

Elementary School

Michigan

Temperature Controls Renovation



Prepared By: Tom Lisowski

Metro Environmental, Inc.

22656 Fifteen Mile Road

Clinton Township, Michigan 48035

Phone Number: (586) 790-2500


Fax Number: (586) 790-2501

An Authorized Representative of

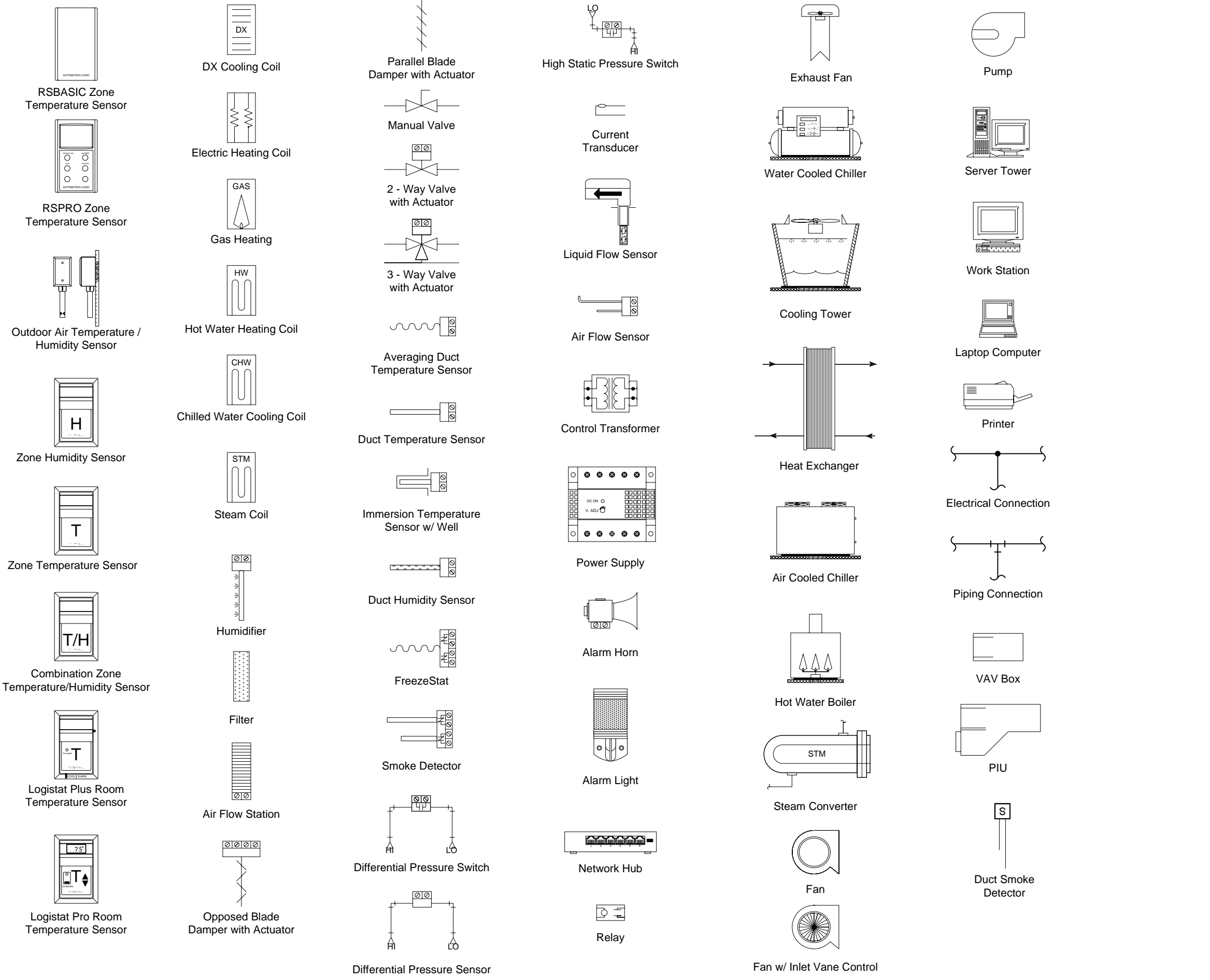
AUTOMATEDLOGIC[®] ... *the power of simplicity*
C O R P O R A T I O N

Table of Contents

1: Title Page	38: VUV-5 Sequence Of Operation
2: Table of Contents	39: Water Source Heat Pumps
3: Symbol Legend	40: Water Source Heat Pump Sequence
4: Abbreviation/Installation Notes	41: Radiant Ceiling Panel Loop Control
5: Cable Specification Chart	42: Cabinet Unit Heaters
6: Installation Details 1	43: Exhaust Fans Serving Pre-School Wing
7: Installation Details 2	44: Exhaust Fans Serving Northwest Rooms
8: Installation Details 3	45: Additional Exhaust Fans
9: Installation Details 4	46: Summary Bill of Materials
10: Installation Details 5	
11: Network Riser	
12: LGR & OAT Controller Wiring	
13: Heat Pump Loop System Schematic	
14: Heat Pump Loop System Controller Wiring	
15: Heat Pump Loop System Sequence	
16: Multi-Zone MZ-1 Control	
17: Multi-Zone MZ-1 Sequence Of Operation	
18: Multi-Zone MZ-1 Zone Control	
19: AHU-1 Control	
20: AHU-1 Sequence Of Operation	
21: AHU-1 Sequence Continued	
22: AHU-2, 3 & 4 Control	
23: AHU-2, 3 & 4 Sequence Of Operation	
24: AHU-5 & Sequence Of Operation	
25: AHU-5 Sequence Continued	
26: AHU-5 VAV Terminal Unit	
27: RTU-1 Control	
28: RTU-1 Sequence of Operation	
29: RTU-1 Sequence of Operation Continued	
30: RTU-2 Control	
31: RTU-2 Sequence of Operation	
32: RTU-2 Sequence of Operation Continued	
33: Supply Fan SF-1 With Reheat Coil	
34: Supply Fan SF-1 Sequence of Operation	
35: VUV-1, 2, 3 & 4 Control	
36: VUV-1, 2, 3 & 4 Sequence Of Operation	
37: VUV-5 Control	

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Table of Contents			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			2 of 46

Symbol Legend



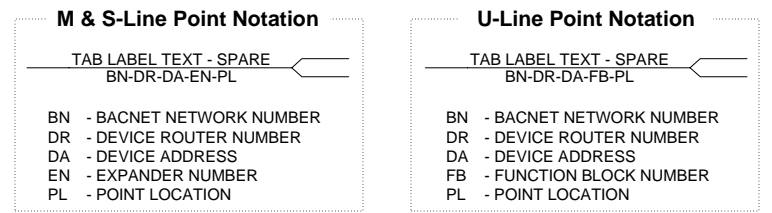
- Symbol Notes**
- ① 120 VAC --- 120 VAC POWER TO PANELS AND CONDUIT BY DIV. 16. POWER SUPPLY DEDICATED PER PANEL.
 - ② 120 VAC UPS --- 120 VAC UPS POWER AND CONDUIT TO FIELD MODULE PANELS (FMPs) BY CONTROLS INSTALLATION SUBCONTRACTOR. POWER SUPPLY DEDICATED PER PANEL.
 - ③ 120 VAC UPS --- 120 VAC UPS POWER AND CONDUIT TO FIELD MODULE PANELS (FMPs) BY DIV. 16. ONE DEDICATED UPS CIRCUIT PER FMP. THESE CIRCUITS ARE INTENDED FOR MISSION CRITICAL OPERATIONS.
 - T TERM 485 120 OHM TERMINATING RESISTOR
 - P PROT 485 NETWORK BOARD
 - D DIAG 485 NETWORK BOARD
 - F FIBER 485 FIBER OPTIC CONVERTER
 - R REP 485 NETWORK REPEATER
 - E ETHERNET CONNECTION JACK
 - EQUIPMENT CONTROLLED / MONITORED BY ALC BUILDING AUTOMATION SYSTEM
 - ALCS CONTROL PANEL (FMP)
 - ⊙ H ZONE HUMIDITY SENSOR
 - ⊙ T ZONE TEMPERATURE SENSOR
 - ⊙ T/H COMBINATION ZONE TEMPERATURE/HUMIDITY SENSOR
 - ⊙ H2 ZONE HYDROGEN SENSOR
 - ⊙ DP DIFFERENTIAL PRESSURE TRANSDUCER
 - ⊙ SP STATIC PRESSURE TRANSDUCER
 - ⊙ U UNITARY CONTROLLER
 - # CABLE/WIRE TYPE MARKER (REFER TO THE CABLE SPECIFICATIONS CHART PAGE)
 - DM-1 INSTALLATION DETAILS REFERENCE (REFER TO THE INSTALLATION DETAILS PAGES FOR THE APPROPRIATE DETAIL)
 - ① PAGE NOTE REFERENCE (THE NUMBER IN THE OVAL REFERS TO THE APPROPRIATE NOTE NUMBER IN THE NOTES TEXT BLOCK)
 - FMP # - # PANEL NOMENCLATURE (THE FIRST # IS THE LANGATE NUMBER AND THE SECOND NUMBER IS THE SEQUENTIAL PANEL NUMBER)

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Michigan 48xxx			
Metro Environmental, Inc.			
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REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			3 of 46

Abbreviation/Installation Notes

ARCNET - Network Comm 156K	DX - Direct Expansion	PS - Power Switch
A/C - Alternating Current	E - Existing	PSI - Pounds Per Square Inch
ACU - Air Conditioning Unit	EA - Exhaust Air	PWR - Power
ADA - Americans with Disabilities Act	EAD - Exhaust Air Damper	R - Relay
AFF - Above Finished Floor	ECON - Economizer	RA - Return Air
AHU - Air Handling Unit	EDH - Electric Duct Heater	RAD - Return Air Damper
AI - Analog Input	EF - Exhaust Fan	RET - Return
ALM - Alarm	EPO - Emergency Power Off	REV - Revision
AMP - Ampere	EVAP - Evaporator	RF - Return Fan
AO - Analog Output	F - Fahrenheit	RH - Relative Humidity
AUTO - Automatic	FBO - Furnished by Others	RM - Room
AUX - Auxiliary	FCU - Fan Coil Unit	RTU - Rooftop Unit
AWG - American Wire Gauge	FM-200 - Chemical Fire Suppression	S - Shield
BAI - BACnet Analog Input	FMP - Field Module Panel	S/S - Start / Stop
BAO - BACnet Analog Output	FO - Fuel Oil	SA - Supply Air
BAS - Building Automation System	FOP - Fuel Oil Pump	SAT - Supply Air Temperature
BBI - BACnet Binary Input	FS - Flow Switch	SCHWP - Secondary Chilled Water Pump
BBO - BACnet Binary Output	G or GND - Ground	SCHWR - Secondary Chilled Water Return
BFF - Below Finished Floor	GEN - Generator	SCHWS - Secondary Chilled Water Supply
BH - Basin Heater	GPM - Gallons Per Minute	SCWP - Secondary Condenser Water Pump
BKUP - Backup	H - Hot (AC Voltage)	SD - Smoke Detector
BLR - Boiler	H2 - Hydrogen	SF - Supply Fan
BOM - Bill Of Materials	HD - Heating Deck	SP - Static Pressure
BTU - British Thermal Units	HGB - Hot Gas Bypass	SPDT - Single Pole Double Throw
C - Celsius	HOA - Hand/Off/Auto	SPST - Single Pole Single Throw
CAV - Constant Air Volume	HP - Heat Pump	SSP - Systems & Service Provider
CCW - Counter Clockwise	HRU - Heat Recovery Unit	ST - Status
CD - Cooling Deck	HTX - Heat Exchanger	STP - Setpoint
CFM - Cubic Feet Per Minute	HU - Humidifier	STS - Static Transfer Switch
CHIV - Chiller Isolation Valve	HW - Hot Water	SUP - Supply
CHLR - Chiller	HWP - Hot Water Pump	SW - Switch
CHW - Chilled Water	HWR - Hot Water Return	T/S - Twisted Shielded
CHWP - Chilled Water Pump	HWS - Hot Water Supply	TB - Terminal Block
CHWR - Chilled Water Return	ID - Inside Diameter	TD - Time Delay
CHWS - Chilled Water Supply	I/O - Input/Output	TEMP - Temperature
CHWV - Chilled Water Valve	IAQ - Indoor Air Quality	TP - Total Pressure
CM - Control Module	IP - Internet Protocol	TPI - Third Party Interface
COND - Condenser	ISO - Isolation	TWR - Cooling Tower
CRAC - Computer Room Air Conditioner	L - Line Voltage	TX - Transformer
CRAH - Computer Room Air Handler	LL - Liquid Level	UH - Unit Heater
CRU - Computer Room Unit	LS - LogiStat	UL - Underwriters Laboratories
CS - Current Switch	LVL - Level	UNET - U-Card Comm Network
CT - Current Transducer	mA - Milliamp	UPS - Uninterrupted Power Supply
CTM - Current Transmitter	MAD - Mixed Air Damper	UST - Underground Storage Tank
CTRL - Control	MAT - Mixed Air Temperature	UV - Unit Ventilator
CTX - Current Transformer	MAU - Makeup Air Unit	VA - Apparent Power (Voltage * Amperage)
CU - Condensing Unit	MAX - Maximum	VAC - AC Voltage
CUH - Cabinet Unit Heater	MGR - Manager	VAV - Variable Air Volume
CW - Clockwise	MIN - Minimum	VD - Volume Damper
CNDW - Condenser Water	MISC - Miscellaneous	VDC - DC Voltage
CWBV - Condenser Water Bypass Valve	N - Neutral	VESDA - Very Early Smoke Detecting Apparatus
CWIV - Condenser Water Isolation Valve	NC - Normally Closed	VFD - Variable Frequency Drive
CWP - Condenser Water Pump	NEC - National Electric Code	VLV - Valve
CWR - Condenser Water Return	NO - Normally Open	VP - Velocity Pressure
CWS - Condenser Water Supply	NTS - Not To Scale	VVTU - Variable Volume Terminal Unit
D/C - Direct Current	OA - Outdoor Air	"WC - Inches of Water Column
DA - Discharge Air	OAD - Outdoor Air Damper	W - Watt
DAT - Discharge Air Temperature	OAH - Outdoor Air Humidity	W/ - With
DD - Double Duct	OAT - Outdoor Air Temperature	WB - Wet Bulb
DDC - Direct Digital Controls	OAT/H - Outdoor Air Temperature / Humidity	W/O - Without
DEV - Device	OBD - Opposed Blade Damper	WSHP - Water Source Heat Pump
DID - Device ID	OD - Outside Diameter	XFMR - Transformer
DH - Duct Heater	OPS - Oil Pressure Switch	ZD - Zone Damper
DI - Digital Input	PAC - Packaged Air Conditioning Unit	
DMPR - Damper	PBD - Parallel Blade Damper	
DO - Digital Output	PCHWP - Primary Chilled Water Pump	
DP - Differential Pressure	PCWP - Primary Condenser Water Pump	
DPDT - Double Pole Double Throw	PDU - Power Distribution Unit	
DPS - Differential Pressure Switch	PIU - Power Induction Unit	
DPST - Double Pole Single Throw	PMP - Pump	
DPT - Differential Pressure Transducer	PNL - Panel	
DSP - Duct Static Pressure	POS - Position	
DWG - Drawing	PPM - Parts Per Million	

Cable Identification/Wire Labels



Monitoring and control points for remote equipment are identified by the Module Point representation shown above. The electrical contractor or installer must label both ends of each control or monitoring point cable using the following format : (BN-DR-DA-EN-PL) or (BN-DR-DA-FB-PL). Adherence to this identification system is mandatory and must be followed using an approved tagging system comparable to the Brady I.D. Pro Plus electronic labeling system or equivalent.

These tags are intended for the wiring for all Analog Inputs (AI's), Digital Inputs (DI's), Analog Outputs (AO's), and Digital Outputs (DO's) except VAV's and terminal equipment where the wire runs are short and the field termination point is seen, or is easily identified. Points using pneumatic tubing follow the same convention.

All communication cable, terminations "in" an "out" of a field module panel, terminal equipment or VAV's must be labeled with "from (equipment name)" and "to (equipment name)" locations. **See Figure 1 below.**

All ARC156 or UNet communication, serial interface, control, and monitoring wiring must be terminated at the locations designated and must be free of splices.

When stripping multi-conductor cables, use only strippers specifically designed for removal of outer sheath insulation so as not to damage the shielding or insulation of the conductors. Use Ideal Catalog #45-514 or #45-165 data cable strippers or equivalent.

When shielded cable is used, do not strip back sheath more than 1" in order to keep twisted pair from separating. Do not ground shield to the panel or chassis ground. The shield should only be connected to the 'Optional Shield' connection at a module. Ungrounded shields must be cut back and taped to prevent contact with metal surfaces (heat shrink is preferred). **See figure 2 below.**

Multi-conductor cabling other than specified or pre-approved by the electrical contractor is unacceptable.

Electrical installation shall be in accordance with the project specifications, national, state, and local electrical codes along with ALC standards as outlined in this and other documents.

LogiStat Plus and LogiStat Pro room temperature sensors shall be mounted 48 inches above the finished floor per the Americans with Disabilities Act.

All pneumatic tubing that exceeds ten feet in length must be rigid copper or poly tubing installed in conduit. All poly tubing in exposed areas must be installed in conduit. Use plenum rated poly tubing for runs made in hung ceilings. Short lengths of less than 16 inches are permitted to be exposed for connection to field devices.

All field module panels (FMPs) will have a dedicated 120vac circuit.

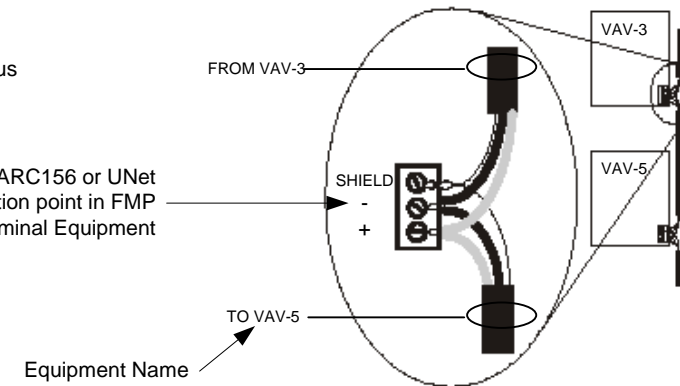


FIGURE 1

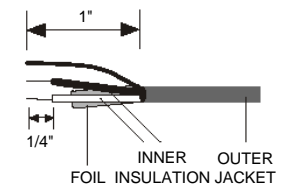
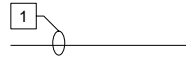
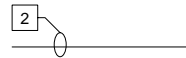
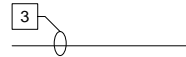
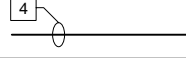
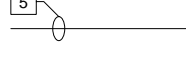
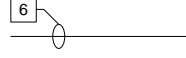



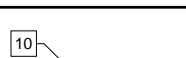
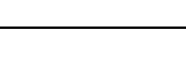
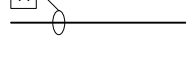


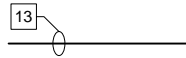


FIGURE 2

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Abbreviation/Installation Notes			
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			DRAWN BY : TL
			CHECKED BY : TS
4 of 46			

Cable Specification Chart

ALCS STANDARD CABLE SPECIFICATIONS AND ABBREVIATIONS							
Cable Line Types	Part Number	Wire Type	Manufacturer	Typical Application	Circuit Type	Color	
	NOT SPECIFIED 12THHN	12 AWG THHN	NOT SPECIFIED	POWER WIRING	120 VAC POWER 120 VAC NEUTRAL 120 VAC GROUND 24 VAC POWER INTERNAL TO PANEL (T1) 24 VAC NEUTRAL INTERNAL TO PANEL (T2) 24 VAC POWER TO FIELD DEVICES (T3) 24 VAC NEUTRAL TO FIELD DEVICES (T4) ANALOG INPUTS (AI's) DIGITAL INPUTS (DI's) DIGITAL OUTPUTS (DO's) ANALOG OUTPUTS (AO's) COMMON FROM POWERED AO's	BLACK WHITE GREEN RED BLACK RED BLACK YELLOW ORANGE VIOLET TAN BLACK	
	NOT SPECIFIED 14THHN	14 AWG THHN	NOT SPECIFIED	POWER WIRING			
	NOT SPECIFIED 16THHN	16 AWG THHN	NOT SPECIFIED	INTERNAL PANEL WIRING			
	NOT SPECIFIED 002360	18/2 AWG TWISTED PAIR, PLENUM RATED, UNSHIELDED	NOT SPECIFIED	LOW VOLTAGE POWER SUPPLY	24 VAC POWER	RED BLACK GRAY JACKET	
	A30008 002360 OR EQUIVALENT	18/2 AWG TWISTED PAIR, PLENUM RATED, UNSHIELDED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	I/O WIRING	INA INB CLASS 2 WIRING ONLY	WHITE BLACK *	
	A30023 002320 OR EQUIVALENT	18/2 AWG TWISTED/SHIELDED PLENUM RATED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	COMMUNICATION RS-485 2-WIRE, SITELINK, I/O REQUIRING SHIELD	NET+ OR TX OR + NET- OR RX OR -	WHITE BLACK *	
	A30009 002370 OR EQUIVALENT	18/3 AWG TWISTED, PLENUM RATED, UNSHIELDED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	I/O WIRING	CLASS 2 WIRING ONLY	BLACK WHITE RED *	
	A30010 002380 OR EQUIVALENT	18/4 AWG TWISTED, PLENUM RATED, UNSHIELDED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	I/O WIRING	CLASS 2 WIRING ONLY	BLACK WHITE RED GREEN *	
	A3ARC156 043006 OR EQUIVALENT	22/2 AWG TWISTED/SHIELDED PLENUM RATED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	ARC156, UNET COMMUNICATION (NO POWER WIRE)	NET+ NET-	WHITE BLACK WITH GREEN JACKET	
	A30004 0043830 OR EQUIVALENT	22/4 AWG TWISTED, UNSHIELDED FOR LOGISTAT, SHIELDED FOR RS, RS PLUS, RS PRO, RS PRO F, PLENUM RATED, STRANDED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	LOGISTAT, RS, RS PLUS, RS PRO, RS PRO F	LOGISTAT GND TEMP SW LS5V	RS / Rnet GRD BLACK Rnet + WHITE Rnet - GREEN +12v RED	BLACK WHITE GREEN RED WITH WHITE JACKET
	A30111 60100 OR EQUIVALENT	18/4 AWG TWISTED/SHIELDED, DOUBLE PAIR, PLENUM RATED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	RS ZONE SENSOR	12V GND NET+ NET-	PAIR1 RED BLACK PAIR 2 WHITE GREEN WITH WHITE JACKET	
	A30101 004340 OR EQUIVALENT	22/4 AWG TWISTED/SHIELDED, DOUBLE PAIR, PLENUM RATED	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	PORTAL 4 WIRE COMMUNICATION	EIA-485-4W EIA-232-4W TX+ TX TX- RX RX+ DTR/RTS RX- DCD/CTS	PAIR 1 RED BLACK PAIR 2 WHITE GREEN WITH WHITE JACKET	
	A3U-LINE 007960+043006 OR EQUIVALENT	(1) PAIR 14AWG FOR POWER & (1) PAIR 22AWG FOR COMMUNICATIONS (PLENUM RATED)	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	UNET (WITH POWER WIRE)	24 VAC GND UNET+ UNET-	PAIR 1 (18 GA) RED GREEN PAIR 2 (22 GA) WHITE BLACK WITH PINK JACKET	
	A32NB-156 007960+043006 OR EQUIVALENT	(1) PAIR 14AWG FOR POWER & (1) PAIR 22AWG FOR COMMUNICATIONS (PLENUM RATED)	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	ARC156 (WITH POWER WIRE)	24 VAC GND NET+ NET-	PAIR 1 (14 GA) RED GREEN PAIR 2 (22 GA) WHITE BLACK WITH GREEN JACKET	
	A50089BLU 555619 OR EQUIVALENT	24/8 AWG CAT 5 ENHANCED, PLENUM RATED 100MHz	MAGNUM CABLE CORPORATION PHONE: 800.421.0820 WEB: http://www.magnumcable.com	ETHERNET	NETWORK COMMUNICATIONS	PR.1 WHITE/BLUE & BLUE PR.2 WHITE/ORANGE & ORANGE PR.3 WHITE/GREEN & GREEN PR.4 WHITE/BROWN & BROWN WITH BLUE JACKET	


Abbreviations

- AWG - American Wire Gauge
- CAT-5 - Ethernet Cable
- DCD/CTS - Serial Hardware Handshaking
- DTR/RTS - Serial Hardware Handshaking
- EIA-232 - Communications Protocol
- EIA-485 - Communications Protocol
- G or GND - Ground
- I/O - Input/Output
- INA - Input A
- INB - Input B
- LS5V - +5vdc Logistat
- NET- - ARCnet comm. -
- NET+ - ARCnet comm. +
- RX- - Receive -
- RX+ - Receive +
- ST - Fiber Optic Connector
- *SW - TLO/Setpoint Adjust
- TEMP - Temperature
- THHN - A thermoplastic-insulated, nylon-jacketed designed for use in dry locations and an conductor operating temperature of up to 90 degrees Celsius.
- TX- - Transmit -
- TX+ - Transmit +
- VAC - Voltage Alternating Current

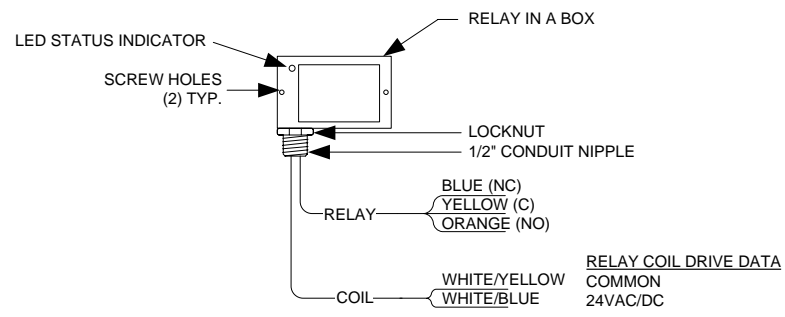
*Abbreviation is specific for the Logistat device. Do not confuse with the switch (SW) abbreviation on the Abbreviation/Installation Notes page.

- * **Cable Jacket Colors**
24vac = Gray
Comm = Green
AI = Yellow
AO = Tan
DI = Orange
DO = Violet

Notes:
1. If a wire substitution is made consult ALC for approval.

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Cable Specification Chart			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
5 of 46			

RIB-1 RELAY IN A BOX - PILOT SERIES (RIBU24C-FA)



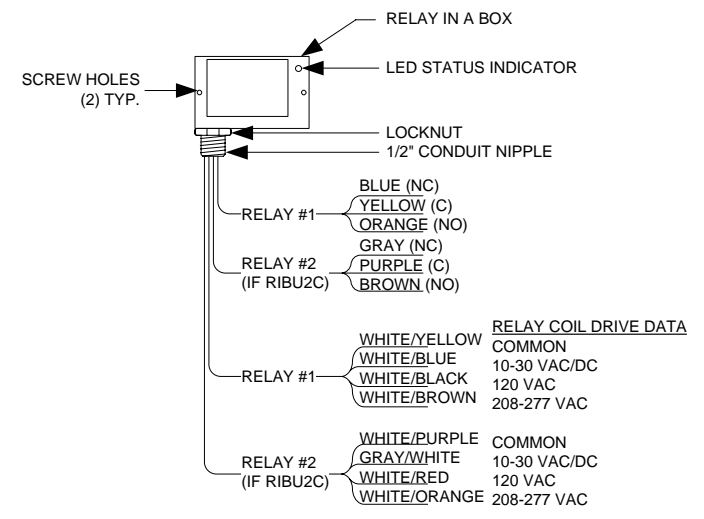
MOUNTING INSTRUCTIONS:
THE RIB PILOT SERIES HAS A 1/2" NPT NIPPLE FROM WHICH ALL WIRES EXIT.

JUNCTION BOX OR EQUIPMENT MOUNTING INSTRUCTIONS
REMOVE A 1/2" CONDUIT KNOCKOUT IN THE EQUIPMENT, INSERT THE WIRES & NIPPLE THROUGH THE HOLE, TIGHTEN THE LOCKNUT, AND CONNECT THE WIRES.

SURFACE MOUNTING INSTRUCTIONS
FASTEN THE RELAY TO THE DESIRED LOCATION USING THE (2) SCREW HOLES IN THE HOUSING.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

RIB-2 RELAY IN A BOX - PILOT SERIES (RIBU1C & RIBU2C)



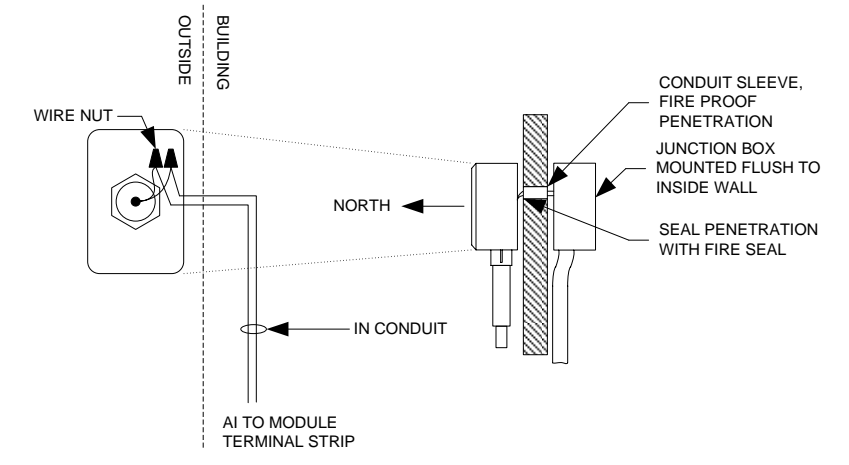
MOUNTING INSTRUCTIONS:
THE RIB PILOT SERIES HAS A 1/2" NPT NIPPLE FROM WHICH ALL WIRES EXIT.

JUNCTION BOX OR EQUIPMENT MOUNTING INSTRUCTIONS
REMOVE A 1/2" CONDUIT KNOCKOUT IN THE EQUIPMENT, INSERT THE WIRES & NIPPLE THROUGH THE HOLE, TIGHTEN THE LOCKNUT, AND CONNECT THE WIRES.

SURFACE MOUNTING INSTRUCTIONS
FASTEN THE RELAY TO THE DESIRED LOCATION USING THE (2) SCREW HOLES IN THE HOUSING.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

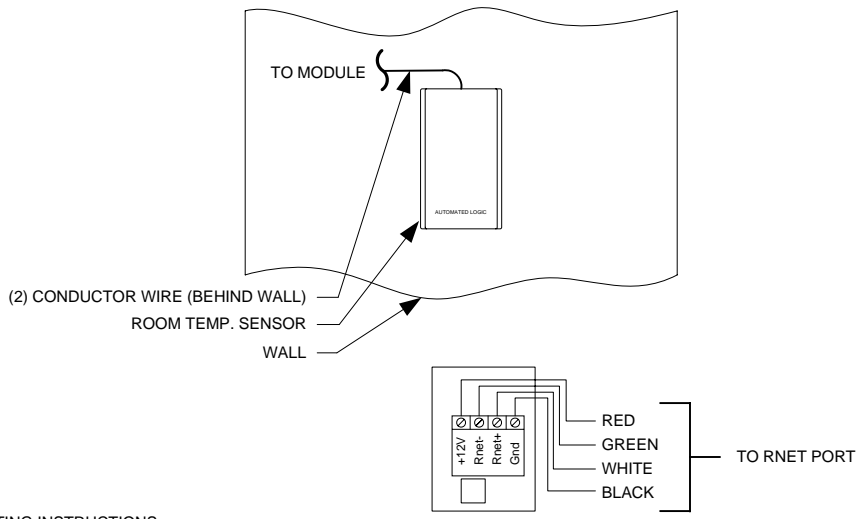
OAT-1 OUTDOOR AIR TEMPERATURE SENSOR



MOUNTING INSTRUCTIONS
1. A SMALL WEEP HOLE (1/8" OR LESS) MUST BE DRILLED INTO THE BOTTOM (PROBE) SIDE OF THE ENCLOSURE TO ALLOW ANY CONDENSATION WITHIN THE ENCLOSURE TO ESCAPE. CAUTION MUST BE TAKEN TO AVOID DAMAGING THE LEAD WIRES AND ANY ELECTRICAL CONNECTIONS WHEN DRILLING THE WEEP HOLE.
2. ATTACH THE MOUNTING TABS TO OPPOSITE CORNERS OF THE BELL BOX WITH SELF TAPPING SCREWS.
3. MOUNT THE OUTSIDE AIR UNIT OUT OF DIRECT SUNLIGHT WITH THE PVC SENSOR COVER POINTING DOWN. MOUNT THE SENSOR ON THE WALL WITH THE NORTH MOST EXPOSURE.
4. TERMINATE THE UNIT AS SHOWN ABOVE. BE SURE TO INCORPORATE A "J-LOOP" INTO THE TERMINATION. A "J-LOOP" IS FORMED BY POINTING THE WIRE NUTS OF A TERMINATION UP CREATING A "J" IN THE CABLE IN ORDER TO REDUCE THE PROBABILITY OF CONDENSATION COLLECTING IN THE WIRE NUT.
5. ATTACH THE COVER. MAKE SURE THE GASKET SEALS ON ALL SIDES. **DO NOT OVER TIGHTEN THE COVER.** IF OVER TIGHTENED, THE BELL BOX WILL CUT THE GASKET AND ALLOW MOISTURE TO ENTER THE ENCLOSURE.
6. SEAL ALL CONDUIT HOLES WITH THE PLUGS PROVIDED AND AN APPROPRIATE SILICON SEALANT.

