSW2-1M

Environmental Rating: NEMA2

Frequency: 50 Hz; 60 Hz

Manual operation: Declutch mechanism

Mounting: Direct coupled

Maximum Noise Rating, Driving (dBA @ 1m): 35

Rotation to Open: By switch

Rotational Stroke Adjustment: Dual Integral Adj. Stops (3 degree increments)

Compatible Damper Shafts:
1/4 to 1/2 in. square or 3/8 to 5/8 in. round
(6 to 13 mm square or 8 to 16 mm round)

Shaft Adapter Type: U-bolt clamp

Supply Voltage: 24 Vac +20%, -15%, 24 Vdc

Power Consumption: 5 VA

Materials: Plenum rated plastic housing

Ingress Protection Rating: IP54

Operating Humidity Range (% RH):
5 to 95% RH, non-condensing

Ambient Temperature Range:
-5°F to +140°F (-20°C to +60° C)

Storage Temperature Range:
-22°F to +176°F (-30°C to +80°C)

Weight: 1 lb (0.45 kg)

Includes: Mounting bracket, screws, shaft adapter, water-tight strain-relief cable fittings

Comments: Integral 1/2 in. NPSM conduit connection.

Approvals:

CE: 89/336/ECC, 73/23/EEC

C-Tick: N314

Underwriters Laboratories, Inc.: UL873, Plenum Rated

Canadian Underwriters Laboratories, Inc.:

cUL C22.2 No. 24-93

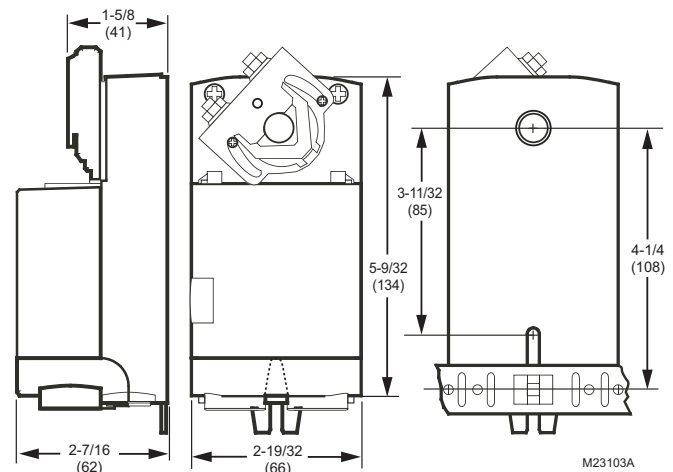


Fig. 4. Non-spring return direct coupled actuator dimensions in inches (mm).

Spring Return Direct Coupled Actuator



APPLICATION

MS4105, MS7405, MS7505, and MS8105 Spring Return Direct Coupled Actuators (DCA) are used within heating, ventilating, and air-conditioning (HVAC) systems. They can drive a variety of quarter-turn, final control elements requiring spring return fail-safe operation.

FEATURES

- **Brushless DC submotor with electronic stall protection on all models**
- **Self-centering shaft adaptor (shaft coupling) for wide range of shaft sizes**
- **Access cover includes enclosed screw terminal strip (22 to 14 AWG) for electrical connections.**
- **Models available with 3 foot 18 AWG color-coded cable**
- **Durable plastic housing with built-in mechanical end limits**
- **Spring return direction field selectable**
- **Shaft position indicator and scale**
- **UL (cUL) listed and CE compliant**
- **All models are plenum rated per UL873**

SPECIFICATIONS

Actuator Type: Damper; Valve

Rotational Stroke: 95 ±3 degrees

Fail Safe Mode: Spring Return

Torque: 44 lb-in. (5 Nm)

Spring Return Torque: 44 lb-in. (5 Nm)

Spring Return Direction: By orientation

External Auxiliary Switches Available: No

Environmental Rating: NEMA2

Frequency: 50 Hz; 60 Hz

Mounting: Direct Coupled

Maximum Noise Rating, Holding (dBA @ 1m):
20 (no audible noise)

Maximum Noise Rating, Driving (dBA @ 1m): 50

Rotation to Open: By switch

Rotational Stroke Adjustment:
Mechanically limited 5 degree increments

Compatible Damper Shafts:
1/4 to 1/2 in. square or 3/8 to 5/8 in. round
(6 to 13 mm square or 9 to 16 mm round)

Shaft Adapter Type: Self-centering clamping

Materials: Plenum rated plastic housing

Supply Voltage: 24 Vac +20%, -15%, 24 Vdc

Power Consumption: 5 VA

Operating Humidity Range (% RH):
5 to 95% RH, non-condensing

Ambient Temperature Range: -40°F to +149°F
(-40°C to +65°C) for two-position actuators only

Storage Temperature Range:
-40°F to +150°F (-40°C to +65°C)

Weight: 3.5 lb. (1.6 kg)

Includes: Mounting bracket, self-centering shaft adapter

Approvals:

CE: EMC 2004/108/EC; Certification Low Voltage Directive 2006/95/EC; IEC 60730-1 and Part 2-14 C-Tick: N314
Underwriters Laboratories, Inc.: UL873
Canadian Underwriters Laboratories, Inc.: cUL C22.2 No. 24-93

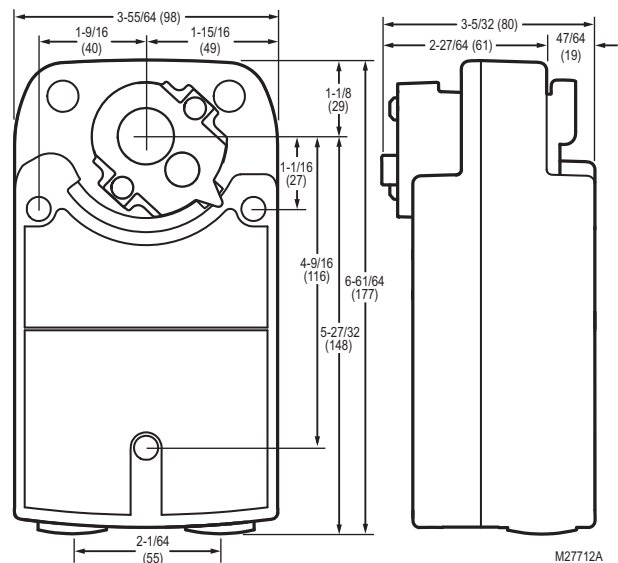


Fig. 5. Spring return direct coupled actuator dimensions in inches (mm).

Table 8. Actuator Accessories and Replacement Parts.

Part Number	Description	MVN613A0000	MVN643A0000	MVN713A0000	MN Non-Fail-Safe Direct Couple Actuators	MS Fail-Safe Direct Couple Actuators
5112-3R	Weather Enclosure Assembly				x	x
MVNAAA	Replacement Valve Adaptor	x	x	x		
MVNAAL	Replacement Valve Adaptor, Low Profile					
MVNAC7131	Replacement Cable with Terminal 1m, Modulation (RED, BLACK, WHITE)			x		
MVNAC6131	Replacement Cable with Terminal 1m, Floating (RED, BLACK, WHITE)	x	x			
MVNAT3	Replacement Screw type Terminal Block, Pluggable	x	x	x		
5112-11	Replacement actuator bracket				x	x
205860	Minimum position Potentiometer				x	x
32006306-001	Resistor Kit (500 ohm); converts 4-20 mA signal to 2-10 Vdc				x	x
Q7002B1009	Universal Interface Module				x	x
STRN-SCSA	Self-centering Shaft Adapter					x
32000085-001	Strain Relief Fitting (10 pack)				x	
AT120A1004	120 to 24 Vac Transformer (20 VA)	x	x	x	x	x
AT140A1000	120 to 24 Vac Transformer (40 VA)	x	x	x	x	x
STRN-STRNRLF	Stain Relief Fitting (10 pack)					x

Application Notes

IMPORTANT

Valve sizing is important for correct system operation. Undersized valves do not have sufficient capacity at maximum load. Oversized valves do not have sufficient authority over the load in modulating applications.

