B O N N E V I L L E P O W E R A D M I N I S T R A T I O N

Appendices to
RTU Premium Ventilation:
Proof of Concept Field Test

Final Report: May 2012

Funded by:

Bonneville Power Administration
Contact: Mira Vowles

Prepared by:

Portland Energy Conservation, Inc. (PECI)
Reid Hart, PE, Associate Director

Contract No. 38702

Appendices

Appendix A – Programmatic Specification

The programmatic specification for installation of the Premium Ventilation measures on stand-alone RTUs is included in the following Appendix. The programmatic specification includes the revised Sequence of Operation (see Appendix B for the original).

Programmatic Specification and Sequence of Operation

Demand Controlled Ventilation
Upgrade to Individual Unitary Air Conditioners

Funded Jointly by
Bonneville Power Administration
Energy Trust of Oregon

Appendix A
to
RTU Premium Ventilation: Proof of Concept Field Test Final Report

May 2012

1400 SW 5th Avenue, Suite 700, Portland, OR 97201
Main 503.248.4636 Fax 503.295.0820
peci.org

Table of Contents

Program Measure Descriptions

The retrofit modifications described in this specification offer building owners a strategy to reduce HVAC system energy. These modifications comprise of three alternative energy conservation measures that result in a refurbishment of a unitary air conditioner system outside-air economizer and the incorporation of demand controlled ventilation (DCV). For application to constant volume single zone rooftop units (RTUs). Once the economizer is upgraded, the building owner may choose to implement one of the following three Energy Conservation Measures (ECMs) to incorporate DCV into their HVAC system:

ECM 1: Standard Demand Controlled Ventilation (Standard DCV)
A DCV system adjusts the amount of outside air to match the actual building occupancy. This measure includes installation of a controller and CO_2 sensor to adjust the ventilation rate to match the actual requirements. The sensor shall be integrated into the HVAC system controls to reset the minimum damper position to meet a CO_2 target setpoint. Implementation of this measure requires that economizers be refurbished and controls optimized. Economizers deliver cool air when there is a cooling load inside the building, reducing mechanical, compressor-driven cooling. Field studies have shown that most economizers are not functional or optimized.

ECM 2: Demand Controlled Ventilation with Fan Cycling (DCV with Fan Cycling)
Building on ECM 1, this measure requires a CO2 sensor and configures controls to adjust the ventilation rate to match the actual requirements. In this ECM, the controls will also cycle the fan to maintain the average CO_2 level. Fan operation only occurs as needed to maintain average ventilation and thermal setpoints.

ECM 3: Demand Controlled Ventilation with Fan VSD (DCV w/ Fan VSD)
This measure also builds on ECM 1 and adds a variable speed drive to the fan motor to provide multiple speed control of the supply fan. The fan runs continuously during occupied hours, moving to high speed when heating or cooling is needed.

ECM 4: Premium Ventilation with Fan Cycling (Prem Vent with Fan Cycling)
Building on ECM 2, this measure includes fan control and demand controlled ventilation. In this ECM, the controls will also provide for: Occupied Mode Deadband; Setpoint limits, lockouts, and user interface; Limited Setpoint override; Robust Optimum Start; and Unoccupied Ventilation Fan and Temperature Control. In addition, premium ventilation controls may include optional strategies such as optimum stop, night flush and occupancy sensor standby.
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ECM 5: Premium Ventilation with Fan VSD (Prem Vent w/ Fan VSD)
Building on ECM 3, this measure includes fan control and demand controlled ventilation. In this ECM, the controls will also provide for: Occupied Mode Deadband; Setpoint limits, lockouts, and user interface; Limited Setpoint override; Robust Optimum Start; and Unoccupied Ventilation Fan and Temperature Control. In addition, premium ventilation controls may include optional strategies such as optimum stop, night flush and occupancy sensor standby.

General Program Requirements

1. These specifications are intended to meet or exceed applicable existing codes and regulations. Codes and regulations, however, are updated periodically and are also subject to change through the code processes at State and local jurisdictions. Therefore, the specifications, codes, and regulations shall apply as follows:
   a. HVAC Measures shall be installed in accordance with these specifications, all applicable State and local codes, and Federal regulations, and the most recent versions of the International Codes and the National Electric Code;
   b. Where State or local code and specification requirements are in conflict, the most stringent of the requirements shall apply. When State or local codes are less restrictive, Bonneville may approve

their use in lieu of these specifications. Such approval must be requested in writing by the Utility and approved in writing by Bonneville prior to installation of the Measure; and

c. In cases where a specific application is not addressed in the specification, codes, or regulations, the Utility shall determine the appropriate action consistent with the codes and these specifications. Utility decisions in these instances shall be thoroughly documented in the Project file.

2. Definitions – For purposes of this specification, the following definitions apply. All other applicable definitions can be found in the main body of this Agreement.

   a. Code. The most recent edition of the International Codes written by the International Conference of Building Officials (ICBO) including the International Building Code (IBC), the International Mechanical Code (IMC), International Plumbing Code (IPC), International Fire Code (IFC), International Energy Conservation Code (IECC), and other associated codes and the National Electric Code (NEC) written by the National Fire Protection Association (NFPA) and associated codes.

3. The Utility shall be responsible for determining HVAC Measures eligible to be installed in each Building per this specification.

4. All HVAC Measures shall be completed in a manner that will provide a safe, permanent, effective, and Workmanlike installation.

5. The Utility shall maintain a copy of an Installer certificate containing the following information where measures are installed:
   a. address of the Building;
   b. date of Installation;
   c. name and Address of Installer;
   d. the cooling capacity of the existing RTUs;
   e. The measure installed for each RTU (including controller product name and model) installed by the Installer;
   f. Acceptance testing results; and
   g. savings analysis inputs and results.

General Construction Requirements

Meetings & General

- Attend a pre-construction project walk-through with owner representative.
- Attend project meetings as scheduled by owner.
- Provide walk-through demonstration of operation for site operation staff and interested parties.

Submittals

- Specification sheets for all items listed under products, with clear indication of model selected and any options.
- Sequence of operation, including existing sequences to coordinate with new sequences. Develop a comprehensive combined sequence incorporating new control modes into existing sequence of operation.
- Final sequence of operation including any changes during construction or acceptance testing.
- Certification of control system integrator qualifications and training
- Provide any required documentation to incenting utility for their energy saving rebate programs.
- Acceptance testing report forms with simplified flow testing and DCV setup for each unit.
- Maintenance and Warranty Manual in a loose leaf binder with information:
  - Product and maintenance information for installed products
  - Final sequence of operation

- Acceptance testing reports for each unit
- Final building permit, if required
- Warranty and contractor contact information

Permits and Warranty

- Secure any necessary or required building permits before commencing work and coordinate inspections with building department.
- Provide one year labor & material warranty on installed components. Control materials, products and labor shall be warranted by the Installer against failure due to manufacturing and installation defects for a period of at least 2 years, from the installation date. The Installer shall provide a written warranty, with the installation date, to the Owner or Owner Designee. Manufacturers' written warranties may be used by Installers to satisfy a part of this requirement where appropriate.

Scope of Work for Base Bid

Provide control measures indicated on units listed in table below. The first line is filled out as an example.

Customer _____ Utility Account # _____

Contact _____ Phone _____ email _____

Work Location (Street Address) _____

Unit Tag	Unit Cooling Capacity (Tons)	Manufact-urer	Heating Source (HP/ Gas)	ECM #	Comments
RTU-1 (example)	5	Trane	Gas	4	Add Economizer

Additional Requirements:

Include Network Gateway, network wiring, Internet connection and software: ☐ yes ☐ no
Include occupancy sensors for standby vacancy setback: ☐ yes ☐ no
Include night flush control for pre-cooling: ☐ yes ☐ no
Include humidity sensors for high humidity economizer lockout: ☐ yes ☐ no
Economizer high limit lockout type: ☐ OSA comparative drybulb ☐ Combined enthalpy and drybulb

ECM 1: Standard Demand Controlled Ventilation

This measure includes a CO_2 sensor that controls the minimum ventilation setpoint. The sensor shall be integrated into the existing control system and reset the minimum damper setpoint to maintain a CO_2 level according to the sequence of operation. Complete the following for the selected unitary air conditioners:

- Provide RTU controls by either:
  - Replace the existing RTU economizer controls with a digital economizer control that is DCV capable, or
  - Replace thermostat and economizer controllers with local integrated direct digital controllers and space interface, including wiring as required.
- Provide and Install one CO_2 sensor in space served or in each unit return air duct (return air duct location allowed only outside of California). Wire the sensor to the new economizer or integrated controller.
- Where required, replace the economizer damper motors with motors using 2-10VDC input.
- Acceptance testing with simplified airflow verification and setting of the area and full ventilation air damper positions to verify total airflow, outside airflow at area setting, and outside airflow at full ventilation.
- Refurbish the economizer damper operators and blades as needed for smooth operation and replace any missing or damaged damper edge seals. If closed outside damper leakage exceeds 20% during acceptance testing, install closed cell foam insulation on all damper edges.
- Check out and acceptance test unit sequence per acceptance testing protocol in *BPA DCV Application Guide*. Test all units and review test results with building representative. Control system integrator shall provide support as required to cycle unit modes during acceptance testing.

ECM 2: Demand Controlled Ventilation with Fan Cycling

This measure includes the same work that would be completed for ECM 1 with the addition of programming to provide ventilation fan cycling. This additional work includes:

- Replace thermostat and economizer controllers with local direct digital controllers.
- Program the controllers to manage the fan cycling sequence.

ECM 3: Demand Controlled Ventilation with Fan VSD

This measure includes the same work that would be completed for ECM 1 with the addition of a variable speed drive (VSD) on the fan motor and associated control sequence programming. This additional work includes:

- Installation of a VSD on the fan motor and either
  - A speed controller wired from the VSD to the existing control system, or
  - Replace thermostat and economizer controllers with local direct digital controllers programmed to manage the VSD control sequence.

ECM 4: Premium Ventilation with Fan Cycling

This measure includes the same work that would be completed for ECM 2 with the addition of programming to provide a Premium Ventilation Package of strategies, including:

- Occupied Mode Deadband: a deadband between mechanical cooling and heating of 5°F is maintained.
- Setpoint limits for cooling and heating, lockout of user override of fan control, and improved user interface;
- Limited Setpoint override only allows override for up to 2 or 3 hours with no “hold” option;
- Robust Optimum Start integrates outside air temperature into the start time algorithm and ramps up setpoint during the warm-up period.
- Unoccupied Ventilation Fan and Temperature Control locks out ventilation when unoccupied except for economizer or night flush.

In addition, premium ventilation controls may include optional strategies such as

- Optimum stop relaxes temperature setpoints during the last 30 to 60 minutes of occupancy.
- Night flush precools the space with outside air during warm season conditions along with a lowered occupied heating setpoint and is appropriate for spaces with moderate to high internal loads.
- Occupancy sensor standby relaxes temperature setpoints and reduces ventilation when the space is vacant during the occupied scheduled period and is appropriate for spaces with periods of vacancy such as meeting rooms, class rooms, and conference rooms.

ECM 5: Premium Ventilation with Fan VSD

This measure is identical to ECM 4, with the exception that a Fan VSD is used rather than fan cycling. So the sequences would be based on ECM 3 with the additional control sequences listed in ECM 4.

(All Measures) Temperature & Humidity Sensors

Outside air temperature and humidity points shall be refurbished as follows or provided unless existing points meet these requirements:

- Provide sensors required for economizer high limit to be differential or comparative dry-bulb control to allow integrated operation.
- Discharge air sensors shall meet sensor requirements.
- Space sensor or interface sensors shall meet sensor requirements.
- Optional space humidity sensors shall meet sensor requirements.
- Optional occupancy sensors shall meet sensor requirements.

Product Specifications

All products provided and installed at site shall be suitable for purpose and meet all applicable codes and standards. All products, wiring, power supplies, and accessories required for a complete and operating system shall be provided under this contract. Contractor is responsible for verifying compatibility of products provided with other provided products and existing products and systems.

General Material Requirements

1. The Utility or Bonneville reserves the right to identify and disapprove for use any weatherization product at any time when it deems the product not satisfactory.
2. Where written acceptance of materials, components, or products is required, the intent is that, unless otherwise stated in the specification or the acceptance, once it is accepted by a Utility or Bonneville for one installation, the material, component, or product shall be acceptable for all other similar installations without resubmittal to the Utility or Bonneville except as noted in item 1 above.
3. All materials shall be resistant to corrosion, degradation from ultraviolet light, and be compatible with other elements and materials (will not react chemically, etc.) so as to enhance long life expectancy of installed Measures.
4. Materials damaged in shipment or in assembly shall not be used.

General Sensor Requirements

A. All sensing inputs shall be provided industry standard signals compatible with existing control systems.
B. Temperatures, humidities, differential pressure signals, and all other signal inputs shall be one of the following types:
   1) 0 - 20 mA
   2) 4 - 20 mA
   3) 0 - 5 VDC
   4) 0 - 10 VDC
   5) 1000 ohm RTDs
   6) 1,000 – 10,000 ohm thermistors
C. All signal inputs shall be compatible with the controllers used and with the requirement for readout of variables as specified.
D. If sensors are not linear, then software will adjust sensor output to be linear.
E. Minimum sensor accuracy (as compared to a test standard) and range are listed in the following Table. All accuracy values should be combined effect numbers taking into account thermal drift, interchangeability, hysteresis, etc.

Sensor Type	Range (Scale)	Min. Accuracy	Max. Resolution Increment*
Duct/Air Handling Unit Temperature	40 – 130°F	± 0.5 Degree F	0.2 Degree F
Room Temperature	50 – 85°F	± 1 Degree F	0.2 Degree F
Outside Air Temperature	- 20 to 120°F	± 0.5 Degree F	0.5 Degree F
Humidity	0 to 100% RH	± 5% RH	0.5 %RH
CO_2 sensors	0 to 2,000 PPM	± 5% full scale ± 75 ppm in Calif.	20 PPM

Sensors shall not drift more than 1% of full scale per year.
*Maximum resolution increment includes combined effect of sensor, analog to digital converter, and system programming.

Carbon Dioxide Sensors

A. Sensor output shall be proportional and linear over the specified range.
B. The transmitter shall be capable of operating from an unregulated 18-30 VDC or VAC power supply.
C. Sensors shall be field adjustable.
D. Self-calibrating sensors are required.
E. Insulation shall be installed between the sensor and open conduit to eliminate false CO_2 readings due to drafts.
F. Sensor may be integral to the controller.
G. When installing, verify that sensor and controller signal type and range settings match.

Humidity Sensor

A. The transmitter shall be a two wire type and provide a proportional signal over the 0-100 % range.
B. The transmitter shall be capable of operating from an unregulated 18-30 VDC power supply. Subjecting the sensing element to direct contact with moisture shall not damage the sensing element.
C. Space humidity sensors may be integral to the controller.
D. Sensors for mounting on insulated ducts or casings are to be equipped with brackets for mounting clear of the isolation.
E. Outside sensor enclosure shall be weatherproof and complete with PVC sun shield.
F. Locate adjacent to existing site outside air sensor.

Outside Air Temperature Sensor

A. Sensor shall be compatible with controller it is connected to.
B. Mount the sensor in one of the following locations:
   - At the same elevation and just outside the outside air intake hood; Outside sensor enclosure shall be weatherproof and complete with PVC sun shield..
   - Alternatively locate inside hood with foam insulation between sensor and hood..

B. Locate to avoid exhaust air, relief air, condenser exhaust, and other heat sources.

Discharge Air Temperature Sensor

A. Sensor shall be compatible with controller it is connected to.
B. Mount the sensor in one of the following locations:
   - Near fan inlet where air stream will be turbulent
   - In supply air duct, at least 12 inches downstream from furnace outlet at least 6” from ductwork side in discharge air stream. This location required for Variable Speed Drive options.

Return Air Temperature Sensor

A. Sensor shall be compatible with controller it is connected to.
B. This sensor is optional for integrated controllers that can use a differential between space temperature and outside temperature for economizer lockout control.
C. Mount the sensor in one of the following locations:
   - Near the space inside the return air grille
   - In return air duct, at least 36 inches upstream from inlet to the RTU mixed air chamber at least 6” from ductwork side in discharge air stream.

Occupancy Sensor

A. Sensor shall provide coverage of at least 75% of the area served by the RTU. Where there are multiple rooms served or a larger area than sensor coverage, use additional sensors wired in parallel or use a dual technology sensor.
B. A sensor with a 24VAC power supply is recommended to avoid the need for power wiring or relays.
C. This sensor is optional for standard and fan control DCV and recommended as a premium ventilation item for spaces that have intermittent occupancy and are unoccupied more than 2 hours a day during the occupied period.
D. Coordinate the time delay off setting in the sensor with the time delay that may be included in the program. Target a total of 15 to 30 minutes. For an advanced programmable thermostat (like the T7351) the full time is set in the sensor. For an integrated controller, a short time (30-90 seconds) is usually set in the sensor with the full time delay programmed in the controller.
E. If a dry contact on an occupancy sensor used for lighting control is used, make sure that the lighting strategy is not occupancy sensor for off and manual switch for on. The signal for ventilation needs to be provided whenever the room is occupied, even if the lights have been left off or turned off.

Wiring

A Input/Output Wiring: Wiring serving inputs and outputs from the BAS shall be cables consisting of single or multiple twisted individually shielded pairs for communication lines. Where recommended by controls manufacturer, each pair shall have an independent shield with drain wire. Sensor wires can be unshielded twisted pairs. Cables installed without conduit shall be plenum rated and comply with NEC article 725. Where automation input/output wiring is run in cable tray furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 340 and/or 725. Where wiring must be exposed to interior spaces, provide and install surface wire mold in routing as approved by owner's representative.
B Any power wiring (not class 2) shall be installed in conformance with requirements of the National Electrical Code.

Replacement Damper Motor

Where damper motor is not operable or not compatible with new controls, replace with new and compatible units. Match torque and configuration as required and match control signal from new controls. A 2-12VDC control input motor is preferred.

Variable Speed Drive

A. Install VSD (Variable Speed Drive) that slows the supply fan motor speed (RPM) and reduces the motor power draw on supply air fan.
    - If the VSD is a Variable Frequency Drive (VFD), it must meet ANSI/IEEE 510 and NEMA ICS7 standards.
    - VFD suitable for variable torque applications.
    - VSD has 0-10 VDC input for speed control
    - VSD has fan start stop input accepting 24VAC signal or has 24VDC source for relay dry contact (provide relay interface with fan start signal)
B. Remove or set at fully open position all air flow throttling devices, such as inlet vanes, discharge dampers, etc. in the HVAC system.

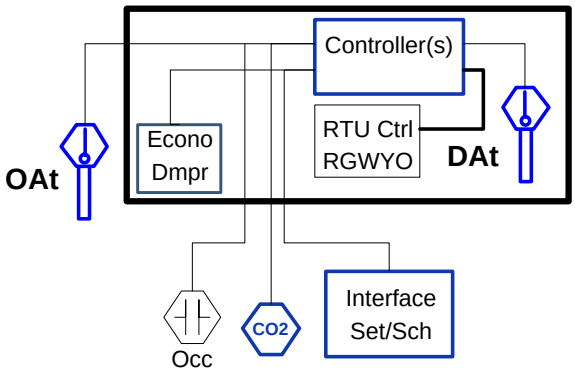
Local Integrated Programmable Controllers

The control equipment is intended to replace an individual packaged unit electromechanical or programmable thermostat. There are two possible configurations:

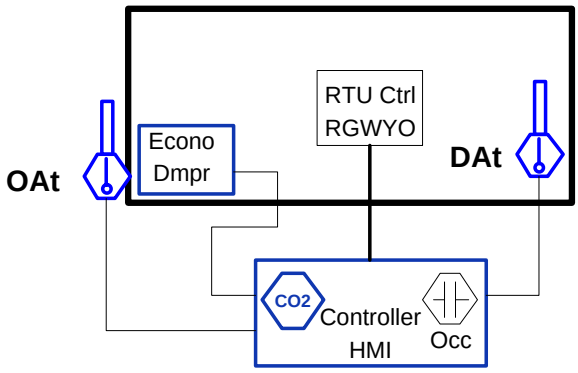
1. Single combined thermostat and custom programmable unit controller with all sensor and control wiring connected to the main control unit in the space.
2. Separate space sensor and interface unit with rooftop custom programmable unit controller with all sensor and control wiring connected to the rooftop control unit. Depending on the product

used, the CO2 and optional occupancy sensors may be separate from the space sensor and interface unit.

Control Configuration 1



Control Configuration 2



Local Integrated Programmable Controllers shall have the following specifications

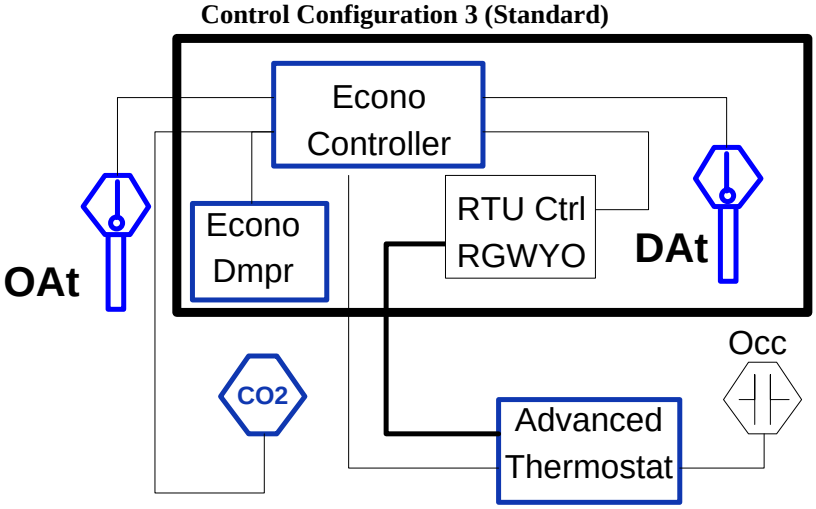
- Custom programmable and programmed with attached sequence of operation
- User interface to allow change of setpoints, schedule, and system mode.
- Analog Input (AI) suitable for 0-10 volt CO_2 sensor with 0.1 VDC resolution.
- Analog Ouput (AO) suitable for 2-10 volt damper motor with 0.1 VDC resolution.
- Binary Ouput (BO) suitable for control of typical RTU HVAC relays (24 VAC, 20-250mA coils).
- Accessible through RS-485 port or Ethernet port for commissioning and program uploading.
- Optional network connectable to optional gateway BACnet compatible (BACnet MS/TP LAN up to 76.8 Kbps) for internet communications.
- Battery backup (5 years nominal) and real time clock

Economizer Controller Upgrade

For most installations, a minimum requirement is to upgrade the economizer controller with one that is DCV compatible. Such economizer controller shall have the following specifications:

- Digital input and display of all settings and operating parameters.
- Capability of dry-bulb differential control (sensors in both outside air and return air location)
- Capability of DCV control with CO_2 sensor input and settings for area and full ventilation.
- Capability of interface to thermostat schedule signal to limit ventilation during warm-up period

Control Configuration 3 (Standard)



Advanced Thermostat Upgrade

In conjunction with upgrading the economizer controller, an improved thermostat can provide better user interface and improved control. Such advanced thermostat shall have the following specifications:

- Seven-day independent schedules and up to 10 holidays.
- Occupancy sensor input with standby temperature setting.
- Fan on during occupied, intermittent during unoccupied.
- Optimum start with separate ramps for heat pump heat and resistance heat.
- Relay output to economizer for occupied period ventilation; integrated with occupancy sensor.
- Time limit on setpoint override, 2 hours, or user setable to 2 hours.
- No “hold” button (freezes current setpoints), only temporary setpoint override.

Ventilation Setpoints

During setup and acceptance testing, fill out the following table to map out the range of OSA setpoints at various occupancy levels. The acceptance testing tool in the *BPA DCV Application Guide for Unitary HVAC* can be used to calculate the required fields. The first line is filled out as an example. Verify total unit airflow using acceptance test.

Unit Tag	Estimated Unit CFM*	Zone Use (Occupancy Category)	Typ Peak People	OSA area CFM	OSA full CFM	OSA% area ***	OSA% full ***	Full CO_2 ppm AQset
RTU-1 (example)	4000	Auditorium	148	130	870	3.3%	22%	1500

*Airflow estimated based on specification. Verify proper fan operation, and notify building representative if airflow is significantly low.

CO_2 setpoints: operate at "OSA area CFM" at or below 450 PPM CO_2

Increase OSA proportionally to "OSA full CFM" as CO_2 increases to **full** CO_2 setpoint (1500 PPM for example)

*** OSA% represents percent outside air and NOT damper position as smaller damper open positions provide greater proportional ventilation. Percentages are based on nominal airflow shown and shall be adjusted based on measured unit CFM to provide the scheduled area and full ventilation CFM.

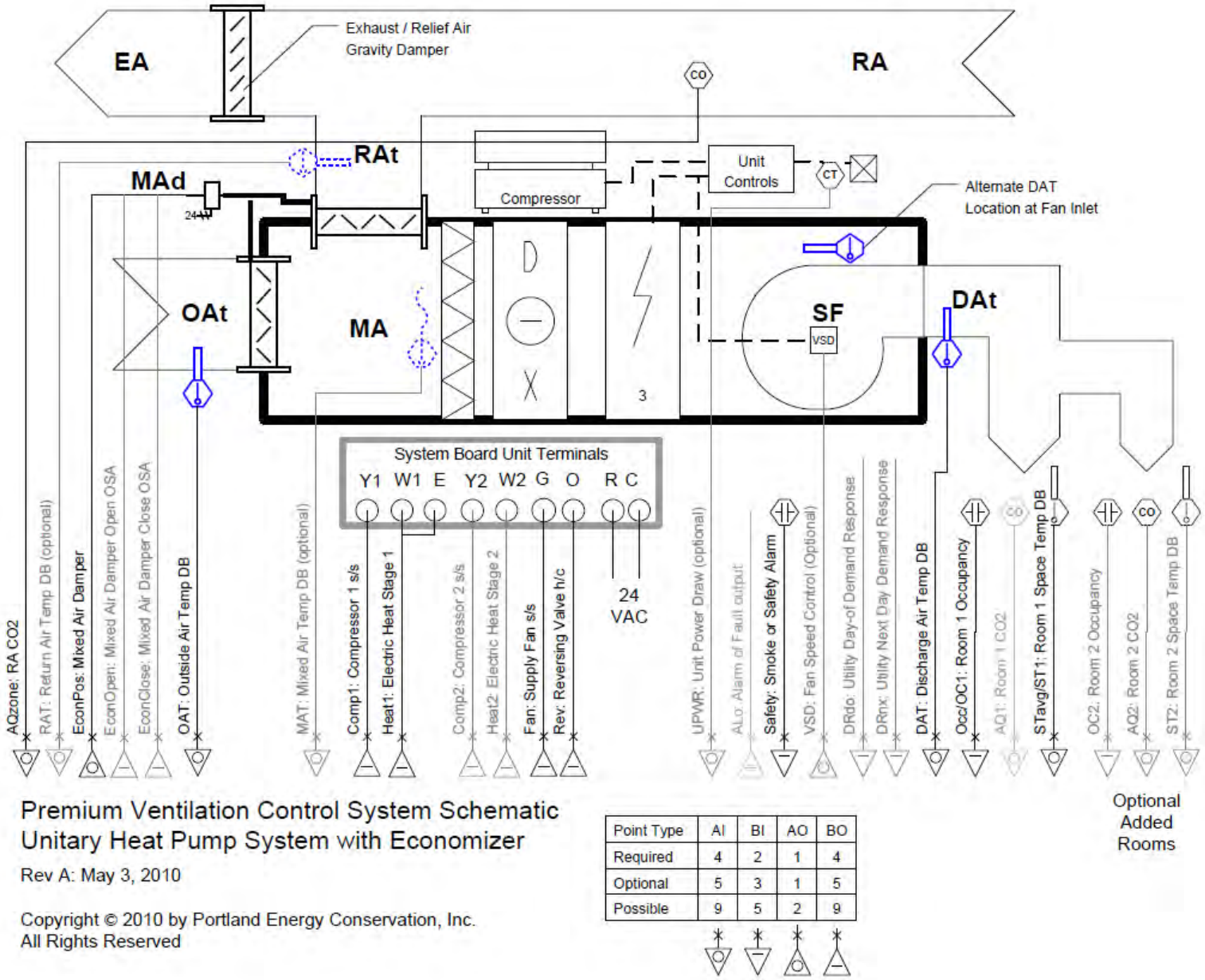
Suggested Sequence of Operation

The following sequence of operation relates only to specific upgrades. The existing sequence of operation for temperature, equipment, and schedule control will remain in place and be documented as a part of this contract. Once the existing sequence is documented, the sequence upgrades listed here shall be integrated into a comprehensive and functional sequence by the control integrator. Where necessary adapt suggested sequence to existing sequence and local conditions and requirements to ensure proper control.

All existing physical and virtual points may not be included in the points/control objects table below. Point tags from the control object tables are referenced with boldface in the sequence, sometimes followed by a default value in parentheses, for example "... by **OAmaxPos** (40%) using ..."

Note: The schematic shown has connections for a heat pump. Connections for standard gas heat RTUs is similar.

Typical RTU Control Schematic



Premium Ventilation Control System Schematic
Unitary Heat Pump System with Economizer

Rev A: May 3, 2010

Point Type	AI	BI	AO	BO
Required	4	2	1	4
Optional	5	3	1	5
Possible	9	5	2	9

Control System Object List - Physical Points

Tag	Point Name	Measure	Units	Type	Low Range	High Range	Comment
OAT	Outside Air Temperature	DB Temperature	deg F	AI	-20	120	
DAT	Discharge Air Temperature	DB Temperature	deg F	AI	40	200	
RAT	Space or return Air Temperature	DB Temperature	deg F	AI	40	120	This input may be virtual point STavg
AQzone (AQ1, AQ2)	Air Quality - Carbon Dioxide concentration	CO_2	ppm	AI	0	2500	Typically 0-10 or 0-5 volts; This input may be virtual point AQzone.
OArh	Outside Relative Humidity	Relative Humidity	% RH	AI	0	100	Locate adjacent to relocated site outside air sensor
EconPos	Economizer damper Position	contact	24 VAC	BO			For damper motor requiring 2-10VDC AO
EconOpen	Economizer damper open	contact	24 VAC	BO			For 3-wire damper motor requiring 24V BO
EconClose	Economizer damper close	contact	24 VAC	BO			For 3-wire damper motor requiring 24V BO
FanStat	Fan status CT	Fan Current	amps	AI			Optional

Shaded points are existing

AI Analogue Input AO Analogue Output

BI Binary or Digital Input BO Binary or Digital Output

Control System Object List - Virtual Parameters [2]

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
STavg;	Average Space Temperature		deg F	A	P			Equal to RAT space or return temperature sensor
AQzone	Zone Air Quality (CO_2)		ppm	A	P			When multiple CO_2 sensors are used, the highest concentration from CO_2 Sensors
AQset	Occupied Air Quality Setpoint (CO_2)	1000	ppm	A	U2	700	2000	Setpoint for fully occupied space
AQlast	CO2 concentration before fan stops		ppm	A	P			CO2 concentration at the time the fan stops

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
OAareaPos	Occupied % OA damper position for vacant space (1.0 = full open). For high speed fan operation during heating or cooling.	0.02	fraction	A	U2	0	0.2	damper position (not % air): Reflects floor area component; may be zero if damper leakage provides adequate area ventilation
OAfullPos	Occupied % OA damper position for design occupied space. For high speed fan operation during heating or cooling.	0.15	fraction	A	U2	0.01	0.8	damper position (not % air): Reflects floor area + people component
OAareaPosLo	Occupied % OA damper position for vacant space when fan running in low speed	0.04	fraction	A	U2	0	0.2	damper position (not % air): Reflects floor area component; may be slightly more than zero if damper leakage provides adequate area ventilation
OAfullPosLo	Occupied % OA damper position for design occupied space when fan running in low speed	0.20	fraction	A	U2	0.01	1	damper position (not % air): Reflects floor area + people component
OAmaxPos	Occupied % OA damper maximum for ventilation	0.4	fraction	A	P	0	1	Upper limit of OA damper position in ventilation mode
OAmaxPosLo	Max OA damper position for ventilation when OA < 0°F	0.15	fraction	A	U2	0	1	Avoids under capacity for heating in extreme cold
OAmaxPosCtr	Max OA damper position for ventilation if OA 40°F -80°F	0.50	fraction	A	U2	0	1	Protects against uncalibrated CO_2 sensor or error
OAmaxPosHi	Max OA damper position for ventilation when OA > 100°F	0.15	fraction	A	U2	0	1	Avoids under capacity for cooling in extreme heat
OApurgePos	Pre-purge OA damper position	0 (CA: 0.05)	fraction	A	U2	0	30	Damper position to provide full air requirement; set zero if no purge is required; Typically same as OAfullPos

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
OArcvPos	Occupied % OA damper position during recovery ventilation		fraction	A	P	OAareaPos	1	damper position (not % air): Required for ventilation recovery after fan is off
OAhiT	Ventilation High Temperature	80	deg F	A	U3	75	90	Max 100% ventilation temperature
OAloT	Ventilation Low Temperature	**60**	deg F	A	U3	50	70	Min 100% ventilation temperature
OApos	Current % OA damper position		fraction	A	P	0	1	Internally calculated variable
EconPos%	Current economizer damper position		fraction	A	P	0.00	1.00	Analog fraction; 1= 100% outside air
FanPost	Post Purge time after heat/cool	3	minutes	A	U3	1	5	Allows heat or cool to be extracted from coil/furnace
FanVSD	VSD installed	No	Logic	B	U2o			
FanVSDspd	VSD speed	95%	fraction	A	P			
FanMaxOff	Maximum off time during occupied	30	minutes	A	U3	15	90	
FanJustOff	Time fan has been off		min	A	P			the elapsed time in minutes the supply fan was off during the occupied period since the end of the last fan operation or end of the last standby period
FanRcvMin	Time allowed for ventilation recovery after fan off period		minutes	A	P			Adjust recovery time longer when OAT is low to avoid comfort problems
FanRcvRatio	The prescriptive ventilation needed as a fraction of the rate ventilation air will be delivered during the recovery period		minutes	A	P			Adjust recovery time longer when OAT is low to avoid comfort problems

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
OccTimeOut	Unoccupied time to activate standby	30	minutes	A	U2	1	120	If the time-out is set in the occupancy sensor, this time out should be set to 1.
CoolSPo	Occupied Cooling Setpoint	75	deg F	A	U1	60	90	
CoolSPu	Unoccupied Cooling Setpoint	85	deg F	A	U1	60	90	
SbySPoffset	Standby Cooling & Heating Setpoint Offset	2	deg F	A	U2	0	10	During standby mode, heating setpoint lowered by this much; cooling setpoint raised by this much; Preferably, user may directly input CoolSPs & HeatSPs
CoolSPs	Standby Cooling Setpoint	77	deg F	A	U2o	35	80	Mech Cooling setpoint during standby; calculated based on SbySPoffset and current cooling setpoint; May be calculated or user input
HeatSPs	Standby Heating Setpoint	68	deg F	A	U2o	35	80	Heating setpoint during standby; calculated based on SbySPoffset and current cooling setpoint; May be calculated or user input
CoolSPc	Current Cooling Setpoint	75	deg F	A	P	35	90	Currently active cooling setpoint depending on modes
HeatSPc	Current Heating Setpoint	70	deg F	A	P	60	Heat SPmax	Currently active heating setpoint depending on modes
EconDif	Economizer differential below cooling	2	deg F	A	U2	1	3	Economizer on below CoolSP

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
EconDATsp	Economizer discharge setpoint	53	deg F	A	U2	45	60	
DATlowSP	Discharge Low Temperature Setpoint	45	deg F	A	U1	35	60	
EconAct	Economizer activation differential	5	deg F	A	U2	1	9	Economizer active at **OAT** < **STavg** - **EconAct** when fan would otherwise be off
HeatSPo	Occupied Heating Setpoint	68	deg F	A	U1	35	80	
HeatSPu	Unoccupied Heating Setpoint	55	deg F	A	U1	35	80	
NFenable	Night Flush is seasonally enabled		T/F	B	P			Enabled when NF_OK and high temperature is hit and low not hit and Heat24 false
Heat24	Heat in last 24 hours		T/F	B	P			Latches True whenever heat is on; restored to false after 24 hours of no heat
NFstartOA	NF enable above this OAT	75	deg F	A	U3	65	85	
NFstopOA	NF disable below this OAT	45	deg F	A	U3	35	50	
CoolDif	Cooling Differential	1.5	Deg F	A	U3	1	4	Mech Cooling off half this value below setpoint
HeatDif	Heating Differential	1.5	Deg F	A	U3	1	4	Heating off half this value above setpoint
OptLead	Optimum Start Lead Time	180	minutes	A	U4	60	300	Minutes before occupied start that normal (at heating design OAT) optimum start setpoint adjustment begins
OptDur	Optimum Start Duration		minutes	A	P			Minutes before occupied start adjusted beyond

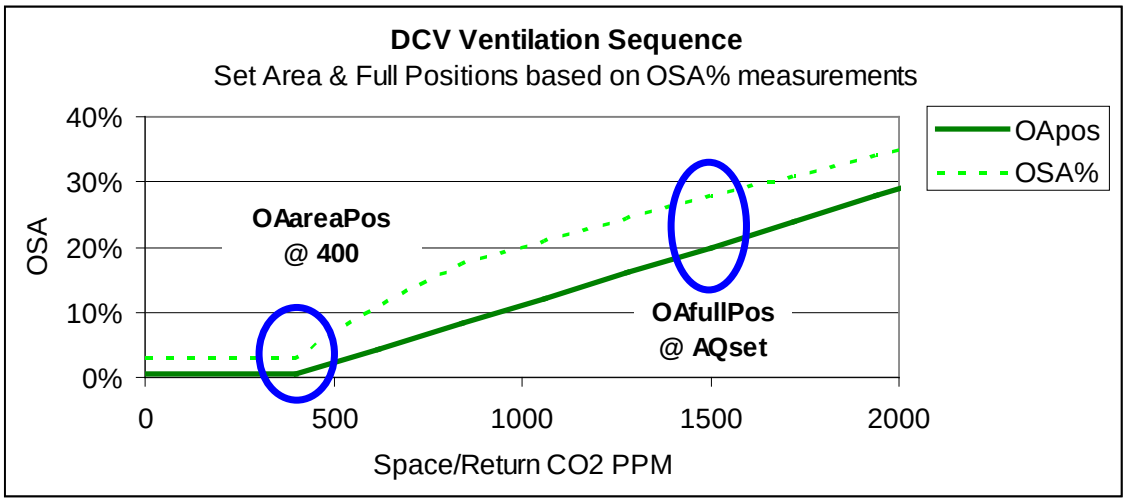
Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
								normal when outside heating or cooling design
OptStart	Optimum Start Time		Minutes /time	A	P			Start time internally calculated
OptStop	Optimum Stop Lead Time	30	minutes	A	U2	0	90	Minutes before end of occupied period that setpoints will be relaxed
HeatDes	Heating Design Temperature	20	deg F	A	U2	-50	40	Approx 99.6% local heating design temperature, deg F DB (see ASHRAE Fundamentals)
CoolDes	Cooling Design Temperature	95	deg F	A	U2	75	120	Approx 0.4% local cooling design temperature, deg F DB (see ASHRAE Fundamentals)
DxSplit	=20 when compressor is on and = 0 otherwise	20	deg F	A	P	0	25	Used in Econo Simple Predictive Algorithm
HeatSPmax	Max Occupied Heating Setpoint	72	deg F	A	U2	35	80	HeatSPo cannot be set above this temperature
CoolSPmin	Min Occupied Cooling Setpoint	73	deg F	A	U2	60	85	CoolSPo cannot be set below this temperature
DeadSP	Minimum deadband between Cooling & Heating Setpoints	5	deg F	A	U3	3	10	
HeatLockOA	Resistance heating lock out	38	deg F	A	U3			Resistance heating locked out above this OA temperature
CoolLockOA	Cooling lockout	56	deg F	A	U3			Mechanical cooling locked out below this OA temperature
OvrTime	Time setpoint override is active for	120	minutes	A	U2	30	240	
OvrUnoc	Override allowed during scheduled unoccupied period	TRUE	Logical	B	U2			Override function operates during unoccupied period unless false

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
OvrBP	Balance point for switch between heating and cooling setpoint	60	deg F	A	U3	40	70	Used for single setpoint input user interfaces (May use OAIoT if points are limited)
OvrSP	User override setpoint	72	deg F	A	U	65	80	Used for single setpoint input user
CoolStageDif	Cooling inter-stage Differential	1.5	deg F	A	U3	1	4	Mech Cooling (Stage 2) on at **CoolSP**x + **Cool2Dif** + half **CoolDif**
HeatStageDif	Heating Interstage Differential	2	deg F	A	U3	1	4	Heating (Stage 2) on at **HeatSP**x - **Heat2Dif** - half **HeatDif**
DR1Ovr	Override allowed during demand response 1 period	FALSE	Logical	B	U2			Override function operates during demand response only if true
DR2Ovr	Override allowed during demand response 2 period	FALSE	Logical	B	U2			Override function operates during demand response only if true

Notes:
1 Reserved
2 Not all virtual or parameter points are shown. Provide all points required for software operation.
3 User set items are distinguished: U user accessible; U1 low level lock, U2 contractor lock, U3 Expert lock

Ventilation Control (ECM 1)

1. Outside damper position **Econpos%** (0-1.0 = 0-100%) shall be determined by following sequence and output as **EconPos** (2-10 VDC) or with floating motor logic as **EconOpen** and **EconClose**. Damper linkage shall be configured to operate return air damper and exhaust air damper (if powered) opposite to outside air damper.
2. Ventilation Override Mode: When activated at the space user interface, a ventilation override mode shall activate the fan for the next 30 minutes with the ventilation rate at **OAfullPos.**
3. Whenever the supply fan is de-energized the outside and exhaust air dampers shall be closed and the return air damper shall be open, the heating and cooling systems shall be deactivated.
4. Ventilation during occupied periods: The room CO_2 sensor readings (**AQ1, AQ2**, etc.) shall be polled to determine the highest reading **AQzone**. If there is only one sensor (**AQ1**), **AQzone** shall be its reading.
    1. Normal ventilation. The damper shall be modulated between **OAareaPos** and **OAfullPos** as follows with an increase above **OAfullPos** as described.
        i. **OAareaPos** is the damper <u>position</u> required to provide the area outdoor air rate scheduled. (Note that this represents the damper <u>position</u>, not the minimum outside air percentage. For most RTUs, the closed damper leakage will often provide the area ventilation rate.) The outside air damper shall be at this position when **AQzone** is at or below 450 ppm.
        ii. **OAfullPos** is the full damper <u>position</u> required to provide the combined people and area outdoor rate. The outside air damper shall be at this position when **AQzone** is at **AQset** (1500 ppm default, adjustable).
        iii. When **AQzone** is between 450 and **AQset** ppm, the damper shall move proportionally between **OAareaPos** and **OAfullPos.**



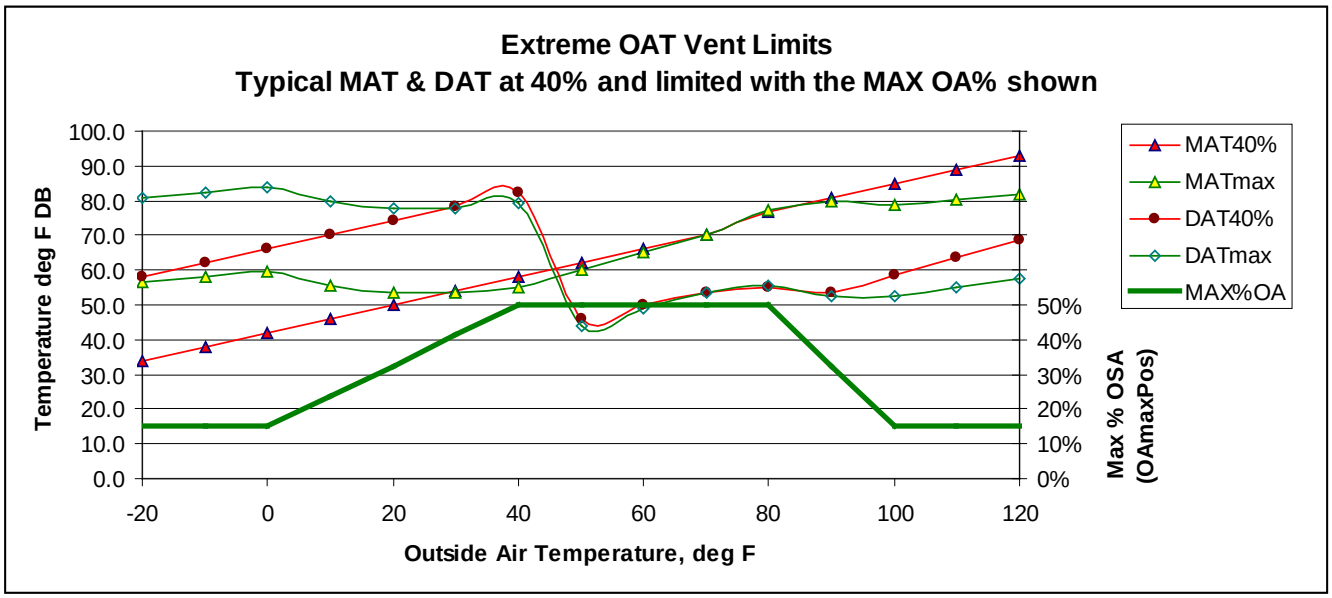
        iv. When **AQzone** exceeds **AQset** ppm, the damper shall increase proportionally above **OAfullPos** limited by **OAmaxPos** using the same proportional gain as above.
        v. To prevent "lack of capacity" conditions, the ventilation damper position shall always be <u>limited to no more than</u> **OAmaxPos** as adjusted based on outside air temperature as shown in the following figure and per this description:
            a. Between 40°F and 80°F OSA, **OAmaxPos** shall be **OAmaxPosCtr** (50%, adjustable by unit)
            b. Between 40°F and 0°F OSA, **OAmaxPos** shall modulate proportionally between **OAmaxPosCtr** and **OAmaxPosLo** (15%, adjustable by unit) and remain at **OAmaxPosLo** below 0°F.
            c. Between 80°F and 100°F OSA, **OAmaxPos** shall modulate proportionally between **OAmaxPosCtr** and **OAmaxPosHi** (15%, adjustable by unit) and remain at **OAmaxPosHi** above 100°F.

        Note: while this strategy may result in brief periods of reduced ventilation during extreme weather conditions; this is preferable to requiring manual reset of outside air minimums to maintain comfort conditions, as this inevitably results in more prolonged periods of reduced

ventilation when settings are not returned to proper automatic operation. For spaces with a ventilation requirement below 30% OSA, the hours of reduced ventilation are very limited and occur when outside temperatures are well outside the standard design conditions.

2. Economizer Ventilation. When economizer cooling is called for, the dampers shall maintain the economizer setpoint, or the ventilation setpoint, whichever is greater.
3. Ventilation Purge Mode: When installed in California, purge mode shall be active for 60 minutes before scheduled occupancy. In purge mode, the fan shall be operational and the ventilation rate at **OAfullPos.**
4. CO_2 Sensor Failure Mode: Should a CO_2 Sensor Failure be detected (voltage or mA input = 0) then during occupied periods the fan shall be operational and the ventilation rate at **OAfullPos.**

4. Ventilation during unoccupied periods: Outside air dampers shall be closed, unless economizer cooling or night flush is called for.



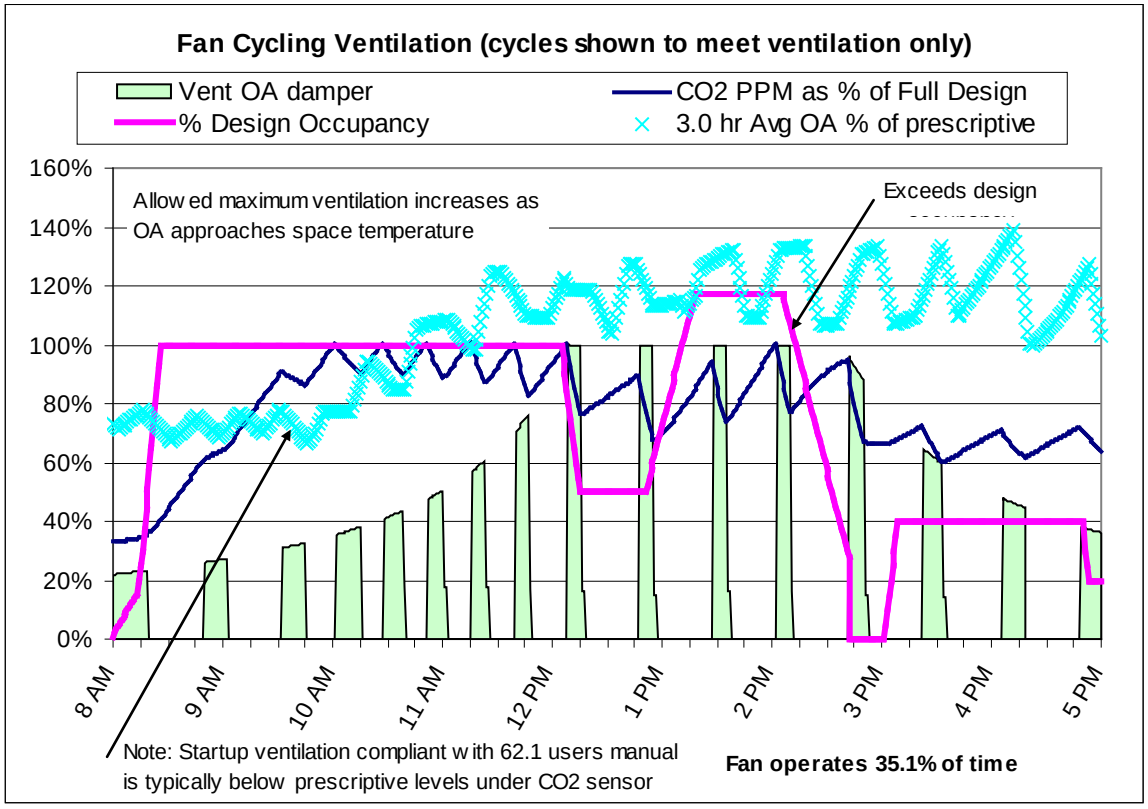
Ventilation Control (ECM 2)

See Fan Cycling & Ventilation Control section.

Fan Cycling & Ventilation Control (ECM 2)

1. Ventilation: In conformance with ASHRAE Standard 62.1-2010 section 6.2.6.2, an average ventilation rate may be maintained when the ventilation is interrupted by fan cycling. In the sequence presented below, the ventilation is increased during a recovery cycle following any time the fan has been off to provide an average ventilation rate. The room CO_2 sensor readings (**AQ1, AQ2**, etc.) shall be polled to determine the highest reading **AQzone**. If there is only one sensor (**AQ1**), **AQzone** shall be its reading. There shall be a normal ventilation mode during heating or cooling operation and a ventilation recovery mode for a period after the fan has been off.
2. Ventilation Startup: If the ventilation pre purge setting (**OApurgePos**) is set to zero and occupancy is sensed, during the 20 minutes immediately following the occupied start time, operate the supply fan with the ventilation damper open to **OArcvPos** as calculated under ventilation recovery mode below.
3. Normal ventilation. Same as ECM 1 Ventilation.
4. Standby and unoccupied periods, the outside damper shall be closed and the fan off, except as needed for heating or cooling operation. At the conclusion of heating or cooling operation, fan shall operate for **FanPost** (3) minutes.
5. When the supply fan is off unless in standby mode, a ventilation recovery mode with supply fan operation shall be initiated for a variable length recovery period when any of the following occur:
    a. **AQzone** exceeds (**AQset** (1000 ppm, adjustable) + 200 ppm)
    b. When fan has been off for **FanMaxOff** (30) minutes.

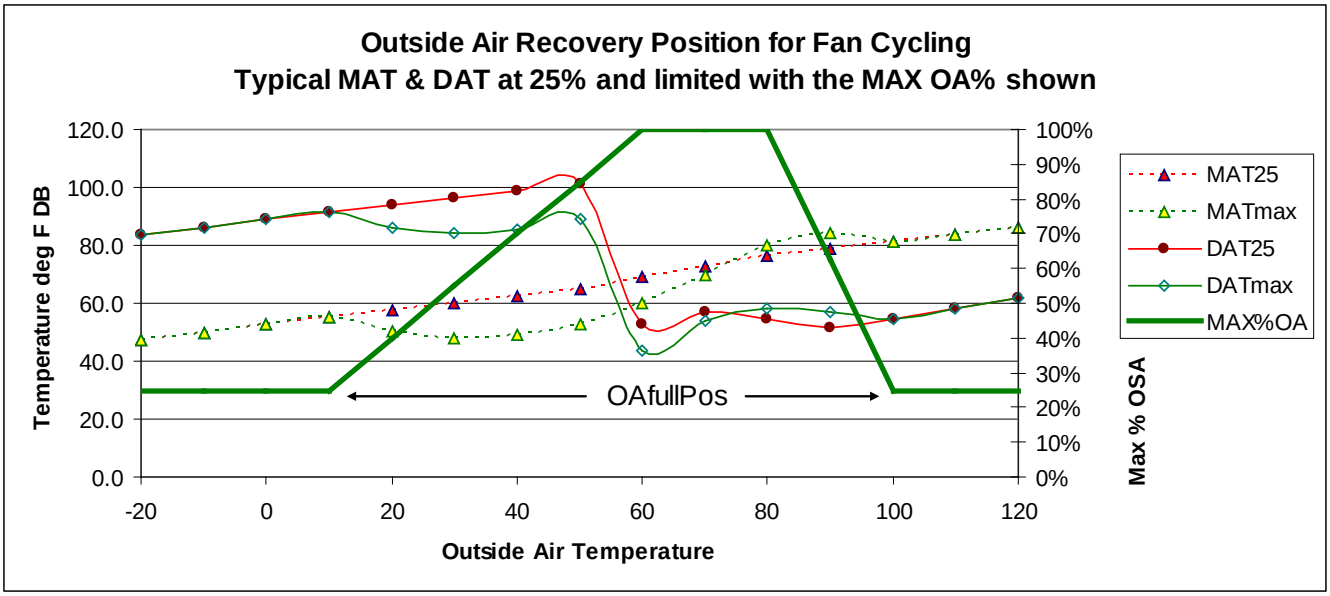
Typical ventilation mode operation is shown below, demonstrating ASHRAE 62.1 compliance:



6. Ventilation recovery mode: After the fan has been off and starts due to either a heating or cooling call, off time limits, or high CO_2 concentration, the ventilation rate shall be increased to provide average ventilation that matches the ASHRAE standard 62.1 ventilation rate for the prescriptive method. Ventilation during this mode shall be limited to a maximum that is full damper opening when outside air is temperate relative to space temperatures (typically between 65°F and 80°F) and ramps down to the full ventilation setting at either heating or cooling design temperatures. Ventilation shall operate for at least 5 minutes up to a time related to the ratio of the space CO2 concentration at the end of the last fan operation period to the target and the allowed ventilation rate for this fan cycle. Should there be a continued call for heating or cooling after the recovery period is complete, ventilation shall return to "Normal Ventilation" mode. Specific algorithms follow that are suggested for this sequence:
    a. Whenever the supply fan stops,
        i. Record the CO_2 concentration at the time the fan stops **AQlast**, ppm
        ii. Begin a timer to record fan off period: **FanJustOff** in minutes; the elapsed time in minutes the supply fan was off during the occupied period since the end of the last fan operation or end of the last standby period.
    b. Whenever the supply fan <u>starts</u> after an off period, except in standby mode, the ventilation shall be shall be maintained at the following position **OArcvPos**:
        i. If outside air is above cooling design (**CoolDes**) or below heating design (**HeatDes**) the damper position shall be **OAfullPos.**
        ii. If outside air is between **OAloT** (60°F) and **OAhiT** (80°F) the outside damper position shall be 100% open.
        iii. If outside air is between heating design (**HeatDes**) and **OAloT** (60°F) the outside damper position shall be proportionally between **OAfullPos** and 100% open.
        iv. If outside air is between **OAhiT** (80°F) and cooling design (**CoolDes**) the outside damper position shall be proportionally between 100% open and **OAfullPos**.
        v. **OAmaxPos** upper limit does not apply during ventilation recovery mode.

vi. If discharge air temperature **(DAT)** falls below **DATlowSP** (45F), then modulate **EconPos** closed until **DAT** exceeds **DATlowSP**.

Ventilation Recovery Position as shown below



7. Ventilation recovery time, the **FanRcvMin** minute recovery period:
   a. Find: **FanRcvRatio**, the prescriptive ventilation needed as a fraction of the rate ventilation air will be delivered during the recovery period, indicating the fan operation time needed relative to fan off time

      FanRcvRatio = (PeoplePortion * (AQlast - 450) / (AQset - 450)
      + 1-peoplePortion) * (OAfullPos / OArcvPos)

      Where:

      PeoplePortion = (OA%full – OA%area) / OA%full

      a. FanRcvMin = 3 min + [(**FanJustOff** + 5) * **FanRcvRatio]**

   b. Maintain ventilation damper at **OArcvPos** damper position with supply fan operating for **FanRcvMin** minutes.
   c. At conclusion of the **FanRcvMin** minute recovery period:
      i. If there is a call for heating, cooling, or economizer requiring fan operation, restore to normal ventilation operation.
      ii. Stop supply fan unless **AQzone** exceeds (**AQset** (1000 ppm) **–** 100 ppm), in which case operate fan with outside damper at **OArcvPos** determined above until **AQzone** <= **AQset**.
8. Economizer Ventilation. When economizer cooling is called for, the dampers shall maintain the economizer setpoint, or the ventilation setpoint, whichever is greater.

Ventilation Control (ECM 3)

Ventilation Control shall be as ECM 1 with the following variations:

1. Proportional method: When the VSD speed (**FanVSDspd**) is less than 90% during occupied periods, the minimum damper position regardless of CO_2 sensor readout shall be increased as follows:

   OAareaPos / **FanVSDspd**; example:

   OAareaPos = 10%; **FanVSDspd** = 70%: Minimum damper position = 10%/70% = 14.3%

2. Hi/Lo method: When fan is operating at low speed during idle (no heating, cooling, or economizing), follow the sequence for ECM 1 with the following substitutions:

a. Substitute **OAareaPosLo** for **OAareaPos**.
b. Substitute **OAfullPosLo** for **OAfullPos**.

Setup of **OAareaPos** and **OAfullPos** damper positions shall be at lowest conditioning (heating or cooling) speed (typically first stage heating).

Economizer Control (All Measures)

Outside Air Economizer: Detailed algorithms are suggested below.

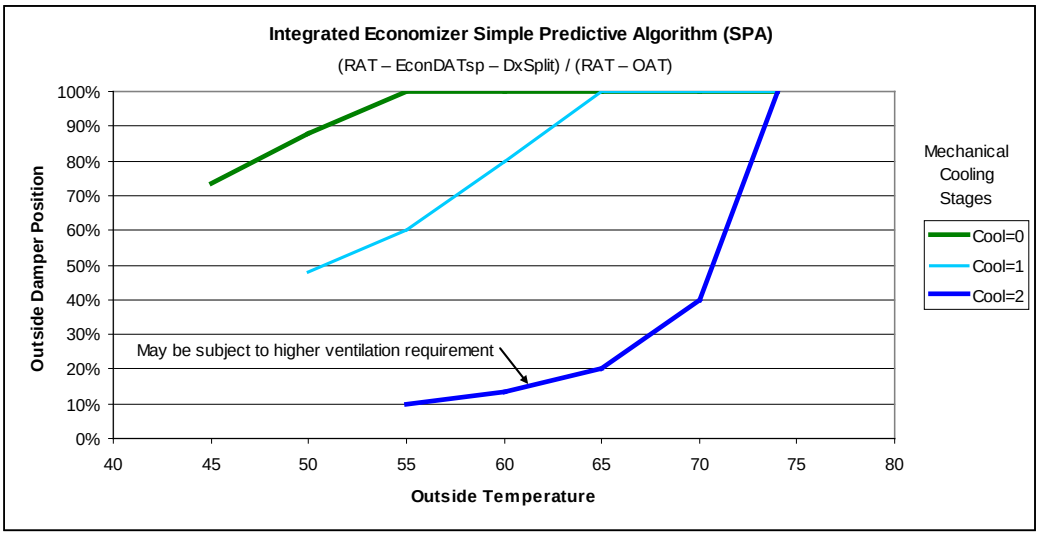
The intent of the economizer sequence is to provide a sensible (dry-bulb) differential changeover using room temperature vs. outside air, enabling the economizer when outside air is colder. When there is a first-stage call for cooling and economizing is enabled, the compressor shall be locked out and the economizer dampers shall modulate to maintain a set discharge temperature. Integration: When enabled, the economizer shall also be active when there is a call for second and third stage mechanical cooling subject to discharge air temperature (**DAT**) control. Include a stability method to allow good economizer response during mild outside temperatures and prevent instability (cycling or hunting) during cold outside temperatures.

a. High limit or changeover control shall use one of the following methods:
    i. Space Comparative Changeover: Economizer cooling is enabled whenever the outside air dry bulb temperature (**OAT**) is less than the space temperature minus **EconAct** (5°F). When mechanical cooling is active or the fan is operating to provide ventilation, integrated economizer cooling is enabled whenever the outside air temperature (**OAT**) is less than the space or return temperature (**RAT**).
    ii. Return Comparative Changeover: Economizer cooling is enabled whenever the outside air temperature (**OAT**) is less than the return temperature (**RAT**) minus **EconAct** (5°F).
    iii. High space humidity lockout (optional). In addition to Space or Return Comparative Changeover, space humidity must be at or below 60% RH.
    iv. Boundary or Combination Changeover: Economizer cooling is enabled whenever **all** of the following conditions are true (equivalent to enthalpy curve ES2 for JADE economizer):
        (a) the outside air dry bulb temperature (**OAT**) is less than 75°F.
        (b) the outside air dewpoint temperature is less than 57°F.
        (c) the outside air enthalpy is less than 26.0 Btu/lb-dry air.

    Note: differential enthalpy, single enthalpy, and differential boundary changeover shall not be allowed.

b. Activation: When enabled and the space or return temperature (**RAT**) exceeds the current cooling setpoint less **EconDif** (2°F) the economizer shall be active.
c. The outside air damper shall modulate in response to the greater of the economizer and ventilation control signals subject to a discharge air temperature low limit of **DATlowSPC** (45°F, adjustable) and an economizer discharge air temperature (**DAT**) setpoint of **EconDATsp** (53°F).
d. To avoid unstable operation at low outside air temperatures, control of discharge air temperature (**DAT**) shall (1) incorporate an error dead band of +/- 0.5°F (adjustable) from setpoint where no damper movement occurs, (2) reset Integral gain at each changeover or cooling system activation, and (3) follow one of these stability schemes:
    i. Have separate PI gain parameters for moderate (**OAT**>40°F, adjustable) and cold (**OAT**<=40F) conditions
    ii. Provide other adaptive PI method such as gain parameters that are a function of OAT.
    iii. Employ a wide proportional band to maintain stability.
    iv. Simple Predictive Algorithm (SPA) with Proportional Integral (PI) Trim (SPA-PIT). This method avoids typical feedback instability by achieving gross position quickly with an SPA and reducing the gains on a PI trim control where they will move slowly enough to function stably at high system gains associated with low outside air temperatures. The PI operates in a trim role by adding the +/- PI trim amount to a SPA calculated value. For economizers, one expression of the SPA is:
        (**RAT – EconDATsp – DxSplit**) / (**RAT – OAT**),
        limit between **OAareaPos** and 100%
        where: **DxSplit** = 10 for stage 1 mechanical cooling, = 20 for full mechanical cooling and
        = 0 when the mechanical cooling compressor is off.

    The economizer Simple Predictive Algorithm (SPA) for different stages of cooling is shown below:



VSD Fan Control (ECM 3)

Variable speed drive control shall be set up by mode according to following table. For implementations that do not have discharge air limit control, contractor shall adjust speed settings as needed so that discharge air limits are maintained based on acceptance testing. Interface with local controller may be in one of two ways:

1. If entire economizer and VSD control programming is internal to local controller and a direct output to VSD and economizer is provided.
2. If local controller outputs typical thermostat outputs to the RTU with a separate economizer controller in the RTU (not incorporated in the local controller) then either (a) the economizer signal needs to be input to the local controller for speed synchronization or (b) an external speed controller can be used.

VFD Speed Setup – Speed logic internal to DDC

Mode	Thermostat Interface	DDC default VSD Speed	Split check |DAT-MAT|	DAT limit setpoint
Fan Only	G	20%-40%***	N/A	N/A
Heat Stage 1	W1	80%	N/A	max 170°F
Heat Stage 2	W2	85%	max 90°F	max 170°F
Cool Single Stage	Y1i**	95%	max 32°F	min 50°F
Cool Stage 1, Interlaced Coil	Y1i**	80%	N/A	min 53°F
Cool Stage 1, Split Coil	Y1i**	90%	N/A	min 58°F
Cool Stage 2	Y2	95%	max 32°F	min 50°F
Economizer*	AUX	100%	N/A	min 53°F

Check cooling and heating speed against split (|MAT-RAT|) and DAT limits at full capacity
*Activate economizer mode when economizer active and dampers > 75% OSA position
*Deactivate economizer mode when economizer inactive or dampers < 20% OSA position
**Y1i is output from economizer controller for actual compressor activation.
*** Fan speed less than 40% for existing motors, 30% for replacement, 20% for PMM
Target 25% "Fan only" speed if motor accommodates; Increase "Fan only"
speed to match exhaust airflow or maintain space pressurization

VFD Speed Setup (EVO 4-speed controller shown)

Function	Tstat	EVO term	VSD VDC	VSD Speed	Split check	DAT check
Fan	G	In1	4.0	40%	N/A	N/A
Heat	W1	In2	8.5	85%	max 90°F	max 170°F
Cool	Y1i	In3	9.5	95%	max 32°F	min 50°F
Econ	AUX	In4	10.0	100%	N/A	N/A

Voltage/speed settings suggested; verify with proper system operation
Check cooling and heating speed against split (|DAT-MAT|) and DAT limits at full capacity
AUX signal from JADE set for Exhaust fan 2 at 75% OSA position
Note that highest active EVO input # controls output (default application 0)
EVO device may not be necessary if VFD provides same logic
Increase "Fan only" speed to match exhaust airflow or maintain space pressurization

VSD Fan on/off operation shall be as follows:

1. Fan shall be powered on during occupied period, pre-purge, night flush, and when setback heating or cooling is required.
    a. When the thermostat calls for heating, cooling, or economizer operation the VSD shall run no higher than 97% (58 Hz) of the original fan motor speed.
    b. When the thermostat is not calling for heating or cooling and CO_2 sensor is not calling for ventilation, then the VSD can lower the fan motor speed to lower than 40% (24 Hz) but no less than 25% (15 Hz) of the original fan motor speed.
    c. Should CO_2 sensor readout exceed AQset by more than 20% and the damper is fully open, then VSD shall operate at 97% (58 Hz) of the original fan motor speed until CO_2 sensor readout is less than AQset,
2. When the thermostat or EMS HVAC control is in standby, setback or unoccupied mode, the VSD must allow the motor to go fully off (0% speed) when the thermostat is not calling for heating, cooling, economizer, or night flush. At the conclusion of heating or cooling operation, fan shall operate at the heat or cool speed for **FanPost** (3) minutes.

Premium Ventilation Control (ECMs 4 and 5)

In addition to DCV and fan control as described in ECMs 2 or 3, Premium ventilation includes several additional control strategies: Occupied Mode Deadband; Setpoint limits, lockouts, and user interface; Limited Setpoint override; Robust Optimum Start; and Unoccupied Ventilation Fan and Temperature Control. In addition, premium ventilation controls may include optional strategies such as optimum stop, night flush and occupancy sensor standby.

1. Occupied Mode Deadband: Occupied mode heating and cooling control may already be well established in the control system. The following sequences incorporate setpoint lockout and integration sequences that may be desirable.
    a. The heatpump, electric or gas heat and DX cooling shall stage through physical outputs (**Comp1, Comp2, Rev, Heat1, Heat2**) in sequence to maintain heating and cooling setpoints: **HeatSPo** and **CoolSPo.** Provide a deadband of at least 5 degrees between heating and cooling setpoint. There are three alternative suggested methods to stage equipment:
        i. Differential Staging. The DX unit shall stage up or down if a steady temperature error exceeds **CoolStageDif** (1.5°F, adjustable). The heating shall stage up or down if a steady temperature error exceeds **HeatStageDif** (2°F, adjustable). If the system cycles under a steady load, the controller shall be adjusted to limit cycling to a single stage.
        ii. Proportional Integral Heating and Cooling loops with timed proportioning output. A ten minute heating or cooling cycle shall be maintained and the stages of heating or economizer and cooling shall cycle on proportional to PID loop output.

iii. Proportional Integral staging. A table showing suggested cut-in (ON on rise) and cut-out (OFF on fall) for outputs based on separate heating and cooling loops setpoint driven PI outputs is shown:

PI Loop Output	Electric Heat 1	Electric Heat 2	Comp1	Comp2	Reversing Valve	Economizer
Heat 0%					Cut-Out	
Heat 10%			Cut-Out		Cut-In	
Heat 20%				Cut-Out		
Heat 30%			Cut-In			
Heat 40%	Cut-Out					
Heat 50%				Cut-In		
Heat 60%		Cut-Out				
Heat 70%	Cut-In					
Heat 90%		Cut-In				
Cool 0%						Cut-Out
Cool 10%					Cut-Out	Cut-In
Cool 20%						
Cool 30%			Cut-Out			
Cool 40%						
Cool 50%				Cut-Out		
Cool 60%			Cut-In			
Cool 70%						
Cool 90%				Cut-In		

b. Compressor operation:
   i. If the outside air temperature is greater than the DX lockout temperature **CoolLockOA** (56°F, adjustable) and the system is not in morning warm-up, DX cooling shall be enabled.
   ii. DX cooling and heat pump compressor operation shall observe the following timing constraints:
      a. When a compressor stage is called to run, it will run for at least the DX minimum on-time (2 min).
      b. When a compressor stage cycles off, it will remain off for at least the DX minimum off-time (5 min).
   iii. Multi-stage compressor operation shall observe the following performance constraints:
      a. Under a steady partial load, if the system cycles, the cycling must be limited to a single stage, while the other stages stay on or off.
      b. Under a steady partial load, if the system stabilizes, the space temperature error must be less than the DX temperature deadband.
c. Safety trips and loss of fan status (**FanStat**), if provided, shall override the time delays and de-energize all compressors.

2. Setpoint limits, lockouts, and user interface:
   a. Cooling occupied setpoint shall be no lower than **CoolSPmin** (73°F). Heating setpoint shall be no higher than **HeatSPmax** (72°F). Note that these are adjustment limits, and that per the previous staging sequence, a deadband of at least **DeadSP** (5) degrees between heating and cooling setpoint shall be maintained.
   b. Once mechanical cooling has completed operation, there will be a 5 minute delay before heating is allowed to operate. Once heating has completed operation, there will be a 5 minute delay before mechanical cooling is allowed to operate. For heat pump systems this requirement shall be met by the minimum 5 minute off time for the compressor.
   c. For heat pump systems electric resistance heat shall be locked out whenever:
      i. Outside air temperature is above **HeatLockOA** (38°F),

ii. Warm up is occurring during the optimum start period before occupancy unless outside air temperature is below 10°F or space temperature is below current ramp optimum start setpoint by more than 3°F,
iii. During compressor minimum off time, or
iv. For 3 minutes after heat pump heating has started

d. Provide user input of occupied heating and cooling setpoints: **HeatSPo** and **CoolSPo** subject to limits and deadband specified. These standard setpoints shall be input on a setup screen and not adjusted on the home screen of the thermostat. See setpoint override.

3. Limited Setpoint override: The setpoint may be overridden by the user within certain limits. Setpoint override shall be available at all times when **OvrUnoc** is true, and only during the occupied schedule when when **OvrUnoc** is false. When overridden, the controller shall restore the normal setpoint at the next change in temperature mode, after **OvrTime** (120 minutes) has elapsed since the override setpoint adjustment, or during demand response periods unless **DR1Ovr** or **DR2Ovr** are true. Depending on display and user interface capabilities, a number of different options may be used to manage the heating and cooling setpoints:
   a. The displayed setpoint adjustment shall match either heating **HeatSPc** or cooling **CoolSPc** current setpoint depending on the active or most recent mode when the setpoint was adjusted or there shall be a separate override setpoint available for heating and cooling. The user shall be able to switch between modes so they can adjust the setpoint of interest. This may be accomplished in one of several ways:
      i. Provision may be provided to change from heating to cooling mode.
      ii. The mode may roll over at the limits. For example if the unit is in the heating mode and the user is trying to lower the cooling setpoint, when they lowered the setpoint and reached the lower limit for heating mode setting, pressed the “down” button again, the mode would switch to cooling and the cooling setpoint would be displayed and adjusted.
      iii. A less desirable, but acceptable option, would be to have the non-displayed setpoint move in the same direction as the active mode setpoint, offset by the deadband and subject to **CoolSPmin** and **HeatSPmax**.
   b. For a single user override setpoint **OvrSP** the following alternative strategy may be used:
      i. When the outside air temperature (**OAT**) is less than **OvrBP** (60°F) (or the most recent mode is heating) the **HeatSPc** is set equal to **OvrSP** (override setpoint) and the **CoolSPc** is **HeatSPc + DeadSP** (5) degrees
      ii. When the outside air temperature (**OAT**) is greater than **OvrBP** plus 10°F (70°F) (or the most recent mode is cooling) the **CoolSPc** is set equal to **OvrSP** (override setpoint) and the **HeatSPc** is **CoolSPc - DeadSP** (5) degrees
      iii. When the outside air temperature (**OAT**) is between **OvrBP** (60°F) and **OvrBP** plus 10°F (70°F) the override setpoint **OvrSP** is used as follows (not necessary for recent mode method):
         a. **HeatSPc** = **OvrSP - (OAT – OvrBP) /** (10 / **DeadSP**)
         b. **CoolSPc** = **OvrSP + (OAT – OvrBP) /** (10 / **DeadSP**)
      iv. **HeatSPc** and **CoolSPc** are subject to limits of **CoolSPmin** (73°F) and **HeatSPmax** (72°F).
      v. Where points or memory are limited, **OAIoT** (60°F) may be substituted for **OvrBP**
   c. When the override is active, setpoints shall be subject to setpoint limits already discussed (**CoolSPmin, HeatSPmax** and **DeadSP).** During the override period, occupancy sensor time out shall be active and restore to a standby offset; however, when occupancy is again detected, the override setpoint shall be restored for the remainder of the original override period.

Note on Robuist Optimum Start: The sequence below probably differs from the typically provided manufacturer's sequence. A research finding is that learning optimum start algorithms based solely on indoor temperature fail to warm up in time when there is an unexpected low night outside temperature. If the following sequence is not implemented, it is recommended that such learning algorithms have the input of a combination of outdoor and indoor temperature since the outdoor temperature point is included in this sequence as an input.

4. Robust Optimum Start: Optimum start mode will gradually move from unoccupied to occupied setpoints, so that when unoccupied space temperature had not drifted all the way to unoccupied setpoints, warm up or cool down time will be reduced. When outside temperature indicates conditions exceed design conditions, the optimum start time is extended. Prior to the scheduled daily occupied start time, the optimum start program shall determine ramp rates and optimum duration as follows:
    a. The assessment shall occur **2** x **OptLead** (180) minutes before the scheduled daily occupied start time.
    b. The optimum start duration **OptDur** in minutes shall be based on outside air temperature at assessment time as follows:
        i. If current OAT < 50: **OptLead** * (50 – [current **OAT**]) / (50 – **HeatDes**)
        ii. If current OAT >= 50: **OptLead** * ([current **OAT**] – 50) / (**CoolDes** – 31)
        iii. maximum of **2** x **OptLead** minutes
        iv. minimum of **60** minutes
    c. Beginning at the optimum start time (**OptStart** = **OptDur** minutes before scheduled occupied time) the heating and cooling setpoints shall be adjusted every 15 minutes, as follows:
        i. Heat: Increase setpoint by 15 * (**HeatSPo – HeatSPu) / OptDur**
        ii. For heatpumps, interstage differential between heat pump heat and electric heat shall be triple normal: 3 * **HeatStageDiff,** returning gradually to normal during the first hour of occupancy.
        iii. Cooling: Decrease setpoint by 15 * (**CoolSPu – CoolSPo) / OptDur**
        iv. Economizer setpoint shall be maintained below occupied cooling setpoint (**CoolSP - EconDif**) unless night flush is active.

5. Unoccupied Fan Control: The supply fan shall be de-energized except when operation is called for as described below.

6. Unoccupied Ventilation Control: Outside air dampers and exhaust dampers shall be closed and return air damper open except as required for night flush or economizer operation.

7. Unoccupied Setback: When the space temperature drops below unoccupied heating space temperature setpoint **HeatSPu** (55°F, adjustable), supply fan shall energize, outside and exhaust dampers shall remain closed, and return damper shall remain open. The heating system shall stage to maintain heating temperature setpoint of **HeatSPu** (55°F, adjustable). Supply fan speed and post heating operation shall be controlled as described in occupied mode. When unoccupied heating space temperature setpoint + differential **HeatDif** (1.5°F) is reached, then the unit shall return to Unoccupied Off mode.

8. Unoccupied Setup: When the space temperature goes above unoccupied cooling space temperature setpoint **CoolSPu** (85°F, adjustable), supply fan shall energize, outside and exhaust dampers shall remain closed, and return damper shall remain open unless economizer is active. The cooling system shall stage to maintain cooling temperature setpoint of **CoolSPu** (85°F, adjustable). Supply fan speed and post cooling operation shall be controlled as described in occupied mode. When unoccupied cooling space temperature setpoint less differential **CoolDif** (1.5°F, adjustable). is reached, then the unit shall return to Unoccupied Off mode. Economizer setpoint shall be maintained **EconDif** (2°F, adjustable) below the cooling setpoint unless night flush is active and shall operate as described under occupied mode.

9. Unoccupied override: When the override button is activated (may be first activation of temperature adjustment) the unit will return to occupied mode for three hours. No "hold" options shall be allowed, in other words, there shall be no user accessed mode to put the unit in permanent temperature hold position, bypassing programming. A vacation or holiday mode shall be allowed, putting the unit in the unoccupied setpoint until deactivated or the set number of days has elapsed.

Optional Additional Sequences

The following modes or similar sequences may be a part of standard programming in the advanced thermostat or premium ventilation controls. If not, they should be strongly considered. Any savings will be in addition to DCV and fan control savings. Virtual point variables may not be included in the points table for these sequences.

1. Optimum Stop Mode: Unless **OptStop** is set to 0, beginning at **OptStop** (30) minutes before the end of the occupied period, gradually increase the cooling setpoint 1.0°F every 15 minutes until **CoolSPs** standby setpoint is reached and gradually decrease the heating setpoint 1.0°F every 15 minutes until **HeatSPs** standby setpoint is reached. During optimum stop period, suspend ventilation unless **AQzone** exceeds (**AQset** (1000 ppm) **–** 100 ppm), in which case operate fan in normal ventilation mode

2. Standby Mode: When no occupancy sensors (**Occ1, Occ2**, etc.) have sensed occupancy (**Occ)** for **OccTimeOut** (30) minutes, then:
    a. Heating and Cooling setpoints shall be adjusted to standby cooling **CoolSPs** and heating **HeatSPs** setpoints, where the standby cooling setpoint **CoolSPs = CoolSPo + SbySPoffset** and the standby heating setpoints **HeatSPs = HeatSPo - SbySPoffset.**
    b. If the fan is operating, Fan operation based on **FanMaxOff** shall be suspended and **FanJustOff** shall be reset to 0. If the fan is off when space becomes occupied, **FanJustOff** timer shall be suspended at its current value until occupancy is again detected.
    c. Economizer setpoint shall remain below normal occupied cooling setpoint (**CoolSPo - EconDif**).
    d. When occupancy is again detected for a period of at least 2 minutes,
        i. If the space temperature is above **CoolSPo,** then beginning with a cooling setpoint at the space temperature gradually decrease the cooling setpoint (**CoolSPc**) 1.0°F every 15 minutes until **CoolSPo** occupied setpoint is reached, otherwise return **CoolSPc** immediately to **CoolSPo.**
        ii. If the space temperature is below **HeatSPo,** then beginning with a cooling setpoint at the space temperature gradually increase the heating setpoint (**HeatSPc**) 1.0°F every 15 minutes until **HeatSPo** occupied setpoint is reached, otherwise return **HeatSPc** immediately to **HeatSPo**.
        iii. Resume incrementing of **FanJustOff** timer.

3. Night Flush: Night flush will use the economizer only to pre-cool the building and be subject to the following conditions:
    a. Night flush shall be enabled (**NFenable = true**) whenever the following 3 conditions are true:
        i. The user setup flag (**NF_OK**) allowing night flush is true, and
        ii. The outside temperature is suitable, that is OAT has exceeded 75°F (**NFstartOA**), and continue until the outside temperature falls below 45°F (**NFstopOA**), and
        iii. There has been no heating operation during the last 24 hours (**Heat24** = false).

    (Note that these conditions may switch independently; for example suitable temperature and user selection may be true, and heating may disable night flush. Once heating is not used for 24 hours, night flush would again be enabled. This night flush enablement is intended to be seasonal, but may switch more often during swing seasons.)
    b. Night flush shall be active when all the following conditions are true
        i. Night flush enabled (**NFenable = true**) as above

ii. Outside air temperature (**OAT**) is less than the space temperature (**STavg**) minus the economizer activation differential **EconAct** (5°F)
iii. Space temperature (**STavg**) is greater than the occupied heating setpoint (**HeatSPo)** plus 1°F. [Note: users who want more aggressive night cooling can lower the occupied heating setpoint during summer months.]
iv. It is between midnight and the start of the occupied period (night flush can continue during the optimum start period)
v. Optional humidity overrides (depending on availability of space or outside humidity sensors, one of the following limits can be applied as an additional condition for night flush operation):
    a. The outside humidity ratio is less than or equal to 0.009 pounds of water per pound of dry air, based on measurement of outside air temperature and relativity humidity. (The intent of this provision is to provide an upper limit of 60% relative humidity at an indoor temperature greater than 69°F) Humidity ratio may be estimated with approved method or the formula:
        Humidity Ratio (lb water/lb air) =
        -0.0071588 + 0.0002975 * [OAT DB] + 0.0084584 * LN([%RH]/100)
    b. The space humidity ratio is less than or equal to 0.009 pounds of water per pound of dry air using the space DB and space %RH similar to above.

c. When night flush is active, mechanical cooling shall be disabled or a separate setpoint maintained for night flush economizer and mechanical cooling on the optimum start ramp, heating shall be disabled, and the supply fan activated, and the economizer discharge air setpoint at 45°F. Heating shall continue to be disabled for one hour following night flush mode operation.

Suggested Products

The following products are known to meet the specifications. Other products that meet the specifications are allowed, as approved by owner's representative.

Carbon Dioxide Sensors: Honeywell C7242, AirTest TR9290, TR9291 or TR9292, Veris Industries CWE series, BAPI BA/AQS-D-10 or BA/AQS-R-10.

Humidity Sensors: Vaisala HMD50U, Automation Components Inc A/RH3-D, Kele H-31k series.

Occupancy sensors: 24VAC: Wattstopper CI-24 PIR and IR-TECH OS-550DT dual technology for larger areas

Variable Frequency Drives: Allen Bradley Powerflex 4 and Honeywell Smart VFD Compact or HVAC

VSD Speed controller: Evolution Controls EVO™/IF-4DI1AO

Local Integrated Programmable Controllers:

- KMC FlexStat
  - BAC-11063CW with integrated occupancy sensor, or
  - BAC-131163CEW with integrated occupancy sensor and CO_2 sensor
- Innotech innTOUCH space interface with one of two optional setups:
  - UM01C and UM01 (1@) microMAX controllers and IG01 network gateway, or
  - MM01C and MM01 (1@) miniMAX controllers
- Alerton VisualLogic™ Display (VLD)
- Transformative Wave Technologies Catalyst controller

Replacement Economizer Controller: Honeywell W7220 JADE economizer controller

Excluded Products

The following products fail to meet the specifications, based on independent testing. Later independent testing may show that product manufacturer has improved and qualify them for program use.

Carbon Dioxide Sensors by the following manufacturers: Digital Control Systems Inc.; Intec Controls Inc.; Sensata (Texas Instruments). Based on excessively high or low reading in independent testing.[1]

[1] Gregory Maxwell, "Product Testing Report: Wall Mounted Carbon Dioxide (CO2) Transmitters" (Iowa Energy Center, June 2009), http://www.energy.iastate.edu/Efficiency/Commercial/download_nbcip/PTR_CO2.pdf.

Appendix B – Construction Documents for Test

The construction documents used for bidding are included on the following pages. Note that the contract itself is not included for brevity. A revised Programmatic Specification (including a revised Sequence of Operation) based on the findings of this investigation are included in Appendix A.

Construction Documents

May 3, 2010

Premium Ventilation Control Upgrade: Fan Cycling DCV

Amazon Community Center, City of Eugene

2700 Hilyard Street, Eugene, OR - (541) 682-5373

Revision History

Revision	Date	Changes
Bid	April 20, 2010	Issued for Bid
A	May 3, 2010	Revised for Addenda; Ventilation setpoints Added; Testing included

Contents

PECI (Engineer) Contact:

P. Reid Hart, PE

Portland Energy Conservation, Inc.
1400 SW 5th Ave Suite 700
Portland, OR 97201

Direct: 503-961-6142
Mobile: 541-510-8545
Email: rhart@peci.org

Expires 6/30/2011

Task Scope of Work (May 3, 2010)

Complete installation of premium ventilation controls using control equipment from three manufacturers on 6 heat pump units at Amazon Community Center in Eugene, OR. Individual unit installation and configuration as follows:

Bldg	unit	Tons	Trane Model \ Serial Number	Control Manuf	Occupancy Sensors	Configuration **
A	HP-3	6.5	WCD075C300BC \ R38100082D	KMC Controls	1 In FlexStat	1: Space controller (FlexStat)
B	HP-4	2.5	WCC030F100BF \ R375U5X1H	Innotech	1	2: RTU controller with space sensor (ICS)*
B	HP-5	4.0	WCC048F300BF \ R131S3A2H	Innotech	1	2: RTU controller with space sensor & interface (miniport)*
C	HP-6	3.5	WCX042G300AB \ Z233X771H	KMC Controls	1 In NetSensor	2: RTU controller with space sensor (NetSensor)
C	HP-7	3.5	WCX042G300AB \ Z2613CH1H	Alerton	1 Ceiling Mount	2: RTU controller (VLC) with space sensor (VLD)
C	HP-8	3.0	WCX036G300AB \ Z245XON1H	Alerton	2	1: Space controller (VLD)

* Innotech units require network gateway installed in box and wiring for battery backup of date/time
** For each manufacturer, provide optimum start per PECI sequence on one unit and Manufacturer's standard optimum start on another.