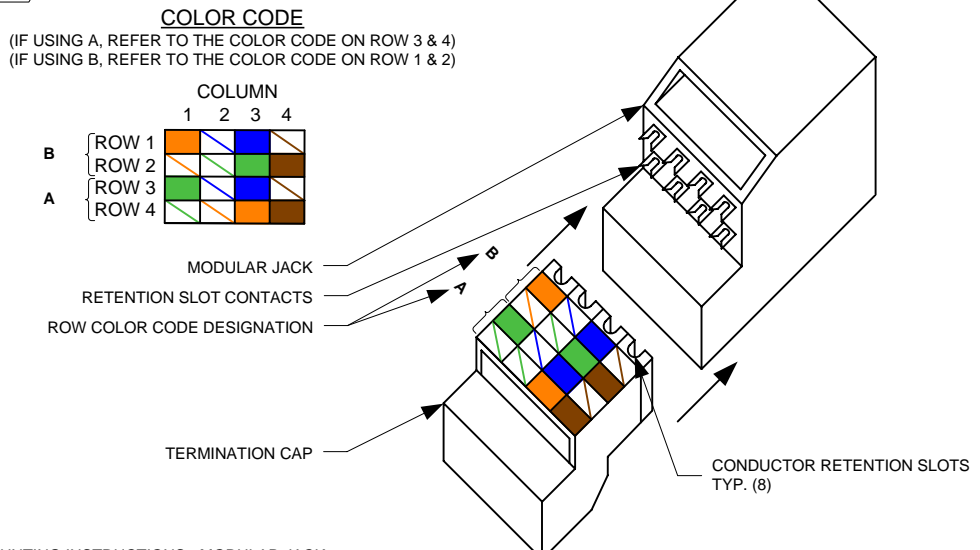
NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

RTS-2 ROOM TEMPERATURE SENSOR - RS SENSORS



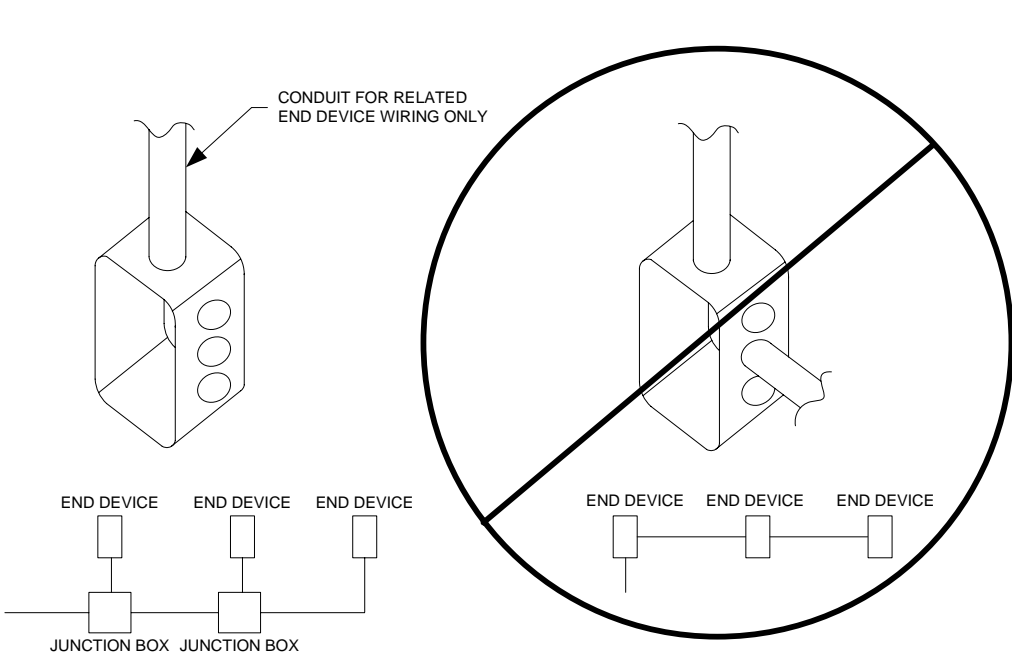
MOUNTING INSTRUCTIONS
1. PULL THE WIRES THROUGH THE WIRE WAY HOLE IN THE BASE PLATE.
2. FOR JUNCTION BOX INSTALLATION, SECURE THE BASE TO THE BOX USING THE #6-32 X 1/2" MOUNTING SCREWS PROVIDED.
3. FOR DRYWALL INSTALLATION, PRE-DRILL (2) 3/16" HOLES 3.275" APART ON CENTER. INSERT THE DRYWALL ANCHORS AND SECURE THE BASE USING #6X1" SHEET METAL SCREWS.
4. TERMINATE THE UNIT FOLLOWING THE ABOVE DETAIL.
5. ATTACH THE COVER BY LATCHING IT TO THE TOP OF THE BASE, ROTATING THE COVER DOWN, AND SNAPPING IT INTO PLACE.
6. SECURE THE COVER BY BACKING OUT THE LOCK DOWN SCREWS USING A 1/16" ALLEN WRENCH UNTIL THEY ARE FLUSH WITH THE BOTTOM OF THE COVER.
NOTE: IN A WALL MOUNT APPLICATION, THE WALL TEMPERATURE AND THE TEMPERATURE OF THE AIR CONTAINED WITHIN THE WALL CAVITY CAN CAUSE ERRONEOUS READINGS. MOREOVER, THE MIXING OF ROOM AIR AND AIR FROM WITHIN THE WALL CAVITY CAN LEAD TO CONDENSATION AND PREMATURE FAILURE OF THE SENSOR. TO PREVENT THESE CONDITIONS, SEAL THE CONDUIT LEADING TO THE JUNCTION BOX AND SEAL THE HOLE IN THE DRYWALL BY USING AN ADHESIVE BACKED, FOAM INSULATED PAD. MOUNT IN A LOCATION THAT WILL NOT BE AFFECTED BY DIFFUSER AND HEAT EQUIPMENT
NOTE: MOUNT THE SENSOR 48" A.F.F. AS PER THE AMERICANS WITH DISABILITIES ACT (ADA) UNLESS OTHERWISE NOTED IN JOB SPECIFICATION.
NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

JCK-1 MINI-JACK TX-5e MODULAR JACK



MOUNTING INSTRUCTIONS - MODULAR JACK
1. FOR MAGNUM CABLE CORPORATION P/N A50089BLU (24/8 CAT5e WIRE), USE ROWS 1 & 2 (B). USE SOLID CONDUCTOR CABLE.
2. ROUTE THE CONDUCTORS THROUGH THE SLOT IN THE TERMINATION CAP. DO NOT UNTWIST THE PAIRS PRIOR TO INSERTING INTO THE TERMINATION CAP. PUSH THE CABLE JACK INTO THE CAP AS FAR AS POSSIBLE.
3. UNTWIST PAIRS, ONE AT A TIME STARTING WITH THE OUTSIDE PAIRS, AND PLACE INTO THE APPROPRIATE RETENTION SLOT BASED ON THE COLOR CODE. **UNTWIST EACH PAIR ONLY AS FAR AS REQUIRED TO PLACE THE CONDUCTORS IN THE SLOTS.**
IF USING A, TERMINATE:
-GREEN ON BOTTOM SLOT OF COLUMN 1
-GREEN / WHITE ON TOP SLOT OF COLUMN 1
-BLUE / WHITE ON BOTTOM SLOT OF COLUMN 2
-ORANGE / WHITE ON TOP SLOT OF COLUMN 2
-BLUE ON BOTTOM SLOT OF COLUMN 3
-ORANGE ON TOP SLOT OF COLUMN 3
-BROWN / WHITE ON BOTTOM SLOT OF COLUMN 4
-BROWN ON TOP SLOT OF COLUMN 4
IF USING B, TERMINATE:
-ORANGE ON BOTTOM SLOT OF COLUMN 1
-ORANGE / WHITE ON TOP SLOT OF COLUMN 1
-BLUE / WHITE ON BOTTOM SLOT OF COLUMN 2
-GREEN / WHITE ON TOP SLOT OF COLUMN 2
-BLUE ON BOTTOM SLOT OF COLUMN 3
-GREEN ON TOP SLOT OF COLUMN 3
-BROWN / WHITE ON BOTTOM SLOT OF COLUMN 4
-BROWN ON TOP SLOT OF COLUMN 4
NOTE: ROWS 1&3 CORRESPOND TO THE BOTTOM ROW OF RETENTION SLOT CONTACTS WHILE ROWS 2&4 CORRESPOND TO THE TOP ROW.
4. TRIM THE CONDUCTORS FLUSH WITH THE CAP USING THE WIRE SNIPPING TOOL. ENSURE ALL CONDUCTORS ARE SEATED.
5. SLIDE THE TERMINATION CAP ONTO HOUSING AND PUSH FORWARD. COMPLETE THE TERMINATION WITH A PAIR OF SMOOTH JAW SLIP LOCK PLIERS.

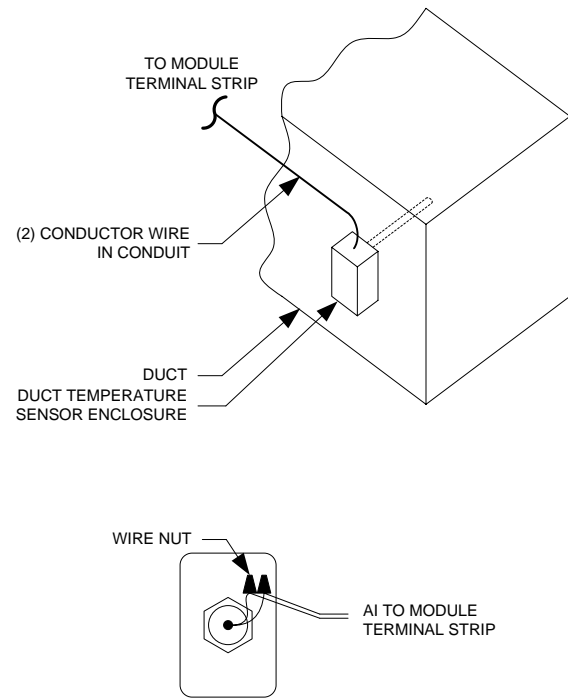
JB-1 END DEVICE TERMINATION BOX DETAIL



ACCEPTABLE INSTALLATION PRACTICE. **UNACCEPTABLE INSTALLATION PRACTICE.**

NOTE: DO NOT USE AN END DEVICE ENCLOSURE AS A RACEWAY FOR OTHER WIRING.

DTS-1 DUCT TEMPERATURE SENSOR

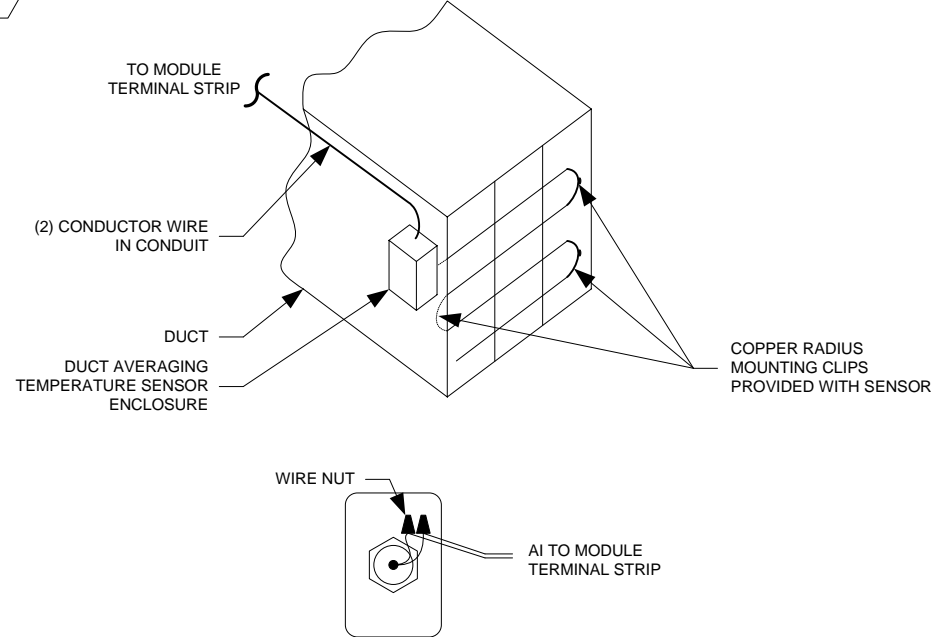


MOUNTING INSTRUCTIONS

1. DRILL A 3/8" HOLE IN THE DUCT WALL FOR THE PROBE.
2. SECURE THE MOUNTING FLANGE TO THE DUCT USING SELF-TAPPING SHEET METAL SCREWS (NOT PROVIDED).
3. TERMINATE THE UNIT AS SHOWN ABOVE.
4. BE SURE TO USE SEALANT FILLED CONNECTIONS AND INCORPORATE A "J-LOOP" INTO THE TERMINATION. A "J-LOOP" IS FORMED BY POINTING THE WIRE NUTS OF A TERMINATION UP CREATING A "J" IN THE CABLE IN ORDER TO REDUCE THE PROBABILITY OF CONDENSATION COLLECTING IN THE WIRE NUT.
5. SEAL ALL CONDUIT HOLES WITH THE PLUGS PROVIDED AND APPROPRIATE SILICON SEALANT

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

DAS-1 DUCT AVERAGING SENSOR



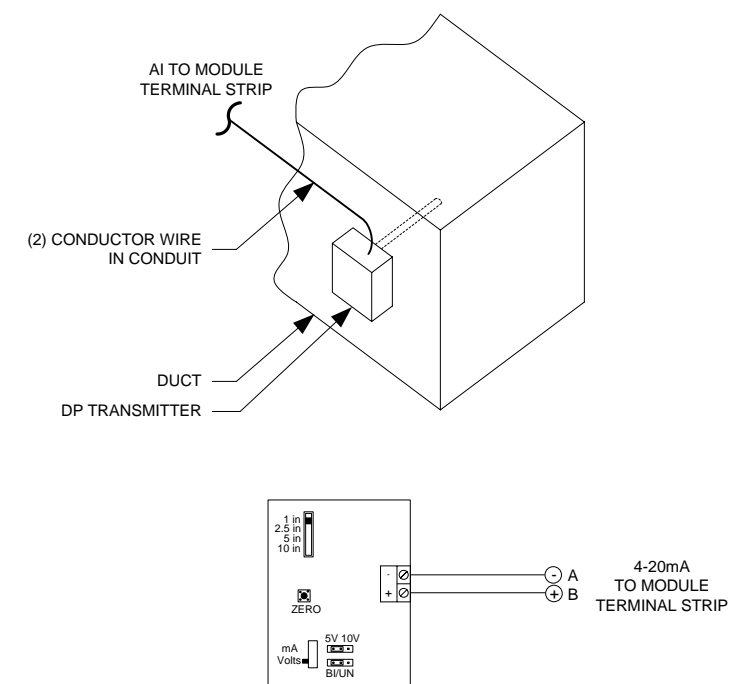
MOUNTING INSTRUCTIONS

1. SECURE THE MOUNTING FLANGE TO THE DUCT USING SELF-TAPPING SHEET METAL SCREWS.
2. INCORPORATE A "J-LOOP" INTO THE TERMINATION. A "J-LOOP" IS FORMED BY POINTING THE WIRE NUTS OF A TERMINATION UP CREATING A "J" IN THE CABLE IN ORDER TO REDUCE THE PROBABILITY OF CONDENSATION COLLECTING IN THE WIRE NUT.
3. EVENLY SPACE THE AVERAGING ELEMENT ACROSS THE AIR FLOW.
4. SECURE THE AVERAGING ELEMENT USING RADIUS MOUNTING CLIPS.

NOTE: WHEN FORMING THE AVERAGING ELEMENT TO THE DESIRED SHAPE, BE SURE THE BEND DIAMETER IS GREATER THAN 6". DO NOT USE SENSOR BOX AS A JUNCTION BOX FOR OTHER WIRING.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

SSP-1 DUCT MOUNTED SUPPLY AIR STATIC PRESSURE TRANSMITTER

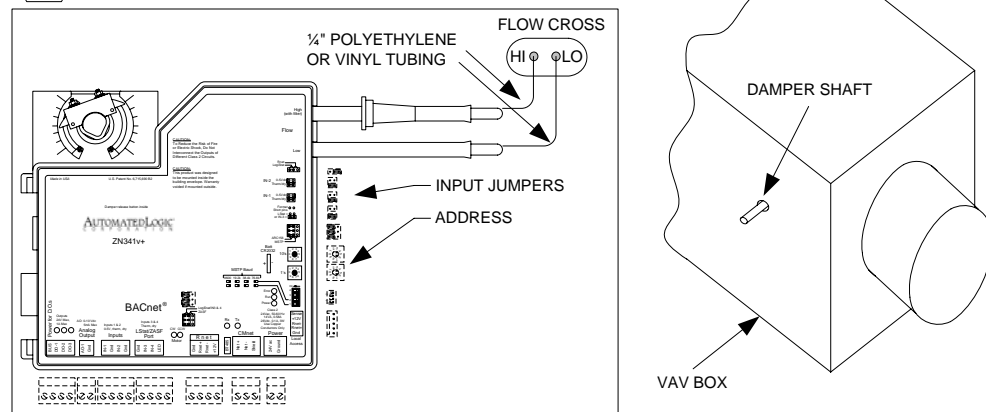


MOUNTING INSTRUCTIONS

1. DRILL A 3/8" HOLE IN THE DUCT WALL FOR THE STATIC PRESSURE PROBE.
2. SECURE THE DEVICE TO THE DUCT USING SELF-TAPPING SHEET METAL SCREWS.
3. INSTALL STATIC PRESSURE PROBE HORIZONTALLY SO THE ENCLOSURE IS IN A VERTICAL PLANE AND THE NAMEPLATE AND LETTERING IS IN AN UPRIGHT POSITION.
4. CONNECT TRANSMITTER TO CONTROL SYSTEM.
5. CONFIGURE ALL JUMPERS AND SWITCHES TO APPROPRIATE POSITIONS.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

VAV-1 ZN141v+ & ZN341v+ TERMINAL CONTROL MODULE



MOUNTING INSTRUCTIONS - ZN141v+ & ZN341v+

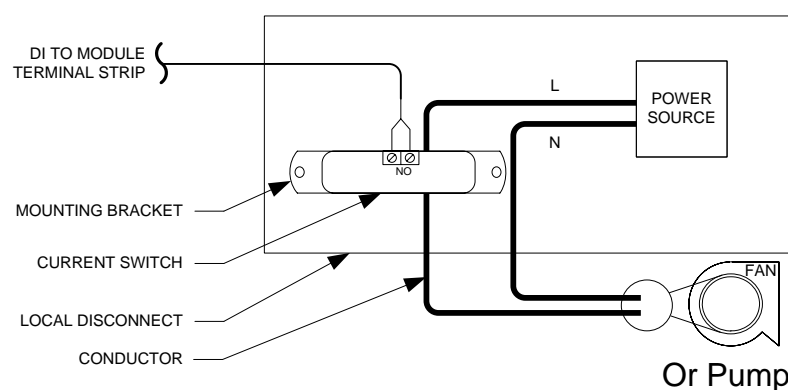
1. PLACE THE MODULE HORIZONTALLY ON THE VAV BOX BY FEEDING THE DAMPER SHAFT THROUGH THE SHAFT SLOT. CAUTION: DO NOT POSITION THE MODULE SO THE SHAFT SLOT IS IN THE UPPER RIGHT OF THE MODULE. THIS POSITION MAY CAUSE CONDENSATION FROM THE VAV SHAFT TO DRIP ON THE ELECTRONIC COMPONENTS OF THE ZN-LINE CONTROLLER.
2. INSERT A MOUNTING SCREW INTO THE STABILIZING SLOT AND TIGHTEN IT TO SECURE THE MODULE.
3. LIGHTLY PULL OUT 2 PLASTIC TABS ON RIGHT SIDE OF CONTROLLER TO REMOVE TETHERED PLASTIC COVER.
4. ROTATE THE DAMPER SHAFT TO THE **FULL CLOSED** POSITION.
5. LOCATE THE DAMPER CLUTCH BUTTON ON THE CONTROLLER, PUSH AND ROTATE THE DRIVE IN THE SAME FULL DIRECTION AS THAT TO **CLOSE** THE DAMPER.
6. TIGHTEN THE (2) NUTS ON THE CLAMP USING A 10MM WRENCH OR SOCKET USING 6-8 FT LB OF TORQUE.
7. PUSH THE DAMPER CLUTCH BUTTON AGAIN AND ROTATE THE DAMPER TO THE **FULL OPEN** POSITION.
8. RE-ATTACH THE TETHERED PLASTIC COVER BY "HOOKING" ON LEFT SIDE AND SNAPPING ON RIGHT SIDE.

TUBING INSTALLATION INSTRUCTIONS TO STANDARD FLOW CROSS
 USE 1/4" POLYETHYLENE OR VINYL TUBING. LEAVE SLACK IN THE TUBING.
 1. CONNECT THE HI PRESSURE PORT TO THE HIGH OR VELOCITY PRESSURE PORT ON THE FLOW CROSS.
 2. CONNECT THE LO PRESSURE PORT TO THE LOW OR STATIC PRESSURE PORT ON THE FLOW CROSS.

STANDARD WIRING & CONFIGURATION INSTRUCTIONS

1. TIE THE COMMUNICATION WIRING SHIELD TOGETHER AND ISOLATE WITH TAPE OR HEAT SHRINK.
 2. MAINTAIN POLARITY WHEN MULTIPLE DEVICES ARE CONNECTED TO A COMMON POWER SUPPLY.
 3. SET THE DEVICE ADDRESS WITH THE ROTARY SWITCHES.
 4. POSITION JUMPERS ON THE INPUT POINTS TO CONFIGURE THE SIGNAL TYPE.
- NOTE: MODULES SHOULD BE MOUNTED INDOORS IN A DRY, CLEAN ENVIRONMENT FREE OF CORROSIVE FUMES. A PROTECTIVE ENCLOSURE MUST BE USED WHEN MOUNTED OUTDOORS. THE MODULES ARE CLASS 2 DEVICES (>30VAC). TAKE APPROPRIATE ISOLATION MEASURES WHEN MOUNTING IN A CONTROL PANEL WHERE CLASS 1 WIRING OR DEVICES ARE PRESENT.

CTS-1 CURRENT SWITCH SINGLE PHASE MOTOR

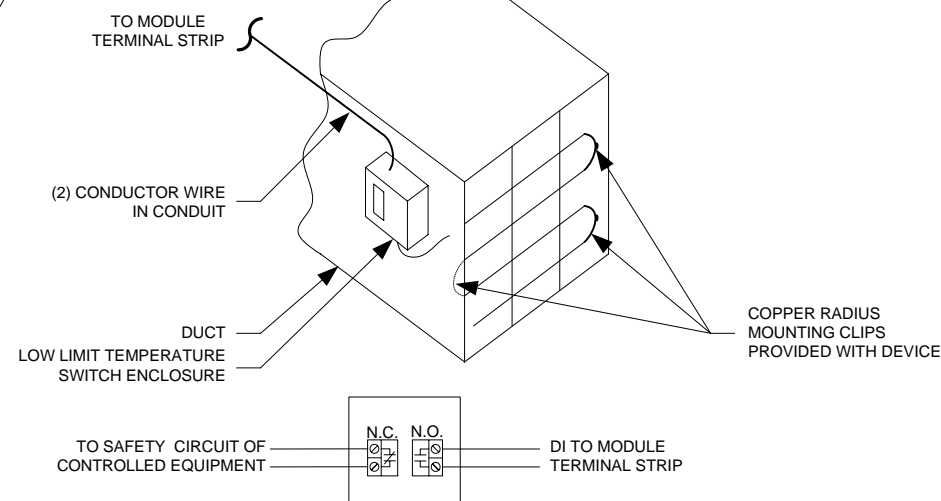


MOUNTING INSTRUCTIONS

1. **ENSURE POWER CONDUCTOR TO BE MONITORED IS DISCONNECTED AND LOCKED OUT FROM THE POWER SOURCE.**
2. INSTALL THE ADJUSTABLE MOUNTING BRACKET TO THE BACK OF THE MOTOR CONTROL CENTER/STARTER. THE SENSOR MAY BE LOCATED AT ANY POINT ON THE CONDUCTOR BETWEEN THE MOTOR AND THE MOTOR STARTER.
3. ALIGN TO PERMIT THE CONDUCTOR TO FIT THROUGH THE HOLE. SLIDE THE CONDUCTOR THROUGH THE CENTER HOLE IN THE SENSOR AND CONNECT THE CONDUCTOR TO THE LUGS ON THE MOTOR STARTER.
 NOTE: LOW AMPERAGE (<1.5A) AND HIGH AMPERAGE (>200A) APPLICATIONS MAY REQUIRE SPECIAL INSTALLATION:
 A. LOW AMPERAGE - TO PROVIDE ADEQUATE CURRENT, WRAP CONDUCTOR THROUGH THE CENTER HOLE AND AROUND THE SENSOR BODY TO PRODUCE MULTIPLE TURNS AND INCREASE CURRENT FLOW. EACH PASS THROUGH THE TRANSDUCER INCREASES THE AMPERAGE BY THE ORIGINAL VALUE.
 B. HIGH AMPERAGE - CURRENT FLOWS IN EXCESS OF 200A REQUIRE THE USE OF AN APPROPRIATELY SIZED EXTERNAL CURRENT TRANSFORMER (CT). INSTALL THE EXTERNAL CT ON THE CONDUCTOR AND RUN THE CT SECONDARY WIRE THROUGH CURRENT SENSOR.
CAUTION: CT'S CAN CONTAIN HAZARDOUS VOLTAGES. INSTALL CT'S IN ACCORDANCE TO MANUFACTURERS' SPECIFICATIONS AND INSTRUCTIONS.
4. WIRE AS SHOWN ABOVE.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

LLS-1 LOW TEMPERATURE LIMIT SWITCH

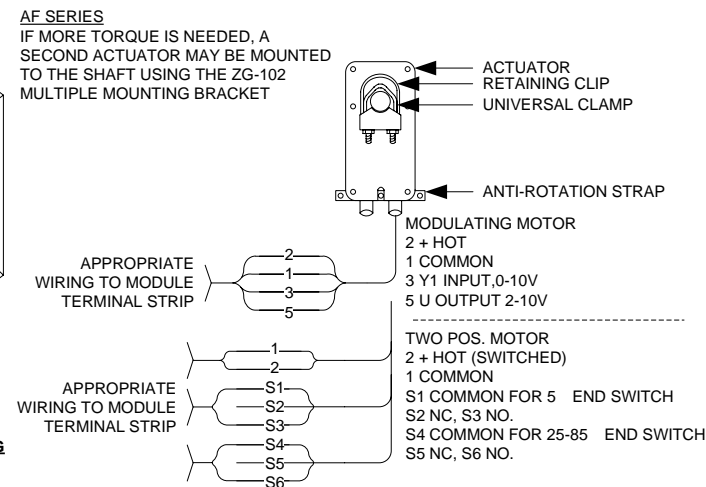
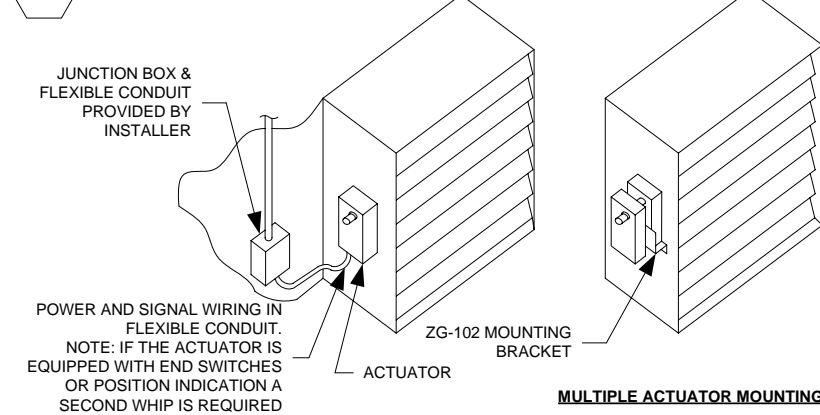


MOUNTING INSTRUCTIONS

1. LOW LIMIT MUST BE MOUNTED IN A VERTICAL POSITION. FOR THE LOW LIMIT SWITCH AND CAPILLARY TUBES, AVOID LOCATIONS SUBJECT TO EXCESSIVE VIBRATION.
 2. ON MANUAL RESET MODELS, POSITION THE CONTROL TO PERMIT CONVENIENT ACCESS TO THE RESET BUTTON.
 3. USE THE MOUNTING HOLES IN THE REAR OF THE CASE FOR FLUSH MOUNTING TO THE DUCT OR FLAT SURFACE.
 4. DRILL A 3/8" HOLE IN THE DUCT WALL FOR THE CAPILLARY ELEMENT.
 5. SECURE THE MOUNTING FLANGE TO THE DUCT USING SELF-TAPPING SHEET METAL SCREWS.
 6. INSTALL CAPILLARY ELEMENT IN A HORIZONTAL SERPENTINE PATTERN ACROSS THE DUCT AS SHOWN ON THE ABOVE DETAIL SO IT IS EXPOSED TO AREAS TO PROTECT THE COIL. DO NOT KINK OR APPLY EXCESSIVE FORCE TO THE CAPILLARY ELEMENT.
 7. INSTALL RADIUS MOUNTING CLIPS AT EVERY BEND.
 8. THE LOW TEMPERATURE LIMIT SWITCH MUST BE MOUNTED IN A MANNER WHICH PROVIDES PROTECTION TO THE ENTIRE SURFACE OF COIL WITH A MAXIMUM OF 1.5' BETWEEN CAPILLARY PASSES. USE MULTIPLE DEVICES IF COIL IS NOT SUFFICIENTLY COVERED.
 9. THE CONTROL ENCLOSURE SHALL BE COMPLETELY MOUNTED ON THE EXTERIOR OF THE AIR HANDLING UNIT AND THE CONTROL ENCLOSURE SHALL NOT BE MOUNTED LOWER THAN THE CAPILLARY TUBING.
- NOTE: DO NOT USE SENSOR BOX AS A JUNCTION BOX FOR OTHER WIRING.

NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

DM-1 DAMPER MOTOR - BELIMO AF SERIES ACTUATORS



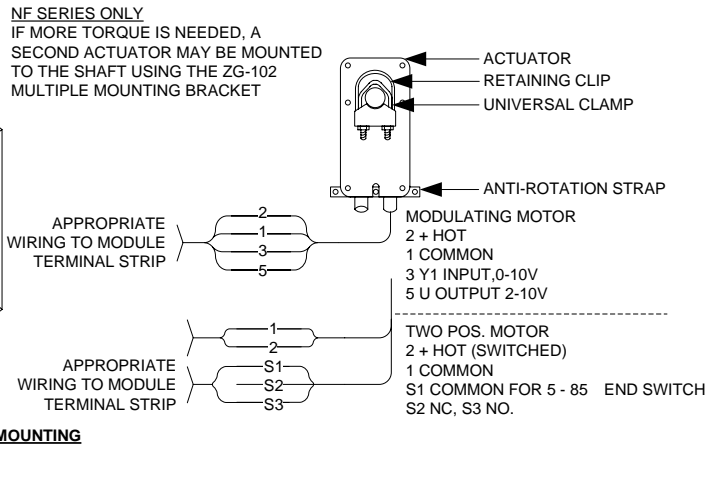
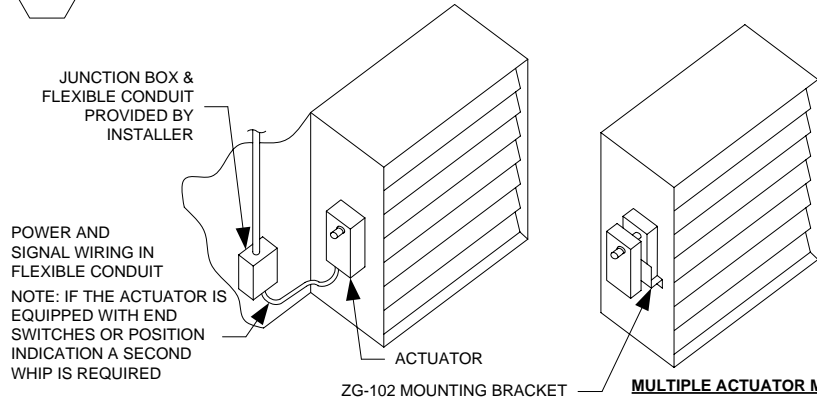
STANDARD MOUNTING INSTRUCTIONS - BELIMO AF SERIES ACTUATORS

- MANUALLY MOVE THE DAMPER TO THE FAIL-SAFE POSITION. IF THE SHAFT ROTATED CCW, THIS IS A CCW INSTALLATION ("CCW" FACES OUT). IF THE SHAFT ROTATED CW, THIS IS A CW INSTALLATION ("CW" FACES OUT).
- TO TEST FOR ADEQUATE SHAFT LENGTH, SLIDE THE ACTUATOR OVER THE SHAFT WITH THE SIDE WITH THE CLAMP FACING OUT. IF THE SHAFT DOES NOT EXTEND AT LEAST 1/8" THROUGH THE CLAMP, SEE THE *SHORT SHAFT MOUNTING INSTRUCTIONS*.
- IF THE CLAMP IS NOT ON THE CORRECT SIDE AS DETERMINED IN STEP 1, RE-MOUNT THE CLAMP AS FOLLOWS. IF IT IS ON THE CORRECT SIDE, PROCEED TO STEP 5. LOOK AT THE UNIVERSAL CLAMP. IF YOU ARE MOUNTING THE ACTUATOR WITH THE "CCW" SIDE OUT, POSITION THE CLAMP SO THAT THE POINTER SECTION OF THE TAB IS POINTING TO 0 AND THE SPLINE PATTERN OF THE CLAMP MATES WITH THE SPLINE OF THE ACTUATOR. SLIP THE CLAMP OVER THE SPLINE.
- LOCK THE CLAMP TO THE ACTUATOR USING THE RETAINING CLIP.
- VERIFY THE DAMPER IS STILL IN ITS FAIL-SAFE POSITION.
- SLIDE THE ACTUATOR OVER THE SHAFT.
- POSITION THE ACTUATOR IN THE DESIRED LOCATION.
- REMOVE THE SCREW FROM ONE END OF THE MOUNTING BRACKET AND PIVOT IT AWAY FROM THE ACTUATOR.
- LOOSEN THE UNIVERSAL CLAMP AND, MAKING SURE NOT TO MOVE THE DAMPER SHAFT, ROTATE THE ACTUATOR APPROXIMATELY 5° IN THE DIRECTION WHICH WOULD OPEN THE DAMPER.
- TIGHTEN THE (2) NUTS ON THE CLAMP USING A 10mm WRENCH OR SOCKET USING 6-8ft-lb OF TORQUE.
- SLIP THE STUD OF THE ANTI-ROTATION STRAP INTO THE SLOT AT THE BASE OF THE ACTUATOR. THE STUD SHOULD BE POSITIONED 1/16" FROM THE CLOSED END OF THE SLOT. BEND THE STRAP AS NEEDED TO REACH THE DUCT. ATTACH THE STRAP TO THE DUCT WITH #8 SELF TAPPING SCREWS.

SHORT SHAFT MOUNTING INSTRUCTIONS - BELIMO AF SERIES ACTUATORS

- DETERMINE THE BEST ORIENTATION FOR THE UNIVERSAL CLAMP ON THE BACK OF THE ACTUATOR (WHERE YOU HAVE THE EASIEST ACCESS TO THE V-BOLT NUTS ON THE CLAMP).
 - ENGAGE THE CLAMP TO THE ACTUATOR AS CLOSE AS POSSIBLE TO THE DETERMINED LOCATION.
 - LOCK THE CLAMP IN PLACE USING THE REMAINING RETAINER CLIP.
 - FOLLOW STEPS 5-9 OF THE *STANDARD MOUNTING INSTRUCTIONS* TO COMPLETE THE SHORT SHAFT INSTALLATION.
- NOTE: ACTUATORS SHOULD BE MOUNTED INDOORS IN A DRY, CLEAN ENVIRONMENT FREE OF CORROSIVE FUMES. A PROTECTIVE ENCLOSURE MUST BE USED WHEN MOUNTED OUTDOORS. INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

DM-2 DAMPER MOTOR - BELIMO LF & NF SERIES ACTUATORS



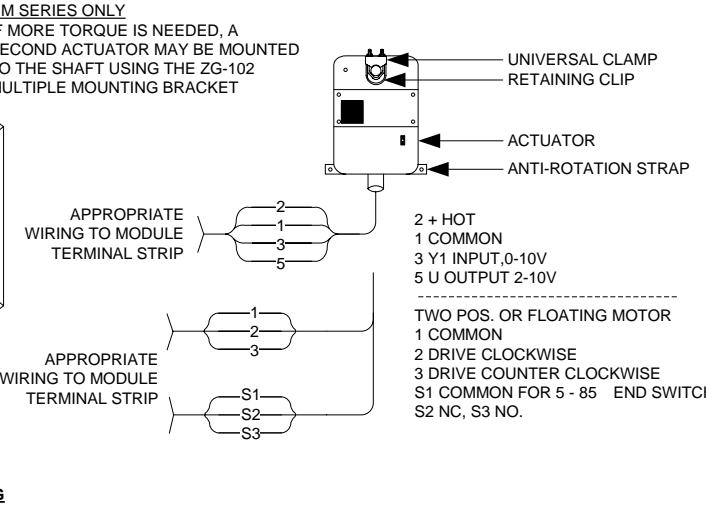
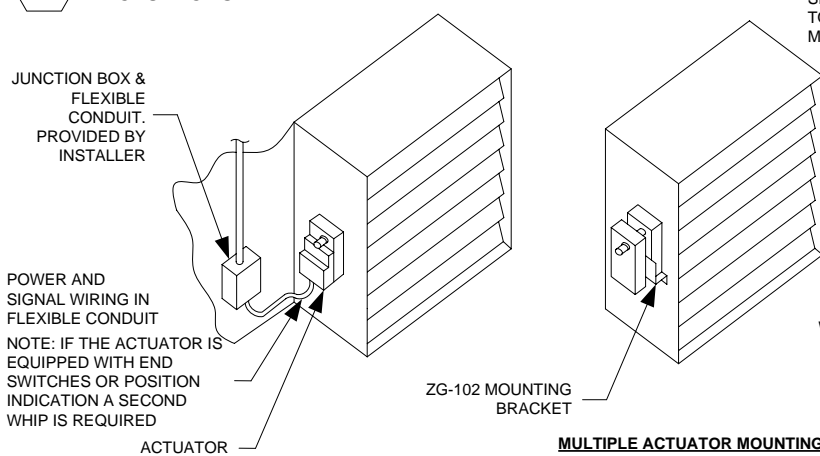
STANDARD MOUNTING INSTRUCTIONS - BELIMO LF & NF SERIES ACTUATORS

- MANUALLY MOVE THE DAMPER TO THE FAIL-SAFE POSITION. IF THE SHAFT ROTATED CCW, THIS IS A CCW INSTALLATION ("CCW" FACES OUT). IF THE SHAFT ROTATED CW, THIS IS A CW INSTALLATION ("CW" FACES OUT).
- TO TEST FOR ADEQUATE SHAFT LENGTH, SLIDE THE ACTUATOR OVER THE SHAFT WITH THE SIDE WITH THE CLAMP. IF THE SHAFT DOES NOT EXTEND AT LEAST 1/8" THROUGH THE CLAMP, SEE THE *SHORT SHAFT MOUNTING INSTRUCTIONS*.
- IF THE CLAMP IS NOT ON THE CORRECT SIDE AS DETERMINED IN STEP 1, RE-MOUNT THE CLAMP AS FOLLOWS. IF IT IS ON THE CORRECT SIDE, PROCEED TO STEP 5. LOOK AT THE UNIVERSAL CLAMP. IF YOU ARE MOUNTING THE ACTUATOR WITH THE "CCW" SIDE OUT, POSITION THE CLAMP SO THAT THE POINTER SECTION OF THE TAB IS POINTING TO 0 AND THE SPLINE PATTERN OF THE CLAMP MATES WITH THE SPLINE OF THE ACTUATOR. SLIP THE CLAMP OVER THE SPLINE.
- LOCK THE CLAMP TO THE ACTUATOR USING THE RETAINING CLIP.
- VERIFY THE DAMPER IS STILL IN ITS FULL FAIL-SAFE POSITION.
- MOUNT THE SPRING RETURN ACTUATOR TO THE SHAFT. TIGHTEN THE UNIVERSAL CLAMP, FINGER TIGHT ONLY.
- MOUNT THE ANTI-ROTATION STRAP AT THE BASE OF THE ACTUATOR. SLIP THE STOP OF THE ANTI-ROTATION STRAP IN THE SLOT OF THE BASE OF THE ACTUATOR. THE STUD SHOULD BE CENTERED APPROXIMATELY 1/4" FROM THE END OF THE SLOT. DO NOT TIGHTEN THE SCREWS.
- REMOVE THE SCREW FROM ONE END OF THE MOUNTING BRACKET AND PIVOT IT AWAY FROM THE ACTUATOR.
- LOOSEN THE UNIVERSAL CLAMP AND, MAKING SURE NOT TO MOVE THE DAMPER SHAFT, ROTATE THE ACTUATOR APPROXIMATELY 5° IN THE DIRECTION WHICH WOULD OPEN THE DAMPER.
- TIGHTEN THE UNIVERSAL CLAMP TO THE SHAFT USING A 10mm WRENCH OR SOCKET USING 6-8 ft-lb OF TORQUE.
- ROTATE THE ACTUATOR TO APPLY PRESSURE TO THE DAMPER SEALS AND RE-ENGAGE THE ANTI-ROTATION STRAP.
- TIGHTEN ALL FASTENERS.