Oversized valves can cause excessive cycling and the seat and ball can be damaged because of the restricted opening.

Proper Use

These valves are only for use in cold, warm, and hot water systems. Not suitable for oil, combustible gases, or steam. They are designed for a medium temperature range of from 35 to 250°F, at a maximum pressure of 360 psig VRN valves are to be operated with the appropriate Honeywell direct coupled actuators only.

Water should be properly filtered, treated and conditioned according to local conditions and the recommendations of the boiler or chiller manufacturers. The installation of a strainers and filters is recommended.

IMPORTANT

The presence of excessive iron oxide (red rust) in the system voids the valve warranty.

Effective Flow Rate

The built-in differential pressure regulator makes fluid flow through the valve independent of changes in supply pressure, eliminating “hunting” by the control system, even at low coil flow. The pressure regulator virtually eliminates cavitation in the valve, and decouples the control valve from the effects of piping components such as reducers and elbows.

Pressure independent control valves are sized to match design coil flow regardless of coil size. VRN2 valves eliminate the need to balance the system for proper flow, and allow chillers to be operated at design temperature differential for maximum efficiency at every load condition. When used in a system with variable speed pump drives, 3-way valves and coil bypass lines are not required. In new construction, VRN2 valves perform better than reverse return piping designs without the extra materials these systems need. Pressure-independent control requires less flow, enabling use of smaller piping, pumps, and chillers.

Flow Characteristics

The VRN2 two-way dynamic pressure-regulating control valves have:

- an equal percentage flow characteristic with characterized flow control insert.

Required Operating Torque

Both Honeywell non-spring return MVN and spring return low torque direct coupled actuators can be utilized with the VRN2 valves. VR valves use a patented seat design that reduces the torque needed from the actuator.

Table 9. Close-off, Differential Pressure Ratings.

Valve Type	Valve Size	Close-off Pressure Rating (psi)
2 way	1/2 in., 3/4 in.	100
	1 in., 1-1/4 in., 1-1/2 in.	100

TYPICAL SPECIFICATIONS

Valve Actuator

Actuator shall accept analog modulating [(0)2-10 Vdc], floating (tri-state), or two-position signal as indicated in the control sequence. Actuators shall be manufactured by Honeywell. Actuator shall provide minimum torque required for full valve shutoff position. Wiring terminals shall be provided for installation to control signal and power wiring.

Actuator shall be available with housing suitable for outdoor installation.

Accessories Identification tags shall be available for all valves.

Pressure Independent Valve

Valve housing shall consist of forged brass rated at no less than 360 psi at 250°F. Standard valve ball shall consist of chemically nickel-plated brass. Manufacturer shall be able to provide optional 316 stainless steel ball and stem. The valve shall have an integral differential pressure regulator to maintain constant pressure drop across valve seat to decouple valve flow from system pressure changes. Flow control accuracy shall be +/-5% or better. Regulator will be constructed from 316 stainless steel with a rolling diaphragm and operate under positive pressure. Regulator shall be located above axis of pipe with 1/4" ISO test port fittings to allow pressure measurement and venting.

Valve stem assembly shall be of a pack-less design and be field-replaceable without removing the valve body from the piping. Teflon™ seals shall hold the stem in alignment, and protect the O-ring from system temperature fluctuations. Stem O-ring shall be made of peroxide-cured EPDM and be isolated from system treatment chemicals by a reservoir of silicon grease. Valve shall have a blow-out proof stem with minimum 600 psi rating.

INSTALLATION

When installing this product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

Preparation



CAUTION

Equipment Damage Hazard

Foreign particles like dirt and metal chips can damage the ball seals.

For trouble-free operation of the product, good installation practice must include initial system flushing, and chemical water treatment. Clean the lines upstream of particles larger than 1/16 inch diameter (welding slag, pipe scale, sand and other suspended particulate). Use of a 50 micron (or finer) system side stream filter is suggested. Remove all filters before flushing.

Do not use boiler additives, solder flux and wetted materials which are petroleum based or contain mineral oil, hydrocarbons, or ethylene glycol acetate. Compounds which can be used, with minimum 50% water dilution, are diethylene glycol, ethylene glycol, and propylene glycol (antifreeze solutions).

If installing these valves in an addition to, or retrofitting an existing building, do not assume that the fluid in the existing piping meets these criteria.

3. Eliminate air from system.
4. Two-way valves are marked to show flow direction.

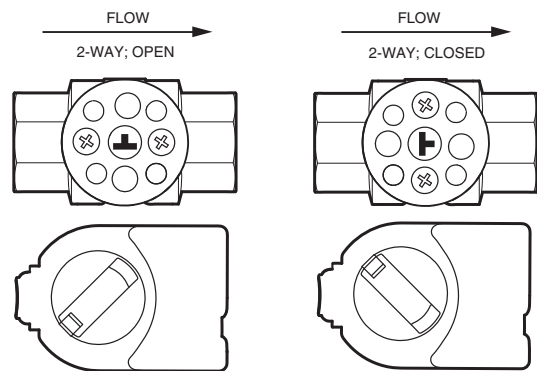
IMPORTANT

Flow arrows must point in the direction of the flow for proper operation.

5. Stem rotation:
 - a. For two-way valves:
 - (1) Clockwise to close.
 - (2) Counterclockwise to open.

NOTE: After valves have been installed in the piping, the installer can determine the ball orientation within the valve from the notches in the top of the valve stem. For two-way valves, the lengthwise direction of the notch indicates the flow through the ball (i.e. when the notch is parallel to the axis of the valve between A and B ports, the ball will allow flow through the valve).

6. Valve must be mounted with the actuator/bracket above the valve body. Do not install the valve with the stem below horizontal or upside down. (See Fig. 7 – 9.)



NOTES: FOR 2-WAY VALVES TO MOUNT ACTUATOR ON OPEN VALVE, TURN ACTUATOR FULLY COUNTER CLOCKWISE AS SHOWN. FOR 2-WAY VALVES TO MOUNT ACTUATOR ON CLOSED VALVE, TURN ACTUATOR FULLY CLOCKWISE AS SHOWN.

M34979

Fig. 6. Orientation of valve.

Mechanical Installation

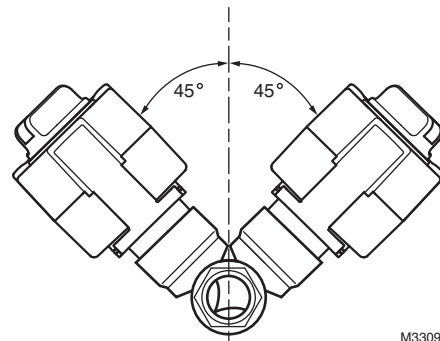
IMPORTANT:

Hold valve with pipe wrench by hexagonal fitting ONLY. Do NOT handle the valve body with the pipe wrench; product damage may result.

The valves are tapped in NPT and should be sealed with an approved pipe sealant. Torque should not exceed 75 lb-ft.

Refer to actuator literature for actuator dimensions.

1. Clean the lines upstream of particles larger than 1/16 in. diameter (welding slag, pipe scale and other contaminants).
2. Proceed with installation once the system specifics (expansion/contraction of the system and its medium as well as operating pressures) are within tolerances.