Contractor's Scope of Work

Attend a pre-construction project walk-through with engineer and owner representatives. Coordinate access with owner. Roof access will be available at all times, and units may be turned off up to 2 hours while served spaces are occupied when outside temperature is between 60°F and 80°F. The rooms are intermittently scheduled and access times can be arranged through City staff.
Complete the following for the six (6) heat pumps listed above:

- Replace the economizer damper motors with Honeywell M7215 motors using 2-10VDC input. Verify proper physical replacement for existing motors with supplier.
- Refurbish the economizer damper operators as needed for smooth operation and install closed-cell foam insulation or weather-stripping on damper blade edges where seals are not present and to fill edge gaps greater than 3/16 inch.
- Upgrade thermostat to a programmable thermostat/controller(s) per table above with sequence as specified in the sequence of operation. Install or update programming provided by control manufacturer as necessary for proper operation. Deliver copies of final program files and documentation to PECI & City.
- Replace or adapt to thermostat wiring as necessary. Assume replacement of wiring for bid purposes and provide a deduct amount if existing wiring can be used (expected for configuration 2).
- Provide, install and wire CO_2 sensors with 0 to 10 VDC output; Honeywell C7242, AirTest eSENSE 9290-L or 9291, BAPI BA/AQS-D-10 or BA/AQS-R-10 or equal or as recommended by controller manufacturer.
- Provide, install and wire temperature and occupancy sensors Watt Stopper CI-24 or equal or as recommended by controller manufacturer.
- Check out and acceptance test unit sequence (with engineer present for the first unit), per attached acceptance testing protocol. Test remaining units and review test results with engineer. Provide documentation to EWEB for their HVAC rebate program.
- Provide one year labor & material warranty on installed components.
- Provide walk-through demonstration of operation for City HVAC staff and interested parties.

Ventilation Setpoints

During setup and acceptance testing, set unit ventilation as follows, using three-temperature measurement of outside air (OSA) percentage.

Bldg	Unit Tag	Estimated CFM*	Zone Use (Occupancy Category)	Typ Peak People	OSA area CFM	OSA full CFM	OSA% area	OSA% full
A	HP-3	2400	Gym (Daycare)	20	110	310	5%	13%
B	HP-4	900	Crafts (Art Class)	20	160	360	18%	40%
B	HP-5	1500	Clay (Art Class)	18	160	340	11%	23%
C	HP-6	1300	Dance (Music)	37	60	250	5%	19%
C	HP-7	1300	Music (Dance)	32	50	210	4%	16%
C	HP-8	1100	Conference	22	30	140	3%	13%

*Airflow estimated based on unit size. Verify proper fan operation, and notify engineer if airflow is significantly low.

The following settings and parameters are provided for convenience. Verify and adjust as needed.

Unit Tag	Full CO_2 ppm AQset	OSA area damper position* OSareaPos	OSA full damper position* OSfullPos	OSA area volts 2-10	OSA full volts 2-10
HP-3	850	0.010	0.057	2.08	2.46
HP-4	750	0.093	0.350	2.74	4.80
HP-5	750	0.043	0.135	2.34	3.08
HP-6	1,400	0.011	0.105	2.08	2.84
HP-7	1,400	0.007	0.080	2.06	2.64
HP-8	1,400	0.002	0.056	2.02	2.45

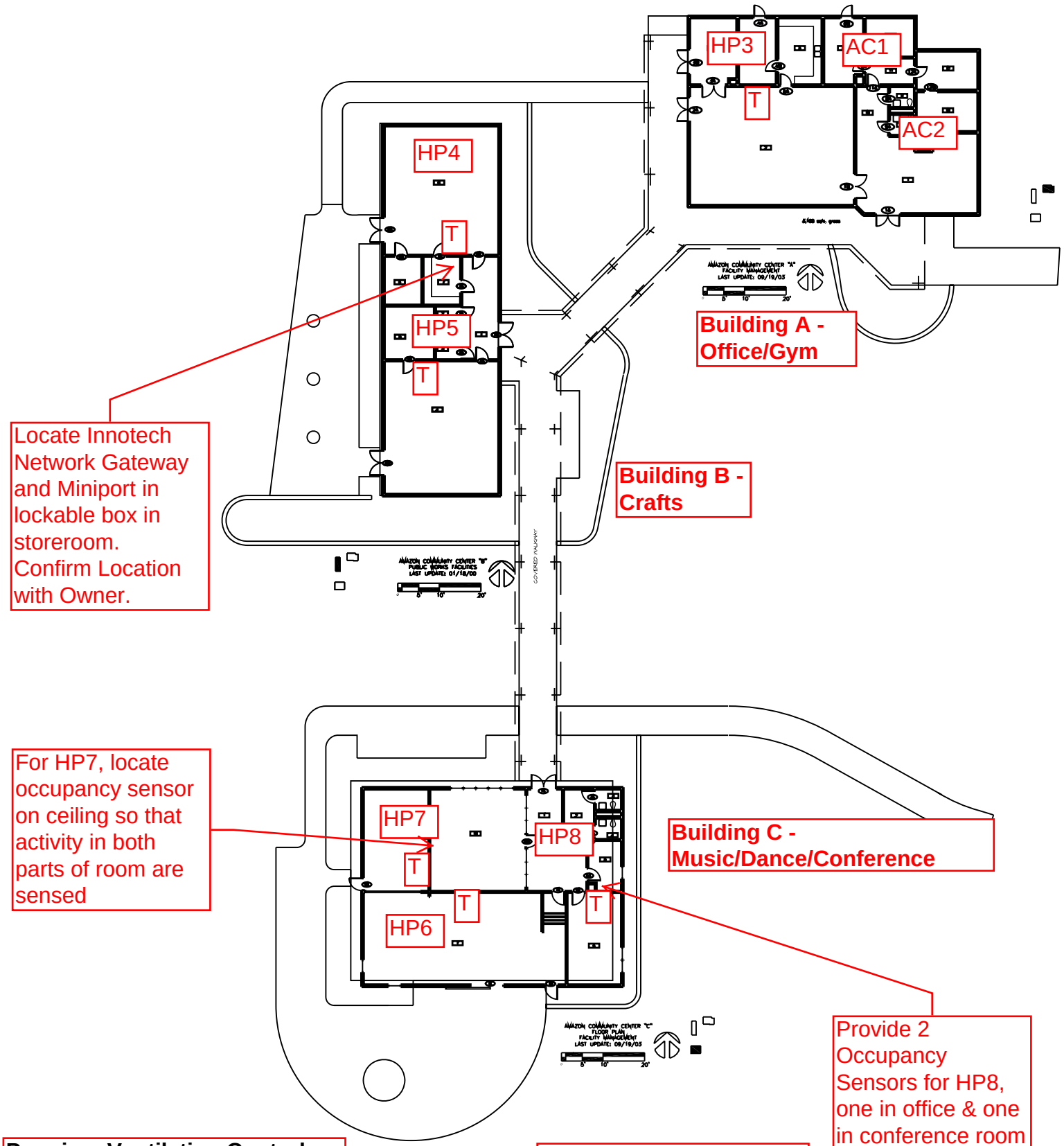
*OA damper settings (fraction open) and voltages (for 2-10 volt damper motors) are typical settings intended as a starting place. Adjust appropriately using outside air measurements to achieve scheduled %OA or CFM.

Control Manufacturer Contacts:

KMC Controls
Nathan Davis
Mobile: (574) 312-0276
E-mail: ndavis@kmccontrols.com

Environmental Control Corp (for Alerton)
2460 W 11th Avenue, Suite 201
Eugene, OR 97402
Tel: (541) 968-8089
Fax: (541) 344-5012
Tom Mahrer
E-mail: tomm@eccportland.com

Innotech America
Scott Gregson
Business: (360) 892-1299
Mobile: (360) 521-9998
E-mail: sgregson@innotechamerica.com



Premium Ventilation Control Upgrade: Fan Cycling DCV Equipment Location Drawing PECI; May 3, 2010

Amazon Community Center, City of Eugene 2700 Hilyard Street, Eugene, OR

Sequence of Operation

Premium Ventilation Customized Programmable Thermostat

Demand Controlled Ventilation (DCV) with Cycling Fan
Revision A - May 3, 2010

CV or VAV Unitary Air Handler, Single Zone, Demand Controlled Ventilation, Economizer.

Note: This sequence is available for use by manufactures developing custom programmable thermostats for the premium ventilation test. It shall be made available to other manufacturers who participate in BPA programs.

As a preliminary sequence, there may be areas that require clarification or correction. Please do not hesitate to direct questions, comments or suggestions to Reid Hart, PE; 503-961-6142 rhart@peci.org

Revision History

Revision	Date	Changes
A	May 3, 2010	Passive Demand Shed Mandatory; Ventilation rate calculation; Startup & Testing Added

SECTION I – DESCRIPTION OF EQUIPMENT

Quick Summary	
Fan Speed:	Temperature Control on Mode (if VSD)
Occupancy Standby Control:	Included; “Hold” disallowed
Space Pressure Control:	None
Minimum OA Control:	Demand Controlled Ventilation based on fan cycling
Economizer:	Differential Dry Bulb Temp
Humidification:	No
Dehumidification:	No

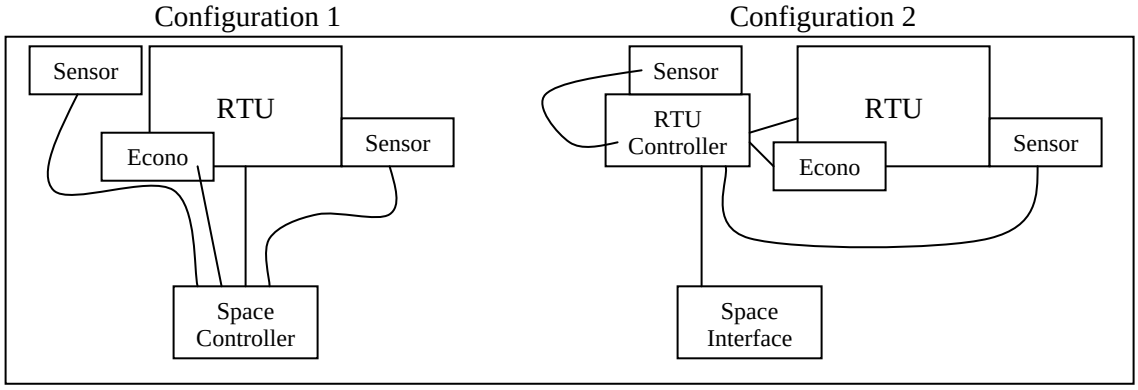
A. OVERVIEW & EQUIPMENT CONFIGURATION

This sequence of control describes the custom programmable thermostat control requirements for a simple unitary constant or variable volume air handling system. These air-handling units are typically in the range of 800 to 15,000 cfm, serving multiple rooms with one zone of control.

The control equipment is intended to replace an individual packaged unit electromechanical or programmable thermostat. For this project, the test units are heat pumps. Installing these controllers in retrofit situations will likely require more wires from a room controller to the unit on the roof than existing thermostats require, so three configurations are anticipated:

There are three possible configurations:

1. Single combined thermostat and custom programmable unit controller with all sensor and control wiring connected to the main control unit in the space. Additional wires to space are typically required.
2. Separate space sensor and interface unit with rooftop custom programmable unit controller with all sensor and control wiring connected to the rooftop control unit. Existing wires to space are usually adequate.
3. Some hybrid of the previous approaches with multiple communicating custom programmable controllers connected by network wiring or wireless communication. Existing wiring to space should be adequate.
   Note: Some controllers may require connection to a network gateway to provide battery backup of date and time.



B. PRIORITIES OF DEVELOPMENT

- The basic thermostat and control sequence shall meet Oregon building code requirements.
- The custom programmable thermostat is intended to directly control existing economizers. Typical economizer damper motors can be controlled with a 0-10 VDC signal either directly or using an adapter on the motor. Some units will require a three-wire motor setup where open and close operation is triggered by separate 24 volt signals.
- There are multiple sequences proposed and they may not all be possible with each implementation due to point or memory limitations. The priority of modes and features is shown in the following table. Note: Priorities 1 through 7 are required for this field test. *The remaining items may be implemented by the manufacturer; however, at this point there is not funding for testing these modes, so the manufacturer must undertake bench testing if they are to be implemented. There may be future testing of implementation of these modes.*

Priority	Mode / Feature Description
1	Space Temperature Control
2	Direct Economizer Control
3	Optimum Start
4	Night Flush
5	Occupancy Sensor Standby
6	Temperature Override Mode
7	Ventilation Override Mode
8	Passive Demand Shed
9	Demand Limit Pre-cool
10	Additional Cooling/Heating Stages
11	Three-wire Damper Output
12	Utility Demand Input
13	Mode Runtime Recording
14	Basic Fault Diagnostics
15	Advanced Fault Diagnostics

C. SYSTEM SCHEMATIC

See schematic following sequence.

D. CONTROL SYSTEM OBJECT LIST

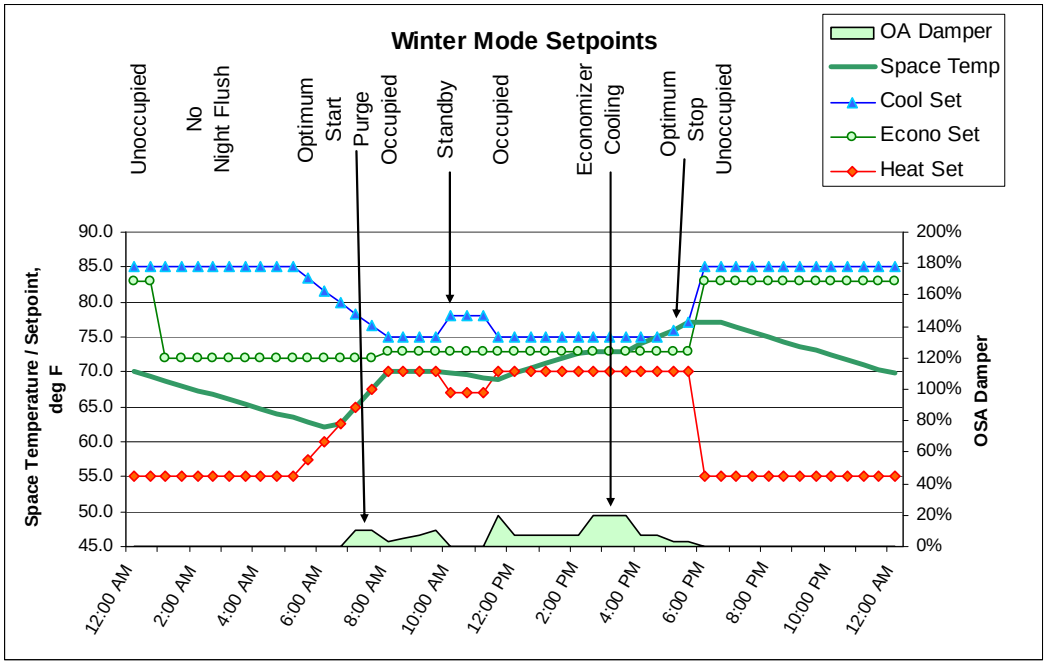
See object list following sequence.

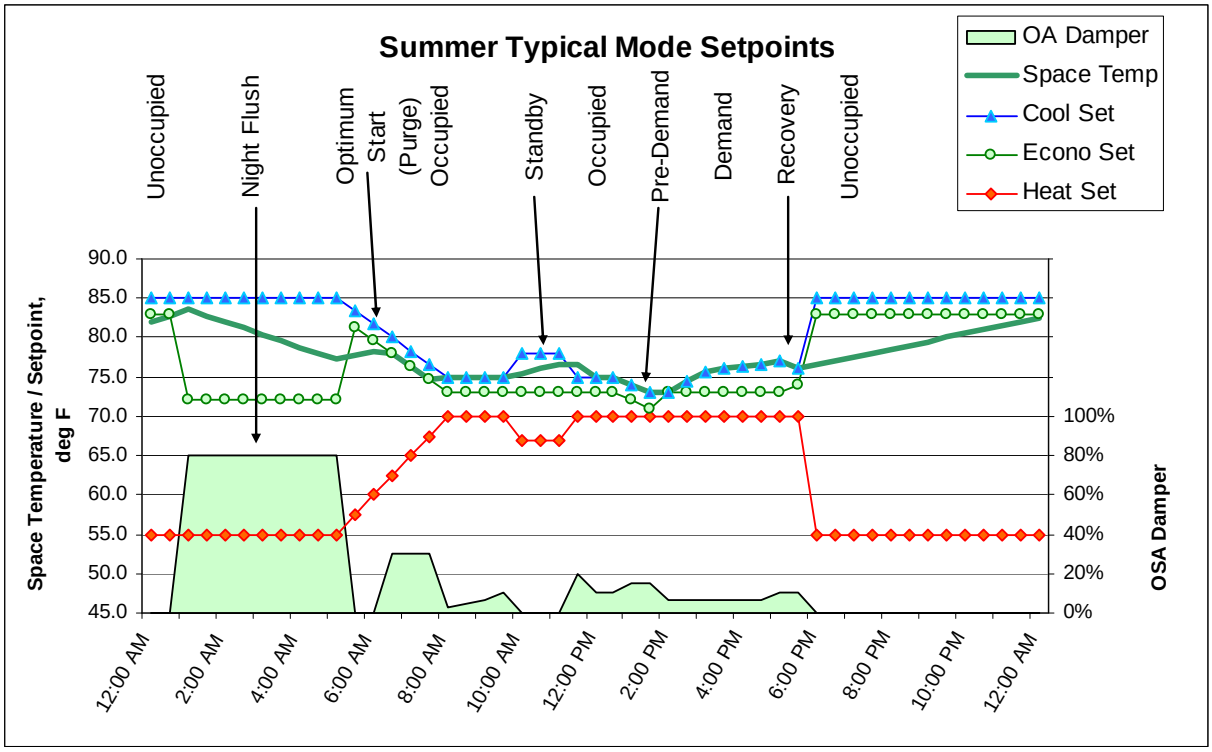
Object or point tags from the object list are shown bold in the sequence, with user-adjustable default values shown in parentheses, as in this example:

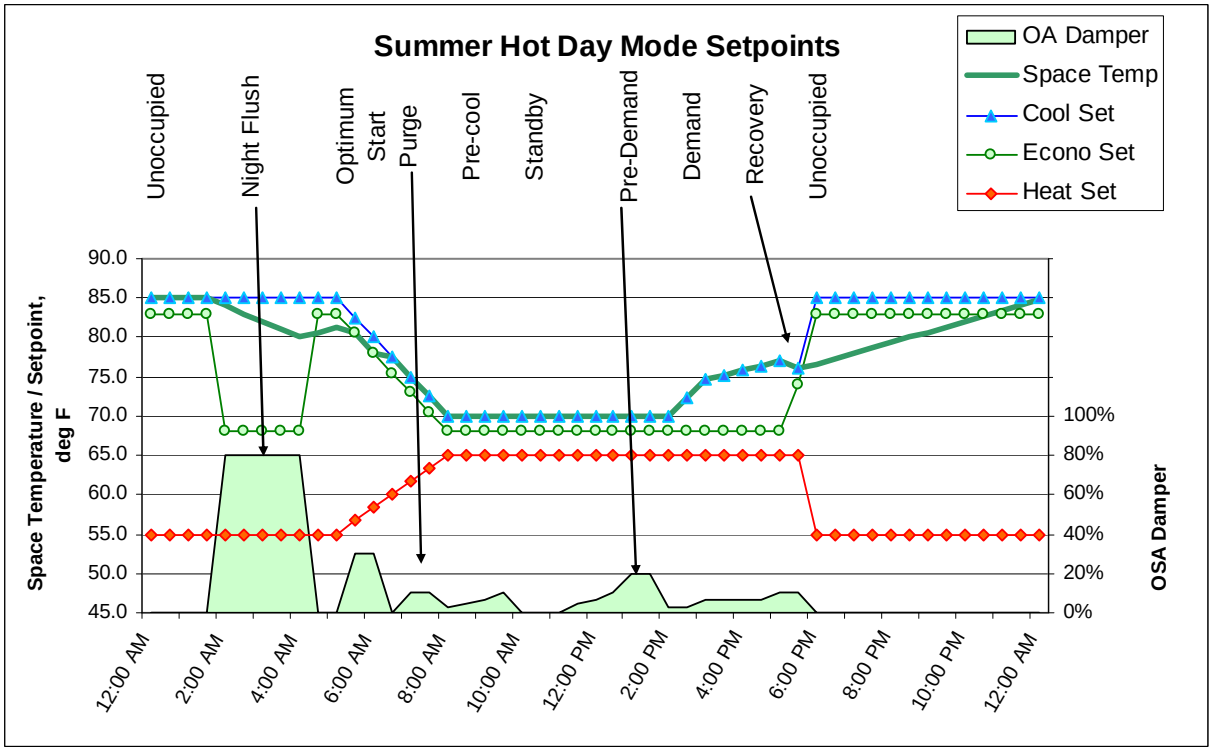
. . . than the DX lockout temperature **CoolLock** (56°F)

E. TYPICAL OPERATION

To assist in describing sequences, typical one day setpoint changes are shown in graphs for heating, moderate cooling, and hot day cooling.







SECTION II – SEQUENCE OF OPERATION

The occupancy mode (Occupied or Unoccupied) shall be determined through a user-adjustable, seven-day schedule with a holiday schedule.

Whenever the supply fan is de-energized, as sensed by either the optional status switch (**FanStat**) or fan command (**Fan**), the outside and exhaust air dampers shall be closed and the return air damper shall be open, the heating and cooling systems shall be deactivated or positioned as described below.

A. OCCUPIED MODE

1. The supply fan shall operate through activation of **Fan** output in submodes as follows:
    a. When cooling is called for, the supply fan shall operate and continue to operate for **FanPost** (3) minutes following cessation of cooling.
    b. When heating is called for, and **FanWithHeat** (Yes) is true, the supply fan shall operate and continue to operate for **FanPost** (3) minutes following cessation of heating.
    c. When economizer or ventilation is called for, supply fan shall operate.
    d. When fan has been off for **FanMaxOff** (30) minutes, fan shall operate for 5 minutes, unless in standby mode.

The modes in grey text are included as optional. Consulting budget is not currently available for testing or troubleshooting; although it may be added later. If these modes are instituted, manufacturers should carefully bench test the sequences before releasing code to the site.

2. When Optional VSD is true [**FanVSD**], then
    a. In heating mode, modulate fan speed to maintain discharge air temperature of 120°F (100°F for heat pump heating).
    b. In cooling mode, modulate fan speed to maintain discharge air temperature of 55°F (50°F for dehumidification). ADJ for 2 stage non-interlaced coils
    c. In economizer mode, modulate fan speed to set maximum speed (initially of 83%).
    d. In ventilation or deadband mode, modulate fan speed to set minimum speed (initially of 30%).

3. The heatpump, electric or gas heat and DX cooling shall stage through physical outputs (**Comp1, Comp2, Rev, Heat1, Heat2**) in sequence to maintain heating and cooling setpoints: **HeatSPo** and **CoolSPo.** Provide a deadband of at least 5 degrees between heating and cooling setpoint. The DX unit shall stage up or down if a steady temperature error exceeds **CoolStageDif** (1.5°F, adjustable). The heating shall stage up or down if a steady temperature error exceeds **HeatStageDif** (2°F, adjustable). If the system cycles under a steady load, the controller shall be adjusted to limit cycling to a single stage.

4. Compressor operation:
    a. If the outside air temperature is greater than the DX lockout temperature **CoolLock** (56°F, adjustable) and the system is not in morning warm-up, DX cooling shall be enabled.
    b. DX cooling and heat pump compressor operation shall observe the following timing constraints:
        1. When a compressor stage is called to run, it will run for at least the DX minimum on-time (2 min).

2. When a compressor stage cycles off, it will remain off for at least the DX minimum off-time (5 min).

c. Multi-stage compressor operation shall observe the following performance constraints:
   1. Under a steady partial load, if the system cycles, the cycling must be limited to a single stage, while the other stages stay on or off.
   2. Under a steady partial load, if the system stabilizes, the space temperature error must be less than the DX temperature deadband.

d. Safety trips and loss of fan status (**FanStat**), if provided, shall override the time delays and de-energize all compressors.

5. Setpoint limits: Cooling occupied setpoint shall be no lower than **CoolSPmin** (73). Heating setpoint shall be no higher than **HeatSPmax** (72).

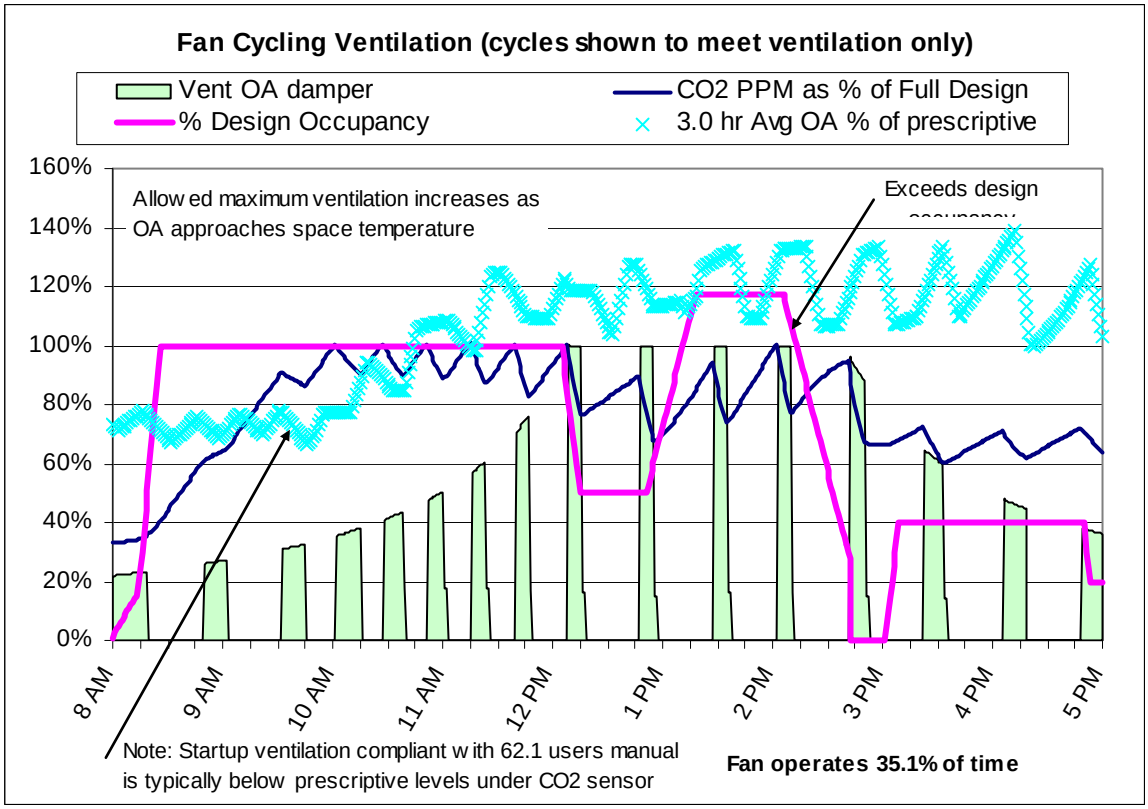
6. Setpoint override: The setpoint may be overridden by the user within certain limits. When overridden, the controller shall restore the normal setpoint at the next change in temperature mode.

7. Outside Air Economizer: The sequence includes a complete overhaul of the damper controls, replacing the damper motor if (usually) necessary to allow a 0-10 volt DC control signal. Detailed algorithms are suggested below. The intent of the economizer sequence is to provide a differential changeover using room temperature vs. outside air, enabling the economizer when outside air is colder. When there is a first-stage call for cooling, the compressor shall be locked out and the economizer shall modulate to maintain a set discharge temperature. Include a stability method to allow good economizer response during mild outside temperatures and prevent instability (cycling or hunting) during cold outside temperatures.
   a. Changeover: Economizer cooling is enabled whenever the outside air temperature (**OAT**) is less than the space temperature (**STavg**) minus **EconAct** (5). When mechanical cooling is active or the fan is operating to provide ventilation, integrated economizer cooling is enabled whenever the outside air temperature (**OAT**) is less than the space temperature (**STavg**).
   b. Activation: When enabled and the space temperature (**STavg**) exceeds the current cooling setpoint less **EconDif** (2) the economizer shall be active. In standby mode, economizer setpoint shall remain below normal occupied cooling setpoint (**CoolSPo - EconDif**).
   c. The outside air damper shall modulate in response to the greater of the economizer and ventilation control signals subject to a discharge air temperature (**DAT**) low limit of 45°F (adjustable) and an economizer discharge air temperature (**DAT**) setpoint of **EconDATsp** (53°F). To avoid unstable operation at low outside air temperatures, control of discharge air temperature (**DAT**) shall (1) incorporate an error deadband of +/- 0.5F (adjustable) from setpoint where no damper movement occurs, (2) reset Integral gain at each changeover or cooling system activation and (3) follow one of these stability schemes:
      i. Simple Predictive Algorithm with Proportional Integral (PI) Trim (SPA-PIT). This method avoids typical feedback instability by achieving gross position quickly with an SPA and reducing the gains on a PI control where they will move slowly enough to function stably at high system gains associated with low outside air temperatures. The PI operates in a trim role by adding the +/- PI trim amount to a SPD calculated value. For economizers, the SPA is:
         (**STavg – EconDATsp – DxSplit**) / (**STavg – OAT**) ,
         limit between OAareaPos and 100%
         where: **DxSplit** = 20 when compressor is on and = 0 otherwise
      ii. Have separate PI gain parameters for moderate (**OAT**>40F, adjustable) and cold (**OAT**<=40F) conditions
      iii. Provide other adaptive PI method such as gain parameters that are a function of OAT.

Important note: The following ventilation method meets ASHRAE Standard 62.1-2007, but is not compliant with 2008 California Title 24 ventilation requirements.

8. Ventilation: In conformance with ASHRAE Standard 62.1-2007 section 6.2.6.2, an average ventilation rate may be maintained when the ventilation is interrupted by fan cycling. In the sequence presented below, the ventilation is increased during a recovery cycle following any time the fan has been off to provide an average ventilation rate. The room CO_2 sensor readings (**AQ1, AQ2**, etc.) shall be polled to determine the highest reading **AQzone**. If there is only one sensor (**AQ1**), **AQzone** shall be its reading. There shall be a normal ventilation mode during heating or cooling operation and a ventilation recovery mode for a period after the fan has been off.

Typical ventilation mode operation is shown below, demonstrating ASHRAE 62.1 compliance:



a. Ventilation Startup: If the ventilation pre purge setting (**OApurgePos**) is set to zero and occupancy is sensed, during the 20 minutes immediately following the occupied start time, operate the supply fan with the ventilation damper open to **OArcvPos** as calculated under ventilation recovery mode below.
b. Normal ventilation. The damper shall be modulated between **OAareaPos** and **OAfullPos** as follows with an increase above **OAfullPos** as described.
   i. **OAareaPos** (1%) is the damper position required to provide the area outdoor rate. (Note that this represents the damper position, not the minimum outside air percentage. For most RTUs, the closed damper leakage will often provide the area ventilation rate.) The outside air damper shall be at this position when **AQzone** is at or below 400 ppm.
   ii. **OAfullPos** (3%) is the full damper position required to provide the combined people and area outdoor rate. The outside air damper shall be at this position when **AQzone** is at **AQset** (1000 ppm, adjustable).

iii. When **AQzone** is between 400 and **AQset** ppm, the damper shall move proportionally between **OAareaPos** and **OAfullPos.**
iv. When **AQzone** exceeds **AQset** ppm, the damper shall increase proportionally above **OAfullPos** limited by **OAmaxPos** (40%) using the same proportional gain as above.

c. Standby period, the outside damper shall be closed.
d. When the supply fan is off unless in standby mode, a ventilation recovery mode with supply fan operation shall be initiated for a variable length recovery period when any of the following occur:
   i. **AQzone** exceeds (**AQset** (1000 ppm, adjustable) + 200 ppm)
   ii. When fan has been off for **FanMaxOff** (30) minutes.
e. Ventilation recovery mode: After the fan has been off, the ventilation rate shall be increased to provide average ventilation that matches the ASHRAE standard 62.1 ventilation rate for the prescriptive method. Ventilation during this mode shall be limited to a maximum that is full damper opening when outside air is at a point between the heating and cooling setpoints and ramps down to the full ventilation setting at either heating or cooling design temperatures. Ventilation shall operate for at least 5 minutes up to a time related to the ratio of the space CO2 concentration at the end of the last fan operation period to the target and the allowed ventilation rate for this fan cycle. Specific algorithms follow that are suggested for this sequence:
   i. Whenever the supply fan stops,
      1. Record the CO_2 concentration at the time the fan stops **AQlast**, ppm
      2. Begin a timer to record fan off period: **FanJustOff** in minutes; the elapsed time in minutes the supply fan was off during the occupied period since the end of the last fan operation or end of the last standby period.
      3. Whenever the supply fan starts after an off period, except in standby mode, the ventilation shall be shall be maintained at the following position **OArcvPos**:
         a. If outside air is above cooling design (**CoolDes**) or below heating design (**HeatDes**) the damper position shall be **OAfullPos.**
         b. If outside air is between **OAloT** (65°F) and **OAhiT** (80°F) the outside damper position shall be 100% open.
         c. If outside air is between heating design (**HeatDes**) and **OAloT** (65°F) the outside damper position shall be proportionally between **OAfullPos** and 100% open.
         d. If outside air is between **OAhiT** (80°F) and cooling design (**CoolDes**) the outside damper position shall be proportionally between 100% open and **OAfullPos**.
         e. **OAmaxPos** does not apply during ventilation recovery mode.
      4. Ventilation recovery time, the **FanRcvMin** minute recovery period:
         a. Find: **FanRcvRatio**, the prescriptive ventilation needed as a fraction of the rate ventilation air will be delivered during the recovery period, indicating the fan operation time needed relative to fan off time

         FanRcvRatio = (PeoplePortion * (AQlast - 400) / (AQset - 400)
         + 1-peoplePortion) * (OAfullPos / OArcvPos)

         Where:

         PeoplePortion = (OA%full – OA%area) / OA%full

         b. FanRcvMin = 3 min + [(**FanJustOff** + 5) * **FanRcvRatio]**
   ii. Maintain ventilation damper at **OArcvPos** damper position with supply fan operating for **FanRcvMin** minutes.
   iii. At conclusion of the **FanRcvMin** minute recovery period:
      1. If there is a call for heating, cooling, or economizer requiring fan operation, restore to normal ventilation operation.

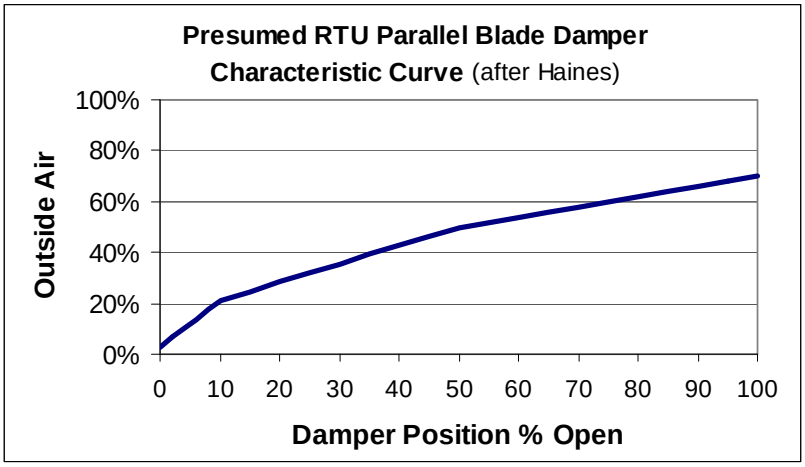
2. Stop supply fan unless **AQzone** exceeds (**AQset** (1000 ppm) **–** 100 ppm), in which case operate fan with outside damper at **OArcvPos** determined above until **AQzone** <= **AQset**.

f. Economizer Ventilation. When economizer cooling is called for, the dampers shall maintain the economizer setpoint, or the ventilation setpoint, whichever is greater.

9. Ventilation Override Mode: When activated at the room interface, a ventilation override mode shall activate the fan for the next 30 minutes with the ventilation rate at **OAfullPos.**
10. Standby Mode: When no occupancy sensors (**Occ1, Occ2**, etc.) have sensed occupancy (**Occ)** for **OccTimeOut** (30) minutes, then:
    a. Heating and Cooling setpoints shall be adjusted to standby cooling **CoolSPs** and heating **HeatSPs** setpoints
    b. If the fan is operating, Fan operation based on **FanMaxOff** shall be suspended and **FanJustOff** shall be reset to 0. If the fan is off when space becomes occupied, **FanJustOff** timer shall be suspended at its current value until occupancy is again detected.
    c. Economizer setpoint shall remain below normal occupied cooling setpoint (**CoolSPo - EconDif**).
    d. When occupancy is again detected for a period of at least 3 minutes,
        i. gradually decrease the cooling setpoint 1.0°F every 15 minutes until **CoolSPo** occupied setpoint is reached and
        ii. gradually increase the heating setpoint 1.0°F every 15 minutes until **HeatSPo** occupied setpoint is reached.
        iii. Resume incrementing of **FanJustOff** timer

The modes in grey text are included as optional. Consulting budget is not currently available for testing or troubleshooting; although it may be added later. If these modes are instituted, manufacturers should carefully bench test the sequences before releasing code to the site.

11. Optionally, during setup, accept % outside air entries for space and full ventilation requirements and adjust for damper nonlinearity (see graph) to enter **OAareaPos** and **OAfullPos** into system memory, given
    a. **OA%leak** = 0.04, % OSA leakage when damper closed
    b. **OA%10** = 0.20, % OSA when damper 10% open
    c. **OAslope1 =** 2.1**,** increase in OA% for each percent increase in damper position from closed to **10**
    d. **OAslope2 =** 0.625**,** increase in OA% for each percent increase in damper position from 10% open to 50% open.
    e. **OAslope3 =** 0.360**,** increase in OA% for each percent increase in damper position from 50% open to 100% open.
    f. For optional implementation, it is preferable that the damper non-linearity slopes be adjustable (user inputs) since it may be necessary to tune to a particular damper. Unfortunately, good lab data on typical RTU damper characteristics is not available, so measurement of ventilation using the temperature method and manually entering **OAareaPos** and **OAfullPos** for each unit or typical situation by the installing contractor is probably necessary for now.
    g. A future desirable enhancement would be for air requirements to be entered, and then have the unit observe discharge temperature during setup or normal ventilation modes and determine outside air percentage at various damper positions when there is adequate temperature difference. This option would require an optional return air sensor.



12. Basic Demand Response mode: Demand response modes are included that do NOT require a utility input (although that can be included) and are designed to activate based on prior day high temperature or outside temperature at beginning of demand response period.
    a. Reset **DR1active** to false, each day at midnight. When **DR1ok** is true and one of the following conditions occurs, make **DR1active** True.
        i. The prior day high temperature exceeds **DR1high** (90°F), or
        ii. The outside temperature one hour prior to **DRtime** (2:00 pm) exceeds **DR1trigger** (83°F), or
        iii. Day-ahead demand response signal (**DRnx**) is active.
    b. When **DR1active** is True then lock out local override temperature adjustments, adjust the cooling setpoint upward. The following logic provides two-thirds (default) of the temperature increase during the first third of the adjustment period, emulating an exponential increase. Stagger the setpoint adjustments on 5 minute intervals based on the duty cycle setting of the thermostat:
        i. One hour prior to **DRtime** (2:00 pm), if **DRpreOK** (precooling) is not activated, decrease the cooling setpoint 0.5 degrees every 15 minutes, arriving at **CoolSPdrStart,** but no lower than **CoolSPp** (70°F)
        ii. Starting at **DRtime** (2:00 pm), increase the cooling setpoint every 15 minutes by ((**CoolSPdrStart – CoolSPdr) * DRtemp1) / (DRdur * DRdur1 / 15)** degrees.
        iii. Starting at **DRtime** (2:00 pm) + (**DRdur * DRdur1)**, increase the cooling setpoint every 15 minutes by ((**CoolSPdrStart – CoolSPdr) * (1 - DRtemp1)) / (DRdur * (1 - DRdur1) / 15)** degrees.
        iv. At the conclusion of the demand response period **DRtime** (2:00 pm) + **DRdur**, for the remainder of the occupied period (if not in optimum stop mode), decrease the cooling setpoint 1.0°F every 15 minutes, but no lower than the higher of **CoolSPp** and **CoolSPo** or if in standby mode: the higher of **CoolSPp** and **CoolSPs**.
        v. In the logic above, if the pre-cooling setpoint **CoolSPp** is set high (80°F+) then both post demand cooling restore and the brief precooling period will be locked out as may be appropriate if the building is not on a time of day demand rate.

The modes in grey text are included as optional. Consulting budget is not currently available for testing or troubleshooting; although it may be added later. If these modes are instituted, manufacturers should carefully bench test the sequences before releasing code to the site.

c. When **DR2ok** is true and either "day-of" demand response signal (**DRdo**) is active or the prior day high temperature exceeds 90F, then add a duty cycle sequence on top of setpoint adjustment above. Every 30 minutes, lock out heating and cooling operation for **DutyOff** (10) minutes based on the duty cycle setting of the thermostat:
    i. For **DutySeq** = 1 start off period at **DRtime** (2:00 pm), and every 30 minutes for duration of demand response period (**DRdur)**.
    ii. For **DutySeq** = 2 start off period 10 minutes after **DRtime** (2:00 pm), and every 30 minutes for duration of demand response period.
    iii. For **DutySeq** = 3 start off period 20 minutes after **DRtime** (2:00 pm), and every 30 minutes for duration of demand response period.

13. Demand Response Precooling mode: If any demand response mode is scheduled to be active and **DRpreOK** is true then starting at scheduled occupied time or six (6) hours prior to **DRtime**, whichever is later, gradually lower occupied period cooling setpoint 1.0°F every 15 minutes to **CoolSPp,** (including for optimum start setpoint calculation if start time preceeds occupied time), lockout local override temperature adjustments, and maintain setpoint until **DRtime** (2:00 pm). Suspend any standby period cooling setpoint adjustments.

14. Optimum Stop Mode: Unless **OptStop** is set to 0, beginning at **OptStop** (30) minutes before the end of the occupied period, gradually increase the cooling setpoint 1.0°F every 15 minutes until **CoolSPs** standby setpoint is reached and gradually decrease the heating setpoint 1.0°F every 15 minutes until **HeatSPs** standby setpoint is reached. During optimum stop period, suspend ventilation unless **AQzone** exceeds (**AQset** (1000 ppm) **–** 100 ppm), in which case operate fan in normal ventilation mode

B. UNOCCUPIED MODE

1. Unoccupied Off: The supply fan shall be de-energized except when operation is called for as described below. Outside air dampers and exhaust dampers shall be closed and return air damper open.

2. Unoccupied Setback: When the space temperature drops below unoccupied heating space temperature setpoint **HeatSPu** (55°F, adjustable), supply fan shall energize, outside and exhaust dampers shall remain closed, and return damper shall remain open. The heating system shall stage to maintain heating temperature setpoint of **HeatSPu** (55°F, adjustable). Supply fan speed and post heating operation shall be controlled as described in occupied mode. When unoccupied heating space temperature setpoint + differential **HeatDif** (1.5°F) is reached, then the unit shall return to Unoccupied Off mode.

3. Unoccupied Setup: When the space temperature goes above unoccupied cooling space temperature setpoint **CoolSPu** (85°F, adjustable), supply fan shall energize, outside and exhaust dampers shall remain closed, and return damper shall remain open unless economizer is active. The cooling system shall stage to maintain cooling temperature setpoint of **CoolSPu** (85°F, adjustable). Supply fan speed and post cooling operation shall be controlled as described in occupied mode. When unoccupied cooling space temperature setpoint less differential **CoolDif** (1.5°F, adjustable). is reached, then the unit shall return to Unoccupied Off mode. Economizer setpoint shall be maintained **EconDif** (2°F, adjustable) below the cooling setpoint unless night flush is active and shall operate as described under occupied mode.

4. Unoccupied override: When the override button is activated (may be first activation of temperature adjustment) the unit will return to occupied mode for three hours. No "hold" options shall be allowed, in other words, there shall be no user accessed mode to put the unit in permanent

temperature hold position, bypassing programming. A vacation or holiday mode shall be allowed, putting the unit in the unoccupied setpoint until deactivated or the set number of days has elapsed.

5. Night Flush: Night flush will use the economizer only to pre-cool the building and be subject to the following conditions:
    a. Night flush shall be enabled whenever the outside temperature exceeds 70°F and continue until the outside temperature falls below 45°F. This enablement is intended to be seasonal, but may switch more often during swing seasons.
    b. Night flush shall be active when all the following conditions are true
        i. Night flush enabled as above
        ii. Outside air temperature (**OAT**) is less than the space temperature (**STavg**) minus the economizer activation differential **EconAct** (5°F)
        iii. Space temperature (**STavg**) is greater than the occupied heating setpoint (**HeatSPo)** plus 1°F. [Note: users who want more aggressive night cooling can lower the occupied heating setpoint during summer months.]
        iv. There have been less than 5 minutes of logged heating in the prior day (if this logging function included)
        v. It is between midnight and the start of the occupied period (night flush can continue during the optimum start period)
    c. When night flush is active, mechanical cooling shall be disabled or a separate setpoint maintained for night flush economizer and mechanical cooling on the optimum start ramp, heating shall be disabled, and the supply fan activated, and the economizer discharge air setpoint at 45°F. Heating shall continue to be disabled for one hour following night flush mode operation.

Note on Optimum Start: The sequence below probably differs from the typically provided manufacturer's sequence. Please provide the sequence below for ONE of each manufacturer's installation. Provide the manufacturer's standard sequence on the other installation..

6. Optimum Start: Optimum start mode will gradually move from unoccupied to occupied setpoints, so that when unoccupied space temperature had not drifted all the way to unoccupied setpoints, warm up or cool down time will be reduced. When outside temperature indicates conditions exceed design conditions, the optimum start time is extended. Prior to the scheduled daily occupied start time, the optimum start program shall determine ramp rates and optimum duration as follows:
    a. The assessment shall occur **2** x **OptLead** (180) minutes before the scheduled daily occupied start time.
    b. The optimum start duration **OptDur** in minutes shall be based on outside air temperature at assessment time as follows:
        i. If current OAT < 50: **OptLead** * (50 – [current **OAT**]) / (50 – **HeatDes**)
        ii. If current OAT >= 50: **OptLead** * ([current **OAT**] – 50) / (**CoolDes** – 31)
        iii. maximum of **2** x **OptLead** minutes
        iv. minimum of **60** minutes
    c. Beginning at the optimum start time (**OptStart** = **OptDur** minutes before scheduled occupied time) the heating and cooling setpoints shall be adjusted every 15 minutes, as follows:
        i. Heat: Increase setpoint by 15 * (**HeatSPo – HeatSPu) / OptDur**
        ii. For heatpumps, interstage differential between heat pump heat and electric heat shall be triple normal: 3 * **HeatStageDiff,** returning gradually to normal during the first hour of occupancy.
        iii. Cooling: Decrease setpoint by 15 * (**CoolSPu – CoolSPo) / OptDur**

iv. Economizer setpoint shall be maintained below occupied cooling setpoint (**CoolSP - EconDif**) unless night flush is active.
v. Stagger setpoint adjustments by 5 minutes per duty cycle assignment (**DutySeq**) so cycle 1 occurs on the hour and every 15 minutes following, cycle 2 occurs 5 minutes past the hour and every 15 minutes following, and cycle 3 occurs 10 minutes past the hour and every 15 minutes following

The modes in grey text are included as optional. Consulting budget is not currently available for testing or troubleshooting; although it may be added later. If these modes are instituted, manufacturers should carefully bench test the sequences before releasing code to the site.

d. For heat pump or electric heating, add a duty cycle sequence in addition to setpoint adjustment above. Every 30 minutes, lock out heating operation for **DutyOff** (10) minutes based on the duty cycle setting of the thermostat:
   i. For **DutySeq** = 1 start off period on the hour, and every 30 minutes therafter for duration of optimum start period (**OptDur)**.
   ii. For **DutySeq** = 2 start off period 10 minutes after the hour, and every 30 minutes therafter for duration of optimum start period (**OptDur)**.
   iii. For **DutySeq** = 3 start off period 20 minutes after the hour, and every 30 minutes therafter for duration of optimum start period (**OptDur)**.

7. Ventilation Pre-Purge: If the ventilation pre purge setting (**OApurgePos**) is greater than 0, during the 60 minutes prior to occupied start time, operate the supply fan with the ventilation damper open to **OApurgePos.**

C. SAFETY SHUTDOWNS

Duct smoke detection, space smoke detection, high duct static, and low temperature limit trips shall de-energize the supply fan and close the outside air and exhaust air dampers. The hardware point **Safety** shall be closed during normal operation, with an open contact indicating a safety condition. Manual reset of the tripped device shall be required to restart the system. Provide a binary input for safety shutdowns. Set **SafetyUsed** parameter to Yes or True if safety input is used. If **SafetyUsed** parameter is No or False, do not initiate safety sequence.

D. STARTUP & TESTING

Provide means for installing and servicing contractor to set parameters required to adjust and test each mode of operation. Use of software on a laptop computer connected via adapter to controller is an acceptable method. Provide software to contractor for startup and throughout warranty period.

1. Setup parameter access shall include but not be limited to:
   a. Set and test damper position and provide output of DAT.
   b, Set and test OSareaPos and OSfullPos for ventilation.
   c. Verify CO_2 sensor output with ppm readout
   d. Verify input of each physical point
   e. Independently set and verify output of each physical point

The modes in grey text are included as optional. Consulting budget is not currently available for testing or troubleshooting; although it may be added later. If these modes are instituted, manufacturers should carefully bench test the sequences before releasing code to the site.

2. Provide display or web accessible sequence to access trended data.
3. Initial automated test through range of system operation modes. Startup test on contractor initiation accessible from unit will cycle unit on half to one minute intervals through all operating modes and stages, including OSA damper closed, 50%, 100%, **OSfullPos**,.and **OSareaPos**.
4. Provide readout of estimated outside airflow: OA%Est = (STavg – (DAT – 1)) / (STavg – OAT); when optional return air sensor is installed, use OA%Est = (RAT – (DAT – 1)) / (RAT – OAT); When difference between RAT or STavg and OAT is less than 10 degrees, provide accuracy warning and when difference is less than 5 degrees do not display.

E. FAULT DIAGNOSTICS AND OPERATION HISTORY

1. Track current day, yesterday, current week, last week, since reset time in minutes for various operating modes listed and described in table below:
   A. Each minute determine mode and add 1 to mode minute counter for current_day; current _week & since_reset.
   B. At midnight, copy current_day into yesterday, then reset current_day to zeros
   C. Sunday at midnight, copy current_week into last_week, then reset current_week to zeros

Mode Tracking Record & Display Minutes & Faults

Mode Tracking	Test (Each minute = one mode)	Today	yest-erday	cur week	last week	since reset
Heat	Heat call and SAT > STavg + 5	M	M	M	M	M
Cool	Cool call and SAT < STavg - 5	M	M	M	M	M
Econo	Econo call (no cool call) and SAT < STavg -2	M	M	M	M	M
Fan Only	No call above and fan on	M	M	M	M	M
Off	Fan off	M	M	M	M	M
Faults	**Test after 3 minutes of mode operation**					
Heat	Heat call and SAT < STavg + 5	F	F	F	F	F
Cool	Cool call and SAT > STavg - 5	F	F	F	F	F
Econo	Econo call (no cool call) and SAT > STavg -2	F	F	F	F	F
Damper	See test procedure below table**	F	F	F	F	F
Schedule	Daily "off" time less than 120 minutes		F	F	F	F

M = number of minutes
F = number of fault occurances

**Damper test to detect dampers open much wider than expected; testing to occur during "fan on" at least 5 minutes after any call for heating, cooling, or economizer is over AND there is at least a 10F difference between space temperature and outside temperature AND the outside damper signal has been constant for more than one minute.

Given current damper position, **OApos** find estimated outside air fraction

a. Current desired outside airflow **OA%Cur =**
OApos <10%: OApos * (OA%10 – OA%leak) / 10% + **OA%leak**
OApos >=10%: (OApos – 10% **) * OAslope + OA%10**

b. Estimated outside airflow: **OA%Est = (STavg – (DAT –** 1**)) / (STavg – OAT)**

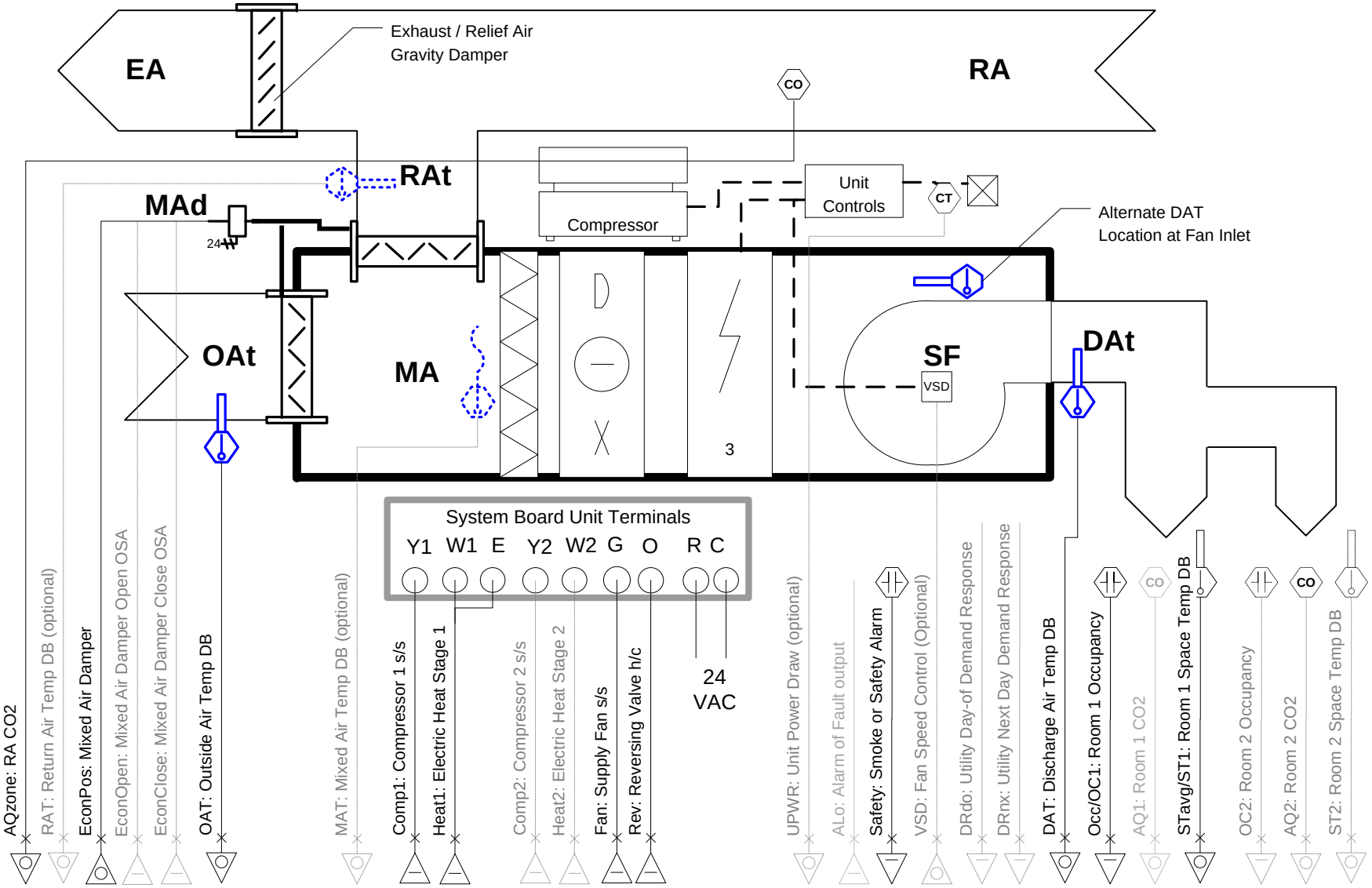
c. Determine error condition; when **OA%Est / OA%Cur > OAerr** (1.5)

2. Report and track lack of heating, cooling, or economizer operation when operation should have occurred. After call for mode has been active for more than three (3) minutes and temperature confirmation above is not achieved, record minutes of fault mode for heating, cooling, or economizer.
3. Report and track schedule fault when OAT is within design conditions and "off" does not occur at least 120 minutes yesterday.
4. Provide display or web accessible sequence to access tracked data.

SECTION III – CONTROL MODE SUMMARY

Mode	Secondary Mode	OA Damper[1]	HP Heat	EI Heat	Cooling	SF (cycle)	SF (VSD)
Occ	Occupied Heat 2	min/DCV	ON	ON	off	ON	Max
Occ	Occupied Heat 1	min/DCV	ON	off	off	ON	Max
Occ	Occupied Deadband	min/DCV	off	off	off	Vent Cycle	40%
Occ	Occupied Economizer Only	53°F DAT	off	off	off	ON	100%
Occ	Occupied Cool + Econo	53°F DAT	off	off	ON 1	ON	100%
Occ	Occupied Cool Only	min/DCV	off	off	ON 1	ON	Min
Occ	Occupied Cool Stage 2	min/DCV	off	off	ON 1&2	ON	Min
Occ	Standby	Same as above; wider heat/cool setpoints; no ventilation					
Occ	Demand Limit PreCool	Decreased Cool Setpoint					
Occ	Demand Limit Prep	Decreasing Cool Setpoint					
Occ	Demand Limit 1	Increasing Cool Setpoint					
Occ	Demand Limit 2	Increasing Cool Setpoint with duty cycle					
Occ	Post Limit Recovery	Decreasing Cool Setpoint					
UnOcc	Off	Closed	off	off	off	off	off
UnOcc	Setback	Closed	ON	off	off	ON	Max
UnOcc	Setup	Economizer	off	off	ON	ON	Min
UnOcc	NightFlush	45°F DAT	off	off	off	ON	100%
UnOcc	WarmUp	Increasing Heat Setpoint with duty cycle; electric heat lockout				cycle	
UnOcc	CoolDown	Decreasing Cool Setpoint with duty cycle				**cycle**	
UnOcc	Pre-Cool	Decreased Cool Setpoint				cycle	
UnOcc	Pre-Purge Ventilation	Purge Set				ON	
Safeties	(smoke or freeze detection)	Closed	off	off	off	off	off

[1]Return air damper shall cycle opposite outside air (OA) damper. Exhaust damper shall cycle with OA damper if motorized.



Premium Ventilation Control System Schematic
Unitary Heat Pump System with Economizer

Rev A: May 3, 2010

Point Type	AI	BI	AO	BO
Required	4	2	1	4
Optional	5	3	1	5
Possible	9	5	2	9

Control System Object List

Physical Points

Tag	Point Name	Measure	Units	Type	Low Range	High Range	Comment
OAT	Outside Air Temperature	DB Temperature	deg F	AI	-20	120	See Note 5
DAT	Discharge Air Temperature	DB Temperature	deg F	AI	40	200	
STavg (ST1, ST2)	Space Air Temperature	DB Temperature	deg F	AI	40	120	This input may be virtual point STavg
AQzone (AQ1, AQ2)	Air Quality - Carbon Dioxide concentration	CO2	ppm	AI	0	2500	Typically 0-10 or 0-5 volts; This input may be virtual point AQzone. See Notes 1 and 2
FanStat	Fan status CT	Fan Current	ampa	AI			Optional
Occ (Occ1, Occ2)	Occupancy sensor(s) See Notes 1 & 3	dry contact	Yes/No	BI			This input may be virtual point Occ. See Note 3
Safety	Safety Lockout	dry contact	Yes/No	BI			Input from smoke detector or fire alarm (See Note 4)
DRnx	Day-Ahead Demand Response	Utility/User Input	Yes/No	BI			Optional; may be supplied as a network broadcast point
DRdo	Day-of Demand Response	Utility/User Input	Yes/No	BI			Optional; may be supplied as a network broadcast point
Comp1	Compressor (stage 1)	contact	24 VAC	BO			Cooling or compressor call
Comp2	Compressor (stage 2)	contact	24 VAC	BO			Cooling or compressor call
Rev	Reversing Valve	contact	24 VAC	BO			For heatpump, switches to heating mode for normally cooling
Heat1	Heat or Furnace (stage 1)	contact	24 VAC	BO			Heating call, or supplemental heat for heatpump
Heat2	Heat or Furnace (stage 2)	contact	24 VAC	BO			Heating call, or supplemental heat for heatpump
Fan	Fan	contact	24 VAC	BO			
FanSpeed	Speed control for VSD		VDC	AO	0	10	Typically 0-10 volts with 0=off
EconPos	Economizer damper position		VDC	AO	0	10	Typically 0-10 volts with 0=closed OSA or 2=closed to OSA
EconOpen	Economizer damper open	contact	24 VAC	BO			3-wire damper motor requiring 2-24V BO
EconClose	Economizer damper close	contact	24 VAC	BO			3-wire damper motor requiring 2-24V BO

Shaded points are optional

AI Analogue Input
BI Binary or Digital Input
AO Analogue Output
BO Binary or Digital Output

Control System Object List - Notes

1. The occupancy sensor and CO2 sensor can be shared to avoid adding hardware points. This would be achieved by routing the CO2 signal through the dry occupancy sensor contacts. When the room is unoccupied, ventilation control will be suspended, so a CO2 signal is not necessary. This will require recording an AQlast value on a regular schedule (every 1-5 min) so that when the CO2 signal is lost, the last value is available for future sequence use. When this hardware approach is used, the time-out (OccTimeOut) should be set in the occupancy sensor and OccTimeOut in the program set to 1 minute; however, if occupancy sensors have a dedicated point, it is preferred that time out be set in the program and the occupancy sensor be set to the minimum time out.

2. Where multiple rooms are served by one unit, one CO2 sensor can be placed in the lower occupancy room, and AQset set 100 ppm below the lowest appropriate setpoint, typically 900 ppm. Where desired and hardware points are available, multiple sensors can be installed, and the highest reading used in the software for AQzone. Where a single CO2 sensor is used it may be installed in the return air duct (except in California).

3. Where there are multiple rooms or a large room area where a single occupancy sensor will not typically be triggered every half hour, install multiple occupancy sensors wired in parallel. For advanced monitoring where multiple hardware points are available, each sensor may be assigned a independent physical point (Occ1, Occ2, etc.) and have software make Occ TRUE if any contact is closed.

4. The safety shut down signal can be shared with the DAT input to avoid adding hardware points, wiring the DAT output through normally closed safety relays in series, as a open or very high resistance across the temperature sensor will indicate system shut down and the DAT input will not be required. This may require a separate safety relay be installed where there is a smoke detector or other safety detection device. For units under 2000 cfm smoke detectors might not be installed and safety shutdown may not be required. Where other approved safety shutdown devices are provided, it is not necessary to provide the control safety input as long as safety shutdown will result in outside and exhaust dampers closing.

5. If two units are controlled with the same outside air signal, then the outside air sensor shall be located near the hood, but outside the hood in a weather shield, locate at a similar height above the roof as the outside air intake. Weather shield shall be similar to Ambient Weather SRS100 or equal. Where a separate outside sensor is installed for each unit, install in a shield as above OR install inside the outdoor intake hood using a 4 inch square of duct board (Plenum rated, UL 181 class 1 rigid air duct listed, insulation value R-2 or greater) to insulate between the sensor and the metal hood.

Control System Object List

Virtual Parameters [2]

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
STavg	Average Space Temperature		deg F	A	P			Average of all space temperature sensors
Occ	Occupancy Sensor - direct input if one sensor; OR function for multiples			B	P			When multiple occupancy sensors are used, **Occ** is true if any are activated
AQzone	Zone Air Quality (CO2)		ppm	A	P			When multiple CO2 sensors are used, the highest concentration from CO2 Sensors
AQset	Occupied Air Quality Setpoint (CO2)	1000	ppm	A	U2	700	2000	Setpoint for fully occupied space
AQlast	CO2 concentration before fan stops		ppm	A	P			CO2 concentration at the time the fan stops
OA%area	Occupied area based OSA cfm percentage as a fraction	0.06	fraction	A	U2	0	1	Area portion of ventilation based on ASHRAE 62.1
OA%full	Occupied area + people based OSA cfm percentage as a fraction (15% = 0.15)	0.15	fraction	A	U2	0	1	Area plus people portion of ventilation at full occupancy based on ASHRAE 62.1
OAareaPos	Occupied % OA damper position for vacant space (1.0 = full open)	0.02	fraction	A	U2	0	0.2	damper position (not % air): Reflects floor area component; may be zero if damper leakage
OAfullPos	Occupied % OA damper position for design occupied space	0.05	fraction	A	U2	0.01	1	damper position (not % air): Reflects floor area + people component
OAmaxPos	Occupied % OA damper maximum for ventilation	0.4	fraction	A	U2	0	1	Upper limit of OA damper position in ventilation mode
OApurgePos	Pre-purge OA damper position	0 (CA: 0.05)	fraction	A	U2	0	30	Damper position to provide full air requirement; set zero if no purge is required; Typically same as OAfullPos
OArcvPos	Occupied % OA damper position during recovery ventilation		fraction	A	P	OAarea Pos	1	damper position (not % air): Required for ventilation recovery after fan is off
OAhiT	Ventilation High Temperature	80	deg F	A	U2	75	90	Max ventilation temperature

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
OAloT	Ventilation Low Temperature	65	deg F	A	U2	50	70	Min ventilation temperature
OApos	Current % OA damper position		fraction	A	P	0	1	Internally calculated variable
OA%cur	Current % OA		fraction	A	P			Internally calculated variable
OA%Est	Estimated % OA		fraction	A	P			Internally calculated variable
OAerr	OA Damper error threshold	1.5	fraction	A	U3	1	2	When when OA%Est / OA%Cur > OAerr, the OA damper is considered stuck open
OA%leak	OA fraction closed	0.04	fraction	A	U3	0.01	0.15	fraction of OA when damper fully closed
OA%10	OA fraction @ 10% position	0.2	fraction	A	U3	0.1	0.5	fraction of OA when damper 10% open
OAslope1	Slope OA above 10%	2.1	slope	A	U3	1	3	Increase in fraction of OA per fraction damper open below 10%
OAslope2	Slope OA above 10%	0.625	slope	A	U3	0.5	1.5	Increase in fraction of OA per fraction damper open 10% to 50%
OAslope3	Slope OA above 10%	0.36	slope	A	U3	0.25	1	Increase in fraction of OA per fraction damper open above 50%
FanPost	Post Purge time after heat/cool	3	minutes	A	U2	1	5	Allows heat or cool to be extracted from coil/furnace
FanWithHeat	Fan activated on heating call	Yes	Logic	B	U2			Set to NO for gas furnace with integral fan controls
FanVSD	VSD installed	No	Logic	B	U2			
FanMaxOff	Maximum off time during occupied	30	minutes	A	U2	15	90	
FanJustOff	Time fan has been off		min	A	P			the elapsed time in minutes the supply fan was off during the occupied period since the end of the last fan operation or end of the last standby period
FanRcvMin	Time allowed for ventilation recovery after fan off period		minutes	A	P			Adjust recovery time longer when OAT is low to avoid comfort problems

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
FanRcvRatio	The prescriptive ventilation needed as a fraction of the rate ventilation air will be delivered during the recovery period		minutes	A	P			Adjust recovery time longer when OAT is low to avoid comfort problems
OccTimeOut	Unoccupied time to activate standby	30	minutes	A	U2	1	120	If the time-out is set in the occupancy sensor, this time out should be set to 1.
DutySeq	Duty Cycle Sequence	Random 1-3		1,2,3	U1	1	3	Indicates which duty cycle this particular thermostat is on. Set thermostats at site to evenly distribute cooling load
DutyOff	Duty Cycle Off Time	10	minutes	time	U2	0	15	0 = no cycle; 10 = 1/3 off; 15 = 50% off
CoolSPo	Occupied Cooling Setpoint	75	deg F	A	U1	60	90	Mech Cooling (Stage 1) on half **CoolDif** above this temp
CoolSPs	Standby Cooling Setpoint	78	deg F	A	U1	60	90	Mech Cooling (Stage 1) on half **CoolDif** above this temp
CoolSPu	Unoccupied Cooling Setpoint	85	deg F	A	U1	60	90	Mech Cooling (Stage 1) on half **CoolDif** above this temp
CoolSPdr	Demand Response Setpoint	77	deg F	A	U2	60	90	For demand response: Maximum setpoint at end of demand response period
CoolSPp	Occupied Precooling Setpoint	70	deg F	A	U2	60	90	For demand response precooling: Mech Cooling (Stage 1) on half **CoolDif** above this temp (Set this parameter high - 85F - to disable pre and post cooling adjustment periods.
CoolSPdrStart	Cool Setpoint at start Demand Response		deg F	A	P			Internally calculated variable
EconDif	Economizer differential below cooling	2	deg F	A	U2	1	3	Economizer on below CoolSP
EconDATsp	Economizer discharge setpoint	53	deg F	A	U2	45	60	
EconAct	Economizer activation differential	5	deg F	A	U2	1	9	Economizer active at **OAT** < **STavg** - **EconAct** when fan would otherwise be off

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
CoolDif	Cooling Differential	1.5	deg F	A	U2	1	4	Mech Cooling off half this value below setpoint
CoolStageDif	Cooling inter-stage Differential	1.5	deg F	A	U2	1	4	Mech Cooling (Stage 2) on at **CoolSP**x + **Cool2Dif** + half **CoolDif**
CoolLock	Mechanical Cooling Lockout	56	deg F	A	U2	45	60	Mech Cooling is locked out below this outside temperature; economizer cooling is allowed
HeatSPmax	Max Occupied Heating Setpoint	72	deg F	A	U2	35	80	
CoolSPmin	Min Occupied Cooling Setpoint	73	deg F	A	U2	60	85	
HeatSPo	Occupied Heating Setpoint	70	deg F	A	U1	35	80	Heating (Stage 1) on half **HeatDif** below this temp
HeatSPs	Standby Heating Setpoint	67	deg F	A	U1	35	80	Heating (Stage 1) on half **HeatDif** below this temp
HeatSPu	Unoccupied Heating Setpoint	55	deg F	A	U1	35	80	Heating (Stage 1) on half **HeatDif** below this temp
HeatDif	Heating Differential	1.5	deg F	A	U2	1	4	Heating off half this value above setpoint
HeatStageDif	Heating Interstage Differential	2	deg F	A	U2	1	4	Heating (Stage 2) on at **HeatSP**x - **Heat2Dif** - half **HeatDif**
OptLead	Optimum Start Lead Time	180	minutes	A	U2	60	300	Minutes before occupied start that normal (at heating design OAT) optimum start setpoint adjustment begins
OptDur	Optimum Start Duration		minutes	A	P			Minutes before occupied start adjusted beyond normal when outside heating or cooling design
OptStart	Optimum Start Time		minutes/time	A	P			Start time internally calculated
OptStop	Optimum Stop Lead Time	30	minutes	A	U2	0	90	Minutes before end of occupied period that setpoints will be relaxed

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
HeatDes	Heating Design Temperature	20	deg F	A	U2	-50	40	99.6% local heating design temperature, deg F DB (see ASHRAE Fundamentals)
CoolDes	Cooling Design Temperature	95	deg F	A	U2	75	120	0.4% local cooling design temperature, deg F DB (see ASHRAE Fundamentals)
DRtime	Demand response period starts, or 3-4 hours before typical daily high if no TOD rates	2:00 pm	minutes	Time	U2	0:00	24:00	Minutes before occupied start that optimum start setpoint adjustment begins
DRdur	Demand Response Duration	180	minutes	A	U2	60	300	Minutes before occupied start that optimum start setpoint adjustment begins
DRdur1	Demand Response Shift Time	0.33	fraction	A	U3	0.2	0.5	fraction of DRdur (period 1) at which shift from steep temperature increase occurs
DRtemp1	Demand Response Shift Rise	0.66	fraction	A	U3	0.5	0.75	fraction of temperature setpoint shift that occurs during period 1 of demand response time
DR1ok	Enable Level 1 Demand Response	Y	logical	B	U2			Level 1 demand response is enabled
DR1active	Enable Level 1 Demand Response		logical	B	U2			Level 1 demand response is active
DR1High	OAT high from previous day indicating peak day	90	deg F	A	U2	80	100	Same day demand response triggered based on prior day high
DR1trigger	Current OAT indicating peak day around DRtime	83	deg F	A	U2	75	95	Same day demand response triggered based on early afternoon temperature
DR2ok	Enable Level 2 Demand Response	No	logical	B	U2			Level 2 demand response is enabled

Tag	Point Name	Default	Units	Type	Set by User3/ Program	Low Limit	High Limit	Comment
DR2active	Enable Level 2 Demand Response		logical	B	U2			Level 2 demand response is active
DRpreOK	Enable precooling for Demand Response	No	logical	B	U2			Only use with peak rate increase tarrif
DxSplit	=20 when compressor is on and = 0 otherwise	20	deg F	A	P	0	25	Used in Econo Simple Predictive Algorithm
SafetyUsed	Safety input is used	No	logical	B	U2			If NO, ignore safety shutdown input.

1 Lockout alarm when unit is de-energized. Provide 15-minute start up delay prior to enabling alarm
2 Not all virtual or parameter points are shown. Provide all points required for software operation.
3 User set items are distinguished: U user accessible; U1 low level lock, U2 contractor lock, U3 Expert lock

Appendix A: Supplemental Acceptance Testing Checklist

Note: preliminary version; requires field testing with multiple contractors

5/2/2010

Items Marked Grey require field research work before finalization or are not appropriate for this sequence

Premium Ventilation Package - Fan Cycling DCV
Functional Test Procedure

Supplement to standard acceptance testing

Mode of Operation	Step	Premium Vent Component Tested	Test Procedure	Data, or pass/fail	Initials, date, time
	1		Note the programmed operating schedule of the unit, and the occupied / unoccupied temperature setpoints.	Weekday "On" schedule: _____ Weekend "On" schedule: _____ Occupied setpoints: ___ºF clg, ___ºF htg Standby setpoints: ___ºF clg, ___ºF htg Unocc'pd setpoints: ___ºF clg, ___ºF htg	
	2		Does the operating schedule match the occupied period? (y=pass, n=fail, note differences)		
	3		Note the as-found economizer lockout setpoint.	Setpoint: ____ºF	
Warm-Up	4		Put the system in unoccupied (off) mode. Adjust the night setback setpoint as necessary to trigger the warm-up cycle. Note the actual space temperature and night setback setpoint.	Space temp: _____ºF Setback setpoint: _____ºF	
	5		Is the fan on? (y=pass, n=fail)		
	6		Note the speed of the fan.	____ rpm, or ____ Hz	
	7	Ventilation lockout	Is the outside air damper closed? (y=pass, n=fail)		
	8	Ventilation lockout	Are damper seals installed on the outside air damper to limit leakage during morning warm-up? (y=pass, n=fail)		
	9	Optimum Start	Is the thermostat's optimum start setting activated? (y=pass, n=fail)		
Normal Occupied	10		Program the schedule or time so that the unit is operating in occupied mode. Return the temperature setpoints to the as-found condition, noted in step 1.		
Occupied, no heat or cool	11	Fan Cycle	Disable any call for heating or cooling or ventilation.	____ rpm, or ____ Hz	
	12	Fan Cycle	Does the fan cycle off? (y=pass, n=fail)		
	13	Fan Cycle	Wait 30 minutes or set the max fan off time shorter		
	14	Fan Cycle	Does the fan cycle on? (y=pass, n=fail)		

Mode of Operation	Step	Premium Vent Component Tested	Test Procedure	Data, or pass/fail	Initials, date, time
Occupied, heating	15	Resistance heat lockout	Simulate a call for heating by raising the thermostat setpoint. Simulate an outside air temperature greater than 35ºF, or note the outside air temperature if it is already above 35ºF.	OAT: ____ºF	
	16		Is the electric resistance heat locked out? (y=pass, n=fail)		
	17	DCV	Note the range of the CO2 sensor output, and the corresponding CO2 levels. For example, "0-10 volt sensor output. 0 volts at 0 ppm CO2, 10 volts at 5,000 ppm CO2."	volts or milliamps, and CO2 levels	
	18	DCV	Note the demand controlled ventilation (DCV) activation setting (volts or milliamps).	____ volts, or ____ milliamps	
	19	DCV	Calculate the corresponding CO2 level related to this setting.	_____ ppm CO2	
	20	DCV	Is the CO2 level full setpoint within 100 ppm of the calculated full level? (y=pass, n=fail)		
	21	DCV	Note the location of the CO2 sensor.		
Occupied, heating, high CO2	22	DCV	Lower the DCV activation setting to below the current CO2 level, or simulate a high CO2 level using a voltage / milliamp source. Note the activation level.	CO2: ____ or volts: ____ or milliamps: ___	
	23	DCV	Is the outside air damper 100% open (or appropriately open based on OSA temp)? (y=pass, n=fail)		
	24	DCV	Is the return air damper 100% closed (or opposite the OA damper)? (y=pass, n=fail)		
Occupied, no heat or cool	25	Fan Cycle	Disable any call for heating or cooling and simulate a call for ventilation above the "full" CO2 setting. Note the method used to simulate call		
	26	Fan Cycle	Does the fan cycle on? (y=pass, n=fail)		
	27	Fan Cycle	Does the outside air damper open above the "full" ventilation setting? (y=pass, n=fail)		
	28	Fan Cycle	Lower the simulated CO2 level to 50% of the "Full" level. Note the number of minutes until the fan cycles off.	_____ minutes	

Mode of Operation	Step	Premium Vent Component Tested	Test Procedure	Data, or pass/fail	Initials, date, time
Occupied, cooling, hot OAT, low CO2	29		Raise the DCV activation setting to the maximum setting possible, to temporarily lock out the DCV. Alternatively, simulate 0 ppm CO2 using a voltage / milliamp source. Note the activation level.	CO2: ____ or volts: ____ or milliamps: ___	
	30	base OA	Simulate a call for cooling. Lower the economizer lockout setpoint to below the current outside air temperature (to simulate hot OA temp). Note the space temperature and the outside air temperature.	Space temp: ____ºF OAT: _____ºF	
	31	base OA	Note the position of the outside air damper (visual estimate).	% open: _____	
	32	base OA	Adjust the minimum (area) damper position setting / dial, visually verify that the damper moves in response. (moves=pass, doesn't move=fail)		
	33	base OA	If the outside air temperature is below 60ºF or above 85ºF, note the return air, outside air, and mixed air temperatures.	RAT: ____ºF OAT: ____ºF MAT: ____ºF	
	34	base OA	Calculate the % minimum outside air using the following equation: % OSA = (MAT-RAT) / (OAT-RAT) * 100	% OSA: _____	
	35	base OA	Simulate a call for cooling. Is the mechanical cooling operating? (y=pass, n=fail)		
Occupied, cooling, cold OAT, low CO2	37		Return the economizer lockout setpoint to its normal position (step 3).		
	38	Economizer	Simulate cool outside air conditions (<55ºF) by either adjusting the lockout setting to below the current OAT, using a cold spray on the OAT sensor, or make no adjustment if the actual OAT<55ºF. Note the method of simulation.	Simulation method (circle one): - Adjust lockout setting - Cold spray - Actual OAT ___ºF.	
	39	Economizer	Simulate a call for cooling. Does stage one cooling activate the economizer? (y=pass, n=fail)		
	40	Economizer	Is the mechanical cooling operating during stage one cooling? (n=pass, y=fail)		
	41	Economizer	Is the fan speed the same as the speed noted in step 6? (y=pass, n=fail)		
Return to normal	42	DCV	Return the DCV activation setting to a setting that corresponds to 1,000 ppm. Note the activation setting (volts or milliamps).	____ volts, or ____ milliamps	
	43		Return the system to 'auto'. Return the operating schedule and occupied / unoccupied temperature setpoints to the as-found condition (step 1). Return the economizer lockout setting to the as-found condition (step 3).		

Appendix C: Bid Results

Bids received from contractors based on the Construction Documents (Appendix B) are included below. Contractor names have been omitted.

Bid Form

Premium Ventilation Control Upgrade: Fan Cycling DCV

Location: Amazon Community Center, City of Eugene
2700 Hilyard Street, Eugene, OR

- Optional Pre-Bid Meeting Friday, April 23, 2010 1:30 pm
  Amazon Community Center, Building A, 2700 Hilyard Street, Eugene, OR
- Completed Bid Due: Tuesday, April 27, 2010 3:00 p.m.
  Via email: rhart@PECI.org
  Via fax: 503-295-0820
  Hand delivery or mail: Reid Hart, 85444 Appletree Ct., Eugene OR 97405
  Mail delivery: PECI; Attn: Reid Hart, 1400 SW 5th Ave Suite 700, Portland, OR 97201

Bldg	unit	Control Manuf	Configuration	Bid Amount (Lump Sum each)
A	HP3	Alerton	2: RTU controller (VLC) with space sensor (VLD)	$ 3,703.00
B	HP4	Innotech	2: RTU controller with space sensor (ICS); plus monitoring CT on one phase	$ 2,835.00
B	HP5	Innotech	2: RTU controller with space sensor & interface (miniport)	$ 2,835.00
C	HP6	KMC Controls	2: RTU controller with space sensor (NetSensor)	$ 2,228.00
C	HP7	KMC Controls	1: Space controller (FlexStat)	$ 2,045.00
C	HP8	Alerton	1: Space controller (VLD)	$ 3,301.00
			Total for 6 control retrofits* (Total of above detail)	$ 16,947.00
			Deduct per controller if new thermostat wires are NOT required	$ 290.00 each
			Allowance per controller to reinstall original controls after 12 months	$ 160.00 each
			Hourly rate for additional research related tasks.	$ 80.00 per hour

* Note: Individual controller prices are for information purpose. The entire project will be awarded to one contractor. The price used for bid evaluation will be the total for 6 control retrofits plus the hourly rate for additional tasks times 48 hours. Lowest bidder with acceptable references will be selected.
Bids shall be good for 60 days. I acknowledge I have read the scope and sequence and am aware of site conditions. Bid amount represents total project costs. PECI will pay for work net of EWEB incentives.

Please provide three client references your firm has provided HVAC controls work for.

I certify that I am authorized to execute this bid on behalf of [redacted]
[full company name]

Signed: [redacted]

Print Na[redacted]

Addendum(s) 1 & 2 Noted

Bid Form

Premium Ventilation Control Upgrade: Fan Cycling DCV

Location: Amazon Community Center, City of Eugene
2700 Hilyard Street, Eugene, OR

- Optional Pre-Bid Meeting Friday, April 23, 2010 1:30 pm
  Amazon Community Center, Building A, 2700 Hilyard Street, Eugene, OR
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  Via email: rhart@PECI.org
  Via fax: 503-295-0820
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  Mail delivery: PECI; Attn: Reid Hart, 1400 SW 5th Ave Suite 700, Portland, OR 97201

Bldg	unit	Control Manuf	Configuration	Bid Amount (Lump Sum each)	
A	HP3	Alerton	2: RTU controller (VLC) with space sensor (VLD)	$ 4,966.00	
B	HP4	Innotech	2: RTU controller with space sensor (ICS); plus monitoring CT on one phase	$ 3,395.00	
B	HP5	Innotech	2: RTU controller with space sensor & interface (miniport)	$ 3,905.00	
C	HP6	KMC Controls	2: RTU controller with space sensor (NetSensor)	$ 3,840.00	
C	HP7	KMC Controls	1: Space controller (FlexStat)	$ 3,745.00	
C	HP8	Alerton	1: Space controller (VLD)	$ 4,250.00	
			Total for 6 control retrofits* (Total of above detail)	$ 24,101.00	
			Deduct per controller if new thermostat wires are NOT required	$ 100.00	each
			Allowance per controller to reinstall original controls after 12 months	$ 570.00	each
			Hourly rate for additional research related tasks.	$ 95.00	per hour

* Note: Individual controller prices are for information purpose. The entire project will be awarded to one contractor. The price used for bid evaluation will be the total for 6 control retrofits plus the hourly rate for additional tasks times 48 hours. Lowest bidder with acceptable references will be selected.
Bids shall be good for 60 days. I acknowledge I have read the scope and sequence and am aware of site conditions. Bid amount represents total project costs. PECI will pay for work net of EWEB incentives.

Please provide three client references your firm has provided HVAC controls work for.

I certify that I am authorized to execute this bid on behalf of: [redacted]

Signed: [redacted]

Print Name [redacted]

See Attached for References

Appendix D: Analysis Periods

Analysis periods outlined in the tables below were used to compare pre and post data for three distinct Amazon Community Center analyses (CO_2 concentration impact of DCV, fan cycling controls effect on fan run time, and sensible cooling provided by the economizer) and one Wacom analysis (sensible cooling provided by the economizer). Due to data loss and corruption issues, the pre and post analysis periods vary for each of these analyses. The analysis periods were defined with the goal of having the closest possible OAT during the pre and post periods, given the constraints on data availability. Note that RTU HP-4 at Amazon was not analyzed due to missing and corrupt data.

Table 1. Analysis Period – CO_2 Concentration Impact of DCV – Amazon

Unit	Baseline Start	Baseline End	Post-retrofit Start	Post-retrofit End	Pre-retrofit Avg OAT	Post-retrofit Avg OAT
HP-3	6/26/10	7/23/10	6/26/11	7/23/11	65	63
HP-5	6/9/10	6/24/10	6/9/11	6/24/11	58	59
HP-6	5/6/10	5/22/10	5/6/11	5/22/11	54	53
HP-7	8/21/10	9/21/10	6/2/11	7/1/11	63	60
HP-8	5/6/10	5/23/10	5/6/11	5/23/11	53	53

Table 2. Analysis Period – Fan Cycling Controls Effect on Fan Run Time – Amazon

Unit	Baseline Start	Baseline End	Post-retrofit Start	Post-retrofit End	Pre-retrofit Avg OAT	Post-retrofit Avg OAT
HP-3	5/6/10	5/22/10	5/6/11	5/22/11	54	53
HP-5	6/9/10	6/25/10	6/9/11	6/25/11	58	59
HP-6	5/6/10	5/23/10	5/6/11	5/23/11	53	53
HP-7	8/21/10	9/20/11	6/2/11	7/1/11	63	60
HP-8	5/6/10	5/23/10	5/6/11	5/23/11	53	53

Table 3. Analysis Period – Sensible Cooling Provided by the Economizer – Amazon

Unit	Baseline Start	Baseline End	Post-retrofit Start	Post-retrofit End	Pre-retrofit Avg OAT	Post-retrofit Avg OAT
HP-3 (date range 1)	5/6/10	5/23/10	5/6/11	5/23/11	53	53
HP-3 (date range 2)	6/26/10	7/23/10	6/26/11	7/23/11	65	63
HP-5	6/9/10	6/25/10	6/9/11	6/25/11	58	59
HP-6	5/6/10	5/24/10	5/6/11	5/6/11	54	53
HP-7	8/21/10	9/21/10	6/2/11	7/1/11	63	60
HP-8	5/6/10	5/23/10	5/6/11	5/23/11	53	53

Table 4. Analysis Period – Sensible Cooling Provided by the Economizer – Wacom

Unit	Baseline Start	Baseline End	Post-retrofit Start	Post-retrofit End	Pre-retrofit Avg OAT	Post-retrofit Avg OAT
IT Office	10/09/10	10/19/10	10/28/10	11/07/10	53	53
CFO SW Office	10/09/10	10/19/10	10/28/10	11/07/10	53	53

Appendix E: Acceptance Testing Results

Acceptance testing of the RTUs at Amazon Community Center was completed in April 2011. The detailed acceptance testing result forms are included on the following pages. Note that the acceptance testing process has been updated based on feedback during this project and final acceptance testing and air flow measuring procedure tools are available in Addendum 1.