SHORT SHAFT MOUNTING INSTRUCTIONS - BELIMO LF & NF SERIES ACTUATORS

- DETERMINE THE BEST ORIENTATION FOR THE UNIVERSAL CLAMP ON THE BACK OF THE ACTUATOR (WHERE YOU HAVE THE EASIEST ACCESS TO THE V-BOLT NUTS ON THE CLAMP).
 - ENGAGE THE CLAMP TO THE ACTUATOR AS CLOSE AS POSSIBLE TO THE DETERMINED LOCATION.
 - LOCK THE CLAMP IN PLACE USING THE REMAINING RETAINER CLIP.
 - FOLLOW STEPS 5-12 OF THE *STANDARD MOUNTING INSTRUCTIONS* TO COMPLETE THE SHORT SHAFT INSTALLATION.
- NOTE: ACTUATORS SHOULD BE MOUNTED INDOORS IN A DRY, CLEAN ENVIRONMENT FREE OF CORROSIVE FUMES. A PROTECTIVE ENCLOSURE MUST BE USED WHEN MOUNTED OUTDOORS. INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

DM-3 DAMPER MOTOR - BELIMO GM, AM, LF & NM SERIES ACTUATORS



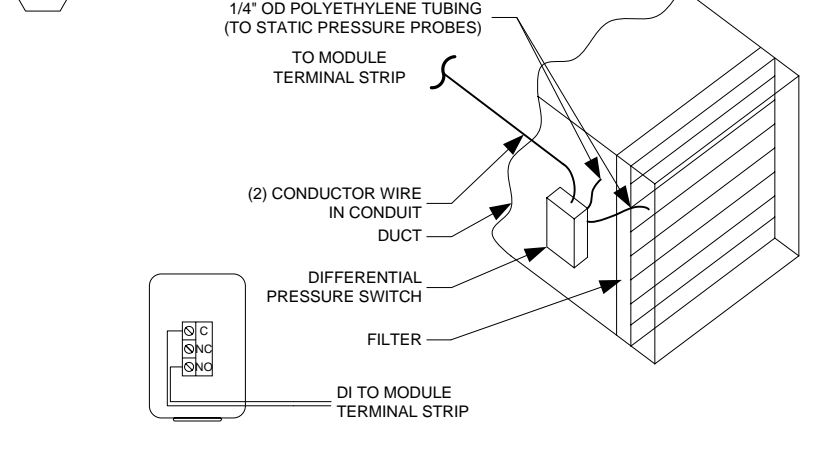
STANDARD MOUNTING INSTRUCTIONS - BELIMO GM & NM SERIES ACTUATORS

- SLIP THE ACTUATOR'S UNIVERSAL CLAMP OVER THE DAMPER SHAFT. MAKE SURE THAT THE BOTTOM OF THE ACTUATOR (METAL SIDE) IS TOWARD THE DUCT AND THE CONTROLS ON THE COVER ARE ACCESSIBLE. PLACE THE ACTUATOR IN THE DESIRED MOUNTING POSITION.
- TURN THE DAMPER SHAFT UNTIL THE BLADES ARE FULLY CLOSED.
- HAND TIGHTEN THE (2) NUTS ON THE UNIVERSAL CLAMP.
- SLIDE THE STUD OF THE ANTI-ROTATION BRACKET INTO THE SLOT IN THE BOTTOM OF THE ACTUATOR. BEND THE STRAP AS NEEDED TO SUPPORT THE REAR OF THE ACTUATOR.
- FASTEN THE STRAP TO THE DUCT WITH (2) SCREWS (#8 SELF TAPPING SHEET METAL SCREWS).
- LOOSEN THE (2) NUTS ON THE UNIVERSAL CLAMP. DISENGAGE THE ACTUATOR GEAR TRAIN BY PRESSING THE "MANUAL OVERRIDE BUTTON." KEEPING THE GEARS DISENGAGED, AND THE DAMPER FULLY CLOSED, ROTATE THE CLAMP UNTIL IT IS ABOUT 5° FROM THE CLOSED POSITION.
- TIGHTEN THE (2) NUTS ON THE CLAMP WITH A 10mm WRENCH. USE 9-11 ft-lb OF TORQUE.

SHORT SHAFT MOUNTING INSTRUCTIONS - BELIMO GM & NM SERIES ACTUATORS

- DISENGAGE THE GEARS WITH THE MANUAL RELEASE BUTTON ON THE CASING.
 - TURN THE ACTUATOR CLAMP BACK TO 5 DEGREES BEFORE CLOSED POSITION AND ALLOW GEARS TO RE-ENGAGE.
 - PULL OUT THE UNIVERSAL CLAMP AFTER REMOVING THE RETAINING CLIP.
 - FIX THE UNIVERSAL CLAMP ONTO THE DAMPER SHAFT.
 - MOVE THE DAMPER INTO THE CLOSED POSITION.
 - POSITION THE ACTUATOR ONTO THE UNIVERSAL CLAMP.
 - REFIT THE RETAINING CLIP.
 - IF NECESSARY, BEND OR CUT THE ANTI-ROTATION STRAP ON EITHER SIDE TO FIT THE DAMPER FRAME.
 - SLIDE THE STUD OF THE ANTI-ROTATION STRAP INTO THE SLOT ON THE ACTUATOR BASE AND FIX IT WITH THE SCREWS TO THE DAMPER FRAME.
- NOTE: ACTUATORS SHOULD BE MOUNTED INDOORS IN A DRY, CLEAN ENVIRONMENT FREE OF CORROSIVE FUMES. A PROTECTIVE ENCLOSURE MUST BE USED WHEN MOUNTED OUTDOORS. INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

DPS-1 AIR DIFFERENTIAL PRESSURE SWITCH



MOUNTING INSTRUCTIONS - DP SWITCH

- SELECT A LOCATION THAT IS FREE FROM VIBRATION, CORROSIVE ATMOSPHERE AND WHERE THE AMBIENT TEMPERATURE IS WITHIN THE LIMITS FOR THE SWITCH.**
- MOUNT STANDARD SWITCHES WITH THE DIAPHRAGM IN A VERTICAL PLANE AND WITH SWITCH LETTERING AND NAMEPLATE IN AN UPRIGHT POSITION. SOME SWITCHES MAY NOT RESET PROPERLY IF MOUNTED IN THE WRONG POSITION.
- CONNECT SWITCH TO SOURCE OF PRESSURE, VACUUM OR DIFFERENTIAL PRESSURE. POLYETHYLENE TUBING WITH 1/4" O.D. IS RECOMMENDED. CONNECT TO THE (2) 1/8" NPT FEMALE PRESSURE PORTS AS NOTED BELOW:
 - DIFFERENTIAL PRESSURES-CONNECT PIPES OR TUBES FROM SOURCE OF GREATER PRESSURE TO HIGH PRESSURE PORT MARKED HI-PR AND FROM SOURCE OF LOWER PRESSURE TO LOW PRESSURE PORT MARKED LO-PR.
 - PRESSURE ONLY-CONNECT TUBE FROM SOURCE OF PRESSURE TO HIGH PRESSURE PORT. THE LOW PRESSURE PORT IS LEFT OPEN TO ATMOSPHERE.
 - VACUUM ONLY-CONNECT TUBE FROM SOURCE OF VACUUM TO LOW PRESSURE PORT. THE HIGH PRESSURE PORT IS LEFT OPEN TO ATMOSPHERE.
- ELECTRICAL CONNECTION TO THE SPDT SNAP SWITCH ARE PROVIDED BY MEANS OF SCREW TERMINALS.

MOUNTING INSTRUCTIONS - STATIC PRESSURE PROBES

- INSTALLATION IS COMPLETED BY DRILLING A 1/4" HOLE IN THE SHEET METAL, INSERTING THE PROBE AND SECURING THE ASSEMBLY BY USING THE MOUNTING FLANGE AS A TEMPLATE TO MARK AND DRILL (2) HOLES FOR THE SELF TAPPING SHEET METAL SCREWS.
- NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

Adjusting the Flow Switch Paddle

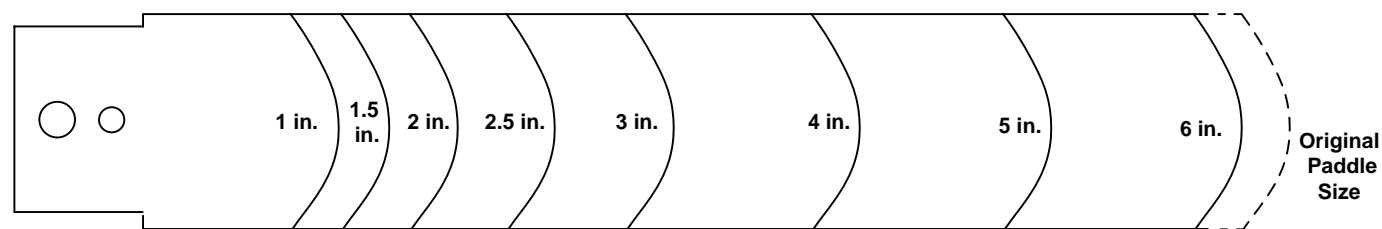


Figure 5: Trimming Template for the Extra Paddle

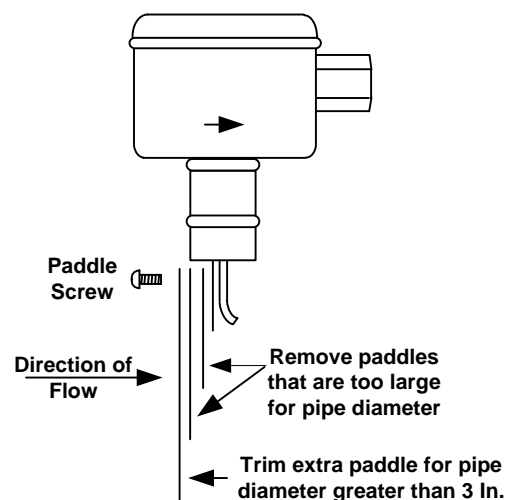


Figure 6: Installing the Paddle

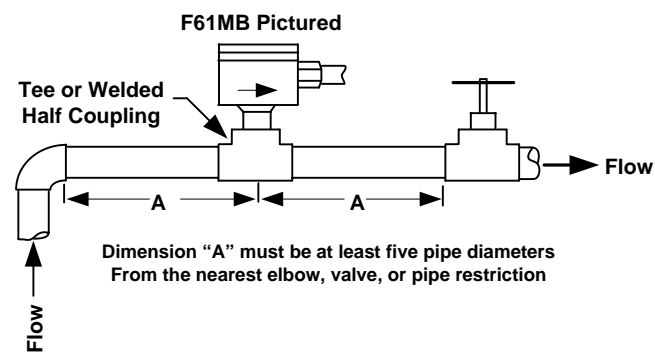


Figure 7: Typical Installation

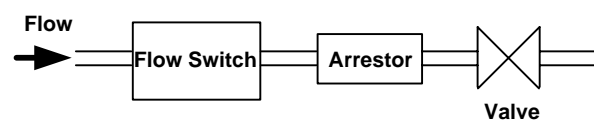


Figure 8: Arrestor Location Schematic

- The F61 comes with a 3-piece paddle (1", 2" & 3" segments) installed. Each piece is removable. Adjust the paddle size of the pipe in which it will be installed. For 1", 2" or 3" pipe, use the paddle segments as supplied.
- If longer paddle is required, the extra paddle may be trimmed to fit 6" or smaller diameter pipe. Use Figure 5 to trim the paddle at the arc corresponding with the pipe size.

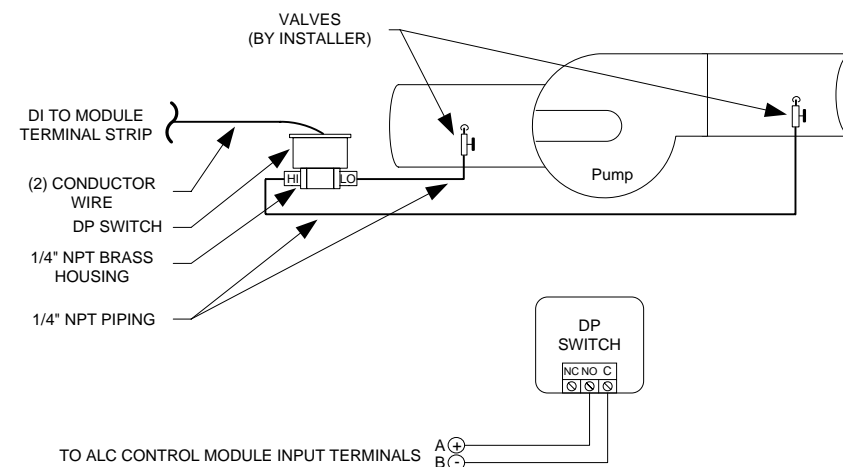
MOUNTING:

- Mount the F61 in a section of pipe where there is a straight run of at least 5 pipe diameters on each side of the flow switch.
- The switch should be mounted so the terminals or wire leads are easily accessible for wiring.
- These flow switches must not be subjected to water hammer. If a fast-closing valve is located downstream of the flow switch, a suitable water hammer arrester must be used.
- Mount the flow switch in a standard 1" x 1" x 1" tee for 1" pipe installation. Use a reducing tee for larger sizes of pipe to keep the flow switch close to the pipe and provide adequate paddle length in the flow stream.
- Screw the flow switch in position so the flat of the paddle is at a right angle to the flow. The arrow on the side of the case must point in the direction of the flow.
- The F61 flow switch may be mounted on a horizontal pipe line or a vertical pipe line with upward liquid flow. It is not recommended for installations with downward flow.

WIRING:

- Make all wiring connections using proper copper conductors only.
- Install all wiring in accordance with NEC and local regulations.
- On F61KB and F61LB models, use the terminal screws furnished (8-32 x 1/4" binder head) Substitution of other screws will void warranty.
- On F61MB models, use external wire leads.

DPS-2 PUMP DIFFERENTIAL PRESSURE SWITCH



MOUNTING INSTRUCTIONS

MOUNT UNIT IN ANY POSITION. LOCATE WHERE SHOCK AND VIBRATION ARE MINIMAL AND AMBIENT TEMPERATURE IS BELOW 161 F (71 C).

SURFACE MOUNTING - INSERT (2) #6 SCREWS THROUGH HOLES ON 2" CENTERS.

SUSPENDED UNIT MOUNTING - MOUNT UNIT FROM ITS (2) PORTS. ALWAYS HOLD A WRENCH ON PRESSURE PORT WHEN MAKING PRESSURE CONNECTION.

MAKING PRESSURE CONNECTION - CONNECT HIGH SIDE PRESSURE TO THE PORT LABELED HIGH. USE A WRENCH ON PRESSURE PORT AND HOLD THE UNIT STEADY. THREAD A 1/4" NPTM FITTING INTO THE PORT.

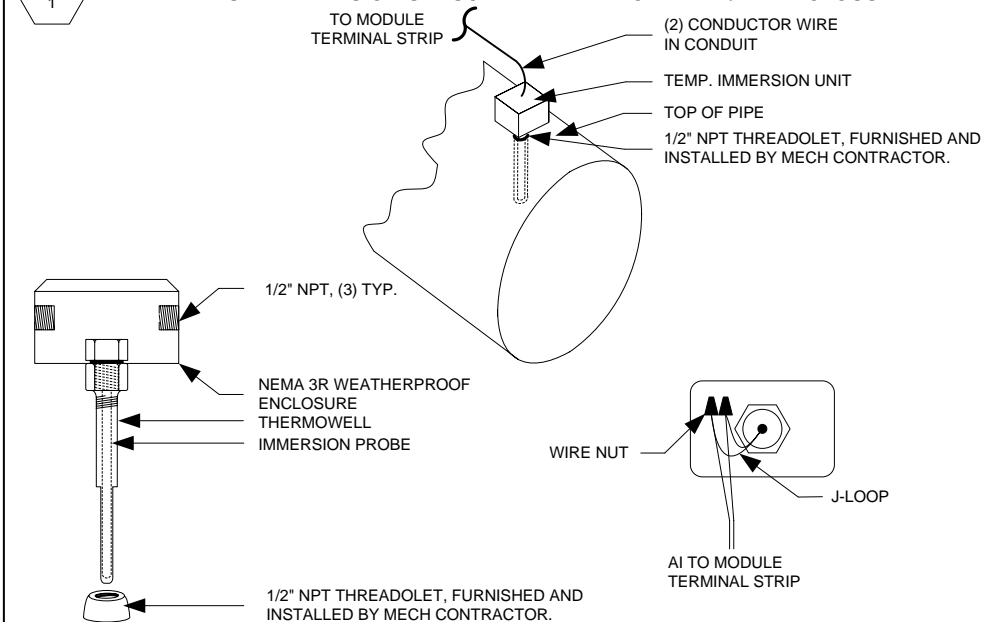
CAUTION: NEVER TIGHTEN BY TURNING THE CONTROL INTO THE FITTING.

WIRING - BACK OUT THE SCREW TERMINAL JUST ENOUGH TO PUT THE STRIPPED WIRE UNDER THE TERMINAL BLOCK CLAMP. MAXIMUM WIRE SIZE IS 16AWG.

SET POINT ADJUSTMENT - USE A SCREWDRIVER TO TURN THE EXTERNAL ADJUSTING SCREW. TURN "IN" (CLOCKWISE) TO INCREASE DIFFERENTIAL PRESSURE SETTING (1 TURN = 1.5 PSID). FOR BEST SETTING ACCURACY, SET THE SWITCH USING THE ACTUAL WORKING PRESSURE ENCOUNTERED IN THE APPLICATION.

NOTE: ISOLATION VALVES MUST BE INSTALLED AT THE PIPE TAP. VALVES TO BE FURNISHED BY OTHERS.

TIS-1 TEMPERATURE IMMERSION SENSOR AND THERMOWELL W/WP ENCLOSURE

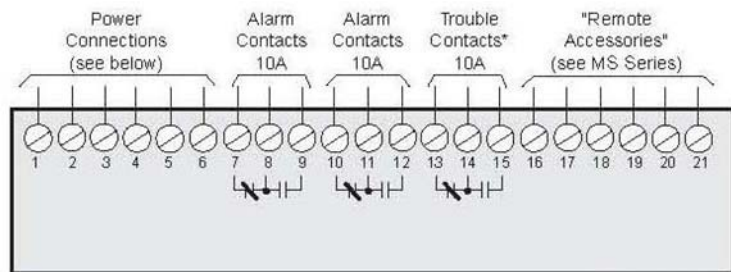


MOUNTING INSTRUCTIONS - IMMERSION UNIT

1. THE THERMOWELL THREADS INTO A 1/2" FNPT THREADOLET FURNISHED AND INSTALLED BY THE MECHANICAL CONTRACTOR.
 2. THE IMMERSION UNIT THREADS INTO A 1/2" FNPT THERMOWELL. NO EXTERNAL HARDWARE IS NEEDED. THERMALLY CONDUCTIVE GREASE MUST BE APPLIED TO THE PROBE PRIOR TO INSERTION TO OPTIMIZE HEAT TRANSFER. NOTE: THE THERMOWELLS ARE DESIGNED TO CONNECT THE 1 1/8" HEX NUT TO THE IMMERSION FITTING ON THE UNIT, DO NOT OVER TIGHTEN OR DAMAGE TO THE FITTING MAY OCCUR.
 3. TERMINATE THE UNIT AS SHOWN ABOVE.
 4. INCORPORATE A "J-LOOP" INTO THE TERMINATION. A "J-LOOP" IS FORMED BY POINTING THE WIRE NUTS OF A TERMINATION UP CREATING A "J" IN THE CABLE IN ORDER TO REDUCE THE PROBABILITY OF CONDENSATION COLLECTING IN THE WIRE NUT.
 5. USE LIQUID TIGHT FITTINGS WITH THE NEMA 3R WEATHERPROOF ENCLOSURE.
- NOTE: INSTALL FLEXIBLE CONDUIT FOR ALL CABLE OR WIRE BROUGHT TO END DEVICE FROM JUNCTION BOX. FLEXIBLE CONDUIT SHOULD NOT EXCEED 18".

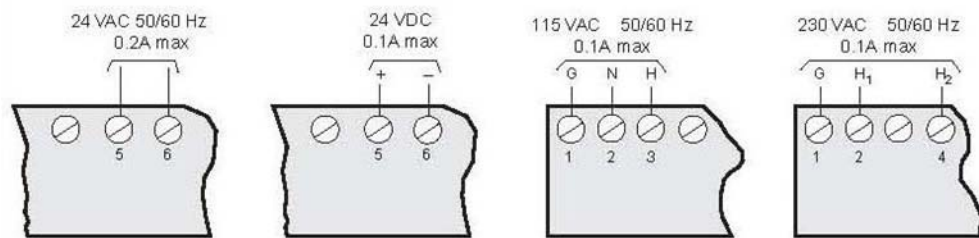
SMK

SMOKE DETECTOR



CAUTION: For terminals 7, 8, 9, 10, 11, and 12, do not use looped wire under terminals. Break wire run to provide supervision of connections.

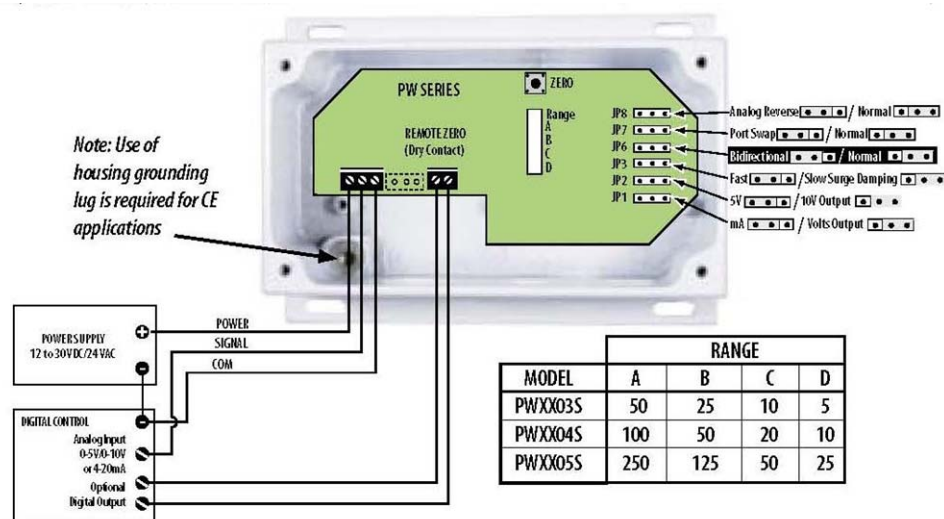
*Trouble contacts are shown in non-energized condition. Under normal operation contacts will be reversed.



Power Connections

DPT 3

WET PRESSURE DIFFERENTIAL 3-WIRE



Note: Use of housing grounding lug is required for CE applications

MODEL	RANGE			
	A	B	C	D
PWXX03S	50	25	10	5
PWXX04S	100	50	20	10
PWXX05S	250	125	50	25

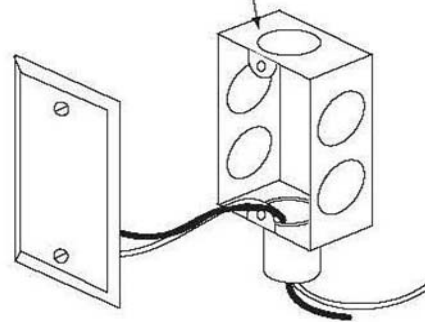
SS

BRUSHED ALUMINUM OR STAINLESS STEEL WALL PLATE TEMPERATURE SENSOR

Toggle bolts or other direct wall-mount screws can be used where conduit is not required. Adapters are not required when mounting directly to electrical outlet boxes. Tighten mounting screws, crushing foam gasketing until plate edges lightly touch the wall. Insulate or seal all interior holes to prevent drafts from affecting the temperature readings. Terminate with butt splices or soldering. Wire nuts are not recommended.

Basic model comes with screws for stainless steel faceplate, two #6-32 screws for handy-box mounting, and 8' (2.4m) of 24 AWG wire. Security screws (XS Option) are #6-32 with a spanner head.

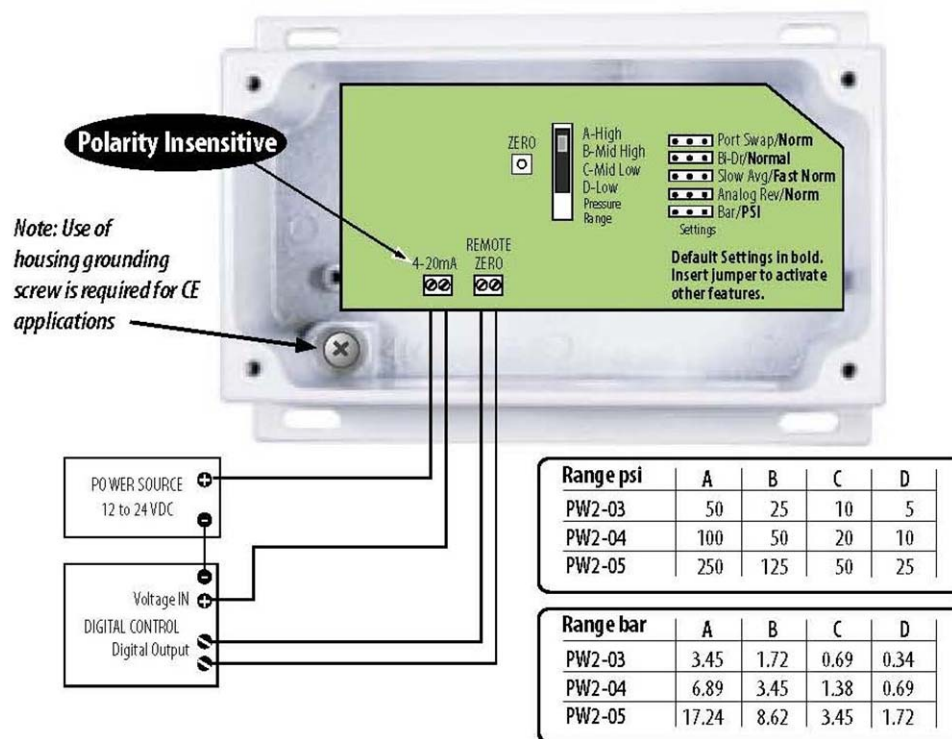
Optional Customer-Supplied Handy Box



The sensor should be mounted approximately five feet above the floor, on an interior wall, away from any heating or cooling generating devices.

DPT 2

WET PRESSURE DIFFERENTIAL 2-WIRE



Polarity Insensitive

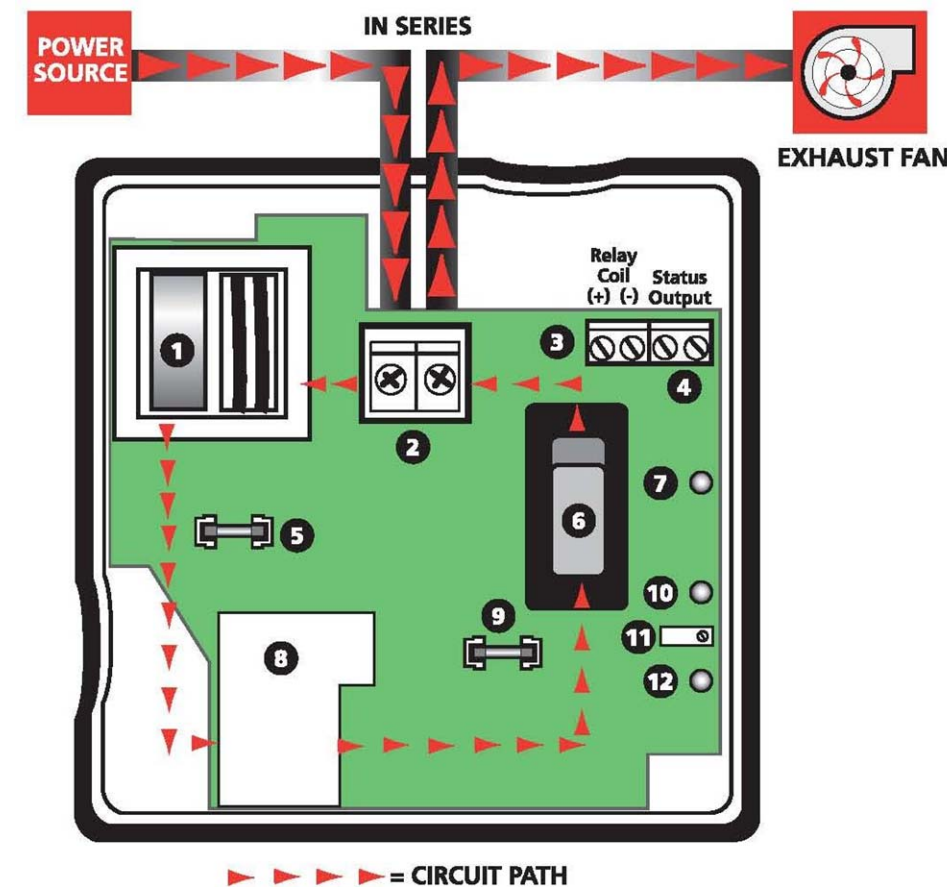
Note: Use of housing grounding screw is required for CE applications

Range psi	A	B	C	D
PW2-03	50	25	10	5
PW2-04	100	50	20	10
PW2-05	250	125	50	25

Range bar	A	B	C	D
PW2-03	3.45	1.72	0.69	0.34
PW2-04	6.89	3.45	1.38	0.69
PW2-05	17.24	8.62	3.45	1.72

H548

FRACTIONAL HP MOTOR STATUS SENSOR / COMMAND RELAY

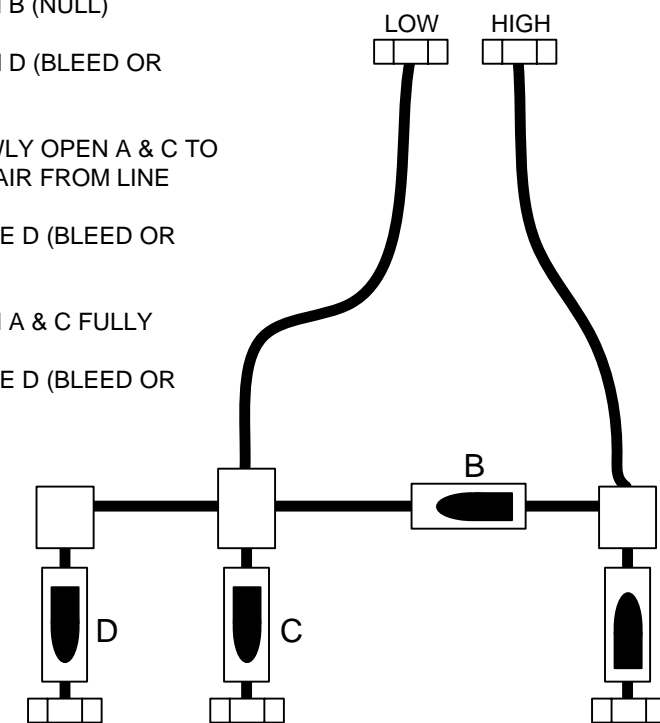


▶▶▶▶ = CIRCUIT PATH

WPV 2

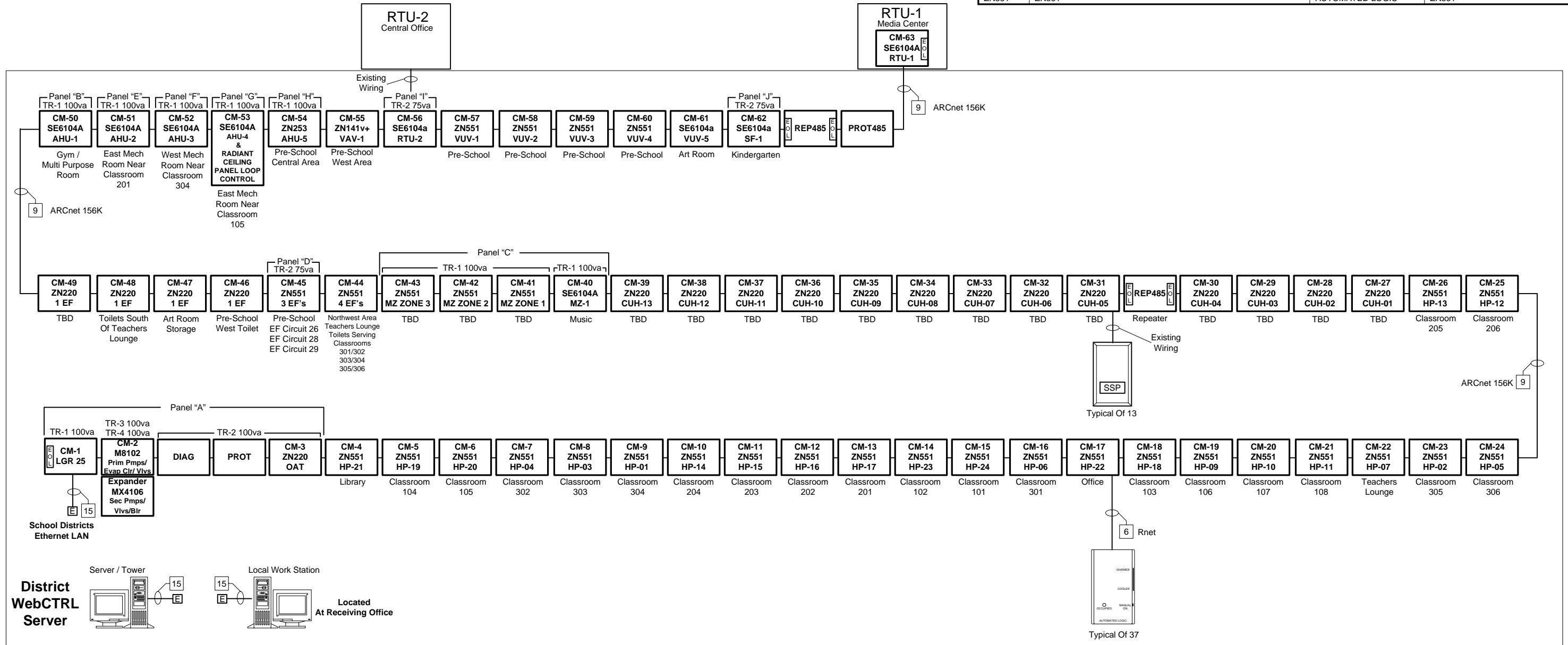
WET PRESSURE BYPASS VALVE ASSEMBLY

1. OPEN B (NULL)
2. OPEN D (BLEED OR PURGE)
3. SLOWLY OPEN A & C TO BLEED AIR FROM LINE
4. CLOSE D (BLEED OR PURGE)
5. OPEN A & C FULLY
6. CLOSE D (BLEED OR PURGE)



Network Riser

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
BT485	END OF LINE SEGMENT CONDITIONER	AUTOMATED LOGIC	BT485	6 ea
DIAG485	ARC156 DIAGNOSTIC DEVICE	AUTOMATED LOGIC	DIAG485	1 ea
LGR25	LGR25	AUTOMATED LOGIC	LGR25	1 ea
M8102	M8102 DDC CONTROLLER	AUTOMATED LOGIC	M8102	1 ea
MX4106	MX4106	AUTOMATED LOGIC	MX4106	1 ea
PROT485	ARC156 PROTECTION DEVICE	AUTOMATED LOGIC	PROT485	2 ea
REP485	REPEATER	AUTOMATED LOGIC	REP485	2 ea
RSPL	ROOM SENSOR WITH ADJUSTMENT AND OVERRIDE	AUTOMATED LOGIC	RSPL	37 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	9 ea
SSP	STAINLESS STEEL WALL PLATE SENSOR	BAPI	ALC/10K-2-SP	13 ea
ZN141v+	ZN141V+	AUTOMATED LOGIC	ZN141V+	1 ea
ZN220	ZN220	AUTOMATED LOGIC	ZN220	18 ea
ZN253	ZN253	AUTOMATED LOGIC	ZN253	1 ea
ZN551	ZN551	AUTOMATED LOGIC	ZN551	32 ea