M33091

Fig. 7. Acceptable valve angle from vertical for MVN actuators.

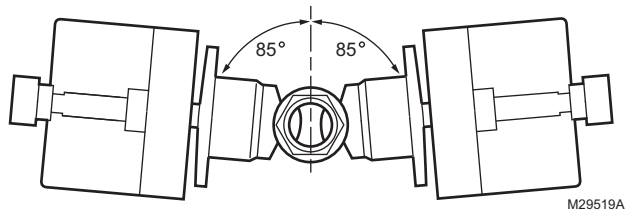


Fig. 8. Acceptable valve angle from vertical for MN and MS actuators.

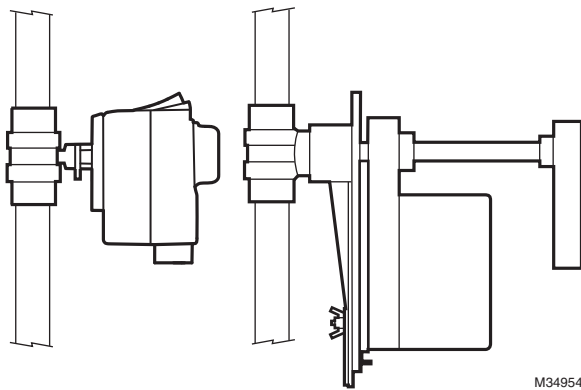
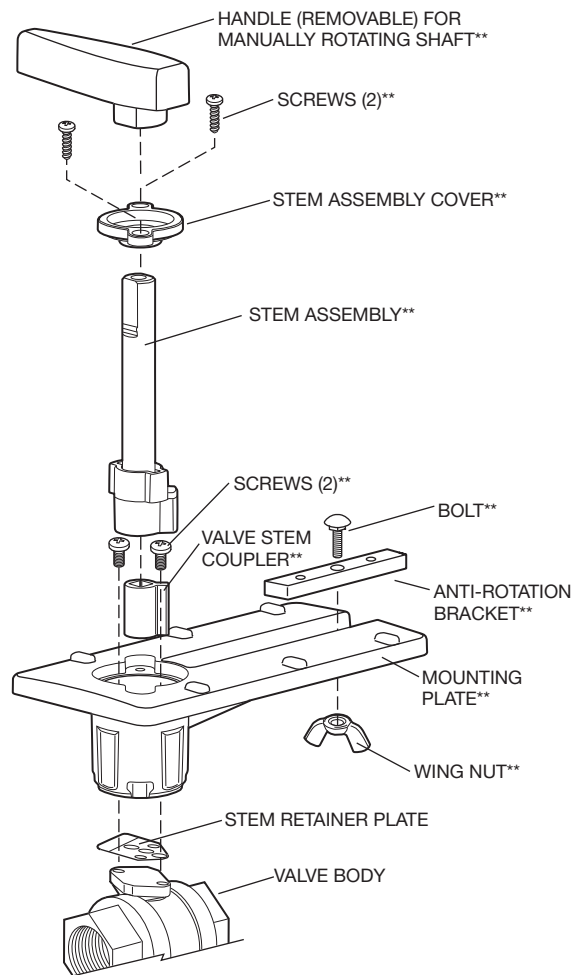


Fig. 9. Vertical valve installation.



** INCLUDED IN REPLACEMENT KIT (PART NO. 5112-11).

M29526B

Fig. 10. Actuator mounting plate adjustment.

Mounting Plate Adjustment

NOTE: See Fig. 10 for valve exploded view.

The Actuator Mounting Plate can be rotated to a different position for installation in confined spaces. This is accomplished as follows:

1. Remove the handle from the shaft and set it aside.
2. Remove the two screws that hold the stem assembly to the mounting plate and set them aside.
3. Remove and set aside the stem assembly.
4. Remove and set aside the two screws that attach the mounting plate to the valve.
5. Remove and set aside hold-down ring from mounting plate.
6. Rotate mounting plate around valve top to the desired position.

NOTE: Take note of the screw hole positions on the valve. They limit the mounting plate positions.

7. Lower ring down to valve body and engage it in the new position relative to the mounting plate.
8. Tighten screws to valve body securing the mounting plate.
9. Reattach the stem assembly to the mounting plate.
10. If desired, replace the handle on the shaft.

Electrical Installation

1. If necessary, remove actuator wiring cover.
2. Wire actuator using Figures 11 through 19 for the application required.
3. Replace cover.

Wiring

VALVES WITH FAIL IN PLACE ACTUATORS

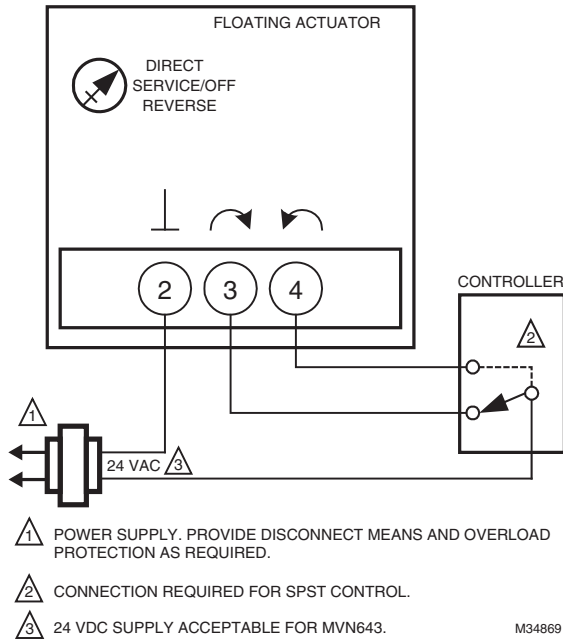


Fig. 11. MN6105 with On/Off Control.

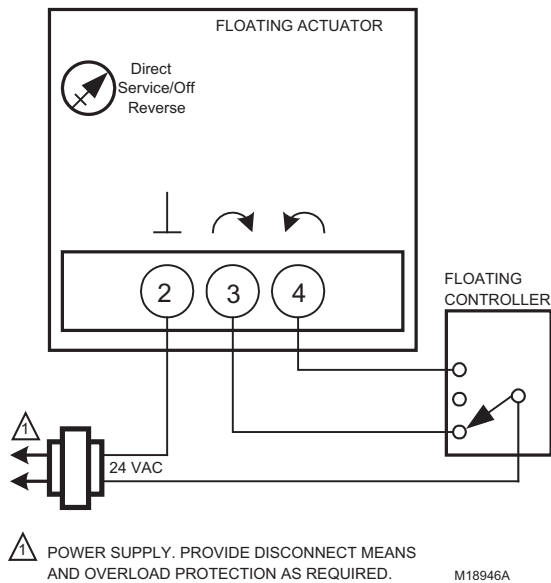


Fig. 12. MN6105 with Floating Control.

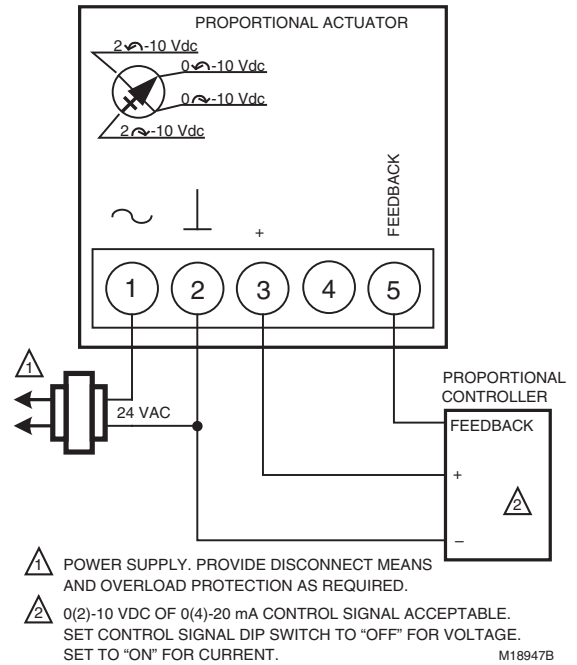


Fig. 13. MN7505 with Modulating Control.