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone Name:		Comment
HP-3	Gym Bldg A		
Manufacturer	Model #	Serial #	
Trane	WCD075C300BC	R38100082D	
Site Name	Address	City, ST, Zip	
Amazon Cmty Ctr	2700 Hilyard St	Eugene OR 97405	
Date & Time of testing	Technician	Contractor	
4/1/2011 5:15 PM	Stacy Castleman	Innovative Air	

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun	
Start	9:00	9:00	9:00	9:00	9:00	9:00	9:00	Typical Business hours
Stop	22:00	22:00	22:00	22:00	22:00	22:00	22:00	Based on interview of site staff
Same = x		x	x	x	x	x	x	

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun	
Start	8:30	8:30	8:30	8:30	8:30	8:30	8:30	Actual operation times from thermostat
Stop	21:30	21:30	21:30	21:30	21:30	21:30	21:30	Start time like 5a or 5:15a
Same = x		x	x	x	x	x	x	End time like 6p or 5:45p
								Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset		
Occupied	69	°F	75	°F		6	
Unoccupied	57	°F	80	°F		23	
Standby	66	°F	78	°F	3	3 3	
Limits	72	°F	73	°F		1	Temp occupied = 2 hrs

	Optimum Start	Holiday Settings	
Activated = X	y	no	Temp
Comments:			

Occupancy Sensor	Active		Sensor delay		Program Delay		
for Standby	y	Y/N	1	min	30	min	Verify 30 minute timeout set at sensor or

Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit		in program, not both
High Limit	68	°F or		or		Enthalpy Setting	

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)	x			Jade Controller

Cool Stage	Single	Dedicated	DDC	Dedicated indicates 2-stage wiring at tstat and cntrlr
(Check One)		x		DDC indicates integrated DDC control

Damper Operation	Full Closed		Full Open		Seals Good		Verify actual damper operation - cycle
	x	Y/N	x	Y/N	N	Y/N	1/2 " gap in OSA damper both sides

Mode Testing	DAT		Damper Position		Split Temp Diff		Split temperature is from mixed air to discharge
Stage 1 Heat	106	°F		% Open	28.9	°F	% Open is eyeball estimate
Stage 2 Heat	104	°F		% Open	26.9	°F	(Can verify airflow during heating test)
Stage 1 Cool		°F		% Open		°F	°F OAT; x Stage 1 economizer
Stage 2 Cool	52	°F		% Open	20.1	°F	

Activated with	Setpoint Adj	Jumper/test	Program	Other; Comment:
(Check One)		x		Jade operation test on dampers

Stage 1 Cool Economizer (if needed)				Split Temp Diff		
Stage 1 Cool		°F	% Open		°F	Use cold spray or deactivate OAT sensor before
						test if not active above
Unoccupied		°F	% Open		°F	Set time just before stop; reset after test

Jade Econo Cycle Test: dampers OK; CO2 Sensor needs adjustment-wrong voltage

Unit Tag: **HP-3**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

Total Unit Airflow	Heat Test		Flow Plates		Velometer		Fan Curve		
Measured by	x	or		or		or			
	Nameplate		Measured		Unit Tons		CFM/Ton		Percent of Nameplate
Airflow	2500	CFM	2,248	CFM	6.3	tons	356.9	CFM	0.8994 %

Ventilation %	Temp Split		Flow Plates		Velometer		Hot Wire	
Measured by		or		or		or		
	Occupancy Type				Floor Area		Area Rate	
Area Information					800	sf	0.06	CFM/sf
	Reported People				People		People Rate	
					32		5	CFM/person

	Needed		Calculated		Target Area %				
Area (Min) Ventilation	55	CFM	48	CFM	2.4%	%	Needed CFM from Installation Schedule		
	OAT		RAT		Target MAT		Set Damper Position		
	60	°F	75	°F	74.633	°F	1%	%	x Verify in programming

	Needed		Calculated		Target Full %				
Full (Max) Ventilation	220	CFM	208	CFM	9.8%	%			
	OAT		RAT		Target MAT		Set Damper Position		
	60	°F	75	°F	73.532	°F	13%	%	x Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2		Damper Position	
Room Empty			PPM	% Open	Room Empty
Blow on Sensor			PPM	% Open	Blow on Sensor

Lo Sensor Range	0	PPM	0	Volts or mA output	Volts		mAmp
Hi Sensor Range	2000	PPM	10	Volts or mA output	x	or	
				Double check dip switches			

CO2 Sensor Settings		CO2			
Area (Min) Ventilation		450	PPM		
Full (Max) Ventilation	Cr setting		PPM		Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	**CO2 sensor measured high voltage; not accepted by JADE as correct input**	**4/29/11**
2	**When CO2 sensor repaired; input Area and Full ventilation settings**	**4/29/11**
3	**OSA Damper has huge gap; high leakage; [Change Order]**	**5/9/11**
4	**Connect Occupied Tstat output to JADE Occupied input**	**5/9/11**
5	**Unoccupied setback verified by trending**	**na**

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			4/1/11
Economizer operation verified & changeover set	x			4/29/11
All heating and cooling stages operate	x			4/1/11
CO2, Outside & Discharge air sensors verified	x			4/29/11
DCV Area (min) & Full (Max) settings verified	x			4/29/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **HP-3**

Heat Test to find Unit CFM

Nominal	**2,500**	CFM	Rated CFM from nameplate
Entering Air	**77.1**	°F	Before heater
Heated Air	**104.7**	°F	After heater
Fan Heat	**0.8**	°F dT	Est 0.8° if entering T is before fan
Electric Cap	**20.3**	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	**100%**	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	**69.284**	MBH	Output
Temp Diff	28.4	°F dT	
Supply Air	**2,248**	**CFM**	

Delivery	90%		Percent of Nominal
Cool Cap	**75**	MBH	
Cool Cap	6.3	tons	
CFM/Ton	**360**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**2,248**	**CFM**										
Floor Area	**600**	sq feet										
People	**20**											
Area Rate	**0.18**	CFM/sf										
People Rate	**10**	CFM/person										
Area Vent (Min)	**108**	CFM										
Full Vent (Max)	**308**	CFM	(2-10 VDC)									
Area Vent (Min)	**5%**	%	2.38					2.1				
Full Vent (Max)	**14%**	%	3.10				3					
Outside Air	**56.5**	°F OAT	**56.5**	**56.5**	**56.5**	**56.5**	**56.5**	**56.5**	**56.5**	**56.5**	**56.5**	
Return Air	**67.6**	°F RAT	**67.7**	**67.7**	**67.4**	**67.4**	**67.4**	**67.4**	**67.4**	**67.4**	**67.4**	
Target:												
Area (Min)	**67.07**	°F MAT										
Full (Max)	**66.08**	°F MAT				full	area					
OSA Dmpr Pos	0.01		0.13	1.00	0.00	0.13	0.01					
Actual target	**62.7**	°F MAT	**61.9**	**60.9**	**63.1**							
Actual % OSA	44.1%		51.8%	60.7%	39.4%	618.3%	#####	618.3%	618.3%	618.3%		

AQset 850

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone Name:		Comment
HP4	Preschool		
Manufacturer	Model #	Serial #	
Trane	WCC030F100BF	R375U5X1H	
Site Name	Address	City, ST, Zip	
Amazon Cmty Ctr	2700 Hilyard St	Eugene OR 97405	
Date & Time of testing	Technician	Contractor	
4/1/2011 1:40p	Stacy Castleman	Innovative Air	

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	8:00	8:00	8:00	8:00	8:00	U	U
Stop	5:00	1:00	5:00	1:00	5:00		
Same = x							

Typical Business hours
Based on interview of site staff

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	8:30	8:30	8:30	8:30	8:30	U	U
Stop	13:30	13:30	13:30	13:30	13:30		
Same = x							

Actual operation times from thermostat
Start time like 5a or 5:15a
End time like 6p or 5:45p
Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset	
Occupied	70.5	°F	75	°F		4.5
Unoccupied	57	°F	80	°F		23
Standby	67.5	°F	77	°F		3 2
Limits	72.5	°F	73	°F		0.5

	Optimum Start	Holiday Settings
Activated = X	x	no
Comments:		

Occupancy Sensor	Active		Sensor delay		Program Delay	
for Standby	y	Y/N	1	min	30	min

Verify 30 minute timeout set at sensor or in program, not both

Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit	
High Limit		°F or	Diff	or		Enthalpy Setting

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)	x			
Cool Stage	Single	Dedicated	DDC	
(Check One)			x	
Damper Operation	Full Closed	Full Open	Seals Good	
	x Y/N	x Y/N	x Y/N	

Dedicated indicates 2-stage wiring at both thermostat and controller
DDC indicates integrated DDC control
Verify actual damper operation - cycle

Mode Testing	DAT		Damper Position		Split Temp Diff				
Stage 1 Heat	81	°F		% Open	10	°F			
Stage 2 Heat	112	°F		% Open		°F			
Stage 1 Cool	54	°F		% Open	19	°F		°F OAT	x Stage 1 economizer
Stage 2 Cool	na	°F		% Open		°F		°F OAT	x Stage 1 economizer

Split temperature is from mixed air to discharge
% Open is eyeball estimate
(Can verify airflow during heating test)

Activated with	Setpoint Adj	Jumper	Program	Other; Comment:
(Check One)	x			

Stage 1 Cool Economizer (if needed)			Split Temp Diff	
Stage 1 Cool	°F	% Open	°F	
Unoccupied	°F	% Open	°F	

Use cold spray or deactivate OAT sensor before test if not active above

Unit Tag: **HP4**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

	Heat Test	Flow Plates	Velometer	Fan Curve
Total Unit Airflow Measured by	x			

	Nameplate	Measured	Unit Tons	CFM/Ton	Percent of Nameplate
Airflow	1000 CFM	899 CFM	2.5 tons	359.6 CFM	0.899 %

	Temp Split	Flow Plates	Velometer	Hot Wire
Ventilation % Measured by				

	Occupancy Type	Floor Area	Area Rate
Area Information	Pre-school	800 sf	0.06 CFM/sf
	Reported People	People	People Rate
		32	5 CFM/person

	Needed	Calculated	Target Area %	
Area (Min) Ventilation	55 CFM	48 CFM	6.1% %	Needed CFM from Installation Schedule
	OAT	RAT	Target MAT	Set Damper Position
	60 °F	75 °F	74.082 °F	% Verify in programming

	Needed	Calculated	Target Full %	
Full (Max) Ventilation	220 CFM	208 CFM	24.5% %	
	OAT	RAT	Target MAT	Set Damper Position
	60 °F	75 °F	71.329 °F	% Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2	Damper Position	
Room Empty		PPM	% Open	Room Empty
Blow on Sensor		PPM	% Open	Blow on Sensor

				Volts	mAmp
Lo Sensor Range	0 PPM	0	Volts or mA output		
Hi Sensor Range	2000 PPM	10	Volts or mA output	x	or
		x	Double check dip switches		

CO2 Sensor Settings		CO2		
Area (Min) Ventilation		450 PPM		
Full (Max) Ventilation	Cr setting	750 PPM	x	Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	CO2 verified with trending	n/a
2	Damper not functioning; Verified control output ok green=open red=closed	4/18/11
3	Schedule reduced based on later staff discussion	4/18/11
4		
5		

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			4/1/11
Economizer operation verified & changeover set	x			4/18/11
All heating and cooling stages operate	x			4/1/11
CO2, Outside & Discharge air sensors verified	x			4/1/11
DCV Area (min) & Full (Max) settings verified	x			4/18/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **HP4**

Heat Test to find Unit CFM

Nominal	**1,000**	CFM	Rated CFM from nameplate
Entering Air	**74**	°F	Before heater
Heated Air	**112.3**	°F	After heater
Fan Heat	**0.8**	°F dT	Est 0.8° if entering T is before fan
Electric Cap	**11.18**	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	**100%**	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	**38.157**	MBH	Output
Temp Diff	39.1	°F dT	42424

Supply Air	**899**	**CFM**	
Delivery	90%		Percent of Nominal
Cool Cap	**30**	MBH	
Cool Cap	2.5	tons	
CFM/Ton	**360**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**899**	**CFM**
Floor Area	**912**	sq feet
People	**32**	
Area Rate	**0.06**	CFM/sf
People Rate	**5**	CFM/person
Area Vent (Min)	**55**	CFM
Full Vent (Max)	**215**	CFM
Area Vent (Min)	**6%**	%
Full Vent (Max)	**24%**	%
Outside Air	**51.0**	°F OAT
Return Air	**70.0**	°F RAT
Target:		
Area (Min)	**68.84**	°F MAT
Full (Max)	**65.46**	°F MAT
Actual target	**67.0**	°F MAT
Actual % OSA	15.8%	

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone Name:	
hp 5	Clay Crafts Room	
Manufacturer	**Model #**	**Serial #**
Trane	WCC048F300BF	R131S3A2H
Site Name	**Address**	**City, ST, Zip**
Amazon Cmty Ctr	2700 Hilyard St	Eugene OR 97405
Date & Time of testing	**Technician**	**Contractor**
4/1/2011 1:40p	Stacy Castleman	Innovative Air

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	9	9	9	9	9	9	9
Stop	21	21	21	21	21	21	21
Same = x		x	x	x	x	x	x

Typical Business hours
Based on interview of site staff

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	9	9	9	9	9	9	9
Stop	21	21	21	21	21	21	21
Same = x		x	x	x	x	x	x

Actual operation times from thermostat
Start time like 5a or 5:15a
End time like 6p or 5:45p
Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset	
Occupied	70	°F	75	°F		5
Unoccupied	57	°F	80	°F		23
Standby	68	°F	77	°F		2 2
Limits	72	°F	73	°F		1

	Optimum Start	Holiday Settings
Activated = X	x	no
Comments:		

Occupancy Sensor	Active		Sensor delay		Program Delay	
for Standby	y	Y/N	1.5	min	30	min

Verify 30 minute timeout set at sensor or program, not both

Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit	
High Limit		°F or	Diff	or		Enthalpy Setting

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)	x			

Cool Stage	Single	Dedicated	DDC
(Check One)			x

Dedicated indicates 2-stage wiring at both thermostat and controller
DDC indicates integrated DDC control

Damper Operation	Full Closed		Full Open		Seals Good	
	y	Y/N	y	Y/N	n	Y/N

Verify actual damper operation - cycle

Mode Testing	DAT		Damper Position		Split Temp Diff	
Stage 1 Heat	111	°F		% Open		°F
Stage 2 Heat	117.5	°F		% Open		°F
Stage 1 (Econo) Cool		°F		% Open		°F
Stage 2 Cool	56	°F		% Open	18	°F

Split temperature is from mixed air to discharge
% Open is eyeball estimate
(Can verify airflow during heating test)

	°F OAT	x	Stage 1 economizer	

Activated with	Setpoint Adj	Jumper	Program	Other; Comment:
(Check One)			x	

Stage 1 Cool Economizer (if needed)				Split Temp Diff	
Stage 1 Cool		°F		% Open	°F
Unoccupied		°F		% Open	°F

Use cold spray or deactivate OAT sensor before test if not active above

Heat Lockout 45 temporary to test optimum start

Unit Tag: **hp 5**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

	Heat Test	Flow Plates	Velometer	Fan Curve
Total Unit Airflow Measured by	x			

	Nameplate	Measured	Unit Tons	CFM/Ton	Percent of Nameplate
Airflow	1600 CFM	1138 CFM	4 tons	284.5 CFM	71%

	Temp Split	Flow Plates	Velometer	Hot Wire
Ventilation % Measured by	x			

	Occupancy Type	Floor Area	Area Rate
Area Information	Crafts Class	896 sf	0.06 CFM/sf
	Reported People	People	People Rate
		18 sf	5 CFM/person

	Needed	Calculated	Target Area %	
Area (Min) Ventilation	55 CFM	54 CFM	4.8%	Needed CFM from Installation Schedule
	OAT	RAT	Target MAT	Set Damper Position
	60 °F	75 °F	74.275 °F	10% Verify in programming

	Needed	Calculated	Target Full %	
Full (Max) Ventilation	220 CFM	144 CFM	19.3%	
	OAT	RAT	Target MAT	Set Damper Position
	60 °F	75 °F	72.1 °F	23% Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2	Damper Position	
Room Empty		PPM	% Open	Room Empty
Blow on Sensor		PPM	% Open	Blow on Sensor

				Volts	mAmp
Lo Sensor Range	0 PPM	0	Volts or mA output		
Hi Sensor Range	2000 PPM	10	Volts or mA output	x	or
		x	Double check dip switches		

CO2 Sensor Settings		CO2	
Area (Min) Ventilation		450 PPM	
Full (Max) Ventilation	Cr setting	750 PPM	Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	CO2 verified with trending	n/a
2		
3		
4		
5		

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			4/4/11
Economizer operation verified & changeover set	x			4/4/11
All heating and cooling stages operate	x			4/4/11
CO2, Outside & Discharge air sensors verified	x			4/4/11
DCV Area (min) & Full (Max) settings verified	x			4/4/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **hp 5**

Heat Test to find Unit CFM

Nominal	**1,600**	CFM	Rated CFM from nameplate
Entering Air	**77**	°F	Before heater
Heated Air	**117.5**	°F	After heater
Fan Heat	**0.8**	°F dT	Est 0.8° if entering T is before fan
Electric Cap	**14.94**	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	**100%**	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	**50.99**	MBH	Output
Temp Diff	41.3	°F dT	71697

Supply Air	**1,138**	**CFM**	
Delivery	71%		Percent of Nominal
Cool Cap	**48**	MBH	
Cool Cap	4.0	tons	
CFM/Ton	**284**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**1,138**	**CFM**	
Floor Area	**912**	sq feet	
People	**32**		
Area Rate	**0.06**	CFM/sf	
People Rate	**5**	CFM/person	
Area Vent (Min)	**160**	CFM	
Full Vent (Max)	**340**	CFM	
Area Vent (Min)	**14%**	%	
Full Vent (Max)	**30%**	%	
Outside Air	**54.3**	°F OAT	
Return Air	**64.0**	°F RAT	
Target:			
Area (Min)	**62.64**	°F MAT	10% ok
Full (Max)	**61.10**	°F MAT	23% ok
Actual target	**61.0**	°F MAT	
Actual % OSA	30.9%		

53% at 100% 0pen

2% with dmpr closed

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone served:	
HP-6	Dance Studio - Bldg C	
Manufacturer	Model #	Serial #
Trane	WCX042G3C0AB	Z233x771H
Site Name	Address	City, ST, Zip
Amazon CC	Hilyard	Eugene OR
Date & Time of testing	Technician	Contractor
4/22/2011 2:30 PM	Stacy Castleman	Innovative Air

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	15:00	9:00	15:00	15:00	15:00	8:00	10:30
Stop	20:00	20:00	20:00	20:00	20:00	21:00	21:00
Same = x							

Typical Business hours
Based on interview of site staff

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	15:00	9:00	15:00	15:00	15:00	8:00	10:30
Stop	20:00	20:00	20:00	20:00	20:00	21:00	21:00
Same = x			M	M	M		

Actual operation times from thermostat
Start time like 5a or 5:15a
End time like 6p or 5:45p
Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset	
Occupied	70	°F	76	°F		6
Unoccupied	60	°F	85	°F		25
Standby	67	°F	79	°F	3	3 3
Limits	72	°F	73	°F		1

Temp occupied = 2 hrs

	Optimum Start	Holiday Settings	
Activated = X	x	N/A	Temp
Comments:			

Occupancy Sensor	Active		Sensor delay		Program Delay	
for Standby	Y	Y/N	2	min	30	min

Verify 30 minute timeout set at sensor or in program, not both

Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit	
High Limit		°F or	Dif	or		Enthalpy Setting

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)	x			

Cool Stage	Single	Dedicated	DDC
(Check One)			x

Dedicated indicates 2-stage wiring at tstat and cntrlr
DDC indicates integrated DDC control

Damper Operation	Full Closed		Full Open		Seals Good	
	Y	Y/N	Y	Y/N	Y	Y/N

Verify actual damper operation - cycle

Mode Testing	DAT		Damper Position		Split Temp Diff	
Stage 1 Heat	110	°F		% Open		°F
Stage 2 Heat	142	°F		% Open		°F
Stage 1 Cool	61	°F	100	% Open		°F
Stage 2 Cool	48	°F	1.1	% Open		°F

Split temperature is from mixed air to discharge
% Open is eyeball estimate
(Can verify airflow during heating test)
56 °F OAT | x | Stage 1 economizer

Activated with	Setpoint Adj	Jumper	Program	Other; Comment:
(Check One)			x	

Stage 1 Cool Economizer (if needed)				Split Temp Diff	
Stage 1 Cool		°F		% Open	°F
Unoccupied		°F		% Open	°F

Use cold spray or deactivate OAT sensor before test if not active above
Set time just before stop; reset after test

Unit Tag: **HP-6**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

	Heat Test	Flow Plates	Velometer	Fan Curve
Total Unit Airflow Measured by	x			

	Nameplate	Measured	Unit Tons	CFM/Ton	Percent of Nameplate
Airflow	1400	1,248 CFM	3.5 tons	356.6 CFM	89%

	Temp Split	Flow Plates	Velometer	Hot Wire
Ventilation % Measured by	x			

	Occupancy Type	Floor Area	Area Rate
Area Information	Class	1,056 sf	0.06 CFM/sf
	Reported People	People	People Rate
		32	5 CFM/person

	Needed	Calculated	Target Area %	
Area (Min) Ventilation	60 CFM	63 CFM	5.1%	Needed CFM from Installation Schedule

OAT	RAT	Target MAT	Set Damper Position	
62 °F	72 °F	71.5 °F	0 %	x Verify in programming
	Actual	68.7		

	Needed	Calculated	Target Full %
Full (Max) Ventilation	250 CFM	223 CFM	20.0%

OAT	RAT	Target MAT	Set Damper Position	
61 °F	72 °F	69.8 °F	5 %	x Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2	Damper Position	
Room Empty		487 PPM	0 % Open	Room Empty
Blow on Sensor		2000 PPM	% Open	Blow on Sensor

				Volts	mAmp
Lo Sensor Range	0 PPM	0	Volts or mA output		
Hi Sensor Range	2000 PPM	10	Volts or mA output	x	or
		x	Double check dip switches		

CO2 Sensor Settings		CO2	
Area (Min) Ventilation		450 PPM	
Full (Max) Ventilation	Cr setting	1300 PPM	Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	**Note: 18%-21% OSA with damper closed**	**n/a**
2	**So set 0% area & 5% full**	**n/a**
3	**Unoccupied verified by trending; problem with setback not occuring noted**	**n/a**
4	**Program adjustment in progress; night setback not operational**	
5		

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			3/23/11
Economizer operation verified & changeover set	x			3/23/11
All heating and cooling stages operate	x			3/23/11
CO2, Outside & Discharge air sensors verified	x			3/23/11
DCV Area (min) & Full (Max) settings verified	x			4/22/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **HP-6**

2/2/11

Heat Test to find Unit CFM

Nominal	1,400	CFM	Rated CFM from nameplate
Entering Air	66	°F	Before heater
Heated Air	103	°F	After heater
Fan Heat	0.8	°F dT	Est 0.8° if entering T is before fan
Electric Cap	15	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	100%	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	51.195	MBH	Output
Temp Diff	37.8	°F dT	57418
Supply Air	**1,248**	**CFM**	
Delivery	89%		Percent of Nominal
Cool Cap	42	MBH	
Cool Cap	3.5	tons	
CFM/Ton	**357**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**1,248**	**CFM**				
Floor Area	1,056	sq feet				
People	32					
Area Rate	0.06	CFM/sf				
People Rate	5	CFM/person				
Area Vent (Min)	**63**	CFM				
Full Vent (Max)	**223**	CFM				
Area Vent (Min)	**5%**	%				
Full Vent (Max)	**18%**	%				
Outside Air	46.2	°F OAT				
Return Air	64.5	°F RAT				
Target:						
Area (Min)	**63.57**	°F MAT				
Full (Max)	**61.23**	°F MAT				
Actual target	60.6	°F MAT	60.6	60.6	60.6	60.6
Actual % OSA	21.3%		21.3%	21.3%	21.3%	21.3%

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone Served:	
HP-7	Game Room - Bldg C	
Manufacturer	**Model #**	**Serial #**
Trane	WCX042G300AB	Z2613CH1H
Site Name	**Address**	**City, ST, Zip**
Amazon CC	Hilyard	Eugene OR
Date & Time of testing	**Technician**	**Contractor**
	Stacy Castleman	Innovative Air

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun	
Start	15:30	15:30	15:30	15:30	15:30	15:30	15:30	Typical Business hours
Stop	18:00	18:00	18:00	18:00	18:00	18:00	18:00	Based on interview of site staff
Same = x		x	x	x	x	x	x	

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun	
Start	15:30	15:30	15:30	15:30	15:30	15:30	15:30	Actual operation times from thermostat
Stop	18:00	18:00	18:00	18:00	18:00	18:00	18:00	Start time like 5a or 5:15a
Same = x		x	x	x	x	x	x	End time like 6p or 5:45p
								Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset		
Occupied	69	°F	75	°F		6	
Unoccupied	57	°F	80	°F		23	
Standby	67	°F	77	°F	2	10	
Limits	72	°F	73	°F		1	Temp occupied = 2 hrs

	Optimum Start	Holiday Settings	
Activated = X	x	no	Temp
Comments:			

Occupancy Sensor	Active		Sensor delay		Program Delay		
for Standby		Y/N		min		min	Verify 30 minute timeout set at sensor or
Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit		in program, not both
High Limit		°F or		or	ES2	Enthalpy Setting	

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)			x	

Cool Stage	Single	Dedicated	DDC	
(Check One)		x		Dedicated indicates 2-stage wiring at tstat and cntrlr
				DDC indicates integrated DDC control

Damper Operation	Full Closed		Full Open		Seals Good		Verify actual damper operation - cycle
	x	Y/N	x	Y/N	x	Y/N	

Mode Testing	DAT		Damper Position		Split Temp Diff		Split temperature is from mixed air to discharge
Stage 1 Heat	95	°F		% Open		°F	Both for Stage 2 % Open is eyeball estimate
Stage 2 Heat	112	°F		% Open		°F	no (Can verify airflow during heating test)
Deadband	66.7	°F		% Open		°F	OAT
Stage 1 Cool	59	°F		% Open		°F	°F OAT x Stage 1 economizer
Stage 2 Cool	36.9	°F		% Open	33.1	°F	

Activated with	Setpoint Adj	Jumper	Program	Other; Comment:
(Check One)			x	

Stage 1 Cool Economizer (if needed)				Split Temp Diff		
Stage 1 Cool		°F	% Open		°F	Use cold spray or deactivate OAT sensor before test if not active above
Unoccupied		°F	% Open		°F	Set time just before stop; reset after test

Jade Econo Cycle Test: dampers OK; CO2 Sensor needs adjustment-wrong voltage

Unit Tag: **HP-7**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

Total Unit Airflow	Heat Test		Flow Plates		Velometer		Fan Curve
Measured by	x	or		or		or	
	Nameplate		Measured		Unit Tons		CFM/Ton	Percent of Nameplate
Airflow	1,400	CFM	870	CFM	3.5	tons	249 CFM	62%

Ventilation %	Temp Split		Flow Plates		Velometer		Hot Wire
Measured by	x	or		or		or	
	Occupancy Type				Floor Area		Area Rate
Area Information	General Use/Waiting				912 sf		0.06 CFM/sf
	Reported People				People		People Rate
					15		5 CFM/person

	Needed		Calculated		Target Area %			
Area (Min) Ventilation	55	CFM	55	CFM	6.3%	%	Needed CFM from Installation Schedule	
	OAT		RAT		Target MAT		Set Damper Position	
	58.2	°F	69.6	°F	68.879	°F	0.03 %	x Verify in programming

	Needed		Calculated		Target Full %			
Full (Max) Ventilation	130	CFM	130	CFM	14.9%	%		
	OAT		RAT		Target MAT		Set Damper Position	
	58.2	°F	69.5	°F	67.811	°F	0.19 %	x Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2		Damper Position	
Room Empty			PPM	% Open	Room Empty
Blow on Sensor			PPM	% Open	Blow on Sensor

Lo Sensor Range	0 PPM	0	Volts or mA output	Volts		mAmp
Hi Sensor Range	2000 PPM	10	Volts or mA output	x	or	
		x	Double check dip switches			

CO2 Sensor Settings		CO2		
Area (Min) Ventilation			PPM	
Full (Max) Ventilation	Cr setting		PPM	Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	Alerton unit vandalized; replace with T7351 & Jade	4/22/11
2	Connect Occupied Tstat output to JADE Occupied input	5/9/11
3	Unoccupied temperature verified by trending	n/a
4	CO2 verified with trending	n/a
5		

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			4/22/11
Economizer operation verified & changeover set	x			4/22/11
All heating and cooling stages operate	x			4/22/11
CO2, Outside & Discharge air sensors verified	x			4/22/11
DCV Area (min) & Full (Max) settings verified	x			4/22/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **HP-7**

Heat Test to find Unit CFM

Nominal	**1,400**	CFM	Rated CFM from nameplate
Entering Air	**72.3**	°F	Before heater
Heated Air	**112**	°F	After heater
Fan Heat	**0.8**	°F dT	Est 0.8° if entering T is before fan
Electric Cap	**11.2**	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	**100%**	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	**38.226**	MBH	Output
Temp Diff	40.5	°F dT	61520
Supply Air	**870**	**CFM**	
Delivery	62%		Percent of Nominal
Cool Cap	**42**	MBH	
Cool Cap	3.5	tons	
CFM/Ton	**249**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**870**	**CFM**										
Floor Area	**912**	sq feet										
People	**15**											
Area Rate	**0.06**	CFM/sf										
People Rate	**5**	CFM/person										
Area Vent (Min)	**55**	CFM										
Full Vent (Max)	**130**	CFM	(2-10 VDC)									
Area Vent (Min)	**6%**	%	2.50				2.2					
Full Vent (Max)	**15%**	%	3.19			3.5						
Outside Air	**59.7**	°F OAT	**59.7**	**59.7**	**58.2**	**60.2**	**58.2**	**58.2**		**58.2**	**58.2**	
Return Air	**70.3**	°F RAT	**70.3**	**70.7**	**69.6**	**69.5**	**69.6**		**69.6**	**69.6**	**69.6**	
Target:												
Area (Min)	**69.63**	°F MAT										
Full (Max)	**68.72**	°F MAT				full	area					
OSA Dmpr Pos	0.06		0.15	1.00	0.00	0.19	0.03					
Actual target	**68.8**	°F MAT	**68.9**	**59.3**	**68.2**	**67.8**	**67.9**					
Actual % OSA	14.2%		13.2%	103.6%	12.3%	18.3%	14.9%		610.5%	610.5%	610.5%	
AQset	1400											

Premium Ventilation Package - Fan Cycling DCV
Acceptance Checklist

Key: Entry | Check One | Optional

Unit Tag	Zone		
HP-8	Conference Room		
Manufacturer	Model #	Serial #	
Trane	WCX036G300AB	Z245XON1H	
Site Name	Address	City, ST, Zip	
Amazon CC	Hilyard	Eugene OR	
Date & Time of testing	Technician	Contractor	
4/29/2011 11:30	Craig	Innovative Air	

Biz Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	8:00	8:00	8:00	8:00	8:00	U	U
Stop	21:00	21:00	21:00	21:00	21:00		
Same = x		x	x	x	x		

Typical Business hours
Based on interview of site staff
"U" for unoccupied

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	8:00	8:00	8:00	8:00	8:00	U	U
Stop	21:00	21:00	21:00	21:00	21:00		
Same = x		x	x	x	x		

Actual operation times from thermostat
Start time like 5a or 5:15a
End time like 6p or 5:45p
Enter "x" if same as previous day

Setpoints	Heat		Cool		Deadband/Offset	
Occupied	69	°F	75	°F		6
Unoccupied	57	°F	80	°F		23
Standby	67	°F	77	°F	2	10
Limits	72	°F	73	°F		1

Temp occupied = 2 hrs

	Optimum Start	Holiday Settings	
Activated = X	y	no	Temp
Comments:			

Occupancy Sensor	Active		Sensor delay		Program Delay	
for Standby	y	Y/N	0.5	min	30	min

Verify 30 minute timeout set at sensor or in program, not both

Economizer	High Limit		A/B/C/D/ "Dif" = D		High Limit	
High Limit	diff	°F or		or		Enthalpy Setting

Type	DryBulb	Enthalpy	Boundary	Other; Comment:
(Check One)	x			

Cool Stage	Single	Dedicated	DDC
(Check One)			x

Dedicated indicates 2-stage wiring at tstat and cntrlr
DDC indicates integrated DDC control

Damper Operation	Full Closed		Full Open		Seals Good	
	y	Y/N	y	Y/N	y	Y/N

Verify actual damper operation - cycle

Mode Testing	DAT		Damper Position		Split Temp Diff	
Stage 1 Heat	91.5	°F		% Open	21.5	°F
Stage 2 Heat	83.7	°F	0	% Open		°F
Stage 1 Cool	61	°F	100	% Open		°F
Stage 2 Cool	39	°F		% Open		°F

Split temperature is from mixed air to discharge
% Open is eyeball estimate
(Can verify airflow during heating test)
58 °F OAT | x | Stage 1 economizer

Activated with	Setpoint Adj	Jumper/test	Program	Other; Comment:
(Check One)		x		

Stage 1 Cool Economizer (if needed)				Split Temp Diff	
Stage 1 Cool		°F	% Open		°F
Unoccupied		°F	% Open		°F

Use cold spray or deactivate OAT sensor before test if not active above
Set time just before stop; reset after test

Jade Econo Cycle Test: dampers OK; CO2 Sensor needs adjustment-wrong voltage

Unit Tag: **HP-8**

Premium Ventilation Package - Fan Cycling DCV
Ventilation & DCV Setup

Key: Entry | Check One | Optional

	Heat Test	Flow Plates	Velometer	Fan Curve
Total Unit Airflow Measured by	x			

	Nameplate	Measured	Unit Tons	CFM/Ton	Percent of Nameplate
Airflow	1,200 CFM	1,430 CFM	3.0 tons	476.6 CFM	1.1915 %

	Temp Split	Flow Plates	Velometer	Hot Wire
Ventilation % Measured by	x			

	Occupancy Type	Floor Area	Area Rate
Area Information	Conference	442 sf	0.06 CFM/sf
	Reported People	People	People Rate
		22	5 CFM/person

	Needed	Calculated	Target Area %	
Area (Min) Ventilation	55 CFM	27 CFM	3.8% %	Needed CFM from Installation Schedule
	OAT	RAT	Target MAT	Set Damper Position
	58.1 °F	70.5 °F	70.025 °F	15% % x Verify in programming

	Needed	Calculated	Target Full %	
Full (Max) Ventilation	215 CFM	137 CFM	15.0% %	
	OAT	RAT	Target MAT	Set Damper Position
	58.1 °F	70.5 °F	68.6 °F	0.40 % x Verify in programming

CO2 Sensor Test	Occupancy Condition	CO2	Damper Position	
Room Empty		PPM	% Open	Room Empty
Blow on Sensor		PPM	% Open	Blow on Sensor

				Volts	mAmp
Lo Sensor Range	0 PPM	0	Volts or mA output		
Hi Sensor Range	2000 PPM	10	Volts or mA output	x	or
		x	Double check dip switches		

CO2 Sensor Settings		CO2	
Area (Min) Ventilation		400 PPM	
Full (Max) Ventilation	Cr setting	1400 PPM	x Verify in programming

Findings needing repair or adjustment or comments

		Date Fixed
1	Revise contractor screen to allow testing	4/29/11
2	CO2 verified with trending	n/a
3	Unoccupied temperature verified by trending	n/a
4	Reversing valve corrected	4/29/11
5		

Acceptance Test Summary:

	Yes	Partial	No	Date
Schedule and setpoints set per program guidelines	x			4/29/11
Economizer operation verified & changeover set	x			4/29/11
All heating and cooling stages operate	x			4/29/11
CO2, Outside & Discharge air sensors verified	x			4/29/11
DCV Area (min) & Full (Max) settings verified	x			4/29/11

Additional "Smart Phone" tools that are used at site for setup
These tools are still in development

Unit Tag: **HP-8**

Heat Test to find Unit CFM

Nominal	**1,200**	CFM	Rated CFM from nameplate
Entering Air	**68**	°F	Before heater
Heated Air	**83.7**	°F	After heater
Fan Heat	**0.8**	°F dT	Est 0.8° if entering T is before fan
Electric Cap	**7.5**	kW	Heater Rating
Gas Cap		MBH	Output or input
Gas Eff	**100%**	%	If Cap is input (100% for output) outherwise ~65%
Total Cap	**25.598**	MBH	Output
Temp Diff	16.5	°F dT	21483
Supply Air	**1,430**	**CFM**	
Delivery	119%		Percent of Nominal
Cool Cap	**36**	MBH	
Cool Cap	3.0	tons	
CFM/Ton	**477**		

Set Area (Min) and Full (Max) Ventilation

Supply Air	**1,430**	**CFM**									
Floor Area	**912**	sq feet									
People	**32**										
Area Rate	**0.06**	CFM/sf									
People Rate	**5**	CFM/person									
Area Vent (Min)	**55**	CFM									
Full Vent (Max)	**215**	CFM									
Area Vent (Min)	**4%**	%	0.15								
Full Vent (Max)	**15%**	%	0.5								
Outside Air	**58.1**	°F OAT	**58.1**	**58.1**	**58.1**	**58.1**	**58.1**	**58.1**		**58.1**	**58.1**
Return Air	**70.5**	°F RAT	**70.5**	**70.5**	**70.5**	**70.5**	**70.5**		**70.5**	**70.5**	**70.5**
Target:											
Area (Min)	**70.03**	°F MAT									
Full (Max)	**68.64**	°F MAT				full					area
OSA Dmpr Pos	0.14		1.00	1.00	0.40	0.50	0.60	0.50		0.10	0.15
Actual target	**68.4**	°F MAT	**58.6**	**58.6**	**68.3**	**67.1**	**61.0**		**60.6**	**68.9**	**72.0**
Actual % OSA	16.9%		96.0%	96.0%	17.7%	27.4%	76.6%		79.8%	12.9%	#####
AQset	1400										

Appendix F: KMC Submittals

To provide a clearer picture of the KMC control equipment installed as part of this field test, their submittals and application guide follow.

BAC-10000 Series

FlexStat™ BACnet Programmable Thermostats

Description and Application

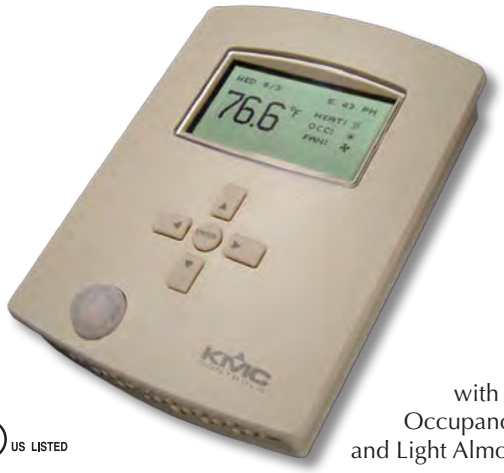
The KMC FlexStat series of flexible, intelligent temperature/humidity/occupancy-sensing, wall-mounted, thermostat/controllers are native BACnet Advanced Application Controllers (B-AAC) for connection with a BACnet system. The set-and-forget FlexStat simplifies networked zone control for common packaged HVAC equipment, such as single- and multi-stage packaged, unitary, and split systems (including high SEER/EER variable speed packaged equipment), as well as factory-packaged and field-applied economizers, water-source and air-to-air heat pumps, fan coil units, central station air handling units, and other similar applications.

In addition, an on-board library of programs permits a single model to be rapidly configured for a wide range of HVAC control applications. Thus, a single "one size fits all" FlexStat model can replace multiple competitor models. A single BAC-10163CW, for example, can be configured for any and all of these application options:

- Air handling unit, with proportional heating and cooling valves, and with optional economizer, dehumidification, and/or fan status
- Fan coil unit, 2-pipe or 4-pipe, proportional or 2-position valves, with optional dehumidification (w/ 4-pipe option) and/or fan status
- Heat pump unit, with up to two compressor stages, and with optional auxiliary heat, emergency heat, dehumidification, and/or fan status
- Roof top unit, with up to two H/C stages, and with optional economizer, dehumidification, and/or fan status

FlexStats also provide the capability to customize the standard library of sequences using KMC's BAC-stage programming tool. This enables a local authorized KMC installing contractor to adapt the standard library to the unique site needs and application specific requirements of a particular project.

Standard hardware options include a mix of output configurations (relays and universal outputs), optional on-board humidity/occupancy sensing, and inputs for additional remote external sensors such as outside air temperature and CO_2 sensors.



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(Shown with Optional Occupancy Sensor and Light Almond Case)

Features

Interface and Function

- User-friendly, 64 x 128 pixel, dot-matrix LCD display and 5 buttons for data selection and entry
- Six On/Off and independent heating and cooling setpoint periods per day
- Schedules can be set uniquely for each day, 5-1-1, or 5-2 daily schedules
- Easy copy function for rapid schedule programming in stand-alone and small network applications
- Built-in, factory-tested libraries of configurable application control sequences
- Integral energy management control with optimum start/stop, energy deadband heating and cooling setpoints, and other advanced features
- Three levels of password-protected access (user/operator/administrator) prevent disruption of operation and configuration
- Integral CMOS temperature and (on relevant models) humidity sensing for accurate operation
- Optional occupancy sensor (shown in photo above)
- Model choices enable "best fit" of sequence in new and retrofit applications with other field devices, such as proportional or 3-wire "floating" actuators and staged equipment; functionally replace most Viconics and other competitors' products
- All models have 72-hour power (capacitor) backup and a real time clock for network time synchronization or full stand alone operation

Specifications and design subject to change without notice.

Features (Cont.)

Inputs

- Three analog inputs (that can also be mapped as binary inputs in Control Basic) for use with external devices such as mixed air temperature, fan status, outside air, and CO_2 sensors
- Analog inputs accept industry-standard 10K ohm thermistor sensors or dry contacts
- Inputs can be configured via a switch for 10K ohm pull-up resistors (for unpowered contacts or devices) or 0–12 VDC
- Input overvoltage protection (24 VAC, continuous)
- 12-bit analog-to-digital conversion on inputs

Outputs

- Up to nine outputs, analog and binary (relays)
- Each short-circuit protected analog output capable of driving up to 20 mA (at 0–12 VDC)
- The NO, SPST (Form "A") relays carry 1 A max. per relay or 1.5 A per bank of 3 relays (relays 1–3, 4–6, and 7–9) @ 24 VAC/VDC
- 8-bit digital-to-analog conversion on outputs

Installation

- Backplate mounts on a standard vertical 2 x 4-inch wall handy-box, and the cover is secured to the backplate by two concealed hex screws
- Two-piece design allows field rough-in and termination of field wiring to back plate without electronics at the site (see the Dimensions section)
- Attractive white (standard) or light almond (optional) plastic case

Connections

- Screw terminal blocks, wire size 14–22 AWG, for inputs, outputs, power, and BACnet network
- Integral peer-to-peer BACnet MS/TP LAN network communications on all devices (with configurable baud rate from 9600 to 76.8K baud)
- A four-pin EIA-485 (formerly RS-485) data port on the underside of the case enables easy temporary computer connection to the BACnet network (access with a KMD-5624 cable—requires use of KMD-5576 or third-party interface)

BACnet® International

Configurability

I/O

- Up to 7 analog input objects (IN1 is space temperature, IN2–IN4 are 0–12 VDC inputs, IN5 is reserved for humidity, IN6 is reserved for motion detection, IN7 is reserved for CO_2)
- Up to 9 analog or binary output objects

Value

- 60 analog value objects
- 40 binary value objects
- 10 multi-state value objects (with up to 16 states each)

Program and control

- 8 PID loop objects
- 10 program objects (contains a library of built-in programs and customized Control Basic programming can be done through BACstage or TotalControl)

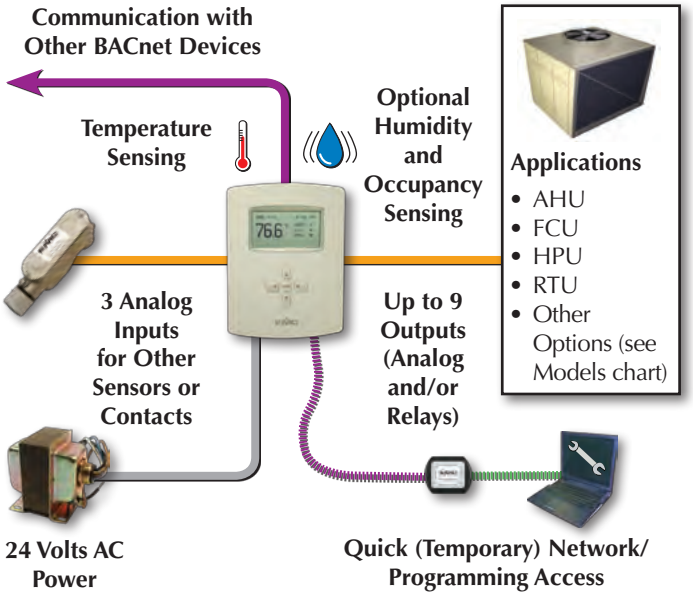
Schedules and trends

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

Alarms and events

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

Sample Installation



Models

Model*	Outputs**	Optional Sensors***	Typical Applications
BAC-10030CW	3 Relays (Binary Outputs) (All models have 3 analog inputs)	None	• 1H/1C packaged and split systems • 1H/1C heat pumps (no aux. heat) • Terminal reheat (staged) • 2-pipe FCUs with 1-speed fan, 2-position valve, fresh air control • 4-pipe FCUs with 1-speed fan, 2-position Heat and Cool valves • Unit heaters • Other single-stage thermostat applications
BAC-10130CW		Humidity	• Same as BAC-10030CW • View room humidity
BAC-11030CW		Occupancy	• Same as BAC-10030CW • Occupancy-based operation
BAC-11130CW		Humidity and Occupancy	• Same as BAC-10030CW • Occupancy-based operation • View room humidity
BAC-10036CW	3 Relays and 6 Analog Outputs	None	• 1H/1C, fan, and 6 universal outputs • 3-speed fan, 2- or 4-pipe FCUs with modulating valves • Central station AHUs with modulating Heat/Cool • Variable-speed fan output • Single-stage applications
BAC-10136CW		Humidity	• Same as BAC-10036CW • Dehumidification sequence • Humidification sequence
BAC-11036CW		Occupancy	• Same as BAC-10036CW • Occupancy-based operation
BAC-11136CW		Humidity and Occupancy	• Same as BAC-10136CW • Occupancy-based operation
BAC-10063CW	6 Relays and 3 Analog Outputs	None	• 2H/2C, fan • Multi-stage packaged or split systems • Multi-stage heat pumps with or without factory-packaged economizers • Central station AHUs with modulating Heat/Cool • 3-speed fan, 2- or 4-pipe FCUs with modulating or 2-position valves
BAC-10163CW		Humidity	• Same as BAC-10063CW • Humidification sequence • Dehumidification sequence
BAC-11063CW		Occupancy	• Same as BAC-10063CW • Occupancy-based operation
BAC-11163CW		Humidity and Occupancy	• Same as BAC-10163CW • Occupancy-based operation
BAC-10090CW	9 Relays	None	• 1H/1C, fan, and 6 binary outputs • 2H/2C, fan, and 4 binary outputs • 3H/3C, fan, and 2 binary outputs • 3H/3C plus ERV, reheat, or 3-speed fan
BAC-10190CW		Humidity	• Same as BAC-10090CW • Dehumidification sequence • Humidification sequence
BAC-11090CW		Occupancy	• Same as BAC-10090CW • Occupancy-based operation
BAC-11190CW		Humidity and Occupancy	• Same as BAC-10190CW • Occupancy-based operation

*__The standard color is white. To order the optional light almond color, remove the "W" at the end of the model number__ (e.g., BAC-11163C). Light almond cases have an additional cost and minimum order quantities.

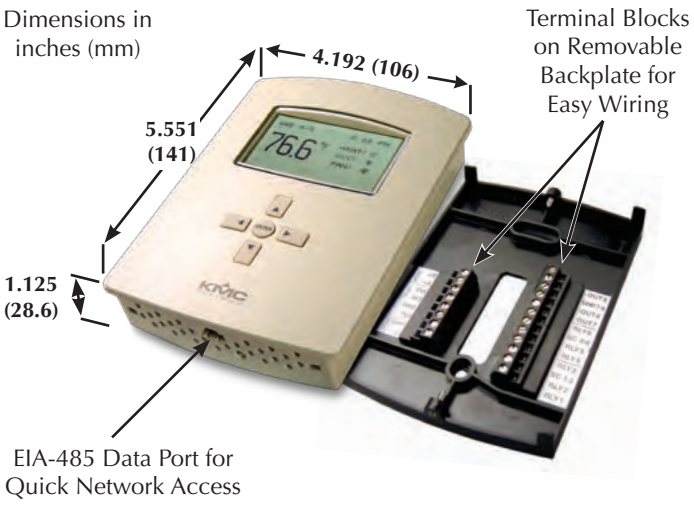
**__Analog outputs__ produce 0–12 VDC @ __20 mA__ maximum, and __relays__ carry __1 A__ max. __per relay or 1.5 A per bank__ of 3 relays (relays 1–3, 4–6, and 7–9) @ 24 VAC/VDC.

***All models have a temperature sensor and 3 analog __inputs__. (*Certain models/features are pending release.*)

Specifications

Supply Voltage	24 VAC (+20%/–15%), Class 2
Supply Power	1 VA steady state, up to 3 VA at start-up
Connections	Wire clamp type terminal blocks; 14–22 AWG, copper Four-pin EIA-485
Outputs (up to 9)	Analog outputs produce 0–12 VDC, **20 mA** maximum Binary outputs (NO, SPST, Form "A" relays) carry **1 A** max. per relay **or** a total of **1.5 A per bank** of 3 relays (relays 1–3, 4–6, and 7–9) @ 24 VAC/VDC
Inputs (IN2–IN4)	Analog 0–12 VDC (active/passive contacts, 10K thermistors)
Display	64 x 128 pixel dot matrix LCD
Case Material	White (standard) or light almond flame-retardant plastic
Dimensions	5.551 x 4.192 x 1.125 inches (141 x 106 x 28.6 mm)
Approvals	UL 916 Energy Management Equipment FCC and BTL listings pending
Weight	0.48 lbs. (218 g)
Occupancy Sensor	10 meter (33 feet) range
Temperature/Humidity Model Sensors	
Sensor Type	CMOS
Temperature Readings	
Accuracy	±0.9° F offset (±0.5° C) from 40 to 104° F (4.4 to 40° C)
Resolution	±0.1°F (±0.1° C)
Operating Range	36 to 120° F (2.2 to 48.8° C)
Response Time	5 to 30 seconds
Humidity Readings	
Range	0 to 100% RH
Accuracy @ 25°C	±2% RH (10 to 90% RH)
Response Time	Less than or equal to 4 seconds
Temperature-Only Model Sensors	
Sensor Type	Thermistor
Accuracy	±0.36° F (±0.2° C)
Resistance	10,000 ohms at 77° F (25° C)
Operating Range	48 to 96° F (8.8 to 35.5° C)
Environmental Limits	
Operating	34 to 125° F (1.1 to 51.6° C)
Shipping	–40 to 140° F (–40 to 60° C)
Humidity	0 to 95% RH (non-condensing)

Dimensions and Connectors



Accessories

HPO-0044	Replacement cover hex screw
KMD-5575	Network repeater/isolator
KMD-5567	Surge suppressor
KMD-5576	EIA-485 to USB Communicator
KMD-5624	PC data port (EIA-485) cable
KMD-5699	FlexStat firmware upgrade kit
SP-001	Flat blade & hex end screwdriver
XEE-6111-040	Transformer, 120-to-24 VAC, 40 VA, single-hub
XEE-6112-040	Transformer, 120-to-24 VAC, 40 VA, dual-hub

Support

FlexStats come with a printed Installation Guide (P/N 913-034-01). Additional documentation for operation, configuration, programming, application, and much more information is available on the award-winning KMC Controls web site (www.kmccontrols.com). The web site will also contain future updates to firmware (that can be upgraded with the KMD-5699 firmware flash upgrade kit).

KMC Controls, Inc.

19476 Industrial Drive, New Paris, IN 46553

574.831.5250

www.kmccontrols.com; info@kmccontrols.com

KMD-1261 and KMD-1281
Temperature, humidity, and motion sensors

Description

NetSensor® models KMD-1261 and KMD-1281 are wall-mounted, temperature and motion sensing, programmable operator interfaces for use in a KMC direct digital controls system. Model KMD-1281 includes humidity sensing.

The simple and functional design combined with programmable buttons make these models an ideal choice for installations that require temperature, humidity, motion sensing, and an operator interface in one unit.

Still . . . Made in the U.S.A.

Features

These models provide the following features:

- Large, easy to read, backlit LCD display for easy temperature viewing, plus smaller characters for time and relative humidity.
- Detect room occupancy up to 33 feet with built-in motion sensor.
- Convenient setpoint buttons accessible without opening the hinged cover. Six additional buttons are located behind the cover.
- Flexible applications with six buttons that may be programmed to display or control the state of any point in the attached controller.
- Accessible data port provides a convenient and quick network connection for computers or other service tools.

Applications

NetSensor models KMD-1261 and KMD-1281 are compatible with the following controllers:

- BAC-5800 series BACnet controllers
- BAC-7000 series BACnet controllers
- KMD-5800 series controllers
- KMD-7000 series controllers

Specifications

Display

Temperature is continuously updated on a 0.38-inch, four-character, liquid crystal display. Time and relative humidity are simultaneously updated and displayed on a smaller display. Automatic backlighting starts on first button pushed and remains on for 10 seconds after the last button is pushed.

Controller Connection

Connector type

Six-wire modular RJ-12 jack.

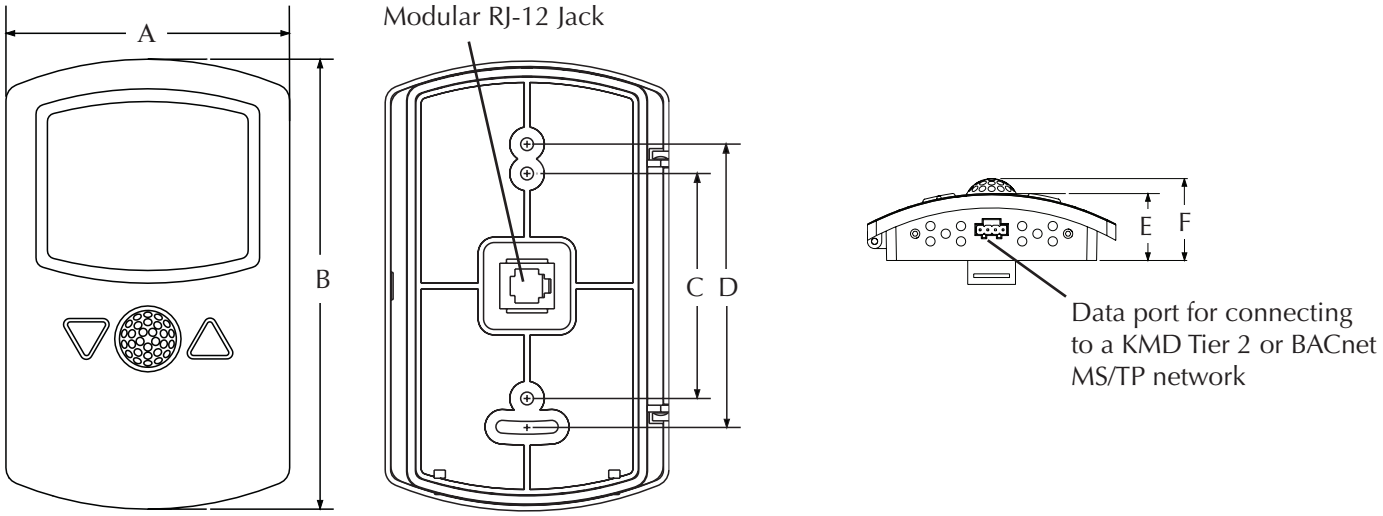
Cable type and maximum length

Connect with cable **not** longer than 75 feet (22.9 meters) and conductors no smaller than #24 AWG. KMC plenum rated cable is recommended. See Accessories section.

Power

5 volts DC supplied from controller.

Specifications and design subject to change without notice.



A	B	C	D	E	F
3.25 in.	5.16 in.	2.58 in.	3.25 in.	0.87 in.	1.07 in.
83 mm	131 mm	66 mm	83 mm	22 mm	27 mm

KMD-1261 sensor specifications

Model KMD-1261 senses temperature and motion.

Temperature Sensor

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

KMD-1281 sensor specifications

Model KMD-1281 senses temperature, humidity, and motion.

Temperature Sensor

Type	CMOS
Accuracy	±0.9° F offset (±0.5° C) from 40° to 104° F (4.4° to 40° C)
Resolution	±0.1°F (±0.1° C)
Operating range	36 to 120° F (2.2 to 48.8° C)
Response time	5 to 30 seconds

Humidity Sensor

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

Environmental Limits

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

Weight

2.8 ounces (80 grams).

Material

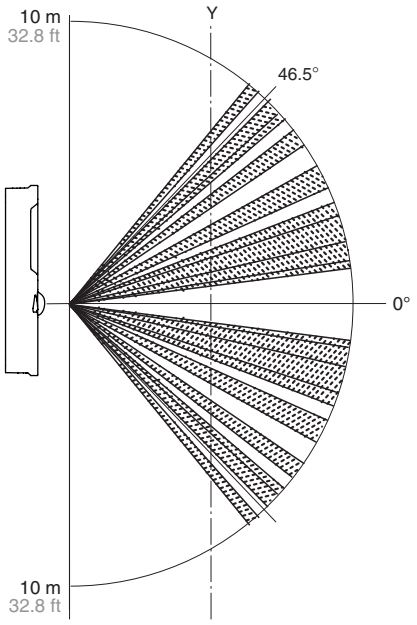
Light almond or white plastic

Mounting

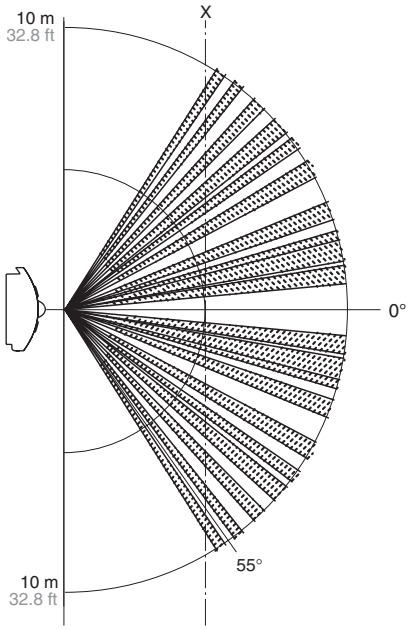
Backplate mounts to a standard 2 x 4 inch vertical handy-box. The NetSensor is secured by two concealed Allen screws.

Motion sensor range

Detector type	Passive infrared
Range	33 feet (10 meters). See diagrams.



Side view



Top view

Accessories

The following accessories and parts are available:

HMO-1161	4 x 4 inch backplate, almond
HMO-1161W	4 x 4 inch backplate, white
HPO-1161	Gasket
HPO-0044	Replacement Allen screws (10)
KMD-5690	25-foot plenum cable with connector
KMD-5691	50-foot plenum cable with connector
KMD-5692	75-foot plenum cable with connector
KMD-5576	EIA-485 to USB Communicator
KMD-5559*	EIA-485 to EIA-232 CommTalk
*KMD-5624	Cable, data port to modular plug (connects KMD-5559 to NetSensor)

Models

Temperature only

KMD-1261	Almond
KMD-12611W	White

Temperature and humidity

KMD-1281	Almond
KMD-1281W	White

Taking on the open systems challenge

BAC-5801/5802 Native BACnet Advanced Application Controller

An 8-input, 8-output controller for general purpose HVAC and building automation applications

KMC CONTROLS

BAC-5801/5802 AAC
Native BACnet Controller

Versatility in terms of use becomes critical on open systems projects, and the BAC-5801 and BAC-5802 were designed to meet such needs. Each is an MS/TP compliant, native BACnet advanced application controller (AAC). Built-in auto addressing automatically assigns MAC addresses and device instance numbers.

This fully programmable direct digital controller features 8 universal inputs and 8 universal outputs, each of which is programmable as an analog or binary object.

Use the versatile controller in standalone applications or networked to other BACnet devices. The AAC enables control of room temperature, humidity, fans, lighting, and other building automation functions.

For added flexibility, you can add up to 8 output override boards featuring triac, relay, and 4–20 mA analog options.

The robust controller can enhance the versatility of any BACnet installation. Add our BACnet operator workstation software and other native BACnet advanced application controllers to meet the challenges of your next open systems project.

SPECIFICATIONS

Inputs

- 8 universal inputs, each of which is programmable as an analog, binary, or accumulator object (accumulators limited to 3 per controller)
- Pull-up resistors for switch contacts and other unpowered equipment
- 0–5 VDC analog input range
- Pulse counting to 16 Hz
- 10-bit analog-to-digital conversion
- Overvoltage input protection
- Removable screw terminal blocks

Outputs

- 8 universal, programmable (as binary or analog) outputs, with slots for output override boards (with 4–20 mA, triac, and relay options)
- 0–10 VDC for analog objects; 0/12 VDC for binary objects
- Short protected outputs, output current limited to 100 mA per output (or 350 mA total)
- Standard and custom units of measure

Programmable Features

- 10 Control Basic program areas
- 8 PID loop objects
- 40 analog and 40 binary value objects
- 8 Schedule objects
- 3 Calendar objects
- 8 Trend objects
- Real-time clock with power backup for up to 72 hours (BAC-5801 only)

Communications

- MS/TP (EIA-485) operating at 9.6, 19.2. 38.4, or 76.8 kbps
- KMD-1160/1180 series NetSensor® compatible

Regulatory

- BACnet Testing Laboratory listed
- CE compliant and FCC Class B, Part 15 Subpart B
- UL 916 and UL 864 (UUKL) listed

building your comfort zone®

19476 Industrial Drive
New Paris, IN 46553-0518
www.kmccontrols.com

Telephone: 877.444.5622
574.831.5250
Fax: 574.831.5252

Appendix G: Innotech Submittals

To provide a clearer picture of the Innotech control equipment installed as part of this field test, their submittals and application guide follow. The actual Innotech program was modified significantly by PECI engineering, and the final program installed is included here.

INNOTECH®
Innovative technology

DS 10.04
AUGUST 2007

MODELS:
MM01: Minimax Controller, Primary Network
MM02: Minimax Controller, Sub System Network

MINIMAX Controller

Overview

The Innotech *MINIMAX* Controller is a state of the art digital processing system that has the capability of controlling various types of industrial, commercial and domestic systems. The *MINIMAX* can operate as a standalone device, using its own universal I/O and TRIAC outputs to receive information and control external equipment, or as part of a network of Innotech devices, where MM01 interfaces with the Primary Network, and MM02 interfaces with the Sub System Network.
The *MINIMAX* controller features Universal I/O channels (UIO) which combine the functions of Universal Input and Analog Output channels into a single software programmable channel. Each UIO can be independently set via software to have input or output functionality. With this structure, you are free to assign functions as required, instead of choosing a fixed controller to fit the job.
The *MINIMAX* configuration program is created on a computer using a Windows based design program. This allows the user to configure the internal processes of the *MINIMAX* by using a graphical programming tool. The user places various process blocks and interconnecting lines to design the required control algorithm for the system.
A connector on the bottom right side of the case provides a RS485 communication interface for communicating with other networked devices.

Features

- 100 millisecond cycle/scan time
- 7 x independent configurable universal inputs / outputs
- 4 x 24VAC Triac outputs
- 1 x RS485 serial communications port (MM02)
- 2 x RS485 serial communications ports (MM01)
- User Selectable Baud rate
- All wire connections by pluggable screw terminals
- Program resides in non-volatile Flash Ram

Approvals

The Innotech *MINIMAX* Controller conforms to:

- EN 61326:1998 for CE Marking and C-Tick Labelling
- Title 47 CFR, Part 15 Class A for FCC Marking
- UL listed to UL916, File Number E242628

Applications

The Innotech *MINIMAX* Controller is designed for mounting inside a control cubicle and offers programmable channels, enabling it to monitor and control all types of external plant and equipment. Although the *MINIMAX* is flexible, it is primarily designed for the air conditioning and building automation industry.
The small size of the *MINIMAX* also gives it the advantage of being installed in small places without taking up valuable switchboard real-estate.
The *MINIMAX* is similiar in operation to the MAXIM I or MAXIM II controllers, but provides universal input/output points that are user configurable and completely independent.

The creation of control strategies is made simple by the use of the MAXIM Config configuration utility, Version 5.20A or greater for MM01 and Version 5.40A or greater for MM02. This utility with its powerful Graphical User Interface allows the user to create an entire control strategy in block-diagram form.

Typical applications include:

- Air conditioning and heating systems
- Lighting control
- Monitoring device
- Distributed I/O points controller
- Cold/Freezer Rooms

Specifications

Power Supply

- 24VAC ± 10% @ 50/60 Hz
- With Triacs operating: ~35VA
- Standby: 5VA
- Transformer rating determined by TRIAC load requirements.

The operating voltage must meet the requirements of Safe Extra Low Voltage (SELV) to EN60730. The transformer used must be a Class 2 safety transformer in compliance with EN60742 and be designed for 100% duty. It must also be sized and fused in compliance with local safety regulations.

Universal Inputs/Outputs

- 7 Universal Inputs/Outputs
  Independently configurable via software to either:
  - Dry Digital Input
  - 0 or 10V Digital Input
  - 10K Thermistor Input
  - 0-10V DC Analog Input
  - LUX sensor input (Light sensor OR P12 LDR)
  - 13Hz PWM (0/10V) Output
  - 0-10V Analog DC Output
  - Digital Output (0V / 10V)
- Each Universal I/O point can be configured independently.
- Input accuracy is ±0.1 volts.
- Output accuracy is ±0.1 volts.
- PWM Duty Cycle accuracy is 10%

Triac Outputs

- 4 Triac Outputs
  Switches 24VAC Power Supply through to Outputs.

- Current rating (per output) :
  min. 20mA / max. 250mA

- Modes: Modulation or Digital On/Off
  Recomended use of pilot relays when switching high voltage/inductive loads.
  Modulation On-Delay staggered between channels.

Optical Indicators

- Red heart beat LED located internally.

MM01:

- Bicolour (Global)-(Net) RS485 Communication LED Transmit (Red), Receive(Green).

MM02:

- Bicolour (SSG-NET) RS485 Communication LED Transmit (Red), Receive(Green).
- Orange ID-LED
  Used as an aid when addressing / locating devices on the SSG-NET network.

Communications

The RS-485 serial communication interface is specific to the product.

- The Minimax (MM01) communications channels provide Global and Net functions for interfacing with other Innotech network resources. Connectivity is provided through a 5-way pluggable screw terminal connector .

- The Minimax (MM02) communication channel is communicating only on a Sub System Network provided by the Sub System Gateway. Connectivity is provided through a 4-way pluggable screw terminal connector. The MM02 also features a EOL termination jumper.

RS485 Comms Termination

MM02 has communication termination requirements. Refer to the document "Installation Manual for Innotech Device Network Cabling", DS 99.04, for a description in the use of End of Line jumpers (EOL) when connecting to a network.

Incorrect use of End of Line Jumpers can cause unreliable communication or total network failure.

Temperature Ratings

- Storage 0 to 50°C non-condensing.
- Operating 0 to 40°C non-condensing.

Enclosure

The *MINIMAX* is housed in a rectangular case suitable for DIN Rail mounting.
The housing is moulded from flame retardant plastics recognised by UL as UL 94-V0.

Colour: Grey

Dimensions: 71(w) x 115.40(h) x 58(d)

Associated Software

MAXCon - Innotech *MAXIM* Controller Configuration utility. It allows the user to internally configure a *MiniMax* by a simple point-and-click approach on a Personal Computer (PC) running Windows.

MAXMon - The Innotech MAXIM Monitor is a monitoring and debugging utility designed to help with commissioning and trouble-shooting a *MiniMax* Controller. It displays the configuration which resides on a *MiniMax* Controller and allows the user to inspect, trend or modify the value at any of the points in the configuration while the controller is running.

MiniMax Simulator - The Innotech MiniMax Simulator utility is a Windows-based software program that simulates a MiniMax Controller. The virtual MiniMax can be powered on, configured and interrogated in the same way as a physical *MiniMax*. Configurations can be downloaded and checked without requiring any hardware installation.

iComm is a communications server used by application software to communicate with Innotech digital controllers. It supports multiple concurrent applications communicating to multiple device networks and serves as the communications hub of any HMI-integrated device network.

MAXtract - is the data log extraction utility for a range of Innotech digital controllers. It allows extraction of all or part of the history log data associated with Maxim Controllers into a specified data format.

Innograph - is Innotech's data log graphing and analysis tool. While it has been designed to specifically cater for the data log graphing capabilities of the Innotech range, it has the flexibility to display data log graphing information from other sources. ***InnoGraph*** allows multiple graphs to be displayed in multiple windows simultaneously. Complete with a host of configurable display options, statistical analysis of data points, analogueue and digital value support, active cursors, colour printing capability and comprehensive zooming and panning features, ***InnoGraph*** is your complete graphing package.

Supervisor/Supervisor Plus is a specialised dynamic monitoring utility for the Genesis II and Maxim Series Digital Controllers. It provides all the functionality that is available from the Genesis II and Maxim Series Digital Controller display panels with greater ease-of-use and flexibility. It is aimed at those users who require some feedback or control of the Genesis II and Maxim systems, but have no desire to be immersed in the technical details of a Genesis II and Maxim configurations.

Note: Supervisor Plus allows the user to change the way the watch items are displayed so that the information is presented in a better and more easily understood manner. The user can set background images, arrange the watch items around the page and customise the fonts used.

Magellan is an event-driven, object oriented real-time Supervisory Control and Data Acquisition package. It provides a simple, intuitive mechanism to effortlessly design either trivial or sophisticated supervisory or control programs using a drag-and-drop approach.

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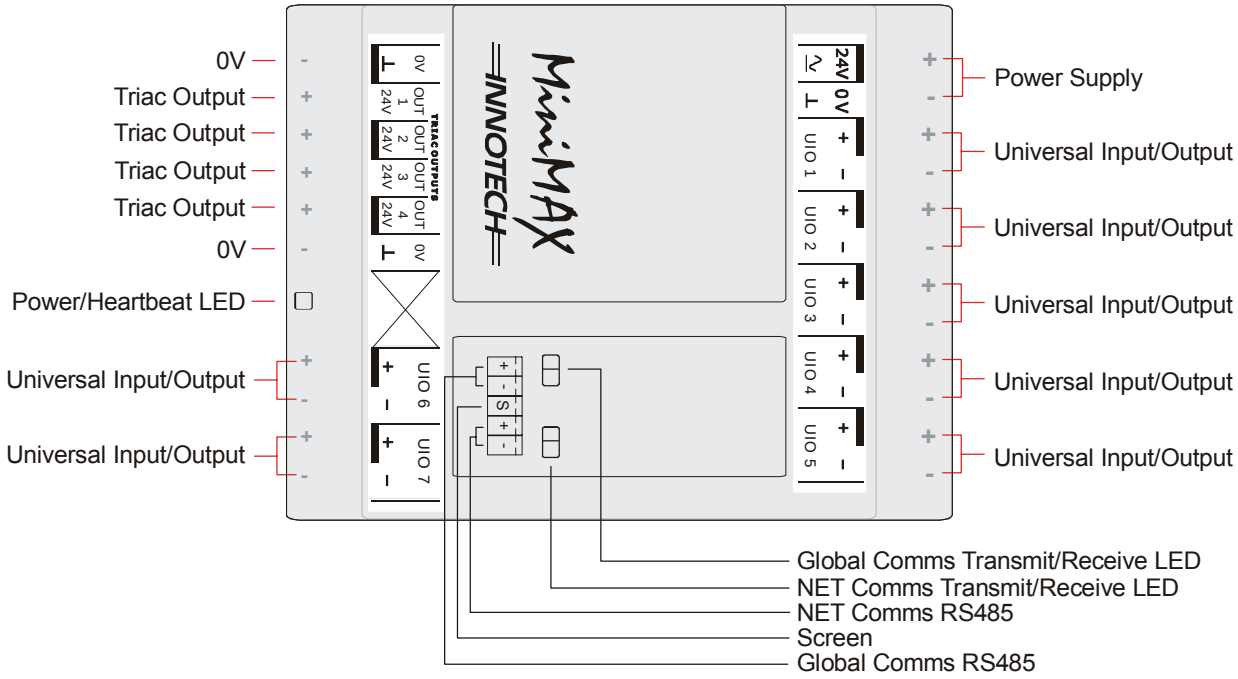
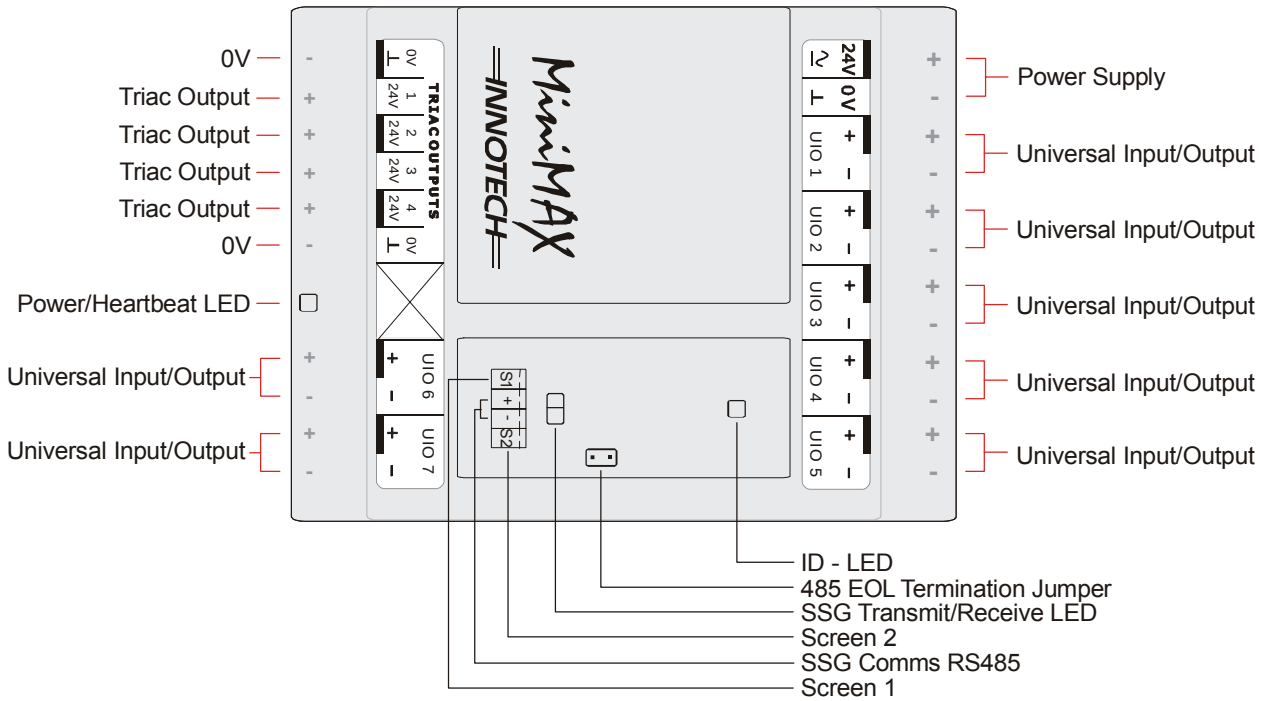
Connection Diagrams

MM01



MM02

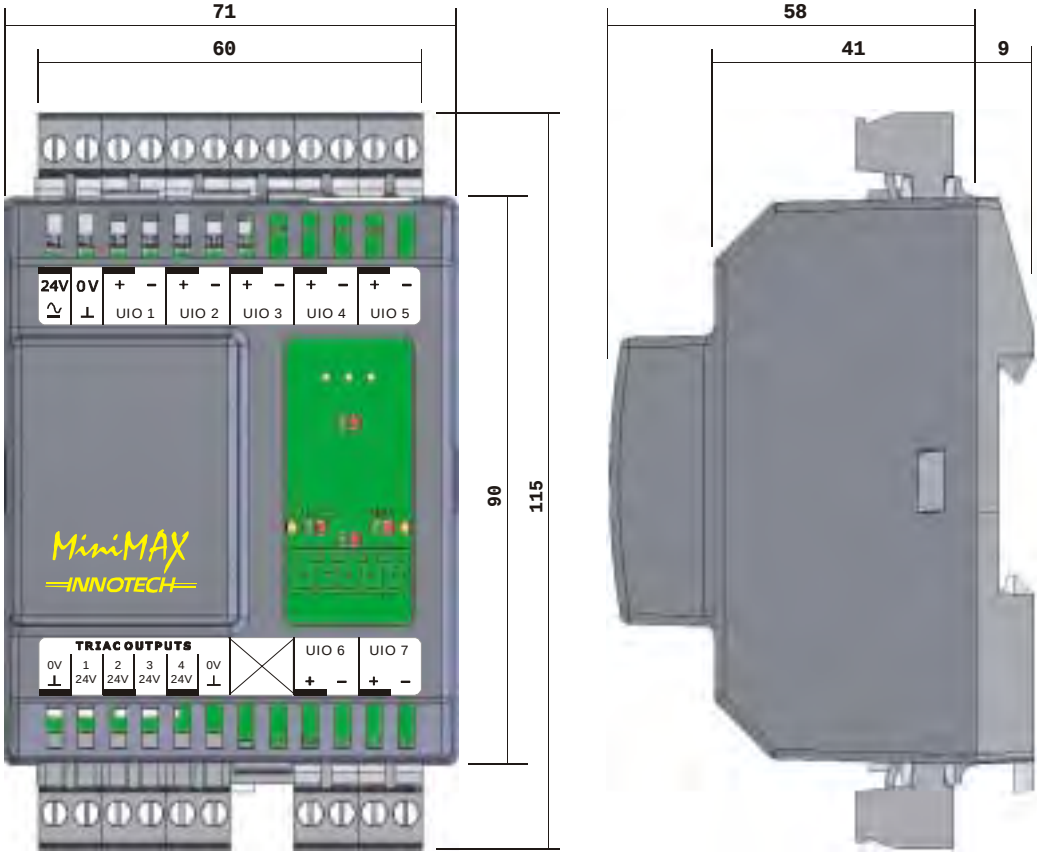


FCC Class A Notice

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

Note – This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
Modifications to this device, may void the authority granted to the user by the FCC to operate this equipment.

Dimensions



INNOTECH®
Innovative technology
Australian Owned, Designed & Manufactured
by Mass Electronics Brisbane
Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
Email: sales@innotech.com.au www.innotech.com.au

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INNOTECH®
Innovative technology

DS 13.03
NOVEMBER 2007

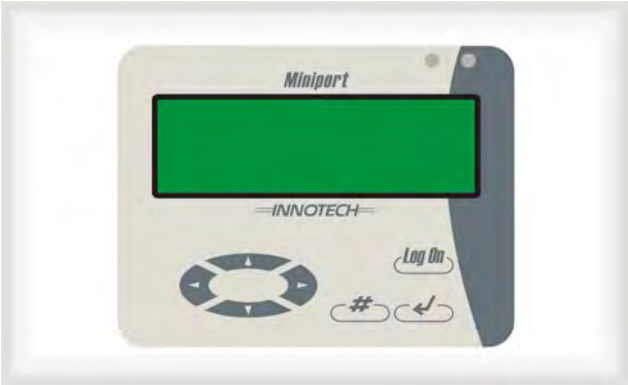
MODELS:
MP01: Human Machine Interface for Maxim Network

MAXIM MINIPORT RS485 Human Machine Interface V ersion

Overview

The *MAXIM MINIPORT* is a network device that allows a user to externally access the Human Machine Interface (HMI) of a MAXIM Series Controller located on the network. Connected to "Net Comms", the *MAXIM MINIPORT* can be used to search for controllers present on the network. A user may then use the *MAXIM MINIPORT* to log onto any one of the available controllers.

The *MAXIM MINIPORT* is designed for surface mounting and allows easy access to networked controllers that are located in remote or inaccessible areas.



Features

- Access to up to 40 networked MAXIM Controllers
- Access to up to 62 Sub Network devices per Sub System Gateway on Primary Network
- 4 line, 80 character Liquid Crystal Display
- Isolated RS485 Communications
- Supports Maxim Controllers that incorporate Netcomms
- Network Display Mode
- Network Searching Facilites
- Can detect and identify GENESIS Controllers on the Network
- User Programmable BaudRates
- User Programmable Sleep Timeout
- Select Button allows User to Connect and Disconnect from an individual MAXIM Controller
- Convenient Re-connect function
- Flash ROM for in-system Firmware upgrades
- Operates on 24VAC or 24VDC
- 57600 and 9600 band comms rate

Applications

The *MAXIM MINIPORT* can be used in a variety of situations. Its main advantage is allowing easy access to a number of controllers from a single point. This enables the user to access a controller without requiring physical access to the chosen controller.

- A single point of access to a MAXIM Controller network
- Mounted on panel doors to give easy access to a group of MAXIM Controllers within the control panel
- Hand held Service Tool
- Wall mounted device
- Used as a monitoring device

Approvals

The Innotech *MAXIM MINIPORT* conforms to:

- EN 55011 Class B Group 1& EN 50082-1for CE Marking
- AS/NZS 2064:1997 for C-Tick Labelling.
- Title 47 CFR, Part 15 Class A for FCC Marking
- UL listed to UL916, File Number E242628

Specifications

Power Supply

- 24VAC ± 10% @ 50/60Hz
- 24VDC ± 10%
- Power Consumption: 1.5W Max.

The operating voltage must meet the requirements of Safety Extra Low Voltage (SELV) to EN60730. The transformer used must be a **Class 2 safety transfomer** that has the energy and voltage limiting characteritics as described in the National Electrical Code, ANSI/NFPA70. It must also be sized and fused in compliance with local safety regulations.

Terminal Identification:

Power Supply

1 = 24V AC Supply
2 = 0V AC Supply
3 = EARTH

TERMINAL 3 NOTE: This connection is for the protection of the communication circuitry. It must be connected to a good quality electrical bonded EARTH. This may be EARTH bus bar of the switchboard or the point that connects the chassis of the equipment the module is in, to electrical EARTH. This point should not be tied to terminal 2.

Comms Connection

SHLD1 = Shield from incoming comms cable
\+ = RS485 (+) signal
\- = RS485 (-) signal
SHLD2 = Shield from outgoing comms cable

Temperature Ratings

- Storage 0 to 50°C non-condensing.
- Operating 0 to 40°C non-condensing.

Enclosure & Mounting

Plastic Enclosure manufactured from flame retardant polycarbonate/ABS plastic listed under UL94.
Colour : Off White.
Dimensions: 200mm X 164mm X 25mm.
Mounting: Wall Mounted.

Wiring

- The cable used for RS485 Comms must be shielded single twisted pair, 120 ohms characteristic impedence, 36 to 45pF per metre capacitance between conductors.
- The Comms cable must be organised as a bus topology. That is, starting at one end, devices are connected to it until the other end of the cable is reached. No “stubs” are allowed. To connect a device to the cable, a cut is made in the cable at the point where the device is to be situated along it. Then, the two new ends of the cable are wired into the device. The shields from the two new ends are then terminated into the terminals marked SHLD1 and SHLD2 respectively. Refer to the Innotech Cabling Manual DS99.04 for more information.

Interface:

The interface of the *MAXIM MINIPORT* has a similar physical layout as a Maxim II Controller with the addition of the Select button.

Modes

The Miniport has three separate configurable modes of operation.

The first Mode is “Sleep Mode” While the Miniport is in this mode, the device when it detects no activity for greater than the “sleep delay” goes into Sleep. Sleep is where the Miniport disconnects from the Innotech network and allows other devices the ability to connect. Note the sleep delay time can be programmed via the setup menu.

The second Mode is “Master Mode” While the Miniport is in this mode, the Miniport remains connected to one predetermined controller on a network. The Miniport if it detects no activity for a fixed period of time will go into a standby mode where the network is polled every 10 seconds. This provides an opportunity for other devices to log on to the network while still displaying the current data of the selected controller. Should the Miniport detect activity on the network the Miniport will go into sleep mode. Once the Miniport detects no activity it reverts to its previous state displaying the information of one predetermined controller.

The third Mode is “Slave Mode” in this mode the display will show what ever is displayed on the Miniport designated as the master. Should the Miniport detect activity on the network the Miniport will go into sleep mode. Once the Miniport detects no activity it reverts to its previous state displaying the information of the Master Miniport.

States

The Miniport can be in three states of operation. These states are Sleep, Configuring and Communicating.

The first State Sleep is when the *MAXIM MINIPORT* is set to Sleep Mode and the unit times outs after a user defined delay to a sleeping mode whenever it is not being used. In this mode it remains dormant, while monitoring the network for activity. If it detects network activity it prevents user access until the network is free, otherwise the user may activate the MMI into another mode. This is because only one device may take control of the Net Comms Network at any one time. This device could be a computer, DDC, MPI (Modem Printer Interface) or a *MAXIM MINIPORT*.

When the Miniport is sleeping pressing the Logon button presents a list of available devices on the network the user can select the desired unit with the < and > arrows the press Logon again to connect to the selected device. Alternitivly the user can press the # button which provides access to the setup menu.

The Second State Configuring. Is when the user presses the # button, a menu is displayed giving the option to "Search", "Setup", "Devices" or "Reconnect".

See mini port Configuration for further detail.

The third state Communicating. Is when the user presses the "Log On" button, where the user can log onto a remote Maxim II Controller. Once the user has connected to a controller using the Log On button. The user can view watch pages, system info and change variables, and operate all other functions in the usual manner. See the Maxim data sheet for user instructions on the Maxim Controller.

When finished interrogating the Maxim, the logon button is used to log off, or disconnect from the controller. When pressed, the *MAXIM MINIPORT* automatically escapes out of the current page, logs off and reverts to the default mode.

Setting Up the Miniport

The Maxim set up menu has four options. Search, Setup, Devices and Reconnect.

The Search option, simply searches the network to produce a list of available devices for connection via the logon screen. Note searches between the Start and Stop

The Set up option, has a sub menu consisting of the following parameters. Mode, Default Maxim, Sleep Delay, Maxim Type, Search Start and Search Stop.

The Device option, will display a list of the active devices found connected to the Miniport as found by the Search option, subject to the start search and stop search parameters.