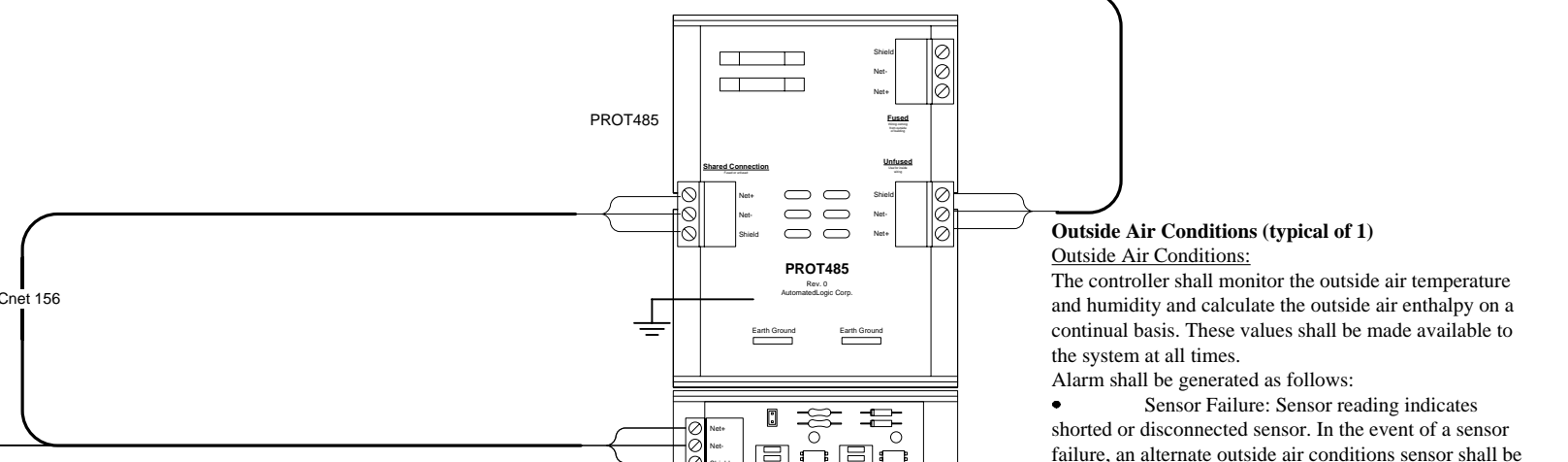
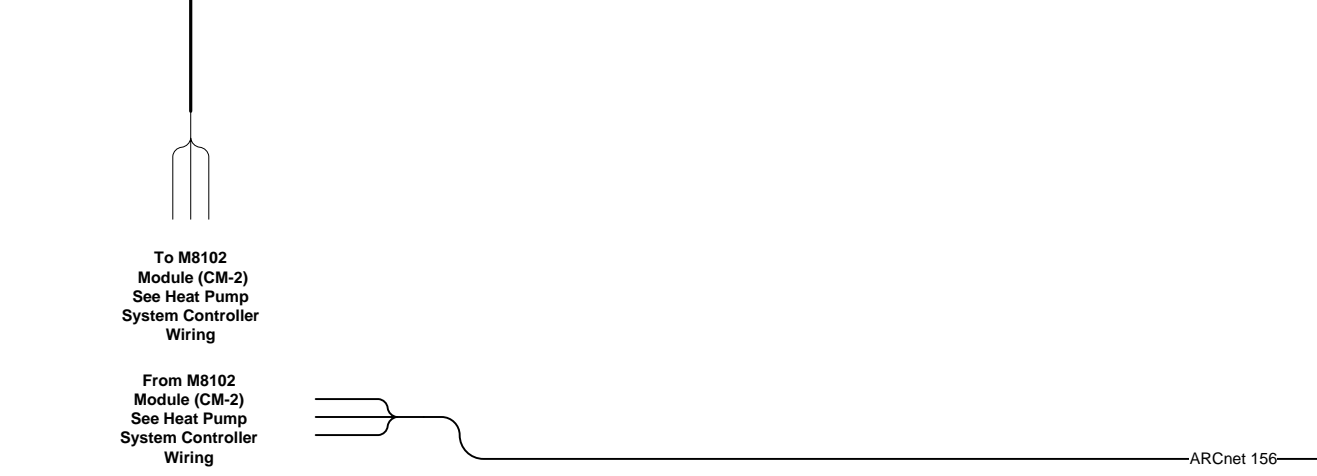
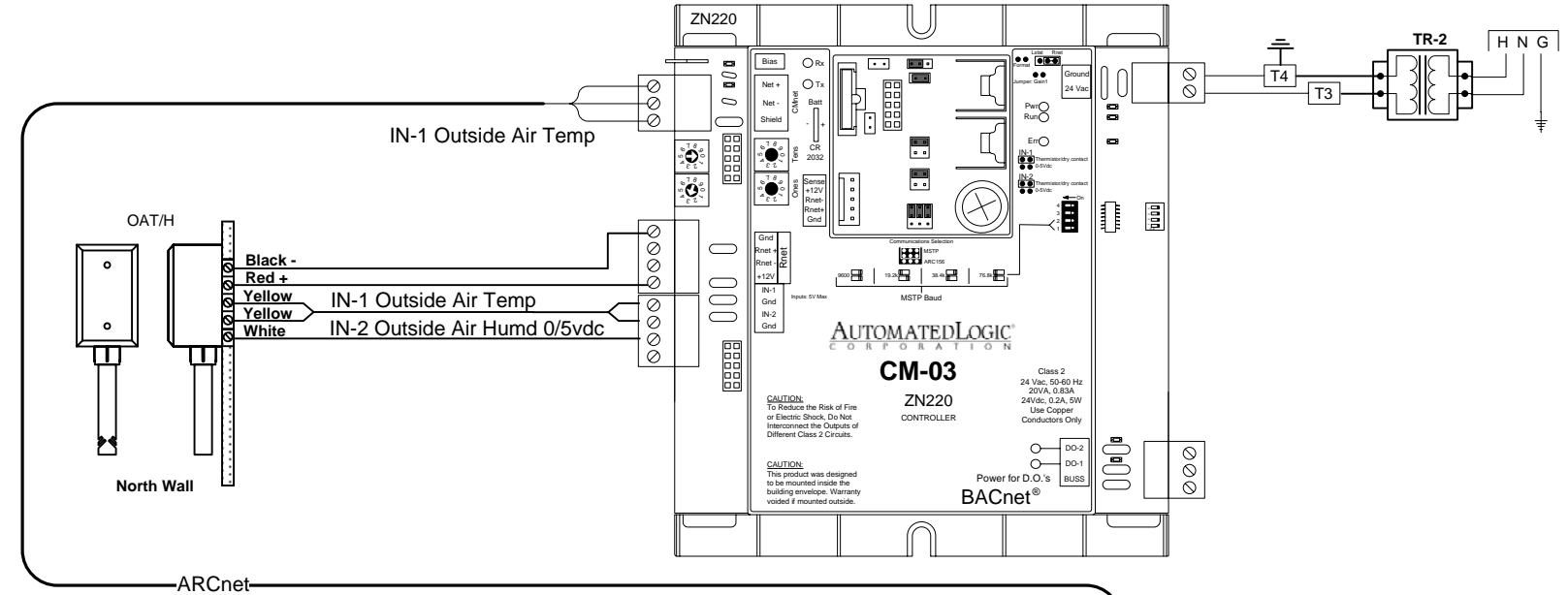
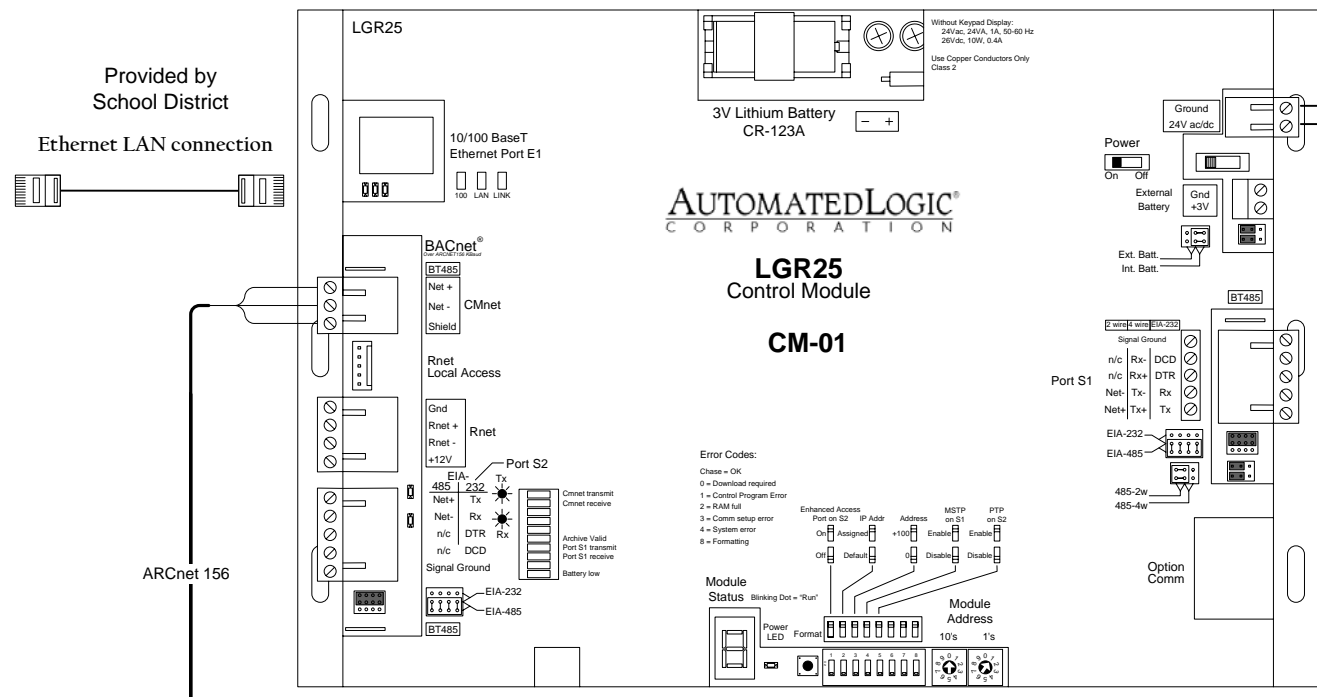
Elementary School			
Michigan 48xxx			
Metro Environmental, Inc.			
Network Riser			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			11 of 46

Note: Actual communications network layout to modules will be shown on the "As Built" drawings.

6 See page 5 for cable identification

LGR & OAT Controller Wiring

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
DIAG485	ARC156 DIAGNOSTIC DEVICE	AUTOMATED LOGIC	DIAG485	0 ea
LGR25	LGR25	AUTOMATED LOGIC	LGR25	0 ea
OAT/H	OUTSIDE AIR TEMPERATURE AND HUMIDITY SENSOR	BAPI	ALC/10K-2-H300-O-WP	1 ea
PANEL A	36X30 ENCLOSURE+PERF+KEYLOCKKIT	HOFFMAN	A-36N30ALP+A36N30MPP+AL12	1 ea
PROT485	ARC156 PROTECTION DEVICE	AUTOMATED LOGIC	PROT485	0 ea
PS	POWER SUPPLY 24VAC IN 24VDC OUT	KELE	DCP-1.5W	1 ea
TR-1,2,3,4	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	4 ea
ZN220	ZN220	AUTOMATED LOGIC	ZN220	0 ea



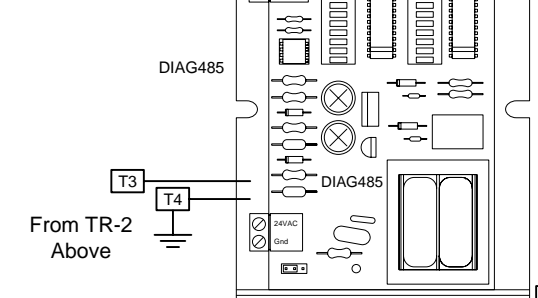
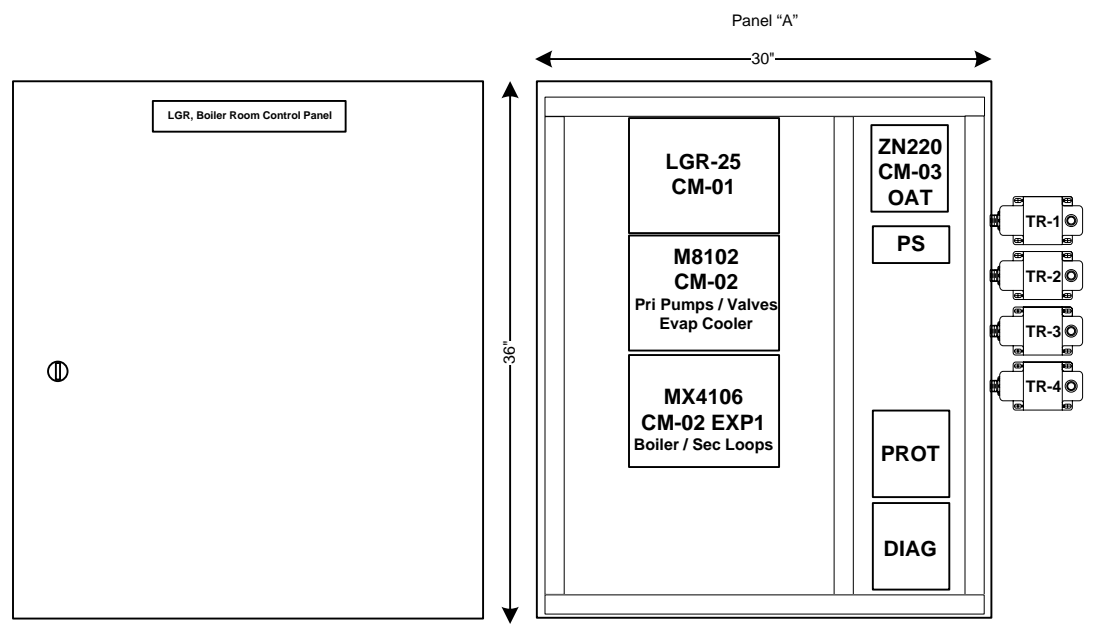
Outside Air Conditions (typical of 1) Outside Air Conditions:
 The controller shall monitor the outside air temperature and humidity and calculate the outside air enthalpy on a continual basis. These values shall be made available to the system at all times.
 Alarm shall be generated as follows:

- Sensor Failure: Sensor reading indicates shorted or disconnected sensor. In the event of a sensor failure, an alternate outside air conditions sensor shall be made available to the system without interruption in sensor readings.

If an OA Temp Sensor cannot be read, a default value of 65°F will be used.
 If an OA Humidity Sensor cannot be read, a default value of 50 % will be used.

Outside Air Temperature History:
 The controller shall monitor and record the high and low temperature readings for the outside air. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Refer to Network Riser Drawing Sheet # 11

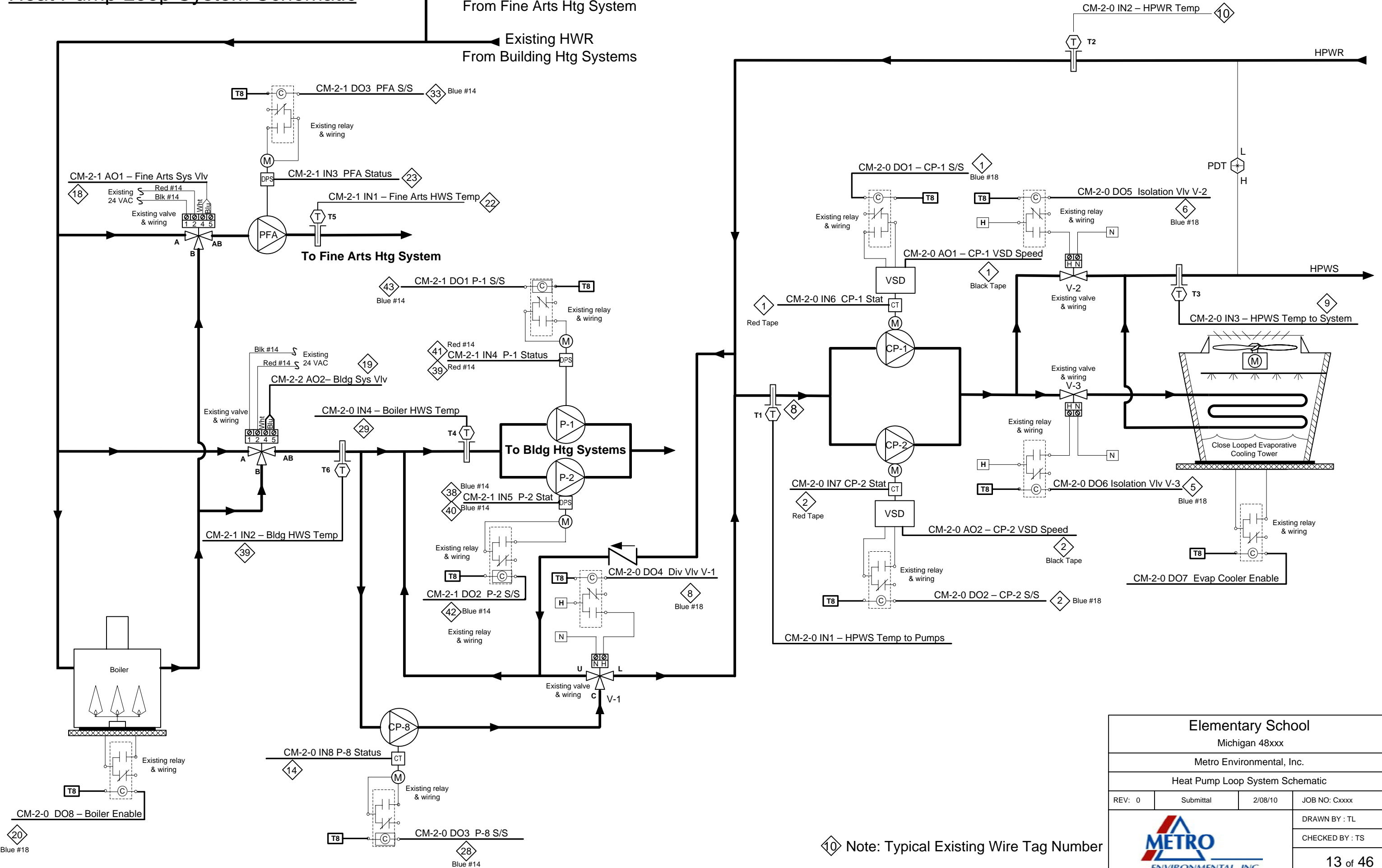


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Metro Environmental, Inc.			
LGR & OAT Controller Wiring			
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			DRAWN BY : TL
			CHECKED BY : TS
			12 of 46

Heat Pump Loop System Schematic

Existing HWR
From Fine Arts Htg System

Existing HWR
From Building Htg Systems

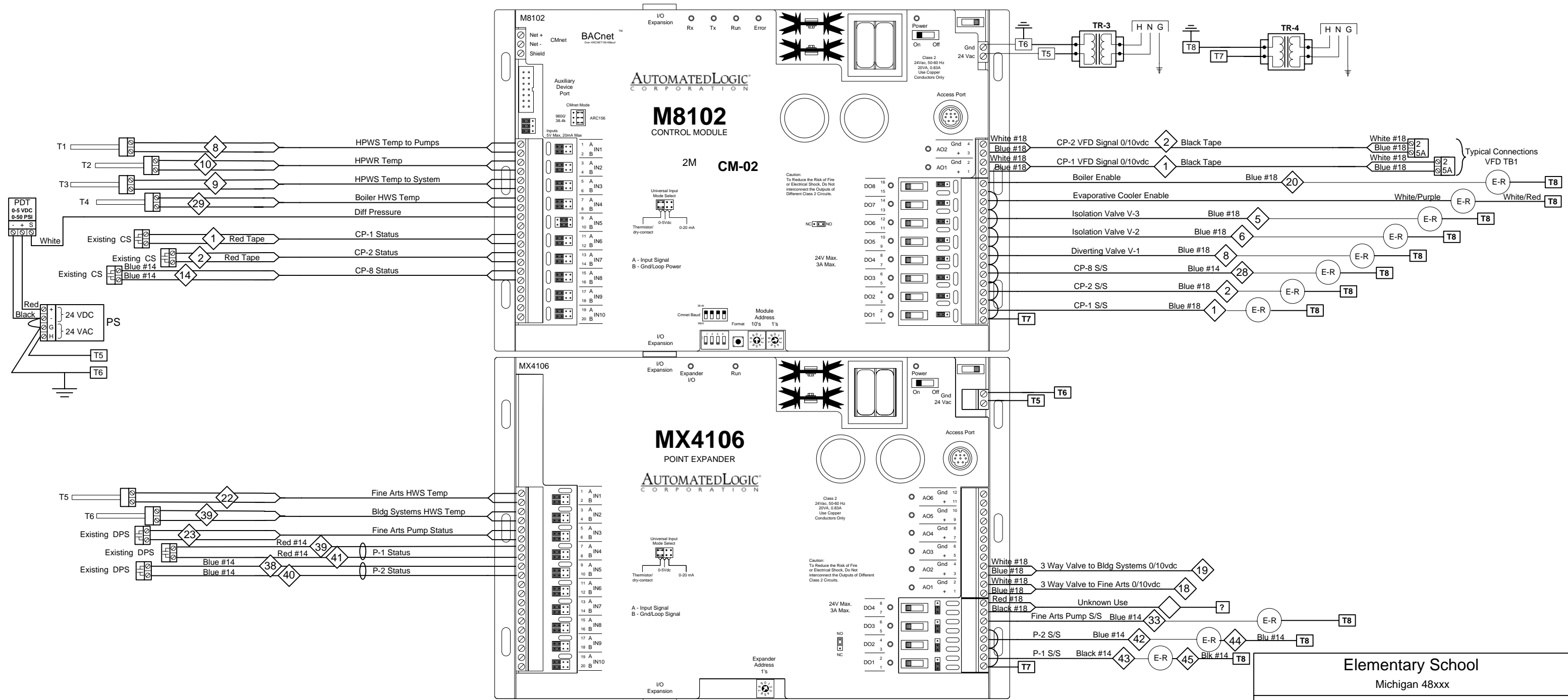


⬠ Note: Typical Existing Wire Tag Number

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Metro Environmental, Inc.			
Heat Pump Loop System Schematic			
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			DRAWN BY : TL
			CHECKED BY : TS
			13 of 46

Heat Pump Loop System Controller Wiring

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
E-CS	EXISTING CURRENT SWITCH SOLID CORE	VERIS	E112-708	6 ea
E-R	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	11 ea
M8102	M8102 DDC CONTROLLER	AUTOMATED LOGIC	M8102	0 ea
MX4106	MX4106	AUTOMATED LOGIC	MX4106	0 ea
PDT	DIFF PRESS TRANSMITTER 0-50 PSI, 0-5 VDC OUT, 24 VDC IN	VERIS	PWLX03S	1 ea
PS	POWER SUPPLY 24VAC IN 24VDC OUT	KELE	DCP-1.5W	0 ea
T1 to T6	IMMERSION TEMP SENSOR	BAPI	ALC/10K-2-1-4"	6 ea
TR-1,2,3,4	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	0 ea



⬠ Note: Typical Existing Wire Tag Number

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Michigan 48xxx

Metro Environmental, Inc.

Heat Pump Loop System Controller Wiring

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CHECKED BY : TS

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14 of 46

Heat Pump Loop System Sequence

Heat Pump Loop General Sequence of Operation:

Heating Mode:

- 1: The Diverting Valve V-1 will route water as required by the HPWR (T2) Temp sensor to the Heat Pump Loop.
- 2: When the HPWR (T2) temperature is less than 76°F (adj.) Isolation Valve V-2 shall open, and Isolation Valve V-3 will be closed
- 3: V-1 will open to permit hot water flow to the Heat Pump Loop only if the temperature at HPWR (T2) Temp sensor is between 64°F (adj.) and 72°F (adj.) and hot water is available at the Boiler HWS (T4) Temp sensor. Valve V-1 will be closed if the temperature at HPWS (T1) rises above 75°F (adj.)
- 4: When the HPWR (T2) temperature is greater than 77°F (adj.), Valve V-2 will close and V-3 will open.
- 5: Circ Pump 8 will run whenever Boiler is enabled (less than 65°F (adj.) OAT). See Boiler sequence.

Cooling Mode:

- 1: Diverting Valve V-1 will be closed to the Heat Pump Loop.
- 2: Isolation Valve V-2 will be closed, and Isolation Valve V-3 will be open to the Evaporative Cooler.
- 3: Evaporative Cooler will be enabled.

General:

Heat Pump Water Loop CP-1/CP-2 Lead/Lag Operation:

The two water pumps shall operate in a lead/lag fashion.

- The lead pump shall run first.
- On failure of the lead pump, the lag pump shall run and the lead pump shall turn off.
- On decreasing water differential pressure, the lag pump shall stage on and run in unison with the lead pump to maintain water differential pressure setpoint.

The designated lead pump shall rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms shall be provided as follows:

- CP-1 Pump 1
 - Failure: Commanded on, but the status is off.
 - Running in Hand: Commanded off, but the status is on.
 - Runtime Exceeded: Status runtime exceeds a user definable limit.
- CP-2 Pump 2
 - Failure: Commanded on, but the status is off.
 - Running in Hand: Commanded off, but the status is on.
 - Runtime Exceeded: Status runtime exceeds a user definable limit.

Heat Pump Loop Water Differential Pressure Control:

The controller shall measure Heat Pump Loop water differential pressure and modulate the hot water pump VFDs in sequence to maintain its water differential pressure setpoint.

The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

The controller shall modulate Heat Pump Loop water pump speeds to maintain a water differential pressure of 12lb_f/in² (adj.). The VFDs minimum speed shall not drop below 20% (adj.).

On dropping Heat Pump Loop water differential pressure, the VFDs shall stage on and run to maintain setpoint as follows:

- The controller shall modulate the lead VFD to maintain setpoint.
- If the lead VFD speed is greater than a setpoint of 90% (adj.), the lag VFD shall stage on.
- The lag VFD shall ramp up to match the lead VFD speed and then run in unison with the lead VFD to maintain setpoint.

On rising Heat Pump Loop water differential pressure, the VFDs shall stage off as follows:

- If the VFDs speeds drops back to 60% (adj.) below setpoint, the lag VFD shall stage off.
- The lead VFD shall continue to run to maintain setpoint.

Alarms shall be provided as follows:

- High Water Differential Pressure: If 25% (adj.) greater than setpoint.

Low Water Differential Pressure: If 25% (adj.) less than setpoint.

Boiler System - Run Conditions:

The boiler system shall be enabled to run whenever outside air temperature is less than 65°F (adj.).

To prevent short cycling, the boiler system shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.

Each boiler shall run subject to its own internal safeties and controls.

The boiler system shall also run for freeze protection whenever outside air temperature is less than 38°F (adj.)

Boiler Enable:

The boiler shall be enabled when the boiler system is commanded on. The boiler shall be enabled after pump status is proven on and shall run subject to its own internal safeties and controls.

General Building Heating System:

Hot Water Pumps P-1/P-2 Lead/Standby Operation:

The two hot water pumps shall operate in a lead/standby fashion.

- The lead pump shall run first.
- On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

The designated lead pump shall rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms shall be provided as follows:

- Hot Water Pump 1
 - Failure: Commanded on, but the status is off.
 - Running in Hand: Commanded off, but the status is on.
 - Runtime Exceeded: Status runtime exceeds a user definable limit.
- Hot Water Pump 2
 - Failure: Commanded on, but the status is off.
 - Running in Hand: Commanded off, but the status is on.
 - Runtime Exceeded: Status runtime exceeds a user definable limit.

Secondary Hot Water Supply Temperature Setpoint:

The secondary hot water supply temperature setpoint shall reset based on outside air temperature.

As outside air temperature rises from 0°F (adj.) to 70°F (adj.) the secondary hot water supply temperature setpoint shall reset downwards from 180°F (adj.) to 110°F (adj.).

Alarms shall be provided as follows:

- High Secondary Hot Water Supply Temp: If greater than 200°F (adj.).
- Low Secondary Hot Water Supply Temp: If less than 100°F (adj.).

Mixing Valve:

The controller shall measure the secondary hot water supply temperature and modulate the mixing valve to maintain its setpoint.

The mixing valve shall be enabled whenever the hot water system is called to run.

The mixing valve shall close whenever the hot water supply temperature rises from 190°F to 200°F (adj.).

Boiler System - Run Conditions:

The boiler system shall be enabled to run whenever outside air temperature is less than 65°F (adj.).

To prevent short cycling, the boiler system shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.

Each boiler shall run subject to its own internal safeties and controls.

The boiler system shall also run for freeze protection whenever outside air temperature is less than 38°F (adj.)

Boiler Enable:

The boiler shall be enabled when the boiler system is commanded on.

The boiler shall be enabled after pump status is proven on and shall run subject to its own internal safeties and controls.

Fine Arts Heating System:

Fine Arts Hot Water Pump:

The hot water pump shall run anytime the boiler is called to run and shall have a user definable delay (adj.) on stop.

Alarms shall be provided as follows:

- Hot Water Pump Failure: Commanded on, but the status is off.
- Hot Water Pump Running in Hand: Commanded off, but the status is on.
- Hot Water Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

Secondary Hot Water Supply Temperature Setpoint:

The secondary hot water supply temperature setpoint shall reset based on outside air temperature.

As outside air temperature rises from 0°F (adj.) to 70°F (adj.) the secondary hot water supply temperature setpoint shall reset downwards from 180°F (adj.) to 110°F (adj.).

Alarms shall be provided as follows:

- High Secondary Hot Water Supply Temp: If greater than 200°F (adj.).
- Low Secondary Hot Water Supply Temp: If less than 100°F (adj.).

Mixing Valve:

The controller shall measure the secondary hot water supply temperature and modulate the mixing valve to maintain its setpoint.

The mixing valve shall be enabled whenever the hot water system is called to run.


The mixing valve shall close whenever the hot water supply temperature rises from 190°F to 200°F (adj.).

Evaporative Cooler

Evaporative Cooling Tower - Run Conditions:

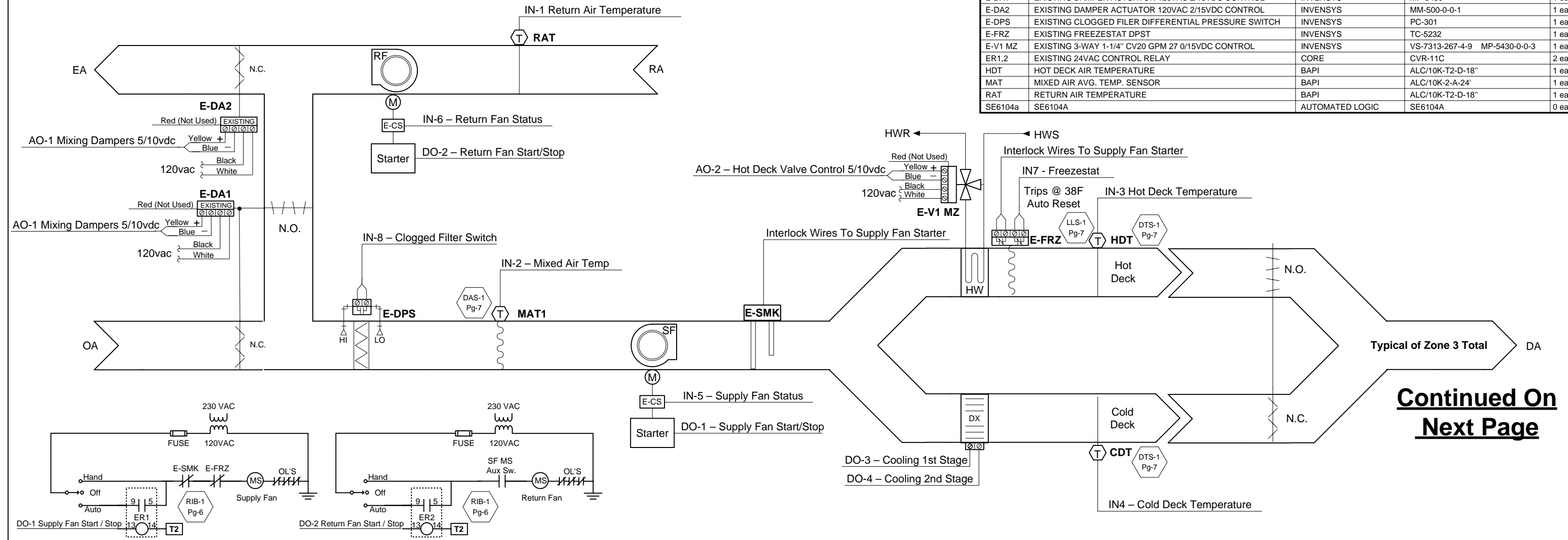
The cooling tower shall be enabled to run whenever the outside air temperature is greater than 54°F (adj.) and the building is Occupied.

The cooling tower condenser water control shall stage its components (spray pump, fan, etc.) in sequence to maintain condenser water supply temperature setpoint. The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field condition

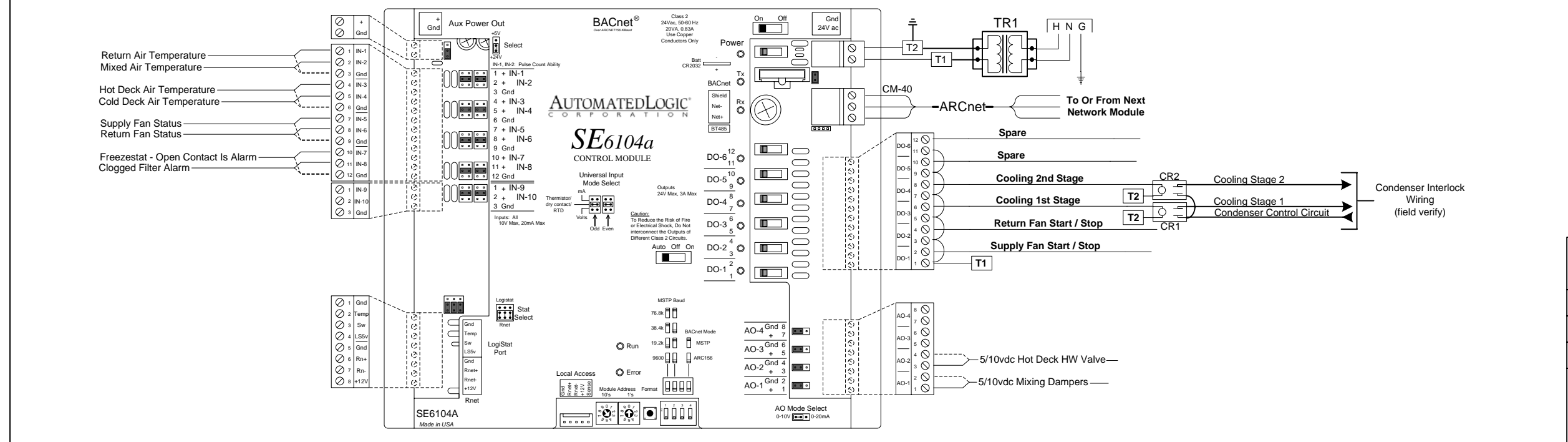
Elementary School			
Michigan 48xxx			
Metro Environmental, Inc.			
Heat Pump Loop System Sequence			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			15 of 46

Multi-Zone MZ-1 Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CDT	COLD DECK AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
CR1,2	COOLING RELAY 24VAC DPDT WITH INDICATING LIGHT	IDEC	RH2B-ULAC24V + SH2B-05 SOCKET	2 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	2 ea
E-DA1	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC CONTROL	INVENSYS	MP-5430	1 ea
E-DA2	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC CONTROL	INVENSYS	MM-500-0-0-1	1 ea
E-DPS	EXISTING CLOGGED FILTER DIFFERENTIAL PRESSURE SWITCH	INVENSYS	PC-301	1 ea
E-FRZ	EXISTING FREEZESTAT DPST	INVENSYS	TC-5232	1 ea
E-V1 MZ	EXISTING 3-WAY 1-1/4" CV20 GPM 27 0/15VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
ER1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
HDT	HOT DECK AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
MAT	MIXED AIR AVG. TEMP. SENSOR	BAPI	ALC/10K-2-A-24"	1 ea
RAT	RETURN AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



Continued On Next Page



Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Multi-Zone MZ-1 Control			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			16 of 46

Multi-Zone MZ-1 Sequence Of Operation

Run Conditions - Scheduled:

The unit will run based upon an operator adjustable schedule.

Emergency Shutdown:

The unit will shut down and generate an alarm upon receiving an emergency shutdown signal.

Freeze Protection:

The unit will shut down and generate an alarm upon receiving a freezestat status.

AHU Optimal Start:

The unit will start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied setpoints. The start time will automatically adjust based on changes in outside air temperature and zone temperatures.

Supply Fan:

The supply fan will run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan will have a user definable (adj.) minimum runtime.