END SWITCHES (CLASS II-ONLY)

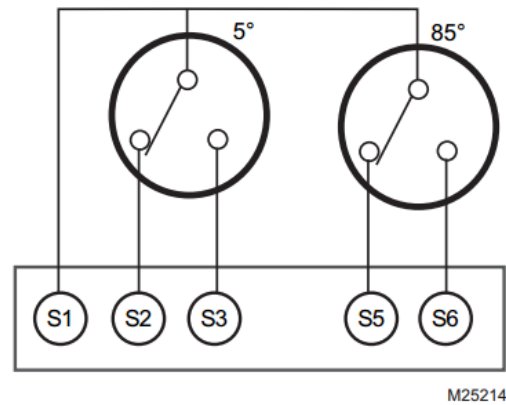


Fig. 14. Wiring for model with aux./end switches.

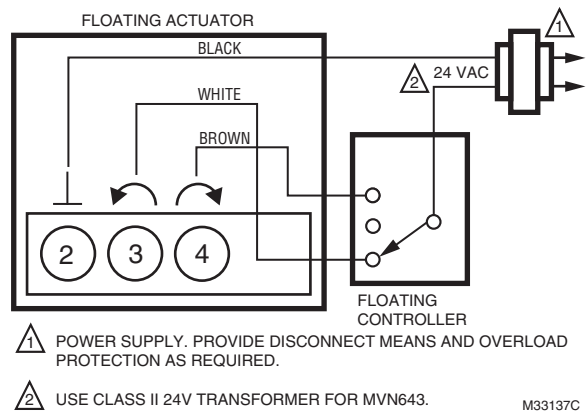


Fig. 15. MVN613 or MVN643 with Floating Control.

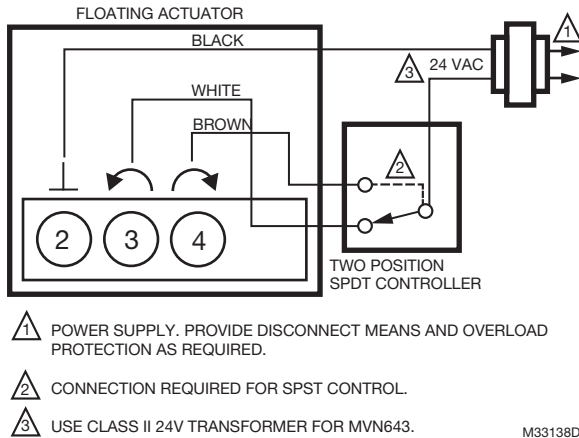


Fig. 16. MVN613 or MVN643 with Two-Position SPDT Control.

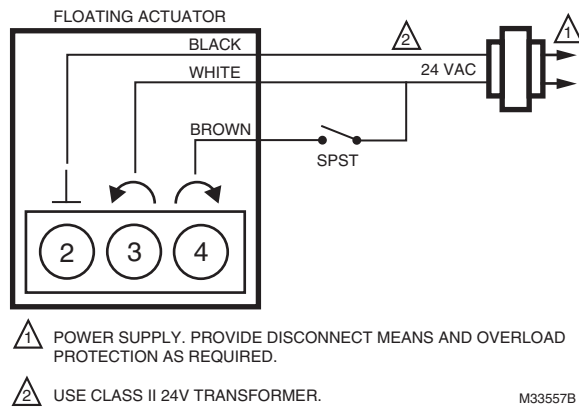


Fig. 17. MVN643 with Two Position SPST Control.

PROPORTIONAL/MODULATING: 4-20mA CONTROLLER OUTPUT WITH 500Ω SERIES RESISTOR

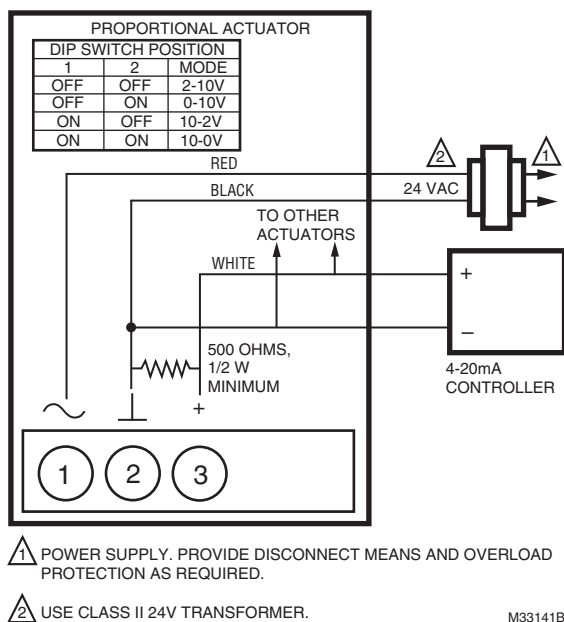


Fig. 18. MVN713 with 4-20mA Control.

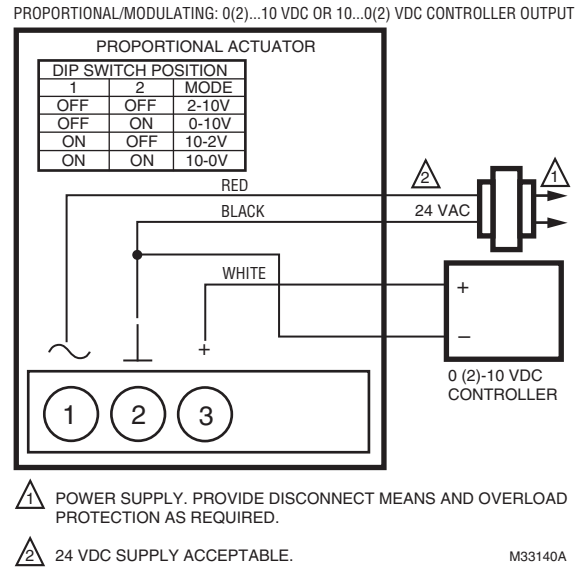


Fig. 19. MVN713 with 0 (2)-10 VDC Control VALVES WITH FAIL-SAFE ACTUATORS

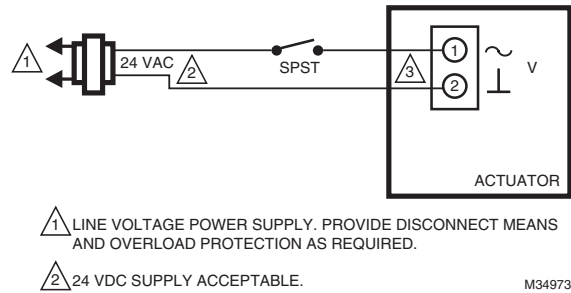


Fig. 20. MS8105 with On/Off Control.