The Reconnect option, will log the user on to the device last connected.

Set Up Parameters

Mode, this sets the mode as defined earlier.

Default Maxim, This is the address of the Maxim selected as either the Master or Default device.

Sleep Delay, this is the time in seconds that the unit will wait after detection no activity before going into its default mode. Set between 30 and 300 seconds in 30 second steps. The default setting is 30 seconds.

Maxim Type, this determines if the Maxim is a Networkable Maxim or a Stand alone Maxim. Note if a stand alone Maxim is used a GENII CONVERTER NT RS485 to RS232 converter is required.

Start Search, This is the start address for the Miniport to begin its search for active devices on the network.

Stop Search, This is the end address for the Miniport to terminate its search for active devices on the network.

FCC Class A Notice

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

Note – This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
Modifications to this device, may void the authority granted to the user by the FCC to operate this equipment.

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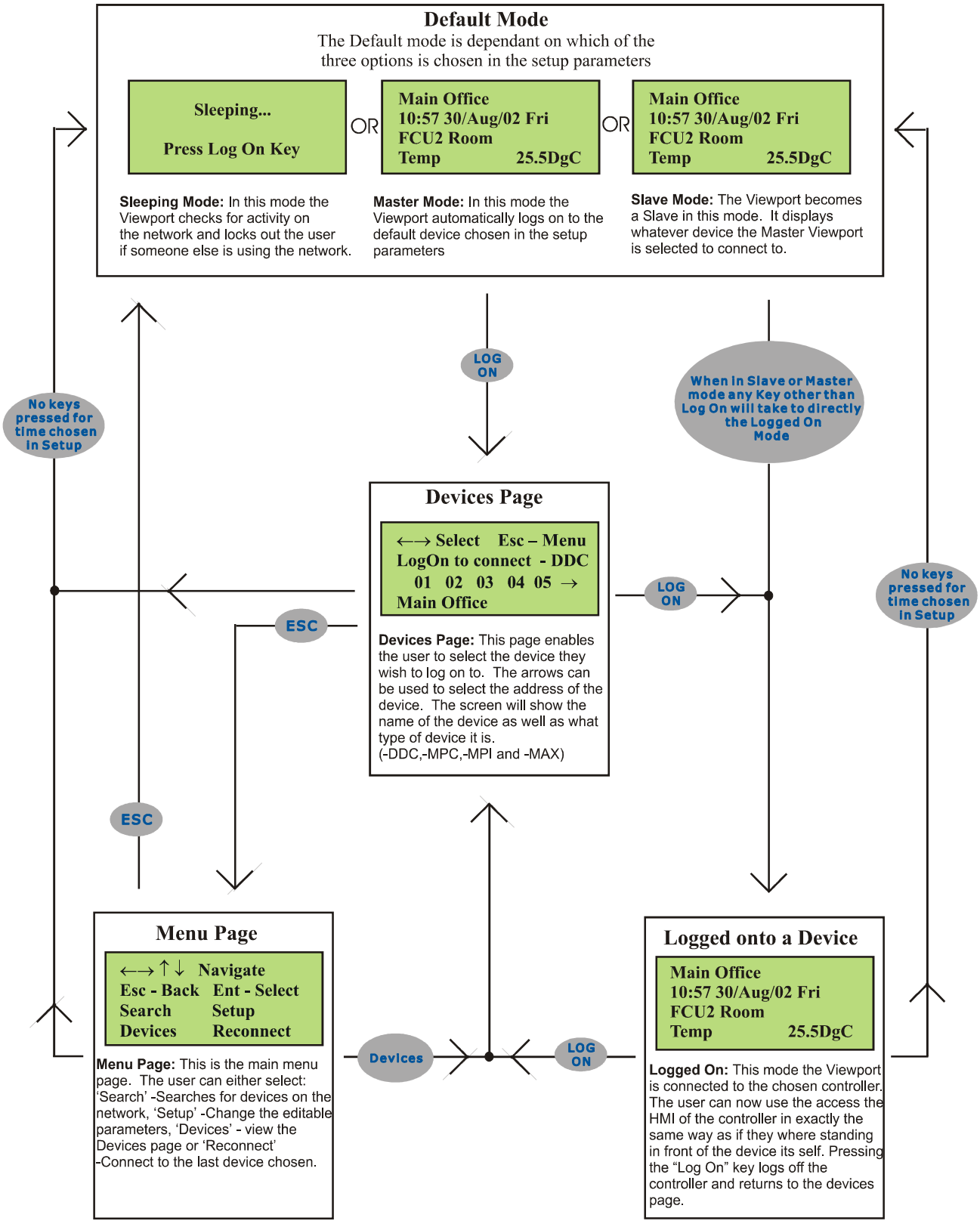
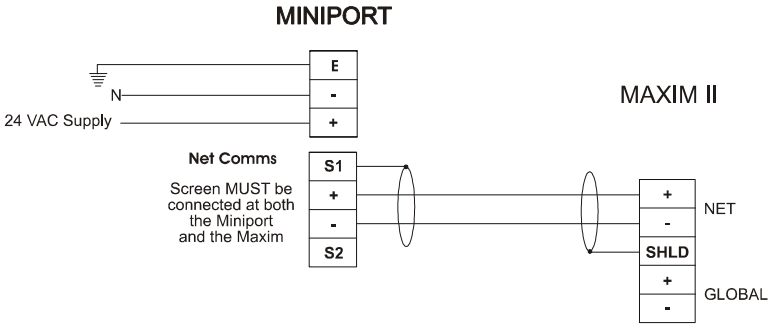
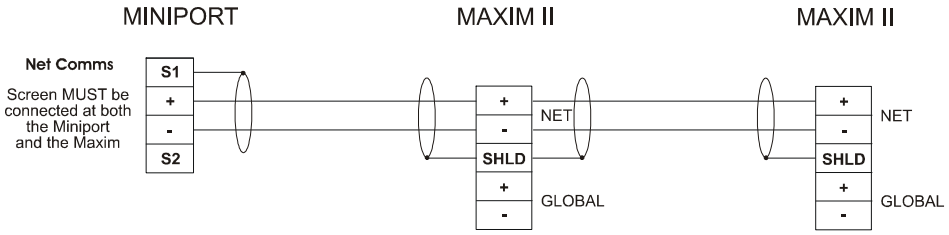

Default Mode
The Default mode is dependant on which of the three options is chosen in the setup parameters
Sleeping...
Press Log On Key
OR
Main Office
10:57 30/Aug/02 Fri
FCU2 Room
Temp 25.5DgC
OR
Main Office
10:57 30/Aug/02 Fri
FCU2 Room
Temp 25.5DgC
Sleeping Mode: In this mode the Viewport checks for activity on the network and locks out the user if someone else is using the network.
Master Mode: In this mode the Viewport automatically logs on to the default device chosen in the setup parameters
Slave Mode: The Viewport becomes a Slave in this mode. It displays whatever device the Master Viewport is selected to connect to.
LOG ON
No keys pressed for time chosen in Setup
When in Slave or Master mode any Key other than Log On will take to directly the Logged On Mode
Devices Page
←→ Select Esc – Menu
LogOn to connect - DDC
01 02 03 04 05 →
Main Office
Devices Page: This page enables the user to select the device they wish to log on to. The arrows can be used to select the address of the device. The screen will show the name of the device as well as what type of device it is.
(-DDC,-MPC,-MPI and -MAX)
LOG ON
No keys pressed for time chosen in Setup
ESC
ESC
Menu Page
←→↑↓ Navigate
Esc - Back Ent - Select
Search Setup
Devices Reconnect
Menu Page: This is the main menu page. The user can either select: 'Search' -Searches for devices on the network, 'Setup' -Change the editable parameters, 'Devices' - view the Devices page or 'Reconnect' -Connect to the last device chosen.
Devices
LOG ON
Logged onto a Device
Main Office
10:57 30/Aug/02 Fri
FCU2 Room
Temp 25.5DgC
Logged On: This mode the Viewport is connected to the chosen controller. The user can now use the access the HMI of the controller in exactly the same way as if they where standing in front of the device its self. Pressing the "Log On" key logs off the controller and returns to the devices page.

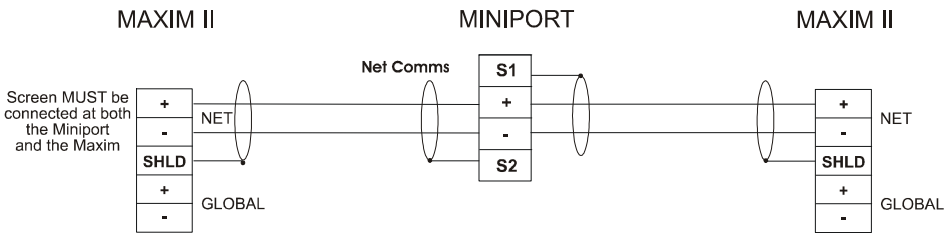
STANDARD CONNECTION



END COMMS CONNECTION



MID COMMS CONNECTION



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Australian Owned, Designed & Manufactured
by Mass Electronics Brisbane
Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
Email: sales@innotech.com.au www.innotech.com.au

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ICS01 ON/OFF, Set Point
ICS02 ON/OFF, Set Point and 3 Speed Fan

Innotech Control Station

Overview

The ICS series Control Stations form part of the Maxim & Genesis Direct Digital Controller range and provide a simple unitary Human Machine Interface (HMI). The HMI offers on/off, setpoint and fan speed control. The HMI is powered by 24VAC and connects directly to the Globals Comms network.

Each ICS can communicate with a designated controller on the network. The ICS units are configured via the Keypad, are compatible with most existing Innotech digital products and are capable of operating at both fast or slow comms.

The interface to the controller is via global Transmit and receive blocks, the configuration simply uses the ICS address to form part of the unique point name.

Features

- One numerical value input
- One numerical value output
- One momentary push button digital input
- One LED indication digital output
- One fan speed input (ICS02 only)
- Housed in a switchplate that mounts in standard electrical wall plates
- Isolated RS-485 interconnection between Innotech Controllers
- Adjustable user input range
- Adjustable decimal place
- Configurable power on settings.

Application Notes

The *Innotech Control Station* extends the capabilities of Innotech controllers by providing a numerical value output, numerical value input, push button digital input and a single LED display output for distributed control via RS-485. The *Innotech Control Station* provides a visual display of a control value and a means to set a parameter. It is not intended for use on a large controller network as this affects the operation.

Models

Feature	ICS01	ICSO2
On/Off	Yes	Yes
Temp. Display	Yes	Yes
Setpoint Adjust	Yes	Yes
Run Status	Yes	Yes
Fan Speed	No	Yes

Installation

- Strictly follow the guidelines when installing the Comms wiring as outlined in the Genesis System Comms Wiring Recommendations.
- Mount the *Innotech Control Station* in a dry and clean location free of excess vibration.

Wiring

- DO NOT connect 240V AC to any terminals.
- The cable used for RS-485 Comms must be shielded single twisted pair, 120 ohms character impedence, 36 to 45pF per metre capacitance between conductors.
- The Comms cable must be organised as a bus topology. That is, starting at one end, devices are connected to it until the other end of the cable is reached. No “stubs” are allowed. To connect a device to the cable, a cut is made in the cable at the point where the device is to be situated along it. Then, the two new ends of the cable are wired into the device. The shields from the two new ends are then terminated into the terminals marked SHLD1. Refer to the Genesis Network Installation Instructions and DS99.04 Cabling Manual for more information.

Approvals

The *Innotech Control Station* conforms to the requirements of EN61326:1998 for CE-Marking as well as to Australian requirements for C-Tick Labelling.

Specifications

Power Supply

- Voltage: 24 volts AC ±10% @ 50/60Hz.
- Power Consumption: 3VA max.

Inputs

- Push buttons for adjusting control values.
- Push button for momentary input of "digital function".

Outputs

- No physical ouputs.
- Display of Temperature and Setpoint.

Terminal Identification

1 = 24V AC Supply.
2 = 0V AC Supply.
3 = Earth.

NOTE - TERMINAL 3 is for the protection of the Comms circuitry and must be connected to a good electrical bonded Earth.

COMMS Connection

S1 = Shield from incoming Comms Cable.
\+ = RS 485 (+) signal.
\- = RS 485 (-) signal.
S2 = Shield from outgoing Comms Cable.
Do not connect. Only used on REM Networks

Temperature Ratings

- Storage 0 to 50°C non-condensing.
- Operating 0 to 40°C non-condensing.

Enclosure

The *Innotech Control Stations* are housed in switchplate that mounts in standard electrical wall plates.
Colour: White
Wall mounted.

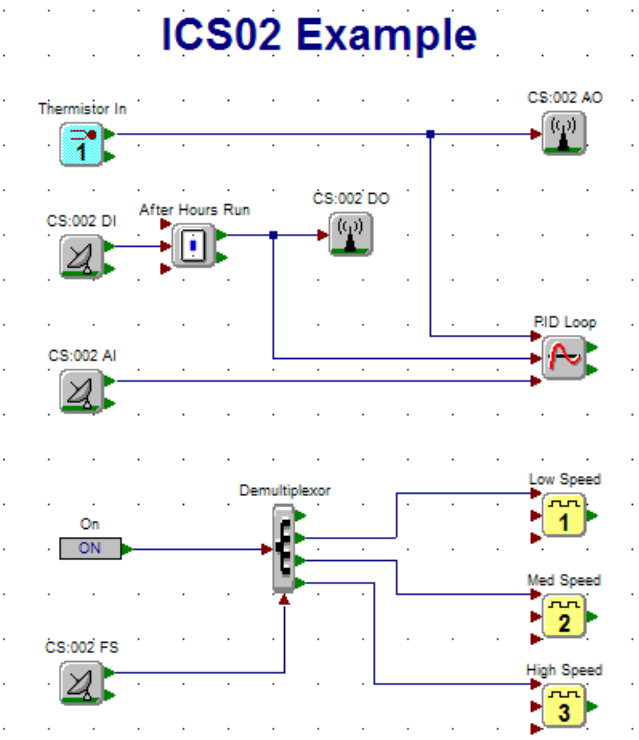
Innotech Controller Configuration

The interface to the Innotech Control Station is with the use of Global Blocks in the configs executed on Innotech Controllers (genesis and Maxim families). The Innotech Control Stations have the following pre-defined Global Blocks:

CS:xxx AI Set Point Adjust
CS:xxx AO Temperature Display
CS:xxx DI On/Off
CS:xxx DO Run Status
CS:xxx FS (ICS02 Only) Fan Speed (0, 1, 2, 3)

Where xxx represents the three digit address. (ie. Address 10 is 010, Address 5 is 005)

To access the points on the Innotech Control Station, Global Blocks with names corresponding to the above names need to be placed in the config. The figure below provides an example for an ICS02 at network address 2:



PROGRAM FUNCTIONS OF THE INNOTECH CONTROL STATION

TO ENTER PROGRAMMING MODE:

To enter Programming Mode depress and hold the  and  buttons for 5 seconds. The display will become blank indicating that you are in the Programming Mode. Release both keys and the display will show parameter 0.

Whilst in the programming mode the following buttons are active:

 Change to the next parameter.

 Increase the current parameters value.

 Decrease the current parameters value.

PARAMETER 0: GLOBAL ADDRESS
The display will show the current GLOBAL Address of the device.

The range of address is 2 to 127.

The default address is 2.

PARAMETER 1: MAXIMUM INPUT VALUE:
The display will show the Maximum Input Value to which the module's input can be set.

The range of Maximum Input Value is 0.0 to 99.9.

The factory default setting is 30.0

PARAMETER 2: MINIMUM INPUT VALUE:

The display will show the Minimum Input Value to which the module's input can be set.

The range of Minimum Input Value is 0.0 to 99.9.

The factory default setting is 15.

PARAMETER 3: DECIMAL PLACES

The display will show the number of decimal places which will be displayed for both the input and output values.

The range of Decimal Places is 0 to 2

The factory default setting is 1

PARAMETER 4: BAUD RATE

The display will show an indication of the communications Baud Rate:

0 = 4800 Baud

1 = 38400 Baud

The factory default setting is 38400 Baud.

TO EXIT PROGRAMMING MODE:

To exit the Programming Mode depress the  and  buttons and the new setting will be saved.

NB. IF PARAMETER 4 IS CHANGED, POWER TO THE ICS0X MUST BE RECYCLED, AFTER EXITING PROGRAMMING MODE.

START UP DEFAULT SETTINGS:
The *Innotech Control Station* Module can be set to start with a default set point.

To set the start up default set point adjust the *Innotech Control Station* Module to the desired set point and then press and hold the  and  buttons for 5 seconds.

The display will become blank indicating that the new set point has been saved.

OPERATING FUNCTIONS OF THE INNOTECH CONTROL STATION

NUMERICAL OUTPUT:
The *Innotech Control Station* will display a 4-digit value with up to 3 decimal places.

NUMERICAL INPUT:
The *Innotech Control Station* will provide a 4-digit value with up to 3 decimal places to Innotech controllers on the global network.

The value can be modified by pressing the  button to increment

by the least significant digit or the  button to decrement by

the least significant digit.

DIGITAL INPUT VALUE:

The  button on the *Innotech Control Station* provides a digital input value to the Innotech Controllers. This operates as a standard momentary switch, i.e. Pressing the  button produces a short period ON value to the controller.

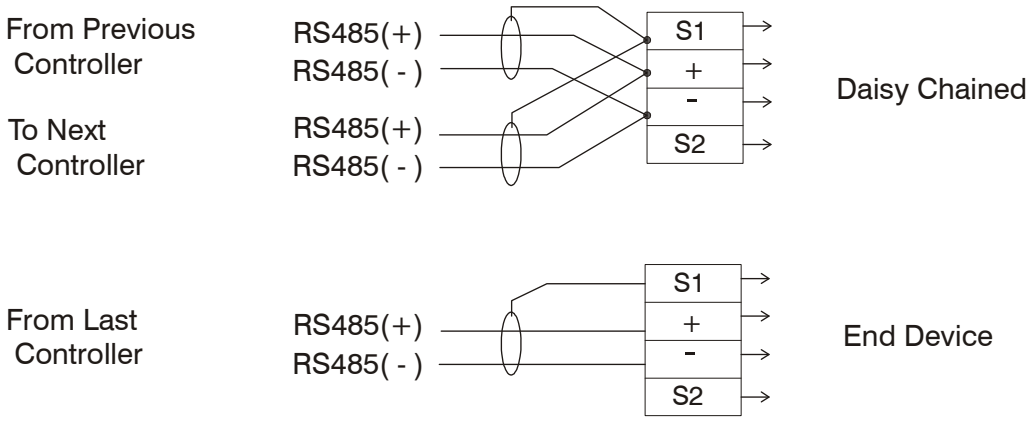
DIGITAL OUTPUT LED:
The *Innotech Control Station* displays a digital state via the system LED during normal operation. This LED, however, cannot be overridden whist the Digital Input Value is in a transitional state.

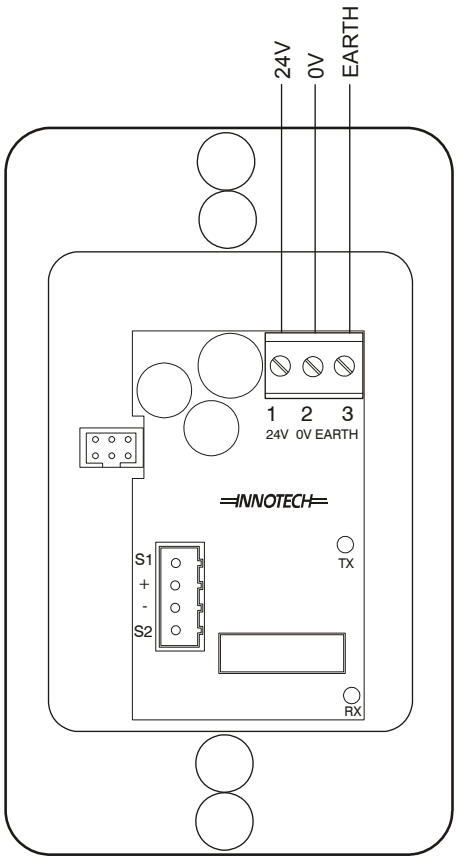
FAN SPEED BUTTON (ICS02 ONLY):

The  button provides means of setting a fan speed.

Pressing the  button cycles between low/medium/high fan speeds. This is indicated on the LEDS above the  button. The  button and LEDS are disabled whilst the Control Station is off (ie. there is no ventilation only mode).

Global Comms Wiring





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Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
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DS 26.01
OCTOBER 2007

MODELS:
IG01: Sub System Gateway

Sub System Gateway

Overview

The Sub System Gateway (SSG) is a state of the art Communication System, providing the ability to add Sub System Networks of Innotech controllers with a single channel of communications to Innotech Net and Global Networks. The SSG also provides logging and a battery-backed real time clock for devices on its network.
Each Device comes preconfigured with a standard SSG configuration containing weekly and yearly schedules optimum start routines.

Features

- 1 x Isolated High Speed RS485 serial Sub System Network Interface
- 2 x RS485 serial Primary Network ports.
- 1 x Isolated Ethernet (10baseT) Primary Network port (Net)
- User selectable Baud rate on RS485 Primary Network ports
- Hosts up to 62 Sub System devices
- Efficient data routing
- Reduces wiring cost due to single wire Sub Networks
- All wires connected by pluggable screw terminals
- Program resides in non-volatile Flash RAM
- Real-Time Clock (battery backed)
- Visual indication of power, system and communication activity

Approvals

The SSG conforms to:

- EN 61326:1998 for CE Marking and C-Tick Labelling
- Title 47 CFR, Part 15 Class A for FCC Marking
- UL listed to UL916, File Number E242628

Applications

The *SSG* is specifically designed to be used in conjunction with Sub System Controllers which have a single channel of communications, such as the MiniMax (MM02) and VAVMax (VM01).

Installation

The SSG should be installed in an environment that does not exceed the maximum operating parameters of the device.
It should be mounted in a dry, clean and vibration free environment.
The small size of the *SSG* also gives it the advantage of being installed in space reduced environments.
The SSG can directly host up to 62 Sub Net devices wired in daisy chain configuration.
Due to the higher communications speed of the Sub System network, good quality RS485 cable should be utilised and short screen connections maintained when connecting controllers.

Installation cont.

This will ensure reliable communication of up to 200m. Repeaters should be used to isolate sections of a network as a protection against external dangers damaging the entire network.
The Innotech network cabling manual DS99.04 contains more valuable information on how to setup your network.

Specifications

Power Supply Requirements

24VAC ± 10% @ 50/60 Hz
Power consumption: 4VA
24VDC + 20% - 10%
Power consumption 2,3W
Recommended transformer rating of 8VA or greater.
The operating voltage must meet the requirements of Safe Extra Low Voltage (SELV) to EN60730. The transformer used must be a Class 2 safety transformer in compliance with EN60742 and be designed for 100% duty. It must also be sized and fused in compliance with local safety regulations.

Battery

Contains a Lithium Battery, dispose of properly
Type CR-2032 Lithium Battery
Nominal voltage 3 Volts
Shelf life - 5 Years dependant on ambient temperature.
CAUTION - Risk of explosion if battery is replaced by an incorrect type.

Temperature Ratings

- Storage -5 to 60°C non-condensing
- Operating 0 to 50°C non-condensing

Encloure/Mounting

The *SSG* is housed in a rectangular case suitable for DIN Rail mounting.
The housing is moulded from flame retardant plastics recognised by UL as UL 94-V0.
Colour: Grey
Dimensions (max): 71mm x 115mm x 67mm

Optical Indicators

LED POWER (Red LED):

- Indicates power is supplied to the device

HEARTBEAT (Green LED):

- Regular flashing indicates device is operational

COMMS (3 x Bicolour LEDs):

- Indicate RS485 network activity on each channel. The LEDs for each channel are physically aligned with the appropriate comms connector for that channel. (Red = Transmit, Green = Receive)

RJ45 LEDs:

- Indicates connectivity to Ethernet (Orange) and network activity (Green)

Communications

- Sub System Comms:
  RS485 Serial communications channel optimised for fast data transmission to a Sub System network of Innotech controllers
  Connectivity is provided through a 5-way pluggable screw terminal connector on the bottom right of the product
- Net and Global Comms:
  RS485 Serial communications channels for data transmission to an Innotech Controller network
  Connectivity is provided through a 5-way pluggable screw terminal connector on the front of the product
- Ethernet:
  Ethernet communications channel for dedicated data transmission to a PC
  Connectivity is provided through an RJ45 socket on the top right of the product

Configuration

The SSG is loaded with a predefined configuration containing weekly and yearly schedules, and optimum start block and global points to provide common schedules to all controllers on the Sub System network.
The blocks in the configuration are editable via the HMI which can be accessed via a Miniport, Software, Viewport or Softport. The software applications Maxmon, Supervisor and Magellan also provide access to the internal config.

RS485 Comms Termination

Generally a daisy chain network configuration is recommended for a high speed network such as the one provided from an SSG. If the SSG is situated at the end of such a network, place the jumper to [EOL] position. The Innotech Cabling Network Manual DS99.04 contains valuable information and examples on how to correctly setup your network wiring.

Attention:
Without any exceptions, there are always only 2 devices on a proper terminated Sub System network that have this jumper fitted!
All other devices should **not** have a jumper in position [EOL]. Incorrect use of EOL jumpers can cause unreliable communications or total network failure.

Networks and Addressing

The SSG is designed for use with a Sub System network of controllers such as VAVMax (VM01) or MiniMax (MM02) and with a standard Innotech Network.
The SSG is managing the resources of all devices that are connected to it. It reduces the load on master controllers in a large network and reduces network traffic.

Example:
The small Innotech controllers, such as the MiniMax (MM02) and VAVMax (VM01), do not provide:
- Logging
- Battery backed time clock
- Global points
- Alarms

The SSG however does, and provides this service to all devices.

The SSG is fully transparent, meaning:
Software applications can access all devices on the Sub Sytem network for monitoring and configuration purposes.
Devices on the Innotech Global comms network will have access to global points to and from the devices on the Sub System network.

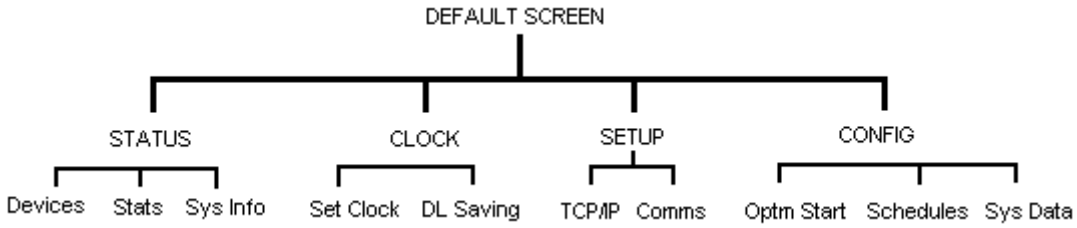
Addressing:
Two addressing schemes are available depending on the user requirements. The two schemes are:

- Automatic:
  Devices on the Sub System Network are each assigned an address by the SSG automatically after startup or when added to the network. This is the factory default setting

- Manual:
  Device addresses are manually allocated by the user with Innotech's communication server, iComm

User Interface

For ease of use the SSG provides remote access to a virtual 4 line, 20 character Human Machine Interface (HMI). Access can be gained by using tools, such as, Soft Port, Miniport and Viewport (V3.0A and above). Navigation through the menu is achieved by using the 6 virtual keypads 'Up', 'Down', 'Left', 'Right', 'Enter' and 'Escape'. The HMI provides menus to access and modify the internal SSG configuration, device setup and device status as shown below.

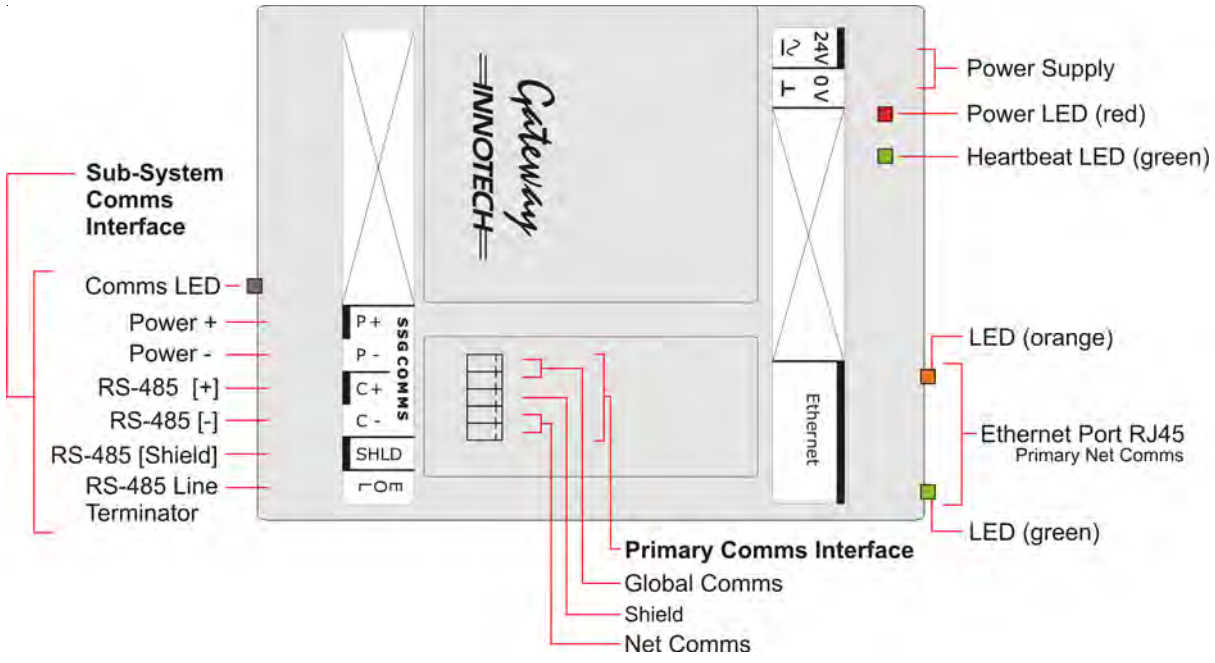


All information displayed on the HMI is in English and standard engineering units.

FCC Class A Notice

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

Note – This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
Modifications to this device, may void the authority granted to the user by the FCC to operate this equipment.



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Amazon Community Center

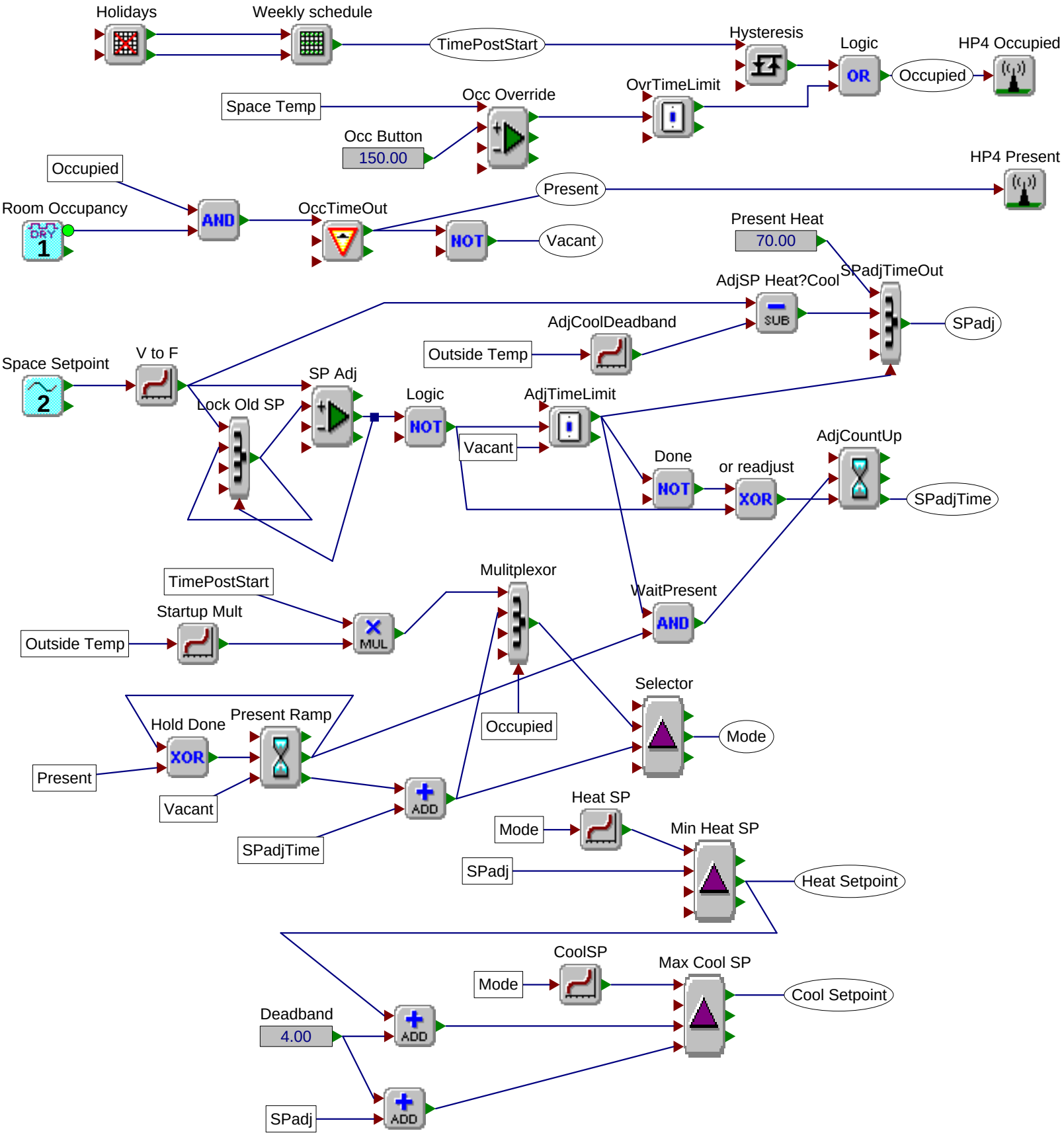
HP4 and HP5 Control

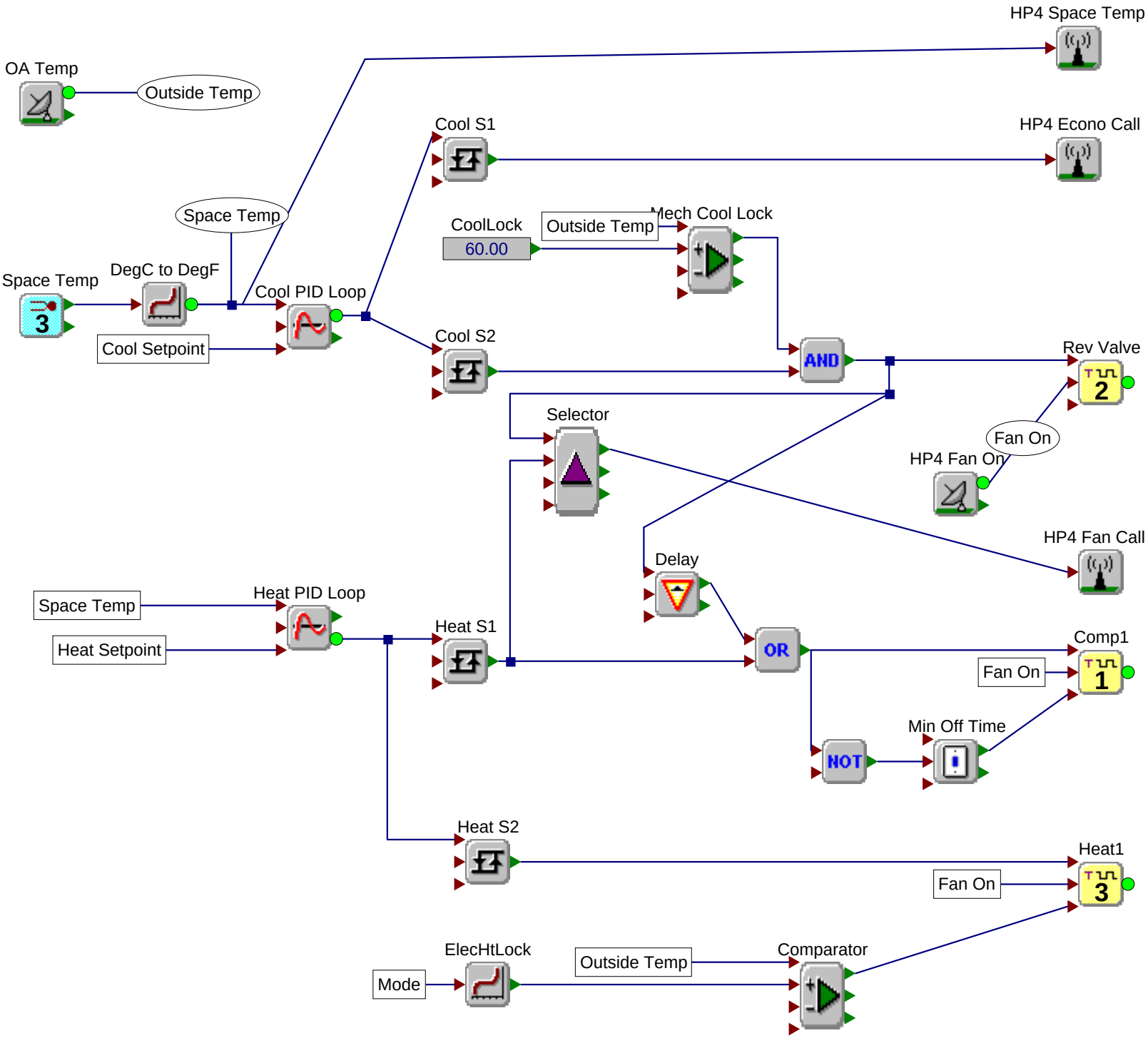
11/11/2010

TABLE OF CONTENTS

HP4 Control Configuration

HP4 Temperature Control

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Cool PID Loop
Cool Setpoint
Cool S2
AND
Rev Valve
Selector
Fan On
HP4 Fan On
HP4 Fan Call
Delay
Space Temp
Heat PID Loop
Heat Setpoint
Heat S1
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Comp1
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Min Off Time
NOT
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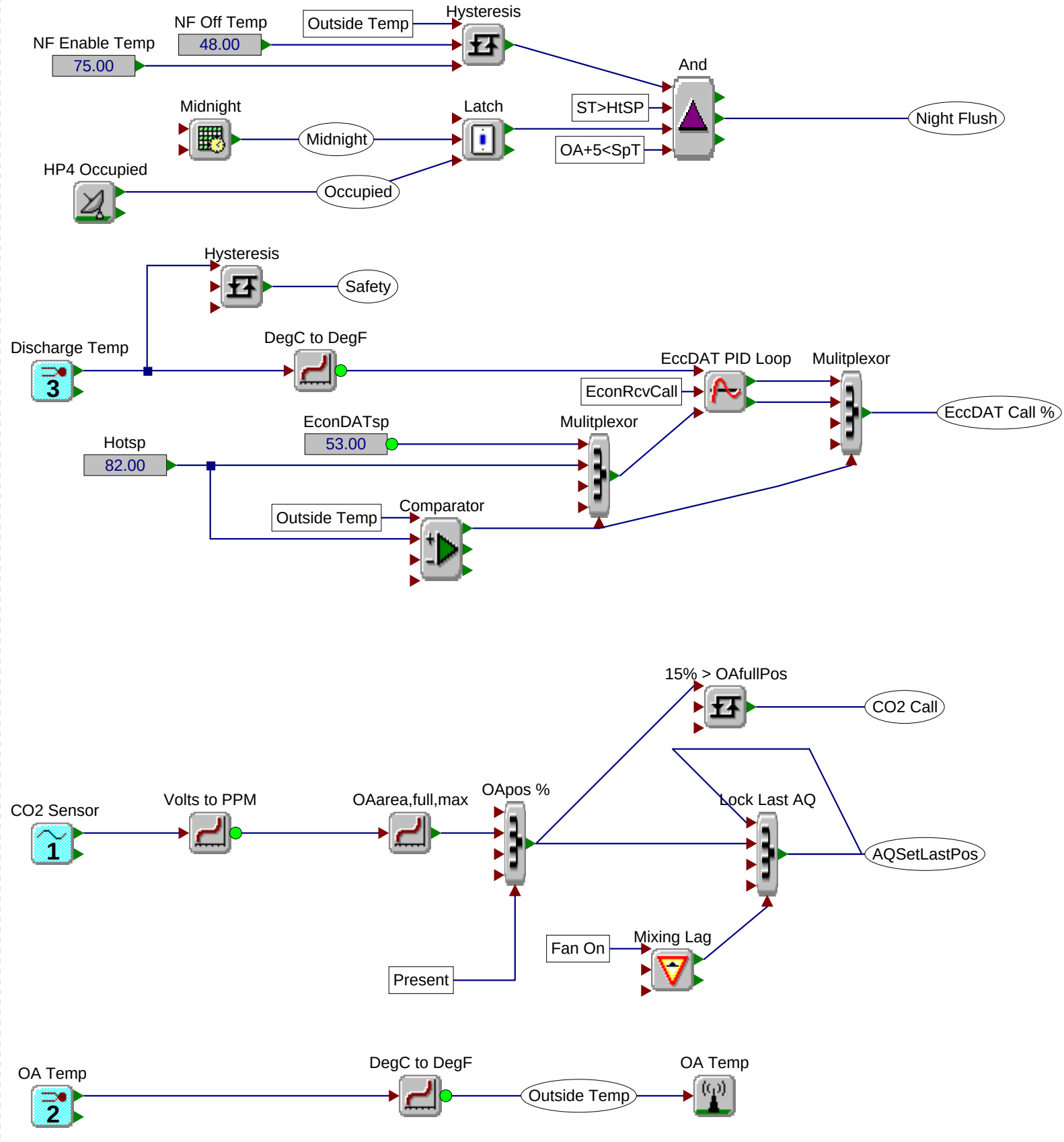
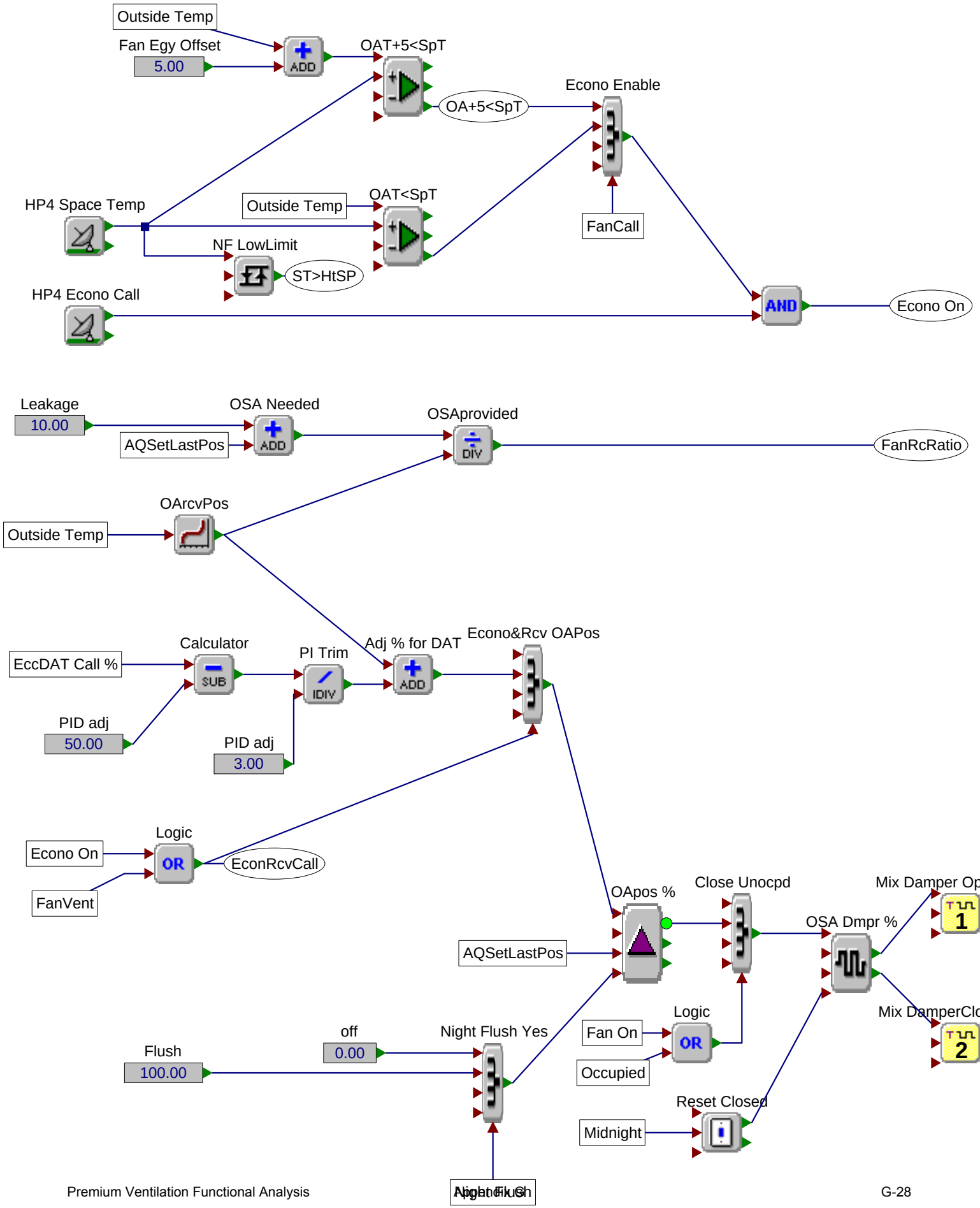
Heat1
Fan On
ElecHtLock
Mode
Outside Temp
Comparator

HP4 Damper Control

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OA+5<SpT
Econo Enable
HP4 Space Temp
Outside Temp
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NF LowLimit
ST>HtSP
FanCall
HP4 Econo Call
AND
Econo On
Leakage
10.00
OSA Needed
AQSetLastPos
ADD
OSAprovided
DIV
FanRcRatio
OArcvPos
Outside Temp
EccDAT Call %
Calculator
SUB
PI Trim
IDIV
Adj % for DAT
ADD
Econo&Rcv OAPos
PID adj
50.00
PID adj
3.00
Econo On
Logic
OR
EconRcvCall
FanVent
OApos %
Close Unocpd
Mix Damper Open
OSA Dmpr %
1
AQSetLastPos
Logic
Fan On
OR
Occupied
Mix DamperClose
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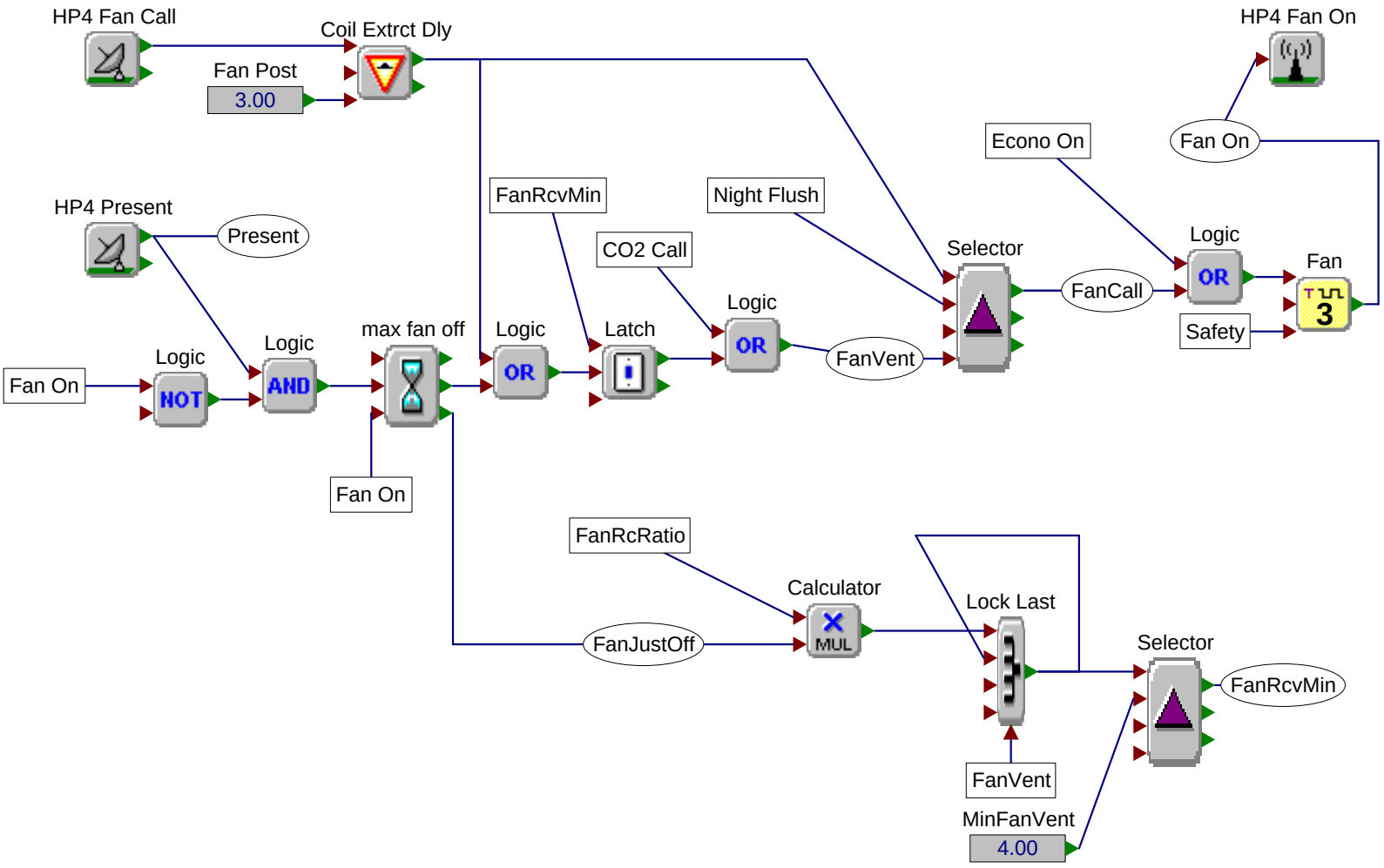
0.00
Night Flush Yes
Flush
100.00
Reset Closed
Midnight
Night Flush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Fan Post
3.00
HP4 Fan On
Econo On
Fan On
HP4 Present
Present
FanRcvMin
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Selector
Logic
OR
Fan
FanCall
Safety
3
Logic
Logic
max fan off
Logic
Latch
Logic
OR
Fan On
NOT
AND
OR
FanVent
Fan On
FanRcRatio
Calculator
Lock Last
Selector
FanJustOff
MUL
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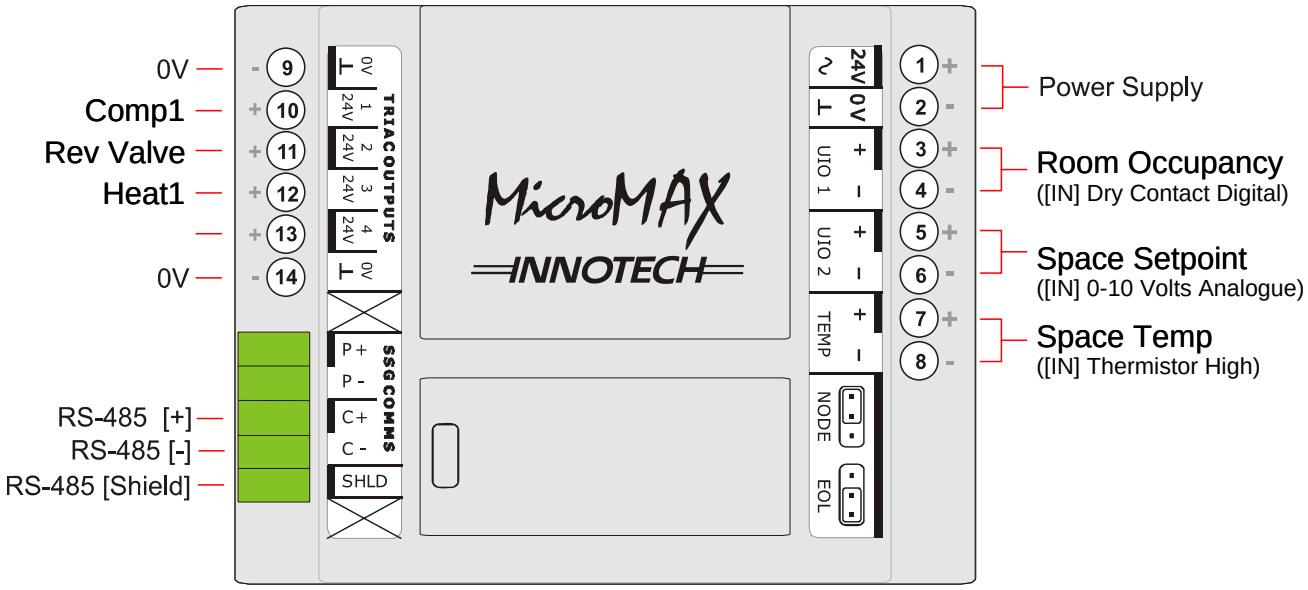
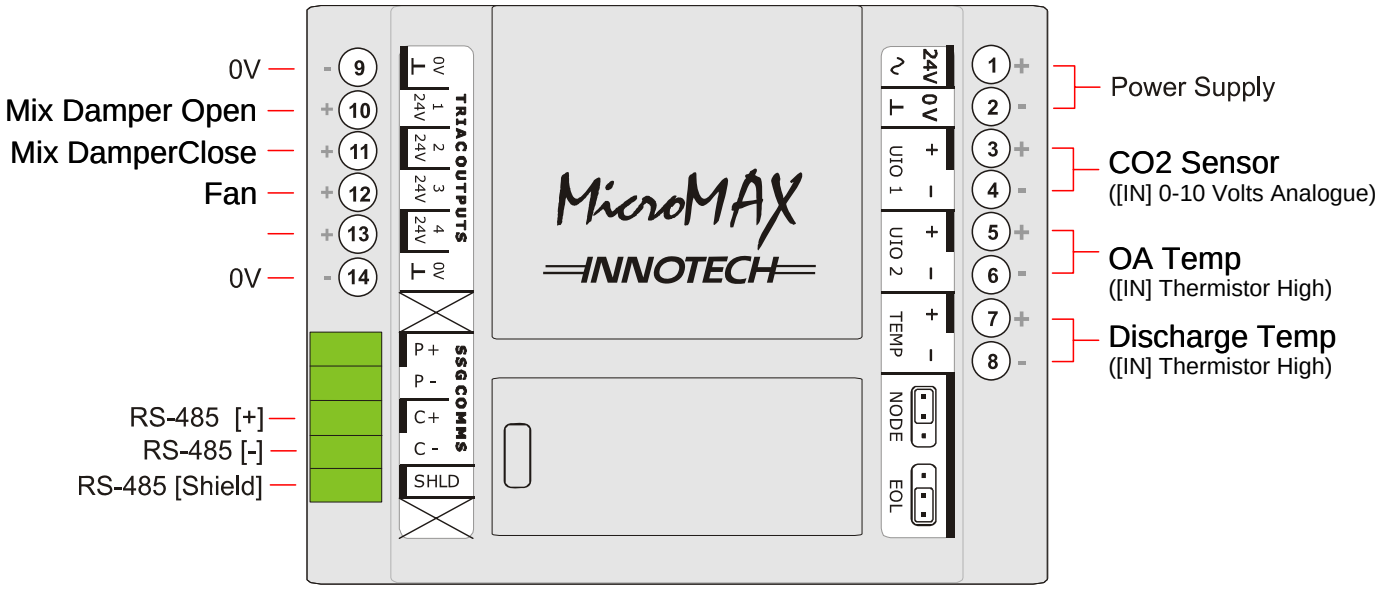
MinFanVent
4.00

HP4 Control Connection Diagram

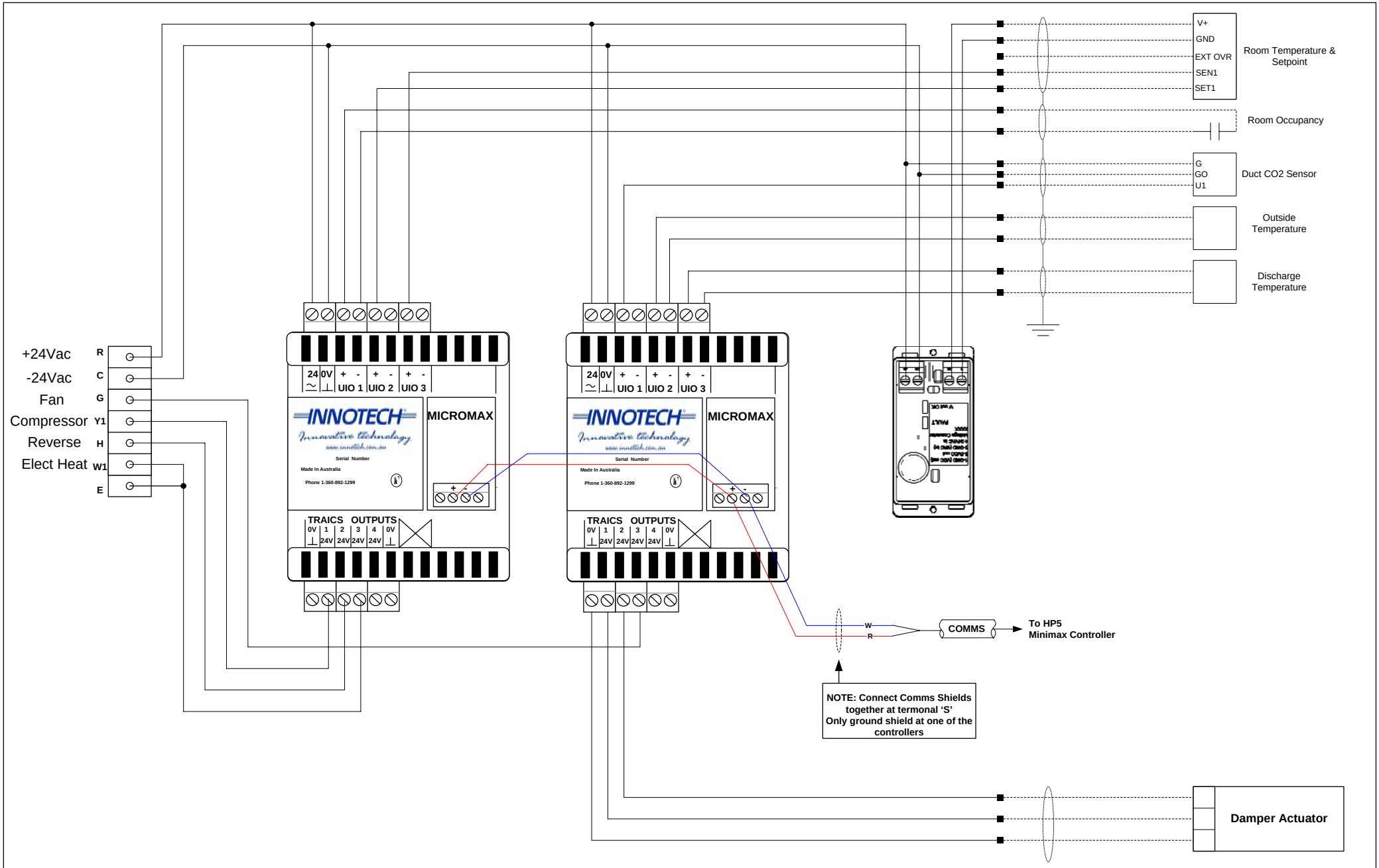
Innotech MicroMax Controller (v6.20)



Innotech MicroMax Controller (v6.20)



HP4 Wiring Diagram



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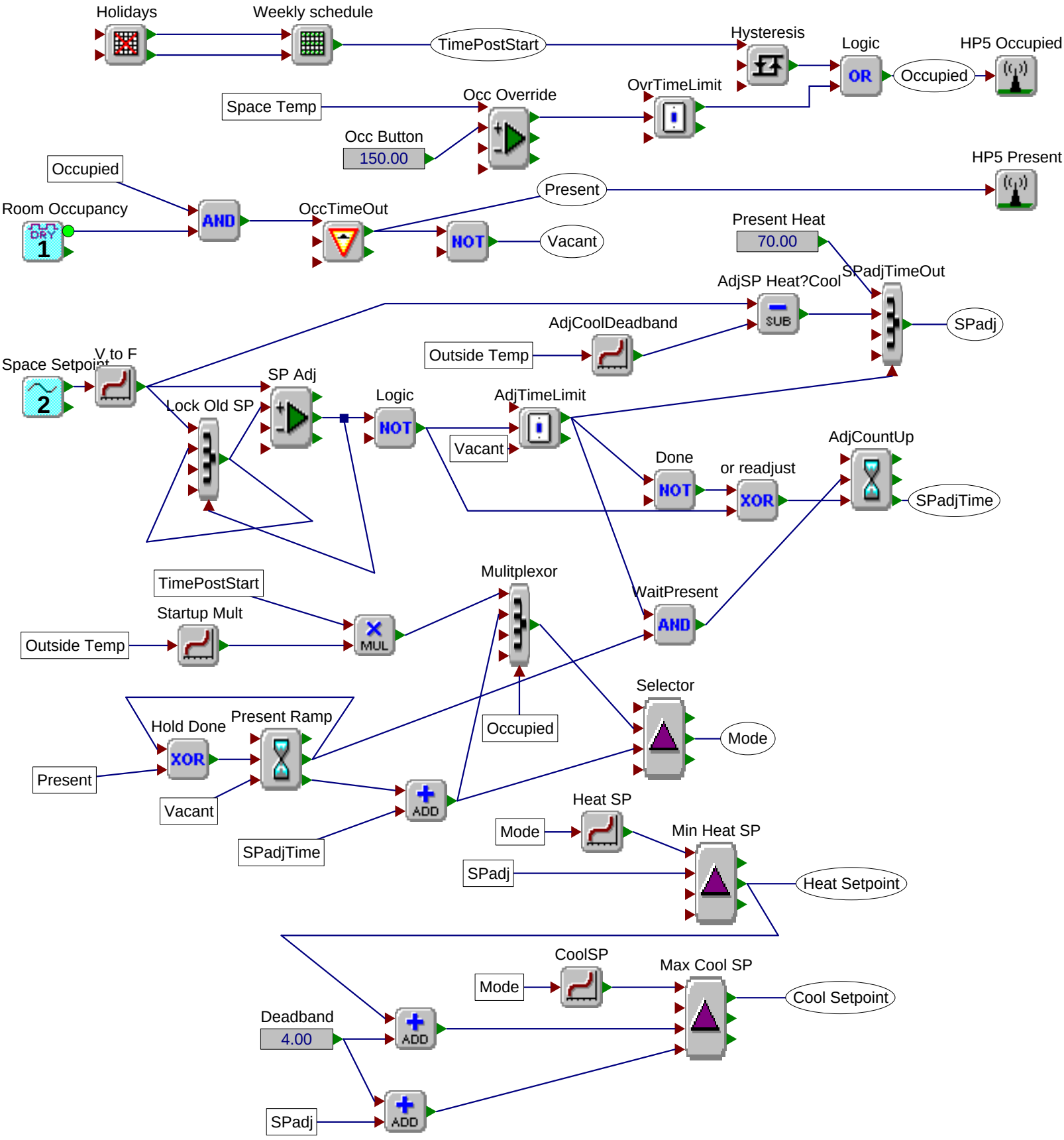
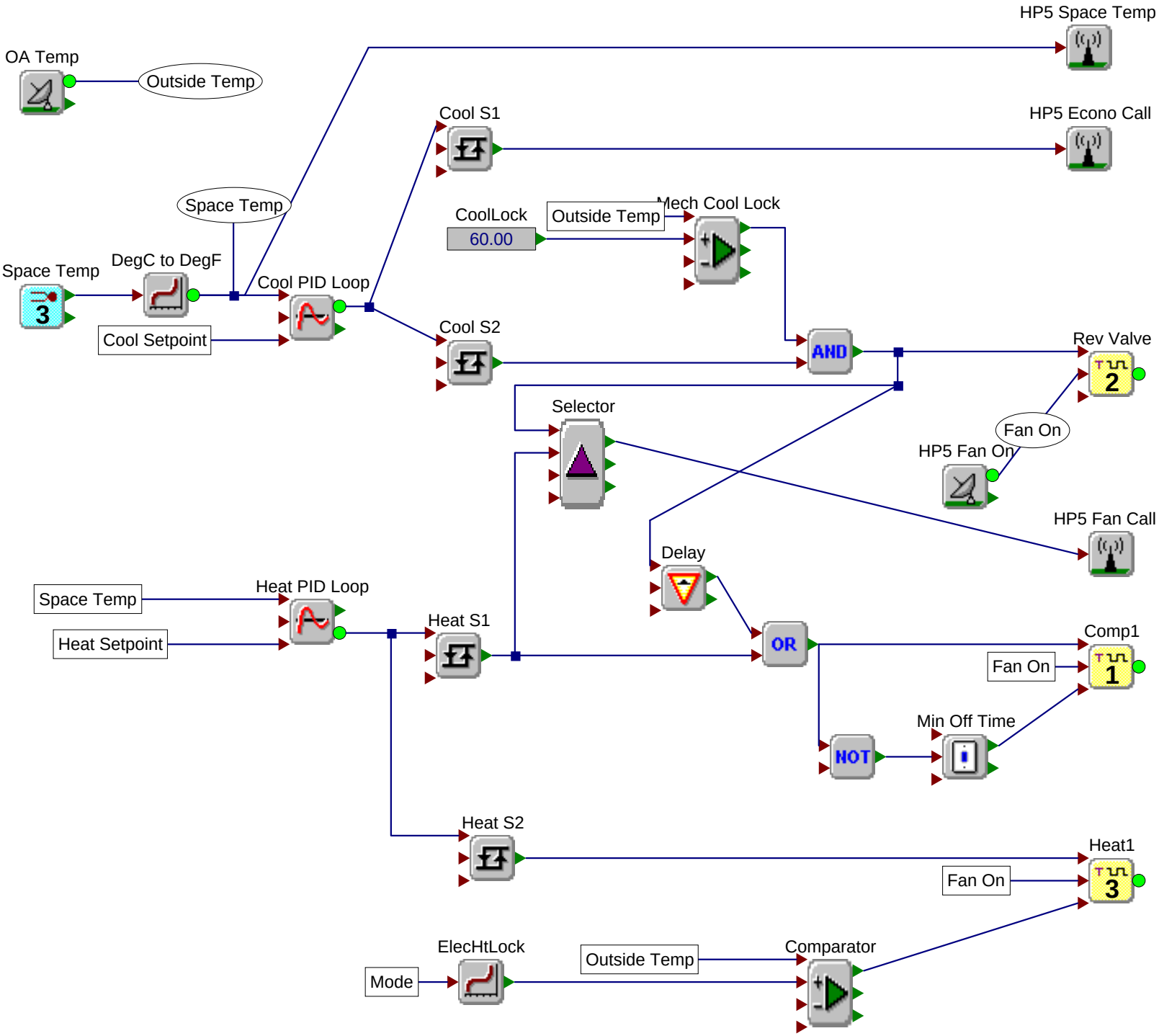
	Project Title: HP4 Control	INNOTECH CONTROLS AMERICA	2027 NW Sierra Lane CAMAS, WA 98607 360-892-1299		CONTRACT NUMBER				
					Detail - 1				

HP5 Control Configuration

HP5 Temperature Control

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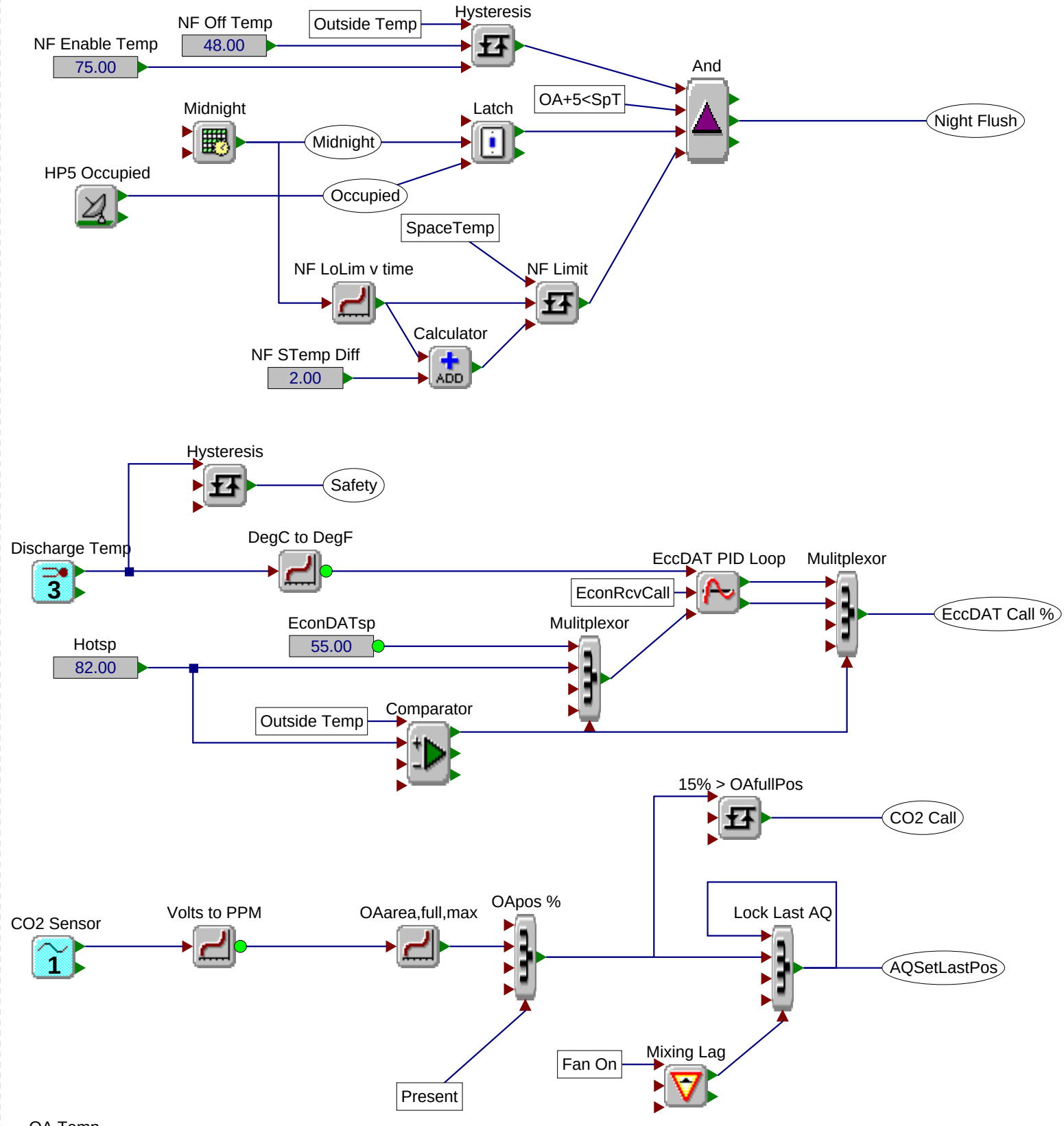
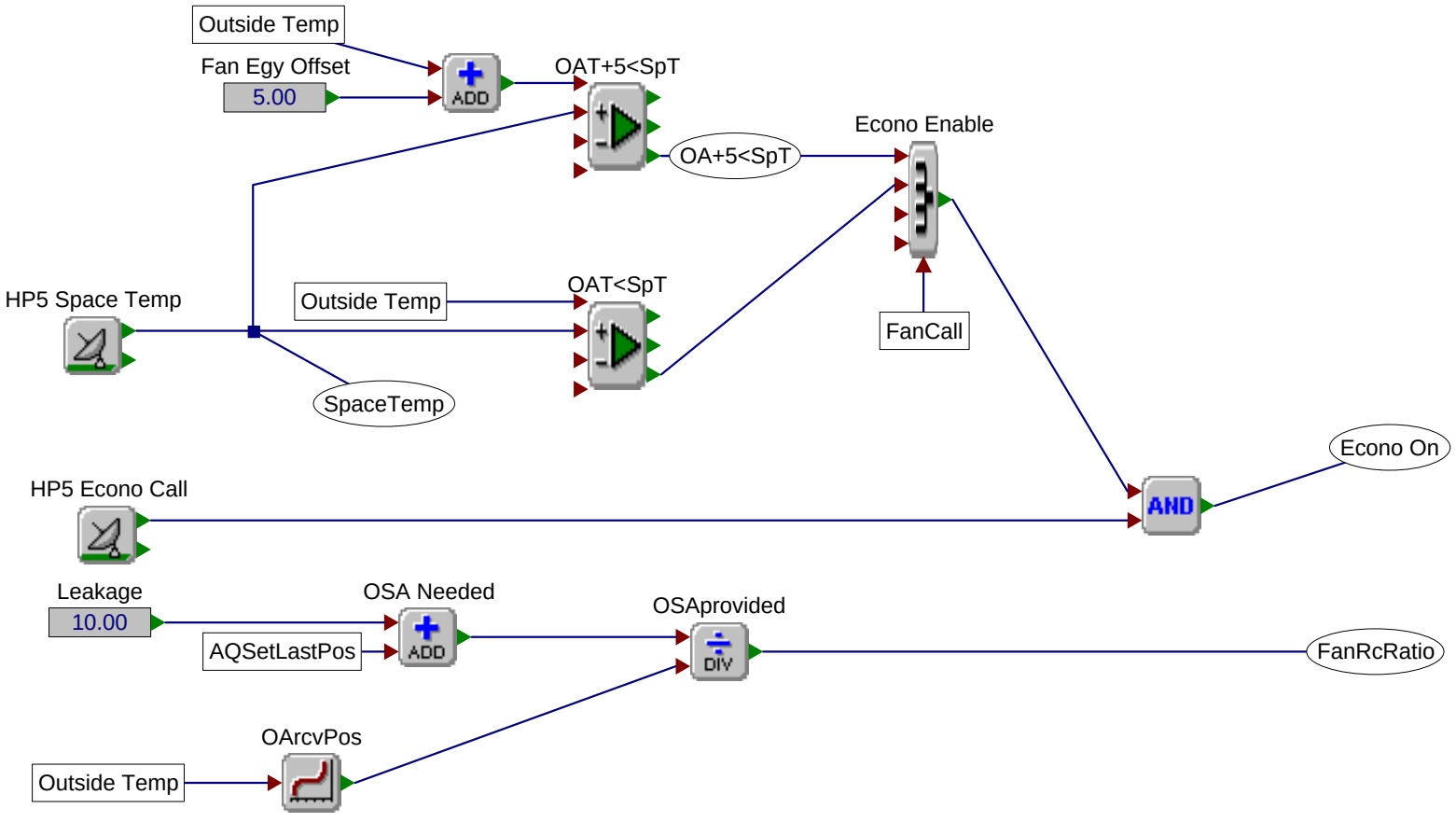
OA Temp
Outside Temp
Cool S1
HP5 Econo Call
Space Temp
CoolLock
60.00
Outside Temp
Mech Cool Lock
Space Temp
DegC to DegF
Cool PID Loop
Cool Setpoint
Cool S2
AND
Rev Valve
Selector
Fan On
HP5 Fan On
HP5 Fan Call
Delay
Space Temp
Heat PID Loop
Heat Setpoint
Heat S1
OR
Comp1
Fan On
Min Off Time
NOT
Heat S2
Heat1
Fan On
ElecHtLock
Mode
Outside Temp
Comparator

HP5 Damper Control - Adv Night Flush

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OA+5<SpT
Econo Enable
HP5 Space Temp
Outside Temp
OAT<SpT
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SpaceTemp
Econo On
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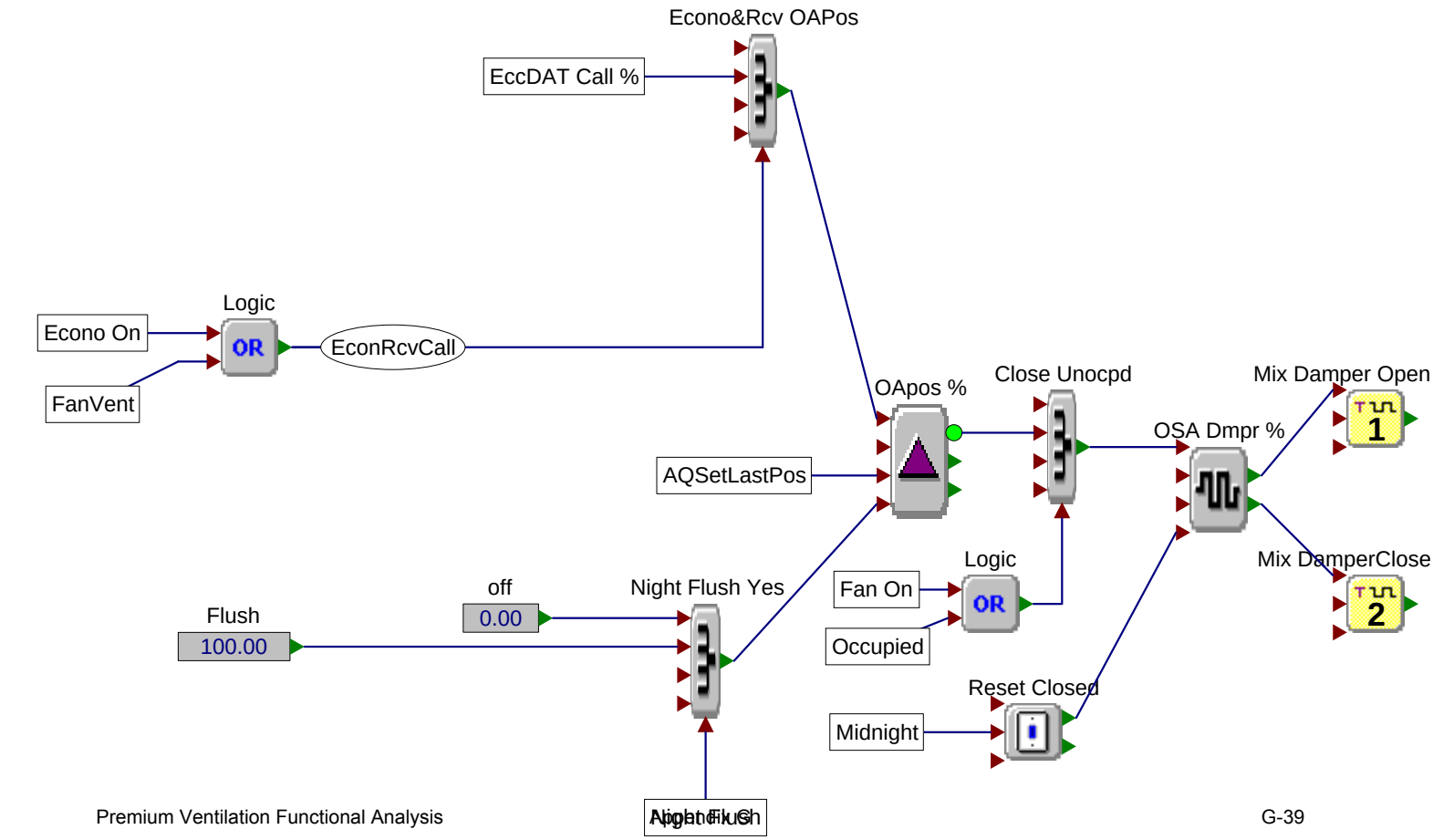
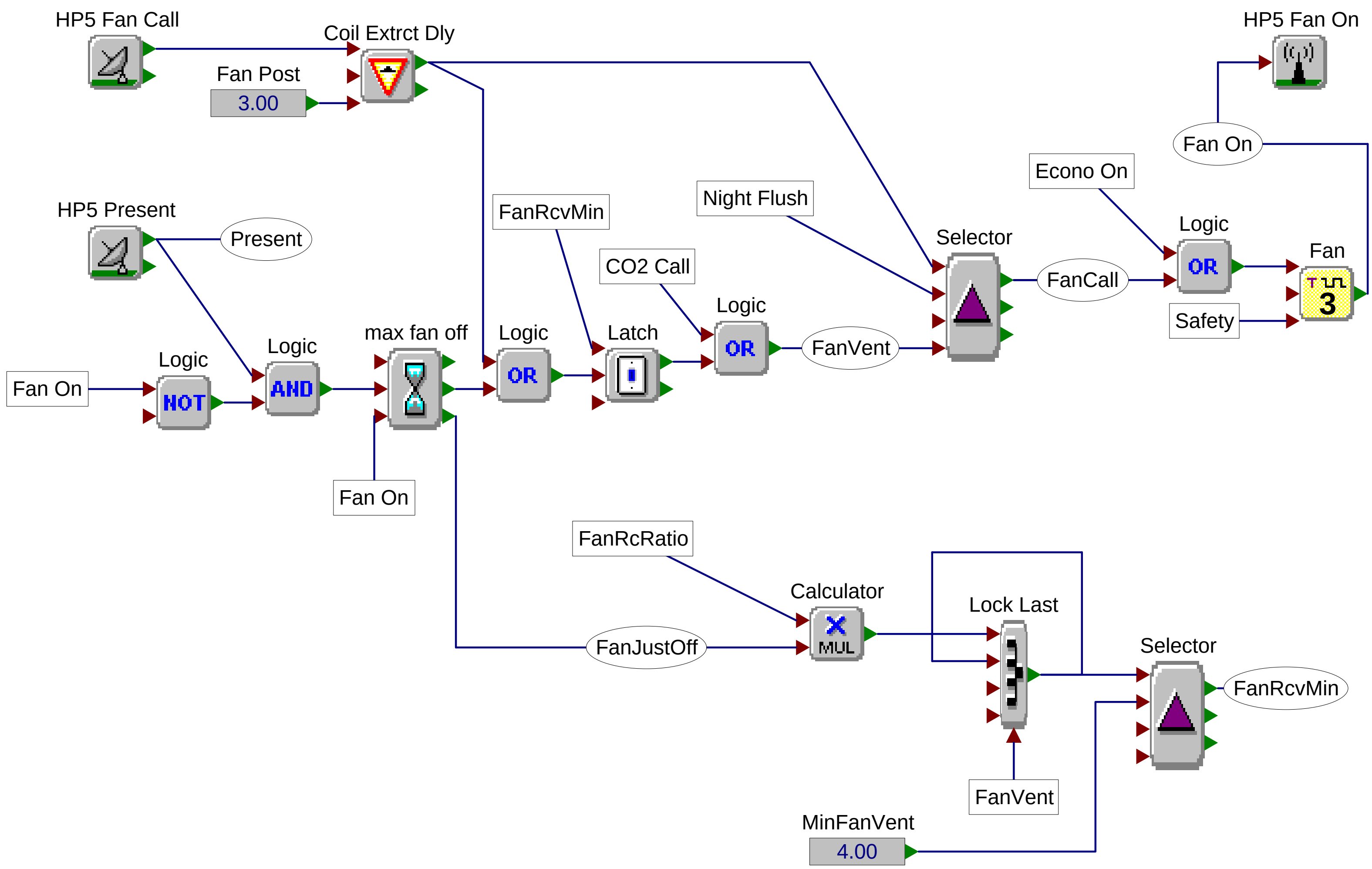
OSAprovided
DIV
FanRcRatio
OArcvPos
Outside Temp


Econo&Rcv OAPos
EccDAT Call %
Logic
Econo On
OR
EconRcvCall
FanVent
OApos %
Close Unocpd
Mix Damper Open
AQSetLastPos
OSA Dmpr %
1
Logic
Mix DamperClose
off
Night Flush Yes
Fan On
Flush
0.00
OR
2
100.00
Occupied
Reset Closed
Midnight
Night Flush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Coil Extrct Dly
Fan Post
3.00
HP5 Fan On
Fan On
Econo On
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Present
FanRcvMin
Night Flush
CO2 Call
Selector
FanCall
Logic
OR
Fan
3
Safety
Logic
OR
FanVent
Fan On
Logic
NOT
Logic
AND
max fan off
Logic
OR
Latch
Fan On
FanRcRatio
Calculator
MUL
FanJustOff
Lock Last
Selector
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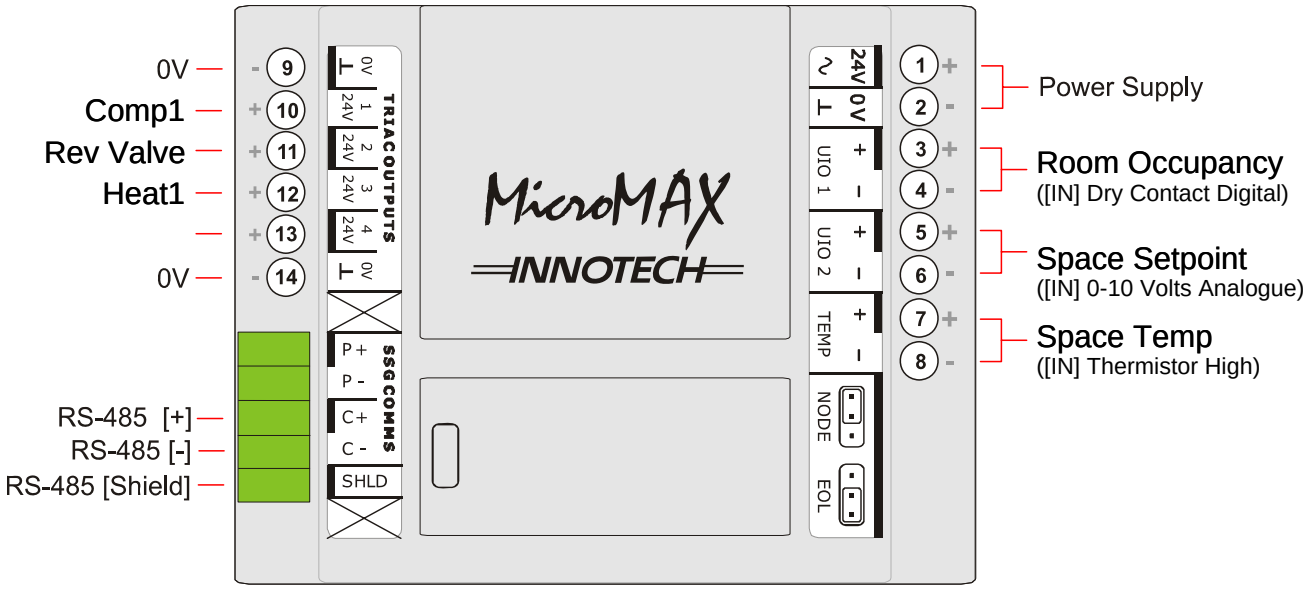
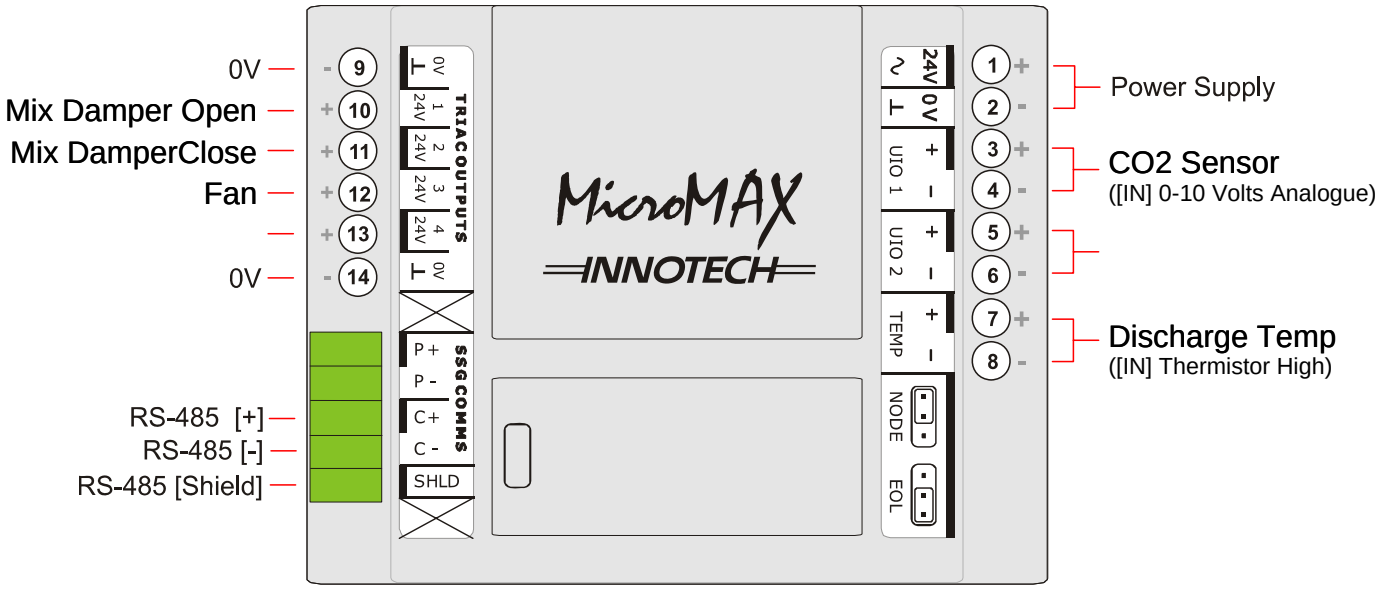
FanVent
MinFanVent
4.00