Alarms will be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cold Deck - Cooling Supply Air Temperature Setpoint - Fixed:

The unit will maintain a fixed cooling supply air temperature setpoint of 55°F (adj.).

Cold Deck - Cooling Coil Valve:

The controller will measure the cooling supply air temperature and modulate the cooling coil valve to maintain its cooling setpoint.

The cooling will be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the supply fan status is on.

The cooling coil valve will open to 50% (adj.) whenever the freezestat (if present) is on.

Alarms will be provided as follows:

- High Cooling Supply Air Temp: If the cooling supply air temperature is 5°F (adj.) greater than setpoint.

Hot Deck - Heating Supply Air Temperature Setpoint - Outside Air Reset:

The heating supply air temperature setpoint will reset based on outside air temperature. As outside air temperature drops from 55°F (adj.) to 30°F (adj.) the heating supply air temperature setpoint will reset upwards from 70°F (adj.) to 110°F (adj.).

Hot Deck - Heating Coil Valve:

The controller will measure the heating supply air temperature and modulate the heating coil valve to maintain its setpoint.

The heating will be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the supply fan status is on.

The heating coil valve will open whenever:

- Heating supply air temperature drops from 40°F to 35°F (adj.).
- OR the freezestat (if present) is on.

Alarms will be provided as follows:

- High Heating Supply Air Temp: If the heating supply air temperature is greater than 120°F (adj.).
- Low Heating Supply Air Temp: If the heating supply air temperature is 5°F (adj.) less than setpoint.

Economizer:

The controller will measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the cooling supply air temperature setpoint. The outside air dampers will maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer will be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air enthalpy is less than 28 Btu/lb (adj.)
- AND the outside air temperature is less than the return air temperature.
- AND the outside air enthalpy is less than the return air enthalpy.
- AND the supply fan status is on.

The economizer will close whenever:

- Mixed air temperature drops from 55°F to 46°F (adj.)
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside and gravity relief air dampers will close and the return air damper will open when the unit is off. If Optimal Start Up is available the mixed air damper will operate as described in the occupied mode except that the outside air damper will modulate to fully closed.

Mixed Air Temperature:

The controller will monitor the mixed air temperature and use as required for economizer control (if active).

Alarms will be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Humidity:

The controller will monitor the return air humidity and use as required for economizer control (if active).

- High Return Air Humidity: If the return air humidity is greater than 70% (adj.).
- Low Return Air Humidity: If the return air humidity is less than 5% (adj.).

Return Air Temperature:

The controller will monitor the return air temperature and use as required for economizer control (if present).

Alarms will be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

Space Temperature Control - Scheduled:

The unit will run according to a user definable time schedule in the following modes:


- Occupied Mode: The unit will maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit will maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms will be provided as follows:

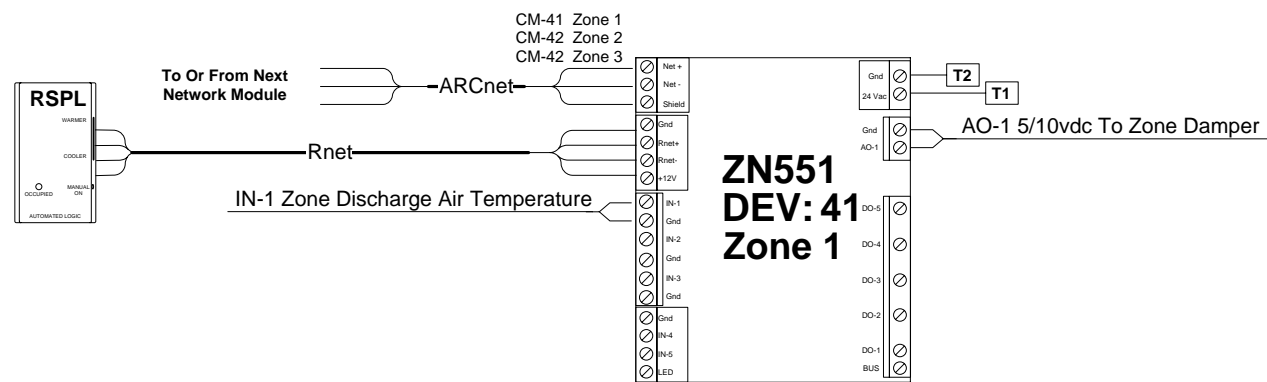
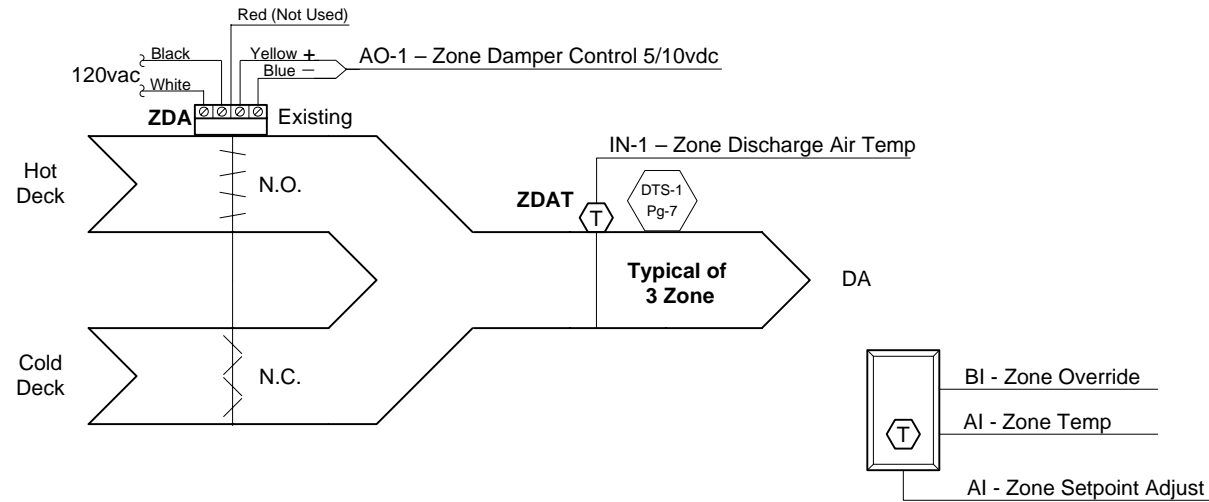
- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Damper Control:

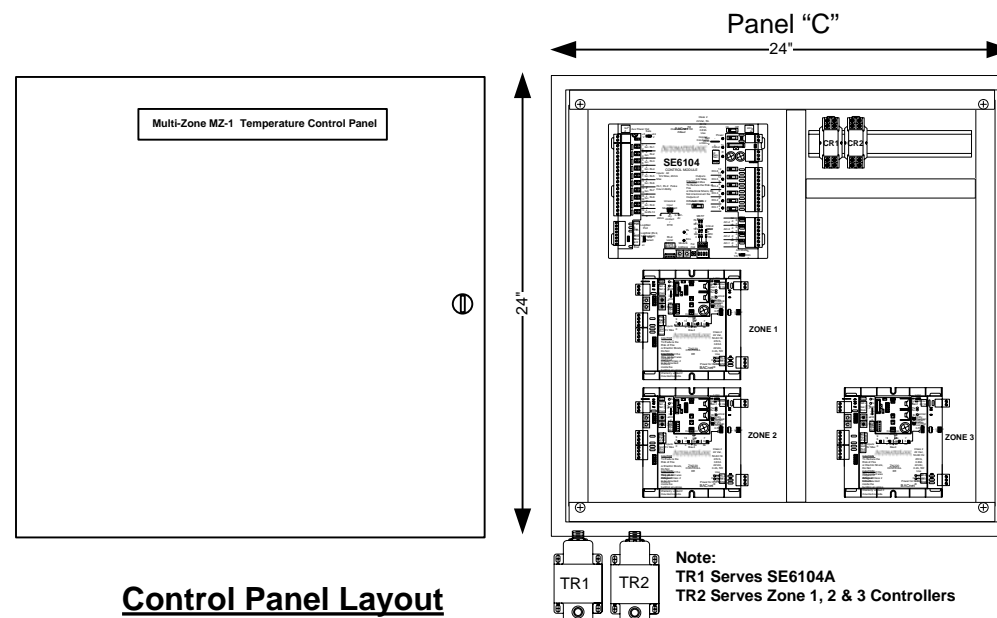
The cooling and heating deck zone dampers will modulate in sequence to maintain zone temperature cooling and heating setpoints.

Elementary School			
Michigan 48xxx			
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Multi-Zone MZ-1 Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			17 of 46

Multi-Zone MZ-1 Zone Control



MZ-1 Typical Temperature Control For 3 Zones



Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
PANEL C	24" X 24" ENCLOSURE+PERF PANEL	HOFFMAN	A24N24ALP + A24N24MPP	1 ea
RSPL	ZONE SENSOR WITH ADJUSTMENT AND OVERRIDE BUTTON	AUTOMATED LOGIC	RSPL	0 ea
TR-1,2	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	2 ea
ZDA	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC	INVENSYS	MP-5430-0-0-3	3 ea
ZDAT	ZONE DISCHARGE AIR TEMPERATURE	BAPI	ALC/10K-T2-D-8"	3 ea
ZN551	ZN551	AUTOMATED LOGIC	ZN551	0 ea

Zone Temperature Control Run Conditions - Scheduled:

The unit will run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit will maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit will maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms will be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Damper Control:

The cooling and heating deck zone dampers will modulate in sequence to maintain zone temperature cooling and heating setpoints.

Discharge Air Temperature:

The controller will monitor the discharge air temperature.

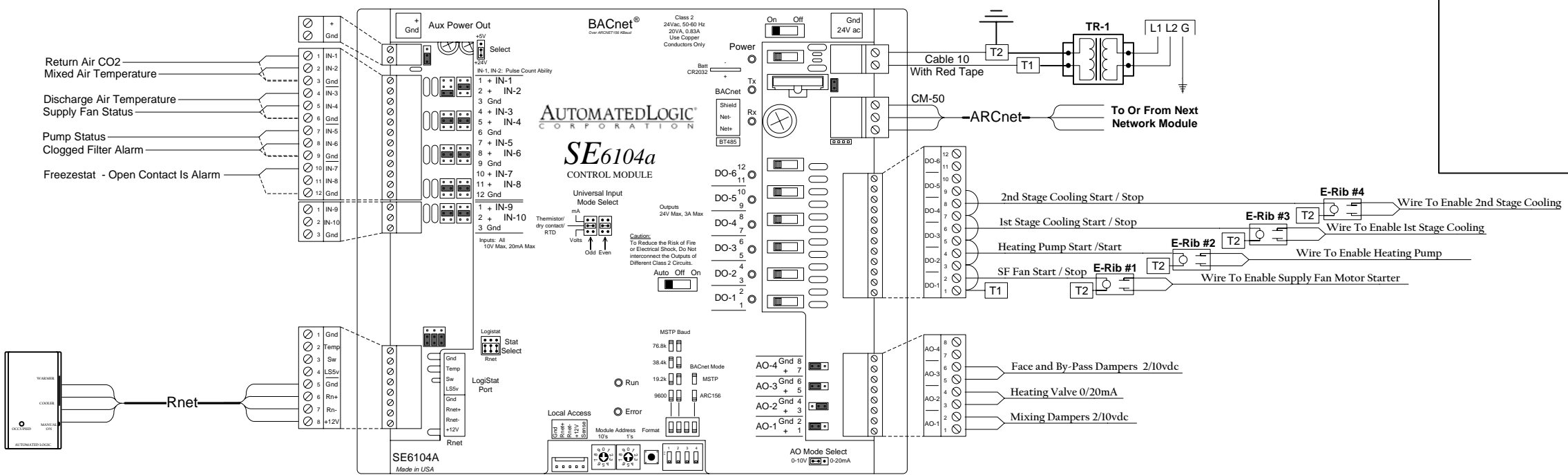
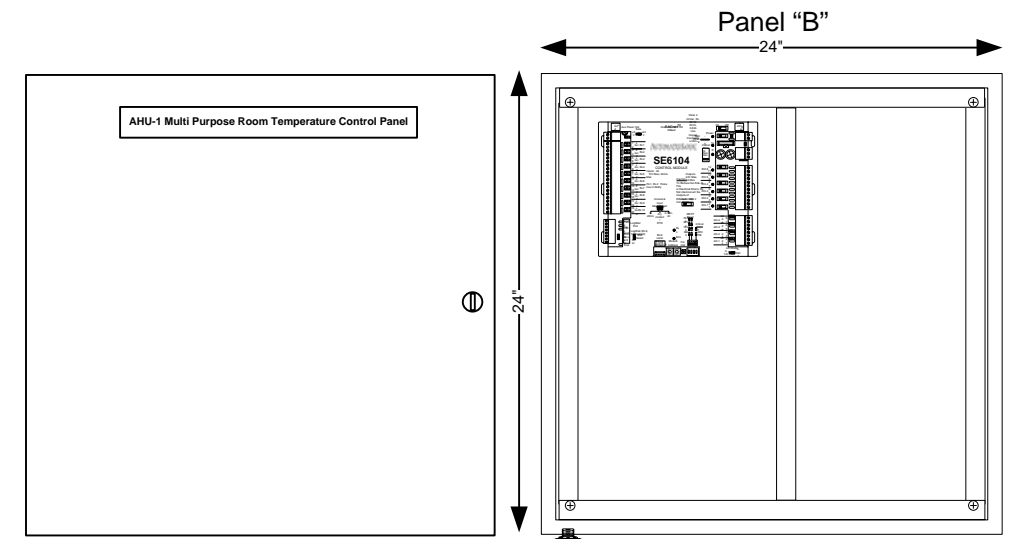
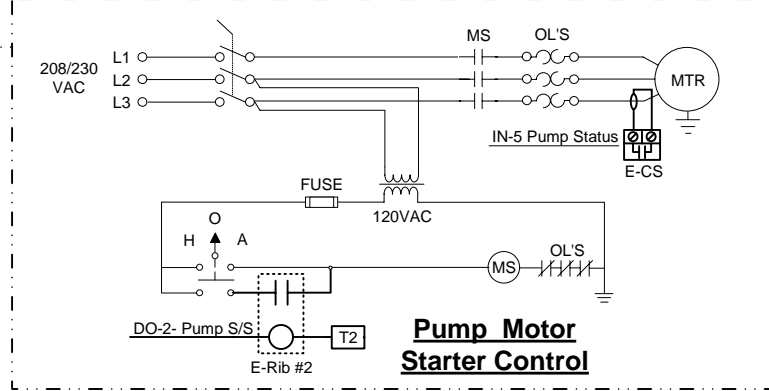
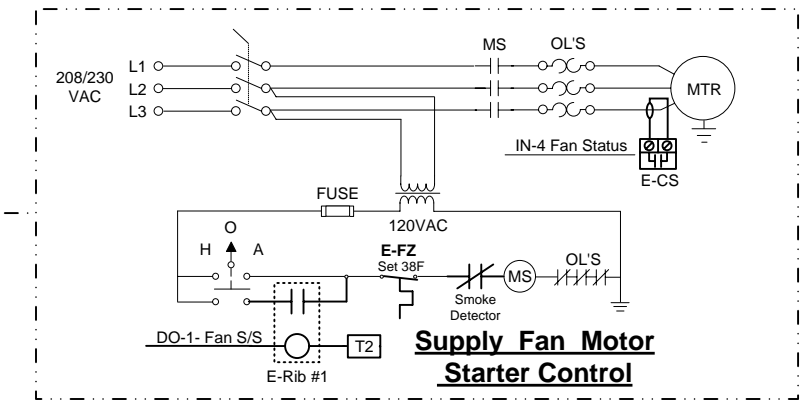
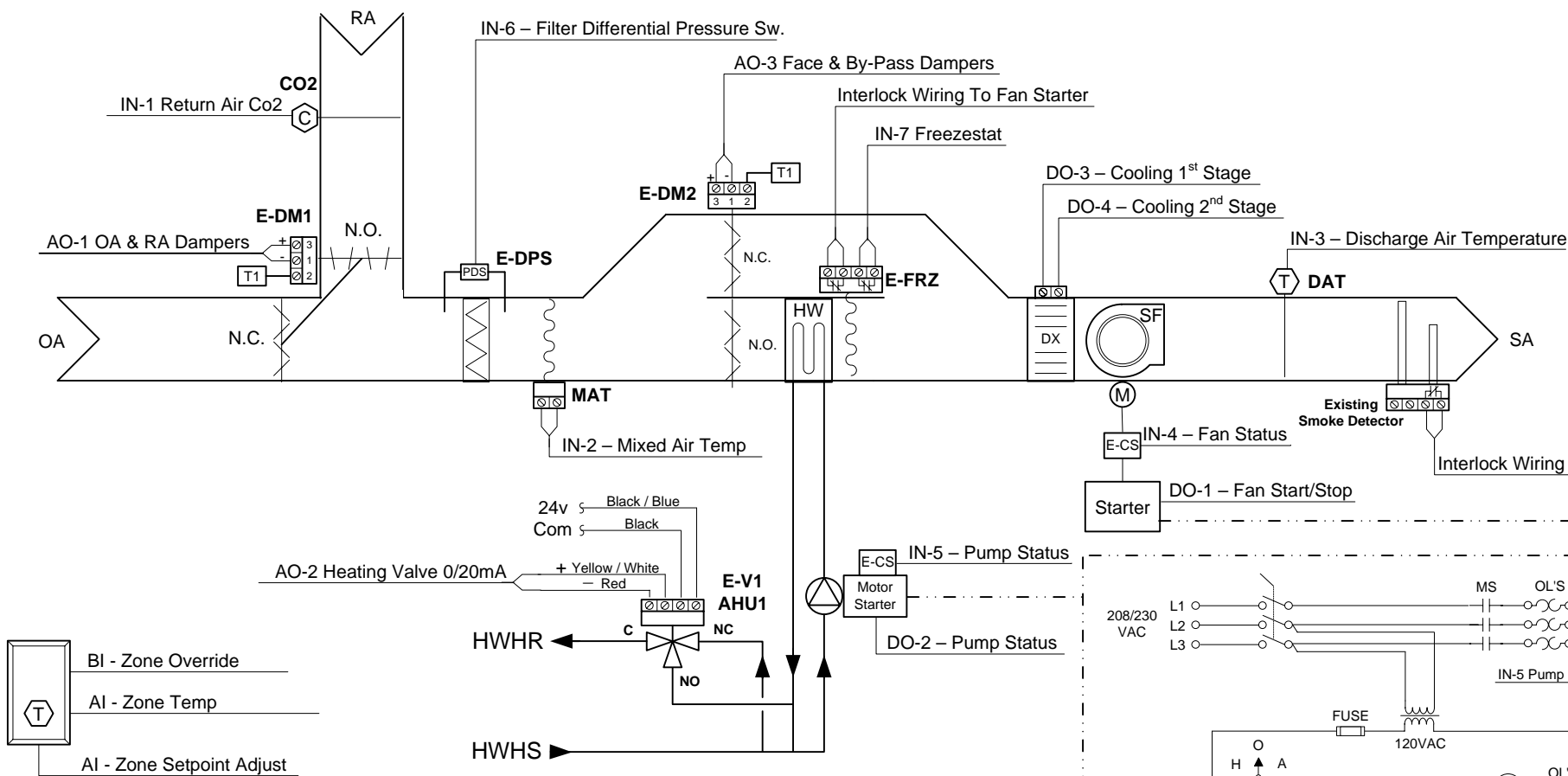
Alarms will be provided as follows:

- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Multi-Zone MZ-1 Zone Control			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			18 of 46

AHU-1 Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CO2	RETURN AIR DUCT MOUNTED CO2 SENSOR	VERIS	CDE	1 ea
E-RIB-1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E-RIB-3,4	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	2 ea
E-DM1	EXISTING DAMPER MOTOR 120VAC 2/15VDC CONTROL	INVENSYS	MP-5430	1 ea
E-DM2	EXISTING DAMPER MOTOR 120VAC 2/15VDC CONTROL	INVENSYS	MM-500-0-0-1	1 ea
E-DPS	EXISTING CLOGGED FILTER DIFFERENTIAL PRESSURE SWITCH	INVENSYS	PC-301	1 ea
E-FRZ	EXISTING FREEZESTAT DPST	INVENSYS	TC-5232	1 ea
E-V1 AHU1	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
MAT	MIXED AIR AVG. TEMP. SENSOR	BAPI	ALC/10K-2-A-24'	1 ea
PANEL B	EXISTING INVENSYS COMMUNICATIONS PANEL	INVENSYS	N/A	1 ea
RSPL	ZONE SENSOR WITH ADJUSTMENT AND OVERRIDE BUTTON	AUTOMATED LOGIC	RSPL	0 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea
TR-1	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	1 ea



Elementary School
Michigan 48xxx

Metro Environmental, Inc.

AHU-1 Control

REV: 0	Submission	2/08/10	JOB NO: Cxxxx
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DRAWN BY : TL
CHECKED BY : TS

METRO ENVIRONMENTAL, INC.

AHU-1 Sequence Of Operation

Single Zone Unit (typical of 1)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 75°F (adj.) cooling setpoint
 - A 72°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 62°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Freeze Protection:

The unit shall shut down, the heating valve will open and the DDC will generate an alarm upon receiving a freezestat status. The existing freezestat cut-out is set at 35F.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime. Existing motor starter current switch will monitor the fan status.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Face & By-Pass Dampers

When outdoor air temperature is above 55F (adj.) the heating coil Face & Bypass dampers will be in the Bypass position. When the outdoor air temperature is between 55F (adj.) and 38F (adj.) the Face and By-Pass dampers will remain in the Face position. Below 38F the Face and By-Pass dampers will modulate to maintain 55F (adj.) discharge air temperature.

Heating Coil Pump

During the occupied mode the heating coil pump will be enabled anytime the outdoor temperature falls below 55F (adj.). Pump status is monitored via existing motor starter current switch. An alarm will be generated if an abnormal condition occurs.

Alarms shall be provided as follows:

- Pump Failure: Commanded on, but the status is off.
- Pump in Hand: Commanded off, but the status is on.
- Pump Runtime Exceeded: Status runtime exceeds a user definable limit

Heating Coil Valve:

Below 55F (adj.) and above 38F (adj.) outdoor air temperature the controller shall measure the zone air temperature and modulate the heating coil valve to maintain the zone heating setpoint. Below 38F outdoor air temperature the heating coil valve will remain full open to the coil and the face and By-Pass dampers will modulate..


Cooling Stages:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Continued On Next Page

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
AHU-1 Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			20 of 46

AHU-1 Sequence Continued

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 50°F to 45°F (adj.).
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation – Return Air CO2 Monitoring:

The outside air dampers will remain closed and begin to modulate toward the minimum position when the return air CO2 climbs above 1000 ppm (adj.) during building occupied hours. During unoccupied hours the outdoor dampers will remain closed.

Prefilter Status:

The controller shall monitor the prefilter status.

Alarms shall be provided as follows:

- Prefilter Change Required: Existing prefilter differential pressure switch exceeds a user definable switch limit (adj.).

Mixed Air Temperature:

The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Supply Air Temperature:

The controller shall monitor the supply air temperature.


Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Unoccupied Mode:

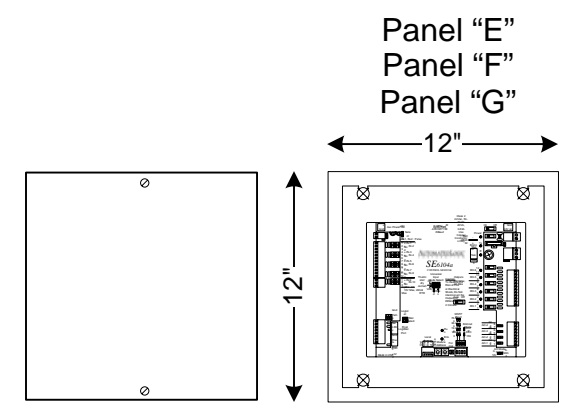
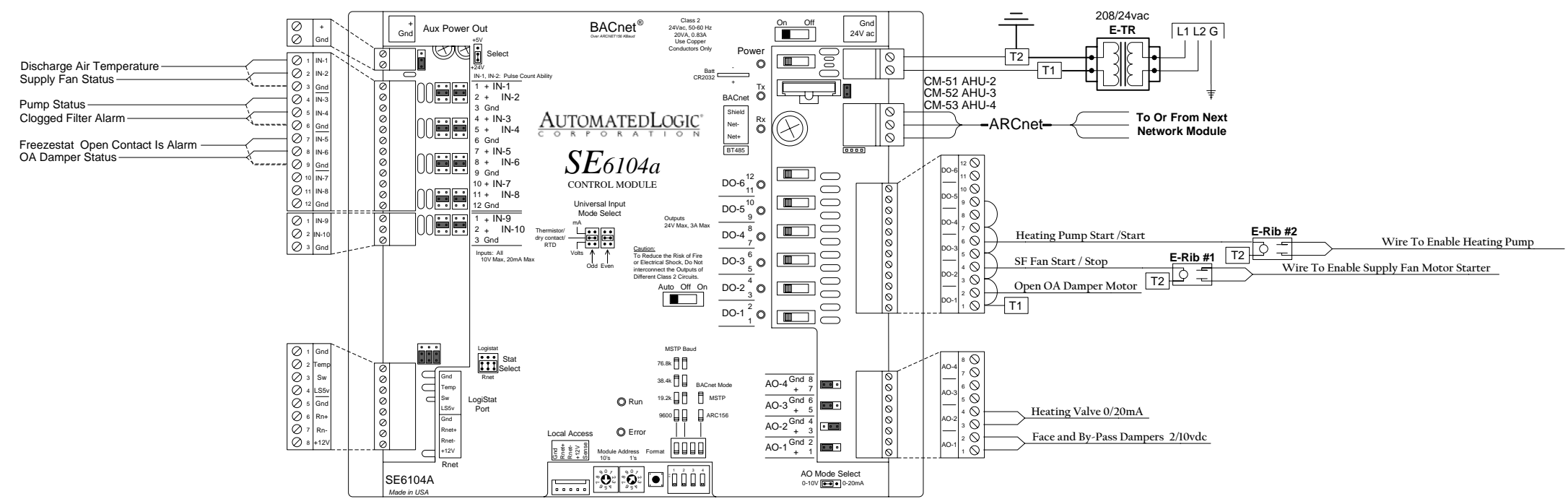
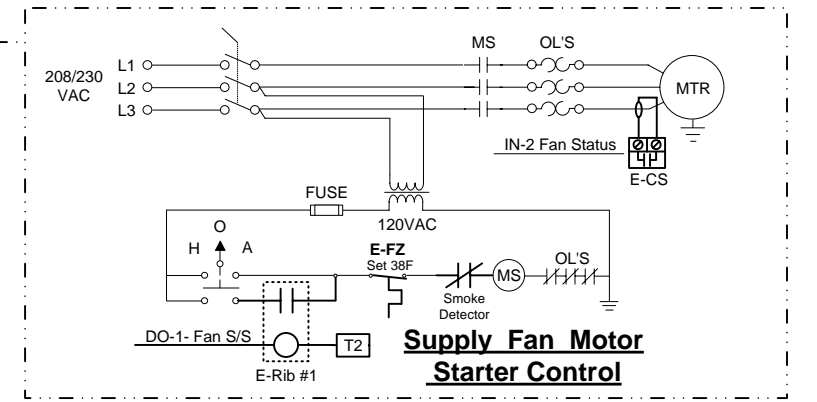
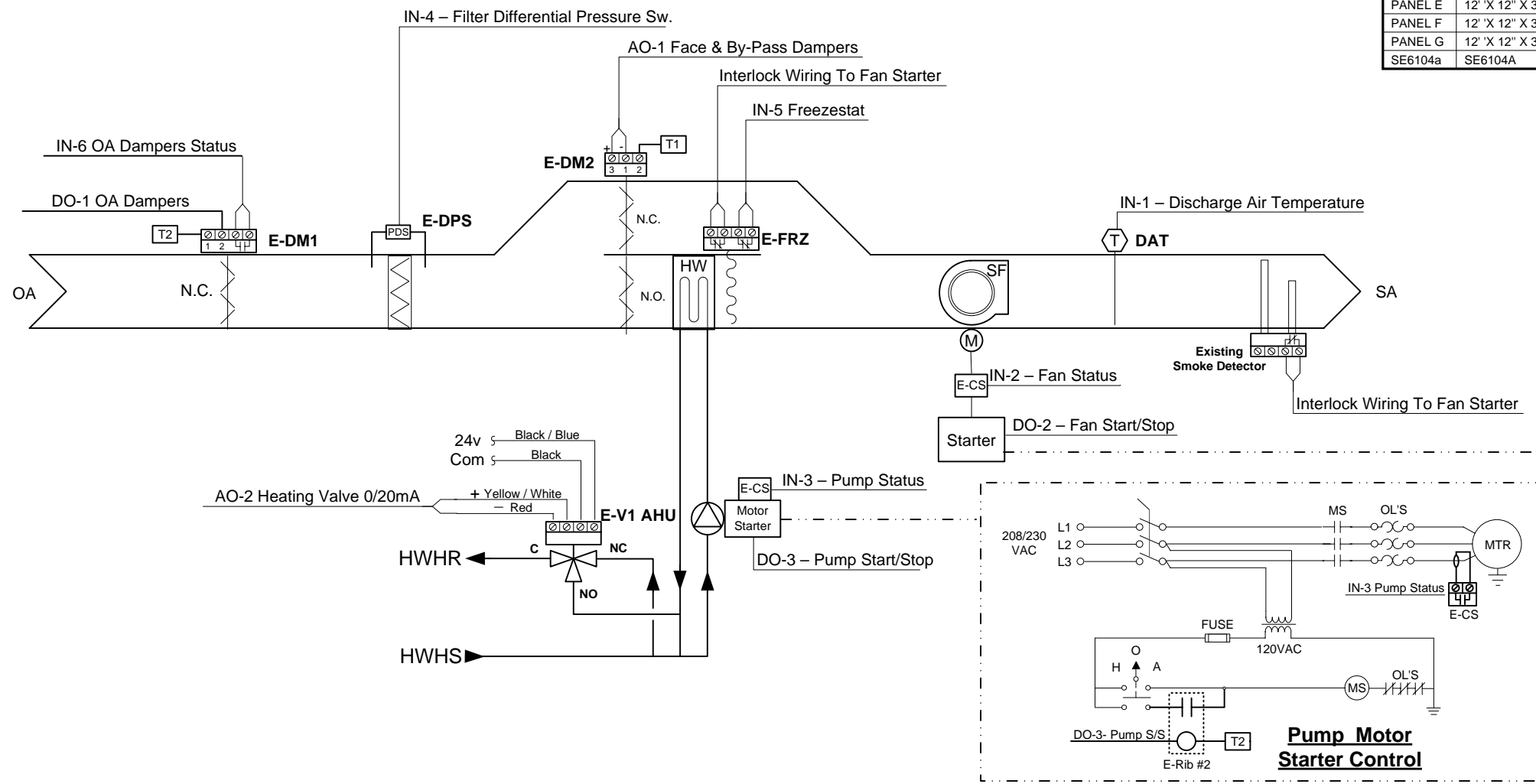
During the unoccupied mode the mechanical cooling remains off. Below 40F outdoor air temperature the heating coil valve will modulate and the heating pump will cycle to maintain a low limit plenum temperature of 50F (adj.). The heating valve will open and the fan will cycle to maintain the unoccupied zone setpoint.

Note: The heating system piping is filled with an unknown glycol mixture.

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
AHU-1 Sequence Continued			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			21 of 46

AHU-2, 3 & 4 Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	2 ea
E-DM1	EXISTING DAMPER MOTOR 24VAC 2-POSITION W/ AUX SW.	BELIMO	AF24-S-US	1 ea
E-DM2	EXISTING DAMPER MOTOR 24V 2/10VDC CONTROL	BELIMO	AF24-SR-US	1 ea
E-DPS	EXISTING CLOGGED FILTER DIFFERENTIAL PRESSURE SWITCH	INVENSYS	PC-301	1 ea
E-FRZ	EXISTING FREEZESTAT DPST	INVENSYS	TC-5232	1 ea
E-RIB1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E-V1 AHU	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	3 ea
PANEL E	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL F	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL G	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



Elementary School
Michigan 48xxx

Metro Environmental, Inc.

AHU-2, 3 & 4 Control

REV: 0	Submission	2/08/10	JOB NO: Cxxxx
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DRAWN BY : TL
CHECKED BY : TS

METRO ENVIRONMENTAL, INC.

22 of 46

AHU-2, 3 & 4 Sequence Of Operation

Makeup Air Unit - Supply Air Temp (typical of 3)

Run Conditions - Interlocked:

The AHU-2, 3 & 4 units run via the DDC occupied mode time schedule unless shutdown on safeties.

Freeze Protection:

The unit shall shut down and generate an alarm upon receiving a freezestat status. The setpoint for the existing freezestat is 35F adjustable at the freezestat. The heating coil valve shall open to 100% (adj.) whenever the freezestat is on.

Outside Air Damper:

The outside air damper shall open anytime the unit runs and shall close anytime the unit stops. The supply fan shall start only after the damper status has proven the damper is open. The outside air damper shall close 10 sec (adj.) after the supply fan stops.

Alarms shall be provided as follows:

- Outside Air Damper Failure: Commanded open, but the status is closed.
- Outside Air Damper in Hand: Commanded closed, but the status is open.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime, unless shutdown on safeties. The status of the fan is monitored via existing motor starter current switch.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Supply Air Temperature Setpoint - Fixed:

The controller shall monitor the supply air temperature and shall maintain a fixed supply air temperature setpoint of 55°F (adj.).

Face & By-Pass Dampers

When outdoor air temperature is above 55F (adj.) the heating coil Face & Bypass dampers will be in the Bypass position. When the outdoor air temperature is between 55F (adj.) and 38F (adj.) the Face and By-Pass dampers will remain in the Face position. Below 38F the Face and By-Pass dampers will modulate to maintain 55F (adj.) discharge air temperature.

Heating Coil Pump

During the occupied mode the heating coil pump will be enabled anytime the outdoor temperature falls below 55F (adj.). Pump status is monitored via existing motor starter current switch. An alarm will be generated if an abnormal condition occurs.

Alarms shall be provided as follows:

- Pump Failure: Commanded on, but the status is off.
- Pump in Hand: Commanded off, but the status is on.
- Pump Runtime Exceeded: Status runtime exceeds a user definable limit

Heating Coil Valve:

Below 55F (adj.) and above 38F (adj.) outdoor air temperature the controller shall measure the supply air temperature and modulate the heating coil valve to maintain its discharge air 55F (adj.) heating setpoint. Below 38F outdoor air temperature the heating coil valve will remain full open to the coil.

Prefilter Status:

The controller shall monitor the prefilter status.

Alarms shall be provided as follows:

- Prefilter Change Required: Existing prefilter differential pressure switch exceeds a user definable limit (adj.).

Supply Air Temperature:

The controller shall monitor the supply air temperature.


Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

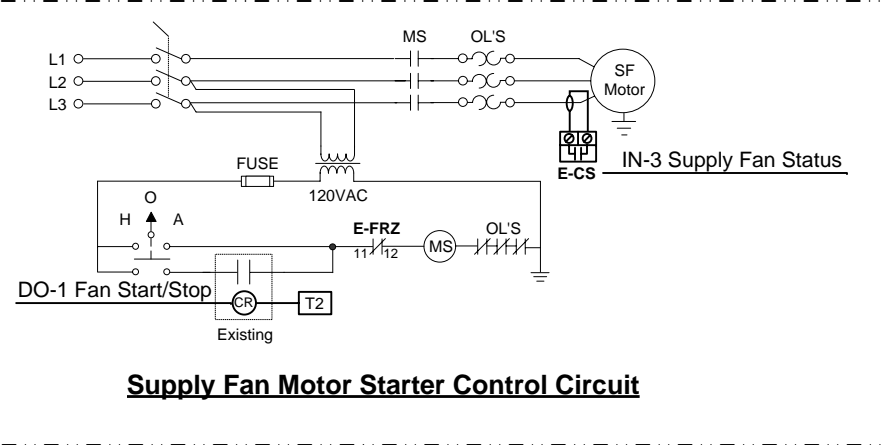
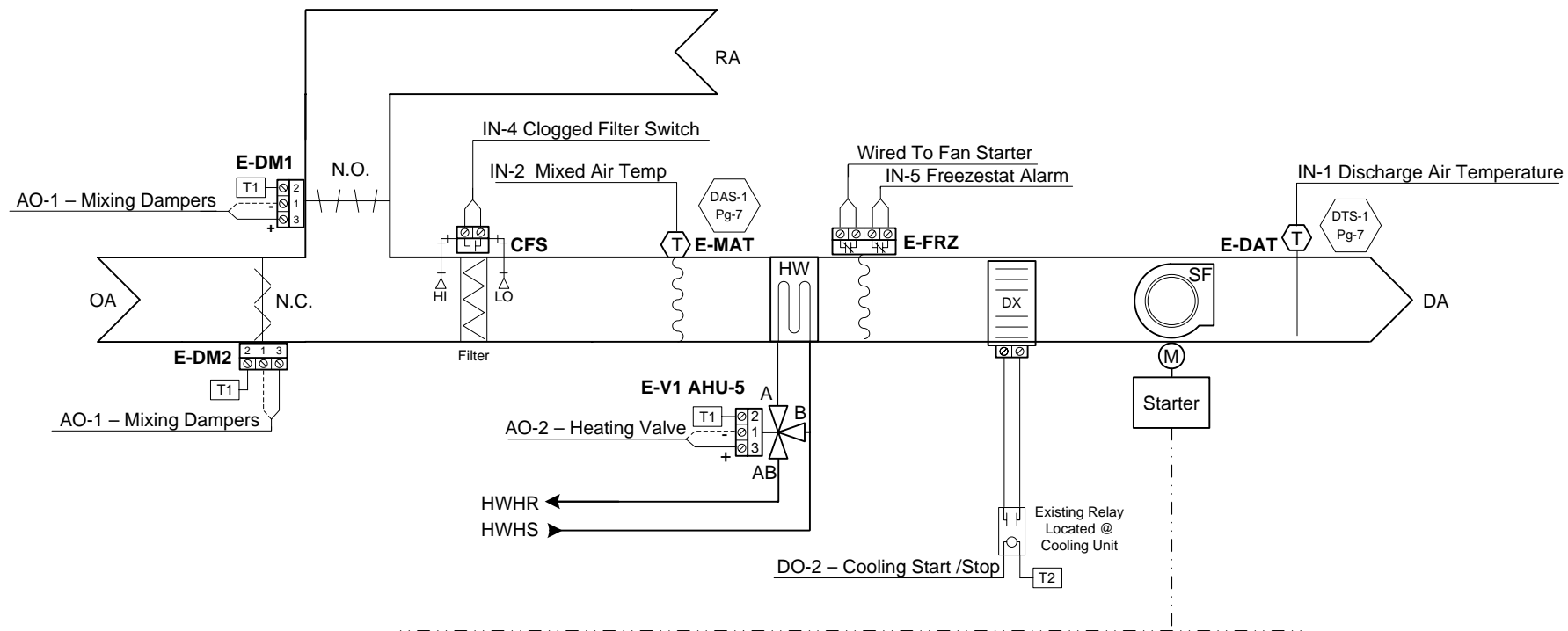
Unoccupied Mode:

During the unoccupied mode the fans remain off, outdoor dampers are closed and mechanical cooling is disabled. Fan cycles with the modulating heating valve to maintain the unoccupied zone setpoint. Below 40F outdoor air temperature the heating coil valve will modulate and the heating pump will cycle to maintain a low limit plenum temperature of 50F (adj.).