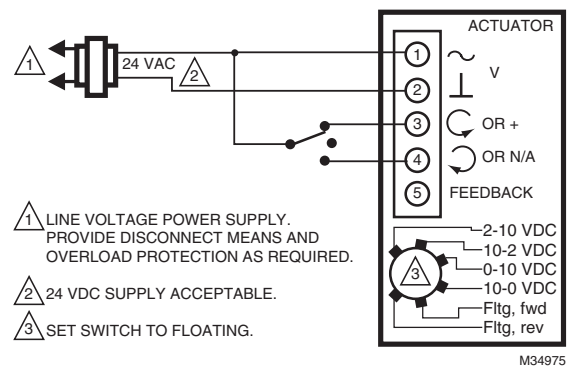


Fig. 21. MS7505 with Floating Control (Floating mode setting).

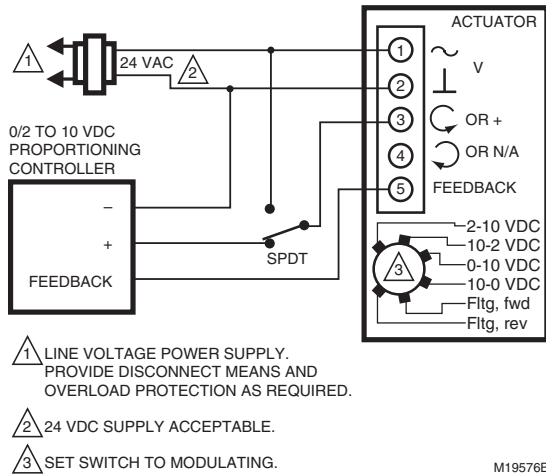


Fig. 22. MS7505 with override to full open (Modulating mode setting).

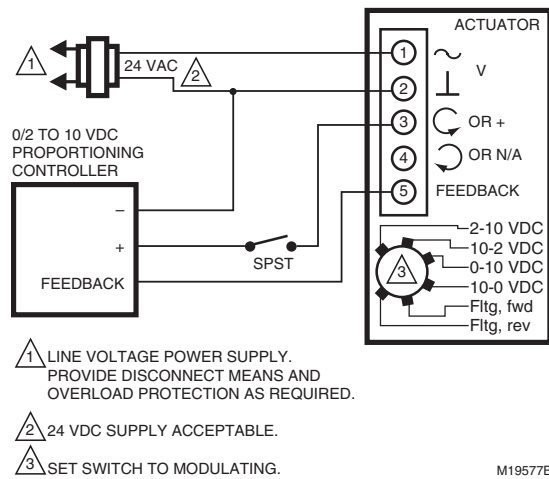


Fig. 23. MS7505 with override to full closed (Modulating mode setting).

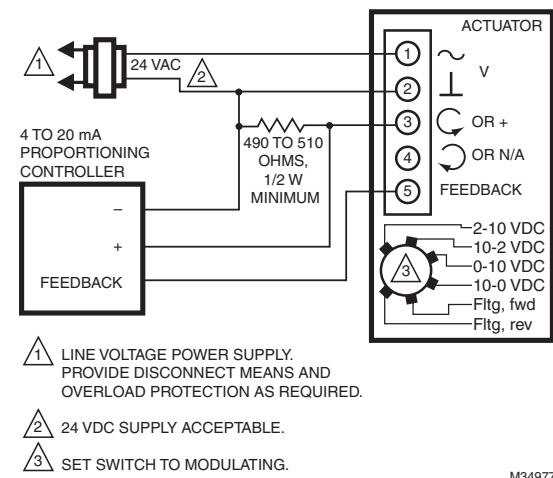
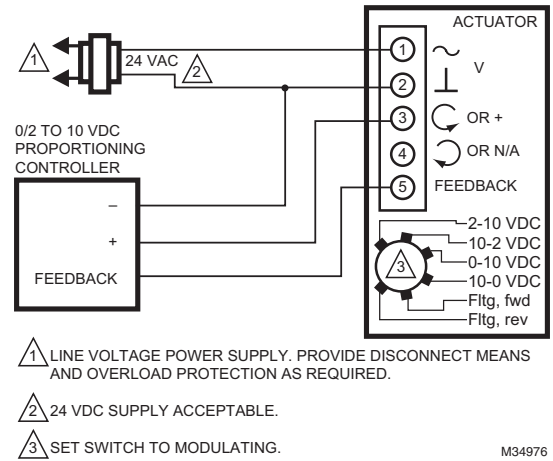


Fig. 24. MS7505 with Proportioning Controllers (Modulating mode setting).

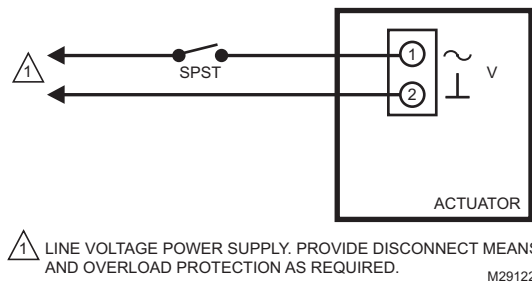


Fig. 25. MS4105 line voltage (120V) two-position control.

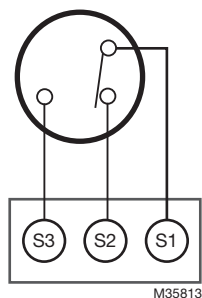


Fig. 26. Wiring for model with aux./end switches.

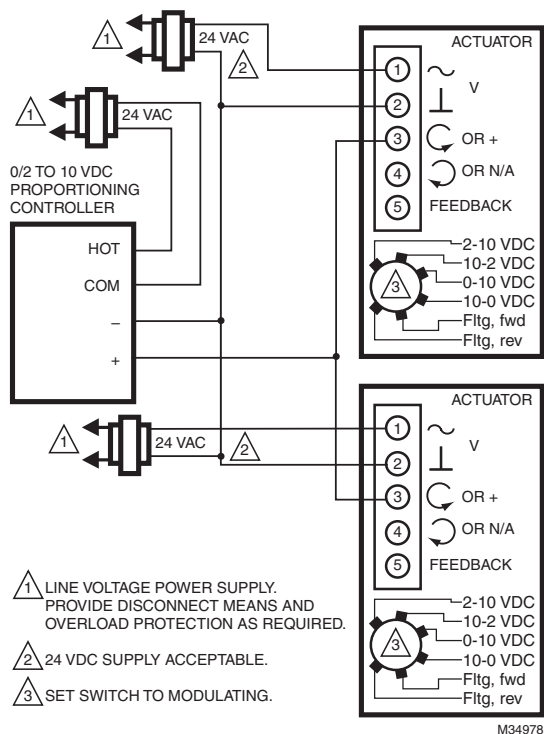


Fig. 27. MS7505 with Proportioning controllers operating multiple actuators (Modulating mode setting).

NOTE: All identified parts except for the valve body and aluminum valve stem coupler are included in Replacement Kit (part no. 5112-11).

OPERATION AND CHECKOUT

Once both the mechanical and electrical installations are complete:

1. Cycle the actuator to verify that the direction of rotation suits the control sequence.
2. If the rotation direction is incorrect:
 - a. For 2-position spring return actuators: Remove, flip over, and replace actuator on the bracket.
 - b. For floating control actuators: Reverse two control signal wires (CW/CCW), or change position of selector switch.

- c. For analog control actuators either:
 - (3) Change setting of reverse/direct-acting switch, or
 - (4) Remount actuator on the bracket.
3. If the control scheme requires fail-safe operation, ensure that, upon removal of power, the fail position coincides with the control sequence.
4. Spring return actuators are factory-configured for normally-closed, fail-safe operation on power loss. To change this action to normally-open, remove and reinstall the actuator in the opposite orientation as follows:
 - a. Loosen the shaft coupling bolt using a 10 mm wrench.
 - b. Loosen all other mounting bolts connecting the actuator to the mounting bracket, and set aside.
 - c. Remove the actuator from the valve shaft.
 - d. Move the Self-Centering Shaft Adaptor to the opposite side of the actuator, as displayed in Fig. 28.