HP5 Control Connection Diagram

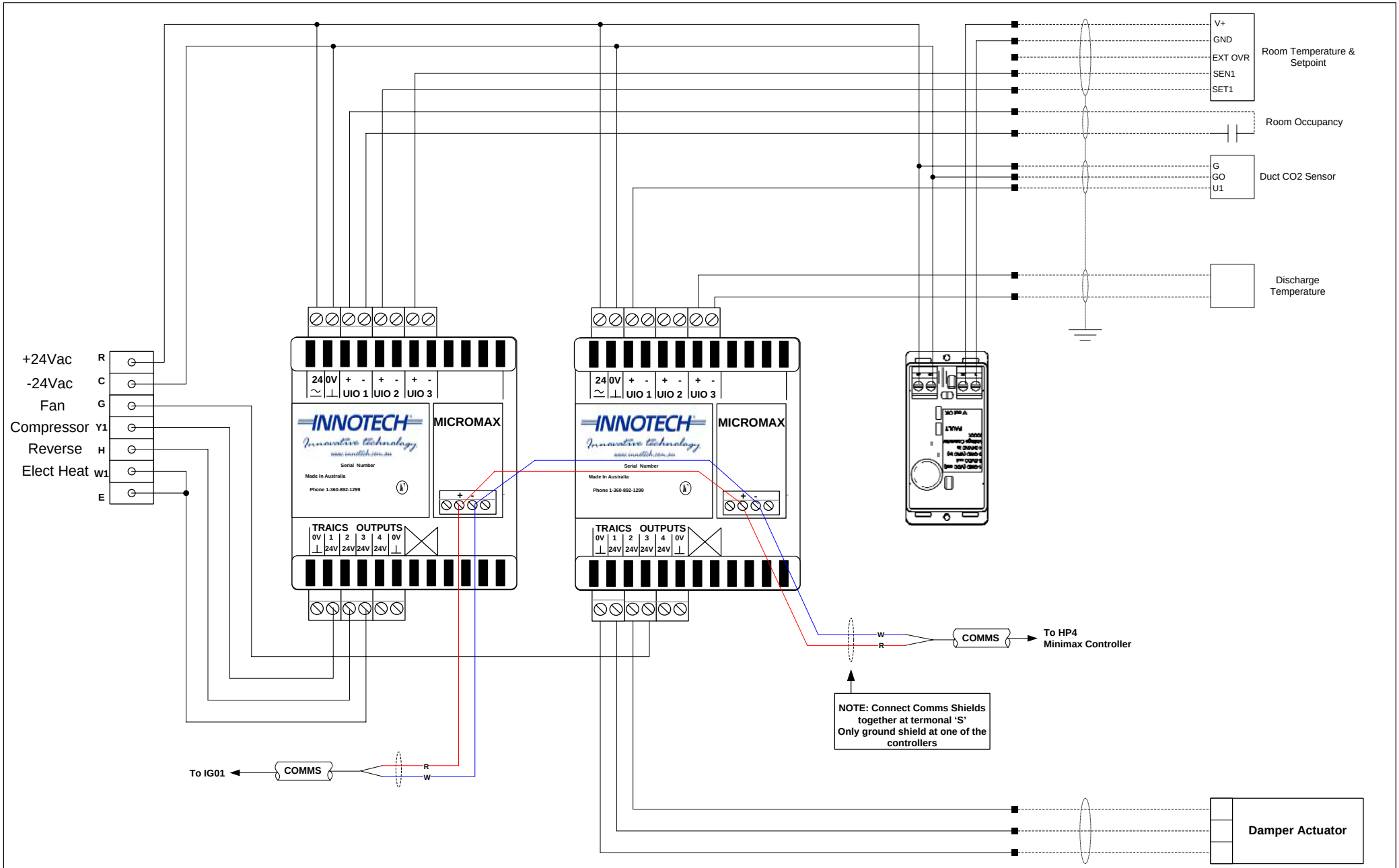
Innotech MicroMax Controller (v6.20)



Innotech MicroMax Controller (v6.20)



HP5 Wiring Diagram



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Sales Engineer	Project Manager	Application Engineer	DRAWN BY	DRAWN DATE	APPROVED BY	APPROVED DATE

Project Title

HP5 Control

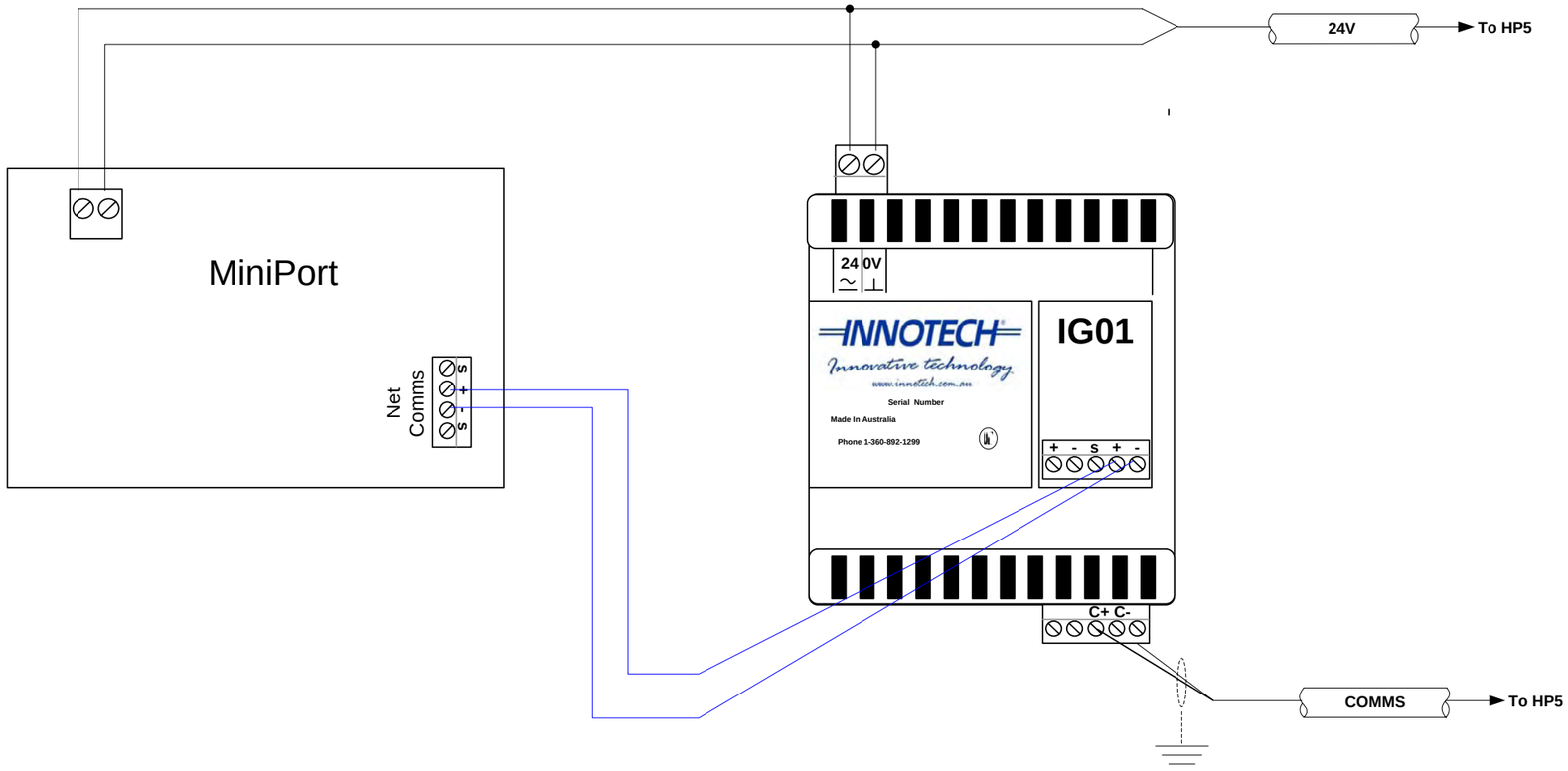
INNOTECH CONTROLS AMERICA

2027 NW Sierra Lane
CAMAS, WA 98607
360-892-1299

CONTRACT NUMBER

Detail - 2

IG01, and Miniport Wiring Diagram



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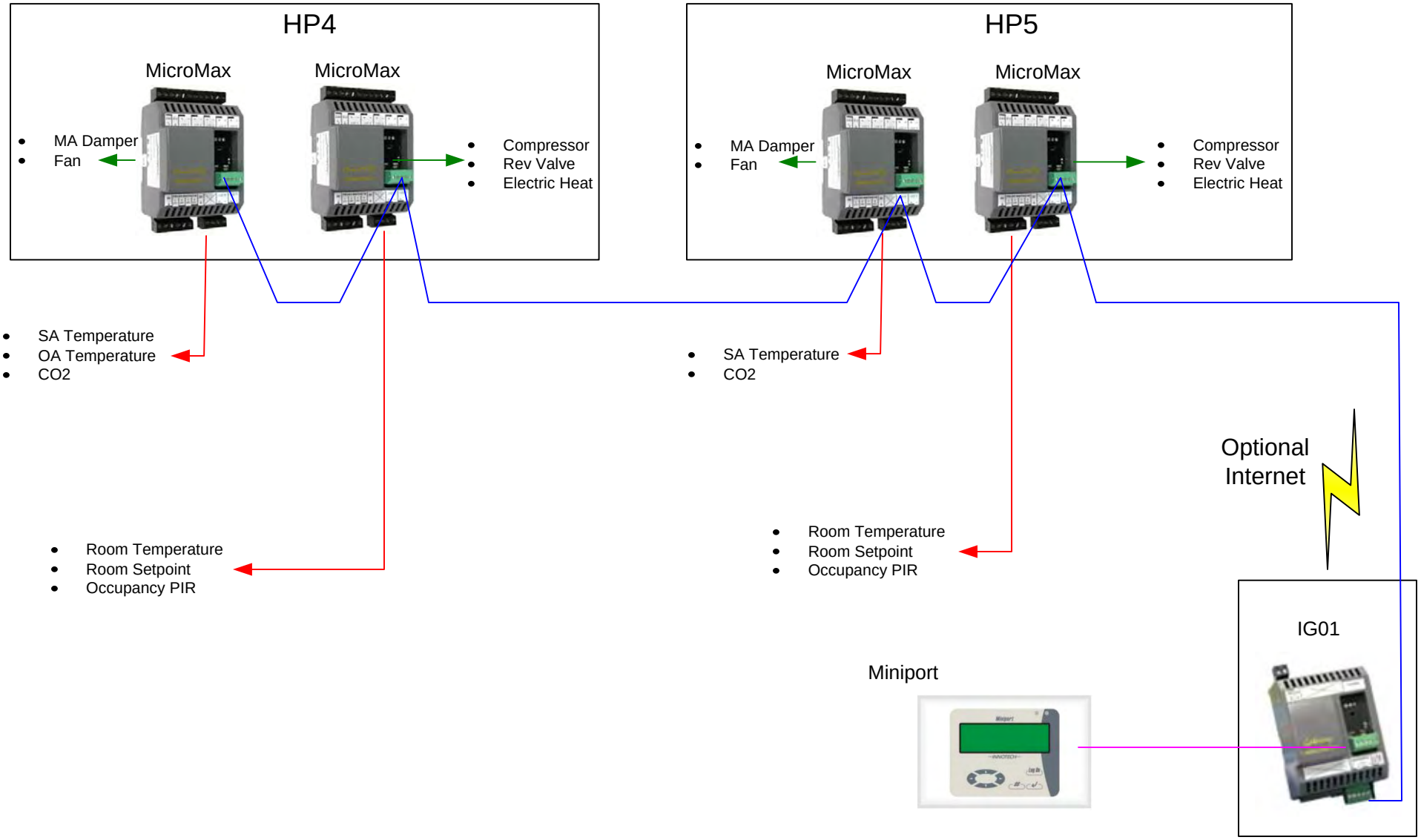
Overview Diagram



INNOTECH AMERICA Innovative technology. Phone: 360-892-1299	System Design	**Drawn for :**	Drawn :	Checked :	Drawing No:
		PECI		Date : 7/19/10	PEC-AM0410

Data Sheets

INNOTECH®
Innovative technology

DS 10.05
November 2009

Model:
UM01: MicroMAX Small Points Contoller

Type: MicroMAX Controller

Overview

The Innotech *MicroMAX* Controller is a state of the art digital processing system that has the capability of controlling various types of industrial, commercial and domestic systems. The *MicroMAX* can operate as a standalone device, using its own universal I/O and TRIAC Outputs to receive information and control external equipment, or as part of a network of Innotech devices, either within the Primary Network or a Sub System Network.

The *MicroMAX* Controller features Universal I/O channels (UIO) which combine the functions of Universal Input and Analog Output channels into a single software programmable channel. Each UIO can be independently set via software to have input or output functionality. With this structure, you are free to assign functions as required, instead of choosing a fixed controller to fit the job.

The *MicroMAX* configuration program is created on a computer using a Windows® based design program. This allows the user to configure the internal processes of the *MicroMAX* by using a graphical programming tool. The user places various process blocks and interconnecting lines to design the required control algorithm for the system.

A connector on the bottom right side of the case provides a RS485 communication interface for communicating with other networked devices.

Applications

The Innotech *MicroMAX* Controller is designed for mounting inside a control cubicle and offers programmable channels, enabling it to monitor and control all types of external plant and equipment. Although the *MicroMAX* is flexible, it is primarily designed for the air conditioning and building automation industry.

The small size of the *MicroMAX* also gives it the advantage of being installed in small places without taking up valuable switchboard real-estate.

The *MicroMAX* is similar in operation to the *MAXIM I* or *MAXIM II* Digital Controllers, but provides Universal Input/Output points that are user configurable and completely independent.

The creation of control strategies is made simple by the use of the Innotech *MAXCon* utility. *MAXCon*, with its powerful Graphical User Interface, allows the user to create an entire control strategy in block-diagram form.

Typical applications include:

- Air conditioning and heating systems.
- Lighting control.
- Monitoring device.
- Distributed I/O points controller.
- Cold/Freezer Rooms.

Features

- 100 millisecond cycle/scan time.
- 1 x dedicated thermistor input.
- 2 x independent configurable Universal Inputs/Outputs.
- 4 x 24 V AC TRIAC Outputs.
- 1 x RS485 Serial Communications Port.
- User selectable Baud Rate:
  - a) Innotech Net Comms 57600bps
  - b) Innotech Sub System Gateway Comms 115200bps
- All wire connections by pluggable screw terminals.
- Program resides in non-volatile flash RAM.
- Real-Time Clock (not battery backed).
- Visual indication of Power, Comms and System Activity.

Approvals

The Innotech *MicroMAX* Controller conforms to:

- EN 61326:1998 for CE Marking and C-Tick Labelling.
- Title 47 CFR, Part 15 Class A for FCC Marking.
- UL listed to UL916, File Number E242628

Specifications

Power Supply Requirements

- 24 V AC ± 10% @ 50 / 60 Hz.
- Transformer nominal rating (maximum TRIAC load): 35VA
- Transformer nominal rating (no TRIAC load): 10VA

The operating voltage must meet the requirements of Safety Extra Low Voltage (SELV) to EN60730. The transformer used must be a Class 2 safety transformer in compliance with EN60742 and be designed for 100% duty. It must also be sized and fused in compliance with local safety regulations.

Temperature Ratings

- Storage: -5 to 60°C non-condensing.
- Operating: 0 to 50°C non-condensing.

Enclosure

The *MicroMAX* is housed in a rectangular case suitable for DIN Rail mounting. The housing is moulded from flame retardant plastics recognised by UL as UL 94-V0.

Colour: Grey.
Dimensions (max): 71mm(w) x 115mm(h) x 67mm(d).

Universal Inputs/Outputs

2 UIOs, independently configurable via software to either:

- Dry Digital Input.
- 0 or 10 V Digital Input.
- 10k Thermistor Input.
- 0-10 V DC Analog Input.
- LUX sensor input (Light sensor ORP12 LDR).
- 13Hz PWM (0/10 V) Output.
- 0-10 V Analog DC Output.
- Digital Output (0 V / 10 V).
- Dry Pulse Counter Input
- 0 or 10 V Pulse Counter Input

Analogue Mode

- Input accuracy: ±0.1 V.
- Input Impedance: ~75kOhms.
- Input resolution: ~10mV.
- Output accuracy: ±0.1 V (R_{Load} > 2kOhms).
- Output resolution: ~40mV.

Digital Mode

- Output current: Max 10mA.
- Output Voltage swing: 0.3 V - 9.5 V @10mA.
- Input Voltage range: 0 V – 10 V.
- Input Impedance (Dry): ~8.8kOhms.
- Switching threshold (Dry): 4.5 V.
- Input Impedance: ~75kOhms.
- Switching threshold: 5 V.
- PWM Duty Cycle accuracy is ±5%.

Temperature Mode

- Designed for use with Innotech *SEN* Series Detectors.
- Nominal sensing range -5°C to 60°C.
- Accuracy ±3.5%FS (R25°C = 10kOhms).

UIO Type	Input Range	Output Range
0-10 V DC Input	0 to 10 V DC	0 to 10 V DC
Dry Digital Input	Open or Closed	OFF or ON
Voltage Digital Input	0 to 10 V DC	OFF or ON
Thermistor Input	659k to 677 ohms	-50 to 100°C
LUX Sensor Input	20kOhm to 400 ohms	0 to 2500 LUX
Dry Pulse Counter Input	Open or Closed 20ms Min. ON Time 20ms Min. OFF Time	0 to 25 pulses per second ±1 pulse accuracy
Voltage Pulse Counter Input	0-10 V Square Wave 20ms Min. ON Time 20ms Min. OFF Time	0 to 25 pulses per second ±1 pulse accuracy
0-10 V DC Output	0 to 100%	0 to 10 V DC
Digital Output	OFF or ON	0 or 10 V DC

Fixed Thermistor Input

- 1 Fixed Thermistor Input
- Designed for use with Innotech *SEN* Series Detectors.
- Nominal sensing range -5°C to 60°C.
- Accuracy ±3.5%FS (R25°C = 10kOhms).

Note: LUX Sensor Input mode is useful for switching based on ambient light levels, but is not suitable for any operation which requires the accurate measurement or recording of light levels.

TRIAC Outputs

- 4 TRIAC Outputs: switches 24 V AC Power Supply through to Outputs.
- Current rating (per output): min. 20mA / max. 250mA.
- Modes: Modulation or Digital On/Off.

Note: The use of pilot relays is recommended when switching high inductive loads.

LED Indication

Red LED
- Power LED located internally.

Bicolour LED
- RS485 Communication
- Transmit (Red), Receive (Green).

Orange LED
- Used as an aid when addressing/locating devices on the Sub System Network.

Communications

1 x RS485:
- Serial communications channel optimised for fast data transmission with the Sub System Gateway.
- Providing Netcomms only if used without the Sub System Gateway
- Communication to Innotech *CT01* Handheld Commissioning Tool.
- Connectivity is provided through a 5-way pluggable screw terminal connector.

Note: this connector is not compatible with the standard 5-way connector used for Global and Net Comms on other Innotech products.

Installation

The *MicroMAX* should be installed in an environment that does not exceed the maximum operating parameters of the device. It should be mounted in a dry, clean and vibration free environment.

It is important to ensure proper ventilation, especially when the Digital TRIAC Outputs are in use.

RS485 Comms Termination

The *MicroMAX* has communication termination requirements when used within a Sub System Network. Refer to the Innotech Network Cabling Manual DS 99.04 for a description in the use of End of Line Jumpers (EOL).

Note: Incorrect use of End of Line Jumpers can cause unreliable communication or total network failure.

Networks and Addressing

Network

The *MicroMAX* is designed primarily for use with the IG01 Sub System Gateway, but can be used as a part of the standard Innotech Network or standalone. The mode of operation is configured by setting the User Selectable Baud Rate.

In a standard Innotech Network, the *MicroMAX* uses NET 57600 baud rate. Since the controller does not have Global Comms and data logging memory, it does not provide the following features:
- Data Logging
- Global Points
- Alarms
- Real Time Synchronisation

In a Sub System Network, the *MicroMAX* uses 115200 baud rate. The IG01 Sub System Gateway transparently provides, for any *MicroMAX* on its network, the above features that the *MicroMAX* does not support in the standard Innotech Network mode.

Addressing

The *MicroMAX* has different addressing schemes associated with the network that it is configured for. The two addressing schemes are:
- IG01 Sub System Gateway Automatic addressing – the IG01 Sub System Gateway will dynamically assign the address.
- Standard Innotech Network Static addressing – the *MicroMAX* is assigned the address by the same means as any other controller on the standard Innotech Network.

Please note, in IG01 Sub System Gateway Addressing Mode the IG01 Sub System Gateway assigns the *MicroMAX* its address when it joins a Sub System Network or power cycles.

Commissioning Tool

A special handheld Commissioning Tool (CT01) can be used to configure a *MicroMAX* on a Sub System Network. The configuration loaded on the *MicroMAX* determines the parameters associated with the control strategy that can be adjusted with the CT01.

If there is no configuration loaded into the *MicroMAX*, then the *MicroMAX* is not operational; therefore no parameters can be changed or monitored.

The CT01 can be connected directly to the *MicroMAX* or to the Sub System Network using the supplied adapter cable to configure multiple *MicroMAX* controllers. The IG01 Sub System Gateway has to be disconnected from the network when the CT01 is connected to the Sub System Network.

For ease of use the CT01 has a 4 line, 20 character Liquid Crystal Display and Keypad. The Keypad consists of seven push buttons to provide input into the *MicroMAX* of interest. These buttons are “Up”, “Down”, “Left”, “Right”, “Log On”, “Enter” and “Escape”. Using these buttons, the user can gain access to the *MicroMAX* controller’s menu structure shown below.

Default ----Status----Clock----Setup----Commission
- Var Setup
- IO Config
- PID Par

For more detailed instructions, please refer to the documentation supplied with the Commissioning Tool CT01.

Associated Software

MAXCon - Innotech MAXIM Controller Configuration utility. It allows the user to internally configure a *MicroMAX* by a simple point-and-click approach on a Personal Computer (PC) running Windows.

MAXMon - The Innotech MAXIM Monitor is a monitoring and debugging utility designed to help with commissioning and trouble-shooting a *MicroMAX* Controller. It displays the configuration which resides on a *MicroMAX* Controller and allows the user to inspect, trend or modify the value at any of the points in the configuration while the controller is running.

MicroMAX Simulator - The Innotech MicroMAX Simulator utility is a Windows-based software program that simulates a *MicroMAX* Controller. The virtual *MicroMAX* can be powered on, configured and interrogated in the same way as a physical *MicroMAX*. Configurations can be downloaded and checked without requiring any hardware installation.

iComm - A communications server used by application software to communicate with Innotech digital controllers. It supports multiple concurrent applications communicating to multiple device networks and serves as the communications hub of any HMI-integrated device network.

MAXtract - The data log extraction utility for a range of Innotech digital controllers. It allows extraction of all or part of the history log data associated with Maxim Controllers into a specified data format.

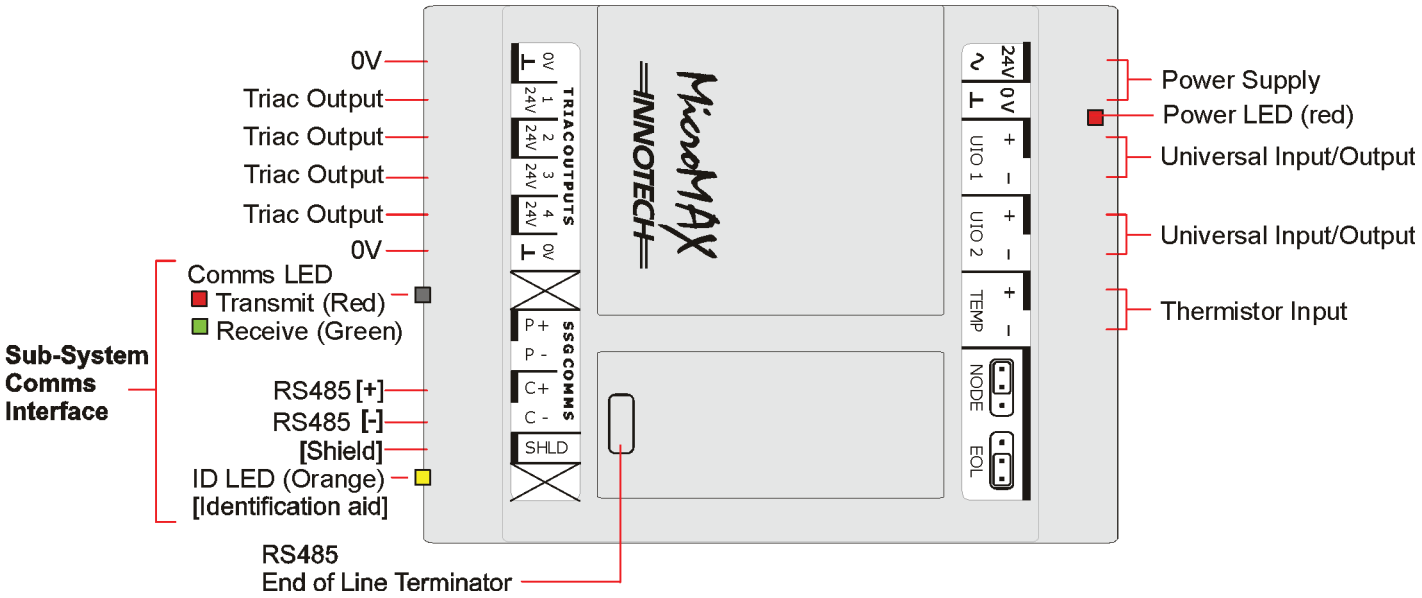
InnoGraph - Innotech's data log graphing and analysis tool. While it has been designed to specifically cater for the data log graphing capabilities of the Innotech range, it has the flexibility to display data log graphing information from other sources. InnoGraph allows multiple graphs to be displayed in multiple windows simultaneously. Complete with a host of configurable display options, statistical analysis of data points, analogue and digital value support, active cursors, colour printing capability and comprehensive zooming and panning features, InnoGraph is your complete graphing package.

Supervisor/Supervisor Plus - A specialised dynamic monitoring utility for the Genesis II and Maxim Series Digital Controllers. It provides all the functionality that is available from the Genesis II and Maxim Series Digital Controller display panels with greater ease-of-use and flexibility. It is aimed at those users who require some feedback or control of the Genesis II and Maxim systems, but have no desire to be immersed in the technical details of a Genesis II and Maxim configurations.

Note: Supervisor Plus allows the user to change the way the watch items are displayed so that the information is presented in a better and more easily understood manner. The user can set background images, arrange the watch items around the page and customise the fonts used.

Magellan - An event-driven, object oriented real-time Supervisory Control and Data Acquisition package. It provides a simple, intuitive mechanism to effortlessly design either trivial or sophisticated supervisory or control programs using a drag-and-drop approach.

Connection Diagram



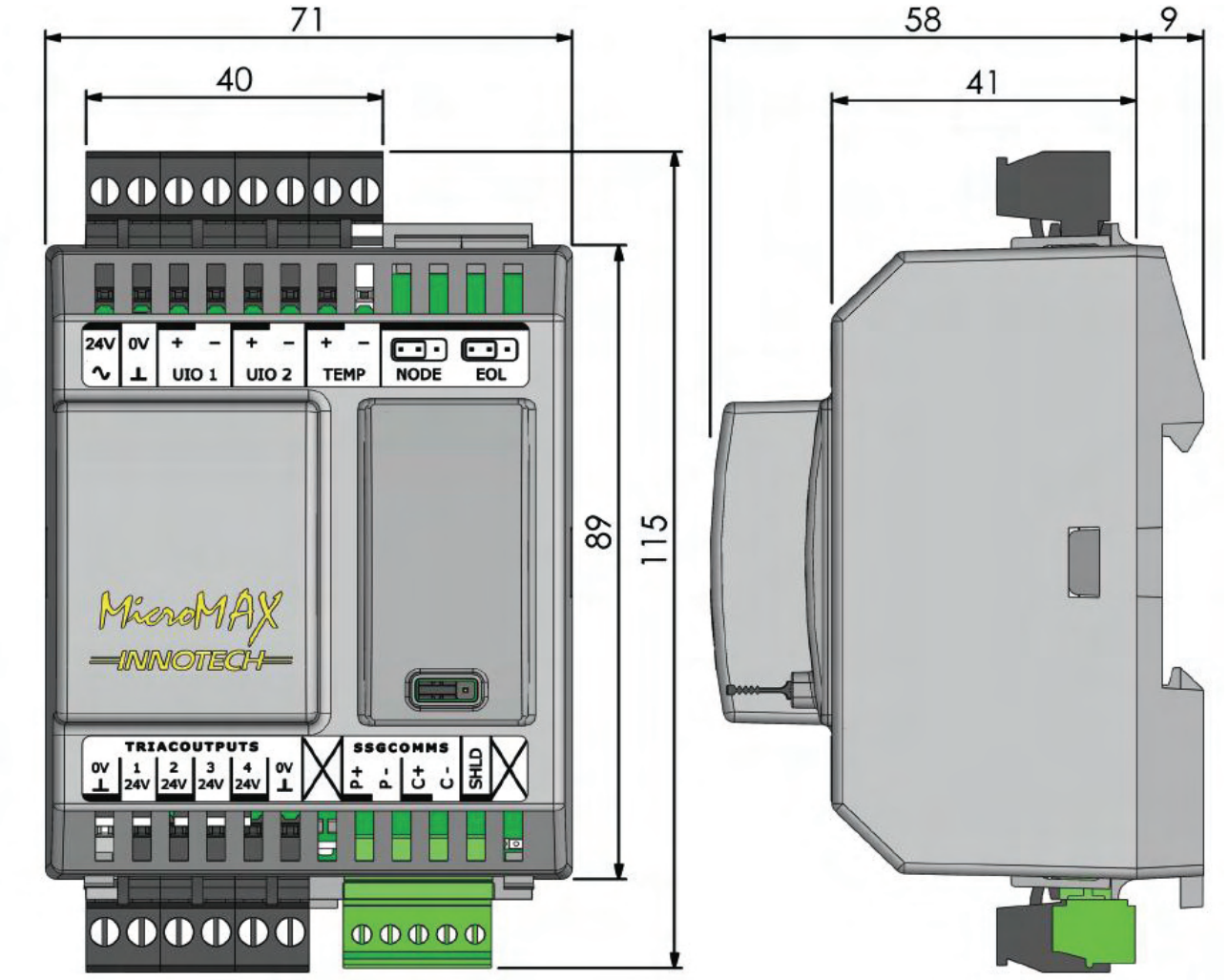
FCC Class A Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Modifications to this device, may void the authority granted to the user by the FCC to operate this equipment.

Dimensional Diagram



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Innovative technology
Australian Owned, Designed & Manufactured
by Mass Electronics Brisbane
Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
Email: sales@innotech.com.au www.innotech.com.au

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DS 26.01
OCTOBER 2007

MODELS:
IG01: Sub System Gateway

Sub System Gateway

Overview

The Sub System Gateway (SSG) is a state of the art Communication System, providing the ability to add Sub System Networks of Innotech controllers with a single channel of communications to Innotech Net and Global Networks. The SSG also provides logging and a battery-backed real time clock for devices on its network.
Each Device comes preconfigured with a standard SSG configuration containing weekly and yearly schedules optimum start routines.

Features

- 1 x Isolated High Speed RS485 serial Sub System Network Interface
- 2 x RS485 serial Primary Network ports.
- 1 x Isolated Ethernet (10baseT) Primary Network port (Net)
- User selectable Baud rate on RS485 Primary Network ports
- Hosts up to 62 Sub System devices
- Efficient data routing
- Reduces wiring cost due to single wire Sub Networks
- All wires connected by pluggable screw terminals
- Program resides in non-volatile Flash RAM
- Real-Time Clock (battery backed)
- Visual indication of power, system and communication activity

Approvals

The SSG conforms to:

- EN 61326:1998 for CE Marking and C-Tick Labelling
- Title 47 CFR, Part 15 Class A for FCC Marking
- UL listed to UL916, File Number E242628

Applications

The *SSG* is specifically designed to be used in conjunction with Sub System Controllers which have a single channel of communications, such as the MiniMax (MM02) and VAVMax (VM01).

Installation

The SSG should be installed in an environment that does not exceed the maximum operating parameters of the device.
It should be mounted in a dry, clean and vibration free environment.
The small size of the *SSG* also gives it the advantage of being installed in space reduced environments.
The SSG can directly host up to 62 Sub Net devices wired in daisy chain configuration.
Due to the higher communications speed of the Sub System network, good quality RS485 cable should be utilised and short screen connections maintained when connecting controllers.

Installation cont.

This will ensure reliable communication of up to 200m. Repeaters should be used to isolate sections of a network as a protection against external dangers damaging the entire network.
The Innotech network cabling manual DS99.04 contains more valuable information on how to setup your network.

Specifications

Power Supply Requirements

24VAC ± 10% @ 50/60 Hz
Power consumption: 4VA
24VDC + 20% - 10%
Power consumption 2,3W
Recommended transformer rating of 8VA or greater.
The operating voltage must meet the requirements of Safe Extra Low Voltage (SELV) to EN60730. The transformer used must be a Class 2 safety transformer in compliance with EN60742 and be designed for 100% duty. It must also be sized and fused in compliance with local safety regulations.

Battery

Contains a Lithium Battery, dispose of properly
Type CR-2032 Lithium Battery
Nominal voltage 3 Volts
Shelf life - 5 Years dependant on ambient temperature.
CAUTION - Risk of explosion if battery is replaced by an incorrect type.

Temperature Ratings

- Storage -5 to 60°C non-condensing
- Operating 0 to 50°C non-condensing

Encloure/Mounting

The *SSG* is housed in a rectangular case suitable for DIN Rail mounting.
The housing is moulded from flame retardant plastics recognised by UL as UL 94-V0.
Colour: Grey
Dimensions (max): 71mm x 115mm x 67mm

Optical Indicators

LED POWER (Red LED):

- Indicates power is supplied to the device

HEARTBEAT (Green LED):

- Regular flashing indicates device is operational

COMMS (3 x Bicolour LEDs):

- Indicate RS485 network activity on each channel. The LEDs for each channel are physically aligned with the appropriate comms connector for that channel. (Red = Transmit, Green = Receive)

RJ45 LEDs:

- Indicates connectivity to Ethernet (Orange) and network activity (Green)

Communications

- Sub System Comms:
  RS485 Serial communications channel optimised for fast data transmission to a Sub System network of Innotech controllers
  Connectivity is provided through a 5-way pluggable screw terminal connector on the bottom right of the product
- Net and Global Comms:
  RS485 Serial communications channels for data transmission to an Innotech Controller network
  Connectivity is provided through a 5-way pluggable screw terminal connector on the front of the product
- Ethernet:
  Ethernet communications channel for dedicated data transmission to a PC
  Connectivity is provided through an RJ45 socket on the top right of the product

Configuration

The SSG is loaded with a predefined configuration containing weekly and yearly schedules, and optimum start block and global points to provide common schedules to all controllers on the Sub System network.
The blocks in the configuration are editable via the HMI which can be accessed via a Miniport, Software, Viewport or Softport. The software applications Maxmon, Supervisor and Magellan also provide access to the internal config.

RS485 Comms Termination

Generally a daisy chain network configuration is recommended for a high speed network such as the one provided from an SSG. If the SSG is situated at the end of such a network, place the jumper to [EOL] position. The Innotech Cabling Network Manual DS99.04 contains valuable information and examples on how to correctly setup your network wiring.

Attention:
Without any exceptions, there are always only 2 devices on a proper terminated Sub System network that have this jumper fitted!
All other devices should **not** have a jumper in position [EOL]. Incorrect use of EOL jumpers can cause unreliable communications or total network failure.

Networks and Addressing

The SSG is designed for use with a Sub System network of controllers such as VAVMax (VM01) or MiniMax (MM02) and with a standard Innotech Network.
The SSG is managing the resources of all devices that are connected to it. It reduces the load on master controllers in a large network and reduces network traffic.

Example:
The small Innotech controllers, such as the MiniMax (MM02) and VAVMax (VM01), do not provide:
- Logging
- Battery backed time clock
- Global points
- Alarms

The SSG however does, and provides this service to all devices.

The SSG is fully transparent, meaning:
Software applications can access all devices on the Sub Sytem network for monitoring and configuration purposes.
Devices on the Innotech Global comms network will have access to global points to and from the devices on the Sub System network.

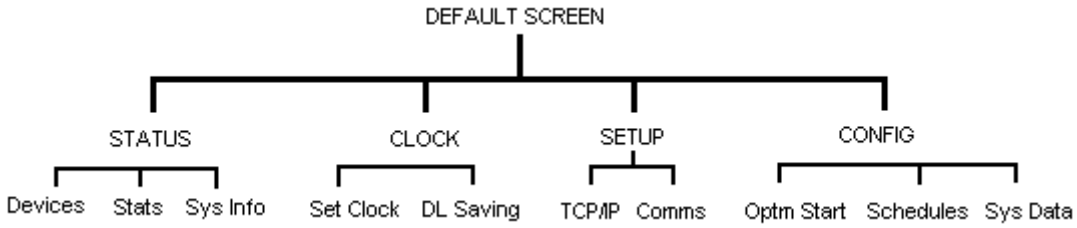
Addressing:
Two addressing schemes are available depending on the user requirements. The two schemes are:

- Automatic:
  Devices on the Sub System Network are each assigned an address by the SSG automatically after startup or when added to the network. This is the factory default setting

- Manual:
  Device addresses are manually allocated by the user with Innotech's communication server, iComm

User Interface

For ease of use the SSG provides remote access to a virtual 4 line, 20 character Human Machine Interface (HMI). Access can be gained by using tools, such as, Soft Port, Miniport and Viewport (V3.0A and above). Navigation through the menu is achieved by using the 6 virtual keypads 'Up', 'Down', 'Left', 'Right', 'Enter' and 'Escape'. The HMI provides menus to access and modify the internal SSG configuration, device setup and device status as shown below.



All information displayed on the HMI is in English and standard engineering units.

FCC Class A Notice

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

Note – This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
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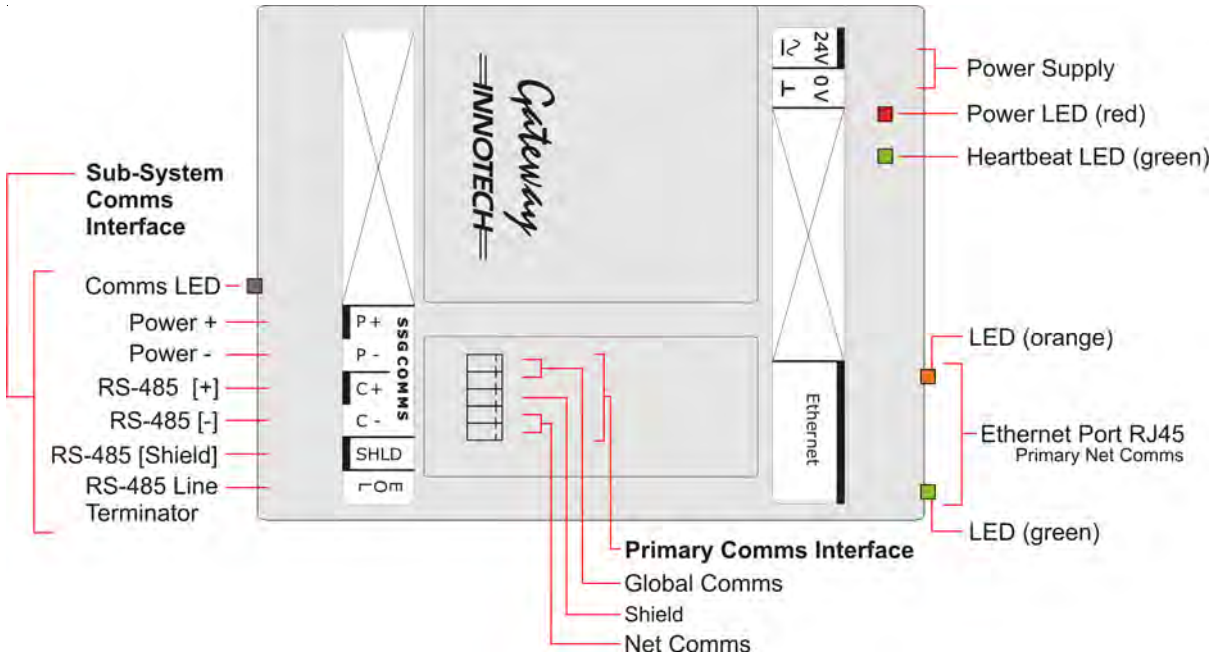

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Australian Owned, Designed & Manufactured
by Mass Electronics Brisbane
Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
Email: sales@innotech.com.au www.innotech.com.au

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DS 13.03
April 2009

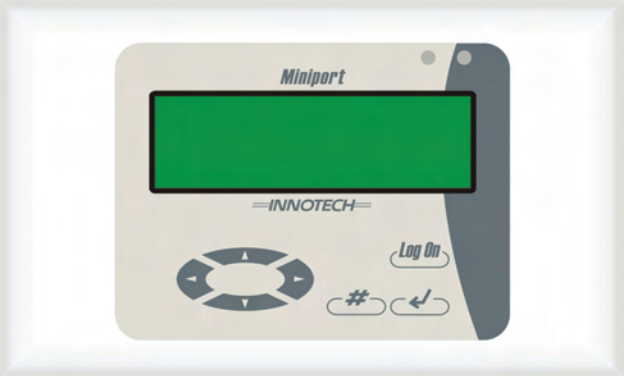
MODELS:
MP01: Human Machine Interface for MAXIM Networks

Type: MAXIM Miniport RS485
Human Machine Interface Version

Overview

The MAXIM Miniport is a network device that allows a user to externally access the Human Machine Interface (HMI) of a MAXIM Series Controller located on the network. Connected to "Net Comms", the MAXIM Miniport can be used to search for controllers present on the network. A user may then use the MAXIM Miniport to log onto any one of the available controllers.

The MAXIM Miniport is designed for surface mounting and allows easy access to networked controllers that are located in remote or inaccessible areas.



Specifications

Power Supply

- 24 V AC ± 10% @ 50/60Hz
- 24 V DC ± 10%
- Power Consumption: 1.5W Max.

The operating voltage must meet the requirements of Safety Extra Low Voltage (SELV) to EN60730. The transformer used must be a Class 2 safety transformer that has the energy and voltage limiting characteristics as described in the National Electrical Code, ANSI/NFPA70. It must also be sized and fused in compliance with local safety regulations.

Terminal Identification

Power Supply

1 = 24 V AC Supply
2 = 0 V AC Supply
3 = EARTH

Terminal 3 Note: This connection is for the protection of the communication circuitry. It must be connected to a good quality electrical bonded EARTH. This may be EARTH bus bar of the switchboard or the point that connects the chassis of the equipment the module is in, to electrical EARTH. This point should not be tied to terminal 2.

Comms Connection

SHLD1 = Shield from incoming comms cable
\+ = RS485 (+) signal
\- = RS485 (-) signal
SHLD2 = Shield from outgoing comms cable

Temperature Ratings

- Storage: 0 to 50°C non-condensing.
- Operating: 0 to 40°C non-condensing.

Enclosure and Mounting

The MAXIM Miniport MP01 is housed in a HDM™ or Clipsal™ style switch plate enclosure, and is moulded from flame retardant plastics recognised by UL as UL 94-V0.

Colour : Off White.
Dimensions (max): 200 mm(w) x 164 mm(h) x 25 mm(d).

Applications

The MAXIM Miniport can be used in a variety of situations. Its main advantage is allowing easy access to a number of controllers from a single point. This enables the user to access a controller without requiring physical access to the chosen controller.

- A single point of access to a MAXIM Controller network.
- Mounted on panel doors to give easy access to a group of MAXIM Controllers within the control panel.
- Hand held Service Tool.
- Wall mounted device.
- Used as a monitoring device.

Features

- Access to up to 40 networked MAXIM Controllers.
- Access to up to 62 Sub Network devices per Sub System Gateway on Primary Network.
- 4 line, 80 character Liquid Crystal Display.
- Isolated RS485 communications.
- Supports MAXIM Controllers that incorporate Netcomms.
- Network Display Mode.
- Network Searching Facilities.
- Can detect and identify GENESIS Controllers on the Network.
- User programmable baud rates.
- User programmable sleep timeout.
- Select button allows user to connect and disconnect from an individual MAXIM Controller.
- Convenient reconnect function.
- flash ROM for in-system firmware upgrades.
- Operates on 24 V AC or 24 V DC.
- 57600 and 9600 baud comms rate.

Approvals

The Innotech MAXIM Miniport conforms to:

- Electromagnetic emission and immunity requirements according to standards EN55011 (CISPR11) and EN50082 for CE Marking and C-Tick Labelling.

Wiring

- The cable used for RS485 Comms must be shielded single twisted pair, 120 ohms characteristic impedance, 36 to 45pF per metre capacitance between conductors.
- The Comms cable must be organised as a bus topology. That is, starting at one end, devices are connected to it until the other end of the cable is reached. No "stubs" are allowed. To connect a device to the cable, a cut is made in the cable at the point where the device is to be situated along it. Then, the two new ends of the cable are wired into the device. The shields from the two new ends are then terminated into the terminals marked SHLD1 and SHLD2 respectively.

Note: Refer to the Innotech Network Cabling Manual DS 99.04 for more information.

Interface

The interface of the MAXIM Miniport has a similar physical layout as a MAXIM II Controller with the addition of the Select button.

Modes

The Miniport has three separate configurable modes of operation.

The first Mode is "Sleep Mode". While the Miniport is in this mode, the device when it detects no activity for greater than the "sleep delay" goes into Sleep. Sleep is where the Miniport disconnects from the Innotech network and allows other devices the ability to connect. Note the sleep delay time can be programmed via the setup menu.

The second Mode is "Master Mode". While the Miniport is in this mode, the Miniport remains connected to one predetermined controller on a network. The Miniport if it detects no activity for a fixed period of time will go into a standby mode where the network is polled every 10 seconds. This provides an opportunity for other devices to log on to the network while still displaying the current data of the selected controller. Should the Miniport detect activity on the network the Miniport will go into sleep mode. Once the Miniport detects no activity it reverts to its previous state displaying the information of one predetermined controller.

The third Mode is "Slave Mode". In this mode the display will show what ever is displayed on the Miniport designated as the master. Should the Miniport detect activity on the network the Miniport will go into sleep mode. Once the Miniport detects no activity it reverts to its previous state displaying the information of the Master Miniport.

States

The Miniport can be in three states of operation. These states are Sleep, Configuring and Communicating.

The first state is Sleep. When the MAXIM Miniport is set to Sleep Mode, it will time out after a user delay into a sleeping mode whenever it is not being used. In this mode it remains dormant, while monitoring the network for activity. If it detects network activity it prevents user access until the network is free, otherwise the user may activate the HMI into another mode. This is because only one device may take control of the Net Comms Network at any one time. This device could be a computer, DDC, MPI (Modem Printer Interface) or a MAXIM Miniport.

When the Miniport is sleeping, pressing the "Log On" button presents a list of available devices on the network the user can select the desired unit with the < and > arrows. Press "Log On" again to connect to the selected device. Alternatively, the user can press the # button which provides access to the setup menu.

The second state Configuring. This state is when the user presses the # button, a menu is displayed giving the option to "Search", "Setup", "Devices" or "Reconnect".

Note: See Miniport Configuration for further detail.

The third state is Communicating. When the user presses the "Log On" button, the user can then log onto a remote MAXIM II Controller. Once the user has connected to a controller using the "Log On" button, the user can view watch pages, system info and change variables, and operate all other functions in the usual manner. See the MAXIM data sheet for user instructions on the MAXIM Controller.

When finished interrogating the MAXIM, the "Log On" button is used to log off, or disconnect from the controller. When pressed, the MAXIM Miniport automatically escapes out of the current page, logs off and reverts to the default mode.

Setting Up the Miniport

The MAXIM set up menu has four options: Search, Setup, Devices and Reconnect.

The Search option simply searches the network to produce a list of available devices for connection via the logon screen. Note searches between the Start and Stop.

The Setup option has a sub menu consisting of the following parameters: Mode, Default MAXIM, Sleep Delay, MAXIM Type, Search Start and Search Stop.

The Device option will display a list of the active devices found connected to the Miniport as found by the Search option, subject to the start search and stop search parameters.

The Reconnect option will log the user on to the device last connected.

Setup Parameters

Mode: this sets the mode as defined earlier.

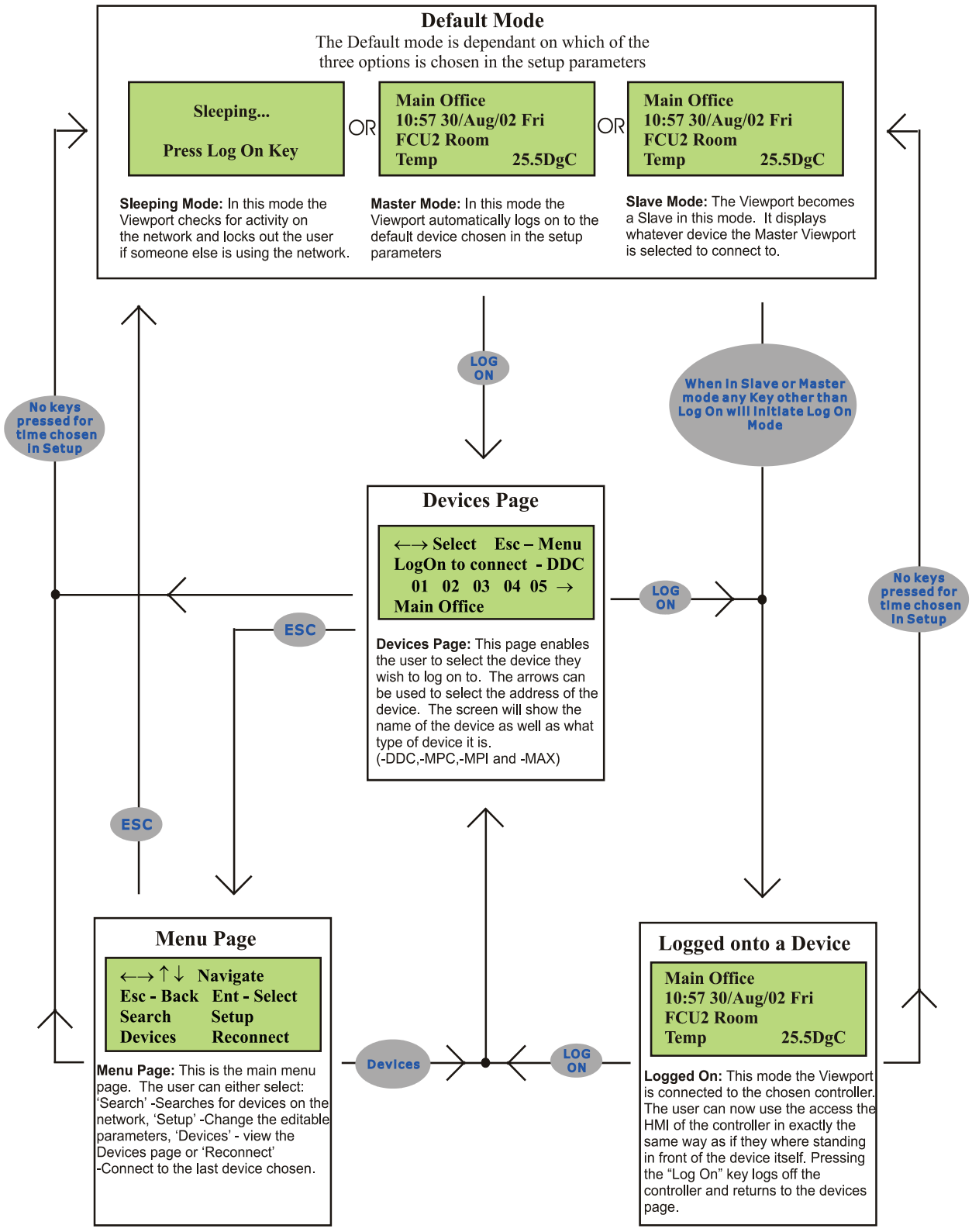
Default MAXIM: this is the address of the MAXIM selected as either the Master or Default device.

Sleep Delay: this is the time in seconds that the unit will wait after detection no activity before going into its default mode. Set between 30 and 300 seconds in 30 second steps. The default setting is 30 seconds.

MAXIM Type: this determines if the MAXIM supports being networked, or is a standalone MAXIM. Note if a standalone MAXIM is used, a GENII Converter NT RS485 to RS232 converter is required.

Start Search: this is the start address for the Miniport to begin its search for active devices on the network.

Stop Search: this is the end address for the Miniport to terminate its search for active devices on the network.



FCC Class A Notice

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2. This device must accept any interference received, including interference that may cause undesired operation.

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Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
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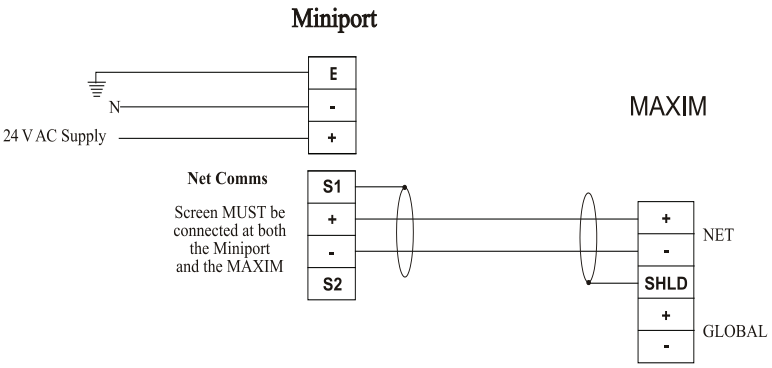
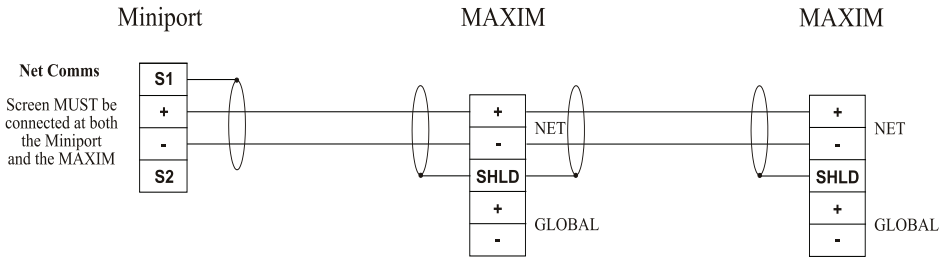
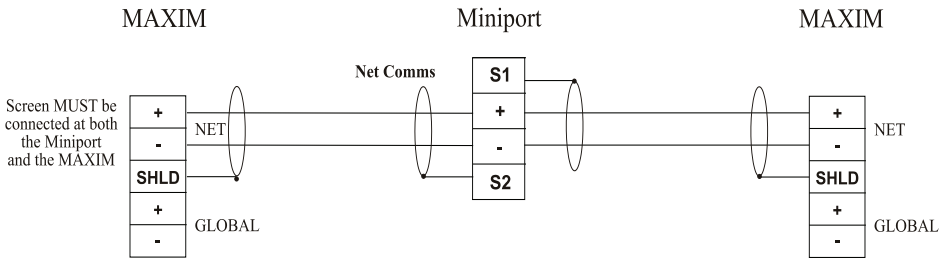
Standard Connection



End Comms Connection



Mid Comms Connection



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Phone: + 61 7 3841 1388 **Fax:** + 61 7 3841 1644
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BAPI-Stat 4™ Room Unit with display

Temperature Sensors

Rev. 06/02/10

Features & Options

- New Enclosure Style
- Robust Tactile Pushbuttons
- Larger LCD Display
- Occupancy Override
- Setpoint Adjust (slider or pushbutton)
- Optional Fanspeed & Mode Control
- Optional Comm. Jack and Test & Balance
- Wide Selection of Temp. Sensing Elements
- Two Year Warranty

BAPI-Stat 4 Units with Warm White Logo Plate

The BAPI-Stat 4 has all the features of the RµP Family rolled into a single enclosure. The BAPI-Stat 4 is similar in size to the Delta enclosure but with a larger LCD display and greater functionality. It provides local indication of Temperature and Setpoint with Setpoint Adjust and Override. It also has optional Fanspeed and Mode Control for applications with Fan Coils, Heat Pumps or Unit Ventilators. The Setpoint Adjust is available as a slidepot or as pushbuttons and is displayed on the LCD for a short time after an adjustment.

The Setpoint can be displayed as an offset (i.e. -2, -1, 0, 1, 2) or as a value within a specified temperature range (i.e. 65 to 80 °F). The Override is a momentary signal that can be configured in parallel with the sensor or setpoint, or as a separate output or a latching switch. An optional 3.5mm (1/8") or RJ11 Communication Jack can be mounted in the base to provide direct access to the network.

BAPI-Stat 4 Units with Off Gray Logo Plate

For detailed specs on the individual Sensors & Transmitters, turn to the Sensors section.

Specifications

Power: 5 VDC regulated or 9 to 40 VDC (15 to 24 VDC recommended) for 0-5V Setpoint
15 to 40 VDC (15 to 24 VDC recommended) 0-10V Setpoint
15 to 28 VAC (Requires a separate pair of shielded wires)

Power Consumption: 25 mA max DC; .6 VA maximum AC

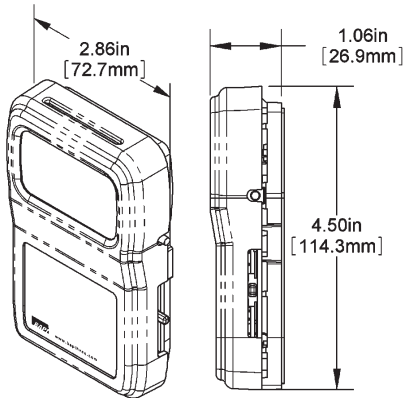
Sensing Element: Thermistor or RTD

Wiring: 2 to 4 pair of 16 to 22AWG**

Comm. Jack: Optional 3.5mm (1/8") Phono Jack or RJ11 Phone Jack

Mounting: Standard 2" by 4" J-box or drywall mount (screws provided)

Environmental Operation Range:
Temperature: 32 to 122 °F (0 to 50 °C)
Humidity: 0 to 95%, non-condensing



VC75 - AC to DC Voltage Converter

BAPI recommends using DC power on room units for a more stable reading. With its compact size and rugged design, BAPI's VC75 is the perfect AC to DC converter. For more info, see Accessories.

** **BAPI** recommends that you do not run wiring for the Room Units in the same conduit as line voltage wiring or with wiring used to supply highly inductive loads such as motors, generators, and coils. Also, these units are not designed for line voltage applications. They are intended to be connected to analog inputs (AI's) set in the "resistive" mode.

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel: +1-608-735-4800 • Fax: +1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Rev. 06/02/10

Ordering Information — BAPI-Stat 4 Room Unit - Temperature

BA/BS4M	BAPI-Stat 2 Style Enclosure with Multi-Mode Pushbuttons
BA/BS4S	BAPI-Stat 2 Style Enclosure with Slidepot Setpoint Adjustment

Display Mode *(Required selection)* — **Pick F (°F) or C (°C) indication**

F	Temperatures Displayed in °F
C	Temperatures Displayed in °C

Setpoint Configuration *(Must select for BA/BS4M. Optional for BA/BS4S)* — ***Warm/Cool legend on base is standard.***

-# SETPOINT DISPLAY OPTIONS (Skip A through F if not required)

Desired Range	Designator	Desired Range	Designator
-2 to +2	**P**	55 to 85 °F or 13 to 30 °C	**D**
-3 to +3	**A**	60 to 80 °F or 15 to 27 °C	**E**
-5 to +5	**B**	65 to 80 °F or 18 to 27 °C	**F**
50 to 90 °F or 10 to 32 °C	**C**	70 to 74 °F or 21 to 23 °C	**L**
		45 to 96 °F or 7 to 36 °C	**G**

SETPOINT OUTPUT VALUE RANGE (Select one if required, skip if not required)

Desired Range	Designator	Desired Range	Designator
889 to 111 Ω[1]	**20**	0 to 20 kΩ	**80**
674 to 274 Ω	**23**	4.75 to 24.75 kΩ	**81**
800 to 1200 Ω	**25**	6.19 to 26.19 kΩ	**82**
909 to 1309 Ω	**26**	7.87 to 27.87 kΩ	**83**
1800 to 2200 Ω	**27**	10 to 30 kΩ	**84**
0 to 1 kΩ	**40**	0 to 100 kΩ	**90**
500 to 1500 Ω	**41**	0 to 5 V[2]	**00**
2 to 3 kΩ	**42**	3.7V to 0.85V [1,2]	**02**
0 to 10 kΩ	**60**	5 to 0 V[2]	**03**
15 to 5 kΩ	**61**	0 to 10 V[3]	**10**

See App. Notes pg 2 for Additional Setpoint Ranges

Pushbutton Fanspeed/Mode Options *(BA/BS4M only)* — ***Skip if not required*** — ***(Single resistive output)***

-XLD	Pushbutton Fanspeed Adjustment [Off (5K), Auto (10K), Lo (15K), Med (20K), Hi (25K)] with LCD Indication
-X01	Pushbutton Fanspeed Adjustment [Off (4.89K), Auto (2.33K), Lo (10.63K), Med (13.24K), Hi (16.33K)] with LCD Indication
-X02	Pushbutton Fanspeed Adjustment [Off (2K), Auto (4K), Lo (6K), Med (8K), Hi (10K)] with LCD Indication
-X06	Pushbutton Fanspeed Adjustment [Off (6.5K), Lo (8.5K), Med (10.5K), Hi (12K)] with LCD Indication
-HCF	Pushbutton Mode [Heat/Auto (5K), Off/Auto (10K), Cool/Auto (15K), Heat/On (20K), Off/On (25K), Cool/On (30K)] with LCD Indication
-H01	Pushbutton Mode [Heat/Auto (0Ω), Off/Auto (2K), Cool/Auto (4K), Heat/On (6K), Off/On (8K), Cool/On (10K)] with LCD Indication

Override Configuration — ***Must select one***

-L#	Override as a Latching Switch (24VDC/VAC @ 800mA max). The "#" represents latching display options 1-9. See App. Notes pg. I5 for more information or contact your BAPI representive.
-J	Override as a Separate Output. (Dry contact only, not intended to switch a load.)
-N	Override in Parallel (//) with Sensor
-P	Override in Parallel (//) with Setpoint: NOT available on voltage setpoint models
-Z	No Override. (Needed if no override is required)

Optional Communication Jack — ***Mounted in unit's base***

-C11L	RJ11 (4 pin) Style Jack with Leads Attached
-C11LT	RJ11 (4 pin) Style Jack with Leads and a Terminal Block Attached
-C35L	3.5 mm Phono Style Jack with Leads Attached
-C35LT	3.5 mm Phono Style Jack with Leads and a Terminal Block Attached
-C22L	RJ22 (4 pin) Style Jack with Leads Attached
-C22LT	RJ22 (4 pin) Style Jack with Leads and Terminal Block Attached

Power Available at Panel — ***Must select one***

-5	Regulated, 5 VDC
-24	9 to 40 VDC or 15 to 28 VAC (See Power Specifications on opposite page)

Direct Out Sensor — ***Must select one***

-0	100 Platinum RTD, 100 Ω @ 0 °C, 0.385 Ω/°C temp. coeff.
-1375	1K Platinum RTD, 1,000 Ω @ 0 °C, 3.75 Ω/°C temp. coeff.
-1NI	1K Ω Nickel RTD, 1,000 Ω @ 21°C, 5 Ω/°C temp. coeff.
-1	1K Platinum RTD, 1,000 Ω @ 0 °C, 3.85 Ω/°C temp. coeff.
-2	2K Silicon RTD, 2,000 Ω @ 20 °C, 8 Ω/°C temp. coeff.
-18	1.8K Thermistor, 1,800 Ω @ 25 °C
-3	3K Thermistor, 3,000 Ω @ 25 °C
-33	3.3K Thermistor, 3,300 Ω @ 25 °C
-102	10K-2 Thermistor, 10,000 Ω @ 25 °C
-103	10K-3 Thermistor, 10,000 Ω @ 25 °C
-10311	10K-3[11K] Thermistor, 5,238 Ω @ 25 °C, 11kΩ shunt resistor
-20	20K Thermistor, 20,000 Ω @ 25 °C
-50	50K Thermistor, 50,000 Ω @ 25 °C
-100	100K Thermistor, 100,000 Ω @ 25 °C
-592	AD592 Semiconductor, 273 µA @ 0 °C

Optional Test and Balance Switch

-TB	Three Position Switch - "Low" & "High" values vary, "Normal" is live sensor value, **call for details**.

Connection Configuration (Select one, default is common ground)

-CG	Common Ground
-DF	Differential Inputs *(only with resistive setpoint)*

Logo Plate Color

-WMW	Warm White Logo Plate Color (standard)
-GRY	Gray Logo Plate Color

EXAMPLE

BA/BS4M	**C**	**-80**	**-XLD**	**-N**	**-C11L**	**-24**	**-102**	**-TB**	**-DF**	**-WMW**

Example Part Number: BA/BS4MC-80-XLD-N-C11L-24-102-TB-DF-WMW

Your Part Number:

All models can be field calibrated so the displayed ambient temperature value matches a reference device (±3°, ½° steps), call for details.
Override indication is activated by logic low or dry contact signal from the controller to GND.
[1]Available on pushbutton (BS2M) models only
[2]Common Ground Only
[3]Requires 15 to 24 VDC or 24VAC power. Common Ground Only

Duct Mounted Thermistor and RTD Temperature Probe

BA/#-D

Installation & Operations

20787_INS_Duct_Passive_RTD_Therm rev. 7/8/09

Overview

The **BA/#-D** is a duct mounted passive resistive sensor. It comes in a variety of probe lengths and optional mounting enclosures shown below. The **BA/#-D** can be ordered with all the most common Thermistor's or RTD's used with virtually any BAS system. All thermistor and (385) RTD sensors come with standard accuracy as well as high accuracy models **[XP]** and **[A]** options respectively.

Identification

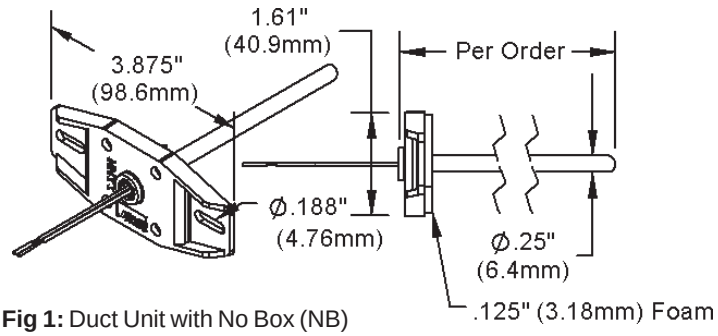


Fig 1: Duct Unit with No Box (NB)

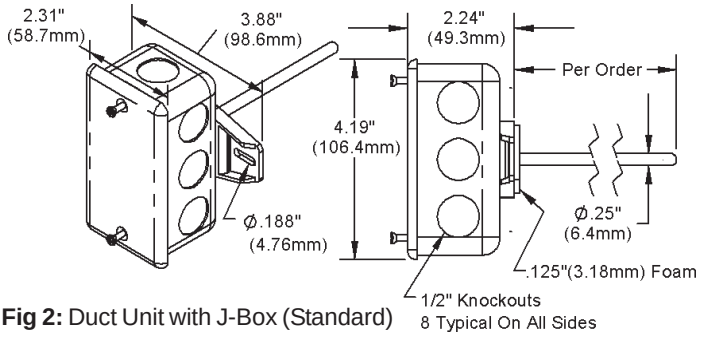


Fig 2: Duct Unit with J-Box (Standard)

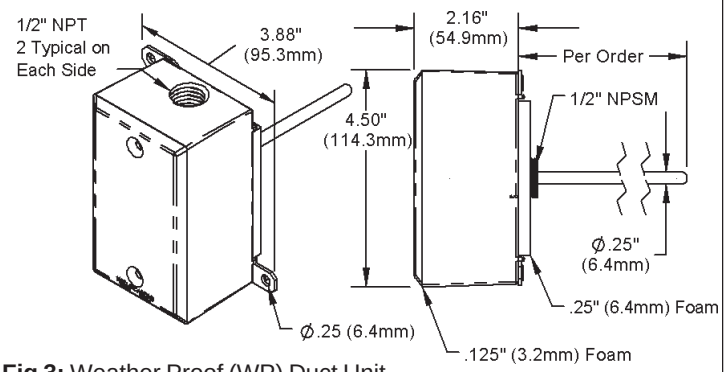


Fig 3: Weather Proof (WP) Duct Unit

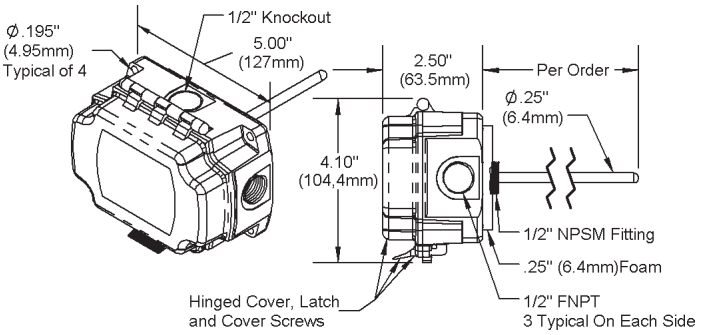


Fig 4: BAPI-Box (BB) Duct Unit

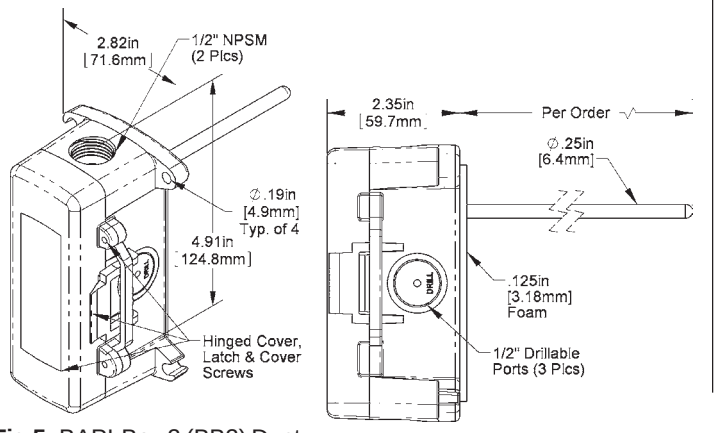


Fig 5: BAPI-Box 2 (BB2) Duct

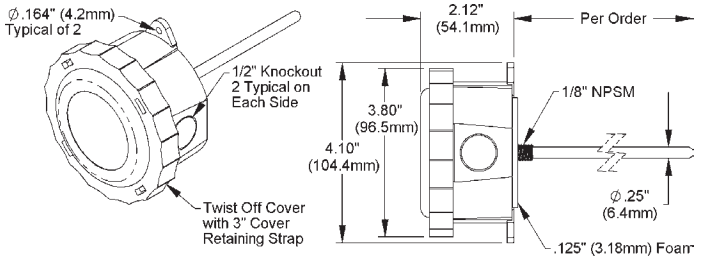


Fig 6: Weather Tight Enclosure (EU) Duct Unit

Mounting

1. Place the sensor in the middle of the duct away from temperature stratified air, coils or humidifiers to achieve the best temperature reading.
2. Drill the probe hole as depicted below for the enclosure being used. **(No box, Handy Box, BB, BB2, WP, EU).** Insert the probe into the duct.
3. Mount the enclosure to the duct using BAPI recommeded #8 screws through a minimum of two opposing mounting tabs provided. Weatherproof (WP) enclosures will require assembly of the mounting tabs on opposite corners. A 1/8 inch pilot screw hole in the duct makes mounting easier through the mounting tabs. Use the enclosure tabs to mark the pilot hole locations.
4. Snug up the sensors so that the foam backing is depressed to prevent air leakage but do not over-tighten or strip the screw threads.

Specifications subject to change without notice.

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel:+1-608-735-4800 • Fax+1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Mounting Continued

Mounting Notes:

Note 1
Be sure not to drill into the weatherproof enclosures **(BB, BB2, WP,EU,EUO)** which will violate the NEMA and/or the IP rating.

Note 2
Be sure to use caulk or Teflon tape on all threaded openings to maintain the appropriate NEMA or IP rating for your application.

Note 3
Conduit entry for outdoor or wet applications should be from the bottom of the enclosure.

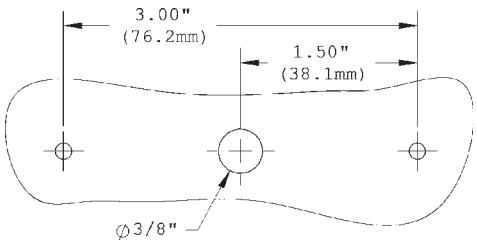


Fig 7-A: Junction Box or No-Box **NB** Mounting Holes

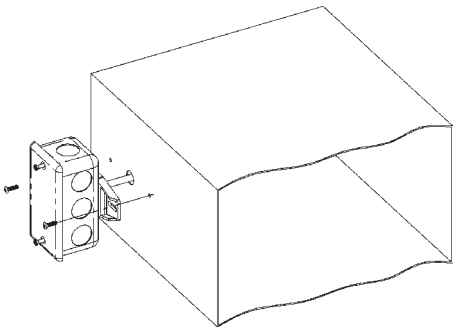


Fig 7-B: Junction Box or No-Box **NB** Duct Installation

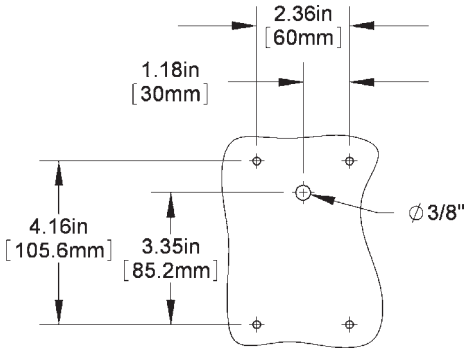


Fig 8-A: BB2 Mounting Holes

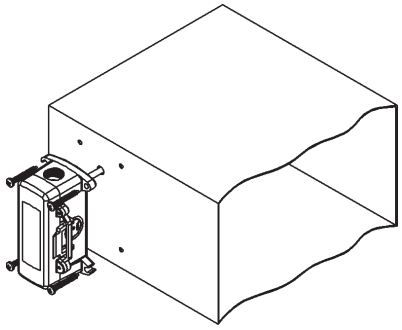


Fig 8-B: BB2 Duct Installation

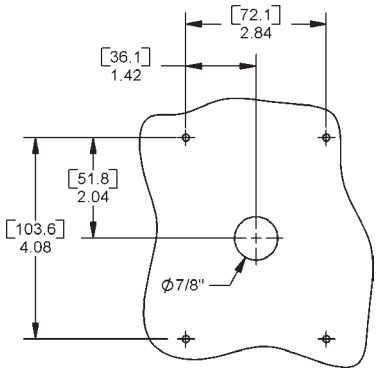


Fig 9-A: BAPI-Box **BB** Enclosure Mounting Holes Rotate 90° for Horizontal Mounting

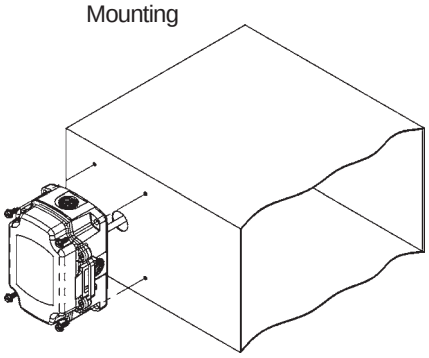


Fig 9-B: BAPI-Box **BB** Duct Installation

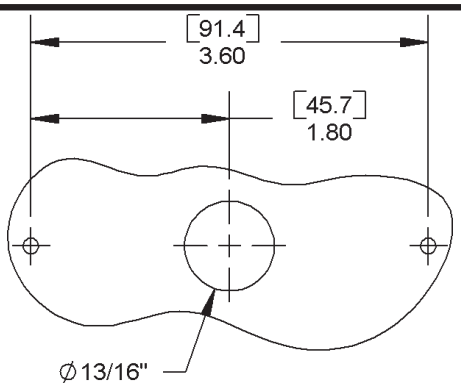


Fig 10- A: EU or **EUO** Enclosure Mounting Holes

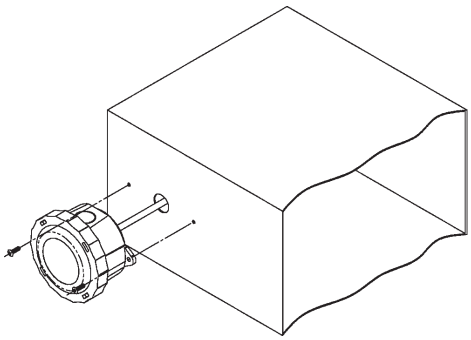


Fig 10-B: EU or **EUO** Enclosure Duct Installation

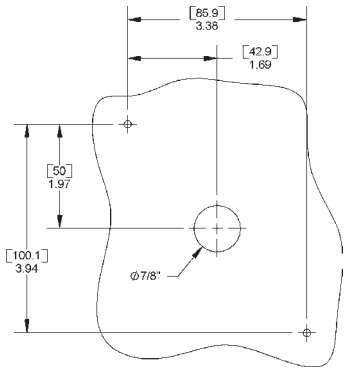


Fig 11-A: Weatherproof Box **WP** Mounting Holes

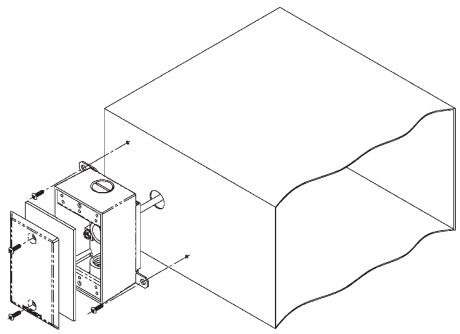


Fig 11-B: Weatherproof Box **WP** Duct installation

Specifications subject to change without notice.

Duct Mounted Thermistor and RTD Temperature Probe

BA/#-D

Installation & Operations

Wiring & Termination

BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes. Do NOT run this device's wiring in the same conduit as high or low voltage AC power wiring.

BAPI's tests show that inaccurate signal levels are possible when AC power wiring is present in the same conduit as the sensor wires.

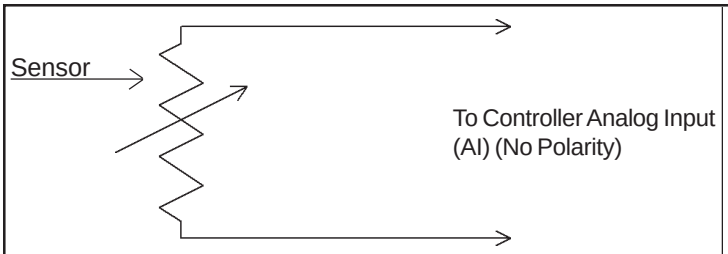


Fig. 14: 2 Wire Thermistor or RTD

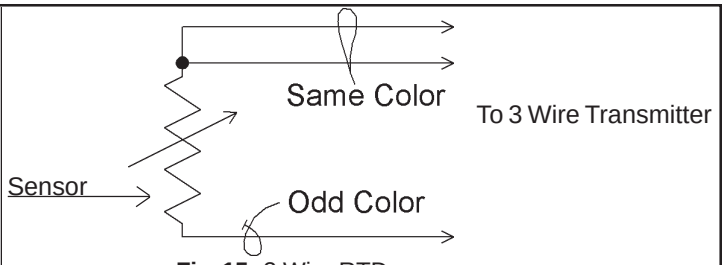


Fig. 15: 3 Wire RTD

Diagnostics

Problems:

Controller reports higher or lower than actual temperature

Possible Solutions:

- Confirm the input is set up correctly in the front end software
- Check wiring for proper termination & continuity. (shorted or open)
- Disconnect wires and measure sensor resistance and verify the "Sensor" output is correct.

Specifications

Sensor	Passive
Thermistor	NTC, 2 wire
RTD	PTC, 2 or 3 wire
Thermistor	Thermal resistor (Bare Sensor)
Accuracy (std)	±0.36ºF, (±0.2ºC)
Accuracy (Hi)	±0.18ºF, (±0.1ºC), **[XP]** option
Stability	< 0.036ºF/Year, (<0.02ºC/Year)
Heat dissipation	2.7 mW/ºC
Probe range	-40º to 221ºF (-40º to 105ºC)
RTD	Resistance Temperature Device (Bare Sensor)
Platinum (PT)	100Ω and 1KΩ @0ºC, 385 curve, 1KΩ @0ºC, 375 curve
PT Accuracy	(std) 0.12% @Ref, or ±0.55ºF, (±0.3ºC)
PT Accuracy	(Hi) 0.06% @Ref, or ±0.277ºF, (±0.15ºC), **[A]**option
PT Stability	±0.25ºF, (±0.14ºC)
PT Self Heating	0.4 ºC/mW @0ºC
PT Probe range	-40º to 221ºF, (-40 to 105ºC)
Nickel (Ni)	1000Ω @70ºF, JCI curve
Ni Probe range	-40º to 221ºF (-40 to 1050ºC)
Sensitivity	Approximate @ 32ºF (0ºC)
Thermistor	Non-linier Go to bapihvac.com click "Sensor Specs"
RTD (PT)	3.85Ω/ºC for 1KΩ RTD 0.385Ω/ºC for 100Ω RTD
Nickel (Ni)	2.95Ω/ºF for the JCI RTD
Lead wire	22awg stranded
Insulation	Etched Teflon, Plenum rated
Probe	304 Stainless steel, 0.25" OD
Duct gasket	1/4" Closed cell foam (imperevious to mold)
Mounting	Extension tabs (ears), 3/16" holes
Enclosure Types	Option, designator
No box	**-NB,** intended for open wiring
2x4 J-box	Standard w/eight ½" knockouts
Weather Proof	**-WP,** w/ two ½" FNPT entries, (Bell box)
BAPI-Box	**-BB,** w/four ½" NPSM & one 1/2" knockout
BAPI-Box 2	**-BB2,** w/Three 1/2" NPSM & three 1/2" knockouts
European round	**-EU, EUO,** w/two ½" knockouts
Enclosure ratings	
No box	**-NB,** No rating
2x4 J-box	Standard, NEMA 1
Weather Proof	**-WP,** NEMA 3R, IP14
BAPI-Box	**-BB,** NEMA 4X, IP66
BAPI-Box 2	**-BB2,** NEMA 4X, IP66
European round	**-EU,** NEMA 4X, IP66
European round	**-EUO,** NEMA 4X, IP66, UV rated
Enclosure materials	
No box	**-NB,** Nylon 66, UL94H-B
2x4 J-box	Galvanized steel, UL94H-B
Weather Proof	**-WP,** Cast Aluminum, UV rated
BAPI-Box	**-BB,** Polycarbonate, UL94V-0, UV rated
BAPI-Box 2	**-BB2,** Polycarbonate, UL94V-0, UV rated
European round	**-EU,** ABS Plastic, UL94V-0
European round	**-EUO,** ABS Plastic, UL94V-0, UV rated
Ambient (Encl.)	0 to 100% RH, Non-condensing
BB, BB2,EUO, EU	-40ºF to 185ºF, (-40º to 85ºC)
J-box, NB, WP	-40ºF to 212ºF, (-40º to 100ºC)
Agency	RoHS, CE PT= DIN43760, IEC Pub 751-1983, JIS C1604-1989

Related Products

BA/SFC1000-100 Sealant filled crimp connectors (100)

BA/SFC2000-100 Sealant filled crimp twist on wire nuts (100)

Specifications subject to change without notice.

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel:+1-608-735-4800 • Fax+1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Termination

BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes. Do NOT run this device's wiring in the same conduit as AC power wiring of NEC class1 or NEC class 2, NEC class 3 or with wiring used to supply highly inductive loads such as motors, contactors and relays.

BAPI's tests show that fluctuating and inaccurate signal levels are possible when AC power wiring is present in the same conduit as the signal lines. If you are experiencing any of these difficulties, please contact your BAPI representative

BAPI does not recommend wiring the sensor with power applied as accidental arcing may damage the product and will void the warranty

Temperature Sensor Lead Wire Colors				
Thermistors				
3K	Yellow/Black		**20K**	White/White
10K-2	Yellow/Yellow		**100K**	Yellow/White
10K-3	Yellow/Red		**2KΩ**	Brown/Brown
10K-4	Black/Blue		**2K-2**	Brown/Orange
10K3(11K)	Yellow/Blue			
Platinum RTDs				
Single Point Two Wire			**Single Point Three Wire**	
100Ω	Red/Red		**100Ω**	Red/Red/Black
1KΩ	Orange/Orange		**1KΩ**	Orange/Orange/Black

Junction Box/No Box Mounting Indoors

The junction box mount is intended for indoor mounting in equipment rooms, plenums or occupied spaces. The figures below show a typical junction box mounting in an air duct. BAPI recommends using #8 sheet metal screws that need 1/8-inch pilot holes to attach the sensor to the duct. After placing the sensing element in the duct, secure the mounting flange to the duct; center the plastic fitting holding the probe in the mounting hole. Make sure that the foam seals the hole; do not over tighten the screws. No box units use the same mounting holes as Junction Box units.