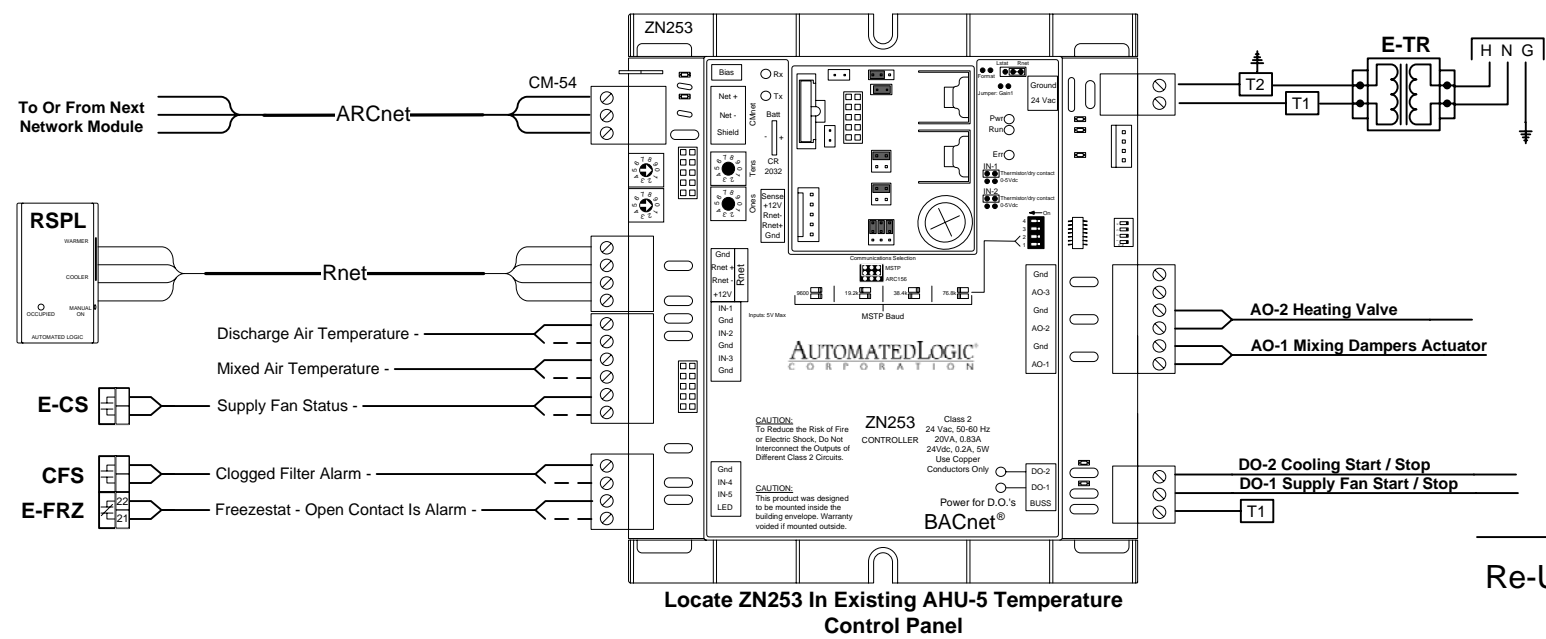
Note: The heating system piping is filled with an unknown glycol mixture.

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
AHU-2, 3 & 4 Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			23 of 46

AHU-5 & Sequence Of Operation



Supply Fan Motor Starter Control Circuit



Re-Use Existing Panel

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CFS	CLOGGED FILTER DIFFERENTIAL PRESSURE SWITCH	CLEVELAND	AFS-222	1 ea
E-CS CR	EXISTING CURRENT SWITCH WITH COMMAND RELAY	VERIS	H948	1 ea
E-DAT	EXISTING DISCHARGE AIR TEMPERATURE SENSOR	ALERTON	TS-2008BT	1 ea
E-DM1,2	EXISTING DAMPER MOTOR 24VAC 2/10VDC CONTROL	BELIMO	LF24-SR	2 ea
E-FRZ	FREEZESTAT	ALCO	FS50	1 ea
E-MAT	EXISTING MIXED AIR TEMPERATURE SENSOR	ALERTON	TS-2008BT	1 ea
E-TR	120/24VAC 75VA TRANSFORMER	HONEYWELL	AT175F1023	1 ea
E-V1 AHU5	EXISTING 3-WAY VALVE 24VAC 2/10VDC CONTROL - FAILS OPEN	BELIMO	B217B+LF-SR	1 ea
PANEL H	EXISTING 12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
RSPL	ROOM SENSOR WITH REMOTE ADJUSTMENT AND OVERRIDE	AUTOMATED LOGIC	RSPL	0 ea
ZN253	ZN253	AUTOMATED LOGIC	ZN253	0 ea

Single Zone Unit (typical of 1)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Demand Limiting - Zone Setpoint Optimization:

To lower power consumption, the zone setpoints shall automatically relax when the facility power consumption exceeds definable thresholds. The amount of relaxation shall be individually configurable for each zone. The zone setpoints shall automatically return to their previous settings when the facility power consumption drops below the thresholds.

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

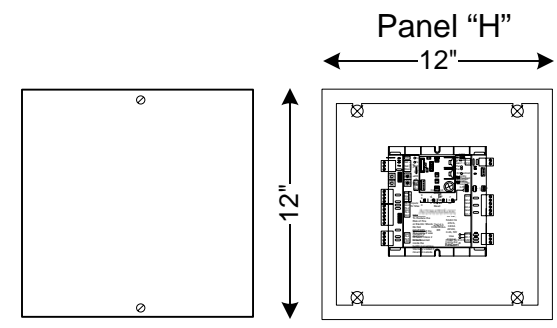
Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Continued On Next Page



Elementary School Michigan 48xxx			
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AHU-5 & Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			24 of 46

AHU-5 Sequence Continued

Freeze Protection:

The unit shall shut down and generate an alarm upon receiving a freezestat status.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Stage:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

The heating coil valve shall open whenever the freezestat (if present) is on.

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Prefilter Differential Pressure Monitor:

The controller shall monitor the differential pressure across the prefilter.

Alarms shall be provided as follows:

- Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

Mixed Air Temperature:

The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:


- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Supply Air Temperature:

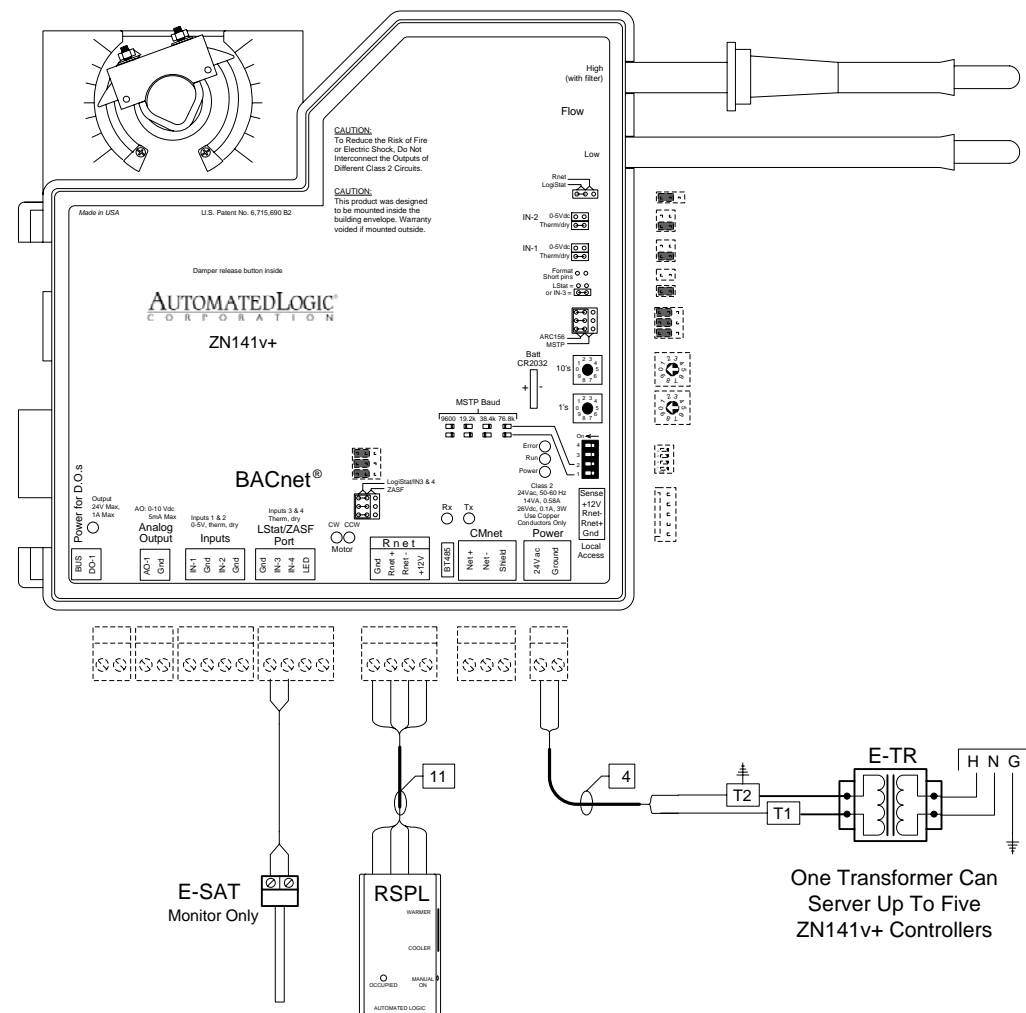
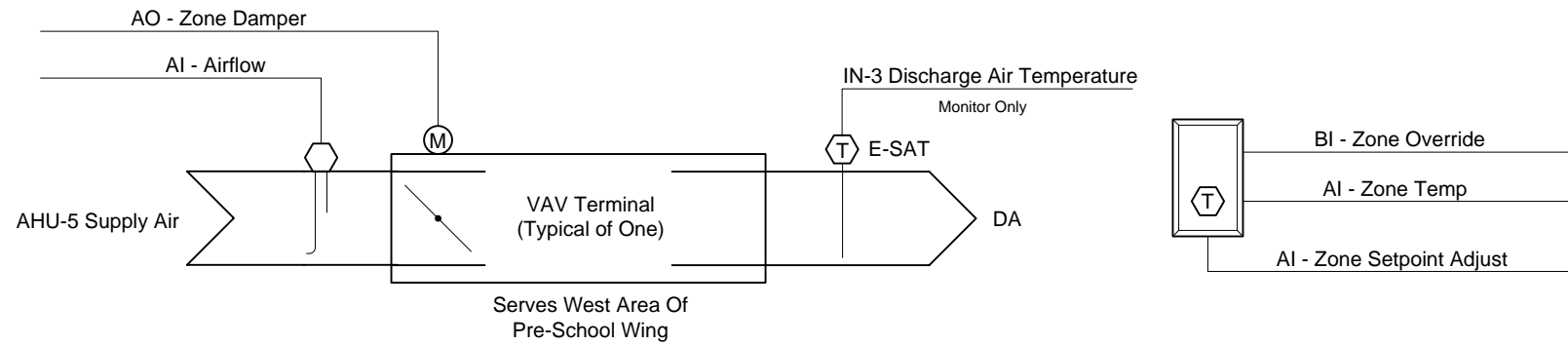
The controller shall monitor the supply air temperature.

Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Elementary School Michigan 48xxx			
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AHU-5 Sequence Continued			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			25 of 46

AHU-5 VAV Terminal Unit



Bill of Materials

DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
E-SAT	EXISTING SUPPLY AIR TEMPERATURE SENSOR	ALERTON	TS2020BT	1 ea
E-TR	120 / 24VAC 100VA TRANSFORMER W/ CIRCUIT BREAKER	FUNCTIONAL DEVICES	TR100VA001	1 ea
RSPL	WALL TEMP SENSOR WITH ADJUSTMENT	AUTOMATED LOGIC	RSPL	0 ea
ZN141v+	VAV TERMINAL BOX CONTROLLER	AUTOMATED LOGIC	ZN141V+	0 ea

Sequence Of Operation

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 84°F (adj.) cooling setpoint.
 - A 60°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Variable Volume Terminal Unit - Flow Control:

The unit shall maintain zone setpoints by controlling the airflow through one of the following:

Occupied:

- When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When the zone temperature is less than the cooling setpoint, the zone damper shall maintain the minimum required zone ventilation (adj.).

Unoccupied:

- When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).
- When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.

Elementary School

Michigan 48xxx

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AHU-5 VAV Terminal Unit

REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
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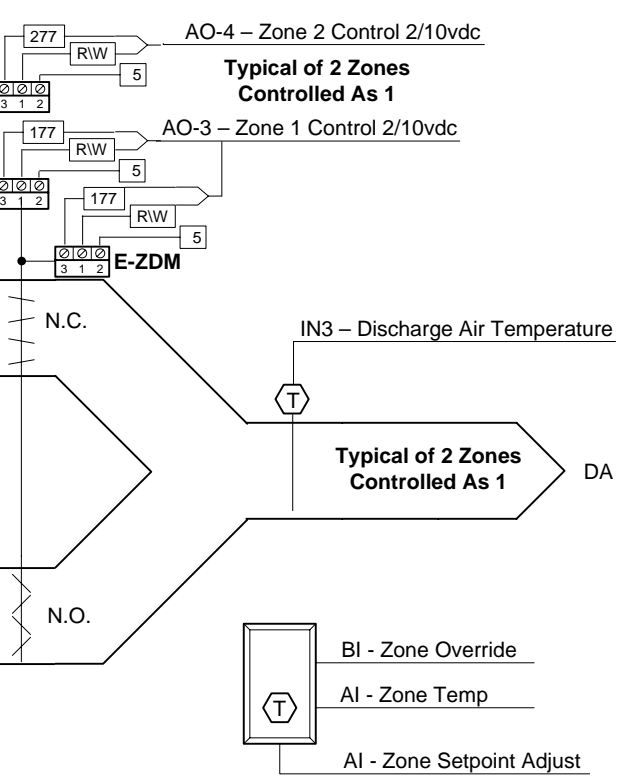
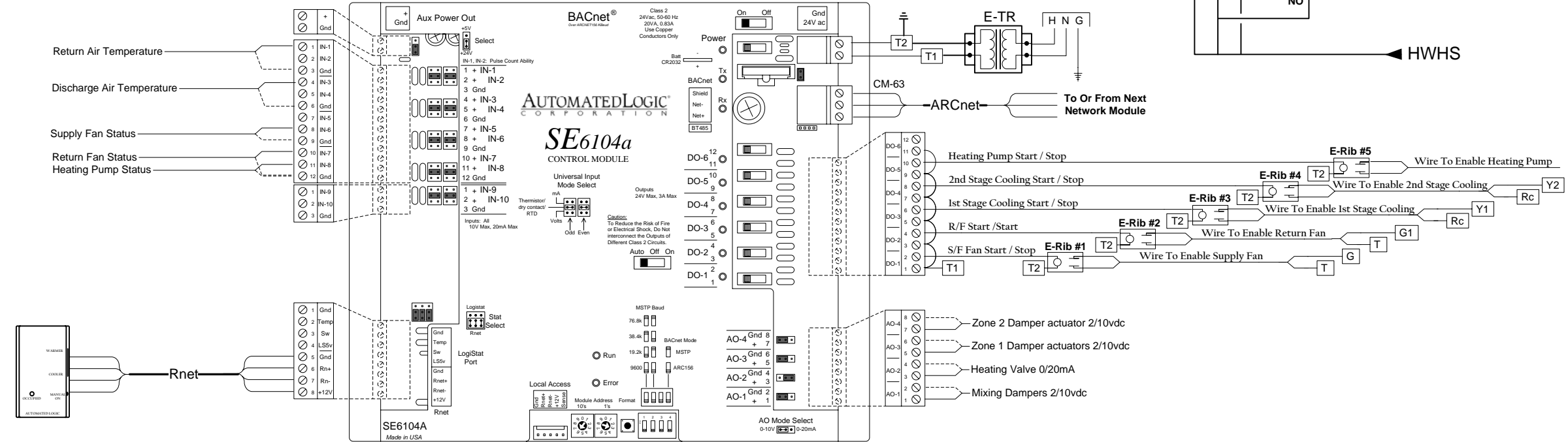
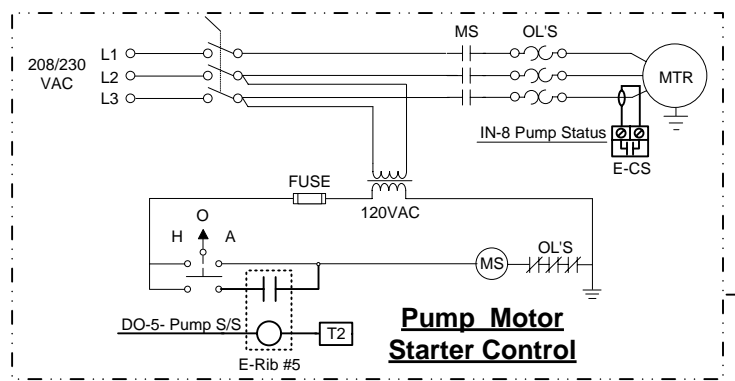
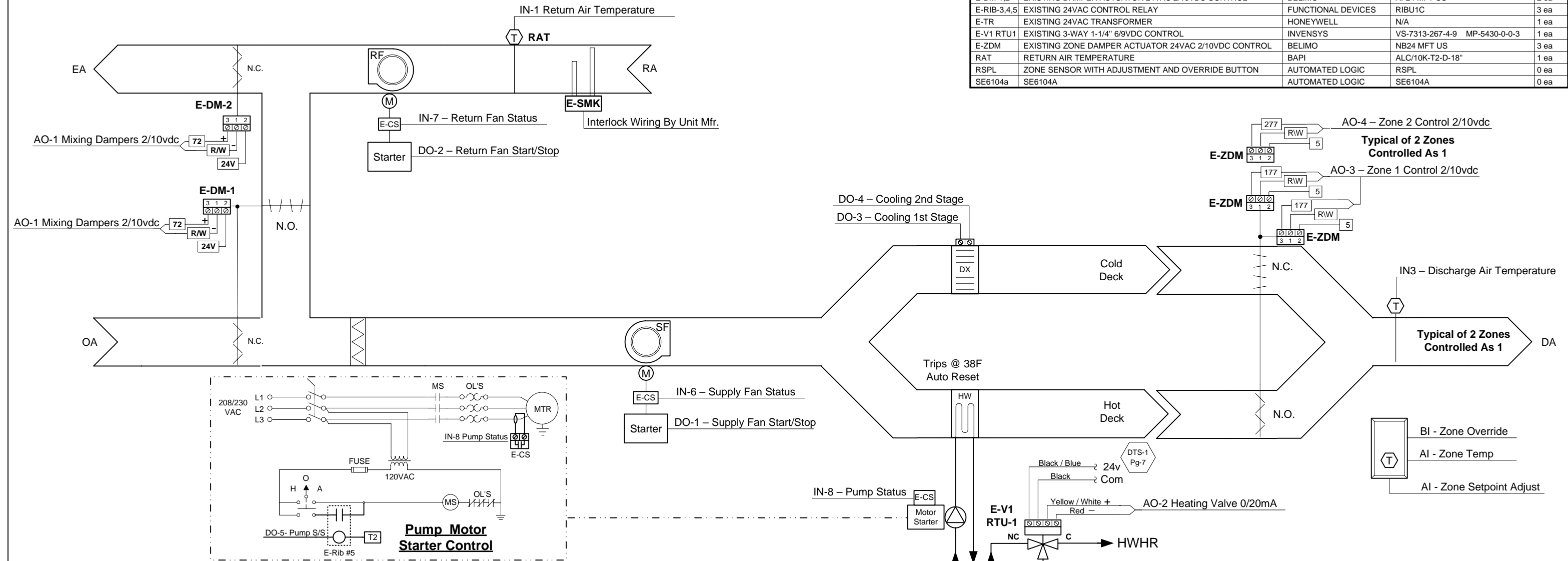


DRAWN BY : TL

CHECKED BY : TS

RTU-1 Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
DAT	DISCHARGE AIR TEMPERATURE SENSOR	BAPI	ALC/10K-T2-D-18"	1 ea
E-RIB1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	3 ea
E-DM-1,2	EXISTING DAMPER ACTUATOR 24VAC 2/10VDC CONTROL	BELIMO	AF24 MFT US	2 ea
E-RIB-3,4,5	EXISTING 24VAC CONTROL RELAY	FUNCTIONAL DEVICES	RIBU1C	3 ea
E-TR	EXISTING 24VAC TRANSFORMER	HONEYWELL	N/A	1 ea
E-V1 RTU1	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
E-ZDM	EXISTING ZONE DAMPER ACTUATOR 24VAC 2/10VDC CONTROL	BELIMO	NB24 MFT US	3 ea
RAT	RETURN AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
RSPL	ZONE SENSOR WITH ADJUSTMENT AND OVERRIDE BUTTON	AUTOMATED LOGIC	RSPL	0 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



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RTU-1 Control

REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
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27 of 46

Controller Located Inside RTU-1

RTU-1 Sequence of Operation

Multi-Zone Unit Converted To Single Zone Unit (typical of 1)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Freeze Protection:

The units packaged controls will shut down the fan if a freezestat condition occurs.

Supply Fan :

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime. Existing current switch monitors fan status.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Return Fan :

The Return fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the return fan shall have a user definable (adj.) minimum runtime. Existing current switch monitors fan status.

Alarms shall be provided as follows:

- Return Fan Failure: Commanded on, but the status is off.
- Return Fan in Hand: Commanded off, but the status is on.
- Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Stage:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Heating Coil Pump

During the occupied mode the heating coil pump will be enabled anytime the outdoor temperature falls below 55F (adj.). Pump status is monitored via existing motor starter current switch. An alarm will be generated if an abnormal condition occurs.

Alarms shall be provided as follows:

- Pump Failure: Commanded on, but the status is off.
- Pump in Hand: Commanded off, but the status is on.
- Pump Runtime Exceeded: Status runtime exceeds a user definable limit

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

The heating coil valve shall open whenever the freezestat (if present) is on.

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

RTU-1 Sequence of Operation Continued

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Prefilter Differential Pressure Monitor:

The controller shall monitor the differential pressure across the prefilter.

Alarms shall be provided as follows:

- Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

Supply Air Temperature:

The controller shall monitor the supply air temperature.


Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Unoccupied Mode:

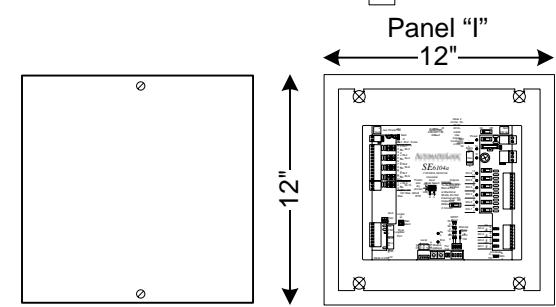
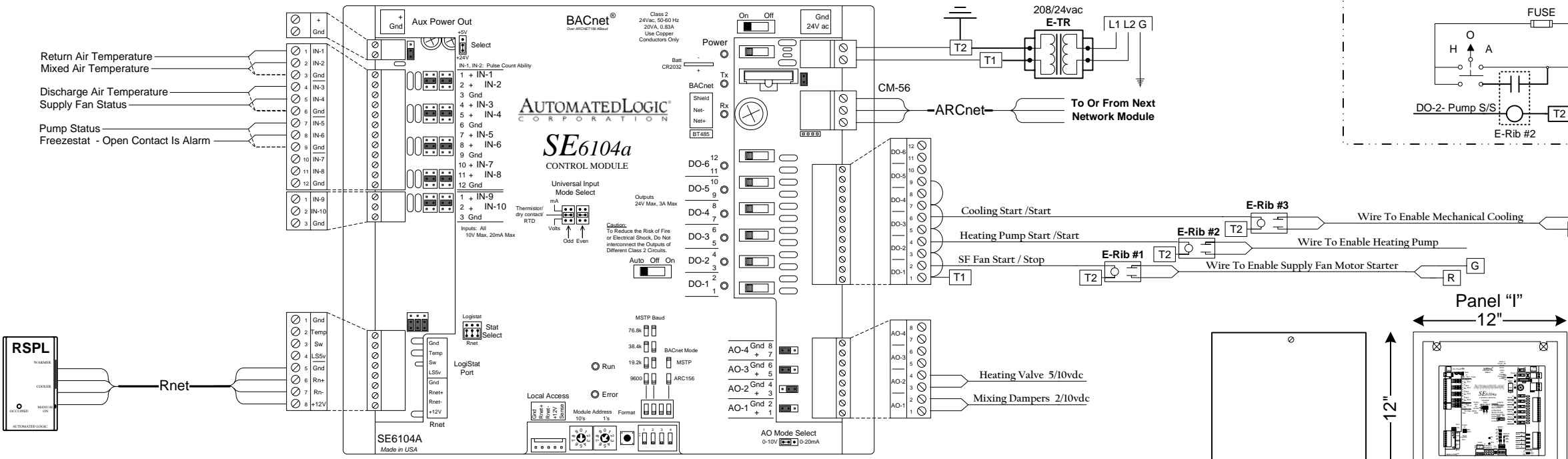
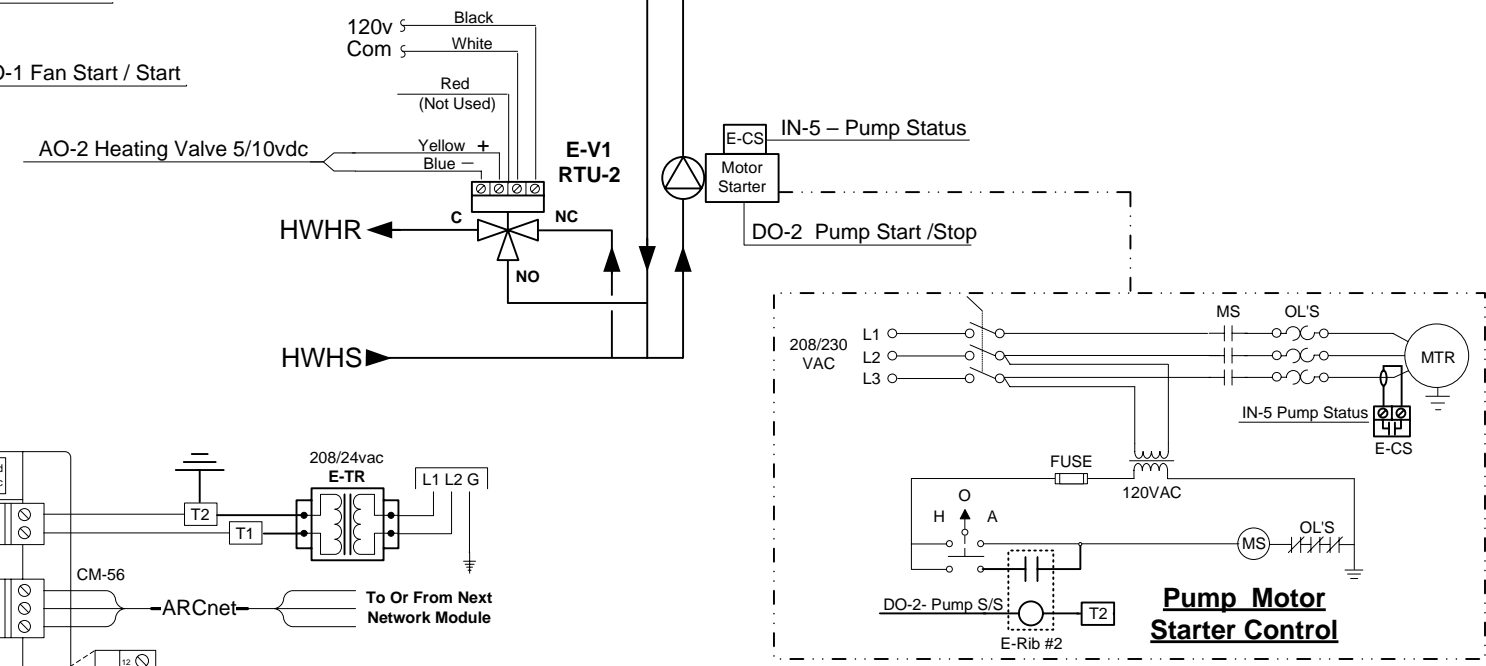
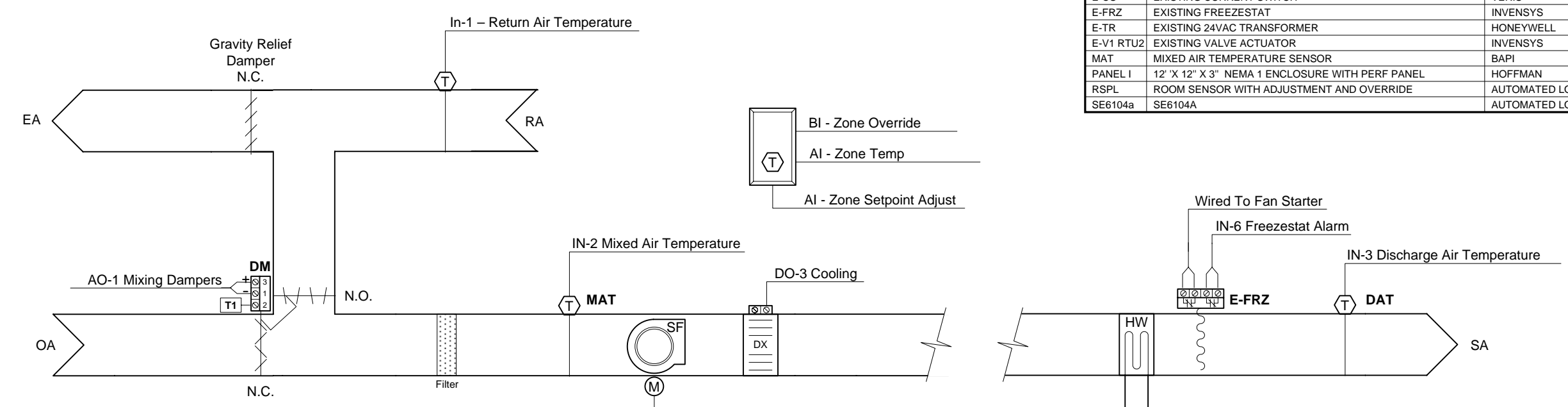
During the unoccupied mode the fan remains off. Below 40F outdoor air temperature the heating coil valve will modulate and the heating pump will cycle to maintain a low limit plenum temperature of 50F (adj.).

Note: The heating system piping is filled with an unknown glycol mixture.

Elementary School			
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RTU-1 Sequence of Operation Continued			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			29 of 46

RTU-2 Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
DAT	DISCHARGE AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	1 ea
DM	DAMPER MOTOR 24VAC 2/10VDC CONTROL - FAIL CLOSED	BELIMO	LF24-SR US	1 ea
E RIB1,2,3	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	3 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-800	2 ea
E-FRZ	EXISTING FREEZESTAT	INVENSYS	TC-5232	1 ea
E-TR	EXISTING 24VAC TRANSFORMER	HONEYWELL	N/A	1 ea
E-V1 RTU2	EXISTING VALVE ACTUATOR	INVENSYS	MP-5210	1 ea
MAT	MIXED AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	1 ea
PANEL I	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
RSPL	ROOM SENSOR WITH ADJUSTMENT AND OVERRIDE	AUTOMATED LOGIC	RSPL	0 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



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RTU-2 Control

REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
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RTU-2 Sequence of Operation

Single Zone Unit (typical of 1)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 74°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Freeze Protection:

If a freezestat condition occurs the fan will shut down and the controller will generate an alarm. The freezestat is set at 35F (adj.) if tripped manual reset is required to return the rooftop unit to normal service.

Supply Fan :

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime. Existing current switch monitors fan status.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Stage:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Heating Coil Pump

During the occupied mode the heating coil pump will be enabled anytime the outdoor temperature falls below 55F (adj.). Pump status is monitored via existing motor starter current switch. An alarm will be generated if an abnormal condition occurs.

Alarms shall be provided as follows:

- Pump Failure: Commanded on, but the status is off.
- Pump in Hand: Commanded off, but the status is on.
- Pump Runtime Exceeded: Status runtime exceeds a user definable limit

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

The heating coil valve shall open whenever the freezestat (if present) is on.

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

RTU-2 Sequence of Operation Continued

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Mixed Air Temperature:

The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

Supply Air Temperature:

The controller shall monitor the supply air temperature.


Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Unoccupied Mode:

During the unoccupied mode the fan remains off. Below 40F outdoor air temperature the heating coil valve will modulate and the heating pump will cycle to maintain a low limit plenum temperature of 50F (adj.).