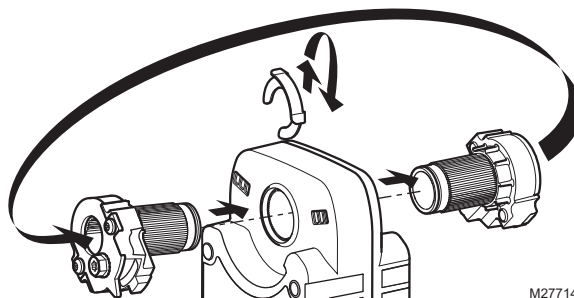


Fig. 28. Change actuator to normally open.

- (1) Remove the retainer clip from the Self-Centering Shaft Adapter and set it aside for later use.
- (2) Remove SCSA from actuator.
- (3) Reinstall SCSA on the opposite side of the actuator, aligning it based on the stroke labeling.
- (4) Replace the retainer clip on the shaft coupling using the groove of the coupling.
- e. Reconnect the actuator to the valve mounting bracket by replacing the screws previously removed (step b).
- f. Tighten the shaft coupling bolt using a 10 mm wrench or socket.

Operation

The differential pressure regulator maintains constant pressure drop across the valve seat through a wide range of head pressures. At a given ball position, flow through the valve will be constant as defined by the formula:

$$Q_{GPM} = C_v \times \frac{\sqrt{P_{IN} - P_{OUT}}}{\sqrt{\rho}}$$

where ρ is the density of the glycol mix.

P_{IN} changes constantly in a multi-zone system as other valves open and close, changing system flow and head pressure according to the characteristics of the supply pump curve. Reaction of the mechanical pressure regulator is instantaneous, eliminating changes in room

temperature due to changes in fluid flow, and reducing the need for the control system to constantly operate the control portion of the valve to correct for the non-load related temperature changes that occur in a system with standard control valves.

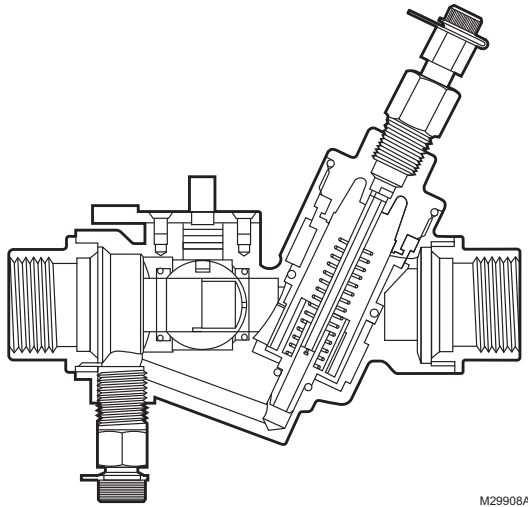


Fig. 29. VRN2 cross section showing fitting, control ball, and pressure regulator.

At full flow in a 2-position control application, a VRN2 behaves as a flow limiter.

The pressure regulator takes a minimum pressure to operate, and has a maximum differential regulation capability. See Fig. 30. The high pressure drop across a VRN2 Valve is comparable to the pressure drop across a control valve and balancing valve in a conventional system design.

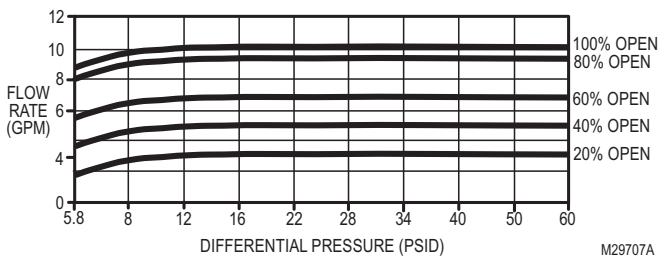


Fig. 30. Pressure regulation, large body models.

SETTINGS AND ADJUSTMENTS

At the full open position, VRN2 valves will maintain flow in the loop. Flow rates are listed in the Specification Data form 62-3115EFS. Under steady state operation, the control system will only require the valve to open enough to satisfy load conditions. During morning recovery from night setback, the controller will usually command the valve to 100%. For optimum performance, choose only the

next larger valve size needed to satisfy design load. Do not oversize valves—reduced rangeability and may result in less accurate temperature control.

Ball valves close between 10 and 15% of stroke, to ensure full seal engagement. If desired, modulating actuators can be set to 0-10 V response so that 2 V of a 2-10 V control signal more closely corresponds to minimum flow. The valve will still close with signal loss.

If desired, maximum flow may be trimmed to a lesser value in one of two ways:

1. With modulating actuator, limit span of control voltage issued by the building automation controller. Valves with flow control inserts have an equal percentage flow characteristic (See Fig. 31). Each 10% reduction in maximum control voltage will result in a 10% reduction in flow.

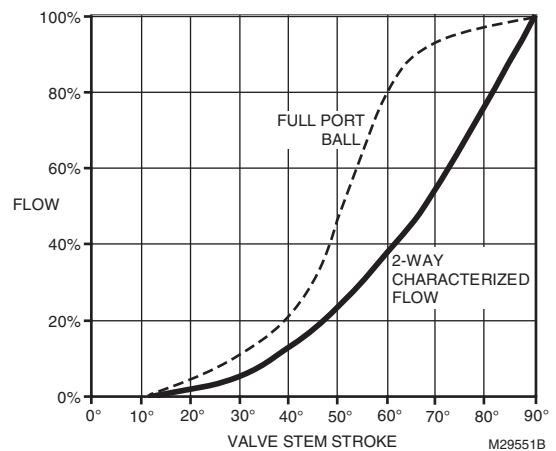


Fig. 31. Typical flow characteristics.

2. To mechanically limit stroke, set DCA to full open position. Loosen shaft coupling and rotate valve shaft to desired maximum flow position, as confirmed by pressure measurement across coil, using coil manufacturer's data. Retighten shaft coupling. Use Fig. 31 as a guide to setting actuator stroke.

If using mechanical adjustment technique with MN/MS7505 modulating actuators, the stroke auto-adaption feature will automatically scale the 2-10 Vdc signal to the mechanical rotation of the ball. See actuator literature for details.

Coil flow can be confirmed by reading pressures at the coil inlet and coil outlet (not across control valve as with conventional balancing—this pressure drop will be constant), and using the manufacturer's data to calculate flow.

Note that the pressure regulator in this valve guarantees that the flow through the coil will not be affected by upstream changes in pressure. Unlike conventional balancing valves, it is not necessary to reconfirm coil flow after adjusting other valves. Any overflow during morning recovery due to oversized pressure regulated valves will not affect other valves in the system, provided pumps are capable of required flow.

Service and Repair

The valve stem can be replaced in-line, if necessary. See Fig. 32.

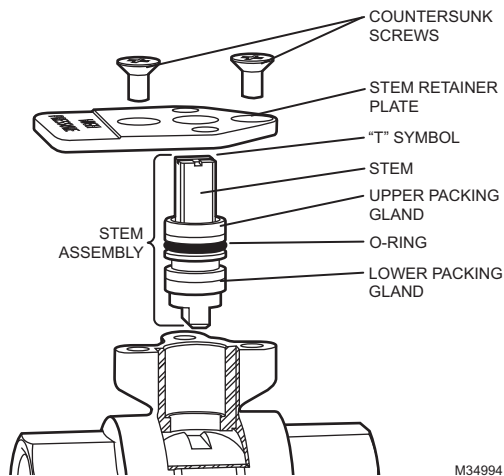


Fig. 32. Replacing the valve stem in-line.