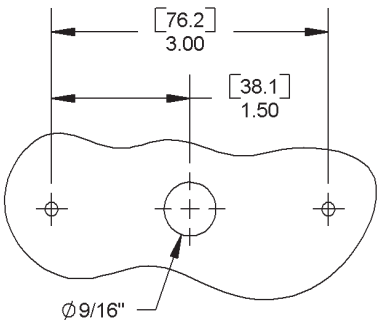


Fig. 1:
Junction Box or No Box mounting holes

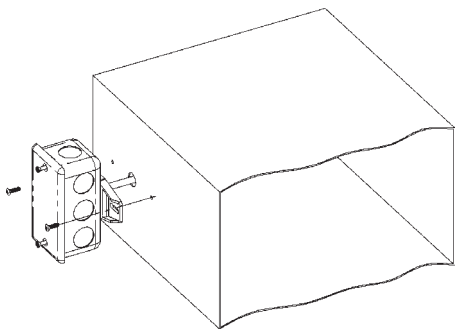


Fig. 2:
Junction box duct installation

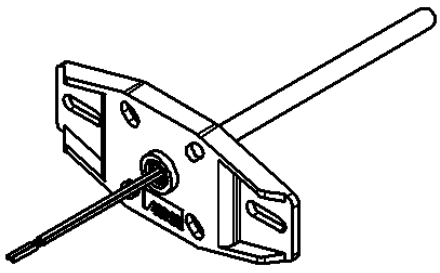


Fig. 3:
No Box Probe

BAPI-Box Mounting

The BAPI-Box Enclosure is watertight and carries an IP66 rating which is similar to a NEMA 4X rating when the included 6-32 screws are fastened on either side of the latch. The BAPI-Box Enclosure is made of high impact, UV-resistant polycarbonate and features a gasketed cover for a waterproof seal, a hinged cover to simplify installation, horizontal or vertical mounting with multiple knockouts and a window in the cover for an LCD display. The BAPI-Box Enclosure is available for the full line of BAPI duct, immersion, outside air and pressure senesors.

Mount the unit to its mounting surface with four #10 scres through the holes in the mounting feet. #10 sheet metal screws require 5/32" (4mm) pilot holes. For concrete or cinder block, drill four 5/32" (4mm) holes, 1-3/4 inch (45mm) deep. Make sure that all screws are started in their holes before tightening evenly. If unit has a foam gasket, only squeeze to about 1/2 of its original thickness.

Be sure to seal conduit connector threads and holes in mounting surface to maintain the integrity of the box.

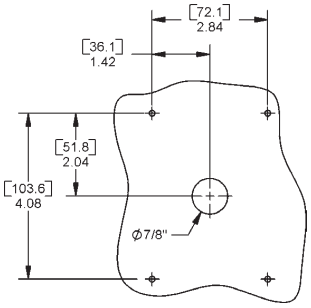


Fig 4: BAPI-Box enclosure mounting holes, rotate 90° for horizontal mount

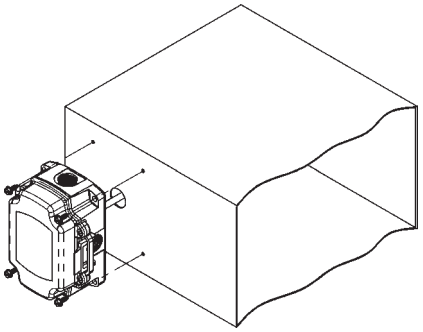


Fig 5: BAPI-Box Duct Instalation

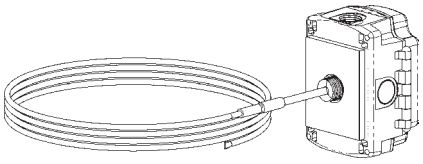


Fig 6: BAPI-Box Temperature Averaging

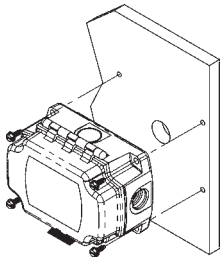


Fig 7: BAPI-Box Wall Installation

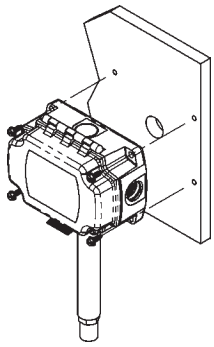


Fig 8: BAPI-Box Outdoor Installation

Weatherproof Box Mounting Indoors

The weatherproof box is intended for outdoor or equipment room mounting. Use the mounting tabs provided to mount the weatherproof box as shown in the figure below. **DO NOT** drill screw holes through the back wall of the box, this destroys the integrity of the box and may void the warranty. The figures below show a typical weatherproof box mounting in an air duct. BAPI recommends using #8 sheet metal screws that need 1/8-inch pilot holes to attach the sensor to the duct. After placing the sensing element in the duct, secure the mounting tabs to the duct; center the plastic fitting holding the probe in the mounting hole. Be sure that the foam seals the hole; do not over tighten the screws. Place the foam gasket between the cover and the box before securing the cover in place with the screws provided. To keep water out of the box, be sure to coat the threads of the box plugs or conduit connectors with caulk before screwing them into the waterproof box.

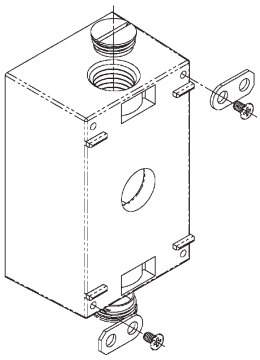


Fig. 9:
Weatherproof box mounting tabs

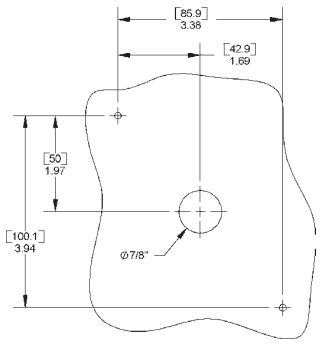


Fig. 10:
Weatherproof box mounting holes

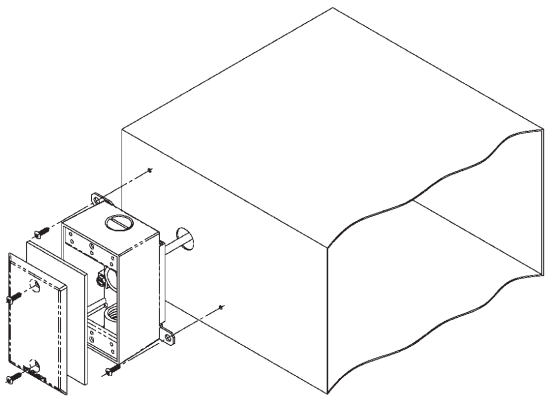


Fig. 11:
Weatherproof box duct installation

IP-66 EU Enclosure Mounting Indoors

The IP-66 enclosure is made from ABS plastic for indoor applications and a UV light stabilized plastic for outdoor applications or indoor applications exposed to direct sun light. The figures below show a typical IP-66 enclosure mounting in an air duct. BAPI recommends using #8 sheet metal screws that need 1/8-inch pilot holes. After placing the sensing element in the duct, secure the mounting feet to the duct; center the plastic fitting holding the probe in the mounting hole. Do not over tighten the screws but be sure that the foam insulation makes an airtight seal. Tighten the lid to two clicks when you are finished making terminations.

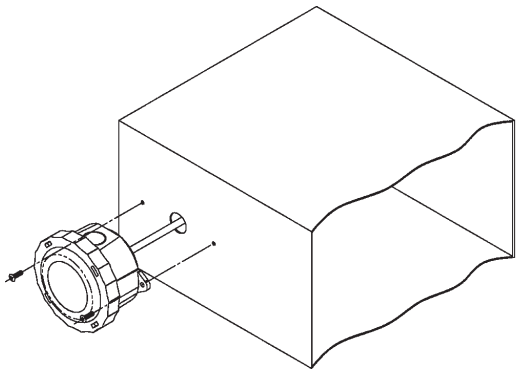


Fig. 12:
IP-66 enclosure duct installation

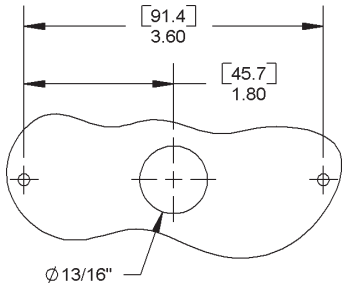


Fig. 13:
IP-66 enclosure mounting holes

IP-66 EU Enclosure and Weatherproof Box Mounting Outdoors

Do not mount in direct sunlight, preferably mount on the north side of the building. Install with the sensor probe pointed down. For best correlation with the local weather bureau's temperature, position the end of the probe between four feet and six and one-half feet above the ground. Drill a hole through your mounting surface as shown in the figures below. Mount the unit to the surface with a wiring knock out centered over the wiring hole. Pull the wiring into the unit and terminate using sealant filled connectors. Best practice is to caulk the wiring hole after the wiring is installed. Be sure that the foam on the back of the unit makes a good weather tight seal. Use the mounting tabs provided to mount the weatherproof box as shown in the figure below.

DO NOT drill screw holes through the back wall of the box, this destroys the integrity of the box and may void the warranty. Note: Air temperature units are shown. To keep water out of the box, be sure to coat the threads of the box plugs or conduit connectors with caulk before screwing them into the weatherproof box.

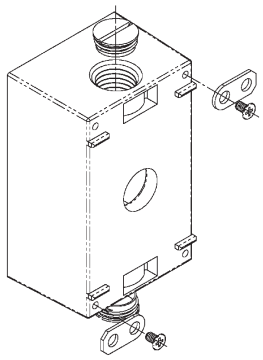


Fig. 14: Weatherproof box enclosure mounting tabs

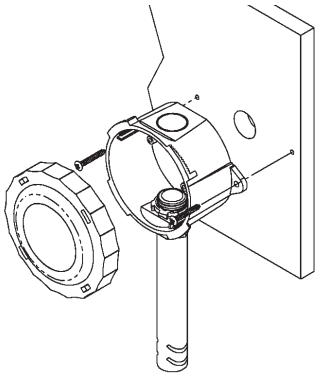


Fig. 15: Outdoor Air/IP-66 rated enclosure installation

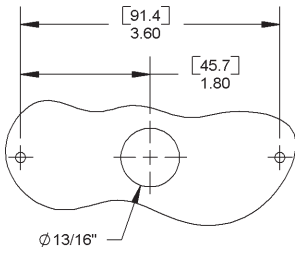


Fig. 16:
IP-66 rated enclosure mounting holes

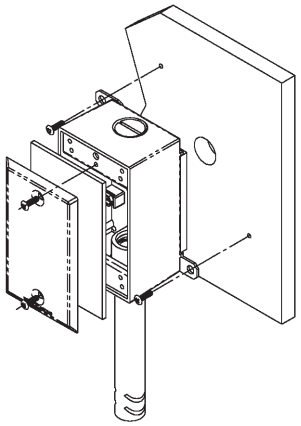


Fig. 17:
Outdoor Air/Weatherproof box installation

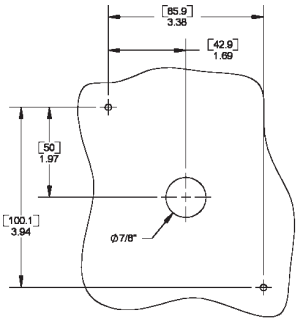


Fig. 18: Weatherproof box enclosure mounting holes

Immersion Sensor Mounting

Place the thermowell into the pipe nipple using Teflon tape and/or pipe dope. Tighten securely but do not over torque. Insert the immersion sensor into the well with the plastic fitting screwing into the opening on the well. Tighten the immersion sensor snugly by hand without too much torque. Make sure that the tip of the immersion sensor is in contact with the bottom of the well. The unit is designed so that the temperature probe moves slightly into the junction box as the sensor hits the bottom of the well. Figure 19 shows a junction box, but weatherproof boxes, IP66 or BAPI-Box enclosures may be used as well.

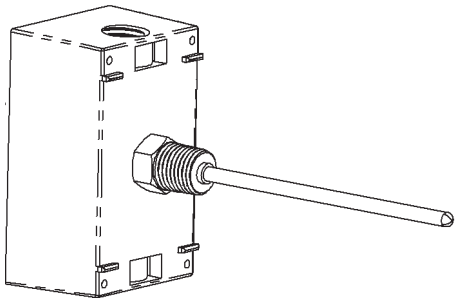


Fig. 19:
T1K transmitter mounted to a Weatherproof box cover and Weatherproof box with an immersion probe

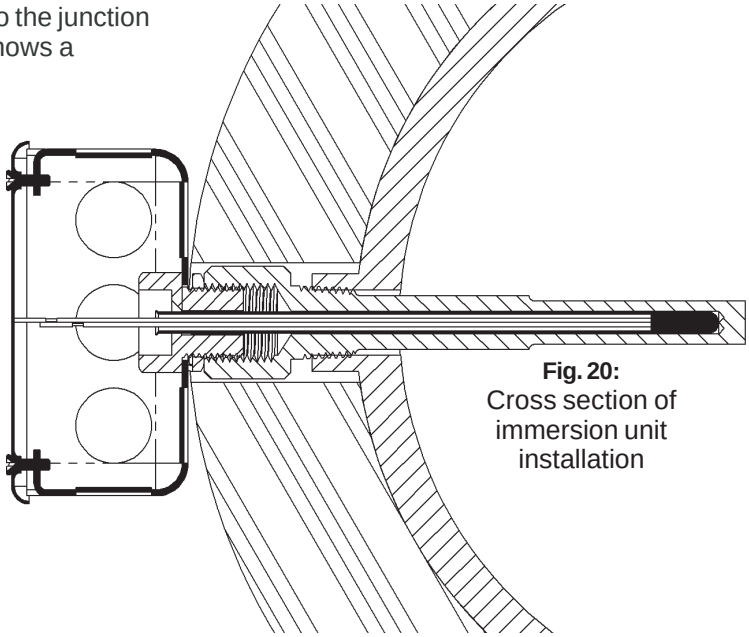


Fig. 20:
Cross section of immersion unit installation

Spring-Loaded Strap Mounting

The spring-loaded strap sensor is used when a large section of insulation cannot be removed from a pipe. The spring-loaded strap sensor accommodates insulation of up to two inches thick. Cut a 1 1/4 inch diameter hole in the insulation and remove the insulation from the hole down to the bare pipe. Be sure to remove all insulation and debris from the hole. Place the copper pad on the end of the spring-mounted foam into the hole; make sure it makes good physical contact with the pipe. Tighten the straps until the strap-mounting bracket contacts the insulation. The spring-loaded strap on sensor is sized for pipe diameters of 5 to 12.5 inches, including the insulation.

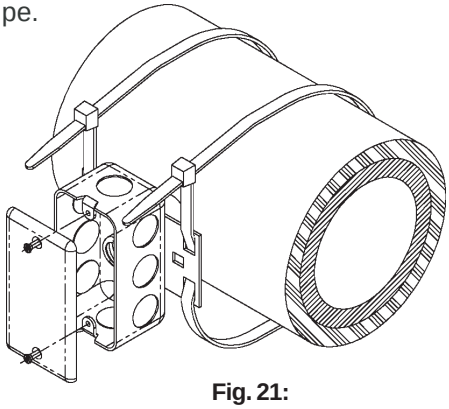


Fig. 21:
Spring-Loaded Strap installation

Clamp On Strap Mounting

Place the clamp-on sensor on bare pipe, or a section of pipe with the insulation removed. Make sure that the copper pad on the foam is in good physical contact with the pipe. Snug the straps so that the assembly does not rotate around the pipe when moderate pressure is applied to the junction box. Do not over tighten. You may place pipe insulation over the whole assembly. The clamp-on strap sensor is sized for bare pipes of 2 to 4.5 inches in diameter. Add another pipe clamp if needed.

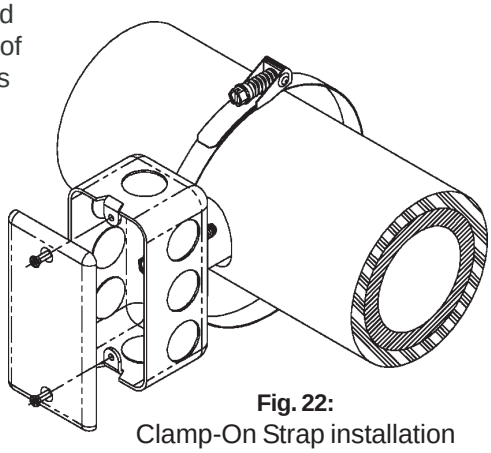


Fig. 22:
Clamp-On Strap installation

RPFEP and FEP Mounting Indoors

Mount the WP or the IP-66 style enclosure as shown in the figures below. Mount with the wire connector down. Route the temperature probe to the spot where you wish to measure the temperature. Best practice is to tie down the wire every two feet. Make sure to caulk the upper screw in plug on the WP enclosure. Center mounting hole shown is only used if you are wiring through the mounting surface.

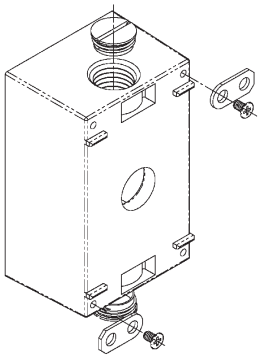


Fig. 23:
Weatherproof box mounting tabs

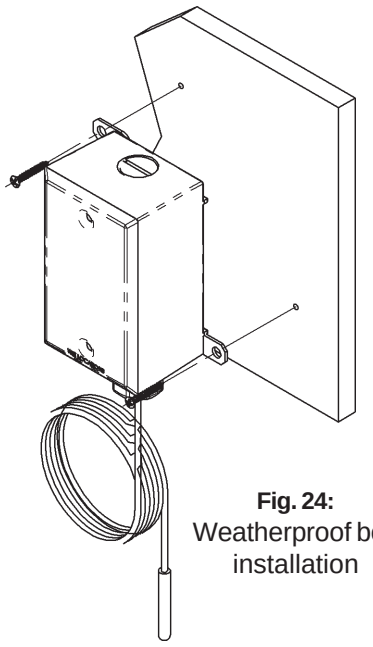


Fig. 24:
Weatherproof box installation

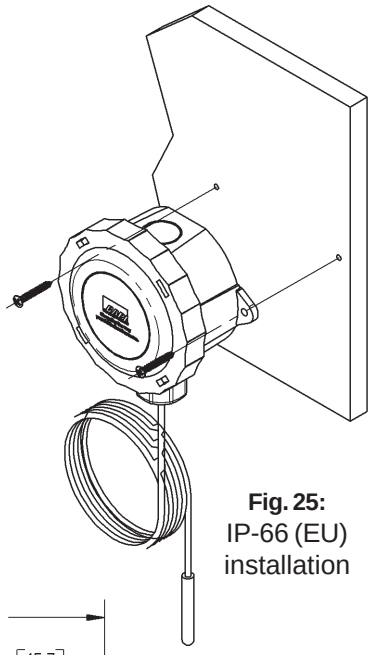


Fig. 25:
IP-66 (EU) installation

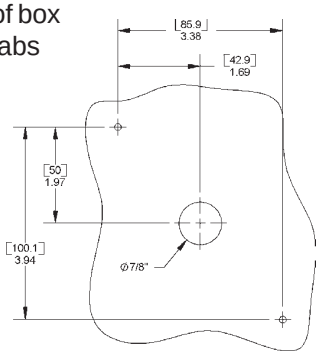


Fig. 26:
Weatherproof box mounting holes

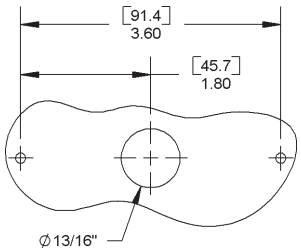


Fig. 27:
IP-66 enclosure mounting holes

Diagnostics

Problems:	**Possible Solutions:**
Controller reports higher than actual temperature	- Confirm the input is set up correctly in the front end software - Verify that the wires are not physically shorted or open - Check wiring for proper termination
Controller reports lower than actual temperature	- Disconnect wires and measure sensor resistance with an Ohm meter - Verify the "Sensor" output is correct (See note below)
Note: Measure the temperature at the temperature sensor's location using an accurate temperature standard. Disconnect the temperature sensor wires and measure the temperature sensor's resistance with an ohmmeter. Compare the temperature sensor's resistance to the appropriate temperature sensor table on the BAPI web site. If the measured resistance is different from the temperature table by more than 5%, call BAPI technical support. BAPI's web site is found at www.bapihvac.com; click on the button labeled SENSORS on the left of the screen and then click on the type of sensor you have.	- Confirm the input is set up correctly in the front end software - Verify that the thermistor is not physically open or shorted - Check wiring for proper termination - Disconnect wires and measure sensor resistance with an Ohm meter - Verify the "Sensor" output is correct (See note below)

Product Description

The Carbon Dioxide (CO_2) Duct Sensors are directly wired to the controller via twisted pair and/or three conductor cables (18 to 22 AWG). The number and type of cables required depends on the model selected. All field wiring is terminated in a terminal block on the sensor body. All CO_2 duct sensors deliver a 0 to 10 Vdc output signal. The QPM2100 is also available as a no logo variant.

Product Numbers

Duct Sensor Product Number	Description
QPM2100	CO_2 only
QPM2100N	CO_2 only, no logo
QPM2102	CO_2 and Volatile Organic Compounds (VOC)
QPM2102D	CO_2 and Volatile Organic Compounds (VOC) with display
QPM2160	CO_2 and temperature
QPM2160D	CO_2 and temperature with display
QPM2162	CO_2, rh and temperature
QPM2162D	CO_2, rh and temperature with display

Additional Reference Documents

CE1N1961 Technical Instructions

Required Tools

- Phillips screwdrivers, No. 1 and No. 2
- Wire cutters/strippers
- Medium flat-blade screwdriver
- Tape measure
- Medium-duty electric drill
- Marker or pencil
- No. 26 (0.147-inch) drill bit
- Small level
- 7/8-inch drill bit or hole saw
- Two No. 8 × 1-inch sheet metal screws

Expected Installation Time

One hour

Prerequisites

- Ensure that the appropriate field wiring is installed.

  Appropriate wiring is one or more twisted pairs, or three conductor cables (plenum or non-plenum as required), within the maximum wiring run length for the individual equipment controller. The maximum recommended length is 750 feet (229 m).
- Ensure that all wiring complies with National Electric Code (NEC) and local regulations.

Mounting Information

Locate the sensor:

- In the center of a duct.
- Away from fans, corners, heating and cooling coils, and so on.
- Away from direct sunlight (for example, not on a rooftop). To ensure correct operation, the sensor's ambient temperature must be between 23°F and 133°F (–5°C to 45°C).
- Where it receives adequate airflow for proper operation.
- Where it can be easily accessed for service.

If used in connection with steam humidifiers, the distance to the humidifier must be a minimum of 9.8 feet (3 m). The distance should be as great as possible, but no more than 33 feet (10 m).

NOTES: To ensure degree of protection IP 54, the sensor must be fitted with the cable entry pointing downward.

Handle the immersion rod carefully. The internal sensing elements are susceptible to impact and shock.

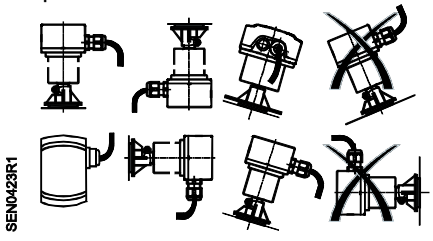


Figure 1. Acceptable Mounting Positions.

Instructions (See Figure 2)

1. Drill a 7/8-inch diameter hole into the duct at the desired location of the sensor.
2. Decide if the sensor will be mounted directly to the duct or if the mounting flange will be used.
   - Sensor Mounting Bracket Installation
     a. Use the bracket as a template, and drill two holes with a No. 26 (0.147-inch) drill bit.
     b. Attach the sensor mounting bracket and gasket to the duct using two No. 8 × 1-inch sheet metal screws. See Figure 2 (4).
     c. Insert the sensor in the duct through the bracket and tighten the mounting screw to set the insertion depth. See Figure 2 (5).
   - Direct Installation:
     a. Remove the sensor cover.
     b. Use the base as a template, and drill four holes with a No. 26 (0.147-inch) drill bit.
     c. Insert the probe through the gasket and into the hole. Secure the head to the duct with four No. 8 × 1-inch sheet metal screws.
     d. Attach conduit or plenum wire to the sensor base.
     e. If you are using conduit, pull the field wiring through the conduit and into the sensor base.
     f. Connect the field wiring to the sensor terminal block on the base. See Figures 3 through 6 for wiring diagrams.
     g. Reinstall the sensor cover. See Figure 2 (9).

The installation is now complete.

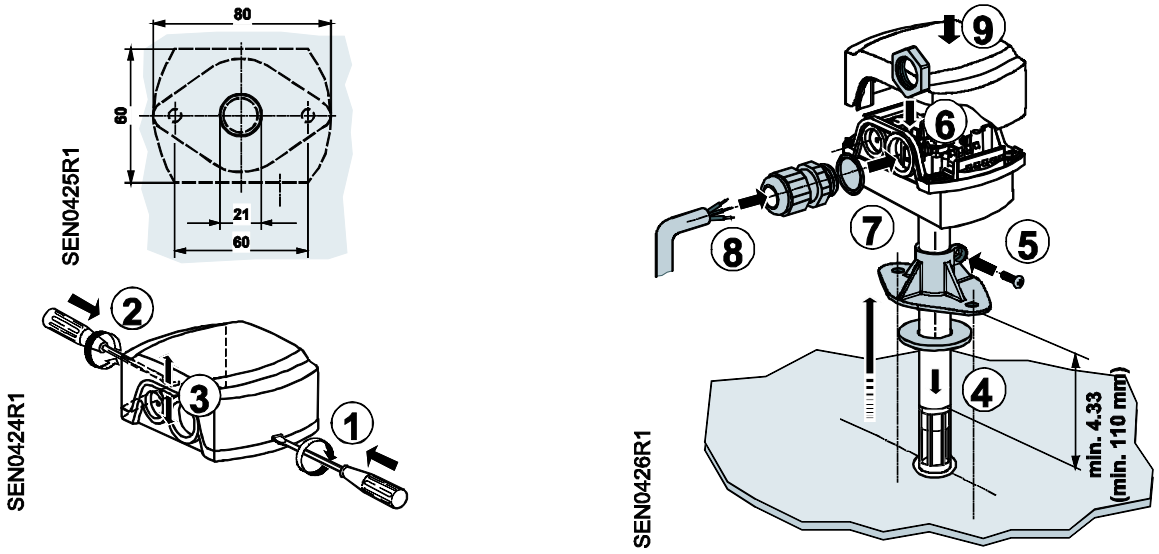


Figure 2. CO_2 Duct Sensor Installation.

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Wiring Diagrams

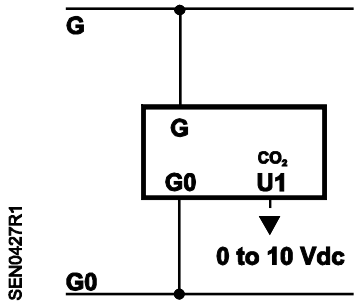

Figure 3. QPM2100, QPM2100D, QPM2100N.

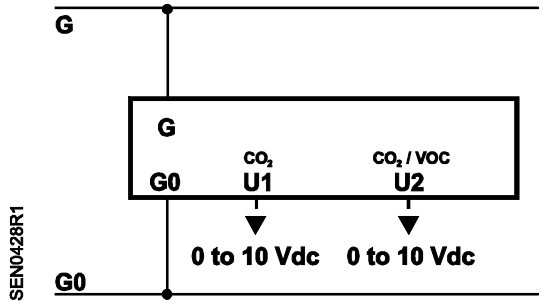

Figure 4. QPM2102, QPM2102D.

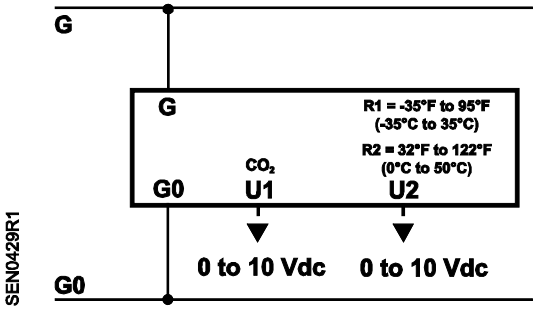

Figure 5. QPM2160, QPM2160D.

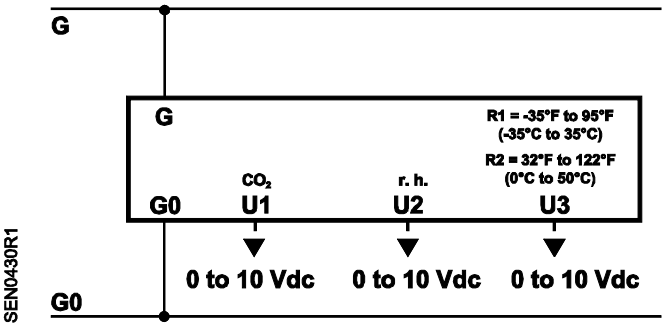

Figure 6. QPM2162, QPM2162D.

G System voltage 24 Vac (SELV) or 15 to 35 Vdc
G0 System ground and measuring neutral
U1 Signal output 0 to 10 Vdc
U2 Signal output 0 to 10 Vdc
U3 Signal output 0 to 10 Vdc

Appendix H: Alerton Submittals

To provide a clearer picture of the Alerton control equipment installed as part of this field test, their submittals and application guide follow. Note that portions of the sequence of operation were included on the block programming pages for reference by the programmer. These text references are not always aligned with the page layout. Refer to the Construction Documents (Appendix B) or the Programmatic Specification (Appendix A) for the actual sequence.

VisualLogic™ Display (VLD)

Features and highlights

- **Capable**
  Internal temperature and humidity sensors, 3 universal inputs, 6 binary outputs and 2 analog outputs.
- **Interoperable**
  BACnet-compliant on MS/TP LAN at up to 76.8 Kbps.
- **Versatile**
  Fully DDC programmable, capable of standalone or integrated operation.
- **Flexible**
  Fully programmable, configurable display, easy to locate wireless sensors.
- **Powerful**
  Offers control of a second VLC using peer-to-peer commands. Modes of operation allow control based on occupancy or schedules.
- **Fast**
  Internal DDC logic loop of 100 msec.
- **Visually appealing**
  Based on industry standard platform, sleek sophisticated design with touchscreen display.

Alerton's BACnet®-based VisualLogic® Display (VLD) is a communicating, intelligent sensor-controller combination with built-in temperature and humidity sensors that targets common controls applications such as roof top units, fan-coil units and heat pumps. It provides a cost-effective solution to meet in-room hotel requirements—an easy-to-use interface, easy-to-see digital display, and Celsius/Fahrenheit change over—where you already have Alerton systems in public or common areas. A versatile wireless addition provides door and occupancy sensor function. Direct digital control (DDC) enables powerful control of units, sophisticated, customizable displays, and a superb user interface.

The VLD combines a configurable display and a VisualLogic controller, making it ideal for retrofits of thermostat installations and places where a single-piece combination is easier to install.

The VLD communicates over an MS/TP LAN so it operates as a fully-functioning BACnet controller and easily integrates with the building automation system. Alerton can also provide seamless integration with hotel reservation and check-in systems with the BCM-HOTEL.

Based on an established industry platform and a sleek, sophisticated design that millions of people have already installed in their own homes, the VLD is a single, cost competitive unit with a familiar and user-friendly interface, so it's an easy to use choice for your customers. The VLD is compatible with Alerton's wireless occupancy kit so you can offer a plug-and-play wireless solution for applications needing motion or door sensing, such as hotel rooms.

6670 185th Avenue Northeast, Redmond, WA 98052 USA • Tel: 425.869.8400 • Fax: 425.869.8445 • www.alerton.com

ALERTON®

VisualLogic Display (VLD)

Technical Data

- **Power** 24 VAC @ 53 VA min. Half-wave rectified. One leg of 24 VAC connects to earth (panel) ground.
- **Inputs** 3 universal inputs with 12-bit accuracy, providing DDC-controlled voltage, current and resistive modes.
- **Internal Sensors** 1 internal temperature sensor, -40–199 deg. F (-40–93 deg. C); 1 internal humidity, 5–95% RH, non-condensing.
- **Binary Outputs** 6 outputs each rated at 24 VAC, 0.5A and using latching pilot relays capable of conducting one (1) amp continuously.
- **Universal Analog Outputs** 2 outputs with 12-bit resolution. Each auto-detects for 0–10 VDC or 4–20 mA. 4–20 mA outputs are sourced by the VLD. Connected loads must return to the VLD ground. The VLD automatically switches from 0–10V mode to 4–20mA current mode when it detects a load value of less than 500 ohms.
- **Processor & Memory** Powerful 32-bit processor with extensive flash memory and RAM resources. Flash memory provides nonvolatile program and data storage, and allows for encrypted updates to the program for future product enhancements.
- **Dimensions** 4.60” (117mm) H x 6.00” (152 mm) W x 1.20” (31mm) D including wallplate.
- **Terminations** A separate wallplate is provided and mounted to the wall; this wallplate provides screw terminal connections for all wiring. When the VLD is seated in the wallplate, all connections are made.
- **Environmental** 0–120 deg. F (-17–49 deg. C). 0–95% RH, non-condensing.
- **Communications** BACnet MS/TP LAN up to 76.8 Kbps.
- **Ratings**

  EMC Directive 89/336/EEC (European CE Mark)

  FCC Part 15, Subpart J, Class A

Ordering Information

Item number	Description
VLD-362	VisualLogic Display controller with 2 fixed inputs, 3 universal inputs, 6 binary outputs and 2 analog outputs
AL-OC-KIT	Wireless occupancy kit; includes (1) receiver, (1) PIR sensor, and (1) door contact sensor
AL-OC-REC	Wireless receiver unit
AL-OC-PIR	Wireless passive infrared (PIR) motion sensor
AL-OC-DS	Wireless door contact sensor

Specifications subject to change without notice

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VLC-444

Features and highlights

- **Capable**
  Four universal inputs, four binary outputs and four analog outputs.
- **Interoperable**
  BACnet-compliant on MS/TP LAN at up to 76.8 Kbps.
- **Versatile**
  Fully programmable for fan-coil units, VFDs and small packaged air conditioning units, and any application requiring a group of four or less analog outputs, such as a group of VFDs or actuators (i.e., dampers and valves).
- **Reliable**
  Extensive on-board filtering, with all program and configuration data backed up in nonvolatile flash memory.
- **Fast**
  Internal logic loop of 100 msec.

The Alerton® BACtalk® VLC-444 is a versatile, high-performance, BACnet-compliant field controller designed for fan-coil units. As a native BACnet controller, the VLC-444 integrates seamlessly with your BACnet system. It communicates at up to 76.8 Kbps on a BACnet MS/TP LAN or can operate as a stand-alone controller.

All VLC-444 control logic is programmed with Alerton's easy-to-learn graphical programming language, VisualLogic®. Programming and setup data is stored in nonvolatile flash memory, ensuring stable and reliable operation. The VLC-444 supports the Alerton Microset II intelligent wall sensor, which offers convenient data display, setpoint adjustment, and technician access to equipment setup parameters.

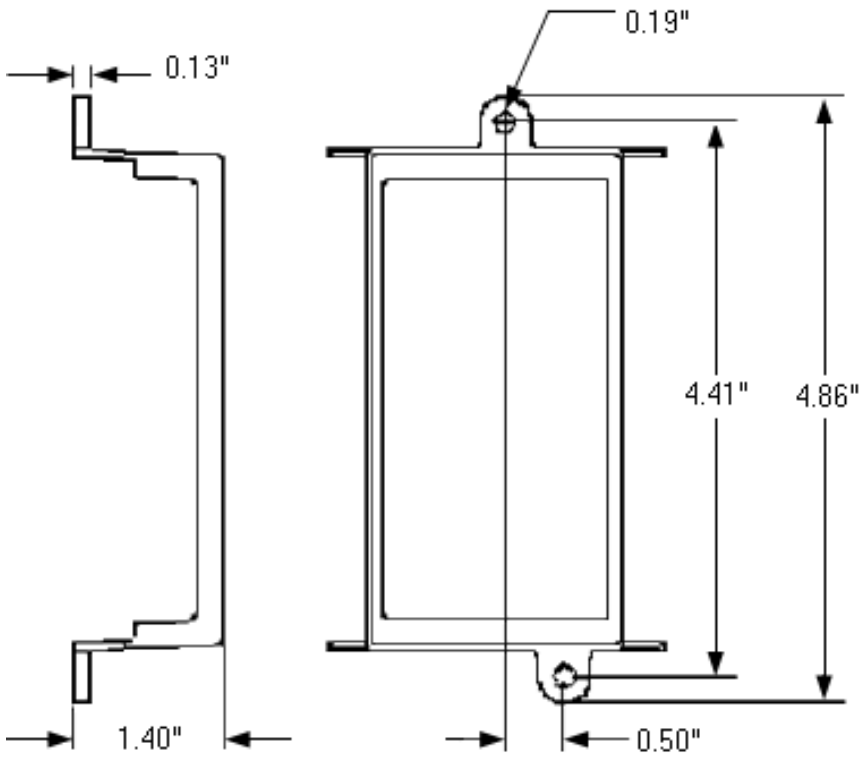
The VLC-444 is built for high-speed processing, with an internal logical loop time of 100 msec.

High-resolution, 12-bit universal auto-sensing inputs for thermistor/dry contact or 0–10 VDC/4–20 mA . For equipment monitoring, an on-board LED for each binary output indicates ON/OFF status, and a separate LED indicates communication activity on the MS/TP LAN.

VLC-444

Technical Data

- **Power** 24 VAC at 5 VA miniumum, plus binary output loads (53 VA maximum). Utilizes a half-wave rectifier. 20 VDC supply at 100 mA is provided at the terminal block to power external 4–20 mA sensors.
- **Inputs** 4 universal inputs with 12-bit resolution. Input 0 can be used for a BACtalk Microset II. Inputs 0–3 are auto-sensing for thermistor/ dry contact or 0–10 VDC/4–20 mA signals.
- **Binary Outputs** 4 outputs, each rated at 24 VAC, 0.5 A. The outputs utilize hot-switched triacs, which have a common connection to the 24 VAC supply.
- **Analog Outputs** 4 outputs with 12-bit resolution. Each is auto-sensing for 0–10 VDC or 4–20 mA. 4–20 mA outputs are sourced by the VLC. Connected loads must return to the VLC ground. 4–20 mA; max. load resistance is 550 ohms. 0–10 VDC; min. load resistance is 1,000 ohms.
- **Processor & Memory** ARM7 processor with on-board flash memory. Flash memory provides nonvolatile program and data storage, and allows for firmware (ROC) updates to the program for future product enhancements.
- **Max. Dimensions** 4.86" (125mm) H x 5.00" (127mm)W x 1.41" (36mm)D.
- **Terminations** Removable header-type screw terminals accept 14–24 AWG wire.



- **Environmental** -40–150 deg. F (-40-65.5 deg. C). 5–95% RH, non-condensing.
- **Communications** BACnet MS/TP LAN up to 76.8 Kbps.
- **Ratings**

  Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916

  EMC Directive 89/336/EEC (European CE Mark)

  FCC Part 15, Subpart J, Class A

Ordering information

Item number	Description
VLC-444	Field controller with 4 universal inputs, 4 binary outputs and 4 analog outputs
VLC-444-C	VLC-444 field controller with available custom DDC

Specifications subject to change without notice

Installation and Operations Guide

VLD

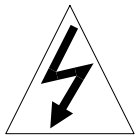
Important safety information and installation precautions

Read all instructions

Failure to follow all instructions may result in equipment damage or a hazardous condition. Read all instructions carefully before installing equipment.

Local codes and practices

Always install equipment in accordance with the National Electric Code and in a manner acceptable to the local authority having jurisdiction.



Electrostatic sensitivity

This product and its components may be susceptible to electrostatic discharge (ESD). Use appropriate ESD grounding techniques while handling the product. When possible, always handle the product by its non-electrical components.

High voltage safety test

Experienced electricians, at first contact, always assume that hazardous voltages may exist in any wiring system. A safety check using a known, reliable voltage measurement or detection device should be made immediately before starting work and when work resumes.

Lightning and high-voltage danger

Most electrical injuries involving low-voltage wiring result from sudden, unexpected high voltages on normally low-voltage wiring. Low-voltage wiring can carry hazardous high voltages under unsafe conditions. Never install or connect wiring or equipment during electrical storms. Improperly protected wiring can carry a fatal lightning surge for many miles. All outdoor wiring must be equipped with properly grounded and listed signal circuit protectors, which must be installed in compliance with local, applicable codes. Never install wiring or equipment while standing in water.

Wiring and equipment separations

All wiring and controllers must be installed to minimize the possibility of accidental contact with other potentially hazardous and disruptive power and lighting wiring. Never place 24VAC or communications wiring near other bare power wires, lightning rods, antennas, transformers, or steam or hot water pipes. Never place wire in any conduit, box, channel, duct or other enclosure containing power or lighting circuits of any type. Always provide adequate separation of communications wiring and other electrical wiring according to code. Keep wiring and controllers at least six feet from large inductive loads (power distribution panels, lighting ballasts, motors, etc.). Failure to follow these guidelines can introduce electrical interference and cause the system to operate erratically.

Warning

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

6670 185th AVE NE
Redmond, WA 98052 USA
Phone: (425)869-8400 FAX: (425)869-8445
Web Site: www.alerton.com

Contents

About VLD

Alerton VisualLogic Display (VLD) is a communicating sensor/controller with built-in humidity sensor and optional wireless capability. It combines the functionality of a VisualLogic Controller (VLC) with a programmable user interface display.

Electrical inputs and outputs wire directly to field equipment, and the control sequence is programmable using Envision for BACtalk's direct digital control (DDC) language, VisualLogic. DDC is programmed and downloaded to the controller using an Envision for BACtalk operator workstation.

Operational information and control data is available to other building controllers and systems through the BACnet protocol (ANSI/ASHRAE standard). This enables a VLD to share data and execute commands initiated from other BACnet-compliant devices.

About this document and related publications

This document provides information about installing and wiring a VLD to equipment, power, and communication channels. It also shows how to operate the user interface.

IMPORTANT Always install equipment in accordance with the National Electric Code and in a manner acceptable to the local authority having jurisdiction (AHJ). No guidelines, instructions, installation practices, or other information presented in this guide may be interpreted to supersede or modify the local codes and practices of the AHJ.

Table 1 Other documentation related to BACtalk VLDs

Document (ID)	Contains
VLD Installation Instructions (LTBT-TM-VLDINST)	Instructions for mounting and wiring the backplate and for mounting the VLD on the backplate. A printed copy ships with each unit.
Data Sheet (LTBT-VLD)	Single-sheet summary of applications, capabilities, and configuration.
Wireless Occupancy Kit Installation Instructions (LTBT-OC-INST)	Instructions for installing the optional occupancy kit (AL-OC-KIT)
Programmer's Guide & Reference for BACtalk Systems (LTBT-TM-PRGRMR)	Information and instructions for programming DDC sequences for VLDs, setting up I/Os in software, and programming data displays to command data.

VLD dimensions

The VLD consists of a mounting plate and a circuit board with a plastic cover. See the VLD Installation Instructions (LTBT-TM-VLDINST) for precise dimensions.

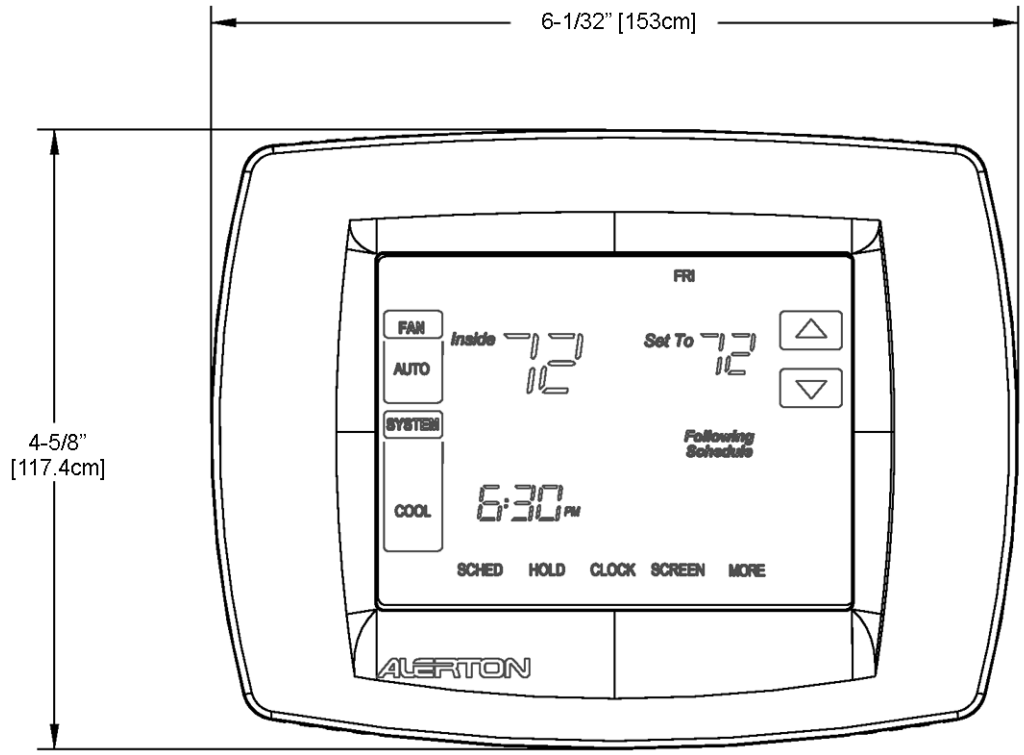


Figure 1 VLD dimensions

Mounting guidelines

The VLD is designed to be wall-mounted indoors, with dimensions ideal for mounting to a single-gang electrical box.

Mount in a clean, dry location away from windows, air ducts, and other places where environmental factors may affect temperature and humidity readings. If you mount the VLD on the interior of an outside wall, thoroughly insulate so outside air behind the sensor doesn't affect the sensor reading.

To meet requirements of the Americans with Disabilities Act, mount no higher than 48" from the floor and with a minimum clear floor space of 30" X 48" (760 X 1220 mm).

CAUTION Thoroughly read all instructions before mounting and wiring. Always install equipment in accordance with applicable electric codes and the instructions.

Installing the wallplate

The VLD can be mounted horizontally on the wall or on a 4 in. x 2 in. (101.6 mm x 50.8 mm) wiring box.

▶ **To install the wallplate**

1. Position and level the wallplate (for appearance only).
2. Use a pencil to mark the mounting holes.

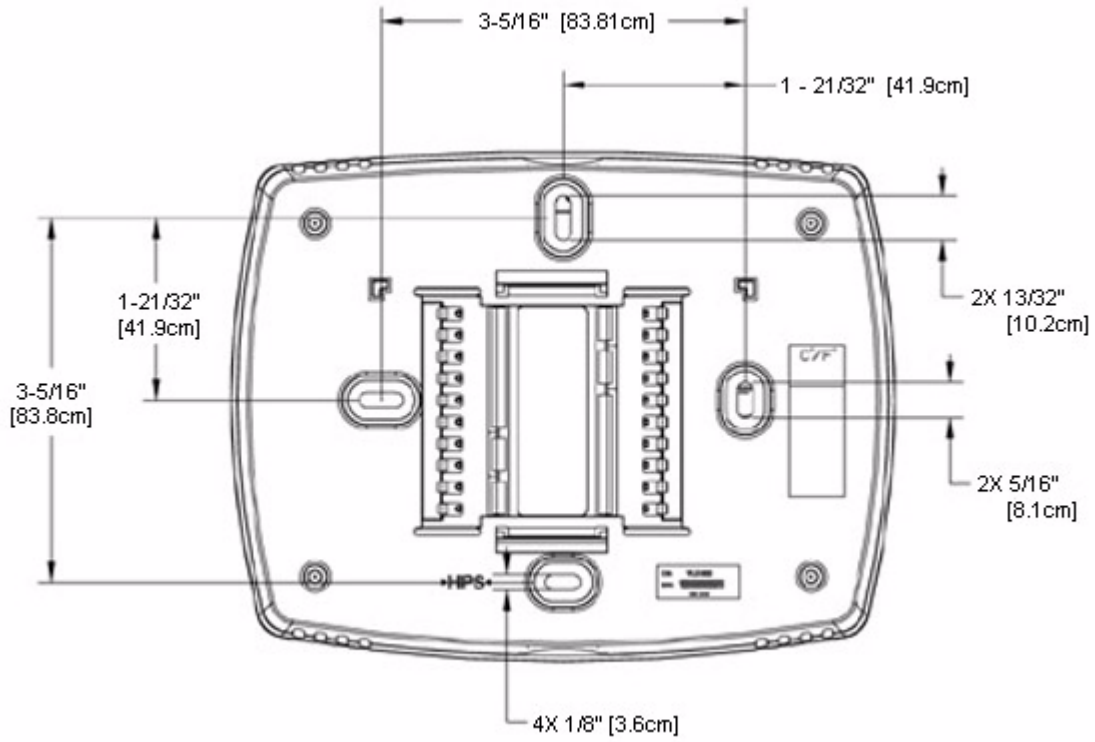


Figure 2 Wallplate dimensions

3. Remove the wallplate from the wall and, if drywall, drill two 3/16-in. holes in the wall, as marked. For firmer material such as plaster, drill

two 7/32-in. holes. Gently tap anchors (provided) into the drilled holes until flush with the wall.

4. Position the wallplate over the holes, pulling wires through the wiring opening.

5. Insert the mounting screws into the holes and tighten.

Wiring the wallplate

CAUTION Disconnect power before wiring. Failure to do so may result in electrical shock or equipment damage.

▶ **To wire the wallplate**

1. Connect wires to the terminal block using Figure 3 as a guide. Note that VLD does not have COM connections. All grounds are tied together.

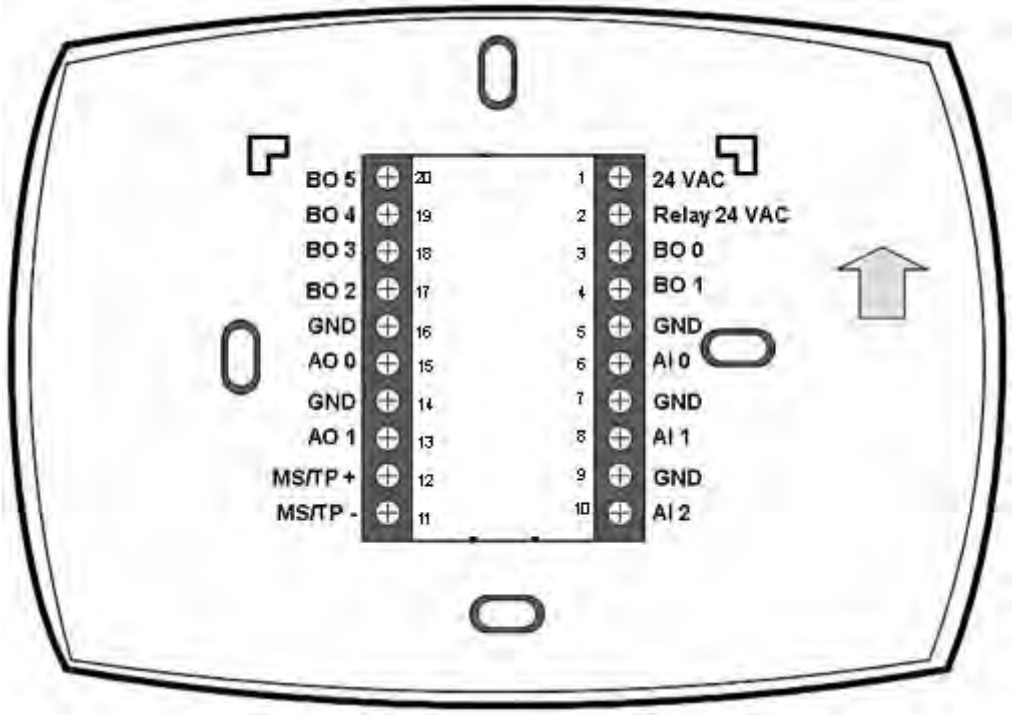


Figure 3 VLD terminal assignments and pin numbers

2. Securely tighten each screw.

3. Push excess wire back into the hole.

4. Plug the hole with nonflammable insulation to prevent drafts from affecting the VLD.

Note A jumper is pre-installed between pins 1 and 2 (24 VAC and Relay 24 VAC). This supplies 24 VAC to BO 1, BO 3, and BO 4. It can be removed if you want to power these inputs from a separate power supply.

Mounting the VLD

To mount the VLD, align the terminal screw blocks with the pins on the back of the VLD and push the VLD faceplate straight onto the wallplate.

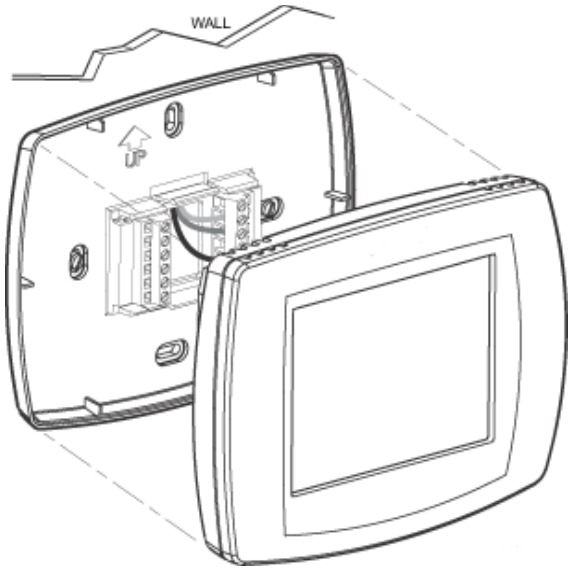


Figure 4 VLD faceplate mounting

Adjusting the date and time

▶ **To adjust the time**

1. Press the **CLOCK** key.
2. Use the arrows to adjust the year, month, and day.
3. Press **DONE**.
4. Adjust the time and press **DONE**.

Setting the MAC address and device instance

The factory default MAC address is 0. Valid MAC addresses are 1-127. The default device instance is 0009999. Valid device instances are 0-4194303.

Note The device instance can also be set using BACtalk operator workstation software.

▶ **To set the MAC address and device instance at the display**

1. From the home screen, press the **SYSTEM** block area (block may not be visible, see Figure 5).

   Blank touch keys appear at the bottom of the screen.

2. Press and hold the two blank keys on either side of the center key for approximately five seconds.

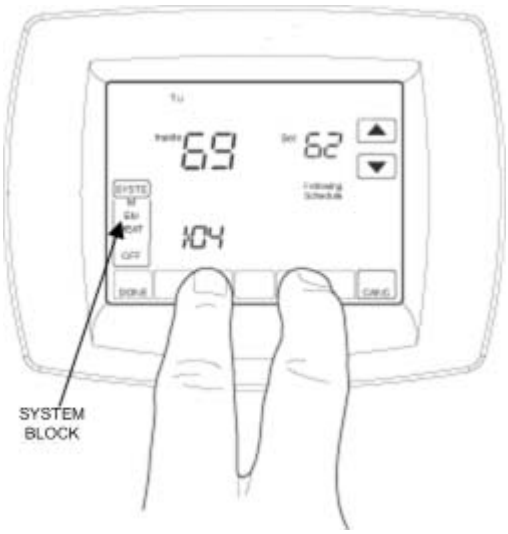


Figure 5 Entering ISU mode

The Installer Setup (ISU) screen appears. An ISU code is displayed in the lower left. It is a four-digit code beginning with zero. The current setting is displayed in the lower right.

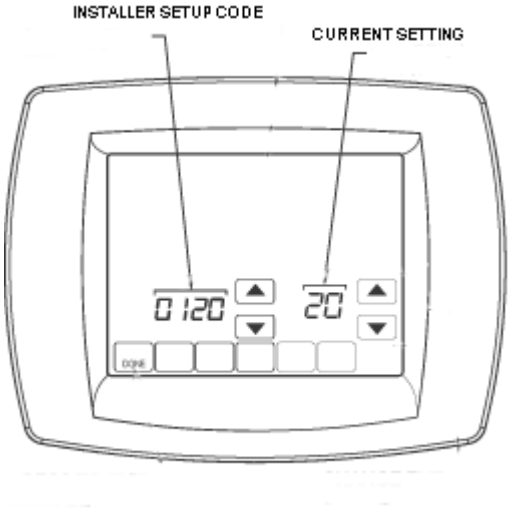


Figure 6 ISU screen

3. Use the down arrow to advance to ISU code 800.
4. Use the up and down arrows to set ISU code 800 (MAC address) to a value between 0 and 127.
5. Set ISU code 801 (first digit of device instance) to a value between 0 and 4.

Note The device instance is set by entering values in four separate ISU codes. See example on page page 11.

6. Set ISU code 802 (second and third digits of device instance) to a value between 00 and 99.
7. Set ISU code 803 (fourth and fifth digits of device instance) to a value between 00 and 99.
8. Set ISU code 804 (sixth and seventh digits of device instance) to a value between 0 and 99.
9. Press **Done** to exit Installer Setup.

   For example, if you want to set the MAC address to 15 and the device instance to 1876, you would use these settings:

   ISU code 800=15
   ISU code 801=0
   ISU code 802=00
   ISU code 803=18
   ISU code 804=76

Identifying terminals and terminating wire

The VLD label identifies wiring terminals by number and function. Terminals are numbered from top to bottom, beginning with 1 on the upper right side of the wallplate and continuing top-to-bottom on the right side of the controller. I/O terminals carry an additional numeric identifier that corresponds to the software I/O. Use this section to identify terminals on the VLD. See later sections for more specific instructions, cautions, and recommendations.

Power supply terminals

Two terminals are used to connect the 24VAC power supply to the VLD.

Ground terminals

These terminals are used for terminating the grounded leg of the 24VAC circuit and the return grounds of AIs, AOs, and BOs.

Universal inputs

Use these terminals (in conjunction with adjacent GND terminals) to connect universal inputs. Input terminals accept a variety of signal types.

Binary outputs (BOs)

Use these terminals to connect BO loads (ON/OFF control). Terminate the BO return ground to the panel/enclosure ground or a GND terminal on the VLD.

Analog outputs (AOs)

Use these terminals to connect AO-loads (modulating control). The AO-return ground must terminate to the nearest GND terminal.

MS/TP LAN communications

Use terminals 11(MS/TP-) and 12 (MS/TP+) to connect the BACnet MS/TP LAN to the VLD. Polarity must be maintained throughout the entire LAN. See “MS/TP LAN configuration” on page 15 for more information.

Using terminal blocks

The VLD uses header-style termination blocks to simplify field wiring of power, communications, and I/Os. Terminal blocks accept wire gage from 12–24 AWG.

▶ **To terminate wire to a VLD**

1. Strip approximately 1/8” of the wire jacket from the end of the wire.
2. Use a small screwdriver (1/8” max) to turn the adjustment screw fully counter-clockwise. The clamps in the wire slot separate as you turn the screw.
3. When the clamps in the wire slot are fully open, insert the stripped end of the wire into it (try to get the jacket flush with the terminal block). If using stranded wire, be sure to insert all strands into the wire slot. If terminating multiple wires, trim wires to same length and tightly twist exposed wire together.
4. Hold the wire in place and turn the adjustment screw clockwise to tighten it until the clamps in the wire slot secure the wire.
5. Tug gently on the wire to ensure it is secure.

Power supply guidelines and requirements

VLD uses 24VAC power from a UL Listed Class 2 24VAC transformer (not provided). The VLD uses a half-wave rectifier to convert the AC power supply to onboard power. This enables multiple VLDs with half-wave power supplies to be powered from a single, grounded transformer.

CAUTION Half-wave devices and full-wave devices must not use the same AC transformer. If a VLD will share its power supply with another device, make sure that the other device utilizes a half-wave rectifier and that polarity of wiring is maintained. Failure to do so can result in equipment damage.

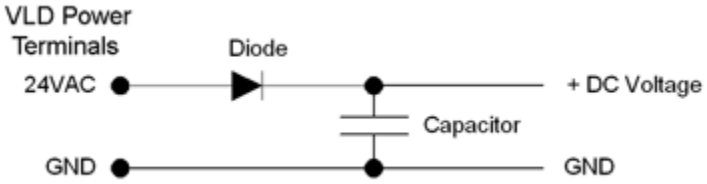


Figure 7 Internal VLD power wiring schematic, half-wave rectifier

VLD power ratings

The VLD minimum current draw is 24 VAC @50ma leading to ~1.2VA.

The minimum applies when the VLD supports no binary output (BO) loads. If the VLD supports AOs, the minimum VA rating includes the draw of all AO-loads energized at maximum rating. The maximum power draw is the minimum VA rating plus the power draw when all BOs are energized at maximum capacity.

Selecting a transformer

The safest way to size a transformer is to ensure that the maximum VA load rating of the VLD is less than 85% of the Nameplate VA rating of the transformer. Even if all outputs are not presently used, this ensures that each VLD has sufficient power for future equipment additions.

IMPORTANT Transformer sizing should never exceed the maximum UL Class 2 rating.

Power supply grounding and wiring

When connecting power to the VLD, ensure that one leg of the VAC secondary circuit connects to a known earth ground. Also ensure that the GND terminal on the VLD connects to the same known earth ground.

Supplying a high-quality ground connection to a VLD and then properly connecting the VLD to the ground is one of the most important things you can do to ensure a trouble-free installation.

The 24VAC secondary leads are not interchangeable. Once a lead connects to the GND terminal on the VLD, it is the grounded lead. Observe and maintain polarity for subsequent connections. The GND terminal provides a reference ground for the circuit board and communications wiring. Use 18 AWG cable for best results.

WARNING Ensure that all VLD power, communications, and I/O cabling are grounded according to these instructions. Failure to follow these instructions may result in VLD operational and communication failures or equipment damage.

Power supply wire selection

If you are considering long power supply wiring runs, using the right wire size is critical. If the wire is too small, the resistance may be too high, resulting in a low voltage supply to the VLD. This is known as *line loss.* The wire size is based on the length of the wire run and the current draw of the VLD. Use Figure 8 to determine wire size; obtain additional information from the transformer manufacturer.

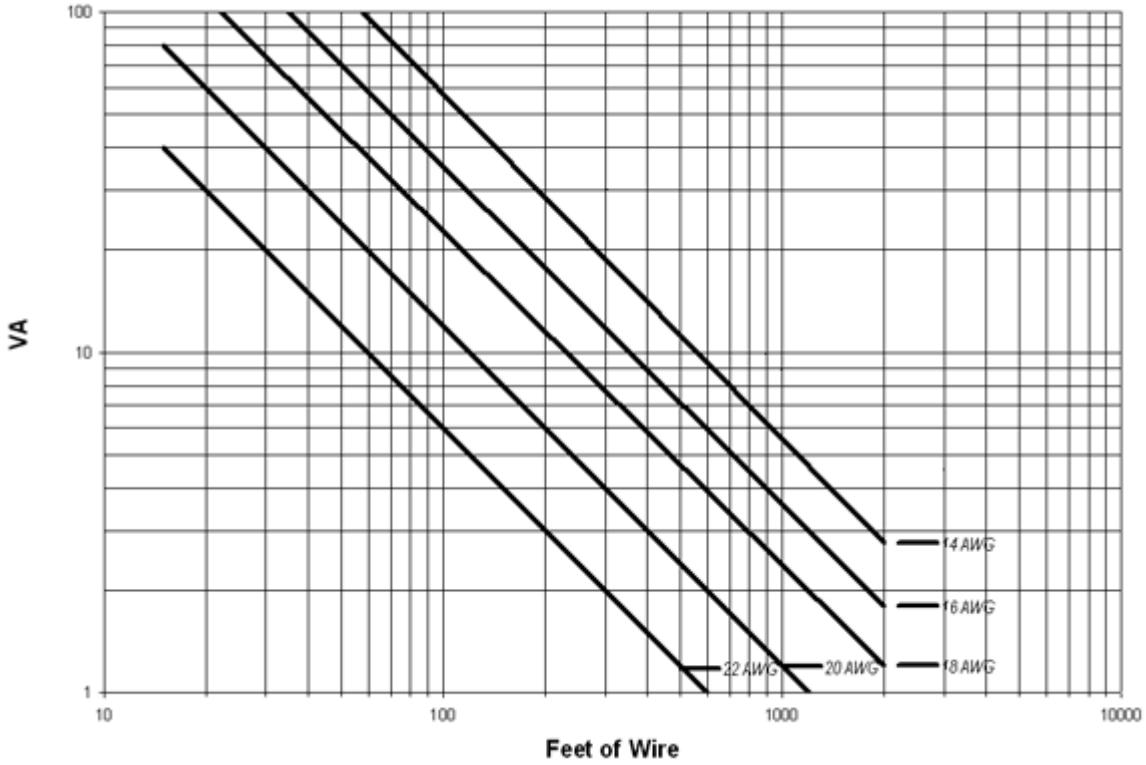


Figure 8 VLD wiring recommendations

Backup Power

The VLD features a built-in supercapacitor that will run the on-board clock for ten days in the event of power loss.

MS/TP LAN configuration

The VLD communicates on the site-wide BACnet system over a twisted-pair MS/TP LAN, which uses the EIA–485 signaling standard. VLDs are master devices on the MS/TP LAN.

Each VLD employs a high-quality EIA–485 transceiver and exerts ¼ unit load on the MS/TP LAN.

Table 2 MS/TP LAN facts

Transmission speed	9.6, 19.2, 38.4, 76.8 Kbps (configured at global controller).
Layout	Bus.
Cabling	BACnet specifies the following. Shielded, twisted-pair cabling with characteristic impedance between 100 and 130W. Distributed capacitance between conductors must be less than 30 pF/foot (100 pF/m). Distributed capacitance between conductor and shield must be less than 60 pF/foot (200 pF/m). Foil or braided shield acceptable.
Segment length	4000 ft. (1071 m.) per segment using recommended wire.
Maximum devices overall	Depends on classification of devices as master or slave. Maximum number of master devices is 128. Maximum number of slave devices or devices overall (mixed master and slave) is 255. This includes VLDs, BACtalk global controllers (all are considered masters) and any other devices, regardless of their relative unit loads.
Maximum devices per segment	Depends on relative unit load of devices (see “Terminating MS/TP LAN cabling” on page 16).
Repeaters	Required when making runs longer than 4000 ft. Three repeaters maximum between any two devices.
Terminating resistors	Matched resistors required at each end of segment bus wired across (+) and (–). Use matched precision resistors rated ¼W ±1% / 80 - 130 Ohms.
Shield grounding	Ground shield drain wire at single point earth (panel) ground, *not VLD ground*. Tape off shield drain wire at other end. Tie shield drain wire through at each VLD.

Terminating MS/TP LAN cabling

MS/TP terminations are located on the lower left of the VLD wallplate.

Maintain polarity of the MS/TP wire run throughout the MS/TP LAN.

Note Basic information about MS/TP terminations at the VLD are provided here. See the *BACtalk System Design Guide* (LTBT-TM-SYSDSGN) for more detailed information and limitations with respect to MS/TP LANs — distance requirements, unit loads, repeater architectures, etc.

MS/TP shield grounding

Proper shield grounding of the MS/TP cabling can help minimize the risk of communications problems and damage to equipment because of transient voltage spikes (for example, lightning strikes).

Follow these guidelines for grounding MS/TP cable shields:

- Each MS/TP segment should have a single point of shield ground, preferably as close to the middle of the cabling run as possible (see Figure 9).
- Do not ground the MS/TP shield using a VLD terminal.
- Never ground both ends of a shield because differences in potential between the grounds may induce current on the shield, causing interference.
- At connecting points of termination, tie the shield through with a wire nut.
- At ungrounded, exposed shield points (the end of a segment), tape back the shield to the wire jacket or, for optimum transient shunting, use 100 V gas discharge tubes or 120 V MOVs between the shield and ground. See Figure 9.

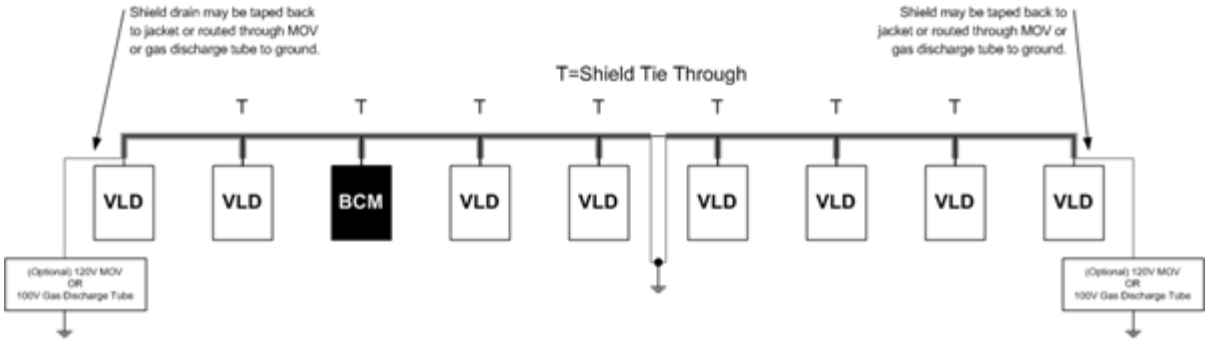


Figure 9 TMS/TP shield drain termination and tie through

Terminating resistors

At the last device on each end of the MS/TP segment, matched terminating resistors wired across Data + and Data – are required for signal integrity (see Figure 10).

Optimum segment performance typically requires “tuning,” a process by which the value of the terminating resistors is selected based on the wave form of signals on the segment. View wave forms using an industrial scope meter. The goal is to have as square a wave form as possible with an amplitude greater than 200 mV. Resistors affect the wave form as follows:

- When the resistance value decreases, the amplitude of the wave form decreases and becomes more square.
- When the resistance value increases, the amplitude of the wave form increases and becomes less square.

Typically, precision resistors in the range 80-130 Ohms (±1%) yield acceptable results. Ideally, the value of the terminating resistors should match the rated characteristic impedance of the installed cable. For example, if the installed MS/TP cable has a listed characteristic impedance of 100 Ohm, install 100 Ohm matched precision resistors.

CAUTION Do not mismatch terminating resistors. Ensure that both resistors on a segment have the same value.

Note In figure 2.6, White is Data - and Black is Data +.

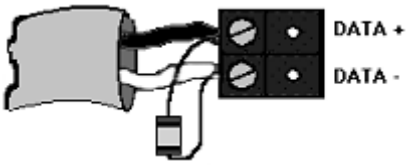


Figure 10 Terminating resistor detail

Real-time operating code (ROC) file

VLD has downloadable software called real-time operating code (ROC file). The ROC file is the brains of the device and handles the more complex functions of the VLD (object support, DDC, I/O control, and so on). The ROC file can be downloaded whenever a software upgrade is necessary. To upgrade the ROC file, use BACtalk operator workstation software.

ROC file version

When servicing a VLD, communicating with Alerton customer support, or reading documentation, you may need the firmware version of a VLD. VLD firmware version information is available in software as the application-software-version property of the VLD Device object.

To view the firmware version of a VLD, use BACtalk operator workstation software to open a display template showing its Device Properties.

VLD ROC version

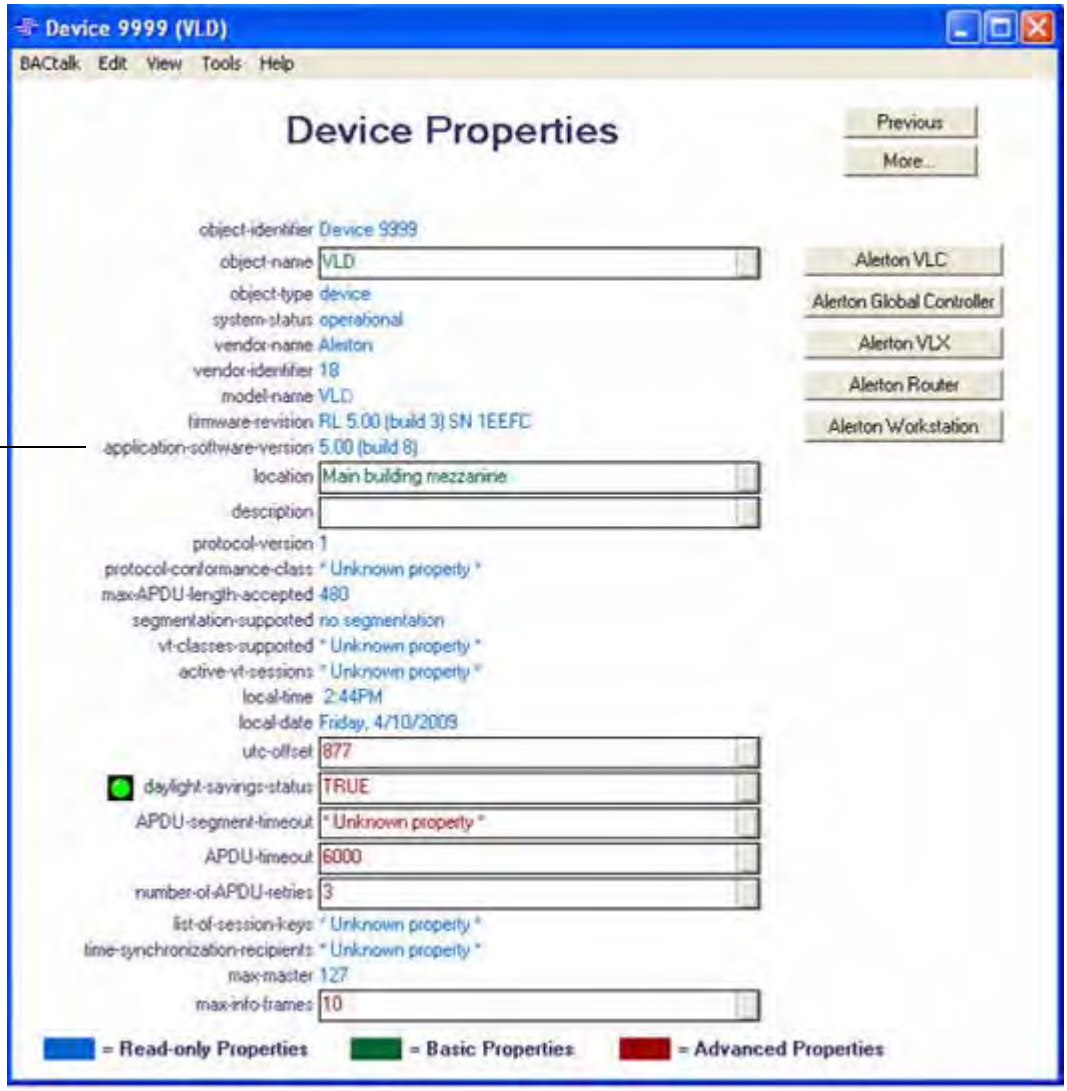


Figure 11 VLD device properties

Operational overview

The VLD operates in one of three modes - Setpoint, Occupancy, or Hotel. While in one of these modes, a user can enter one of two configuration modes - Installer Setup or Field Service.

Setpoint mode - interface is similar to the Honeywell VisionPro. See page 26 for details.

Occupancy mode - interface is similar to the Alerton Microset. See page 27 for details.

Hotel mode - a subset of the functionality available in Occupancy mode. Designed for hospitality applications. See page 30 for details.

Installer Setup utility - configuration mode similar to that of the VisionPro. See page 31 for details.

Field Service utility - configuration mode similar to the Alerton Microset. See page 33 for details.

Note All VLD operating logic executes in DDC. Data displays can directly reference data points in the VLD.

In addition to the standard operating mode screens, a custom screen can be managed by DDC for additional user feedback or control selection. See “Custom screen” on page 25.

These operating modes pertain to user interaction via the touchscreen and display only. Actual control behavior is determined by the DDC loaded into the unit. Physical control is separated from the user input controls so that, in case of conflicting inputs, DDC controls the system. The job engineer is free to choose the extent of control that will be allowed to users. VLD uses typical Alerton Microset conventions, which are supported fully in Occupancy mode and to some extent in Setpoint mode. Because of this, DDC written for VLC/Microset applications requires few modifications to run properly in a VLD.

Screen elements

The user interface is presented in different screens, which are made up of blocks, keys, and displays. The elements that appear on a given screen are determined by the purpose of the screen and by configuration settings. Custom screens can be created to meet specific needs.

Blocks include the SYSTEM block and the FAN block. Both blocks are on the left side of the screen. You can set the blocks to be visible or not visible to users. In addition, the items that appear in the SYSTEM block can be configured as visible and not visible. Figure 12 shows the blocks.

Keys are areas of the touch screen programmed to respond to touch. Keys have labels or icons that indicate their functions. Keys are visible only when relevant the current display screen. Figure 12 shows examples of keys.

Displays provide the user with information about current conditions and settings. They respond to keys. For example, the inside air temperature DISPLAY will increment when the up arrow KEY is pressed. Figure 13 shows examples of displays.

Figure 12 and Figure 13 show the basic features of the user interface.

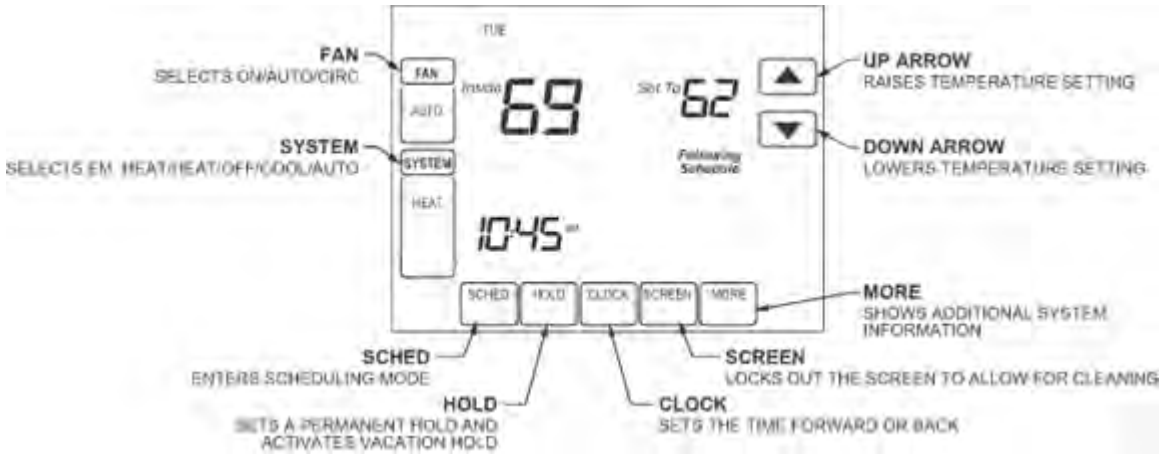


Figure 12 VLD user interface - blocks and keys (Setpoint mode with heat (one setpoint))

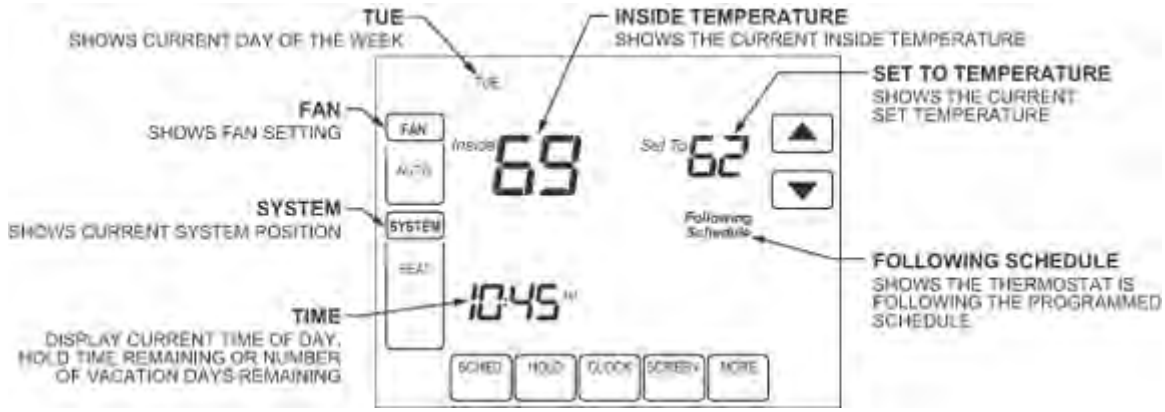


Figure 13 VLD user interface - displays

Common features

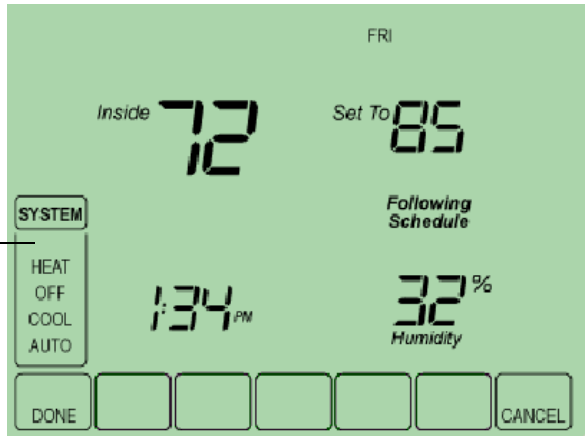
This section describes features common to all operating modes (Setpoint, Occupancy, and Hotel).

SYSTEM block

The SYSTEM block can be used to provide information to the user about the current control state. The information displayed is controlled by DDC using AVs and BVs. The user can also be allowed to use this block to select a control state. User selections are not implemented or displayed unless DDC is programmed to act on them. See discussion of AV-110 and AV-111.

The SYSTEM block, when made visible, allows a user to select one of five system functions - EMHEAT, HEAT, OFF, COOL, and AUTO. To select a function the user presses the SYSTEM block. All of the enabled choices (each of the five can be configured to appear or not) are shown in the block with the

current function flashing. The user presses the SYSTEM block to cycle through the choices and presses DONE to save and exit.



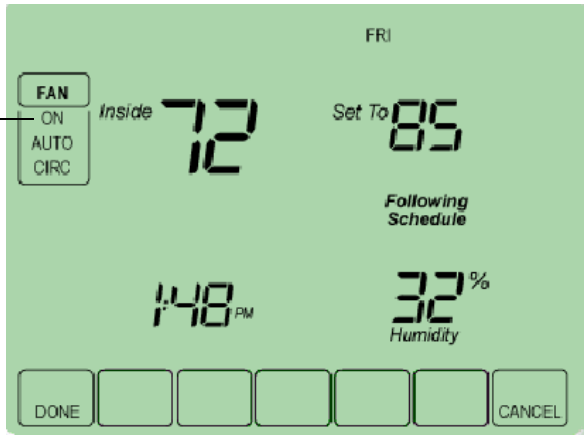
To enable function selection to affect the screen, set the VLD to Setpoint mode and use DDC to transfer AV-111 to AV-110.

Note EMHEAT is selectable by the user but has no separate indication on AV-111 or AV-110. BV-125 provides the indication to the screen when AV-110 indicates 2 (heat) that EMHEAT is to be displayed. When AV-111 is transferred to AV-110 via DDC, EMHEAT will be shown if enabled. If DDC is controlling the SYSTEM block via AV-110 independent of AV-111, set BV-125 to Active and AV-110 to 2 (heat) in order to show EMHEAT in the SYSTEM block.

FAN block

The FAN block can be used to provide information to the user about the current control state. The information displayed is controlled by DDC using AVs and BVs. The user can also be allowed to use this block to select a control state. User selections are not implemented or displayed unless DDC is programmed to act on them.

Fan control can be enabled (BV-80=1) to allow users control of the fan. When enabled, the user presses the FAN block to select a fan setting. All enabled options are displayed and the current setting blinks. Press the FAN block to cycle through the options. Press **DONE** to save and the selection.



The fan setting can be displayed in one of three formats (selected by AV-137).

AV-137 value	Available settings
0	OFF LO MEd HI
1	OFF 1 2 3
2	0% 33% 66% 100%

DDC can be programmed to display the current fan setting without allowing the user to change it.

English and metric units

You can set the VLD to display English or metric units based on the selection in the DDC header file or you can toggle that status in software. The English or metric setting at the VLD is referred to as the native units mode.

BV69 can be set ON to reverse native units mode for the VLD display. Thus, if the VLD is set to English, and BV-69 is ON, the VLD displays units in appropriate metric equivalents. This enables the system to display units at the VLD according to occupant preference without a programmer having to write separate DDC sequences around each unit of measure.

Humidity display

If your system includes a humidifier, dehumidifier, or outside humidity sensor, the inside humidity can be displayed below and to the right of the temperature. Outside humidity can also be displayed on the MORE screen. To enable outside humidity display, set BV-101 to 1. If both humidity and OAT are enabled on the main screen, they will be displayed alternately every few seconds.

Outside air temperature (OAT) display

The outside air temperature can be displayed when the user presses MORE from the main screen. It can also be displayed on the main screen. If both OAT and humidity are enabled on the main screen, they will be displayed alternately every few seconds. For OAT read at another unit to display at the VLD, the OAT value must be written in DDC to the Present Value of AV-103.

Schedule display and editing

If enabled in DDC, a user can view or edit the internal VLD schedule. To deny a user read permission, set BV-114 to 1. To deny schedule editing permission, set BV-141 to 1.

LCD backlight operation

BV-79 controls backlight operation. If BV-79 is OFF, the backlight turns ON when any key is pressed and stays on for 20 seconds after there is no key activity. If BV-79 is ON, the backlight is ON continuously.

Clock operation

The VLD real-time clock provides time and date for displaying the date and time, implementing daylight savings settings, and implementing schedules. If AC power is lost, a supercapacitor will power the clock for ten days. If the date and time are lost, the VLD will display the set time and date screens when powered up.

Note The real-time clock is separate from the CPU time keeping utility. It only affects the items listed in this section.

Daylight savings (DLS) settings can be controlled by VLD or by BACtalk operator workstation software. If Installer Setup (ISU) parameter 330 is set to non-zero, VLD will control DLS settings. If ISU 330 is zero, DLS is controlled by BACtalk operator workstation software.

The clock accepts time syncs from BACtalk operator workstation software. If configured in DDC, the date and time can also be set manually using the display. To deny a user permission to set the clock, set BV-116 to 1.

The last time command, whether from the user screen or BACnet, takes precedence.

▶ **To adjust the real-time clock**

1. Press CLOCK.
2. Use the arrow keys to select a year, month, and day.
3. Press DONE.
4. Select a time.
5. Press DONE.

MORE key navigation

The MORE key allows a programmer to make additional screens available to users. Enabling the display of one or more of these screens causes the MORE key to appear on the main screen. The screens that can be made available are:

- Outside air temperature
- Inside/outside humidity
- Custom screen (See “Custom screen” on page 25)
- Humidifier control
- Dehumidifier control
- Filter
- Dehumidifier pad
- UV lamp

When the user presses **MORE**, the first enabled screen appears. Pressing **MORE** again displays the next, and so on.