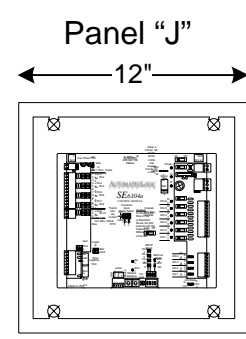
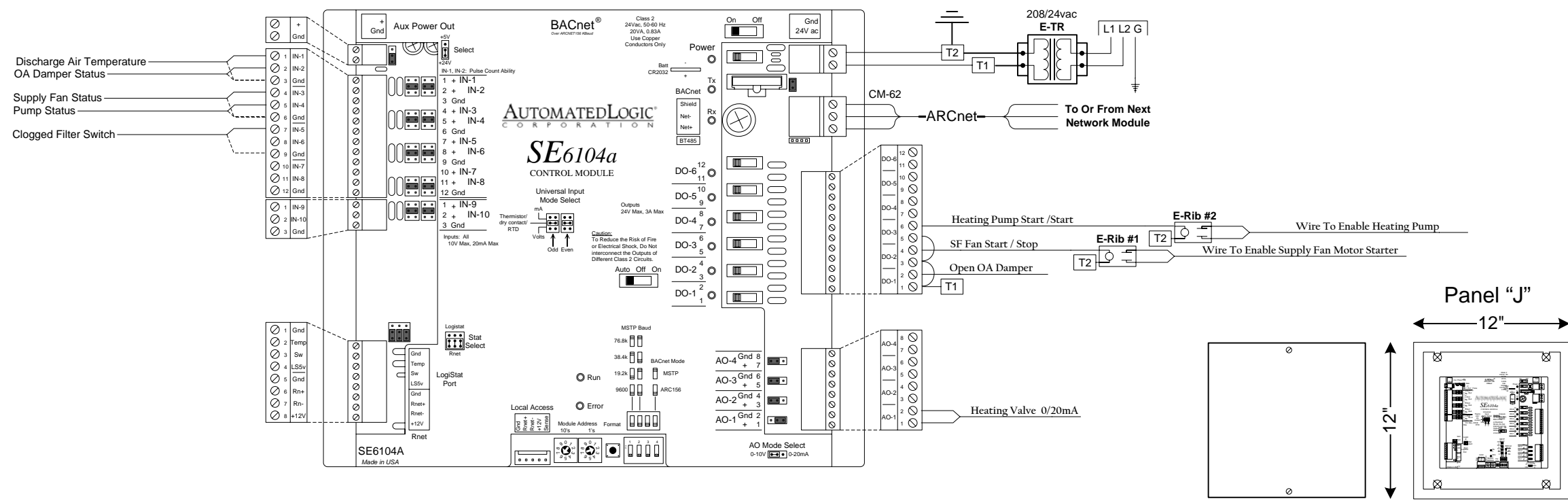
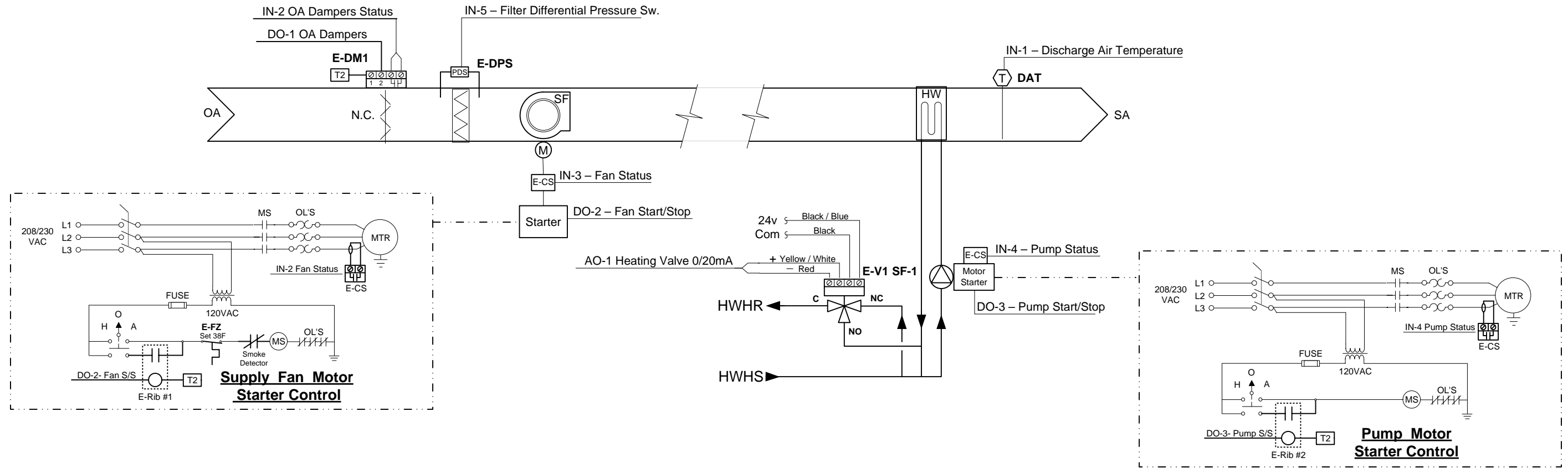
Note: The heating system piping is filled with an unknown glycol mixture.

Elementary School			
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RTU-2 Sequence of Operation Continued			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			32 of 46

Supply Fan SF-1 With Reheat Coil

Bill of Materials

DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
DAT	DISCHARGE AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	1 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	2 ea
E-DM1	EXISTING DAMPER MOTOR 24VAC 2-POSITION W/ AUX SW.	BELIMO	AF24-S-US	1 ea
E-DPS	EXISTING CLOGGED FILTER DIFFERENTIAL PRESSURE SWITCH	INVENSYS	PC-301	1 ea
E-FRZ	EXISTING FREEZESTAT DPST	INVENSYS	TC-5232	1 ea
E-RIB1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E-V1 SF-1	EXISTING 3-WAY 3/4" VALVE 0/20MA CONTROL	INVENSYS	MPR-5413	1 ea
E-V1SF1	EXISTING 24VAC 3-WAY 3/4" 4/20MA CONTROL	INVENSYS	MP-5413	1 ea
PANEL J	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



Elementary School
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Supply Fan SF-1 With Reheat Coil

REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
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METRO ENVIRONMENTAL, INC.

Supply Fan SF-1 Sequence of Operation

Supply Fan SF-1 with Reheat (Typical of One)

Supply fan will be started and stopped from the DDC controller based on occupied and unoccupied schedules.

Existing current switch will monitor the Supply fan status. If an abnormal condition occurs an alarm will be generated by the controller.

Outside inlet air damper motor will be interlocked with the DDC controller to prove open before the fan is started.


When the outdoor temperature drops below 55F (adj.) the heating coil pump will start. Existing current switch will monitor the pump. If an abnormal condition occurs the controller will generate an alarm.

Reheat coil 3-way mixing valve will be controlled to maintain 55F discharge discharge air temperature.

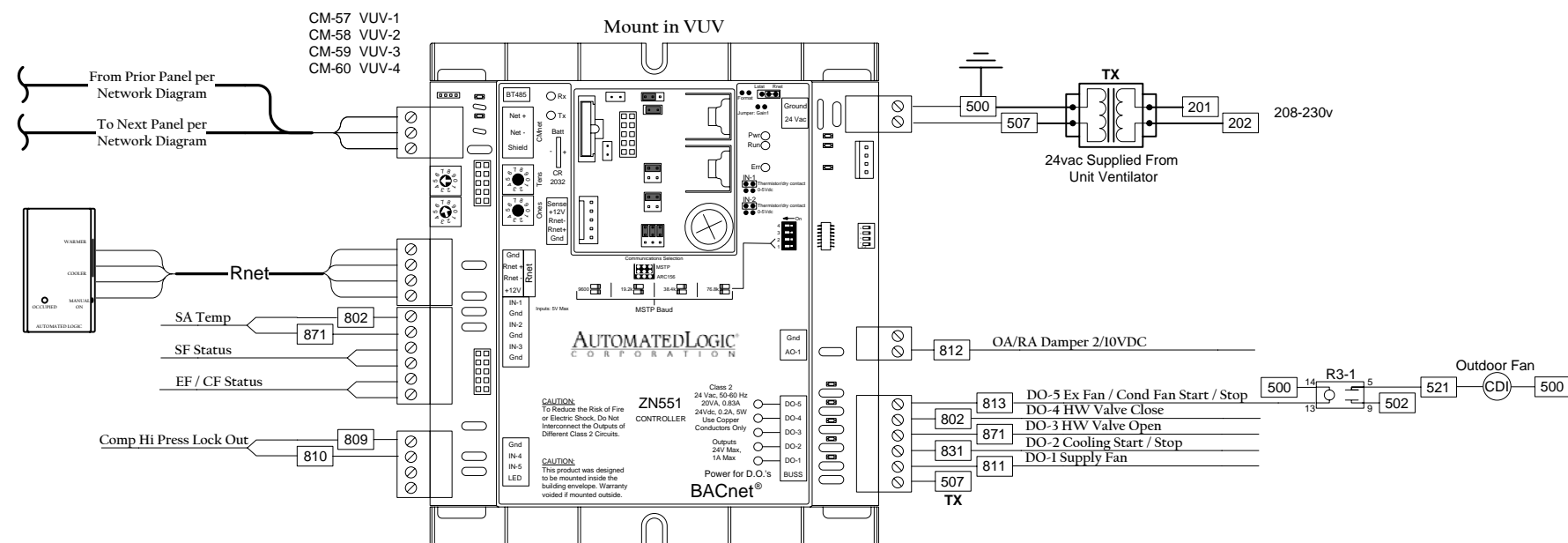
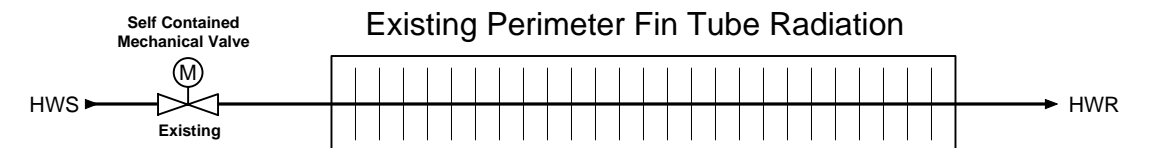
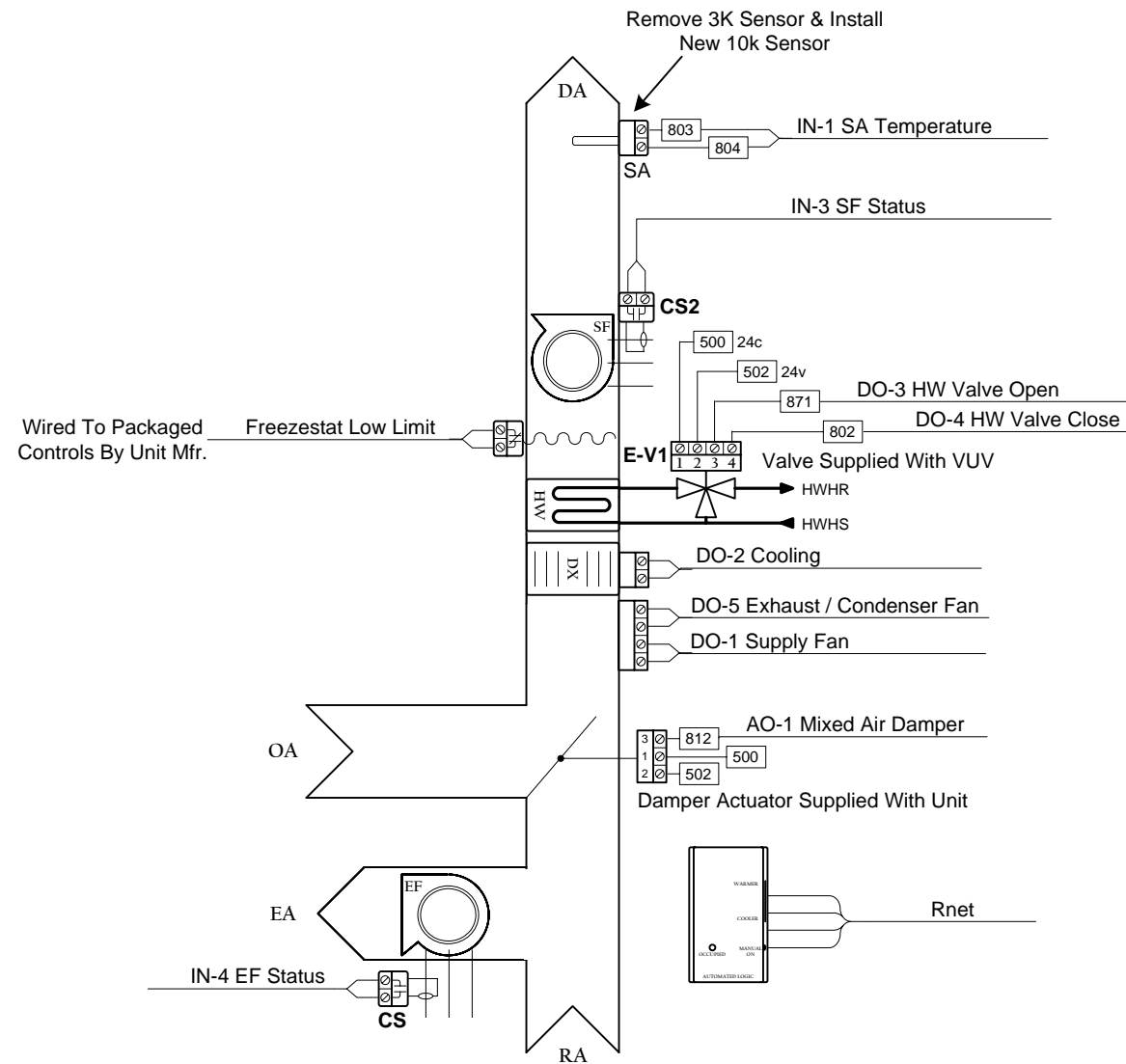
Filter status will be monitored by the DDC controller. An alarm will be generated when the filter is clogged.

When the fan stops the outdoor damper will close. Below 40F (adj.) the heating coil valve will modulate and the heating pump will cycle to maintain a low limit plenum temperature of 50F (adj.)

Note: The heating system piping is filled with an unknown amount of glycol.

Elementary School			
Michigan 48xxx			
Metro Environmental, Inc.			
Supply Fan SF-1 Sequence of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxx
			DRAWN BY : TL
			CHECKED BY : TS
			34 of 46

VUV-1, 2, 3 & 4 Control



Bill of Materials

DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CS	CURRENT SENSOR	SENAVA	C-1200	8 ea
E-V1 VUV	EXISTING VALVE FLOATING CONTROL	BELIMO	N/A	4 ea
R3	24VAC DPDT WITH INDICATING LIGHT	IDEC	RH2B-ULAC24V + SH2B-05 SOCKET	4 ea
RSPL	RSPL ROOM SENSOR W/SETPOINT AND OVERRIDE,RNET	AUTOMATED LOGIC	RSPL	0 ea
SA	SUPPLY AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	4 ea
ZN551	ZONE CONTROLLER	BAPI	ZN551	0 ea

Elementary School

Michigan 48xxx

Metro Environmental, Inc.

VUV-1, 2, 3 & 4 Control

REV: 0 Submittal 2/08/10 JOB NO: Cxxxx



DRAWN BY : TL

CHECKED BY : TS

VUV-1, 2, 3 & 4 Sequence Of Operation

Unit Ventilator (typical of 4)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

Occupied Mode: The unit shall maintain

A 74°F (adj.) cooling setpoint

A 70°F (adj.) heating setpoint.

Unoccupied Mode (night setback): The unit shall maintain

A 85°F (adj.) cooling setpoint. VUV cooling to remain "Off"

A 62°F (adj.) heating setpoint.

Alarms shall be provided as follows:

High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).

Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Freeze Protection:

The unit shall shut down via unit packaged controls when a low temperature condition occurs.

Supply and Exhaust Fans:

The supply and exhaust fans shall run on low or medium speeds (adjusted by air balancer) anytime the unit is commanded to run unless shutdown on safeties. When the space temperature is 2F (Adj.) or higher above the setpoint the supply and exhaust fans will be at high speed.

Cooling:

The controller shall measure the zone temperature and energize the compressor to maintain its cooling setpoint. To prevent short cycling the compressor there is a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

Outside air temperature is greater than 60°F (adj.).

AND the zone temperature is above cooling setpoint.

AND the fan is on.

Compressor Status:

The controller shall monitor the compressor status.

Alarms shall be provided as follows:

Compressor Failure: Commanded on, but the status is off.

Compressor in Hand: Commanded off, but the status is on.

Compressor Runtime Exceeded: Compressor status runtime exceeds a user definable limit (adj.).

Condenser Exhaust / Exhaust Air Fan Status:

The controller shall monitor the CE/EA status.

Alarms shall be provided as follows:

CE/EA Failure: Commanded on, but the status is off.

CE/EA in Hand: Commanded off, but the status is on.

CE/EA Runtime Exceeded: Compressor status runtime exceeds a user definable limit (adj.).

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

Outside air temperature is less than 65°F (adj.).

AND the zone temperature is below heating setpoint.

AND the fan is on.

The heating coil valve shall open whenever the freezestat (if present) is on.

Economizer (ASHRAE Cycle II):

The controller shall measure the zone temperature and modulate the mixed air dampers in sequence to maintain the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open during heating and ventilation whenever occupied.

The economizer shall be enabled whenever:

Outside air temperature is at least 3°F (adj.) less than the Zone Temperature.

AND the outside air temperature is less than 65°F (adj.)

The economizer shall close whenever the freezestat (if present) is on. The outside air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

The controller shall monitor the discharge air temperature. Should discharge temperature drop below a user definable temperature (adj.), the controller shall enable the heating, close the outside damper and open the return damper.

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Discharge Air Temperature:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).

Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Fan Status:


The controller shall monitor the fan status.

Alarms shall be provided as follows:

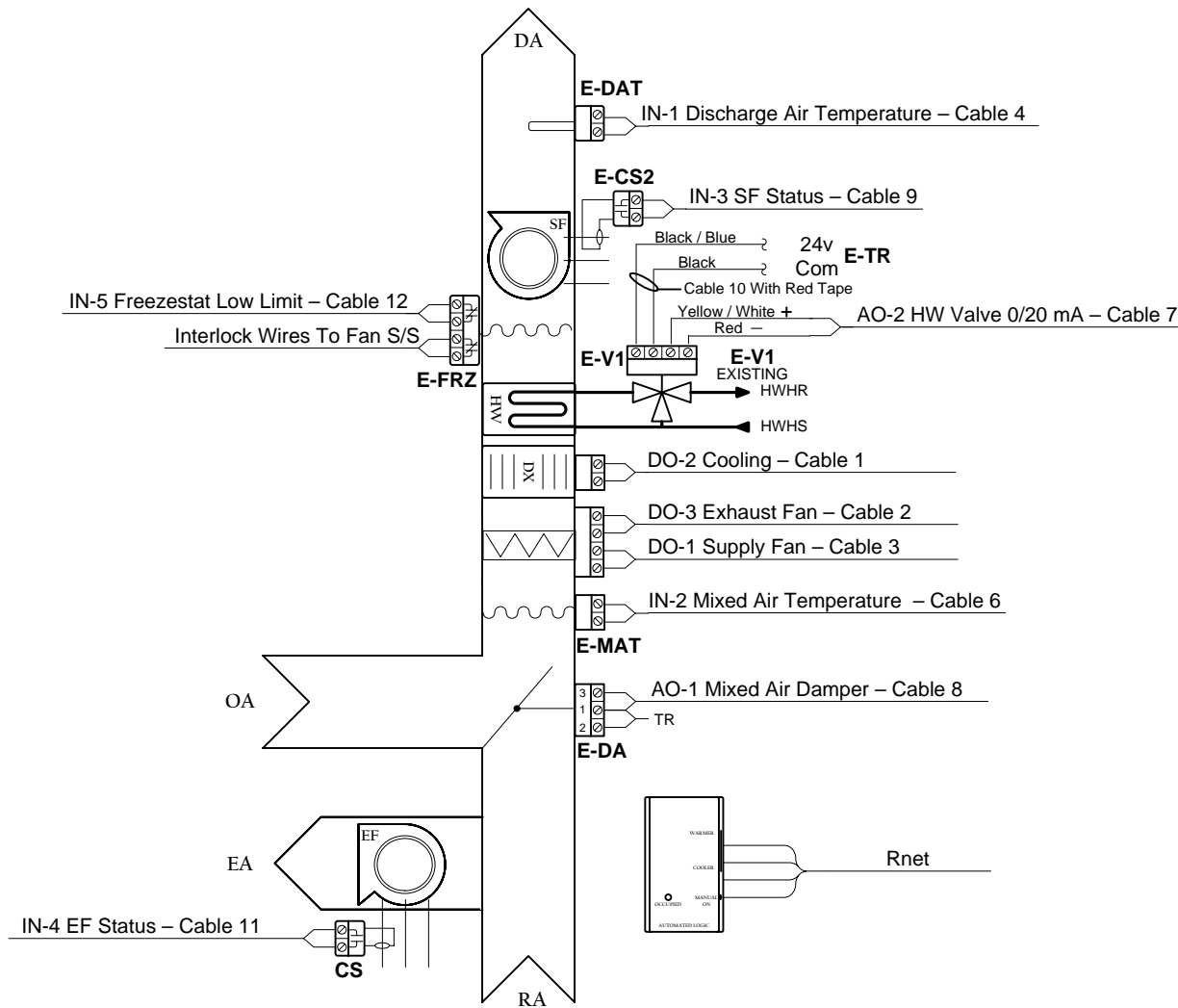
Fan Failure: Commanded on, but the status is off.

Fan in Hand: Commanded off, but the status is on.

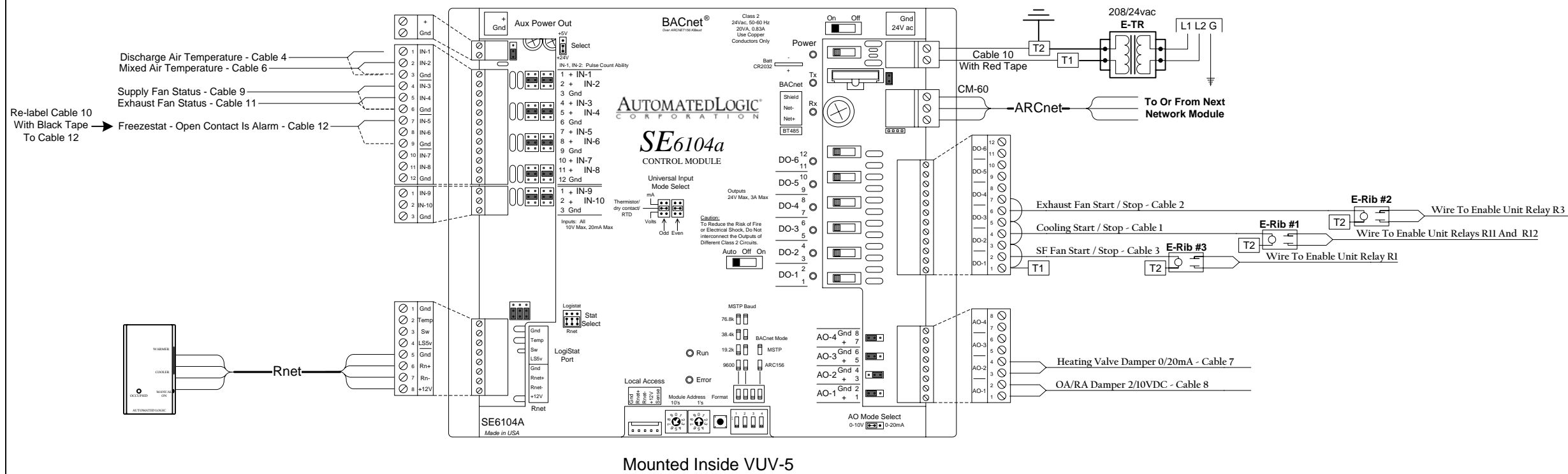
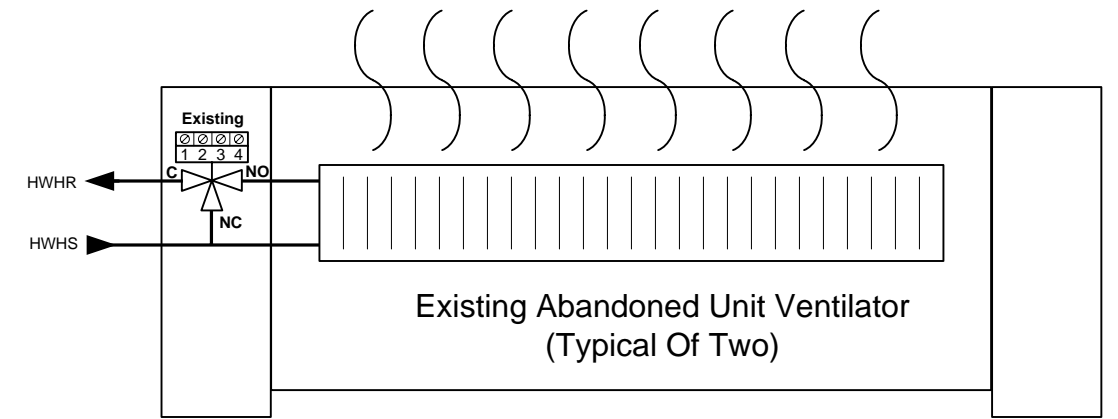
Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
VUV-1, 2, 3 & 4 Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			36 of 46

VUV-5 Control



Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CS	CURRENT SENSOR	SENAVA	C-1200	1 ea
DAT	DISCHARGE AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	1 ea
E-CS2	EXISTING CURRENT SENSOR	VERIS	E112-708	1 ea
E-FRZ	EXISTING FREEZESTAT	INVENSYS	TC-5232	1 ea
E-V1 VUV5	EXISTING VALVE 0/20 MA CONTROL	INVENSYS	MPR-5613-0-0-3	1 ea
MAT	MIXED AIR TEMPERATURE SENSOR 12'	BAPI	ALC-10K-2-A-12'	1 ea
RSPL	RSPL ROOM SENSOR W/SETPOINT AND OVERRIDE,RNET	AUTOMATED LOGIC	RSPL	0 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea



Mounted Inside VUV-5

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
VUV-5 Control			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			37 of 46

VUV-5 Sequence Of Operation

Unit Ventilator (typical of 1)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

Occupied Mode: The unit shall maintain

A 74°F (adj.) cooling setpoint

A 70°F (adj.) heating setpoint.

Unoccupied Mode (night setback): The unit shall maintain

A 85°F (adj.) cooling setpoint. VUV cooling to remain "Off"

A 62°F (adj.) heating setpoint.

Alarms shall be provided as follows:

High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).

Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Freeze Protection:

The unit shall shut down and generate an alarm upon receiving a freezestat status.

Supply and Exhaust Fans:

The supply and exhaust fans shall run on low or medium speeds (adjusted by air balancer) anytime the unit is commanded to run unless shutdown on safeties. When the space temperature is 2F (Adj.) or higher above the setpoint the supply and exhaust fans will be at high speed.

Cooling:

The controller shall measure the zone temperature and energize the compressor to maintain its cooling setpoint. To prevent short cycling the compressor there is a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

Outside air temperature is greater than 60°F (adj.).

AND the zone temperature is above cooling setpoint.

AND the fan is on.

Compressor Status:

The controller shall monitor the compressor status.

Alarms shall be provided as follows:

Compressor Failure: Commanded on, but the status is off.

Compressor in Hand: Commanded off, but the status is on.

Compressor Runtime Exceeded: Compressor status runtime exceeds a user definable limit (adj.).

Condenser Exhaust / Exhaust Air Fan Status:

The controller shall monitor the CE/EA status.

Alarms shall be provided as follows:

CE/EA Failure: Commanded on, but the status is off.

CE/EA in Hand: Commanded off, but the status is on.

CE/EA Runtime Exceeded: Compressor status runtime exceeds a user definable limit (adj.).

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

Outside air temperature is less than 65°F (adj.).

AND the zone temperature is below heating setpoint.

AND the fan is on.

The heating coil valve shall open whenever the freezestat (if present) is on.

Economizer (ASHRAE Cycle II):

The controller shall measure the zone temperature and modulate the mixed air dampers in sequence to maintain the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open during heating and ventilation whenever occupied.

The economizer shall be enabled whenever:

Outside air temperature is at least 3°F (adj.) less than the Zone Temperature.

AND the outside air temperature is less than 65°F (adj.)

The economizer shall close whenever the freezestat (if present) is on. The outside air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

The controller shall monitor the discharge air temperature. Should discharge temperature drop below a user definable temperature (adj.), the controller shall enable the heating, close the outside damper and open the return damper.

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Discharge Air Temperature:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).

Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Fan Status:


The controller shall monitor the fan status.

Alarms shall be provided as follows:

Fan Failure: Commanded on, but the status is off.

Fan in Hand: Commanded off, but the status is on.

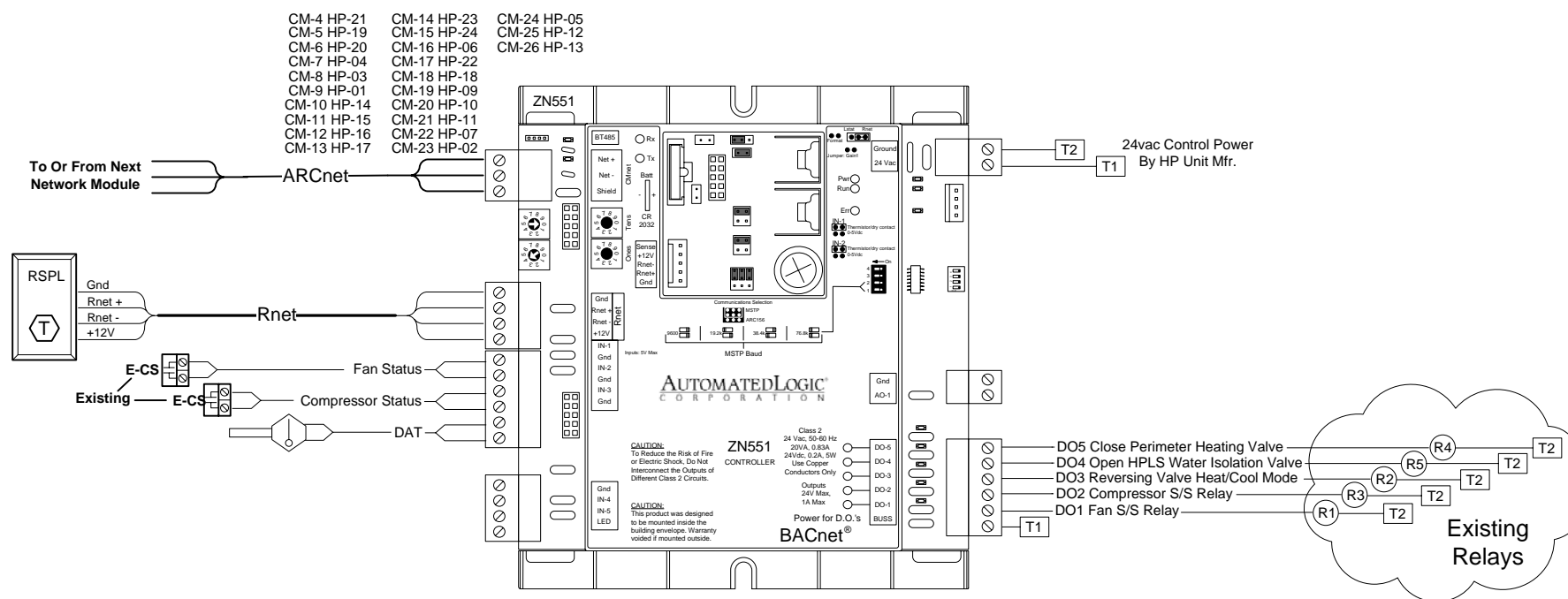
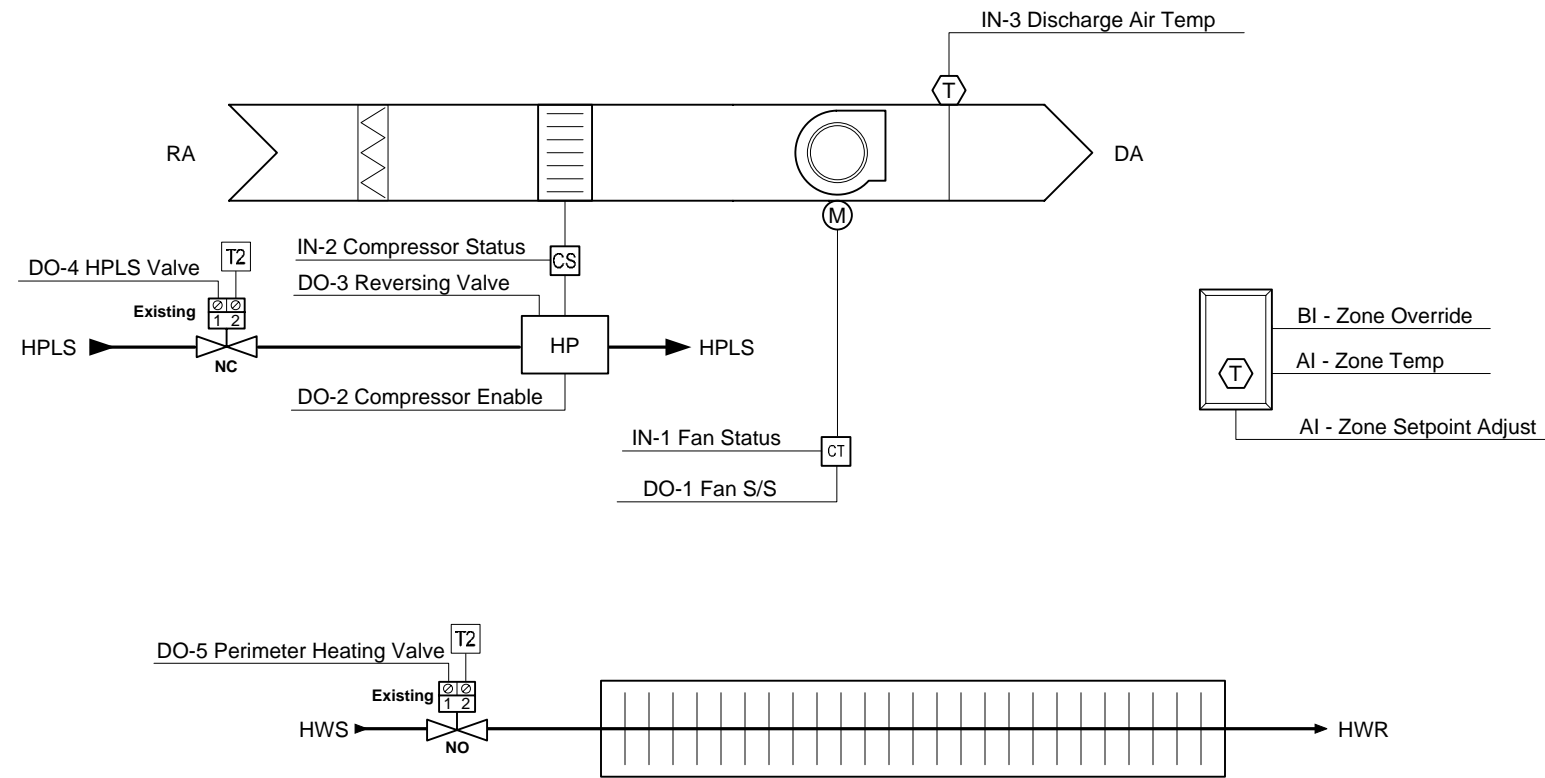
Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

Elementary School			
Michigan 48xxx			
Metro Environmental, Inc.			
VUV-5 Sequence Of Operation			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			38 of 46

Water Source Heat Pumps

Bill of Materials

DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
DAT	DISCHARGE AIR SENSOR	BAPI	ALC/10K-2-D-8"	23 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	46 ea
R1,2,3,4,5	24VAC SPDT RELAYS	CORE	CVR-11C	115 ea
RSPL	ZONE SENSOR WITH ADJUSTMENT AND OVERRIDE BUTTON	AUTOMATED LOGIC	RSPL	0 ea
ZN551	ZN551	AUTOMATED LOGIC	ZN551	0 ea



- CM-4 HP-21
- CM-5 HP-19
- CM-6 HP-20
- CM-7 HP-04
- CM-8 HP-03
- CM-9 HP-01
- CM-10 HP-14
- CM-11 HP-15
- CM-12 HP-16
- CM-13 HP-17
- CM-14 HP-23
- CM-15 HP-24
- CM-16 HP-06
- CM-17 HP-22
- CM-18 HP-18
- CM-19 HP-09
- CM-20 HP-10
- CM-21 HP-11
- CM-22 HP-07
- CM-23 HP-02
- CM-24 HP-05
- CM-25 HP-12
- CM-26 HP-13

Elementary School Michigan 48xxx			
Metro Environmental, Inc. Water Source Heat Pumps			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
39 of 46			

Water Source Heat Pump Sequence

Water Source Heat Pump (typical of 23)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 75°F (adj.) cooling setpoint
 - A 72°F (adj.) heating setpoint

- Unoccupied Mode (night setback): The unit shall maintain
 - A 85°F (adj.) cooling setpoint.
 - A 62°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Fan:

The fan shall run anytime the unit is occupied, cycles during unoccupied with a call for heat and cool unless shutdown on safeties.

Heating and Cooling - 1 Compressor Stage:

The controller shall receive a signal from the loop water source monitor indicating that there is water flow and that the water temperature is within acceptable limits for a minimum of two minutes.

The controller shall measure the zone temperature, open the isolation valve and cycle the compressor to maintain its setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The compressor shall run subject to its own internal safeties and controls. The isolation valve will close when the compressor cycles off.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the fan is on.
- AND the reversing valve is in heat mode.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the fan is on.
- AND the reversing valve is in cool mode.

On mode change, the compressor shall be disabled and remain off until after the reversing valve has changed position.

Alarms shall be provided as follows:

- Compressor Runtime Exceeded: The compressor runtime exceeds a user definable limit (adj.).

Compressor Status:

The controller shall monitor the compressor status.

Alarms shall be provided as follows:

- Compressor Failure: Commanded on, but the status is off.
- Compressor in Hand: Commanded off, but the status is on.
- Compressor Runtime Exceeded: Compressor status runtime exceeds a user definable limit (adj.).

Filter Hours:

The controller shall monitor the fan runtime.

Alarms shall be provided as follows:

- Filter Change Required: Filter has been in use for more than 2200hr (adj.).

Discharge Air Temperature:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Fan Status:


The controller shall monitor the fan status.

Alarms shall be provided as follows:

- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.
- Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

Perimeter radiation heating valve will open whenever:

- Outside air temperature is less than 55°F (adj.) and there is a call for heat greater than 10% in either occupied or unoccupied mode.