Follow steps 1 to 6 of “Mounting Plate Adjustment” on page 14, then:

1. If the lower packing gland is stuck, remove it with gland removal tool or rubber-tipped dental tool.



CAUTION

Avoid scratching the inside of the valve neck.
This may cause a leak when re-assembled.

2. Carefully remove any fouling or corrosion from inside of valve.
3. Align arrow with short leg of “T” symbol on new stem assembly.

NOTE: “T” symbol will vary.

4. Insert the new stem assembly. Be sure to line up the stem key with the ball slot.
 5. Fasten stem retainer high pressure plate to the valve using the new countersunk screws. Then fasten the mounting plate to the valve.
 6. Repressurize valve and confirm stem does not leak before proceeding.
 7. Slide the sub shaft over the stem with the tab oriented as shown in Fig. 32.
 8. Replace the thermal break, shaft, and shaft cover. If shaft has come loose from thermal break, push firmly on end of shaft until blade in shaft snaps into thermal break.
 9. Replace actuator and secure it to shaft and mounting plate.
 10. Snap handle onto top of shaft.
- Any other service to valve such as seat seal replacement requires removal of valve from piping.

Automation and Control Solutions

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ACTUATORS & DAMPERS

DIRECT COUPLED ACTUATORS NON-SPRING RETURN

MN SERIES

DESCRIPTION

The **Honeywell MN Series actuators** are non-spring return direct coupled actuators from Honeywell. They are designed and tested to provide reliable non-spring return control for dampers and valves that require up to 300 in-lb (34 Nm) of torque. The **MN Series** is powered by 24 VAC/VDC and has an excellent feature set that combines flexibility and simplicity.

FEATURES

- **Adjustable mechanical range stops**
- **Auto adapt on modulating models**
- **Internal or field-installable auxiliary switches**
- **Signal mode switch**
- **Adjustable zero and span**
- **Mechanical override declutch**
- **Detachable wiring cover**
- **Consistent wiring**



MN6105A1011, 44 in-lb
MN7510A2209, 88 in-lb



MN6120A1002, 175 in-lb
MN7234A2008, 300 in-lb



COMMON SPECIFICATIONS

Supply Voltage	21-27 VAC 50/60 Hz, 24 VDC (except MN6120, MN6134)	Noise	
Motor	Brushless DC; Synchronous with magnetic clutch (floating 175, 300 in-lb)	44, 88 in-lb	<35 dB @ 3' (1m)
Wiring Action	Enclosed terminals	175, 300 in-lb	<40 dB @ 3' (1m)
Rotation	Switching selectable direct/reverse acting	Resolution	400 steps
Drive Time	95° ± 3°	Life Expectancy	60,000 cycles, 1 million repositions
Manual Override	Disengage button	Operating Temperature	-5° to 140°F (-20° to 60°C)
		Operating Humidity	5 to 95% RH
		Approvals	UL File #E4996, CE, C-tick, plenum rated
		Warranty	5 years

INDIVIDUAL SPECIFICATIONS

Model	Torque	Supply VA	Control Signal	Input Impedance	Feedback	Auxiliary Switch
MN6105A1011	44 in-lb (5 Nm)	5.0 VA	Two-position, floating		None	SW2 add-on
MN6105A1201	44 in-lb (5 Nm)	5.0 VA	Two-position, floating		None	Internal, dual SPDT, class II only
MN7505A2001	44 in-lb (5 Nm)	5.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	SW2 add-on
MN7505A2209	44 in-lb (5 Nm)	5.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	Internal, dual SPDT, class II only
MN6110A1003	88 in-lb (10 Nm)	5.0 VA	Two-position, floating		None	SW2 add-on
MN6110A1201	88 in-lb (10 Nm)	5.0 VA	Two-position, floating		None	Internal, dual SPDT, class II only
MN7510A2001	88 in-lb (10 Nm)	5.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	SW2 add-on
MN7510A2209	88 in-lb (10 Nm)	5.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	Internal, dual SPDT, class II only
MN6120A1002	175 in-lb (20 Nm)	6.0 VA	Two-position, floating		None	SW2 add-on
MN6120A1200	175 in-lb (20 Nm)	6.0 VA	Two-position, floating		None	Internal, dual SPDT, class II only
MN7220A2007	175 in-lb (20 Nm)	6.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	SW2 add-on
MN7220A2205	175 in-lb (20 Nm)	6.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	Internal, dual SPDT, class II only
MN6134A1003	300 in-lb (34 Nm)	9.0 VA	Two-position, floating		None	SW2 add-on
MN7234A2008	300 in-lb (34 Nm)	8.0 VA	Prop. 0/2-10 VDC, 0/4-20 mA	100 kΩ @ 0/2-10 VDC; 500Ω @ 4-20 mA	0/2-10 VDC	SW2 add-on

ACTUATORS & DAMPERS

DIRECT COUPLED ACTUATORS NON-SPRING RETURN

MN SERIES



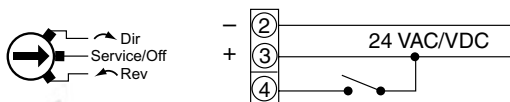
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ACTUATORS & DAMPERS

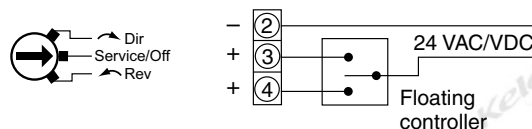
DIMENSIONS

Model	Torque	Dimensions	Maximum Shaft Diameter	Minimum Shaft Length	Enclosure Rating	Weight
MNXX05	44 in-lb (5 Nm)	2.4"H x 2.6"W x 5.3"L (6.2 x 6.6 x 13.4 cm)	0.63" (1.6 cm)	1.62" (4.1 cm)	NEMA 2 (IP54)	1.0 lb (0.4 kg)
MNXX10	88 in-lb (10 Nm)	2.4"H x 2.6"W x 5.3"L (6.2 x 6.6 x 13.4 cm)	0.63" (1.6 cm)	1.62" (4.1 cm)	NEMA 2 (IP54)	1.0 lb (0.4 kg)
MNXX20	175 in-lb (20 Nm)	3.9"H x 3.6"W x 8.8"L (10.0 x 9.2 x 22.3 cm)	1.06 in (2.7 cm)	0.87" (2.2 cm)	NEMA 2 (IP54)	3.2 lb (1.45 kg)
MNXX34	300 in-lb (34 Nm)	3.9"H x 3.6"W x 8.8"L (10.0 x 9.2 x 22.3 cm)	1.06 in (2.7 cm)	0.87" (2.2 cm)	NEMA 2 (IP54)	3.2 lb (1.45 kg)

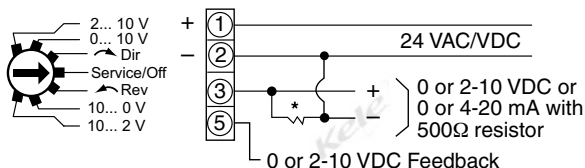
WIRING



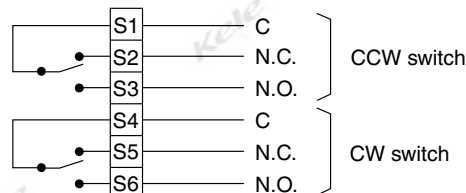
MN61xx
Two-position Control



MN61xx, MN75xx
Floating Control



MN75xx/72xx
Proportional Control
0 or 2-10 VDC or 0 or 4-20 mA Signal*
(ZG-R01 500Ω resistor required for 4-20 mA signal)