Touchscreen cleaning

If the display screen needs to be cleaned, the user presses **SCREEN**. The display will lock for 30 seconds allowing the user to wipe the screen without pressing any keys. When the display reads 0, press SCREEN to continue cleaning or DONE to quit. Use a non-abrasive glass cleaner.

Filter, humidifier pad, and UV lamp notifications

Notifications can be set to inform the user that a filter, humidifier pad, or UV lamp needs to be changed. Notifications can be triggered by an elapsed run time or by DDC writing to an associated BV. When a notification is ON, a display alternately flashes the word “CHANGE” and the name of the item.

Notifications set by timer

Notifications can be set up using the touchscreen in Installer Setup mode (see “Installer Setup (ISU) Mode” on page 31).

ISU Code	Description	Allowed Values
500	Filter change reminder AV-124	0 – reminder not used 1 – 10 days 2 – 30 days 3 – 60 days 4 – 90 days 5 – 120 days 6 – 365 days
510	Humidity pad change reminder AV-125	0 – reminder not used 1 – 90 days 2 – 180 days 3 – 365 days
520	UV lamp change reminder AV-126	0 – reminder not used 1 – 365 days

Notifications set by DDC

Theses notifications can also be forced ON by setting the associated BV to 1.

- BV-111 forces the CHANGE FILTER notification.
- BV-112 forces the CHANGE UV LAMP notification.
- BV-113 forces the CHANGE HUMIDIFIER PAD notification.

Custom screen

You can create a custom screen that displays numbers and text and provides user touchscreen feedback for DDC to monitor. The custom screen is configured using the of points listed in “Appendix B: Custom display configuration” on page 57.

A user reaches the custom screen by pressing **MORE** twice from the main screen.

The VLD screen has digit fields in the upper left, upper right, lower right, and lower left areas of the screen. Arrows can be displayed next to the upper right, lower right, and lower left blocks. When any of these three blocks is enabled, numeric, and editable, VLD will automatically display the arrows and will process user adjustments to the displayed value. These adjustments are limited by assigned maximum and minimum values. Each time the user presses an arrow, the associated value will increment or decrement. The amount of each increment or decrement can be configured.

If a block is enabled and numeric but not flagged as editable, the arrow keys will be disabled.

Custom screens support DDC interaction by providing key push feedback in BVs. A DDC application can take input from a custom screen by watching the appropriate BVs and taking any desired action. If a block is not flagged as numeric, the adjustment arrows can still be manually turned on and DDC can respond to user key pushes to make any desired adjustments.

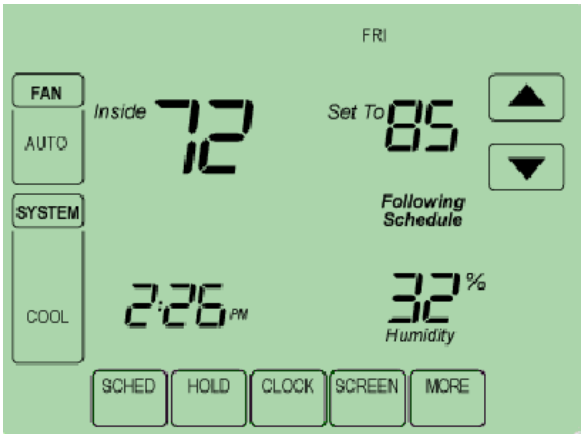
Setpoint mode

This section describes the functionality unique to Setpoint mode. See also “Common features” on page 21.

Setpoint mode is similar to the Honeywell VisionPro interface. It is typically used for residential applications. The screens in Setpoint mode mimic the VisionPro, but physical control performed by the VLD depends on the DDC uploaded to it. A job engineer may program DDC that mimics VisionPro behavior, or may program other behavior.

The internal schedules contain “Wake/Leave/Return/Sleep” periods, each with a definable start time and assignable heating and cooling setpoints. The user is allowed to temporarily or permanently override the scheduled setpoints.

Note The internal schedule used by this interface is not visible remotely using BACnet.



When HEAT (AV-110=2) or COOL (AV-110=1) are selected in the SYSTEM block, only one setpoint is displayed on the main screen. If OFF (AV-110=0) is selected, no setpoint is displayed.

Schedule configuration in Setpoint mode

VLD can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133.

Schedule Usage	ISU Parameter 160	BV-133
No internal schedule	0	0
7-day internal schedule	4	1

If the internal schedule is OFF, the user can adjust the setpoint (within setpoint limits).

Schedules are stored in flash memory so they persist through power cycles.

In setpoint mode, each schedule period consists of a start time, a heating setpoint, and a cooling setpoint. The maximum number of periods per day is configured using ISU parameter 540 (AV-129). A value of 2 specifies two periods per day - Wake and Sleep. A value of 4 specifies 4 periods per day - Wake, Leave, Return, and Sleep. The scheduler selects the last valid period start before the present time as the period to use. Setpoint mode schedules are not accessible via BACnet. The only way to view, edit and save a schedule is from the unit LCD screen.

Schedule setpoint overrides in Setpoint mode

An override is created by one of three methods:

Temporary - press an arrow next to a setpoint. The words “Hold Temperature Until” appear above the time display, which shows the default ending time (the beginning of the next schedule transition). Use the arrows to adjust the ending time. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Permanent - press HOLD. The words “Permanent Hold” appear below the time display and the override takes effect.

Vacation - while in Permanent Hold, press **HOLD**. The words “Hold Temperature Until” appear above the time display. Use the arrows to select the number of days (1-365) you want the override to last. Wait a few seconds. The arrows next to the ending time disappear and the override takes effect.

Pressing **CANCEL** returns the VLD to the current schedule.

The Setpoint mode override status (AV-113 and MV-13), hold until time (AV 130), and number of vacation days left (AV-130) can be adjusted remotely using BACnet or by DDC.

A user’s ability to set Permanent or Vacation holds can be disallowed by setting BV-115 and BV-130, respectively.

Occupancy mode

This section describes the functionality unique to Occupancy mode. See also “Common features” on page 21.

Occupancy mode (AV-123=0) is similar to the Alerton VLC/Microset interface. In occupancy mode, the VLD can operate in the Occupied or the Unoccupied state. In addition, an optional after-hours override can temporarily over-ride the Unoccupied state.

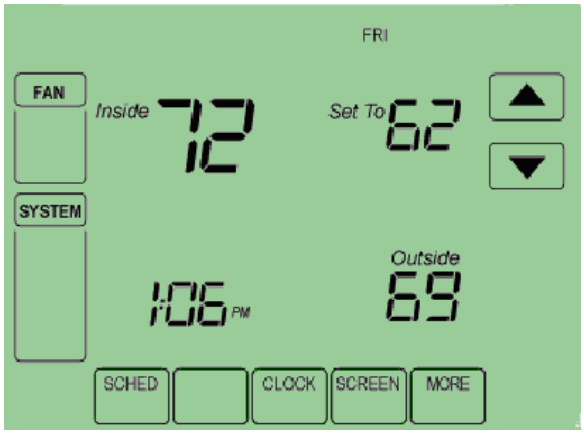
Occupancy mode emulates the user interface and behavior of the Alerton VLC/Microset setup. It is typically used in office and commercial buildings. The internal schedule determines the times that the space will be considered occupied or unoccupied. While occupied, the unit controls to a user-adjustable setpoint. While unoccupied, the unit controls to unoccupied setpoints determined by the building engineer. The internal schedule is visible using BACnet and can be saved and downloaded from the operator workstation. The user is allowed to override occupied setpoints in a manner similar to the Alerton VLC/Microset setup.

The internal schedule can be disabled to allow a BACnet global controller to control the VLD.

Occupied state

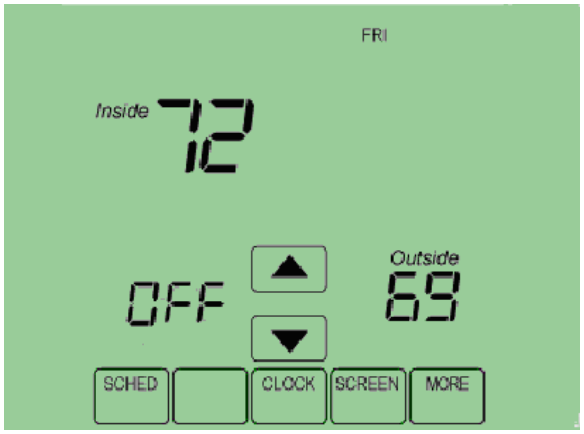
In the Occupied state (BV-67=1), the LCD displays the occupant-selected space temperature setpoint (AV-90). The unit controls to occupied heating and cooling setpoints (derived by subtracting and adding heating and cooling offsets from/to the space temperature setpoint.).

The occupant can adjust the setpoint using the arrows (within minimum and maximum setpoint limits).



Unoccupied state

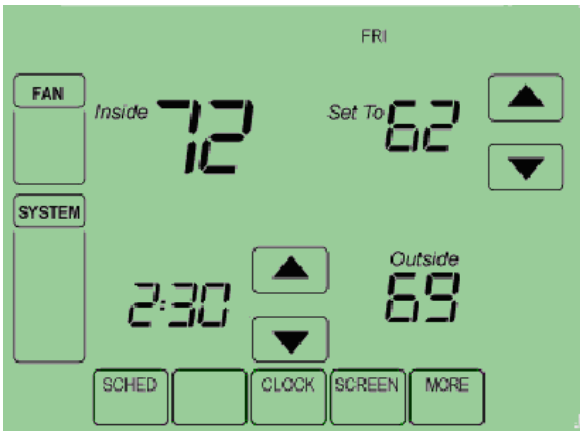
In the Unoccupied state (BV-67=OFF), the LCD displays the word OFF and the VLD controls to unoccupied setpoints.



The OFF display will alternate with the time display (if enabled) every few seconds. The Unoccupied setpoints can be displayed on the Unoccupied screen by setting BV-105 to ON.

After-hours override

After-hours override enables a user to override a scheduled unoccupied status. Pressing an arrow next to the OFF display will start an after-hours override.



In override, VLD calculates current setpoints (AV-99 and AV-100) using occupied setpoint logic. The user can change the timer in half-hour increments and adjust the setpoint and fan speed (if enabled).

The after-hours timer (AV-98) automatically counts down whenever it is set to a non-zero value.

To disable this feature, set the after-hours timer limit (AV-97) to zero.

Schedule configuration in Occupancy mode

VLD can be configured to follow an internal schedule by setting ISU parameter 160 or BV-133. If the internal schedule is OFF, VLD follows the schedule sent

by a BACnet global controller. Schedules are stored in flash memory so they persist through power cycles.

Schedule Usage	ISU Parameter 160	BV-133
No internal schedule	0	0
7-day internal schedule	4	1

In occupancy mode the internal schedule is formatted as a BACnet schedule object with one weekly schedule (7days, 4 commands per day). The maximum number of periods per day is always 4. Each command consists of a start time and an occupancy command (0=OFF, 1=ON). For a list of supported BACnet properties associated with the schedule object, see “Schedule object properties” on page 41.

To enable the internal schedule, set ISU parameter 160 (BV-133) to 4. Once enabled, the schedule will write occupancy status to BV-40, priority 16. The internal schedule can be overridden by sending schedule commands from a global controller to BV-40, priority 9, or by the operator using BV-40, priority 8. (This assumes that unit DDC transfers BV-40 to BV-64 as the occupancy indicator.)

To select the number of program periods per day for the internal schedule, set ISU parameter 540 (AV-129) to 2 or 4.

To edit the internal schedule in Envision for BACtalk, use the Raw Schedule Editor (Tools>Advanced>Schedules). Note that you cannot use the Envision for BACtalk Schedule Wizard to edit the VLD internal schedule.

To edit the internal schedule at the VLD display screen, press **SCHED** and then press **EDIT**.

Setpoint adjustment in Occupancy mode

Within limits, a user can adjust a setpoint by pressing the arrows next to a setpoint display. The maximum and minimum temperatures the user can select are defined by AV-91 (Setpoint High Limit) and AV-92 (Setpoint Low Limit).

Hotel mode

Hotel mode is a subset of the functionality available in Occupancy mode. It is intended for use in hospitality installations.

Hotel mode emulates the user interface and behavior of the Alerton VLC/Microset setup.

Hotel mode states

In Hotel mode, the VLD operates in one of three states - Rented, Standby, or Vacant.

Rented

In the Rented state (BV-64=1), a user can change the setpoint and display units (Fahrenheit/Celsius). User access to fan controls is optionally selected by the building system operator. In addition, the unit can be programmed to display inside and outside air temperatures, time, and day of week.

In the Rented state, the MORE key is programmed to toggle the display between Fahrenheit and Celsius units. The MORE key is blank to accommodate an “F/C” decal, which is supplied with the VLD and can be affixed over the MORE key.

Standby

The Standby state (BV-131=1) occurs when a room is rented but DDC senses that the room is unoccupied. This state is typically used to relax setpoints while nobody is in the room. In Standby, the display shows only the inside air temperature. When motion is detected, the display reverts to the Rented state.

The VLD requires infrared sensors, door switches, and additional DDC to detect room occupancy.

DDC can indicate this state to the VLD user interface by setting BV 131 to Active.

A user should never see the screen in a Standby state. If they do, occupancy detection is not working properly. If a user does see this screen, pressing any key returns the unit to rented mode for two minutes.

Vacant

When a room is vacant (BV-64=0), the VLD displays only the inside air temperature and the word “OFF”.

In the Vacant state, DDC will usually control to unoccupied setpoints. A housekeeping override is provided to allow reverting to Rented setpoints for up to 99 minutes. During a housekeeping override, the number of minutes remaining in the override are displayed instead of time of day. The override can be cancelled by adjusting the override minutes to 0. During housekeeping override the user has the same control over setpoint as in the Rented state.

Vacant mode allows technicians to access the Field service and Installer setup screens using the standard access procedures. Note that a PIN security option can be enabled to restrict access to these screens. The SCREEN key is displayed and allows cleaning of the screen in while in Vacant mode.

Installer Setup (ISU) Mode

Installer setup mode provides access to functions specific to installation of a VLD. Some VLD configuration parameters can be altered from the ISU (Installer Setup) screens. The ISU parameters are identified by the same numbers used in Honeywell’s VisionPro and the meaning of the values of the ISU parameters can be cryptic. The ISU parameters can also be accessed via BACnet.

Installer Setup capability closely emulates that of the Honeywell VisionPro. The codes use the same numbering, but new codes have been added for the MAC address and device instance.

You can require a PIN to access ISU mode by setting AV-133 to a non-zero, four-digit number.

▶ **To access the ISU screens**

1. From the home screen, press the **SYSTEM** block.

2. Five blank touch keys appear on the bottom of the screen between the **Done** and **Cancel** keys. Press and hold the two blank keys on either side of the center key for approximately five seconds.
3. If a PIN code is required, use the top arrows to select the first two digits of the code and the bottom arrows to select the third and fourth digits of the code, and then press **DONE**.

   The ISU screen appears.
4. Use the arrows to select parameters and values.
5. Press **DONE** when finished.

Table 3 provides a list of ISU parameters

Table 3 ISU parameters

ISU Parameter Code	Description	Allowed Values
120	Year, first 2 digits	19-21
130	Year, second 2 digits	00-99 (00-54 if ISU 200=21)
140	Month	1-12
150	Day	1-31
160	Schedule format BV-133	0 – not programmable (BV-133=0) 4 – 7 day programmable (BV-133=1)
280	Backlight control BV-79	0 – on for 20 seconds after keypress 1 – low always on, bright after keypress
320	Swap English/Metric BV-69	1 – show opposite units to specified in DDC header
330	Daylight saving AV-127	0 – off; no automatic adjustments 1 – pre 2007 scheme 2 – 2007 and later scheme
500	Filter change reminder AV-124	0 – reminder not used 1 – 10 days 2 – 30 days 3 – 60 days 4 – 90 days 5 – 120 days 6 – 365 days
510	Hum pad change reminder AV-125	0 – reminder not used 1 – 90 days 2 – 180 days 3 – 365 days
520	UV lamp change reminder AV-126	0 – reminder not used 1 – 365 days

Table 3 ISU parameters

ISU Parameter Code	Description	Allowed Values
540	Program periods AV-129	2 – Wake/Sleep 4 – Wake/Leave/Return/Sleep
640	Clock format BV-83	12 – 12 hour (BV-83=0) 24 – 24 hour (BV-83=1)
670	Keypad lock AV-128	0 – no lock 1 – access temperature settings only 2 – fully locked
700	Sensed room temperature offset (AV-138)	-4 to +4 degrees F
701	Sensed room humidity offset (AV-139)	-5% TO +5% Humidity cannot be adjusted above 100% or below 0%.
702	Sensed outside air temperature offset (AV-140)	-4 to +4 degrees F
703	Sensed outside humidity offset (AV-141)	-5% TO +5% Humidity cannot be adjusted above 100% or below 0%.
800	MS/TP MAC	0-127
801	BACnet Device Instance - first digit	0-4
802	BACnet Device Instance second and third digits	00-99
803	BACnet Device Instance forth and fifth digits	00-99
804	BACnet Device Instance sixth and seventh digits	

Field Service Mode

Field service mode enables technicians to query and command key operating variables in the VLD while at the VLD touchscreen. A technician presses a particular key sequence at the VLD to enter field service mode. In field service mode a technician uses the left arrows to scroll through data codes and the right arrows to change the value associated with a code.

Field Service capability closely emulates that of the VLC/Microset combination. The standard codes are the same and the user can create customized codes in the same manner. Dealers who have created customized FS codes can also use those codes on the VLD.

The lower left of the LCD shows the two-digit data code and the main area displays the data value. A pre-defined list of data codes is available (see Table 4 on page 34). You can add customized codes to this list and assign data points to them in the DDC header. See the *Programmer's Guide and Reference for BACtalk Systems (LTBT-TM-PRGRMR)* for more information.

Note Fixed codes appear with a colon before them. This enables a technician to distinguish them quickly from custom codes.

The data range in field service mode is –199.9 to 99.9.

You can deny users access to field service mode by setting BV-68 to ON. You can also require a PIN code in order to enter Field Service mode by setting AV-132 to the desired PIN number.

Field service mode ends automatically if there is no key activity for five minutes.

▶ **To set field service codes**

1. Press **SYSTEM**.
2. Press and hold the center bottom key (blank) for about five seconds.
3. If a PIN code is required, use the top arrows to select the first two digits of the code and the bottom arrows to select the third and fourth digits of the code, and then press **DONE**.

   The field service screen appears.
4. Press the left up or down arrows until the desired code appears.

   Field service codes appear in the order shown in Table 4 . After fixed codes are exhausted, custom codes (if enabled) display in the order entered in DDC.
5. Press the right up or down arrows to adjust the value associated with the code.
6. Press the left up or down arrows to accept the change and scroll to a different code.
7. Press **DONE** to exit Field Service mode.

Table 4 Field service mode fixed codes.

Code	Data point	Meaning
:UC	AV-95	Unoccupied cooling setpoint
:UH	AV-96	Unoccupied heating setpoint
:CO	AV-93	Cooling offset
:HO	AV-94	Heating offset
:HS	AV-100	Occupied heating setpoint
:CS	AV-99	Occupied cooling setpoint

Table 4 Field service mode fixed codes.

Code	Data point	Meaning
:AL	AV-97	Override limit
:HI	AV-91	Setpoint high limit
:LO	AV-92	Setpoint low limit
:SP	AV-90	Occupant-selected space temperature setpoint

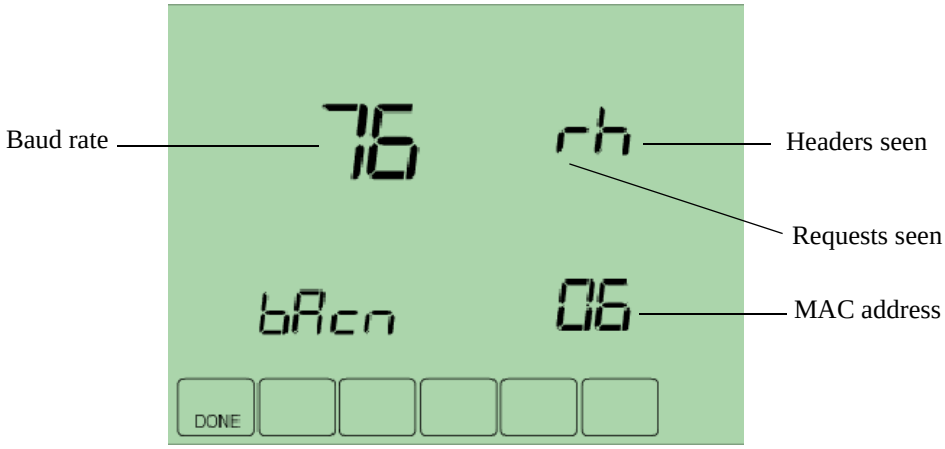
Checking MS/TP communication

You can check MS/TP communication from the display. The VLD will indicate if MS/TP packets and headers have been seen, the baud rate, and the MAC address.

▶ **To check MS/TP communication**

1. Enter Field Service mode.
2. Ensure the UC code is displayed.
3. Press the blank key normally labeled **MORE** (bottom row, second from right).
4. Press the down arrow.

   The MS/TP communication screen appears.



5. Press **DONE** twice to exit.

Appendix A: BACnet object and property reference

This section shows the BACnet objects available in the VLD. The tables that follow list individual points and give details about the properties of each object listed.

VLD objects

Object (instance range)	Remarks
AI-(0-2)	Analog input objects associated with physical, universal input terminals on VLDs. AIs are identified as AI-nn, where nn is the input terminal number.
AO-(0-7)	Analog output objects associated with physical output terminals. AOs are identified as AO-nn, where nn is the output terminal number.
AV-(90–107)	RESERVED AVs for Alerton legacy Microset behavior.
AV-(0-89)	General use AVs.
AV-(108-136)	Screen control and feedback
AV-(210-233	Custom screen control and feedback
BI (0-2)	Binary input objects associated with physical, universal input terminals on VLD. BIs are identified as BI-nn, where nn is the input terminal number.
BO (0-5)	Binary output objects associated with physical output terminals on VLD. BOs are identified as BO-nn, where nn is the output terminal number.
BV-(0-63)	General use BVs. BV-40 supports the priority-array property. BV-40 is typically used by Alerton DDC applications to receive scheduled occupancy commands from a global controller. The priority array allows a BACnet user to override the occupancy command. When in Occupancy mode with an internal schedule enabled, internal schedule commands are written to BV-40 priority 16, therefore DDC applications that use BV-40 can easily use either internal or external scheduling.
BV-(90-147)	Screen control and feedback
BV-(200-202)	AI-current mode select
BV-(210-299)	Custom screen control and feedback
BV-(300-301)	AO-current mode detection feedback
BV-(400-402)	AI-pullup enables
MV-(0-23)	Multistate values used only for values that will not be modified by DDC.
Device	Provides general information about a device

Object (instance range)	Remarks
File (254)	Provides information about the ROC file.
File (0)	Provides information about the current DDC file.
File (2048)	Provides information about the DDC trap file.
Program 254	Firmware program. Entry into boot loader requires writing password to property ALERBP_DOWNLOAD_PASSWORD with 1's complement of the first 10 characters of the firmware revision.
Program 0	DDC program The Instance_Of property contains the DDC rep/job/application/display information The Reason_For_halt, Description_Of_Halt, and related properties display any DDC errors.
File 1	DDC trap file
File 240	Legacy method of setting device instance. Has special security feature
File 254	File object used to do firmware download. Has special semantics.
File 260	AI-Linearization data. Only writable by halting associated program object.
File 261	AI-and AO-Calibration data. Only writable by halting associated program object
Program 260	Allows access to AI-linearization data when halted. Halting requires writing password to property ALERBP_DOWNLOAD_PASSWORD with 1's complement of the first 10 characters of the firmware revision.
Program 261	Allows access to calibration data when halted. Halting requires writing password to property ALERBP_DOWNLOAD_PASSWORD with 1's complement of the first 10 characters of the firmware revision.
Schedule 0	Internal schedule used only in Occupancy mode and only if enabled by BV-133

Object properties

Device object properties

Property	Access	Notes
Object Identifier	R/W	Not writable in VLD
Object Name	R/W	
Object Type	R	
System Status	R	OPERATIONAL
Vendor Name	R	“Alerton”
Vendor Identifier	R	18
Model Name	R	”VLD-XXXXXX”
Firmware Revision	R	(comes from boot loader) initially “RL 5.00 (build x)”
Application Software Version	R	“5.00 (build y)” or similar
Location	R/W	
Description	R/W	
Protocol Version	R	1
Protocol Revision	R	4
Protocol Services Supported	R	atomicReadFile, atomicWriteFile, readProperty, readPropertyMultiple, writeProperty, writePropertyMultiple, deviceCommunicationsControl, reinitializeDevice, i-Am, unconfirmedPrivateTransfer, timeSynchronization, who-Has, who-Is, utcTimeSynchronization
Protocol Object Types Supported	R	analog-input, analog-output, analog-value, binary-input, binary-output, binary-value, device, file, program, schedule
Object List	R	Too large to return in a single request, so returns “segmentation not supported”. Individual array entries can be read.
Max APDU Length Accepted	R	480
Segmentation Supported	R	no-segmentation
Local Time	R/W	Default = “00:00:00”
Local Date	R/W	Default = “Jan 1, 1900"
UTC Offset	R/W	Default = 0
Daylight Savings Status	R/W or R	Read-only if ISU parameter 330 is set to one of the auto-adjust options.
APDU Timeout	R/W	Default = 6000, limited to 100..60000
Number of APDU Retries	R/W	Default = 3, limited to 0..16
Max Master	R	127
Max Info Frames	RW	Default = 3, limited to 1..60
Device Address Binding	R	Empty List

AI-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AI nnn"
Object Type	R	
Present Value	R/W	Value handled as described in the sequence of operation
Description	R/W	Read only if configured in DDC header via Visual Logic
Status Flags	R	All false
Event State	R	NORMAL
Out Of Service	R	FALSE
Units	R	Value set in DDC file via Visual Logic except where noted otherwise in the sequence of operation

AO-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AO-nn"
Object Type	R	
Present Value	R/W	Limit 0.0 .. 102.4
Description	R/W	Read only if configured in DDC header via Visual Logic
Status Flags	R	Usually no flags set. The out-of-service bit shall be set whenever the point is configured as such via Visual Logic.
Event State	R	normal
Out Of Service	R	Value configured in DDC file via Visual Logic. See below.
Units	R	Value configured in DDC file via Visual Logic
Priority Array	R/W	Limit 0.0 .. 102.4
Relinquish Default	R	Value configured in DDC file via Visual Logic

AV-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"AV-nnn" except where noted otherwise
Object Type	R	
Present Value	R/W	As described below
Description	R/W	Read only if configured in DDC header via Visual Logic

Property	Access	Notes
Status Flags	R	No flags set
Event State	R	Normal
Out Of Service	R	FALSE
Units	R	As described below

BI object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	“BI nnn”
Object Type	R	BINARY INPUT
Present Value	R	As described in the sequence of operation
Description	R/W	Read only if configured in DDC header via VisualLogic
Status Flags	R	All false
Event State	R	NORMAL
Out Of Service	R	FALSE
Polarity	R	NORMAL

BO object properties

Property	Access	Default location and value
Object Identifier	R	
Object Name	R	“BO nn”
Object Type	R	BINARY OUTPUT
Present Value	R/W	See sequence of operation below
Description	R/W	Read only if configured in DDC header via Visual Logic
Status Flags	R	Usually no flags set. The out-of-service bit shall be set whenever the point is configured as such via Visual Logic.
Event State	R	normal
Out Of Service	R	Selectable in DDC header
Polarity	R	NORMAL
Priority Array	R/W	RAM
Relinquish Default	R	Selectable in DDC header

BV-object properties

Property	Access	Notes
Object Identifier	R	
Object Name	R	"BV-nnn" for most BVs, except where otherwise noted
Object Type	R	
Present Value	R/W	As described below
Description	R/W	Read only if configured in DDC header via Visual Logic
Status Flags	R	No flags set
Event State	R	NORMAL
Out Of Service	R	FALSE
Priority Array	R/W	BV-40 only
Relinquish Default	R/W	BV-40 only

MV-object properties

Property	Access	Notes
Out of Service	R	False
Event State	R	Normal
Status Flag	R	NO flags set
Object Name	R	"MV-nnn" except where otherwise noted
Description	R.W	
State Text	R	As described below
Present Value	R	As described below
Number of States	R	
Object ID	R	

Schedule object properties

Property	Access	Notes
Object Identifier	R/O	SCHEDULE 0
Object Name	R/O	"Schedule 0"
Object Type	R/O	SCHEDULE
Present_Value	R/O	
Description	R/O	"Main Schedule"
Effective_Period	R/O	ANYTIME (always in effect)
Weekly_Schedule	R/W	7 days, 4 events per day maximum
Schedule_Default	R/W	Inactive (enum 0)
List_Of_Object_Property_References	R/O	Empty

Property	Access	Notes
Priority_For_Writing	R/O	16
Status_Flags	R/O	All bits clear
Reliability	R/O	NO FAULT DETECTED
Out_Of_Service	R/O	FALSE

Standard AVs and BVs

This section lists the logical points in the VLD. Points with access type of "R/O" are computed by the VLD and provided as inputs to the user application. Points with access type "R/W" are written by the user application or via BACnet in order to provide information to the VLD.

Legacy (Microset) AVs

The following AVs function in a fashion substantially similar to the same AVs in a Microset.

Point	Object_Name	Units	Access	Notes
AV-90	Setpoint (SP)	Deg F/C	R/W	This is the user-specified setpoint in occupancy mode
AV-91	Setpoint High Limit	Deg F/C	R/W	
AV-92	Setpoint Low Limit	Deg F/C	R/W	
AV-93	Cooling SP Offset	Deg F/C	R/W	AV93 + AV94 represents the deadband surrounding the setpoint AV-90
AV-94	Heating SP Offset	Deg F/C	R/W	AV93 + AV94 represents the deadband surrounding the setpoint AV-90
AV-95	Unoccupied Cooling SP	Deg F/C	R/W	Cooling setpoint in unoccupied mode
AV-96	Unoccupied Heating SP	Deg F/C	R/W	Heating setpoint in unoccupied mode
AV-97	After Hours Timer Limit	Hours	R/W	Maximum value of AV98
AV-98	After Hours Timer	Hours	R/W	Current after hours timer Set to 0.0 if not in occupancy mode or if not in tenant override mode. Value reverts to 0.0 in case of power failure.
AV-99	Current Cooling SP	Deg F/C	R/O	Occupancy mode: BV67 ON: AV108 + AV106 BV67 OFF: AV108 Setpoint mode: AV108 + AV106

Point	Object_Name	Units	Access	Notes
AV-100	Current Heating SP	Deg F/C	R/O	Occupancy mode: BV67 ON: AV109 - AV106 BV67 OFF: AV109 Setpoint mode: AV109 - AV106
AV-101	Displayed Room Temperature	Deg F/C	R/W	Temperature displayed on the screen. Sensed Room Temperature (AV-104) adjusted by Room Temperature Offset (AV-138).
AV-102	Displayed Room Humidity	%RH	R/O	Space humidity displayed on the screen. Sensed Room Humidity (AV-105) adjusted by Room Humidity Offset (AV-139).
AV-103	Displayed Outside Air Temperature	Deg F/C	R/W	Outside air temperature to display on screen. Sensed Outside Air Temperature plus Outside Air Temperature Offset (AV-140). For proper screen display, units should match native units in DDC header.
AV-104	Sensed Room Temperature	Deg F/C	R/O	Room temperature reading from on-board sensors. Usually transferred to AV-101.
AV-105	Sensed Room Humidity	%RH	R/O	Room humidity reading from on-board sensor. Usually transferred to AV-102.
AV-106	Demand Offset	Deg F/C	R/W	See AV-99 and AV-100. Can be used by DDC to relax setpoints when energy use is heavy.
AV-107	Displayed Outside Humidity	%RH	R/W	Outside humidity to display on screen. Sensed humidity plus Outside Humidity Offset (AV-141).
AV-108	SP Mode Cooling SP	Deg F/C	R/O	Occupancy mode: Updated from the legacy Microset setpoints as follows: BV67 ON: AV90 + AV93 BV67 OFF: AV95 Setpoint mode: Storage for the current UI cooling setpoint. Gets updated from the schedule in “Following Schedule” mode.

Point	Object_Name	Units	Access	Notes
AV-109	SP Mode Heating SP	Deg F/C	R/O	Occupancy mode: Get updated from the legacy microset setpoints as follows: BV67 ON: AV90 - AV94 BV67 OFF: AV96 Setpoint mode: Storage for the current UI heating setpoint. Gets updated from the schedule in "Following Schedule" mode.

Legacy (Microset) BVs

The following BVs function substantially the same as corresponding BVs in a Microset.

Point	Object Name	Access	Description
BV-64	Time Schedule Output	R/W	Occupancy mode: ON: Places unit into occupied mode OFF: Places unit into unoccupied (or tenant override) mode Setpoint mode: ignored
BV-65	User ON/OFF in Occupied Mode	n/a	Replaced by BV-142 "Master OFF"
BV-66	After Hours Timer Status	R/O	ON: occupancy mode and after-hours is in progress. OFF: occupied or if in setpoint mode
BV-67	Occupied / Unoccupied Status	R/0	Occupancy Mode: ON: Selects occupied setpoints in AV99 and AV100 OFF: Selects unoccupied setpoints in AV99 and AV100. Setpoint Mode: Ignored
BV-68	Field Service Lockout	R/W	OFF: Field service mode is allowed ON: Field service mode is not accessible
BV-69	Swap English / Metric	R/W	ON: Causes the display to operate in English/Metric mode opposite from what is specified in BV71. OFF: English/Metric mode is specified by BV71
BV-71	English (OFF) / Metric (ON)	R/O	ON: The DDC header specifies Metric OFF: The DDC header specifies English
BV-72	Fan Low Speed	R/O	Fan stage 1

Point	Object Name	Access	Description
BV-73	Fan Medium Speed	R/O	Fan stage 2
BV-74	Fan High Speed	R/O	Fan stage 3
BV-77	Heating ICON	R/W	ON: Display “heat on” when in the “Displaying Home” state
BV-78	Cooling ICON	R/W	ON: Display “cool on” when in the “Displaying Home” state
BV-79	Backlight ON	R/W	ON: Backlight always on dimly when not interacting with user OFF: Backlight turns completely off when not interacting with user Backlight always comes on full during user interaction
BV-80	Enable Fan Speed Control	R/W	ON: Allow the “FAN” control to be visible to the end user OFF: FAN control is always hidden
BV-81	Select Hotel Mode	R/W	ON: Select Hotel mode
BV-82	Enable Time Display	R/W	ON: Display current time on standard backdrop
BV-83	24Hr Time Format	R/W	ON: Use 24Hr time format
BV-84	Enable Space Humidity	R/W	ON: Display space humidity

Mode select BVs

Point	Object Name	Access	Description
BV-200 ... BV-202	AI*n* Current Mode	R/W	ON: Configures the corresponding AI-in current mode OFF: Configures the corresponding AI-in voltage mode
BV-300 ... BV-301	AO*n* Current Mode	R/O	Read-only. “Active” indicates AO0..AO1 has detected current mode (load is 550 Ohms or less). “Inactive” indicates voltage mode (load is 1K Ohm or higher).
BV-400 ... BV-402	AI*n* Pullup	R/W	Enables the pullup on AI0..A3. Gets set to default value from DDC header at beginning of first pass of DDC, allowing DDC to override the default. An Active setting of one of these pullup BVs overrides the setting of the corresponding AI-current mode BV-(see above).

UI control AVs and BVs

The following AVs, BVs, and MVs control the VLD user interface.

General control AVs

Point	Object Name	Access	Description
AV-110	SP Mode Setpoint Model	R/W	Setpoint Mode: Chooses the setpoint model, and also selects the layout of the Generic Backdrop display 0.0: use OFF Format (no setpoints shown) 1.0: use 1-setpoint format (cooling) 2.0: use 1-setpoint format (heating) 3.0: use 2-setpoint format Occupancy Mode: Ignored
AV-111	SYSTEM Setpoint Model	R/W	Provides a compatible output from the SYSTEM control that can be transferred into the setpoint model AV-110 (above) to reproduce default VisionPro behavior. The values produced by the SYSTEM control are limited by the configuration AVs, BVs, and MVs. 0.0: “OFF” selected 1.0: “COOL” selected 2.0: “HEAT”/”EM HEAT” selected 3.0: “AUTO” selected
AV-123	Occupancy Mode Select	R/W	Sets system to Occupancy mode.
AV-124	Filter Change Reminder	R/W	Enables the filter change reminder.
AV-125	Humidity Pad Change Reminder	R/W	Enables the humidity pad change reminder.

Point	Object Name	Access	Description
AV-126	UV Lamp Change Reminder	R/W	Enables the UV lamp change reminder.
AV-127	Daylight Savings	R/W	Sets Daylight savings to Off, pre-2007 scheme, or post-2007 scheme.
AV-128	Keypad Lock	R/W	Locks the keypad.
AV-132	Field Service Mode Security PIN	R/W	Allows access to Field Service mode only by authorized users.
AV-133	ISU Mode Security PIN	R/W	Allows access to ISU mode only by authorized users.
AV-137	Fan Setting Display Format	R/W	Selects the format in which fan settings are shown on the display.

General control BVs

Point	Object Name	Access	Description
BV-80	Enable Fan Speed Control	R/W	ON: Allow the “FAN” control to be visible to the end user OFF: FAN control is always hidden
BV-84	Enable Space Humidity	R/W	ON: Display space humidity as appropriate OFF: Never display the space humidity
BV-100	Enable OSA Temp	R/W	ON: Display the OSA temp as appropriate OFF: Never display the OSA temp
BV-101	Enable OSA Humidity	R/W	ON: Display outside humidity as appropriate OFF: Never display outside humidity
BV-102	Enable System Control	R/W	ON: Allow the “SYSTEM” control to be visible OFF: The “SYSTEM” control is always hidden
BV-103	Hide Fan and System	R/W	ON: Hide the FAN and SYSTEM controls in unoccupied mode (regardless of other display settings) OFF: Show them if allowed
BV-104	Enable DOW	R/W	ON: Allow day of week to be shown is possible OFF: Never show the day of week
BV-105	Show Unocc Setpoints	R/W	ON: Display the unoccupied heating/cooling setpoints in unoccupied mode OFF: Don't display them

General control MVs

Point	Object Name	Access	Description
MV-0	Time Mode	R	Provides feedback about the device's time handling capability: Normal clock operation will result in a present value of 3. 1: “Time Of Day Unknown Mode” 2: “Time Of Day Available Mode” 3: “Date/Time Available Mode”
MV-1	Schedule Model	R	Provides feedback about the device's schedule model 1: “Setpoint” (VisionPro-style) 2: “Occupancy” (Microset-style)
MV-2	Keypad Lock	R	Provides feedback about the keypad access level: 1: “full access” 2: “setpoints only” 3: “locked”
MV-3	DLS Mode	R	Provides feedback about the mode of Daylight Saving operation 1: “OFF” 2: “Auto (pre-2007)” 3: “Auto (2007 and later)”
MV-4	SP Increment	R	Amount of change in setpoint per arrow press 1: “1 deg F / 0.5 deg C” (default)
MV-5	Schedule Increment	R	Amount of change in schedule times per arrow press 1: “1 min” (default)

Optional screen segment control BVs

In Setpoint Mode, the setpoint layout is controlled by AV-110, see above.

Point	Object_Name	Access	Description
BV-77	Heating ICON	R/W	ON: Display “heat on” icon
BV-78	Cooling ICON	R/W	ON: Display “cool on” icon
BV-106	Show Wait	R/W	ON: Display “Wait”
BV-107	Show Aux heat on	R/W	ON: Display “Aux heat on”
BV-108	Show Recovery	R/W	ON: Display “Recovery”
BV-109	Show FROST	R/W	ON: Display “FROST”
BV-110	Show DEHUMIDIFIER	R/W	ON: Display “DEHUMIDIFIER”
BV-111	Force CHANGE FILTER	R/W	ON: Force “CHANGE FILTER” to be displayed (can also be automatically displayed due to filter timer)

Point	Object_Name	Access	Description
BV-112	Force CHANGE UV LAMP	R/W	ON: Force “CHANGE UV LAMP” to be displayed (can also automatically be displayed due to UV lamp timer)
BV-113	Force CHANGE HUMIDIFIER PAD	R/W	ON: Force “CHANGE HUMIDIFIER PAD” to be displayed (can also be displayed due to humidifier pad timer)
BV-114	Disable SCHED key	R/W	OFF: Allow “SCHED” key to be used to access standard scheduling UI (if appropriate) ON: The “SCHED” key is always invisible
BV-115	Disable Permanent HOLD key	R/W	OFF: Allow “HOLD” key to be used to access the Permanent Hold UI ON: the “HOLD” key is invisible or used for Vacation HOLD, if enabled.
BV-130	Disable Vacation HOLD key	R/W	OFF: Allow “HOLD” key to be used to access the standard Vacation Hold UI (if appropriate) ON: the “HOLD” key is invisible.
BV-116	Disable CLOCK key	R/W	OFF: Allow “CLOCK” key to be used to set clock (if appropriate) ON: the CLOCK key is always invisible
BV-131	Hotel Standby Mode	R/W	Set Active by DDC to indicate to the display that DDC is controlling to standby mode. Useful for visual indication if DDC mistakenly thinks the room is unoccupied.
BV-142	Master OFF	R/W	OFF: no effect ON: Override occupied status in Occupancy Mode. Home screen shows “OFF” without override arrows and user setpoint is not displayed. Used to implement user ON/OFF or fan control ON/OFF. Replaces the legacy BV65.

SYSTEM control BVs

The following points control the behavior of the SYSTEM control (if enabled).

BVs 122-125 indicate the last user-selected SYSTEM state. Only one of these BVs can be ON at any given time when set using the user interface. DDC can set these BVs and can set more than one ON. If the system control is “OFF”, all these BVs shall be OFF.

If a user sets the SYSTEM control to OFF, then all of the these BVs are set to off unless overwritten by DDC.

Point	Object Name	Access	Description
BV-117	Allow System OFF	R/W	ON: Allow the “OFF” state
BV-118	Allow System HEAT	R/W	ON: Allow the “HEAT” state
BV-119	Allow System COOL	R/W	ON: Allow the “COOL” state
BV-120	Allow System AUTO	R/W	ON: Allow the “AUTO” state
BV-121	Allow System EM HEAT	R/W	ON: Allow the “EM HEAT” state
BV-122	System HEAT Mode	R/O	ON: HEAT mode is selected
BV-123	System COOL Mode	R/O	ON: COOL mode is selected
BV-124	System AUTO Mode	R/O	ON: AUTO mode is selected
BV-125	System EM HEAT Mode	R/O	ON: EM HEAT mode is selected

SYSTEM control MV

Point	Object Name	Access	Description
MV-6	User SYSTEM selection	R	Current selected mode 1: “OFF” 2: “HEAT” 3: “COOL” 4: “AUTO” 5: “EM HEAT”

FAN control BVs

The following points configure the behavior of the FAN control. A maximum of one of these BVs can be on at any given time.

If the fan control is not visible to the user, then the R/O values read consistently with an “OFF” setting.

Point	Object Name	Access	Description
BV-126	Enable fan OFF select	R/W	ON: Allow the “OFF” state
BV-127	Enable fan stage1 select	R/W	ON: Allow the “Stage 1" state
BV-128	Enable fan stage2 select	R/W	ON: Allow the “Stage 2" state
BV-129	Enable fan stage3 select	R/W	ON: Allow the “Stage 3" state
BV-72		R	Fan stage 1
BV-73		R	Fan stage 2
BV-74		R	Fan stage 3

FAN control MVs

If the fan control is not visible to the user, the R/O values read consistently with an OFF setting.

Point	Object Name	Access	Description
MV-7	Fan status	R	Fan stage. Text shown depends on stage configuration (see above). 1: “OFF” or “00” or “F0” 2: “ON”, “33”, “50”, “LO”, or “F1” 3: “ON”, “50”, “66”, or “F2” 4: “ON”, “99”, “HI”, or “F3”
MV-8	Fan OFF text	R/W	OFF state display configuration 1: “OF” 2: “00” 3: “F0”
MV-9	Fan stage 1 text	R/W	Stage 1 display configuration 1: “On” 2: “33” 3: “50” 4: “LO” 5: “F1”
MV-10	Fan stage 2 text	R/W	Stage 2 display configuration 1: “On” 2: “50” 3: “66” 4: “HI” 5: “F2”
MV-11	Fan stage 3 text	R/W	Stage 3 display configuration 1: “On” 2: “99” 3: “HI” 4: “F3”

Schedule control BVs

Point	Object Name	Access	Description
BV-114	Deny schedule viewing	R/W	If set, the user is not allowed to view schedules.
BV-133	Enable internal schedule	R/W	ON: Internal 7-day scheduling is enabled (subject to other factors). The BACnet schedule object is visible via BACnet OFF: Disables use of internal scheduling mechanism. The BACnet schedule object is invisible. All UI components related to schedule editing are disabled. This is ISU parameter 160. BV-133=0 shown as ISU 160=0. BV-133=1 shown as ISU 160=4.
BV-141	Disable schedule edit	R/W	ON: Inhibits screen EDIT key. Internal schedules may be viewed but not edited.
AV-129	Weekday periods ISU value	R/W	2: Two schedule periods per day 4: Four schedule periods per day

Schedule control AVs

Point	Object Name	Units	Access	Description
AV-113	SP Override Mode AV		R/W	While in setpoint mode, indicates the setpoint override state. This point can be written in DDC to cancel the override status 1.0: scheduled 2.0: temporary 3.0: permanent 4.0: vacation 5.0: initial
AV-130	Hold until time	Minutes	R/W	While in setpoint mode, indicates the minute of the day (0-1440) at which a temporary or vacation override is to expire.
AV-131	Vacation days remaining	Days	R/W	While in setpoint mode, indicates the number of days remaining in a vacation override.

Schedule control MVs

Point	Object Name	Access	Description
MV-12	Schedule Format	R	This point is a human-friendly version of AV-129, ISU parameter 540 (see above) 1: “2 commands per day” 2: “4 commands per day”
MV-13	SP Override Mode	R	While in setpoint mode, indicates the setpoint override state. This point is a human-friendly version of AV-113 (see above) 1: “scheduled” 2: “temporary” 3: “permanent” 4: “vacation”

Filter timer control BVs

Point	Object Name	Access	Description
BV-134	Filter Enable	R/W	ON: Enable filter timer and automatic “change filter” warning OFF: detail display shall be skipped, “change filter” warning shall not be activated automatically
BV-135	Filter ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

Filter timer control AVs

Point	Object_Name	Units	Access	Notes
AV-114	Filter Runtime	Hours	R/W	Current filter runtime hours. Can be reset via DDC or by pressing the “reset” key on the details display
AV-115	Filter Runtime Limit	Hours	R	Filter runtime limit

UV lamp timer control BVs

Point	Object_Name	Access	Description
BV-136	UV Lamp Enable	R/W	ON: Enable UV Lamp timer and automatic “UV Lamp” warning OFF: detail display shall be skipped, “UV Lamp” warning shall not be activated automatically
BV-137	UV Lamp ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

UV lamp timer control AVs

Point	Object_Name	Units	Access	Notes
AV-116	UV Lamp Runtime	Hours	R/W	Current UV Lamp runtime hours. Can be reset via DDC or by pressing the “reset” key on the details display
AV-117	UV Lamp Runtime Limit	Hours	R	UV Lamp runtime limit

Humidifier pad timer control BVs

Point	Object_Name	Access	Description
BV-138	Humidifier Pad Enable	R/W	ON: Enable Humidifier Pad timer and automatic “Humidifier Pad” warning OFF: detail display shall be skipped, “Humidifier Pad” warning shall not be activated automatically
BV-139	Humidifier Pad ON	R/W	ON: Accumulator ON OFF: Accumulator OFF

Humidifier pad timer control AVs

Point	Object_Name	Units	Access	Notes
AV-118	Humidifier Pad Runtime	Hours	R/W	Current Humidifier Pad runtime hours. Can be reset via DDC or by pressing the “reset” key on the details display
AV-119	Humidifier Pad Runtime Limit	Hours	R	Humidifier Pad runtime limit

Dehumidifier and humidifier BVs

Point	Access	Description
BV-140	R/W	ON: Enable dehumidifier setpoint on detail screen (also requires humidity to be enabled or you cannot get to the detail screen) OFF: Dehumidifier setpoint not shown on detail screens
BV-143	R/W	ON: Enable humidifier setpoint on detail screens (also requires humidity to be enabled or you cannot get to the detail screen) OFF: Humidifier setpoint not shown on humidity detail screen
BV-144	R/W	ON: Enable AUTO/OFF user selection on humidifier detail screen OFF: AUTO/OFF option not shown on humidifier detail screen
BV-145	R/W	User humidifier AUTO/OFF selection. ON=AUTO.
BV-146	R/W	ON: Enable AUTO/OFF user selection on dehumidifier detail screen OFF: AUTO/OFF option not shown on dehumidifier detail screen
BV-147	R/W	User dehumidifier AUTO/OFF selection. ON=AUTO.

Dehumidifier and humidifier AVs

Point	Object_Name	Units	Access	Notes
AV-120	Dehumidifier Setpoint	% RH	R/W	Current dehumidifier setpoint
AV-121	Dehumidifier SP Max	% RH	R/W	Dehumidifier max. limit
AV-122	Dehumidifier SP Min	% RH	R/W	Dehumidifier min. limit
AV-134	Humidifier Setpoint	% RH	R/W	Current humidifier setpoint
AV-135	Humidifier SP Max	% RH	R/W	Humidifier max. limit
AV-136	Humidifier SP Min	% RH	R/W	Humidifier min. limit

Temperature and Humidity Offset AVs

Point	Object_Name	Units	Access	Notes
AV-138	Sensed Temperature Offset	Deg F/C	R/W	Limited to +/- 4 degrees F.
AV-139	Sensed Humidity Offset	%RH	R/W	Limited to +/- 5%.
AV-140	Sensed Outside Air Temperature Offset	Deg F/C	R/W	Limited to +/- 4 degrees F. Added to Sensed Outside Air Temperature (AV-103) to produce Displayed Outside Air Temperature (AV-13.
AV-141	Sensed Outside Air Humidity Offset	%RH	R/W	Added to AV-107 to generate OA humidity on the details screens. Limited to +/- 5%.

Appendix B: Custom display configuration

Basic controls

This table shows the points that enable, disable, and reset the custom display.

Point	Object_Name	Access	Description
BV-210	Custom 1 Enable	R/W	ON: Enable Custom Details Screen 1 OFF: Custom Detail 1 Screen will be skipped, all related parameters are ignored
BV-211	Reset	R/W	“RESET” key visible

Upper left controls

This table shows the points associated with the controls that appear in the upper left corner of the display.

Point	Object_Name	Access	Description
BV-212	ULHC enable	R/W	ON: Enable value OFF: Value is blank
MV-20	ULHC mode	R/W	Item display mode: 1: Numeric value (range 0 to 99.5, resolution 0.5) 2: Alphanumeric value
BV-213	ULHC decimal	R/W	ON: Show decimal point and 10th's place in numeric mode
BV-214	ULHC lead zero	R/W	ON: Display leading zeros
AV-210	UHLH number	R/W	Current numeric value
AV-211	ULHC left character	R/W	10's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
AV-212	ULHC right character	R/W	1's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.

Upper right controls

This table shows the points associated with the controls that appear in the upper right corner of the display

Point	Object_Name	Access	Description
BV-215	URHC enable	R/W	ON: Enable value OFF: Value is blank
MV-21	URHC mode	R/W	Item display mode: 1: Numeric value (range 0.0 to 99.5, resolution 0.5) 2: Alphanumeric value
BV-216	URHC decimal	R/W	ON: Show decimal point and 10th's place
BV-217	URHC lead zero	R/W	ON: Display leading zeros

Point	Object_Name	Access	Description
BV-218	URHC edit	R/W	ON: value is editable (only works for numeric value) OFF: value is not editable
AV-216	URHC minimum	R/W	Minimum allowable numeric value
AV-217	URHC maximum	R/W	Maximum allowable numeric value
AV-218	URHC delta	R/W	Up/down increment
AV-213	URHC number	R/W	Current numeric value
AV-214	URHC 10 char	R/W	10's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
AV-215	URHC 1 char	R/W	1's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
BV-262	URHC Adj Arrows	R/W	Up/Down Arrows (upper right)

Lower left controls

This table shows the points associated with the controls that appear in the lower left corner of the display

Point	Object_Name	Access	Description
BV-219	LLHC enable	R/W	ON: Enable value OFF: Value is blank
MV-22	LLHC mode	R/W	Item display mode: 1: Numeric value (range -999 to 9999, integers only) 2: Alphanumeric value 3: HH:MM mode (numeric value in minutes since midnight 23:59 max) 4: MM:SS mode (numeric value is in seconds, 99:59 max)
BV-220	LLHC lead zero	R/W	ON: Display leading zeroes in numeric mode
BV-221	LLHC edit	R/W	ON: value is editable (ignored for alphanumeric) OFF: value is not editable
AV-222	LLHC minimum	R/W	Minimum allowable numeric value (ignored for alphanumeric)
AV-223	LLHC maximum	R/W	Maximum allowable numeric value (ignored for alphanumeric)
AV-224	LLHC delta	R/W	Up/down increment (ignored for alphanumeric)
AV-219	LLHC number	R/W	Current numeric value (ignored for alphanumeric)
AV-225	LLHC 1000 char	R/W	1000's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.

Point	Object_Name	Access	Description
AV-226	LLHC 100 char	R/W	100's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
AV-220	LLHC 10 char	R/W	10's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
AV-221	LLHC 1 char	R/W	1's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
BV-266	LLHC Adj Arrows	R/W	Up/Down Arrows (lower left)

Lower right controls

This table shows the points associated with the controls that appear in the lower right corner of the display

Point	Object_Name	Access	Description
BV-222	LRHC enable	R/W	ON: Enable value OFF: Value is blank
MV-23	LRHC mode	R/W	Item display mode: 1: Numeric value (range -99.5 to 199.5, resolution 0.5) 2: Alphanumeric value
BV-223	LRHC decimal	R/W	ON: Show decimal point and 10th's place in numeric mode
BV-224	LRHC lead zero	R/W	ON: Display leading zeroes in numeric mode
BV-225	LRHC edit	R/W	ON: value is editable (numeric mode only) OFF: value is not editable
AV-230	LRHC minimum	R/W	Minimum allowable numeric value
AV-231	LRHC maximum	R/W	Maximum allowable numeric value
AV-232	LRHC delta	R/W	Up/down increment
AV-227	LRHC number	R/W	Current numeric value
AV-228	LRHC 10 char	R/W	10's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
AV-229	LRHC 1 char	R/W	1's place alphanumeric character for alphanumeric mode. See “Custom screen supported characters” on page 62.
BV-226	LRHC leading 1	R/W	Show leading 1 (lower right, ignored in numeric mode)
BV-276	LRHC Adj Arrows	R/W	Up/Down Arrows (lower right)

Pre-defined display items

This table shows the points associated with pre-defined display items.

Point	Object_Name	Access	Description
BV-228	Mon text	R/W	“MON”
BV-229	Tue text	R/W	“TUE”
BV-230	Wed text	R/W	“WED”
BV-231	Thu text	R/W	“THU”
BV-232	Fri text	R/W	“FRI”
BV-233	Sat text	R/W	“SAT”
BV-234	Sun text	R/W	“SUN”
BV-235	Mon check	R/W	“MON” check mark
BV-236	Tue check	R/W	“TUE” check mark
BV-237	Wed check	R/W	“WED” check mark
BV-238	Thu check	R/W	“THU” check mark
BV-239	Fri check	R/W	“FRI” check mark
BV-240	Sat check	R/W	“SAT” check mark
BV-241	Sun check	R/W	“SUN” check mark
BV-227	Day boxes	R/W	Boxed around days of week
BV-242	Ok to pick	R/W	“OK TO PICK MULTIPLE DAYS”
BV-243	Screen locked	R/W	Not used
BV-244	Change	R/W	“CHANGE”
BV-245	Filter	R/W	“FILTER”
BV-246	UV Lamp	R/W	“UV LAMP”
BV-247	Hum Pad	R/W	“HUMIDIFIER PAD”
BV-250	Inside	R/W	“Inside” (upper-left)
BV-251	ULHC % Humidity	R/W	“% and Humidity” (upper-left)
BV-253	Set to	R/W	“Set To” (upper-right)
BV-254	Aux	R/W	“Aux” (upper-right)
BV-255	Heat On	R/W	“Heat On” (upper-right)
BV-256	Wait	R/W	“Wait” (upper-right)
BV-257	Cool On	R/W	“Cool On” (upper-right)
BV-258	Heat Adjust	R/W	“HEAT” (upper-right, between “UP” and “DN”)
BV-259	Frost	R/W	“FROST” (upper-right)
BV-260	Follow	R/W	“Following Schedule”
BV-269	Hold Until	R/W	“Hold Temperature Until”
BV-268	Permanent	R/W	“Permanent Hold”

Point	Object_Name	Access	Description
BV-264	Am	R/W	“AM”
BV-263	Pm	R/W	“PM”
BV-265	Days	R/W	“DAYS” (lower-left)
BV-261	Recovery	R/W	“Recovery”
BV-270	Cancel Period	R/W	“Cancel Period” (lower left)
BV-272	DE	R/W	“DE” (lower right, couples with BV-273 to make “DEHUMIDIFIER”)
BV-273	HUMIDIFIER	R/W	“HUMIDIFIER” (lower right)
BV-279	Cool Adj	R/W	“COOL” (lower-right, between “UP” and “DN”)
BV-271	Outside	R/W	“Outside” (lower-right)
BV-274	LRHC Humidity	R/W	“Humidity” (lower-right)
BV-275	Minutes	R/W	“Minutes” (lower-right)
BV-280	Vent	R/W	“VENT” (lower-right)
BV-278	LLRC minus	R/W	“-” (lower-right, ignored in numeric mode)
BV-277	LLRC %	R/W	“%” (lower-right)

Key/BV-assignments

This table lists the points assigned to keys in custom screens. When a key is pressed, the associated BV-responds as dictated by DDC.

Point	Object_Name	Access	Description
BV-294	RESET key	R/O	Responds to the “RESET” key on this detail display. If the reset key is disabled, this reads “OFF”.
BV-281	Mon key	R/O	Responds to the “MON” key at the top of the display
BV-282	Tue key	R/O	Responds to the “TUE” key at the top of the display
BV-283	Wed key	R/O	Responds to the “WED” key at the top of the display
BV-284	Thu key	R/O	Responds to the “THU” key at the top of the display
BV-285	Fri key	R/O	Responds to the “FRI” key at the top of the display
BV-286	Sat key	R/O	Responds to the “SAT” key at the top of the display
BV-287	Sun key	R/O	Responds to the “SUN” key at the top of the display
BV-297	FAN key	R/O	Responds to the “FAN” control area
BV-298	SYSTEM key	R/O	Responds to the “SYSTEM” control area
BV-288	URHC up key	R/O	Responds to the upper-right “UP” control (even in numeric mode)
BV-289	URHC dn key	R/O	Responds to the upper-right “DN” control (even in numeric mode)

Point	Object_Name	Access	Description
BV-290	LRHC up key	R/O	Responds to the lower-right “UP” control (even in numeric mode)
BV-291	LRHC dn key	R/O	Responds to the lower-right “DN” control (even in numeric mode)
BV-292	LLHC up key	R/O	Responds to the lower-left “UP” control (even in numeric or HH:MM/MM:SS mode)
BV-293	LLHC dn key	R/O	Responds to the lower-left “DN” control (even in numeric or HH:MM/MM:SS mode)
BV-295	CANCEL PERIOD key	R/O	Responds to the “CANCEL PERIOD” key.

Custom screen supported characters

This table shows the characters supported in VLD custom screens.

0: “0”	10: “A”	20: “L”	30: “h”
1: “1”	11: “b”	21: “n”	31: “o”
2: “2”	12: “C”	22: “O”	32: “u”
3: “3”	13: “d”	23: “P”	33: “-“(dash)
4: “4”	14: “E”	24: “r”	34: “_” (underscore)
5: “5” or “S”	15: “F”	25: “S”	35: ““(blank)
6: “6”	16: “g”	26: “t”	
7: “7”	17: “H”	27: “U”	
8: “8”	18: “I”	28: “y”	
9: “9”	19: “j”	29: “c”	

Appendix C: Ordered List of Control Points

Point	Object Name		Point	Object Name
AV-100	Current Heating SP		AV-101	Displayed Room Temperature
AV-102	Displayed Room Humidity		AV-103	Displayed Outside Air Temperature
AV-104	Sensed Room Temperature		AV-105	Sensed Room Humidity
AV-106	Demand Offset		AV-107	Displayed Outside Humidity
AV-108	SP Mode Cooling SP		AV-109	SP Mode Heating SP
AV-110	SP Mode Setpoint Model		AV-111	SYSTEM Setpoint Model
AV-113	SP Override Mode AV		AV-114	Filter Runtime
AV-115	Filter Runtime Limit		AV-116	UV Lamp Runtime
AV-117	UV Lamp Runtime Limit		AV-118	Humidifier Pad Runtime
AV-119	Humidifier Pad Runtime Limit		AV-120	Dehumidifier Setpoint
AV-121	Dehumidifier SP Max		AV-122	Dehumidifier SP Min
AV-123	Set system to Occupancy mode		AV-124	Filter Change Reminder
AV-125	Humidity Pad Change Reminder		AV-126	UV Lamp Change Reminder
AV-127	Daylight savings		AV-128	Keypad lock
AV-129	Weekday periods ISU value		AV-130	Hold until time
AV-131	Vacation days remaining		AV-132	Field Service mode security PIN
AV-133	ISU mode security PIN		AV-134	Humidifier Setpoint
AV-135	Humidifier SP Max		AV-136	Humidifier SP Min
AV-137	Fan Setting Display Format		AV-138	Sensed Temperature Offset
AV-139	Sensed Humidity Offset		AV-140	Sensed Outside Air Temperature Offset
AV-141	Sensed Outside Air Humidity Offset		AV-210	UHLH number
AV-211	ULHC left character		AV-212	ULHC right character
AV-213	URHC number		AV-214	URHC 10 char
AV-215	URHC 1 char		AV-216	URHC minimum
AV-217	URHC maximum		AV-218	URHC delta
AV-219	LLHC number		AV-220	LLHC 10 char
AV-221	LLHC 1 char		AV-222	LLHC minimum
AV-223	LLHC maximum		AV-224	LLHC delta
AV-225	LLHC 1000 char		AV-226	LLHC 100 char
AV-227	LRHC number		AV-228	LRHC 10 char
AV-229	LRHC 1 char		AV-230	LRHC minimum
AV-231	LRHC maximum		AV-232	LRHC delta
AV-90	Setpoint (SP)		AV-91	Setpoint High Limit
AV-92	Setpoint Low Limit		AV-93	Cooling SP Offset
AV-94	Heating SP Offset		AV-95	Unoccupied Cooling SP
AV-96	Unoccupied Heating SP		AV-97	After Hours Timer Limit
AV-98	After Hours Timer		AV-99	Current Cooling SP
BV-100	Enable OSA Temp		BV-101	Enable OSA Humidity
BV-102	Enable System Control		BV-103	Hide Fan and System
BV-104	Enable DOW		BV-105	Show Unocc Setpoints
BV-106	Show Wait		BV-107	Show Aux heat on
BV-108	Show Recovery		BV-109	Show FROST
BV-110	Show DEHUMIDIFIER		BV-111	Force CHANGE FILTER
BV-112	Force CHANGE UV LAMP		BV-113	Force CHANGE HUMIDIFIER PAD
BV-114	Disable SCHED key		BV-114	Deny schedule viewing
BV-115	Disable Permanent HOLD key		BV-116	Disable CLOCK key
BV-117	Allow System OFF		BV-118	Allow System HEAT

Point	Object Name		Point	Object Name
BV-119	Allow System COOL		BV-120	Allow System AUTO
BV-121	Allow System EM HEAT		BV-122	System HEAT Mode
BV-123	System COOL Mode		BV-124	System AUTO Mode
BV-125	System EM HEAT Mode		BV-130	Disable Vacation HOLD key
BV-131	Hotel Standby Mode		BV-133	Enable internal schedule
BV-134	Filter Enable		BV-135	Filter ON
BV-136	UV Lamp Enable		BV-137	UV Lamp ON
BV-138	Humidifier Pad Enable		BV-139	Humidifier Pad ON
BV-140	Enable dehumidifier setpoint on detail screen		BV-141	Disable schedule edit
BV-142	Master OFF		BV-143	Enable humidifier setpoint on detail screens
BV-144	Enable AUTO/OFF user selection on humidifier detail screen		BV-145	User humidifier AUTO/OFF selection
BV-146	Enable AUTO/OFF user selection on dehumidifier detail screen		BV-147	User dehumidifier AUTO/OFF selection
BV-200 - BV-202	AI*n* Current Mode		BV-210	Custom 1 Enable
BV-211	Reset		BV-212	ULHC enable
BV-213	ULHC decimal		BV-214	ULHC lead zero
BV-215	URHC enable		BV-216	URHC decimal
BV-217	URHC lead zero		BV-218	URHC edit
BV-219	LLHC enable		BV-220	LLHC lead zero
BV-221	LLHC edit		BV-222	LRHC enable
BV-223	LRHC decimal		BV-224	LRHC lead zero
BV-225	LRHC edit		BV-226	LRHC leading 1
BV-227	Day boxes		BV-228	Mon text
BV-229	Tue text		BV-230	Wed text
BV-231	Thu text		BV-232	Fri text
BV-233	Sat text		BV-234	Sun text
BV-235	Mon check		BV-236	Tue check
BV-237	Wed check		BV-238	Thu check
BV-239	Fri check		BV-240	Sat check
BV-241	Sun check		BV-242	Ok to pick
BV-243	Screen locked		BV-244	Change
BV-245	Filter		BV-246	UV Lamp
BV-247	Hum Pad		BV-250	Inside
BV-251	ULHC % Humidity		BV-253	Set to
BV-254	Aux		BV-255	Heat On
BV-256	Wait		BV-257	Cool On
BV-258	Heat Adjust		BV-259	Frost
BV-260	Follow		BV-261	Recovery
BV-262	URHC Adj Arrows		BV-263	Pm
BV-264	Am		BV-265	Days
BV-266	LLHC Adj Arrows		BV-268	Permanent
BV-269	Hold Until		BV-270	Cancel Period
BV-271	Outside		BV-272	DE
BV-273	HUMIDIFIER		BV-274	LRHC Humidity
BV-275	Minutes		BV-276	LRHC Adj Arrows
BV-277	LLRC %		BV-278	LLRC minus

Point	Object Name		Point	Object Name
BV-279	Cool Adj		BV-280	Vent
BV-281	Mon key		BV-282	Tue key
BV-283	Wed key		BV-284	Thu key
BV-285	Fri key		BV-286	Sat key
BV-287	Sun key		BV-288	URHC up key
BV-289	URHC dn key		BV-290	LRHC up key
BV-291	LRHC dn key		BV-292	LLHC up key
BV-293	LLHC dn key		BV-294	RESET key
BV-295	CANCEL PERIOD key		BV-297	FAN key
BV-298	SYSTEM key		BV-300 - BV-301	AO*n* Current Mode
BV-400 - BV-402	AI*n* Pullup		BV-64	Time Schedule Output
BV-65	User ON/OFF in Occupied Mode		BV-66	After Hours Timer Status
BV-67	Occupied / Unoccupied Status		BV-68	Field Service Lockout
BV-69	Swap English / Metric		BV-71	English (OFF) / Metric (ON)
BV-72	Fan stage 1		BV-73	Fan stage 2
BV-74	Fan stage 3		BV-77	Heating ICON
BV-78	Cooling ICON		BV-79	Backlight ON
BV-80	Enable Fan Speed Control		BV-81	Select Hotel Mode
BV-82	Enable Time Display		BV-83	24Hr Time Format
BV-84	Enable Space Humidity		MV-0	Time Mode
MV-1	Schedule Model		MV-10	Fan stage 2 text
MV-11	Fan stage 3 text		MV-12	Schedule Format
MV-13	SP Override Mode		MV-2	Keypad Lock
MV-20	ULHC mode		MV-21	URHC mode
MV-22	LLHC mode		MV-23	LRHC mode
MV-3	DLS Mode		MV-4	SP Increment
MV-5	Schedule Increment		MV-6	User SYSTEM selection
MV-7	Fan status		MV-8	Fan OFF text
MV-9	Fan stage 1 text			

Appendix D: Quick Reference

Field Service Codes

(Press SYSTEM block and hold down bottom middle key.)

:UC	Unoccupied cooling setpoint (AV-95)
:UH	Unoccupied heating setpoint (AV-96)
:CO	Cooling offset (AV-93)
:HO	Heating offset (AV-94)
:HS	Occupied heating setpoint (AV-100)
:CS	Occupied cooling setpoint (AV-99)
:AL	Override limit (AV-97)
:HI	Setpoint high limit (AV-91)
:LO	Setpoint low limit (AV-92)
:SP	Occupant-selected space temperature setpoint (AV-90)

Installer Setup Codes

(Press SYSTEM block and hold down keys on either side of bottom middle key.)

120	Year, first 2 digits
130	Year, second 2 digits
140	Month
150	Day
160	Schedule format (BV-133)
280	Backlight control (BV-79)
320	Swap English/Metric (BV-69)
330	Daylight saving (AV-127)
500	Filter change reminder (AV-124)
510	Hum pad change reminder (AV-125)
520	UV lamp change reminder (AV-126)
540	Program periods (AV-129)
640	Clock format (BV-83)
670	Keypad lock (AV-128)
700	Sensed temperature offset (AV-138)
701	Sensed humidity offset (AV-139)
702	Sensed outside air temperature offset (AV-140)
703	Sensed outside air humidity offset (AV-141)
800	MS/TP MAC address
801	BACnet Device Instance first digit
802	BACnet Device Instance second and third digits
803	BACnet Device Instance fourth and fifth digits
804	BACnet Device Instance sixth and seventh digits

	Function	Description
1	Days of Week	Shows the current day of the week. In Schedule Setup mode, shows all days; check marks appear beside selected days.
2	Maintenance needed messages	Flashes when it is time to change a filter, UV lamp, or humidifier pad.
3	FAN block	Displays the current fan setting and allows users to select a setting.
4	Inside condition	Displays the current inside temperature and/or humidity.
5	Setpoint	Displays the current setpoint
6	Heating adjustment	Pressing the arrows adjusts the heating setpoint.
7	SYSTEM block	Displays the current system setting and allows users to select a setting.
8	Schedule block	Displays schedule holds and allows users to change schedules.
9	Outside condition	Displays the current outside temperature and/or humidity.
10	Cooling adjustment	Pressing the arrows adjusts the cooling setpoint.
11	SCHED EDIT	Displays the current schedule. In schedule mode, displays the Edit Schedule screen.
12	HOLD WAKE	Allows users to place the system on Permanent or Vacation hold. In Edit Schedule mode, flashing bar indicates that WAKE is the active schedule period.
13	CLOCK LEAVE	Allows users to change the system date and time. When editing a schedule, flashing bar indicates that LEAVE is the active schedule period.
14	SCREEN RETURN	Locks the screen for cleaning. In Edit Schedule mode, flashing bar indicates that RETURN is the active schedule period.
15	MORE SLEEP	Displays additional screens. In Edit Schedule mode, flashing bar indicates that SLEEP is the active schedule period.

Appendix I: Honeywell T7351 & JADE Specifications

Standard specification sheets for the JADE economizer controller are included in the following Appendix. The specification sheet for the Honeywell T7351 advanced programmable thermostat is unable to be included in this Appendix due to security placed on the pdf document by Honeywell. The T7351 specification sheet can be accessed at http://customer.honeywell.com/techlit/pdf/63-0000s/63-2666.pdf.

Honeywell

JADE™ Economizer Module
(MODEL W7220)

PRODUCT DATA

PRODUCT DESCRIPTION

The JADE™ Economizer System is an expandable economizer control system, which includes a W7220 Economizer Module (controller) with an LCD and keypad. The W7220 can be configured with optional sensors.

The W7220 Economizer Module can be used as a stand-alone economizer module wired directly to a commercial set back space thermostat and sensors to provide Outdoor Air dry-bulb economizer control.

The W7220 Economizer Module can be connected to optional Sylk Bus sensors for single or differential economizer control. The W7220 Economizer Module provides power and communications on the Sylk Bus for the Sylk Bus sensors.

The W7220 Economizer Module automatically detects sensors by polling the Sylk Bus to determine which sensors are present. If a sensor loses communications after it has been detected, the W7220 Economizer indicates a device fail error on its LCD.

System Components

The JADE™ Economizer System includes an Economizer Module, 20k mixed air sensor, damper actuator, an optional CO_2 sensor, and either a 20k outdoor air temperature sensor or Sylk Bus sensors for measuring Outdoor Air and return air enthalpy, temperature, and humidity.

Economizer Module

This is the core of the JADE™ Economizer System and includes the user interface for the system. The W7220 Economizer Module provides the basic inputs and outputs to provide simple economizer control. When used with the optional Sylk Bus sensors, the Economizer Module provides more advanced economizer functionality.

Sylk Bus Sensors (optional)

The Sylk Bus Sensor is a combination temperature and humidity sensor which is powered by and communicates on the Sylk Bus. Up to three sensors may be configured with the JADE™ Economizer Module.

CO_2 Sensor (optional)

A CO_2 sensor (non-communicating or non-Sylk Bus) can be added for Demand Control Ventilation (DCV).

Contents

E4436

63-2700-03

SPECIFICATIONS

W7220A Economizer Module

The module is designed for use with any Honeywell 2 to 10 Vdc or Honeywell Sylkbus communicating actuator. The module includes terminals for a CO_2 sensor, Mixed Air sensor, and an Outdoor Dry Bulb sensor. Enthalpy and other options are available with Sylk Bus sensors.

User Interface: Provides status for normal operation, setup parameters, checkout tests, and alarms and error conditions with a 2-line 16 character LCD display and a four button keypad.

Electrical

Rated Voltage: 20 to 30 Vac RMS; 50/60 Hz
Transformer: 100 VA maximum system input

Nominal Power Consumption (at 24 Vac, 60 Hz): 11.5 VA without sensors and actuator

Relay Digital Output Rating at 30 Vac (maximum power from Class 2 input only): 1.5A run;
3.5A inrush @ 0.45PF (200,000 cycles) or
7.5A inrush @ 0.45PF (100,000 cycles)

External Sensors Power Output: 21 Vdc +/- 5% @ 48mA

IMPORTANT

All inputs and outputs must be Class 2 wiring.

Inputs

SENSORS:

NOTE: A Mixed air (MA) analog sensor is required on all W7220 units; either an Outdoor Air (OA) sensor for dry bulb change over or an OA Sylkbus sensor for outdoor enthalpy change over is required in addition to the MA sensor. An additional Return Air (RA) Sylkbus sensor can be added to the system for differential enthalpy changeover.

Dry Bulb Temperature and Mixed Air, C7250A:
2-wire (18 to 22 AWG);
Temperature range -40 to 150 °F (-40 to 65 °C).

Temperature and Humidity, C7400S1000 (optional):
Sylk Bus; 2-wire (18 to 22 AWG)
Temperature: range -40 to 150 °F (-40 to 65 °C)
Humidity: range 0 to 100% RH with 5% accuracy.

NOTE: Up to three (3) SYLK Bus sensors may be connected to the JADE™ Economizer module. For outdoor air (OA), return air (RA) and discharge (supply) air (DA).

DCV (CO_2) Sensor (C7232):
2-10 Vdc control signal; minimum impedance >50k ohm.

4 Binary inputs:
1-wire 24 Vac + common GND (see page 5 for wiring details). 24 Vac power supply: 20 to 30 Vac 50/60Hz; 100 VA Class 2 transformer.

Outputs

Actuator signal: 2-10 Vdc; minimum actuator impedance is 2k ohm; Sylkbus two-wire output for Honeywell Sylkbus communicating actuators.

Exhaust fan, Y1, Y2 and AUX1 O:
All Relay Outputs (at 30 Vac):
Running: 1.5A maximum
Inrush: 7.5A maximum

Environmental

Operating Temperature: -40 to 150 °F (-40 to 65 °C). Exception of display operation down to -4 °F with full recovery at -4 °F from exposure to -40 °F

Storage Temperature: -40 to 150 °F (-40 to 65 °C)

Shipping Temperature: -40 to 150 °F (-40 to 65 °C)

Relative Humidity: 5% to 95% RH non-condensing

Dimensions (See Fig. 1 on page 2):
Height: 4.98 inches (126.4 mm)
Width: 6.3 inches (160 mm)
Depth: 1.34 inches (34 mm)

Weight: 0.58 lb. (0.265 kg)
Approvals: UL listed (XAPX) for USA and Canada.

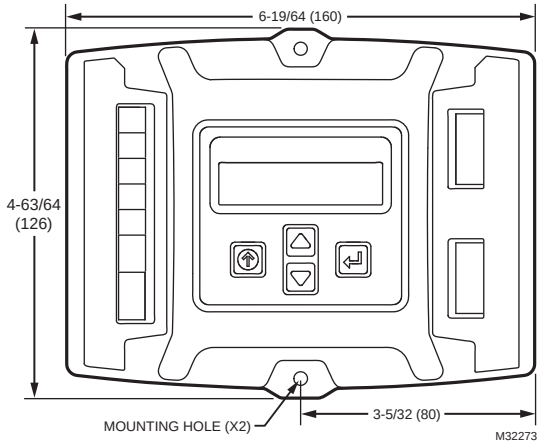


Fig. 1. Dimensions in inches and (mm) showing mounting holes.

BEFORE INSTALLATION

Review the “Specifications” on page 2 before installing the The JADE™ Economizer System.

When Installing This Product

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

INSTALLATION AND SETUP

The following installation procedures should be performed in the order listed:

1. Mounting — see “Mounting” on this page.
2. Wiring — see “Wiring” on this page.
3. Interface and Programming overview – see page 12.
4. Setup and Configuration — see page 17
5. Checkout — see page 22.

Troubleshooting and Alarms begin on page 24.

MOUNTING

This section describes the mounting procedures for the JADE™ Economizer module and the sensors.

Economizer Module Location and Mounting

IMPORTANT

Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the module’s circuit board, or in areas where escaping gas or other explosive vapors are present.

IMPORTANT

The module must be mounted in a position that allows clearance for wiring, servicing, and removal.

Mount the Economizer module on any convenient interior location using the two mounting holes provided on the enclosure using #6 or #8 screws (screws are not provided and must be obtained separately). Use the dimensions in Fig. 1 on page 2 as a guide.

The Economizer module may be mounted in any orientation. However, mounting in the orientation shown in Fig. 1 on page 2 permits proper viewing of the LCD display and use of the keypad.

Sensor Location and Mounting

The JADE™ Economizer W7220 uses digital sensors for control. The C7250 temperature sensors (MA[a] and OA[b]) are 20k NTC. A MA sensor is required for all applications and is mounted in the mixed air section of a rooftop unit either directly to the sheet metal using self tapping sheet metal screws or in the air stream using the duct mounting kit. Duct mount kit is part number 50053060-001.

Optional OA, RA[c] and DA[d] Sylkbus sensors communicate with the W7220 on the two-wire communication bus and can either be wired using a two pin header or using a side connector. Each Sylkbus sensor includes a two pin side connector with the packaging. The SKU number of the Sylkbus sensor is C7400S. All OA, RA and DA sensors are the same SKU number. The sensor is set for the appropriate type of sensing using the three position DIP switch located on the sensor. OA position is OFF, OFF, OFF; RA is ON, OFF, OFF and DA is OFF, ON, OFF. During installation the sensors are set for the usage desired. See “Sylk Bus Sensor Wiring” on page 6 for DIP switch details.

NOTE: The protective film on the dip switch is only necessary during the factory assembly process. Simply push through the film to set the dip switches; this will not harm the device.

Once installed, a sensor can be changed to a different application by simply changing the DIP switch setting.

[a] MA = Mixed Air
[b] OA = Outdoor Air
[c] RA = Return Air
[d] DA = Discharge Air

Sensor Mounting

The sensors can be mounted directly on to the sheet metal of unit or can be mounted in the air stream using the duct mounting kit (order separately).

The kit contains a rod to hold the sensor in the duct, a flange to secure the sensor rod to the duct wall and fill the hole and a gasket to prevent air from leaking through the duct wall. There are five (5) kits in a bag assembly. See Fig. 2.

The rod has slots for threading the wire to prevent loose or hanging wire in the duct and can be adjusted for 6 to 12 inch length. The flange has extended relief for ease of mounting. See 3.

The labels on the sensors and controller are color coded for ease of installation. Orange sensors can only be wired to orange terminals on the controller. Brown sensors can only be wired to S-bus (brown) terminals.

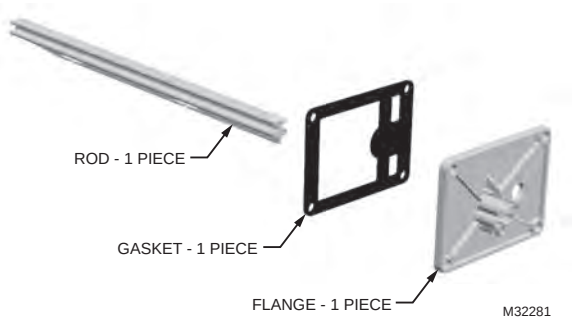


Fig. 2. Duct Mounting Kit (Part No. 50053060-001).

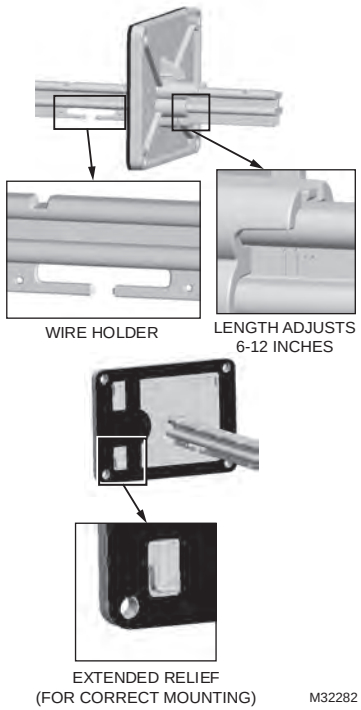


Fig. 3. Duct Mounting Adjustments.

WIRING

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Module wiring in the field is terminated to the four screw terminal blocks located on the left and right sides.

Module wiring at the OEM factory is terminated via the header pin terminals located on the left and right sides. The header terminal pins and the terminal blocks have common terminations for the appropriate input or output. The part number of the mating female connector for OEMs is 35977. See OEM wiring diagram in Fig. 13.

The remainder of this section describes the wiring for the JADE™ Economizer module, W7220A.

⚠ WARNING

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

⚠ CAUTION

Equipment Damage Hazard.
Electrostatic discharge can short equipment circuitry.
Ensure that you are properly grounded before handling the unit.

Economizer Module Wiring Method

Wire the sensors and outputs, then wire the power connection.

Each terminal can accommodate the following gauges of wire:
- Single wire – from 18 AWG to 22 AWG solid or stranded
- Multiple wires – up to two 22 AWG stranded
- For the 24 Vac connections: single wire – from 14 to 18 AWG solid or stranded
- For S-BUS wiring, the sensors may be mounted up to 200 ft. (61 m) from the JADE controller.
- All wiring is polarity insensitive.

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

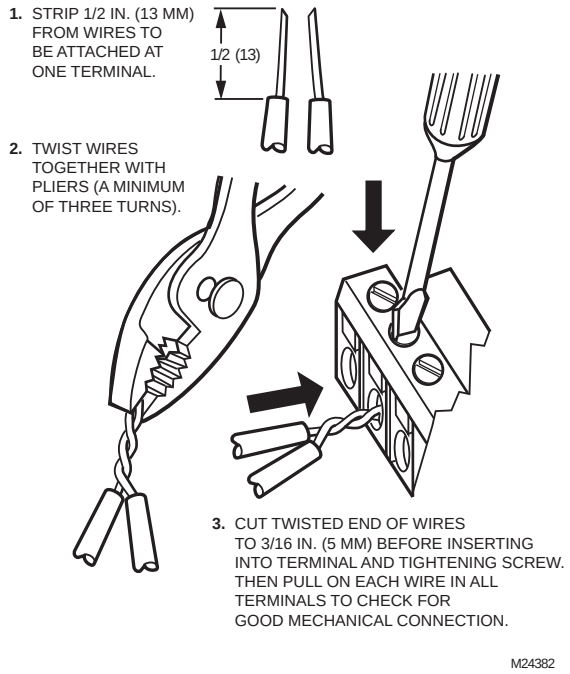


Fig. 4. Attaching two or more wires at terminal blocks.

Economizer Module Wiring Details

The wiring connection terminals for each module/sensor are:
- "JADE™ Economizer Module Wiring" on this page.
- "Sylk Bus Sensor Wiring" on page 6.

JADE™ Economizer Module Wiring

Use Fig. 5 and Tables 1 and 2 to locate the wiring terminals for the Economizer module.

NOTE: The four terminal blocks are removable. You can slide out each terminal block, wire it, and then slide it back into place.

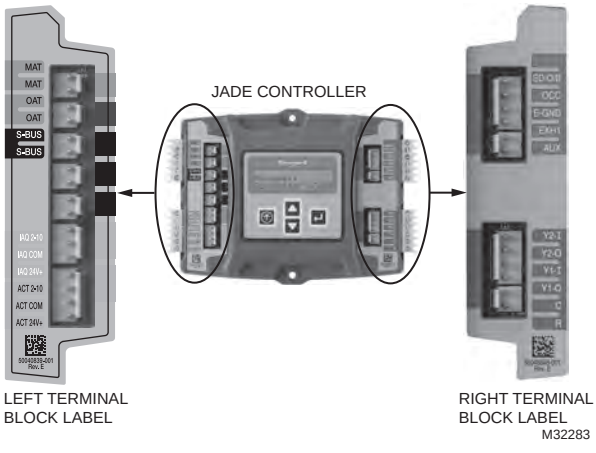


Fig. 5. W7220 Economizer module terminal connection labels.

Table 1. Economizer Module - Left hand terminal blocks.

Label	Type	Description
Top Left Terminal Block		
MAT MAT	20k NTC and COM	Mixed Air Temperature Sensor (polarity insensitive connection)
OAT OAT	20k NTC and COM	Outdoor Air Temperature Sensor (polarity insensitive connection)
S-BUS S-BUS	SYLK Bus	Sylk Bus sensor (polarity insensitive connection)
Bottom Left Terminal Block		
IAQ 2-10	2-10 Vdc	Air Quality Sensor Input (e.g. CO_2 sensor)
IAQ COM	COM	Air Quality Sensor Common
IAQ 24V	24 Vac	Air Quality Sensor 24 Vac Source
ACT 2-10	2-10 Vdc	Damper Actuator Output (2-10 Vdc)
ACT COM	COM	Damper Actuator Output Common
ACT 24V	24 Vac	Damper Actuator 24 Vac Source

Table 2. Economizer Module - Right hand terminal blocks.