Elementary School			
Michigan 48xxx			
Metro Environmental, Inc.			
Water Source Heat Pump Sequence			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			40 of 46

Radiant Ceiling Panel Loop Control

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-800	1 ea
E-V1	EXISTING 1-1/2" 3-WAY MIXING VALVE	HONEYWELL	N/A	1 ea
HWS	HOT WATER SUPPLY TEMPERATURE SENSOR	BAPI	ALC/10K-2-1-4"	1 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	0 ea

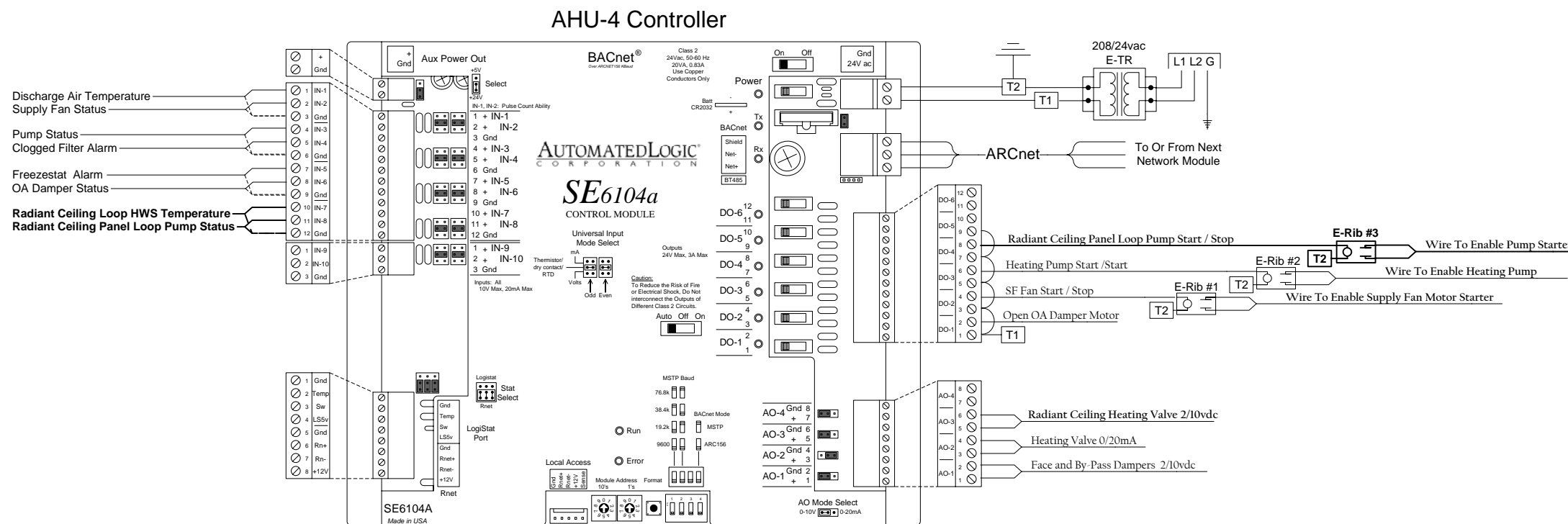
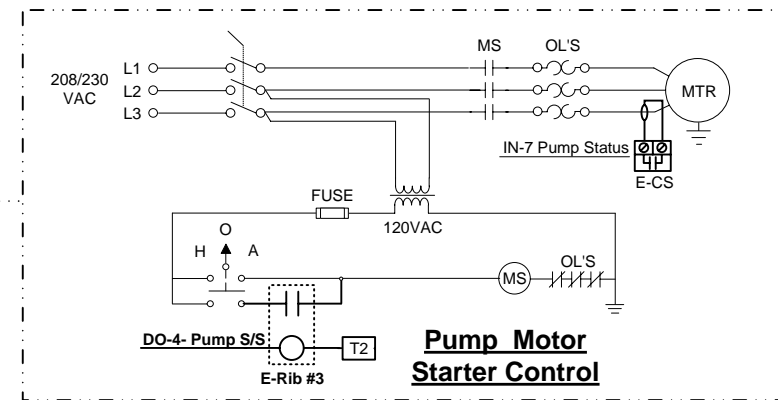
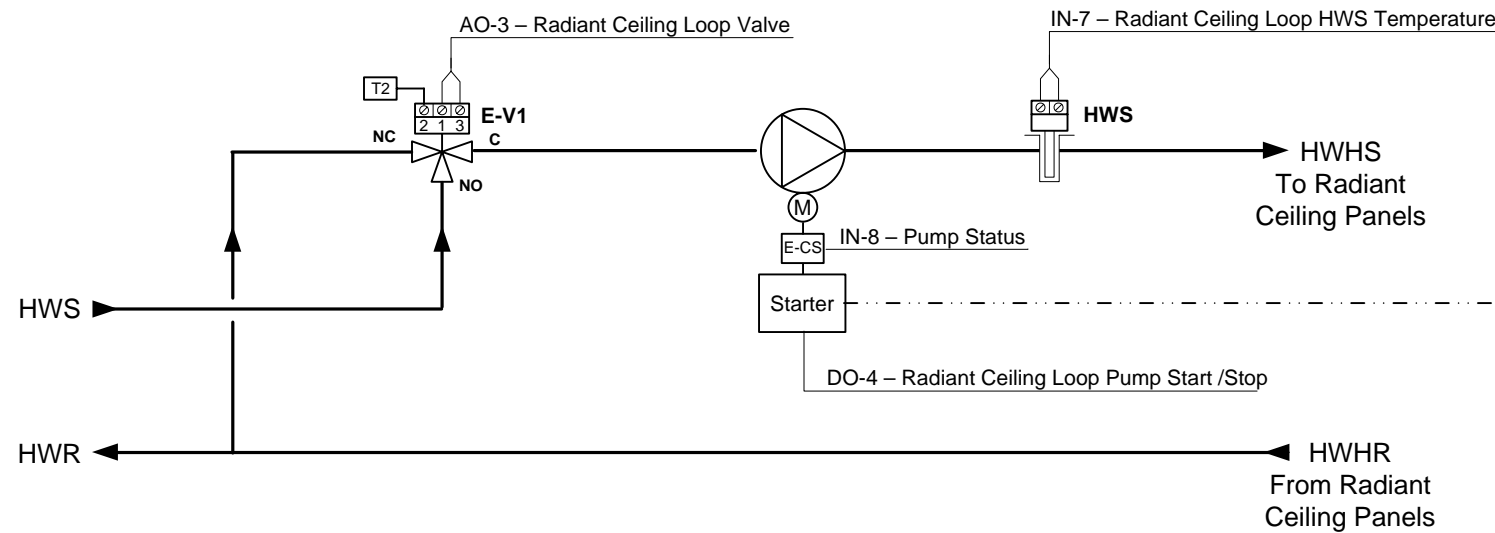
Radiant Ceiling Panel Loop HWHS Reset Schedule	
Outside Air Temp.	Hot Water Supply Temp.
≤ 0F	180F
≥ 55F	120F

Sequence of Operation

Radiant ceiling panel circulating pump activates when outdoor air temperature drops below 55F (adj.)

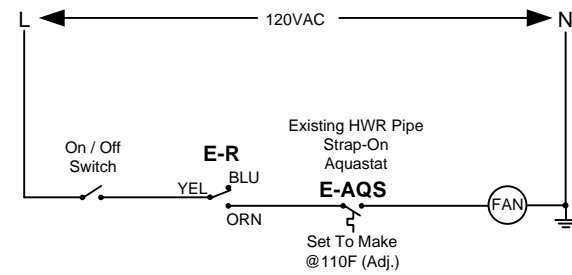
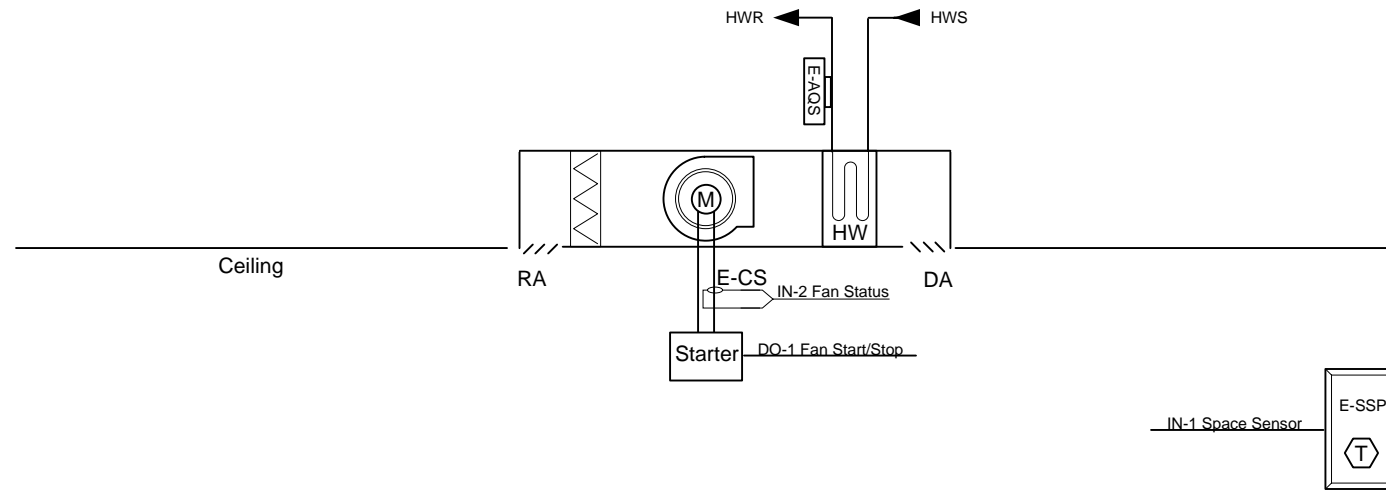
DDC monitors pump status via current switch and generates an alarm if an abnormal condition occurs.

DDC modulates 3-way mixing valve to maintain loop supply water temperature based on outdoor reset temperature schedule

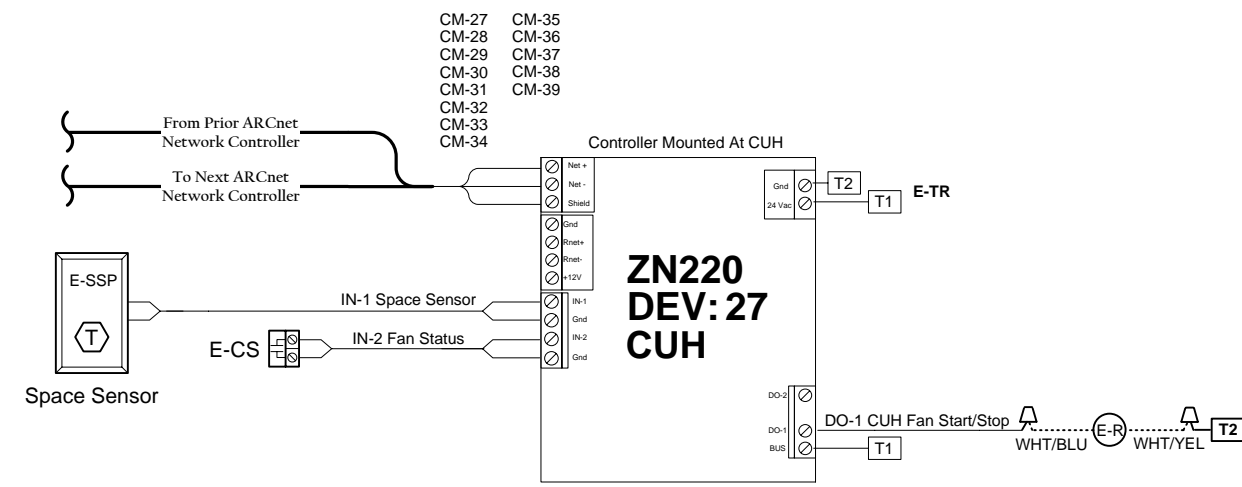


Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Radiant Ceiling Panel Loop Control			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
41 of 46			

Cabinet Unit Heaters



**Existing Cabinet Unit Heater Control
(Typical of 13)**



Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
E-AQS	EXISTING STRAP ON AQUASTAT	INVENSYS	TC-2974	13 ea
E-CS	EXISTING CURRENT SWITCH	VERIS	E112-700	13 ea
E-R	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	13 ea
E-SSP	ZONE SENSOR STAINLESS STEEL WALL PLATE	EXISTING	EXISTING	13 ea
E-TR	120/24V 50VA TRANSFORMER	EXISTING	EXISTING	13 ea
ZN220	ZONE CONTROLLER	AUTOMATED LOGIC	ZN220	0 ea

Sequence Of Operation

Cabinet Unit Heater (typical of 13)

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain a heating setpoint of 68°F (adj.).
- Unoccupied Mode (night setback): The unit shall maintain a heating setpoint of 55°F (adj.).

Alarms shall be provided as follows:

- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Fan:

The fan will run anytime the zone temperature drops below the heating setpoint and hot water is available as sensed by the pipe mounted aquastat after relay R is enabled. When relay R is disabled the fan will stop.

Heating Coil Valve:

The cabinet unit heaters do not have valves.

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Cabinet Unit Heaters			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			42 of 46

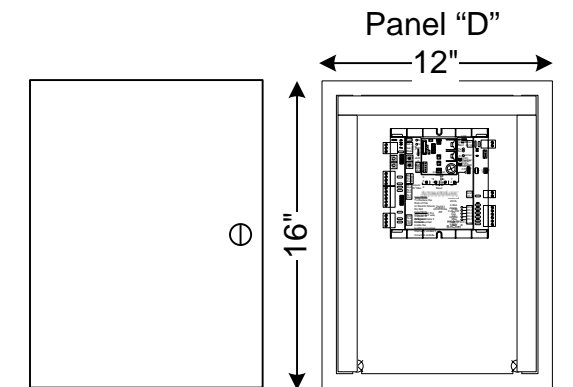
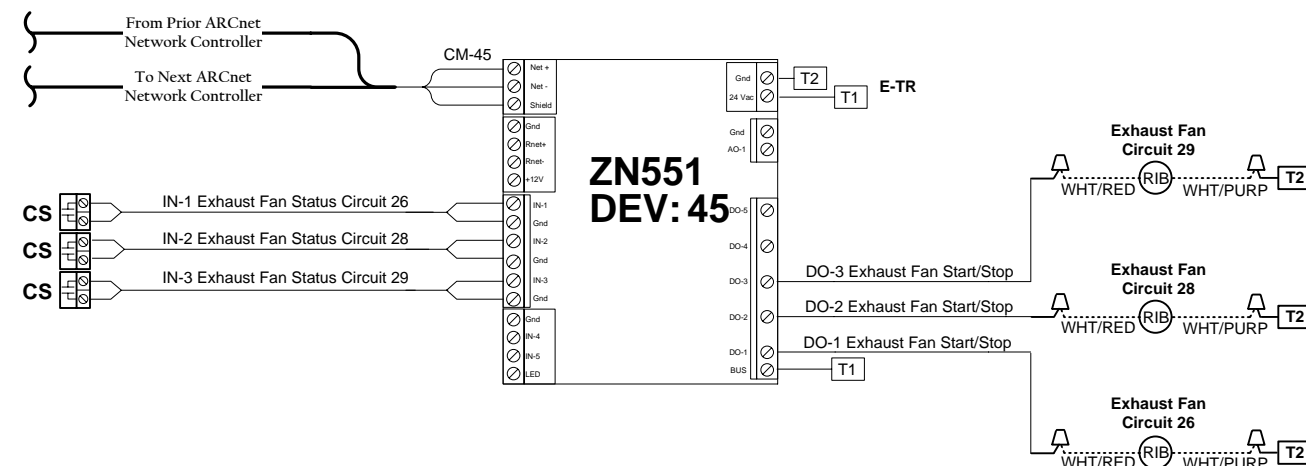
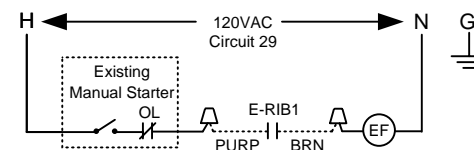
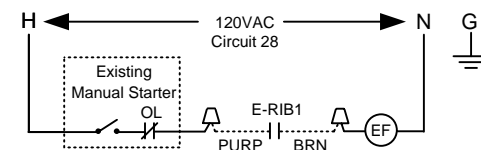
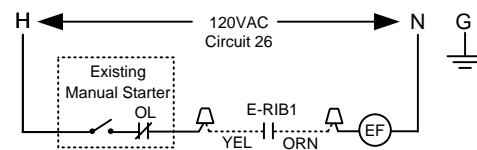
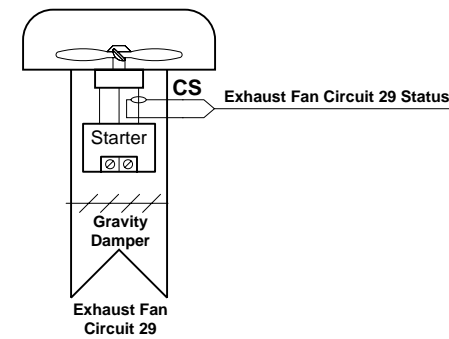
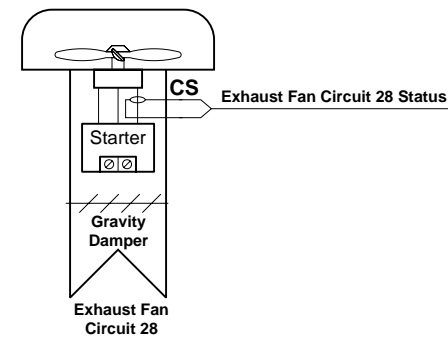
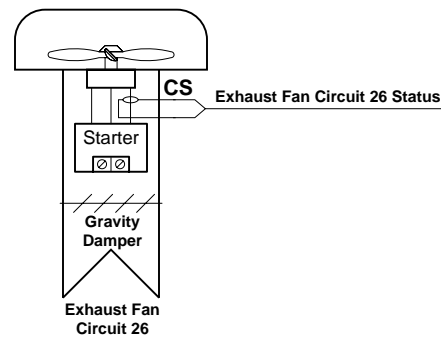
Exhaust Fans Serving Pre-School Wing

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CS	CURRENT SWITCH	SENAVA	C-1200	3 ea
E-RIB1	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	3 ea
E-TR	EXISTING 24VAC TRANSFORMER	HONEYWELL	N/A	1 ea
PANEL D	16"X12"X6" NEMA 1 ENCLOSUE WITH PERF PANEL	HOFFMAN	A16N126 W/ A16N12PP	1 ea
ZN551	ZONE CONTROLLER	AUTOMATED LOGIC	ZN551	0 ea

Sequence of Operation

Exhaust fans are started and stopped based on an occupied time schedule.

DDC controller will monitor the exhaust fan statuses via current switches. If an abnormal condition occurs the controller will generate an alarm.



Locate Control Panel In Electrical Room
Serving The Exhaust Fans

Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Exhaust Fans Serving Pre-School Wing			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			43 of 46

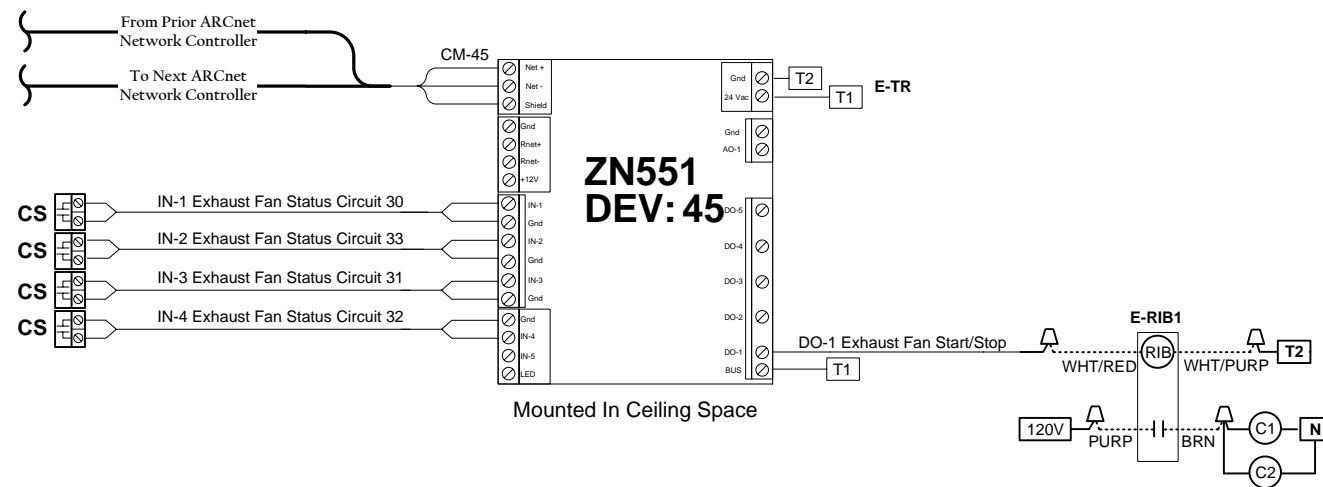
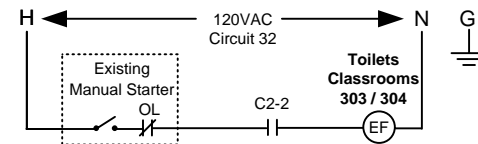
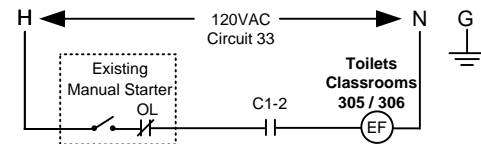
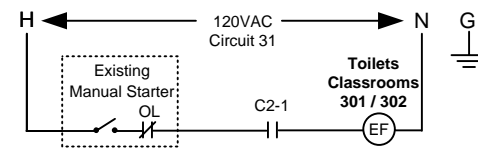
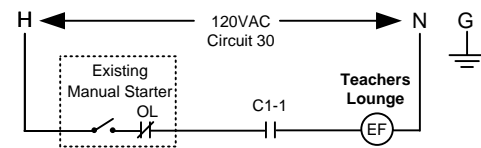
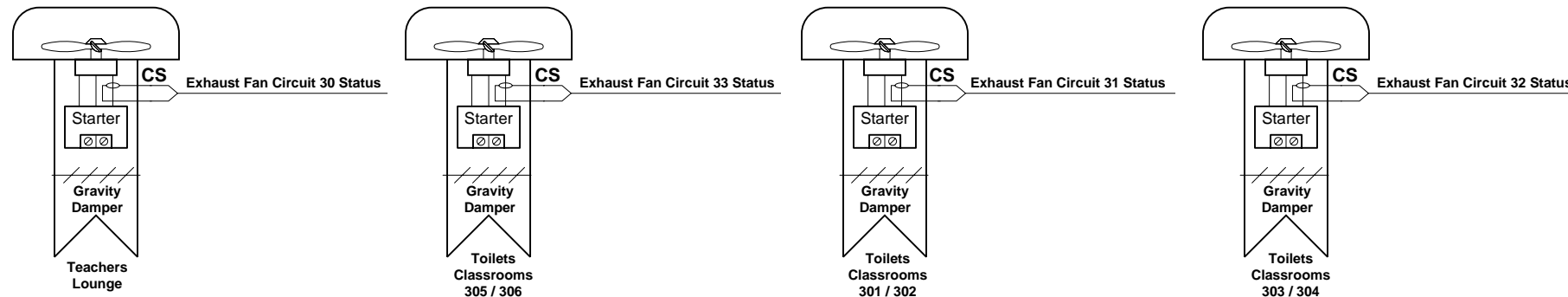
Exhaust Fans Serving Northwest Rooms

Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
CS	CURRENT SWITCH	SENA	C-1200	3 ea
E RIB1	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	1 ea
E-TR	EXISTING 24VAC TRANSFORMER	HONEYWELL	N/A	1 ea
ZN551	ZONE CONTROLLER	AUTOMATED LOGIC	ZN551	0 ea

Sequence of Operation

Exhaust fans are started and stopped based on an occupied time schedule.

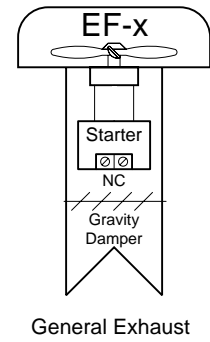
DDC controller will monitor the exhaust fan statuses via current switches. If an abnormal condition occurs the controller will generate an alarm.



Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Exhaust Fans Serving Northwest Rooms			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			44 of 46

Additional Exhaust Fans

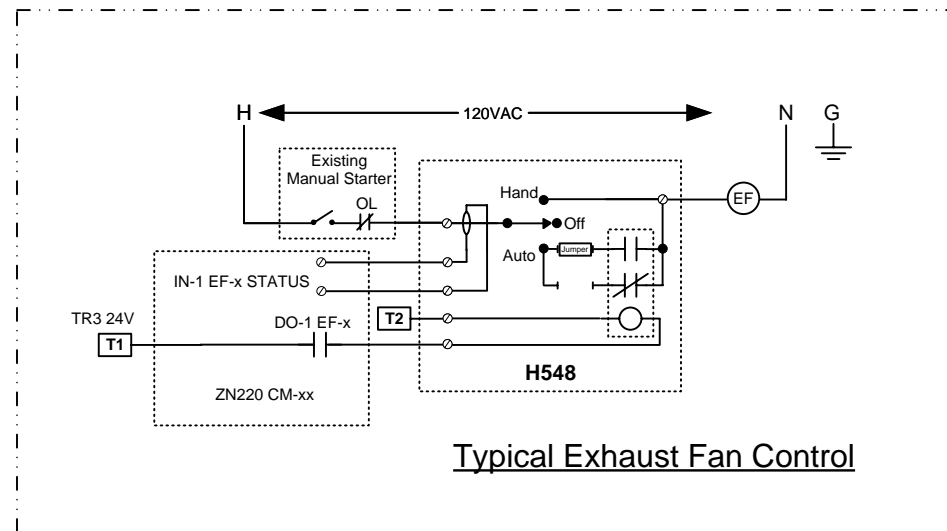
Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
H548	COMMAND RELAY WITH CURRENT SWITCH	VERIS	H548	4 ea
TR3	120/24VAC TRANSFORMER 50VA	FUNCTIONAL DEVICES	TR50VA005	4 ea
ZN220	DIGITAL CONTROLLER	AUTOMATED LOGIC	ZN220	0 ea



Sequence of Operation

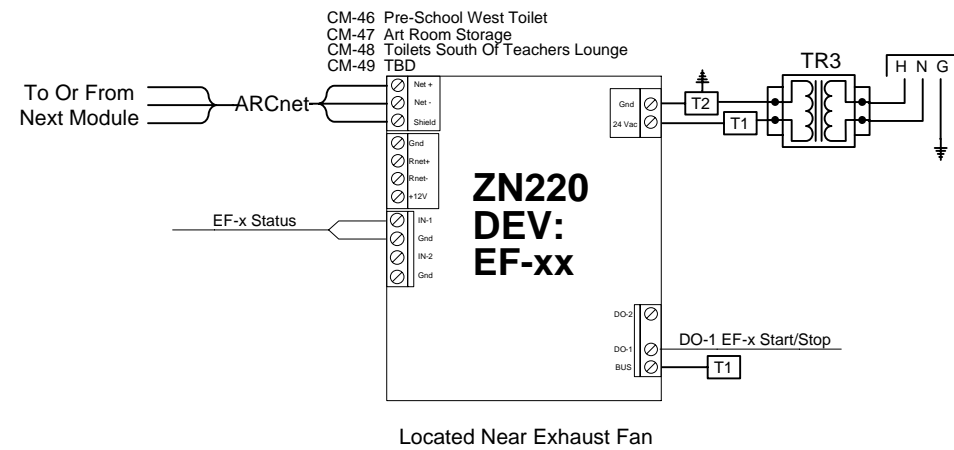
Exhaust fans are started and stopped based on an occupied time schedule.

DDC controller will monitor the exhaust fan status via current switch. If an abnormal condition occurs the controller will generate an alarm.



Typical Exhaust Fan Control In The Following Areas:

- 1) Preschool West Bathroom.
- 2) Toilets South of Teachers Lounge
- 3) Art Room Storage
- 4) To Be Determined (TBD).



Elementary School Michigan 48xxx			
Metro Environmental, Inc.			
Additional Exhaust Fans			
REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
			DRAWN BY : TL
			CHECKED BY : TS
			45 of 46

Summary Bill of Materials

Summary Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
BT485	END OF LINE SEGMENT CONDITIONER	AUTOMATED LOGIC	BT485	6 ea
CDT	COLD DECK AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
CFS	CLOGGED FILER DIFFERENTIAL PRESSURE SWITCH	CLEVELAND	AFS-222	1 ea
CO2	RETURN AIR DUCT MOUNTED CO2 SENSOR	VERIS	CDE	1 ea
CR1,2	COOLING RELAY 24VAC DPDT WITH INDICATING LIGHT	IDEC	RH2B-ULAC24V + SH2B-05 SOCKET	2 ea
CS	CURRENT SENSOR	SENA	C-1200	14 ea
CS	CURRENT SENSOR	SENA	C-1200	1 ea
DAT	DISCHARGE AIR TEMPERATURE SENSOR	BAPI	ALC/10K-T2-D-18"	4 ea
DAT	DISCHARGE AIR SENSOR	BAPI	ALC/10K-2-D-8"	23 ea
DIAG485	ARC156 DIAGNOSTIC DEVICE	AUTOMATED LOGIC	DIAG485	1 ea
DM	DAMPER MOTOR 24VAC 2/10VDC CONTROL - FAIL CLOSED	BELIMO	LF24-SR US	1 ea
E RIB-1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E RIB-3,4	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E RIB1	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	4 ea
E RIB1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
E RIB1,2,3	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	3 ea
E-AQS	EXISTING STRAP ON AQUASTAT	INVENSYS	TC-2974	13 ea
E-CS	EXISTING CURRENT SWITCH SOLID CORE	VERIS	E112-708	79 ea
E-CS CR	EXISTING CURRENT SWITCH WITH COMMAND RELAY	VERIS	H948	1 ea
E-CS2	EXISTING CURRENT SENSOR	VERIS	E112-708	1 ea
E-DA1	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC CONTROL	INVENSYS	MP-5430	1 ea
E-DA2	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC CONTROL	INVENSYS	MM-500-0-0-1	1 ea
E-DAT	EXISTING DISCHARGE AIR TEMPERATURE SENSOR	ALERTON	TS-2008BT	1 ea
E-DM-1,2	EXISTING DAMPER ACTUATOR 24VAC 2/10VDC CONTROL	BELIMO	AF24 MFT US	2 ea
E-DM1	EXISTING DAMPER MOTOR 120VAC 2/15VDC CONTROL	INVENSYS	MP-5430	3 ea
E-DM1,2	EXISTING DAMPER MOTOR 24VAC 2/10VDC CONTROL	BELIMO	LF24-SR	2 ea
E-DM2	EXISTING DAMPER MOTOR 120VAC 2/15VDC CONTROL	INVENSYS	MM-500-0-0-1	2 ea
E-DPS	EXISTING CLOGGED FILER DIFFERENTIAL PRESSURE SWITCH	INVENSYS	PC-301	4 ea
E-FRZ	EXISTING FREEZESTAT DPST	INVENSYS	TC-5232	7 ea
E-MAT	EXISTING MIXED AIR TEMPERATURE SENSOR	ALERTON	TS-2008BT	1 ea
E-R	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	24 ea
E-RIB-3,4,5	EXISTING 24VAC CONTROL RELAY	FUNCTIONAL DEVICES	RIBU1C	3 ea
E-RIB1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	4 ea
E-SAT	EXISTING SUPPLY AIR TEMPERATURE SENSOR	ALERTON	TS2020BT	1 ea
E-SSP	ZONE SENSOR STAINLESS STEEL WALL PLATE	EXISTING	EXISTING	13 ea
E-TR	120/24VAC 75VA TRANSFORMER	HONEYWELL	AT175F1023	19 ea
E-V1	EXISTING 1-1/2" 3-WAY MIXING VALVE	HONEYWELL	N/A	1 ea
E-V1 AHU	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	3 ea
E-V1 AHU1	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
E-V1 AHU5	EXISTING 3-WAY VALVE 24VAC 2/10VDC CONTROL - FAILS OPEN	BELIMO	B217B+LF-SR	1 ea
E-V1 MZ	EXISTING 3-WAY 1-1/4" CV20 GPM 27 0/15VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
E-V1 RTU1	EXISTING 3-WAY 1-1/4" 6/9VDC CONTROL	INVENSYS	VS-7313-267-4-9 MP-5430-0-0-3	1 ea
E-V1 RTU2	EXISTING VALVE ACTUATOR	INVENSYS	MP-5210	1 ea
E-V1 SF-1	EXISTING 3-WAY 3/4" VALVE 0/20MA CONTROL	INVENSYS	MPR-5413	1 ea
E-V1 VUV	EXISTING VALVE FLOATING CONTROL	BELIMO	N/A	4 ea
E-V1 VUV5	EXISTING VALVE 0/20 MA CONTROL	INVENSYS	MPR-5613-0-0-3	1 ea
E-V1SF1	EXISTING 24VAC 3-WAY 3/4" 4/20MA CONTROL	INVENSYS	MP-5413	1 ea
E-ZDM	EXISTING ZONE DAMPER ACTUATOR 24VAC 2/10VDC CONTROL	BELIMO	NB24 MFT US	3 ea
ER1,2	EXISTING 24VAC CONTROL RELAY	CORE	CVR-11C	2 ea
H548	COMMAND RELAY WITH CURRENT SWITCH	VERIS	H548	4 ea
HDT	HOT DECK AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	1 ea
HWS	HOT WATER SUPPLY TEMPERATURE SENSOR	BAPI	ALC/10K-2-I-4"	1 ea
LGR25	LGR25	AUTOMATED LOGIC	LGR25	1 ea
M8102	M8102 DDC CONTROLLER	AUTOMATED LOGIC	M8102	1 ea
MAT	MIXED AIR AVG. TEMP. SENSOR	BAPI	ALC/10K-2-A-24"	4 ea
MX4106	MX4106	AUTOMATED LOGIC	MX4106	1 ea
OAT/H	OUTSIDE AIR TEMPERATURE AND HUMIDITY SENSOR	BAPI	ALC/10K-2-H300-O-WP	1 ea
PANEL A	36X30 ENCLOSURE+PERF+KEYLOCKKIT	HOFFMAN	A-36N30ALP+A36N30MPP+AL12	1 ea
PANEL B	EXISTING INVENSYS COMMUNICATIONS PANEL	INVENSYS	N/A	1 ea
PANEL C	24" X 24" ENCLOSURE+PERF PANEL	HOFFMAN	A24N24ALP + A24N24MPP	1 ea
PANEL D	16"X12"X6" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	A16N126 W/ A16N12PP	1 ea
PANEL E	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL F	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL G	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL H	EXISTING 12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL I	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PANEL J	12" X 12" X 3" NEMA 1 ENCLOSURE WITH PERF PANEL	HOFFMAN	B12-P	1 ea
PDT	DIFF PRESS TRANSMITTER 0-50 PS1, 0-5 VDC OUT, 24 VDC IN	VERIS	PWLX03S	1 ea
PROT485	ARC156 PROTECTION DEVICE	AUTOMATED LOGIC	PROT485	2 ea
PS	POWER SUPPLY 24VAC IN 24VDC OUT	KELE	DCP-1.5W	1 ea
R1,2,3,4,5	24VAC SPDT RELAYS	CORE	CVR-11C	115 ea
R3	24VAC DPDT WITH INDICATING LIGHT	IDEC	RH2B-ULAC24V + SH2B-05 SOCKET	4 ea
RAT	RETURN AIR TEMPERATURE	BAPI	ALC/10K-T2-D-18"	2 ea
REP485	REPEATER	AUTOMATED LOGIC	REP485	2 ea
RSPL	ROOM SENSOR WITH ADJUSTMENT AND OVERRIDE	AUTOMATED LOGIC	RSPL	37 ea

Summary Bill of Materials				
DID	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY
SA	SUPPLY AIR TEMPERATURE SENSOR	BAPI	ALC/10K-2-D-8"	4 ea
SE6104a	SE6104A	AUTOMATED LOGIC	SE6104A	9 ea
SSP	STAINLESS STEEL WALL PLATE SENSOR	BAPI	ALC/10K-2-SP	13 ea
T1 to T6	IMMERSION TEMP SENSOR	BAPI	ALC/10K-2-I-4"	6 ea
TR-1	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	1 ea
TR-1,2	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	2 ea
TR-1,2,3,4	TRANSFORMER 120/24VAC 100VA	FUNCTIONAL DEVICES	TR100VA001-28	4 ea
TR3	120/24VAC TRANSFORMER 50VA	FUNCTIONAL DEVICES	TR50VA005	4 ea
ZDA	EXISTING DAMPER ACTUATOR 120VAC 2/15VDC	INVENSYS	MP-5430-0-0-3	3 ea
ZDAT	ZONE DISCHARGE AIR TEMPERATURE	BAPI	ALC/10K-T2-D-8"	3 ea
ZN141v+	ZN141V+	AUTOMATED LOGIC	ZN141V+	1 ea
ZN220	ZN220	AUTOMATED LOGIC	ZN220	18 ea
ZN253	ZN253	AUTOMATED LOGIC	ZN253	1 ea
ZN551	ZN551	AUTOMATED LOGIC	ZN551	32 ea

Elementary School

Michigan 48xxx

Metro Environmental, Inc.

Summary Bill of Materials

REV: 0	Submittal	2/08/10	JOB NO: Cxxxx
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