SW2 Auxiliary Switch Kit
Switch ratings: Adjustable between 5 and 85 degrees, 24 VAC/VDC, 5A resistive, 3A inductive
Models with internal switches have same contact ratings

ORDERING INFORMATION

MODEL

MN6105A1011
MN6105A1201
MN7505A2001
MN7505A2209
MN6110A1003
MN6110A1201
MN7510A2001
MN7510A2209
MN6120A1002
MN6120A1200
MN7220A2007
MN7220A2205
MN6134A1003
MN7234A2008

DESCRIPTION

Non-spring return, 44 in-lb (5 Nm), two-position/tri-state control
Non-spring return, 44 in-lb (5 Nm), two-position/tri-state, aux switches
Non-spring return, 44 in-lb (5 Nm), proportional/two-pos/tri-state control
Non-spring return, 44 in-lb (5 Nm), proportional/two-pos/tri-state, aux sw.
Non-spring return, 88 in-lb (10 Nm), two-position and tri-state control
Non-spring return, 88 in-lb (10 Nm), two-position/tri-state, aux switches
Non-spring return, 88 in-lb (10 Nm), proportional/two-pos/tri-state control
Non-spring return, 88 in-lb (10 Nm), proportional/two-pos/tri-state control, aux sw.
Non-spring return, 175 in-lb (20 Nm), two-position and tri-state control
Non-spring return, 175 in-lb (20 Nm), two-position/tri-state control, aux switches
Non-spring return, 175 in-lb (20 Nm), proportional
Non-spring return, 175 in-lb (20 Nm), proportional/aux sw.
Non-spring return, 300 in-lb (34 Nm), two-position and tri-state control
Non-spring return, 300 in-lb (34 Nm), proportional control

ACCESSORIES

32004254-003
50001194-001
SW2
ZG-R01

Replacement shaft coupler for KA-301, MNxx34
Universal surface mount bracket with crank arm and 1/2" shaft
2X/SPDT/AUX SWTCH/KA/KAS/1000-X
500Ω, 1/2W, 1% resistor

Z2050Q-J, 1/2", ZoneTight Valve



Technical Data

Service	chilled, hot water, up to 60% glycol
Flow Characteristic	equal percentage
Controllable Flow Range	75°
Size [mm]	0.5" [15]
End Fitting	NPT female ends
Body	forged brass
Ball	chrome plated brass
Stem	brass
Seat	Teflon® PTFE
Seat O-ring	EPDM (lubricated)
Diaphragm	EPDM
Body Pressure Rating [psi]	360
Media Temperature Range (Water)	36°F to 212°F [2°C to 100°C]
Maximum Allowable Operating Temperature	212°F [100°C] *
Media Temperature Limit	250°F [121°C] *
Max Differential Pressure (Water)	40 psi
Close-Off Pressure	75 psi
Cv	5.9
Weight	0.2 lb [0.1 kg]
Leakage	0%
Servicing	maintenance free

* If temperature exceeds 212°F operating range due to a boiler control failure the valve will safely contain the hot water but manufacturers product warranty becomes invalid. Valve and actuator replacement is at the expense of others.

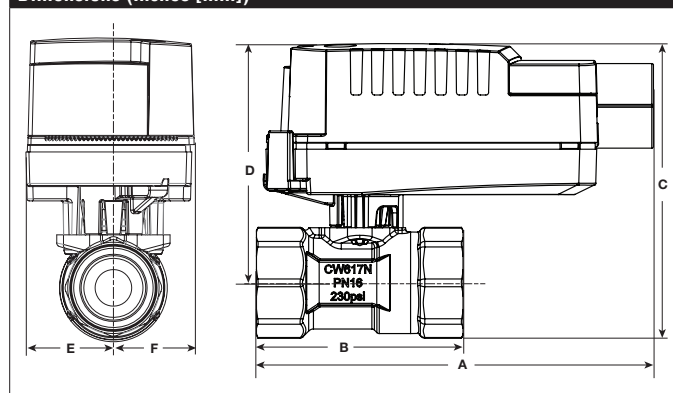
Application

The QCV zone valves are suited for large commercial buildings where higher close-off and the ability to change flow is desired. Common applications include unit ventilators, fan coil units, VAV reheat coils, fin tube casing, radiant panels and duct coils. The valve fits in space restricted areas and can be assembled without the use of tools.

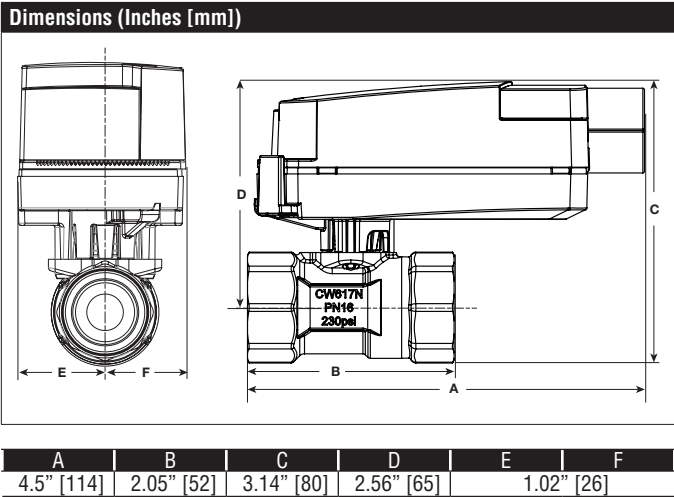
Suitable Actuators

	Non-Spring	Electronic Fail-Safe
Z2050Q-J	CQ	CQK

Dimensions (Inches [mm])



A	B	C	D	E	F
4.5" [114]	2.05" [52]	3.27" [83]	2.71" [69]	0.94" [23.88]	0.94" [24]



CQKB24-SR-RL

Modulating, Electronic Fail-Safe, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data

Power Supply	24 VAC $\pm$ 20%, 50/60 Hz
Power Consumption Running	2.5 W
Power Consumption Holding	0.5 W
Transformer Sizing	5 VA (class 2 power source)
Electrical Connection	3ft [1m], 18 GA plenum cable with 1/2" conduit connector
Overload Protection	electronic throughout 0° to 90° rotation
Operating Range Y	2 to 10 VDC, 4 to 20 mA w/ ZG-R01 (500 Ω , 1/4 W resistor)
Angle of Rotation	90°, adjustable with mechanical stop
Position Indication	pointer
Running Time (Motor)	75 sec
Running Time (Fail-Safe)	60 sec
Bridge Time	2 sec delay before fail-safe activates
Pre-charging Time	5 to 20 seconds
Humidity	5 to 95% RH non-condensing
Ambient Temperature Range	35°F to 104°F [1.7°C to 40°C]
Storage Temperature Range	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA 2
Housing Material	UL94-5VA
Agency Listings†	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC and 2006/95/EC
Noise Level (Motor)	max. 35 dB (A)
Servicing	maintenance free
Quality Standard	ISO 9001
Weight	0.4 lb [0.2 kg]

Wiring Diagrams

INSTALLATION NOTES

- A** Actuators with appliance cables are numbered.
- 2** Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 3** Actuators may also be powered by 24 VDC.
- 5** Only connect common to negative (-) leg of control circuits.
- 7** A 500 Ω resistor (ZG-R01) converts the 4 to 20 mA control signal to 2 to 10 VDC.
- 18** Actuators with plenum cable do not have numbers; use color codes instead.
- 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.