Label	Type	Description
Top Right Terminal Block		
	n/a	The first terminal is not used
AUX2 I	24 Vac IN	Shut Down (SD) or Heat (W) Conventional only or Heat Pump Changeover (O/B) in Heat Pump mode.
OCC	24 Vac IN	Occupied / Unoccupied Input
E-GND	EGND	Earth Ground - System Required
EXH1	24 Vac OUT	Exhaust Fan 1 Output
AUX1 O	24 Vac OUT	Programmable: Exhaust fan 2 output or ERV or System Alarm output.
Bottom Right Terminal Block		
Y2-I	24 Vac IN	Y2 in - Cooling Stage 2 Input from space thermostat
Y2-O	24 Vac OUT	Y2 out - Cooling Stage 2 Output to stage 2 mechanical cooling
Y1-I	24 Vac IN	Y1 in - Cooling Stage 1 Input from space thermostat
Y1-O	24 Vac OUT	Y1 out - Cooling Stage 1 Output to stage 1 mechanical cooling
C	COM	24 Vac Common
R	24 Vac	24 Vac Power (Hot)

Sylk Bus Sensor Wiring

Use Fig. 6 and Table 3 to locate the wiring terminals for each Sylk Bus sensor.

Use Fig. 6 and Table 4 to set the DIP switches for the desired use of the sensor.

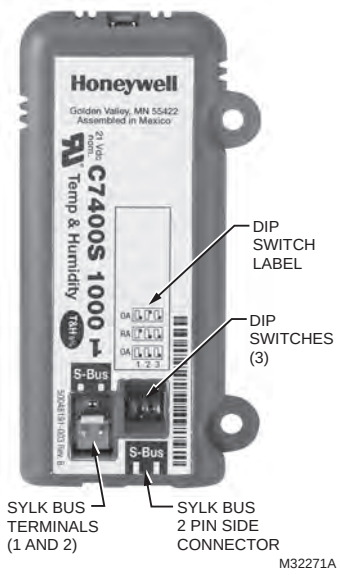


Fig. 6. Sylk Bus sensor DIP switches.

Table 3. SYLK Bus Sensor Wiring Terminations.

Terminal		Type	Description
Nbr	Label		
1	S-BUS	SYLK Bus	Sylk Bus Communications (Sensor Bus) polarity insensitive
2	S-BUS	SYLK Bus	Sylk Bus Communications (Sensor Bus) polarity insensitive

Table 4. SYLK Bus Sensor DIP Switch Settings.

Use	DIP Switch Positions for Switches 1, 2, & 3		
	1	2	3
DA[a]	OFF	ON	OFF
RA[b]	ON	OFF	OFF
OA[c]	OFF	OFF	OFF

[a] DA = Discharge Air
[b] RA = Return Air
[c] OA = Outdoor Air

WIRING APPLICATION EXAMPLES

This section describes the wiring configurations for the JADE™ Economizer system. The configurations are:

- — “Stand-alone Economizer”
- — “Economizer with Sylk Bus Sensors” on page 9

Stand-alone Economizer

The most basic configuration is the stand-alone Economizer (see Fig. 7 and Fig. 8).

A stand-alone Economizer is directly wired to sensors, actuators, thermostat, and mechanical controls in the roof top unit. It does not require Sylk Bus communications.

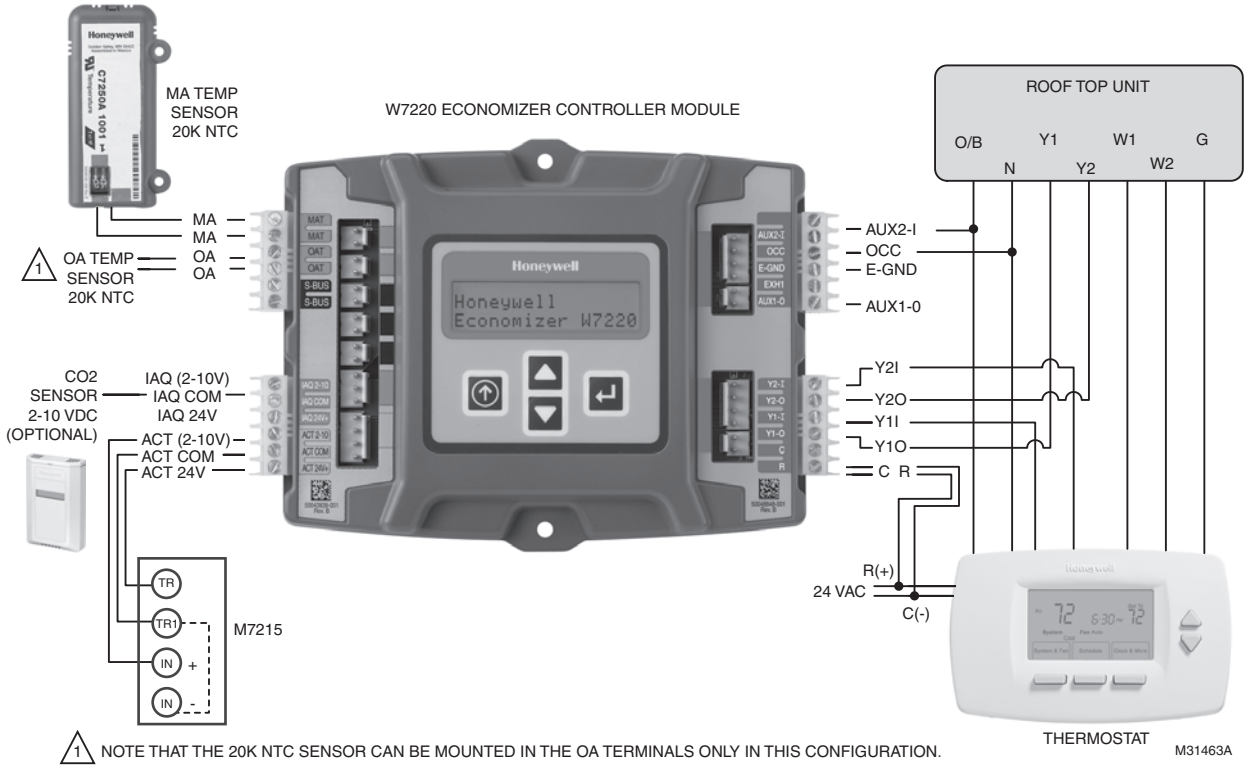


Fig. 7. Stand-alone dry bulb Economizer configuration with black motor M7215.

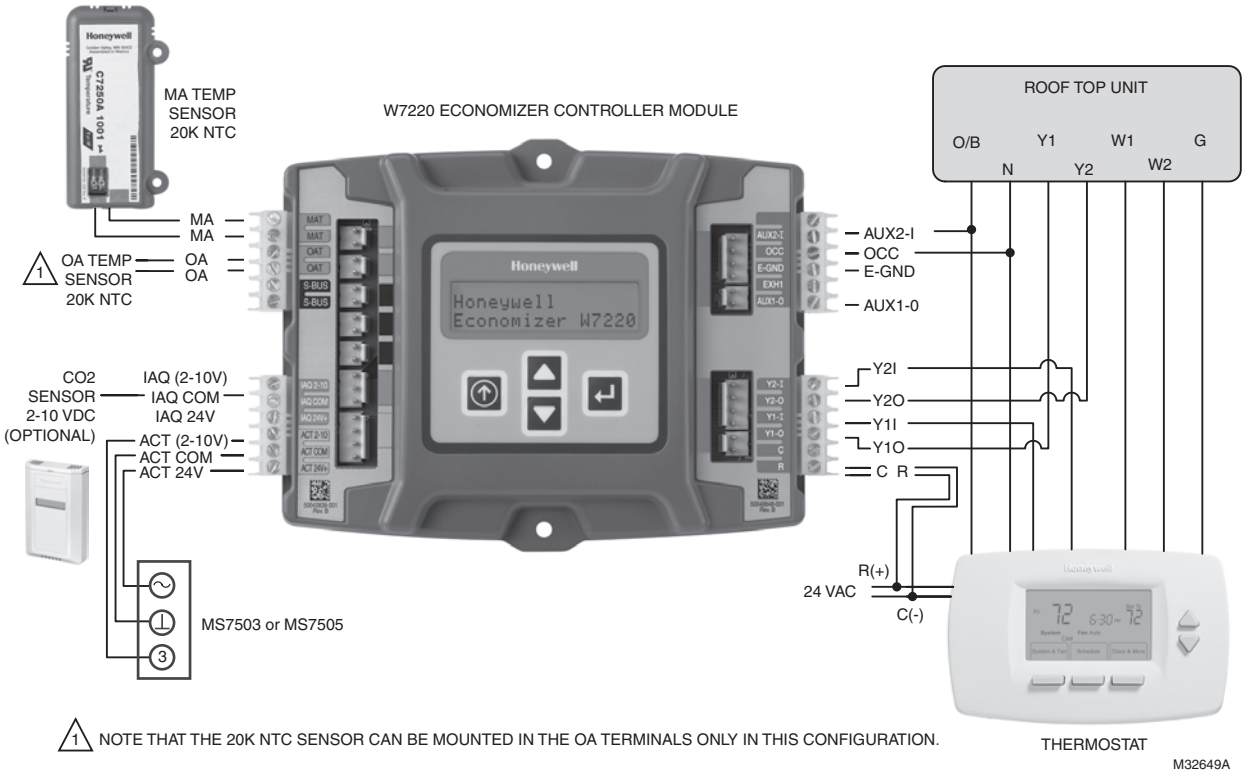


Fig. 8. Stand-alone dry-bulb Economizer configuration with Honeywell MS7503 or MS7505 Direct Coupled Actuator.

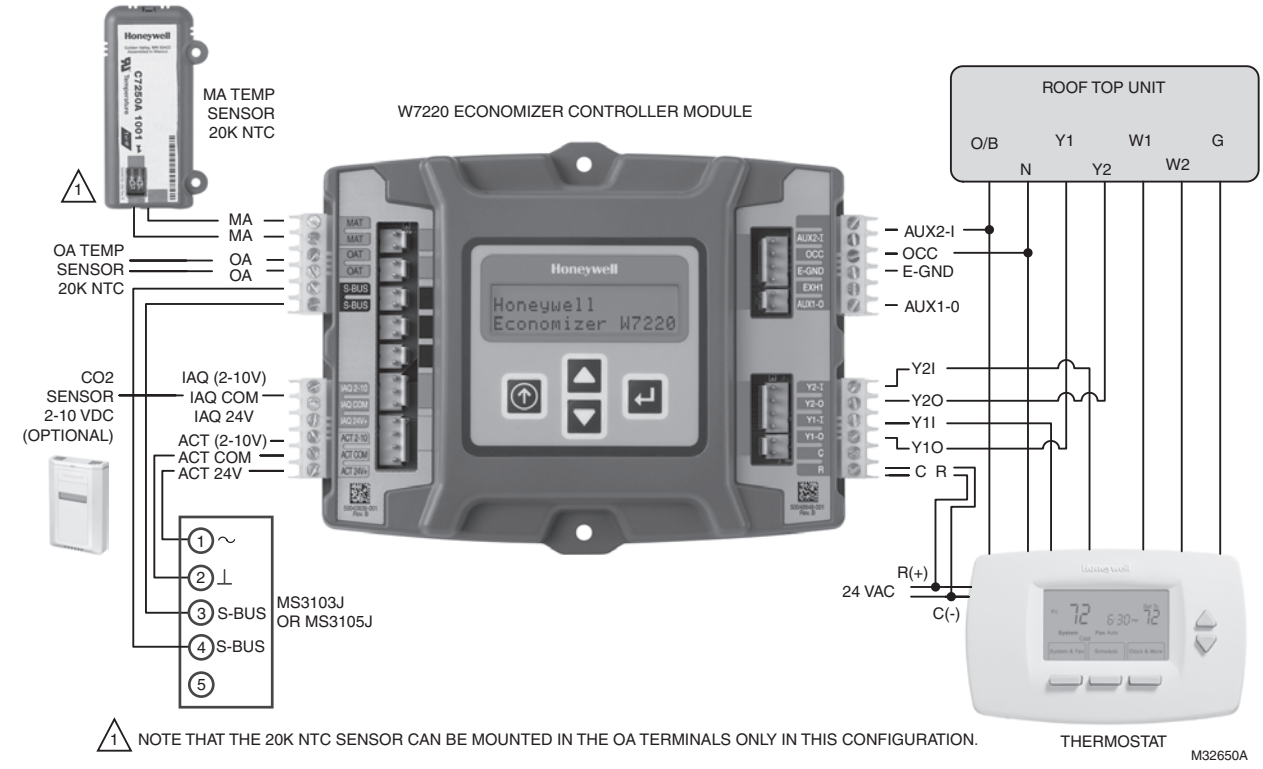


Fig. 9. Stand-alone dry-bulb Economizer configuration with Honeywell MS3103J or MS3105J communicating actuators.

Economizer with Sylk Bus Sensors

A standalone economizer with Sylk Bus sensors has additional sensors attached using Sylk Bus communications (see Fig. 10, Fig. 11 and Fig. 12). The Sylk Bus reduces wiring requirements while providing additional functionality.

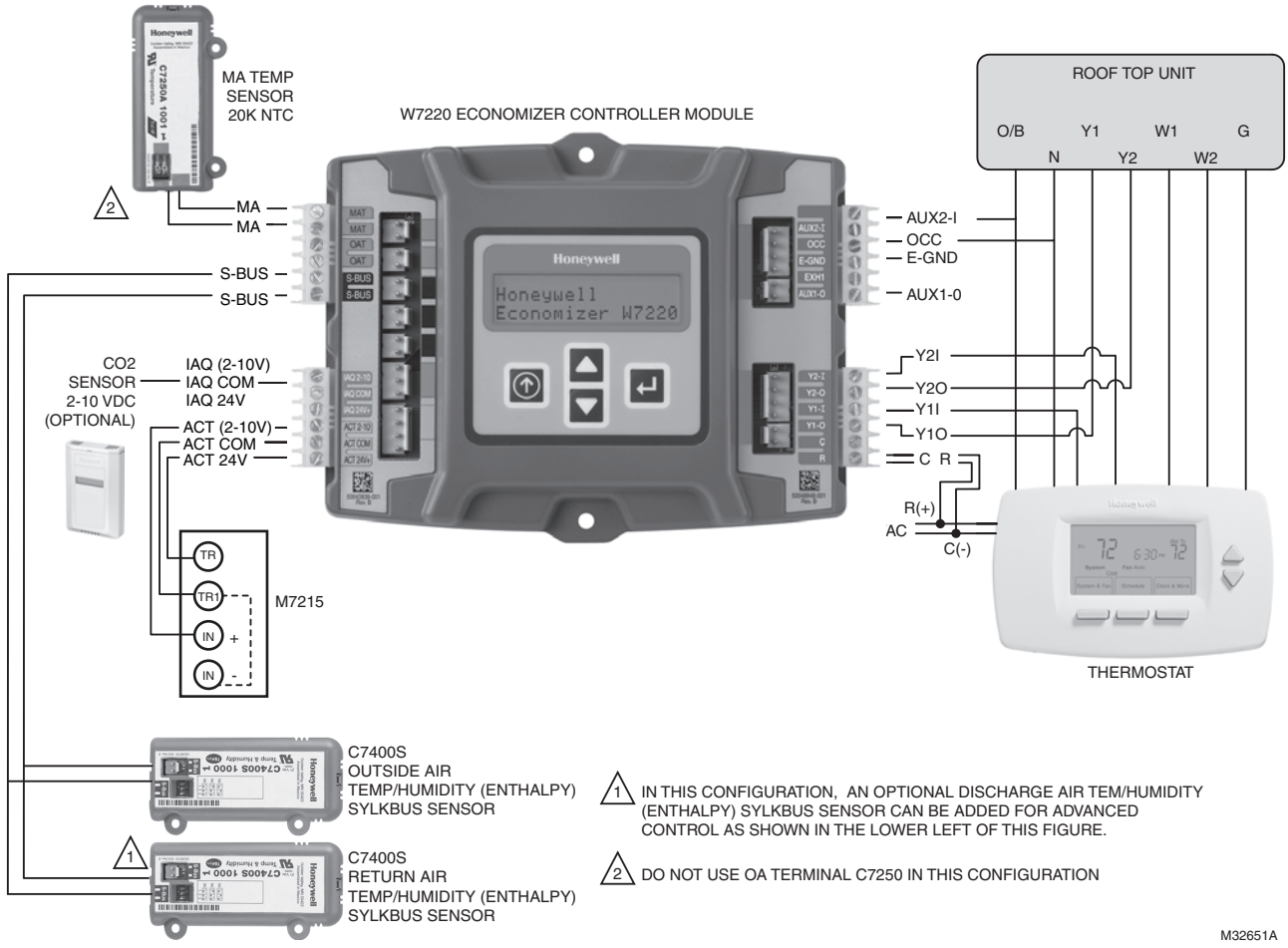


Fig. 10. Economizer with Sylk Bus sensors for enthalpy configuration with Honeywell M7215 black motor.

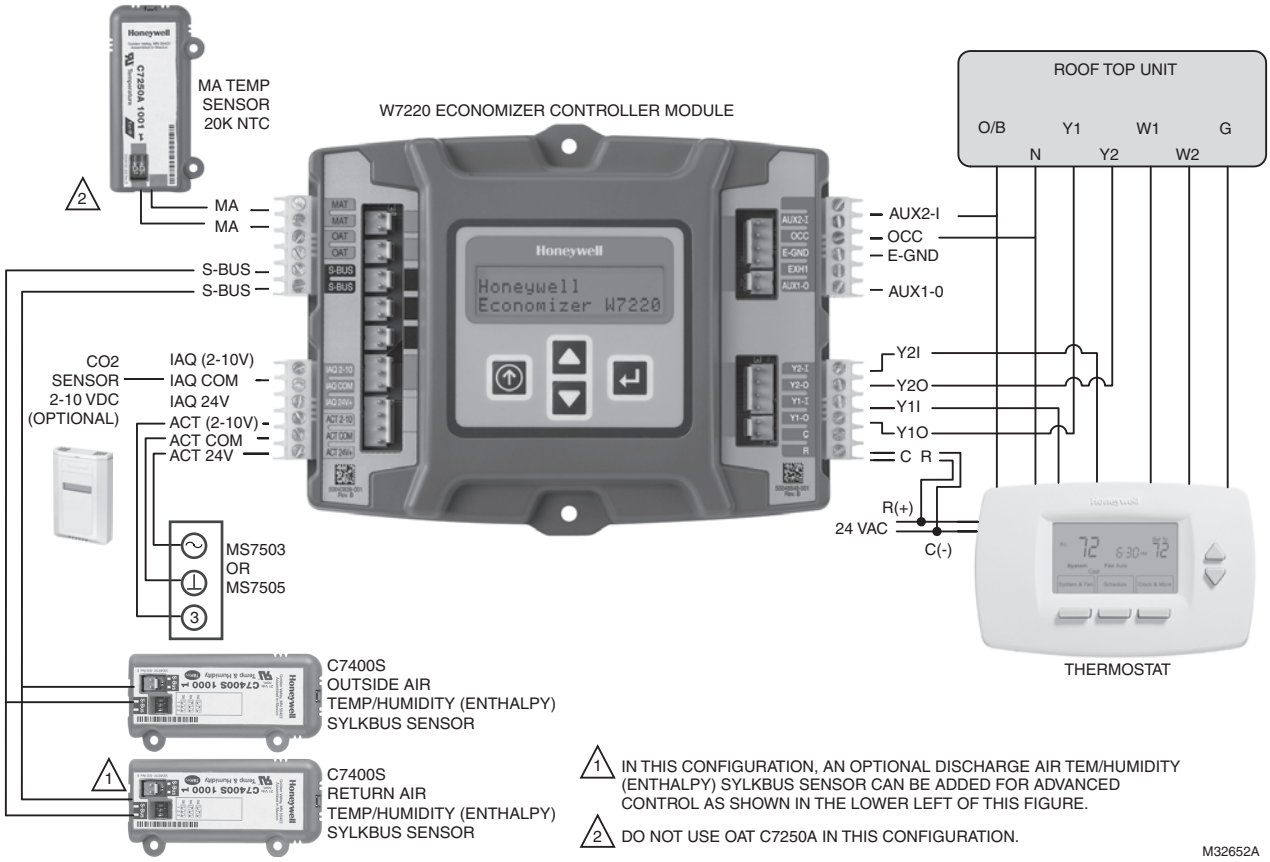


Fig. 11. Economizer with Sylk Bus sensors for enthalpy configuration with a Honeywell MS7503 or MS7505 Direct Coupled Actuator.

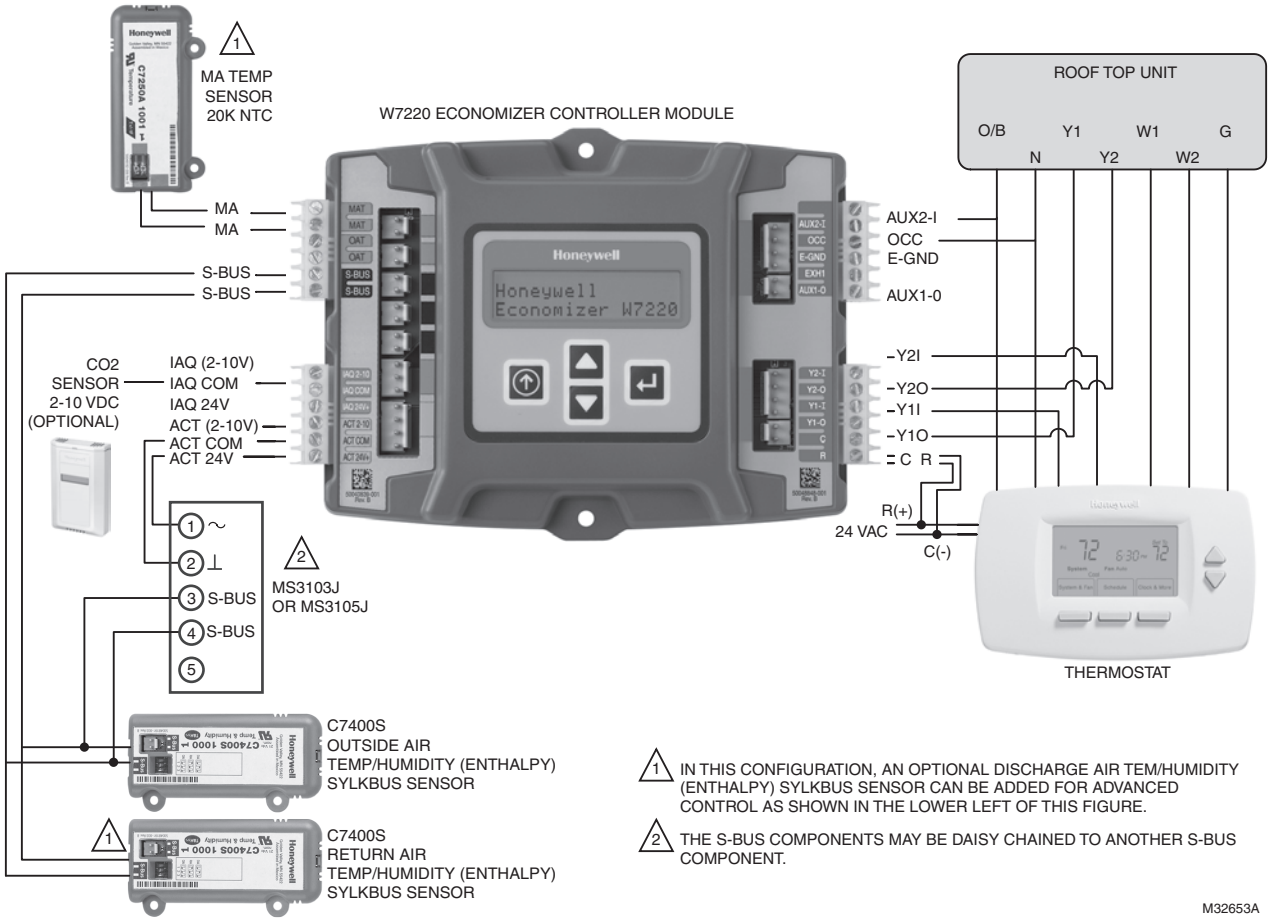
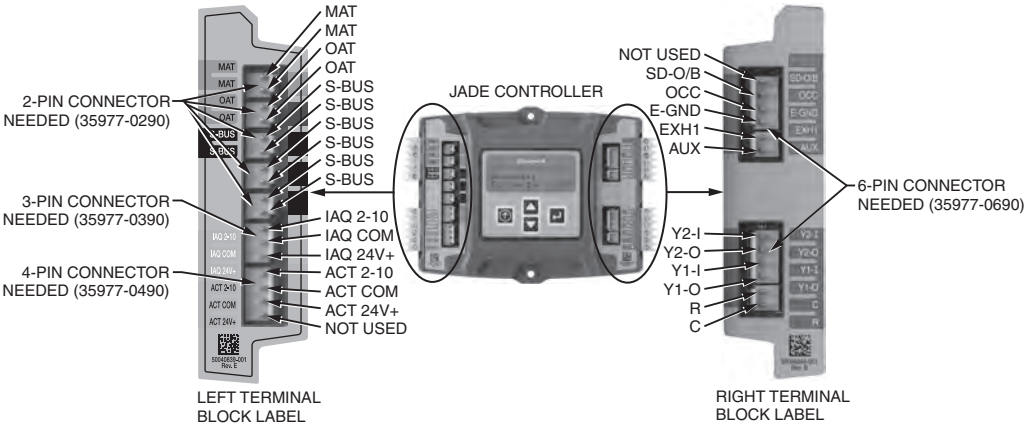


Fig. 12. Economizer with Sylk Bus sensors for enthalpy configuration with a Honeywell MS3103J or MS3105J communicating actuators.



PART NUMBER	PIN COUNT	MANUFACTURER	
MOLEX PLASTIC HOUSING 35977-0290 PLUS 2 PIECES 0359229002 METAL CONDUCTOR	2	MOLEX	
MOLEX PLASTIC HOUSING 35977-0390 PLUS 3 PIECES 0359229002 METAL CONDUCTOR	3	MOLEX	
MOLEX PLASTIC HOUSING 35977-0490 PLUS 4 PIECES 0359229002 METAL CONDUCTOR	4	MOLEX	
MOLEX PLASTIC HOUSING 35977-0690 PLUS 6 PIECES 0359229002 METAL CONDUCTOR	6	MOLEX	
TYPE 42743-2	1	AMP	1/4 INCH QUICK CONNECT FOR M7215 BLACK MOTOR

M31402B

Fig. 13. OEM wiring harness information. Refer to previous wiring diagrams for detailed application wiring.

INTERFACE OVERVIEW

This section describes how to use the Economizer's user interface for:
- Keypad and menu navigation
- Settings and parameter changes
- Menu structure and selection

User Interface

The user interface consists of an LCD display and a 4-button keypad on the front of the Economizer module. The LCD is a 16 character by 2 line dot matrix display.

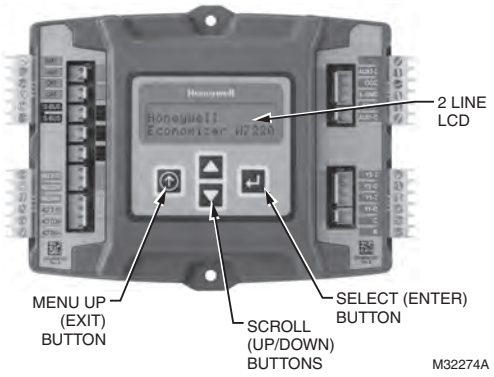


Fig. 14. Economizer LCD and Keypad Layout.

Keypad

The four navigation buttons illustrated in Fig. 14 are used to scroll through the menus and menu items, select menu items, and to change parameter and configuration settings.

Using the Keypad with Menus

To use the keypad when working with menus:
- Press the ▲ button to move to the previous menu.
- Press the ▼ button to move to the next menu.
- Press the ↵ button (Enter) to display the first item in the currently displayed menu.
- Press the ⓘ button (Menu up) to exit a menu's item and return to the list of menus.

Using the Keypad with Settings and Parameters

To use the keypad when working with Setpoints, System and Advanced Settings, Checkout tests, and Alarms:
- Navigate to the desired menu.
- Press the ↵ button (Enter) to display the first item in the currently displayed menu.
- Use the ▲ and ▼ buttons to scroll to the desired parameter.
- Press the ↵ button (Enter) to display the value of the currently displayed item.
- Press the ▲ button to increase (change) the displayed parameter value.[a]
- Press the ▼ button to decrease (change) the displayed parameter value.[a]
- Press the ↵ button to accept the displayed value and store it in non-volatile RAM.
- CHANGE STORED displays.
- Press the ↵ button (Enter) to return to the current menu parameter.
- Press the ⓘ button (MenuUp/Exit) to return to the previous menu.

Menu Structure

Table 5 on page 13 illustrates the complete hierarchy of menus and parameters for the JADE™ Economizer system.

The Menus in display order are:
- STATUS
- SETPOINTS
- SYSTEM SETUP
- ADVANCED SETUP
- CHECKOUT
- ALARMS

IMPORTANT

Table 5 on page 13 illustrates the complete hierarchy. Your menu parameters may be different depending on your configuration.

For example if you do not have a DCV (CO_2) sensor, then none of the DCV parameters appear.

[a] When values are displayed, pressing and holding the ▲ or ▼ button causes the display to automatically increment.

Table 5. Menu Structure[a].

Menu	Parameter	Parameter Default Value	Parameter Range and Increment[b]	Notes
STATUS	ECON AVAIL	NO	YES/NO	YES = economizing available; the system can use Outdoor Air for free cooling when required.
	ECONOMIZING	NO	YES/NO	YES = Outdoor Air being used for 1st stage cooling.
	OCCUPIED	NO	YES/NO	YES = OCC signal received from space thermostat or unitary controller. YES = 24 Vac on terminal OCC No = 0 Vac on terminal OCC.
	HEAT PUMP	n/a[c]	COOL HEAT	Displays COOL or HEAT when system is set to heat pump (non-conventional)
	COOL Y1-IN	OFF	ON/OFF	Y1-I signal from space thermostat or unitary controller for cooling stage 1. ON = 24 Vac on term Y1-I OFF = 0 Vac on term Y1-I
	COOL Y1-OUT	OFF	ON/OFF	Cool Stage 1 Relay Output to stage 1 mechanical cooling (Y1-OUT terminal).
	COOL Y2-IN	OFF	ON/OFF	Y2-I signal from space thermostat or unitary controller for second stage cooling. ON = 24 Vac on term Y2-I OFF = 0 Vac on term Y2-I
	COOL Y2-OUT	OFF	ON/OFF	Cool Stage 2 Relay Output to mechanical cooling (Y2-OUT terminal).
	MA TEMP	_ _._ °F	-40 to 150 °F	Displays value of measured mixed air from MAT sensor. Displays --.- if not connected, short, or out- of-range.
	DA TEMP	_ _._ °F	-40 to 150 °F	Displays when Discharge Air Sylk Bus sensor is connected and displays measured discharge air temperature. Displays --.-°F if sensor sends invalid value, if not connected, short or out-of-range.
	OA TEMP	_ _._ °F	-40 to 140 °F	Displays measured value of outdoor air temperature. Displays --°F if sensor sends invalid value, if not connected, short or out-of-range.
	OA HUM	_ _ %	0 to 100%	Displays measured value of outdoor humidity from QA Sylkbus sensor. Displays --% if not connected, short, or out- of-range.
	RA TEMP	_ _._ °F	0 to 140 °F	Displays measured value of return air temperature from RAT sensor. Displays --°F if sensor sends invalid value, if not connected, short or out-of-range.
	RA HUM	_ _ %	0 to 100%	Displays measured value of return air humidity from RA Sylkbus sensor. Displays --% if sensor sends invalid value, if not connected, short or out-of-range.
	IN CO2	_ _ _ ppm	0 to 2000 (3500) ppm	Displays value of measured CO2 from CO2 sensor. Invalid if not connected, short or out-of-range. May be adjusted in Advanced menu by Zero offset and Span
	DCV STATUS	n/a	ON/OFF	Displays ON if above setpoint and OFF if below setpoint, and ONLY if a CO2 sensor is connected.
	DAMPER OUT	2.0V	2.0 to 10.0 V	Displays output position to the damper actuator.[e]
	ACT POS.	n/a	0 to 100%	Displays actual position of actuator.
	ACT COUNT	n/a	1 to 65,535	Displays number of times actuator has cycled. 1 Cycle equals 180° of movement in any direction.
	ACTUATOR	n/a	OK/Alarm (on Alarm menu)	Displays Error if voltage or torque is below actuator range
	EXH1 OUT	OFF	ON/OFF	Output of EXH1 terminal. ON = relay closed; OFF = relay open.
	EXH2 OUT	OFF	ON/OFF	Output of AUX1 O terminal; displays only if AUX1 O = EXH2
	ERV	OFF	ON/OFF	Output of AUX1 O terminal; displays only if AUX1 O = ERV
	MECH COOL ON	0	0, 1, or 2	Displays stage of mechanical cooling that is active.
	FAN SPEED	n/a	LOW or HIGH	Displays speed of fan on a 2-speed fan unit
	W (HEAT IN)	n/a	ON/OFF	Displays status of heat on a 2-speed fan unit.

Table 5. Menu Structure[a]. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment[b]	Notes
SETPOINTS	MAT SET	53ºF	38 to 65 ºF; increment by 1	Setpoint determines where the economizer will modulate the OA damper to maintain the mixed air temperature.
	LOW T LOCK	32ºF	-45 to 80 ºF; increment by 1	Setpoint determines outdoor temperature when the mechanical cooling cannot be turned on. Commonly referred to as the Compressor lockout.
	DRYBLB SET	63ºF	48 to 80 ºF; increment by 1	Setpoint determines where the economizer will assume outdoor air temperature is good for free cooling; e.g.; at 63 ºF unit will economizer at 62 ºF and below and not economize at 64 ºF and above. There is a a 2 ºF deadband.
	ENTH CURVE	ES3	ES1, ES2, ES3, ES4, or ES5	Enthalpy boundary “curves” for economizing using single enthalpy. See “Enthalpy Settings” on page 17 and Product Data sheet form 63-2700 for description of enthalpy curves.
	DCV SET	1100ppm	500 to 2000 ppm increment by 100	Displays ONLY if Setpoint for Dem OA dampers will space ppm level below the setpoint.
	MIN POS	2.8 V	2 to 10 Vdc	Displays ONLY if a CO2 sensor is NOT connected.
	VENTMAX	2.8 V	2 to 10 Vdc or 100 to 9990 cfm increment by 10	Displays only if a CO2 sensor is connected. Used for Vbz (ventilation max cfm) setpoint. Displays 2 to 10 V if <3 sensors (RA,OA and MA). In AUTO mode dampers controlled by CFM With 2-speed fan units VENTMAX L (low speed fan) and VENTMAX H (high speed fan) settings are required. Default for VENTMAX L is 3.2V nd VENTMAX H is 2.8 v
	VENTMIN	2.25 V	2 to 10 Vdc or 100 to 9990 cfm increment by 10	Displays only if CO2 sensor is connected. Used for Va (ventilation min cfm) setpoint. Displays 2 to 10 V if <3 sensors (RA,OA and MA). Va is only set if DCV is used. This is the ventilation for less than maximum occupancy of the space. In AUTO mode dampers controlled by CFM With 2-speed fan units VENTMIN L (low speed fan) and VENTMIN H (high speed fan) settings are required. Default for VENTMIN L is 2.5V nd VENTMIN H is 2.25 v
	ERV OAT SP	32ºF	0 to 50 ºF; increment by 1	Only when AUX1 O = ERV
	EXH1 SET	50%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 1 is powered by the economizer. With 2-speed fan units Exh1 L (low speed fan) and Exh1 H (high speed fan) settings are required. Default for Exh1 L is 65% nd Exh1 H is 50%
	EXH2 SET	75%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 2 is powered by the economizer. Only used when AUX1 O is set to EHX2. With 2-speed fan units Exh2 L (low speed fan) and Exh2 H (high speed fan) settings are required. Default for Exh2 L is 80% nd Exh2 H is 75%

With 2-speed fan units MIN POS L (low speed fan) and MIN POS H (high speed fan) settings are required. Default for MIN POS L is 3.2V and MIN POS H is 2.8V

Table 5. Menu Structure[a]. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment[b]	Notes
SYSTEM SETUP	INSTALL	01/01/11		Display order = MM/DD/YY Setting order = DD, MM, then YY.
	UNITS DEG	ºF	ºF or ºC	Sets economizer controller in degrees Fahrenheit or Celsius.
	EQUIPMENT	CONV	CONV HP	CONV = conventional. HP O/B = Enables Heat Pump mode. Use AUX2 I for Heat Pump input from thermostat or controller.
	AUX2 I	n/a	SD/W or HP(O)/ HP(B)	In CONV mode: SD = Enables configuration of shutdown (default); W = Informs controller that system is in heating mode. In HP O/B mode: HP(O) = energize heat pump on Cool (default); HP(B) = energize heat pump on Heat.
	FAN TYPE	1 speed	1 speed/ 2 speed	Sets economizer controller for operation of 1 speed or 2 speed supply fan
	FAN CFM	5000cfm	100 to 15000 cfm; increment by 100	This is the capacity of the RTU. The value is found on the label from the RTU manufacturer.
	AUX1 OUT	NONE	NONE ERV EXH2 SYS	• NONE = not configured (output is not used) • ERV= Energy Recovery Ventilator[d] • EXH2 = second damper position relay closure for second exhaust fan. • SYS = use output as an alarm signal
	OCC	INPUT	INPUT or ALWAYS	When using a setback thermostat with occupancy out (24 Vac), the 24 Vac is input “INPUT” to the OCC terminal. If no occupancy output from the thermostat then change program to “ALWAYS” OR ad a jumper from terminal R to OCC terminal.
	FACTORY DEFAULT	NO	NO or YES	Resets all set points to factory defaults when set to YES. LCD will briefly flash YES and change to NO but all parameters will change to factory default values.
ADVANCED SETUP	MA LO SET	45ºF	35 to 55 ºF; increment by 1º	Temp to activate Freeze Protection (close damper and alarm if temp falls below setup value)

Table 5. Menu Structure[a]. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment[b]	Notes
ADVANCED SETUP	FREEZE POS	CLO	CLO MIN	Damper position when freeze protection is active (closed or MIN POS).
	CO2 ZERO	0ppm	0 to 500 ppm; increment by 10	CO2 ppm level to match CO2 sensor start level.
	CO2 SPAN	2000ppm	1000 to 3000 ppm; increment by 50	CO2 ppm span to match CO2 sensor.
	STG3 DLY	2.0h	0 min, 5 min, 15 min, then 15 min intervals. Up to 4h or OFF	Delay after stage 2 for cool has been active. Turns on 2nd stage of cooling when economizer is 1st stage and mechanical cooling is 2nd stage. Allows three stages of cooling, 1 economizer and 2 mechanical. OFF = no Stage 3 cooling.
	SD DMPR POS	CLO	CLO OPN	Indicates shutdown signal from space thermostat or unitary controller. When controller receives 24 Vac input on the SD terminal in conventional mode, the OA damper will open if programmed for OPN and OA damper will close if programmed for CLO. All other controls, e.g., fans, etc. will shut off.
	DCVCAL ENA	MAN	MAN (manual) AUTO	Turns on the DCV automatic control of the dampers. Resets ventilation based on the RA, OA and MA sensor conditions. See Product Data sheet 63-2700 for details. Requires all 3 RA, OA and MA sensors. This operation is not operable with a 2-speed fan unit.
	MAT T CAL	0.0 F°	+/-2.5F°	Allows for the operator to adjust for an out of calibration temperature sensor
	OA T CAL	0.0F°	+/-2.5F°	Allows for the operator to adjust for an out of calibration temperature sensor
	OA H CAL	0% RH	+/-10% RH	Allows for the operator to adjust for an out of calibration humidity sensor
	RA T CAL	0.0F°	+/-2.5F°	Allows for the operator to adjust for an out of calibration temperature sensor
	RA H CAL	0% RH	+/-10% RH	Allows for the operator to adjust for an out of calibration humidity sensor
	DA T CAL	0.0 F°	+/-2.5F°	Allows for the operator to adjust for an out of calibration temperature sensor
	2SP FAN DELAY	5 Minutes	0 to 20 minutes in 1 minute increments.	When in economizing mode this is the delay for the high speed fan to try to satisfy the call for second stage cooling before the first stage mechanical cooling is enabled.
CHECKOUT[f]	DAMPER VMIN-HS	n/a	n/a	Positions damper to VMIN position
	DAMPER VMAX-HS (LS)	n/a	n/a	Positions damper to VMAX position. With 2-speed fan units the damper will position to VMAX low speed fan.
	DAMPER OPEN	n/a	n/a	Positions damper to the full open position.
	DAMPER CLOSE	n/a	n/a	Positions damper to the fully closed position
	CONNECT Y1-O	n/a	n/a	Closes the Y1-O relay (Y1-O)
	CONNECT Y2-O	n/a	n/a	Closes the Y2-O relay (Y2-O)
	CONNECT EX 1	n/a	n/a	Closes the power exhaust fan 1 relay (EXH1)
	CONNECT AUX1 O	n/a	n/a	Energizes the AUX1 O output. The AUX1 O is replaced by: • ERV • EXH2 • SYS Based of AUX1 O switch settings or is not available if AUX1 O is set to NONE

Table 5. Menu Structure[a]. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment[b]	Notes
ALARMS(_)	MA T SENS ERR	n/a	n/a	Alarms display only when they are active. The menu title "ALARMS (_)" includes the number of active alarms in parenthesis ().
	CO2 SENS ERR	n/a	n/a	
	OA T SENS ERR	n/a	n/a	
	DA ENTHL ERR	n/a	n/a	
	SYS ALARM	n/a	n/a	When AUX1 O is set to SYS and there is any alarm (e.g., failed sensors, etc.), the AUX1 O terminal has 24 Vac out.
	ACT UNDER V	n/a	n/a	Voltage received by Actuator is above expected range
	ACT OVER V	n/a	n/a	Voltage received by Actuator is below expected range
	ACT STALLED	n/a	n/a	Actuator stopped before achieving commanded position
	NOTE: The alarms listed are examples. Additional alarms display depending on the parameter settings and configuration.			

[a] Table 5 illustrates the complete hierarchy. Your menu parameters may be different depending on your configuration. For example if you do not have a DCV (CO_2) sensor, then none of the DCV parameters appear.

[b] When values are displayed, pressing and holding the ▲ or ▼ button causes the display to automatically increment.

[c] n/a = not applicable

[d] ERV Operation: When in Cooling mode AND the conditions are NOT OK for economizing - the ERV terminal will be energized. In the Heating mode the ERV terminal will be energized when the OA is below the ERV OAT setpoint in the setpoint menu.

[e] When used with Honeywell communicating actuator the damper out is reported in XX.X% open versus XX.X Vd.

[f] After 10 minutes without a command or mode change, the controller will change to normal operation.

SETUP AND CONFIGURATION

Before being placed into service, the JADE™ Economizer module must be setup and configured for the installed system.

IMPORTANT

During setup, the Economizer module is live at all times.

The setup process uses a hierarchical menu structure that is easy to use. You press the ▲ and ▼ arrow buttons to move forward and backward through the menus and press the ↵ button to select and confirm setup item changes.

Time-out and Screensaver

When no buttons have been pressed for 10 minutes, the LCD displays a screen saver, which cycles through the Status items. Each Status items displays in turn and cycles to the next item after 5 seconds.

Enthalpy Settings

When the OA temperature, enthalpy and dew point are below the respective setpoints, the Outdoor Air can be used for economizing. Fig. 15 shows the new single enthalpy boundaries in the W7220. There are 5 boundaries (setpoints ES1 through ES5), which are defined by dry bulb temperature, enthalpy and dew point.

Refer to Table 6 for the ENTH CURVE setpoint values.

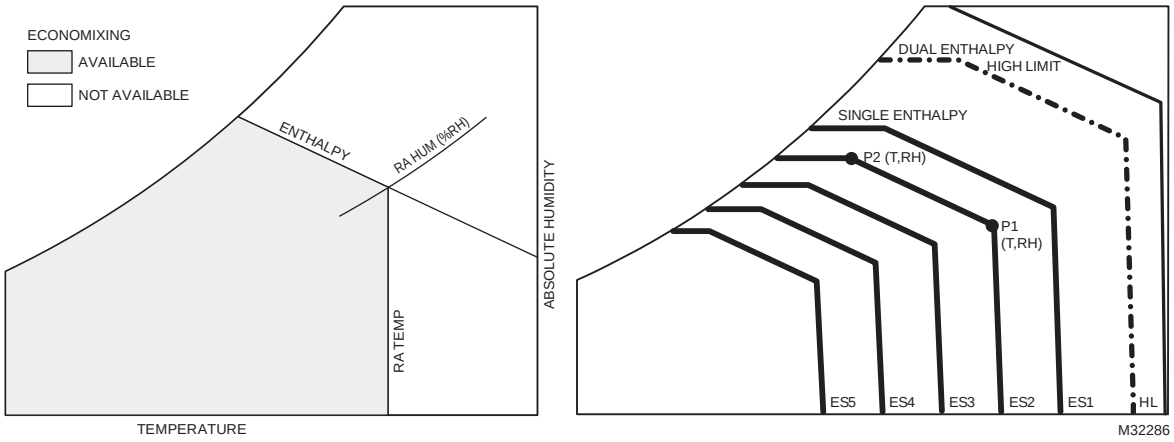


Fig. 15. Single Enthalpy curve and boundaries.

Table 6. Single Enthalpy and Dual Enthalpy High Limit Curves.

Enthalpy Curve	Temp. Dry-Bulb (°F)	Temp. Dewpoint (°F)	Enthalpy (btu/lb/da)	Point P1		Point P2	
				Temp. °F	Humidity %RH	Temp. °F	Humidity %RH
ES1	80.0	60.0	28.0	80.0	36.8	66.3	80.1
ES2	75.0	57.0	26.0	75.0	39.6	63.3	80.0
ES3	70.0	54.0	24.0	70.0	42.3	59.7	81.4
ES4	65.0	51.0	22.0	65.0	44.8	55.7	84.2
ES5	60.0	48.0	20.0	60.0	46.9	51.3	88.5
HL	86.0	66.0	32.4	86.0	38.9	72.4	80.3

To use enthalpy the W7220 must have a C7400S Sylkbus sensor for OA. The W7220 calculates the enthalpy and dew point using the OA temperature and humidity input from the OA sensor. When the OA temperature, OA humidity and OA dew point are all below the selected boundary, the economizer sets the economizing mode to YES, economizing is available.

When all of the OA conditions are above the selected boundary, the conditions are not good to economize and the mode is set to NO.

Fig. 15 shows the 5 current boundaries. There is also a high limit boundary for differential enthalpy. The high limit boundary is ES1 when there are no stages of mechanical cooling energized and HL when a compressor stage is energized.

Table 6 provides the values for each boundary limit.

Economizer Setup and Configuration

To setup and configure the Economizer module, use the System Setup menu, the Advanced Setup menu (if necessary), and the Setpoints menu. Refer to Table 7.

Setup and configure the module in the following order:

1. Enter the System Setup parameters.
2. If needed, enter the Advanced Setup parameters.
3. Enter the Setpoint settings.

To make a parameter or setpoint change:

1. Use the ▲ and ▼ buttons to move to the desired menu.
2. Press the ↵ button (Enter) to display to the first parameter.
3. Use the ▲ and ▼ buttons to move to the desired parameter.
4. Press the ↵ button (Enter) to select the parameter and display its value.
5. Use the ▲ and ▼ buttons to change or increase/ decrease the parameter value.
6. Press the ↵ button (Enter) to store the new value for the parameter.
7. CHANGE STORED displays.
8. Press the ↵ button (Enter) to return to the current menu parameter.
9. Repeat steps 4 through 8 for each parameter you want to change.
10. When finished, press the ⓘ button (MenuUp/Exit) to return to the previous menu.
11. Repeat the above steps for each of the three menus - System Setup, Advanced Setup, and Setpoints.

Table 7. Setup and Setpoint Menus.

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
SYSTEM SETUP	INSTALL	01/01/11		Display order = MM/DD/YY Setting order = DD, MM, then YY.
	UNITS DEG	°F	°F or °C	Sets economizer controller in degrees Fahrenheit or Celsius.
	EQUIPMENT	CONV	CONV Heat Pump	CONV = conventional HP O/B = Enables Heat Pump mode. Use AUX2 I for Heat Pump input from thermostat or controller.
	AUX2 I	n/a	SD/W or HP(O)/HP(B)	In CONV mode: SD = Enables configuration of shutdown (default); W = Informs controller that system is in heating mode. In HP O/B mode: HP(O) = energize heat pump on Cool (default); HP(B) = energize heat pump on Heat.
	FAN TYPE	1 speed	1 speed/ 2 speed	Sets economizer controller for operation of 1 speed or 2 speed supply fan
	FAN CFM	5000cfm	100 to 15000 cfm; increment by 100	This is the capacity of the RTU. The value is found on the label from the RTU manufacturer.
	AUX1 OUT	NONE	NONE ERV EXH2 SYS	• NONE = not configured (output is not used) • ERV= Energy Recovery Ventilator[a] • EXH2 = second damper position relay closure for second exhaust fan. • SYS = use output as an alarm signal
	OCC	INPUT	INPUT or ALWAYS	When using a setback thermostat with occupancy out (24 Vac), the 24 Vac is input “INPUT” to the OCC terminal. If no occupancy output from the thermostat then change program to “ALWAYS” OR ad a jumper from terminal R to OCC terminal.
	FACTORY DEFAULT	NO	NO or YES	Resets all set points to factory defaults when set to YES. LCD will briefly flash YES and change to NO but all parameters will change to factory default values.

Table 7. Setup and Setpoint Menus. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
ADVANCED SETUP	MA LO SET	45ºF	35 to 55 ºF; increment by 1º	Temp to activate Freeze Protection (close damper and alarm if temp falls below setup value)
	FREEZE POS	CLO	CLO MIN	Damper position when freeze protection is active (closed or MIN POS).
	CO2 ZERO	0ppm	0 to 500 ppm; increment by 10	CO2 ppm level to match CO2 sensor start level.
	CO2 SPAN	2000ppm	1000 to 3000 ppm; increment by 50	CO2 ppm span to match CO2 sensor.
	STG3 DLY	2.0h	0 to 4.0 hours or OFF; 0,5 min, 15 min. then 15 min. increments up to 4 hours	Delay after stage 2 for cool has been active. Turns on 2nd stage of cooling when economizer is 1st stage and mechanical cooling is 2nd stage. Allows three stages of cooling, 1 economizer and 2 mechanical. OFF = no Stage 3 cooling.
	SD DMPR POS	CLO	CLO OPN	Indicates shutdown signal from space thermostat or unitary controller. When controller receives 24 Vac input on the SD terminal in conventional mode, the OA damper will open if programmed for OPN and OA damper will close if programmed for CLO. All other controls, e.g., fans, etc. will shut off.
	DCVCAL ENA	MAN	MAN (manual) AUTO	Turns on the DCV automatic control of the dampers. Resets ventilation based on the RA, OA and MA sensor conditions. See Product Data sheet 63-2700 for details. Requires all 3 RA, OA and MA sensors. This operation is not operable when 2-speed fan mode enabled.
	MAT T CAL	0.0F	+/-2.5F	Allows for the operator to adjust for an out of calibration temperature sensor
	OA T CAL	0.0F	+/-2.5F	Allows for the operator to adjust for an out of calibration temperature sensor
	OA H CAL	0% RH	+/-10% RH	Allows for the operator to adjust for an out of calibration humidity sensor
	RA T CAL	0.0F	+/-2.5F	Allows for the operator to adjust for an out of calibration temperature sensor
	RA H CAL	0% RH	+/-10%	Allows for the operator to adjust for an out of calibration humidity sensor
	DA T CAL	0.0F	+/-2.5F	Allows for the operator to adjust for an out of calibration temperature sensor
	2SP FAN DELAY	5 Minutes	0 to 20 minutes in 1 minute increments.	When in economizing mode this is the delay for the high speed fan to try to satisfy the call for second stage cooling before the first stage mechanical cooling is enabled.

Table 7. Setup and Setpoint Menus. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
SETPOINTS	MAT SET	53ºF	38 to 65 ºF; increment by 1	Setpoint determines where the economizer will modulate the OA damper to maintain the mixed air temperature.
	LOW T LOCK	32ºF	-45 to 80 ºF; increment by 1	Setpoint determines outdoor temperature when the mechanical cooling cannot be turned on. Commonly referred to as the Compressor lockout.
	DRYBLB SET	63ºF	48 to 80 ºF; increment by 1	Setpoint determines where the economizer will assume outdoor air temperature is good for free cooling; e.g.; at 63 ºF unit will economizer at 62 ºF and below and not economize at 64 ºF and above. There is a a 2 ºF deadband.
	ENTH CURVE	ES3	ES1, ES2, ES3, ES4, or ES5	Enthalpy boundary “curves” for economizing using single enthalpy. See “Enthalpy Settings” on page 17 and Product Data sheet form 63-2700 for description of enthalpy curves.
	DCV SET	1100ppm	500 to 2000 ppm increment	Displays ONLY if a CO2 sensor is connected. lation of dampers will al OA to the setpoint.
	MIN POS	2.8 V	2 to 10 Vdc	Displays ONLY if a CO2 sensor is NOT connected.
	VENTMAX	2.8 V	2 to 10 Vdc or 100 to 9990 cfm increment by 10	Displays only if a CO2 sensor is connected. Used for Vbz (ventilation max cfm) setpoint. Displays 2 to 10 V if <3 sensors (RA,OA and MA). With 2-speed fan units VENTMAX L (low speed fan) and VENTMAX H (high speed fan) settings are required. Default for VMAX L is 3.2V nd VENTMAX H is 2.8 V
	VENTMIN	2.25 V	2 to 10 Vdc or 100 to 9990 cfm increment by 10	Displays only if CO2 sensor is connected. Used for Va (ventilation min cfm) setpoint. Displays 2 to 10 V if <3 sensors (RA,OA and MA). Va is only set if DCV is used. This is the ventilation for less than maximum occupancy of the space. With 2-speed fan units VENTMIN L (low speed fan) and VENTMIN H (high speed fan) settings are required. Default for VENTMIN L is 2.5V nd VENTMIN H is 2.25V
	ERV OAT SP	32ºF	0 to 50 ºF; increment by 1	Only when AUX1 O = ERV
	EXH1 SET	50%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 1 is powered by the economizer. With 2-speed fan units Exh1 L (low speed fan) and Exh1 H (high speed fan) settings are required. Default for Exh1 L is 65% nd Exh1 H is 50%
	EXH2 SET	75%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 2 is powered by the economizer. Only used when AUX1 O is set to EHX2. With 2-speed fan units Exh2 L (low speed fan) and Exh2 H (high speed fan) settings are required. Default for Exh2 L is 80% nd Exh2 H is 75%

With 2-speed fan units MIN POS L (low speed fan) and MIN POS H (high speed fan) settings are required. Default for MIN POS L is 3.2V and MIN POS H is 2.8V

[a] ERV Operation: When in Cooling mode AND the conditions are NOT OK for economizing - the ERV terminal will be energized. In the Heating mode the ERV terminal will be energized when the OA is below the ERV OAT setpoint in the setpoint menu.

CHECKOUT

Inspect all wiring connections at the Economizer module's terminals, and verify compliance with the installation wiring diagrams.

For checkout, review the Status of each configured parameter and perform the Checkout tests.

NOTE: See "Interface Overview" on page 12. for information about menu navigation and use of the keypad.

⚠ WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Disconnect power supply before beginning wiring or making wiring connections, to prevent electrical shock or equipment damage.
If any wiring changes are required, first be sure to remove power from the Economizer module before starting work. Pay particular attention to verifying the power connection (24 Vac).

Power Up

After the module is mounted and wired, apply power.

Power Up Delay

Upon power up (or after a power outage or brownout), the W7220 controller module begins a 5 minute power up delay before enabling mechanical cooling.

Initial Menu Display

On initial start up, **Honeywell** displays on the first line and **Economizer W7220** on the second line. After a brief pause, the revision of the software appears on the first line and the second line will be blank.

Power Loss (Outage or Brownout)

All setpoints and advanced settings are restored[a] after any power loss or interruption.

NOTE: If power goes below 18 Vac, the W7220 controller module assumes a power loss and the 5 minute power up delay will become functional when power returns above 18 Vac.

Status

Use the Status menu (see Table 8) to check the parameter values for the various devices and sensors configured.

NOTE: See "Interface Overview" on page 12. for information about menu navigation and use of the keypad.

[a] All settings are stored in non-volatile flash memory.

Table 8. Status Menu.

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
STATUS	ECON AVAIL	NO	YES/NO	YES = economizing available; the system can use Outdoor Air for free cooling when required.
	ECONOMIZING	NO	YES/NO	YES = Outdoor Air being used for 1st stage cooling.
	OCCUPIED	NO	YES/NO	YES = OCC signal received from space thermostat or unitary controller. YES = 24 Vac on terminal OCC No = 0 Vac on terminal OCC.
	HEAT PUMP	n/a[a]	COOL HEAT	Displays COOL or HEAT when system is set to heat pump (non-conventional)
	COOL Y1-IN	OFF	ON/OFF	Y1-I signal from space thermostat or unitary controller for cooling stage 1. ON = 24 Vac on term Y1-I OFF = 0 Vac on term Y1-I
	COOL Y1-OUT	OFF	ON/OFF	Cool Stage 1 Relay Output to stage 1 mechanical cooling (Y1-OUT terminal).
	COOL Y2-IN	OFF	ON/OFF	Y2-I signal from space thermostat or unitary controller for second stage cooling. ON = 24 Vac on term Y2-I OFF = 0 Vac on term Y2-I
	COOL Y2-OUT	OFF	ON/OFF	Cool Stage 2 Relay Output to mechanical cooling (Y2-OUT terminal).
	MA TEMP	_ _._ °F	0 to 140 °F	Displays value of measured mixed air from MAT sensor. Displays --.- if not connected, short, or out- of-range.

Table 8. Status Menu. (Continued)

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
STATUS (continued)	DA TEMP	_ _._ °F	0 to 140 °F	Displays when Discharge Air Sylk Bus sensor is connected and displays measured discharge air temperature. Displays --.-°F if sensor sends invalid value, if not connected, short or out-of-range.
	OA TEMP	_ _._ °F	-40 to 140 °F	Displays measured value of outdoor air temperature. Displays --°F if sensor sends invalid value, if not connected, short or out-of-range.
	OA HUM	_ _ %	0 to 100%	Displays measured value of outdoor humidity from QA Sylkbus sensor. Displays --% if not connected, short, or out-of-range.
	RA TEMP	_ _._ °F	0 to 140 °F	Displays measured value of return air temperature from RAT sensor. Displays --°F if sensor sends invalid value, if not connected, short or out-of-range.
	RA HUM	_ _ %	0 to 100%	Displays measured value of return air humidity from RA Sylkbus sensor. Displays --% if sensor sends invalid value, if not connected, short or out-of-range.
	IN CO2	_ _ _ ppm	0 to 2000 ppm	Displays value of measured CO2 from CO2 sensor. Invalid if not connected, short or out-of-range.
	DCV STATUS	n/a	ON/OFF	Displays ON if above setpoint and OFF if below setpoint, and ONLY if a CO2 sensor is connected.
	DAMPER OUT	2.0V	2.0 to 10.0 V	Displays voltage output to the damper actuator.*1
	ACT POS.	n/a	0-100%	Command actuator position from controller
	ACT COUNT	n/a	0-100%	Actual reported actuator position
	ACTUATOR	n/a	OK or ALARM	See alarm section for actuator alarms
	EXH1 OUT	OFF	ON/OFF	Output of EXH1 terminal. ON = relay closed; OFF = relay open.
	EXH2 OUT	OFF	ON/OFF	Output of AUX1 O terminal; displays only if AUX1 O = EXH2
	ERV	OFF	ON/OFF	Output of AUX1 O terminal; displays only if AUX1 O = ERV
	MECH COOL ON	0	0, 1, or 2	Displays stage of mechanical cooling that is active.
	FAN SPEED	n/a	LOW or HIGH	Displays speed of fan on a 2-speed fan unit
	W (HEAT IN)	n/a	ON/OFF	Displays status of heat on a 2-speed fan unit.

[a] n/a = not applicable

*1 When used with Honeywell communicating actuator the damper out is in XX.X% versus XX.X Vd.

Checkout Tests

Use the Checkout menu (Table 9) to test the damper operation and any configured outputs. Only items that are configured are shown in the Checkout menu.

NOTE: See "Interface Overview" on page 12. for information about menu navigation and use of the keypad.

To perform a Checkout test:

1. Scroll to the desired test in the Checkout menu using the ▲ and ▼ buttons.
2. Press the ↵ button to select the item.
3. RUN? appears.
4. Press the ↵ button to start the test.
5. The unit pauses and then displays IN PROGRESS.
6. When the test is complete, DONE appears.
7. When all parameters have been tested, press the button (Menu up) to end the test (e.g. turn off the relay).

The checkout tests can all be performed at the time of installation or any time during the operation of the system as a test that the system is operable.

Table 9. Checkout Menu.

Checkout Item	Checkout Test
DAMPER VMIN-HS	Positions damper to VMIN position.
DAMPER VMAX-HS (LS)	Positions damper to VMAX position. With 2-speed fan units the damper will position to VMAX low speed fan.
DAMPER OPEN	Positions damper to the full open position. Exhaust fan contacts enable during the DAMPER OPEN test. Make sure you pause in this mode to allow for exhaust contacts to energize due to the delay in the system.
DAMPER CLOSE	Positions damper to the fully closed position.
CONNECT Y1-O	Closes the Y1-O relay (Y1-O). See **CAUTION** on this page
CONNECT Y2-O	Closes the Y2-O relay (Y2-O). See **CAUTION** on this page

Table 9. Checkout Menu. (Continued)

Checkout Item	Checkout Test
CONNECT AUX1 O	Energizes the AUX1 O output. If AUX1 O setting is: • NONE – no action taken • ERV – 24 Vac out. Turns on or signals an ERV that the conditions are not good for economizing but are good for ERV operation.[a] • SYS – 24 Vac out. Issues a system alarm.
CONNECT EXH1	Closes the power exhaust fan 1 relay (EXH1)

[a] ERV Operation: When in Cooling mode AND the conditions are NOT OK for economizing - the ERV terminal will be energized. In the Heating mode the ERV terminal will be energized when the OA is below the ERV OAT setpoint in the setpoint menu.

⚠ CAUTION

Equipment damage may result.

Be sure to allow enough time for compressor startup and shutdown between checkout tests so that you do not short-cycle the compressors.

TROUBLESHOOTING

Power Loss (Outage or Brownout)

All setpoints and advanced settings are restored[a] after any power loss or interruption.

NOTE: If power goes below 18 Vac, the W7220 controller module assumes a power loss and the 5 minute power up delay will become functional when power returns above 18 Vac.

Alarms

The Economizer module provides alarm messages that display on the 2-line LCD.

NOTE: Upon power up, the module waits several seconds before checking for alarms. This allows time for all the configured devices (e.g. sensors, actuator) to become operational.

[a] All settings are stored in non-volatile flash memory.

If one or more alarms are present and there has been no keypad activity for at least 5 minutes, the Alarms menu displays and cycles through the active alarms.

You can also navigate to the Alarms menu at any time.

Table 10. Alarms Menu.

Menu	Alarm
ALARMS(_)	MA T SENS ERR
	CO2 SENS ERR
	OA T SENS ERR
	DA ENTHL ERR
	SYS ALARM[a]
	ACT UNDER VOLTAGE
	ACT OVER VOLTAGE
	ACT STALLED
NOTES: 1. The Alarms menu displays only when alarm(s) are active and includes the number of active alarms in parenthesis (). 2. The alarms listed are a few examples. Additional alarms display depending on the parameter settings and configuration.	

[a] When AUX1 O is set to SYS and there is any alarm (e.g., failed sensors, etc.), the AUX1 O terminal has 24 Vac out and the LCD displays the SYS ALARM.

Clearing Alarms

Once the alarm has been identified and the cause has been removed (e.g. replaced faulty sensor), the alarm can be cleared from the display.

To clear an alarm, perform the following:

1. Navigate to the desired alarm.
2. Press the ↵ button.
3. ERASE? displays.
4. Press the ↵ button.
5. ALARM ERASED displays.
6. Press the ⏫ button (MenuUp/Exit) to complete the action and return to the previous menu.

NOTE: If an the alarm still exists after you clear it, it re-displays within 5 seconds.

Automation and Control Solutions
Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

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Appendix J: Site User Guide

To assist users at the site, a Site User Guide was compiled and site training held for site operations staff, facilities staff, and the City energy manager. This Site User Guide is included in the following Appendix.

User acceptance of the control system is important for proper operation and maintaining setpoints in a reasonable range.
The following user guide was developed for the test site, and delivered with a training for the site staff and the City facilities staff.
This site was unique in that three different control systems were tested, so the user guide is longer than would typically be required.
It is important that a set of comprehensive documentation with items relevant to the site be prepared and delivered along with a user training.
The following guide can serve as a sample of the type of customized documentation to expect in addition to standard manufacturer operating instructions.

Amazon Community Center HVAC controls supplemental operating information

Bldg A Gym HP3 6.5 Tons Cooling Capacity Honeywell T7351/JADE

The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**8:30**	**8:30**	**8:30**	**8:30**	**8:30**	**8:30**	**8:30**
Stop	**21:30**	**21:30**	**21:30**	**21:30**	**21:30**	**21:30**	**21:30**

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

For operation during non-scheduled hours: Open the thermostat door and press the "Temporary Occupied" button. Standard occupied heating and cooling settings will be activated for two (2) hours, then standard settings will be restored.

City authorized maintained temperatures are between 69°F and 76°F when occupied.

Bldg C Game Room HP7 3.5 Tons Cooling Capacity Honeywell T7351/JADE

The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**15:30**	**15:30**	**15:30**	**15:30**	**15:30**	**15:30**	**15:30**
Stop	**18:00**	**18:00**	**18:00**	**18:00**	**18:00**	**18:00**	**18:00**

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

For operation during non-scheduled hours: Open the thermostat door and press the "Temporary Occupied" button. Standard occupied heating and cooling settings will be activated for two (2) hours, then standard settings will be restored.

City authorized maintained temperatures are between 69°F and 76°F when occupied.

Bldg B Preschool HP4 2.5 Tons Cooling Capacity Innotech

The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**7:30**	**7:30**	**7:30**	**7:30**	**7:30**	**Unocp**	**Unocp**
Stop	**18:00**	**18:00**	**18:00**	**18:00**	**18:00**		

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

For operation during non-scheduled hours: Press the "Walking Man" button. Then set the desired temperature with the up or down arrows. The occupied override will be in effect for 2 hours, then standard settings will be restored.

City authorized maintained temperatures are between 69°F and 76°F when occupied.

Bldg B Clay Crafts HP5 4.0 Tons Cooling Capacity Innotech

The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**9:00**	**9:00**	**9:00**	**9:00**	**9:00**	**Unocp**	**13:00**
Stop	**20:00**	**21:00**	**21:00**	**21:00**	**15:30**		**16:00**

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

For operation during non-scheduled hours: Press the "Walking Man" button. Then set the desired temperature with the up or down arrows. The occupied override will be in effect for 2 hours, then standard settings will be restored.

City authorized maintained temperatures are between 69℉ and 76℉ when occupied.

Bldg C Studio B HP6 3.5 Tons Cooling Capacity KMC Controls

The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**15:00**	**9:00**	**15:00**	**15:00**	**15:00**	**8:00**	**10:30**
Stop	**20:00**	**20:00**	**20:00**	**20:00**	**20:00**	**21:00**	**21:00**

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

City authorized maintained temperatures are between 69℉ and 76℉ when occupied.

For operation during non-scheduled hours:

- Press the Left arrow button.
- Press Down to get to the "OCC" line and then
- [Enter] (twice) to edit the mode setting.
- Press Down or Up to get to desired mode (Unoccupied Override = ON)
- [enter] to select.
- Press Left to exit to Home.

The occupied override will be in effect for 2 hours

Bldg C Conference HP8 3.0 Tons Cooling Capacity Alerton VLD
The thermostat is programmed with occupied hours as follows:

RTU Sched	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Start	**8:00**	**8:00**	**8:00**	**8:00**	**8:00**	**U**	**U**
Stop	**21:00**	**21:00**	**21:00**	**21:00**	**21:00**		

During occupied hours, the heating and cooling setpoints will be relaxed a couple of degrees when the room is vacant. When occupancy is detected, standard heating and cooling temperatures will automatically be restored within a few minutes.

Should further temporary adjustment of setpoints be needed **during scheduled hours**: Use the up arrow to increase temperature and the down arrow to decrease temperature. The new setpoint will be in effect for 2 hours, then standard settings will be restored.

City authorized maintained temperatures are between 69°F and 76°F when occupied.

Advanced Settings (Note, due to customization not all standard manual instructions apply):

Making Schedule Adjustments:
Bldg A Gym HP3 6.5 Tons Cooling Capacity Honeywell T7351/JADE

Making Schedule Adjustments: See the Honeywell T7351 User Guide, page 8
Making Setpoint Adjustments: See the Honeywell T7351 User Guide, page 3
Accessing Setup Information & setpoints: See the Honeywell T735 Operating Guide (Appendix I)

Bldg C Game Room HP7 3.5 Tons Cooling Capacity Honeywell T7351/JADE

Making Schedule Adjustments: See the Honeywell T7351 User Guide, page 8Making Setpoint Adjustments: See the Honeywell T7351 User Guide, page 3
Accessing Setup Information & setpoints: See the Honeywell T735 Operating Guide (Appendix I)

SETTINGS

Using Thermostat Keys

The thermostat keys are used to:

- set current time and day,
- program times and setpoints for heating and cooling,
- override the program temperatures,
- display present setting,
- set system and fan operation,
- perform simple configuration.

NOTE: See Fig. 1 for keypad information.

Setting Temperature

Refer to Table 1 for default temperature setpoints. See Programming section for complete instructions on changing these.

Table 1. Default Setpoints.

Control	Occupied	Not Occupied	Standby
Heating	70 °F (21 °C)	55 °F (13 °C)	67 °F (19 °C)
Cooling	75 °F (24 °C)	85 °F (29 °C)	78 °F (26 °C)

Setting System and Fan

System default setting is Auto. The fan default is set so the fan operates continuously during:

— Occupied periods,
— Heating and cooling equipment stages in Not Occupied and recovery periods.

NOTE: Use *System* and *Fan* keys to change settings.

System Settings

— Auto: Thermostat automatically changes between heating and cooling based on sensed indoor temperature.
— Cool: Thermostat controls cooling.
— Off: Heating, cooling, and fan are all off.
— Heat: Thermostat controls heating.
— Em Heat: Auxiliary heat serves as first stage. Compressor stages are locked off.

Fan Settings

— On: Fan operates continuously in occupied and standby periods. Fan cycles with call for heat or cool during not occupied periods.
— Auto: Fan cycles with call for heating or cooling during occupied, standby, and not occupied periods.

NOTE: This is further modified by selection of conventional or electric heat.

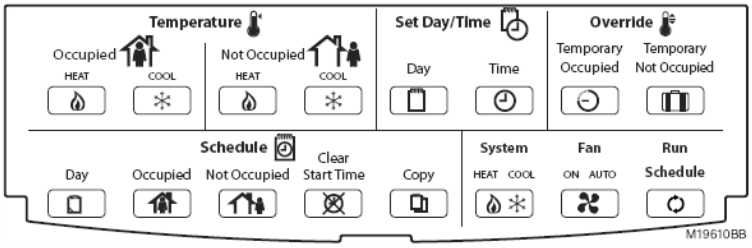


Fig. 1. Thermostat key locations.

When using the keypad to change the day/time:

1. Press *Set Day* until the current day is displayed.

   NOTE: Sun = Sunday, Mon = Monday, Tue = Tuesday, Wed = Wednesday, Thu = Thursday, Fri = Friday, Sat = Saturday.

2. Press *Set Time*.
3. Press up ▲ or down ▼ until the current time is displayed.

NOTE: Tapping *Set Time* changes the time in one hour increments.

4. Press *Run Schedule*.

Setting Schedule Times

Use the keys in the "Schedule" area of the keypad for this procedure.

1. Press *Occupied*.

   NOTE: Anytime a start time is not required, press *Clear Start Time*.

2. Press *Day* until desired day is displayed.
3. Press *Occupied* or *Not Occupied* until the proper period is displayed.
4. Press up ▲ or down ▼ until the desired start time is displayed.
5. Repeat steps 3 and 4 for a given day.
6. Repeat steps 2 through 5 until finished.

Copying a Day

Use the keys in the "Schedule" area of the keypad for this procedure.

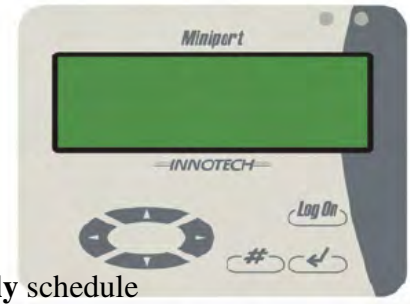
NOTE: The thermostat must be in program mode to use the copy feature. If the thermostat is already in program mode, skip step 1.

1. Press *Occupied*.
2. Press *Day* to select the day to be copied.
3. Press *Copy*.
4. Press *Copy* again.
5. Press *Day* until the day to receive the copy is displayed.
6. Press *Copy*.

   NOTE: DONE displays for two seconds then the program display reappears.

Bldg B Preschool HP4 2.5 Tons Cooling Capacity Innotech
Bldg B Clay Crafts HP5 4.0 Tons Cooling Capacity Innotech

Making Schedule Adjustments:

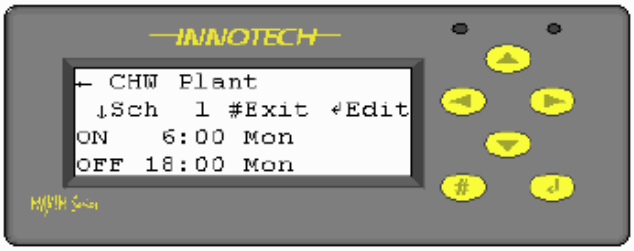


Access unit in locked cabinet in storage room
On miniport:
1. Press [logon] button
2. Press [enter] button (lower right)
3. Use [right/left arrows] to select module, then press [enter]
4. Press [enter] button for menu
5. See Innotech Operating Instructions guide, page 31 and **edit weekly** schedule

2-8-3-5 Clock – Schedule – Weekly – Edit

Selecting the Daily, Weekly or Yearly options allows the operator to ***Add, Edit*** or ***Delete*** an existing schedule times and/or dates. A typical screen display is shown left.

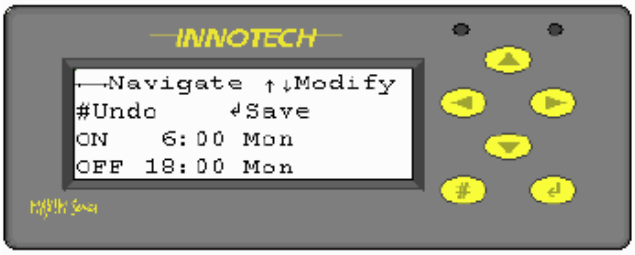
Figure 42 : Weekly Schedule



Select the *Wkly / Edit Wkly* menu option and press ↲ and the Weekly Schedule Edit screen is displayed.

Use the ◄ or ► buttons to select the Schedule to edit.

Figure 43 : Weekly Schedule Edit (1)



Press ↲ again and the ON time begins to flash.

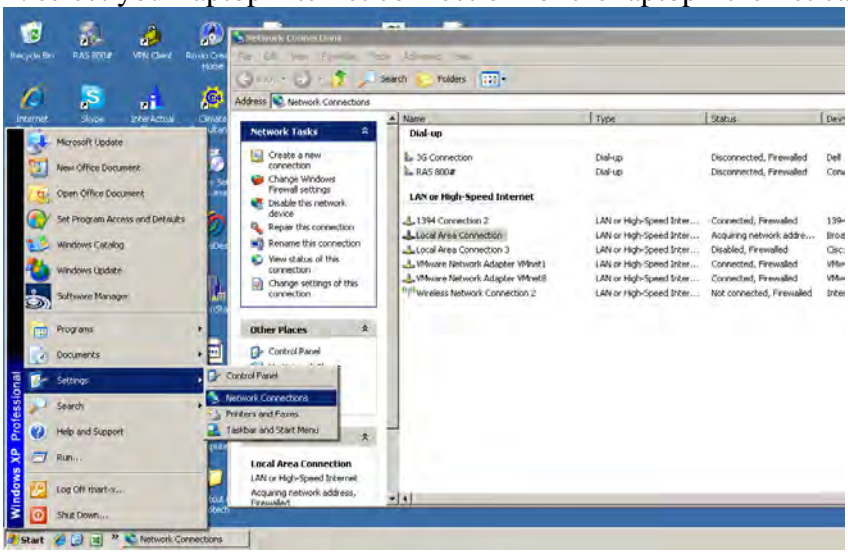
Following the instructions below to Edit an existing switch time in the *Wkly* schedule block.

Figure 44 : Weekly Schedule Edit (2)

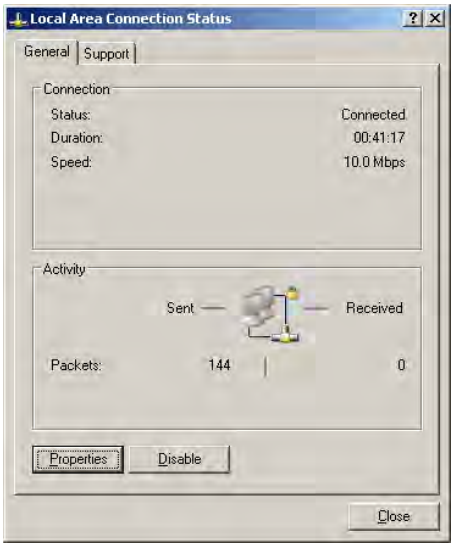
1. Press ↲ again and the ON time begins to flash.
2. Use ▲ or ▼ buttons to change the time.
3. Use ◄ or ► buttons to select the *ON* or *OFF* times and the respective *hours*, *minutes* or *Day* to be changed.
4. At each point the selected value will flash.
5. Once the correct time has been set up, press ↲ to save or # to abort the changes.

Making Innotech Setpoint Adjustments & Accessing Setup Information:
Download and install software from:
http://www.innotech.com.au/DownloadFiles/Software/maxim_v560_rel1.exe
Connect to Innotech modules via software per below:

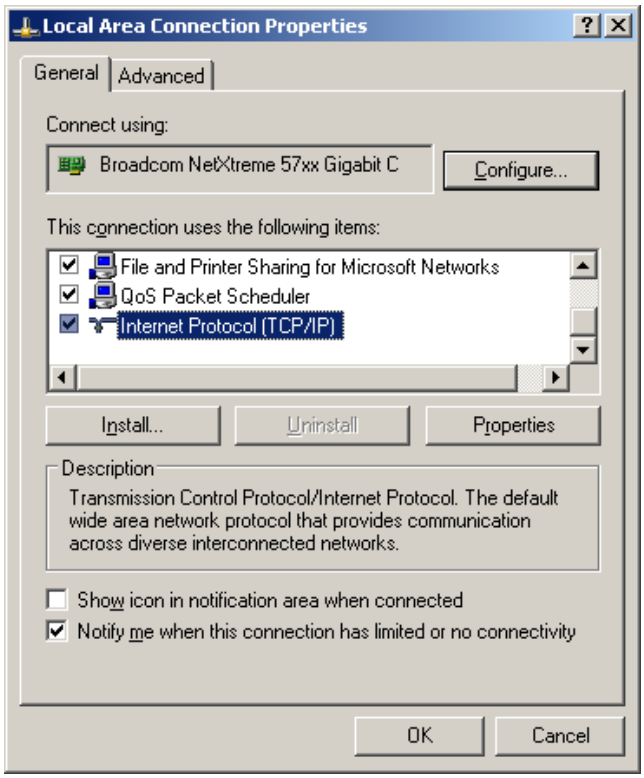
1. select your laptop internet connection for the laptop Ethernet cable port: (XP shown)



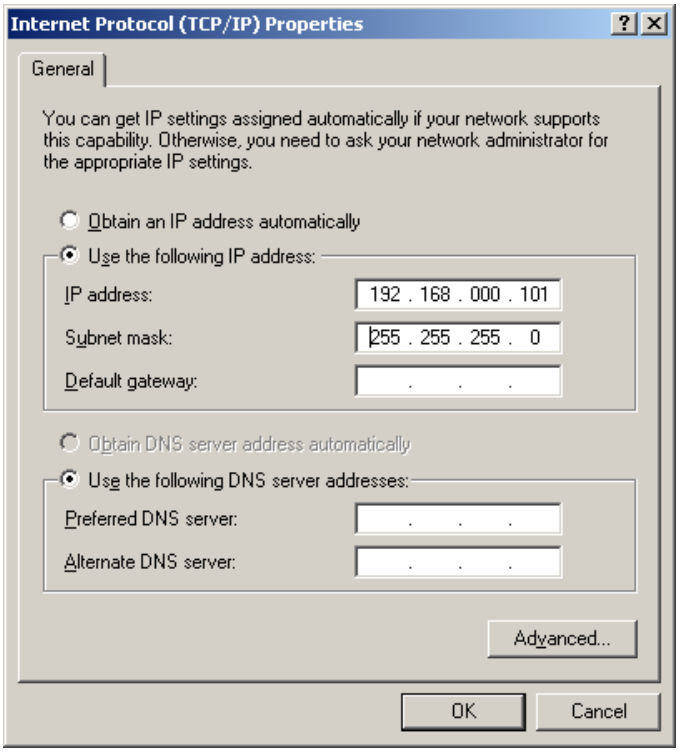
2. Double click that connection above
Hit properties below



3. select TCP/IP and hit properties button



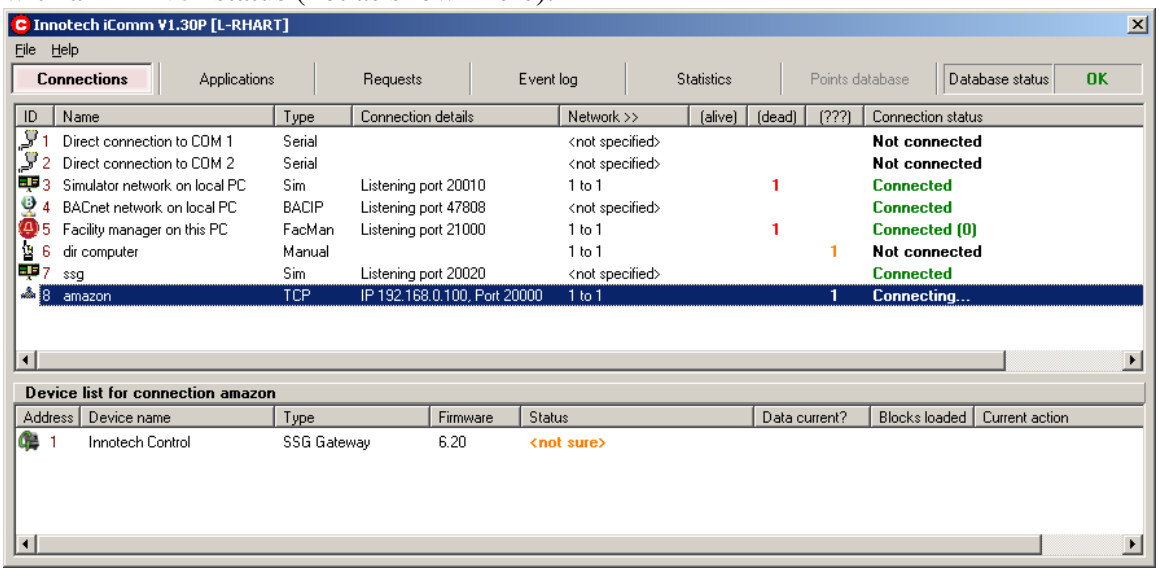
4. Select “use the following IP address” and enter address matching gateway + 1



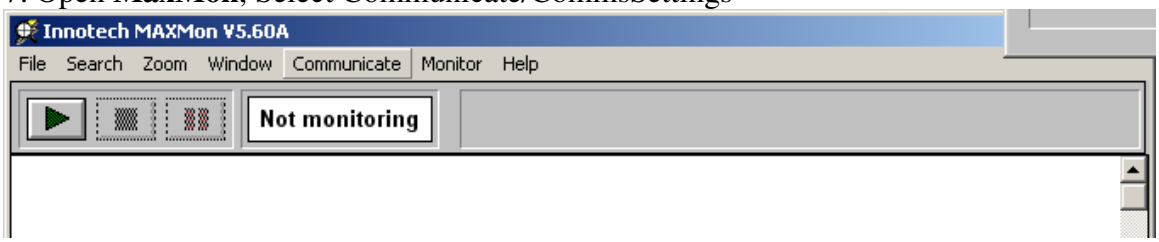
Click OK on each open dialog box

5. Connect the laptop Ethernet port to the gateway Ethernet port with a crossover type cable (typically yellow – but that does not guarantee it is crossover type)

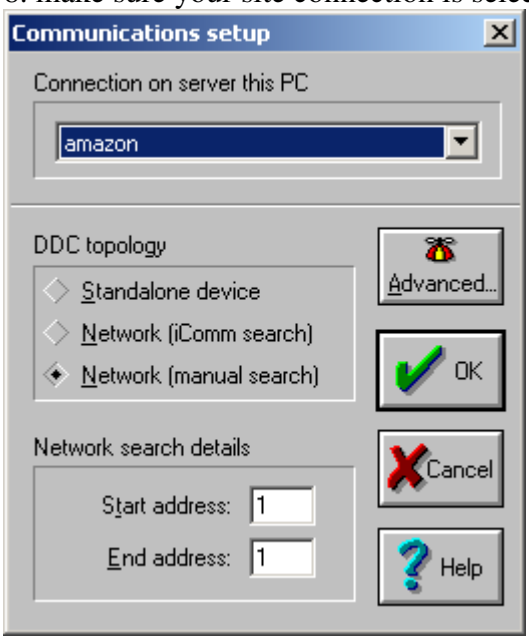
6. Open Innotech **iComm** and select “Amazon” connection or right-click to create a new TCP/IP connection. If successful, all the modules at the site will appear in the lower box with an “Alive” status (not as shown here).



7. Open **MaxMon**, Select Communicate/CommsSettings



8. make sure your site connection is selected; hit OK



9. Hit the "Play" button in **MaxMon** and select the unit you want to monitor.

You will be able to put monitoring points on or change setpoints as needed in MaxMon

Bldg C Studio B HP6 3.5 Tons Cooling Capacity KMC Controls

Making Schedule Adjustments: See the KMC Operation Guide, page 14 (select "individual days")
Making Setpoint Adjustments: See the KMC Operation Guide, page 15

KMC:

Schedules

```
SCHEDULE
WEEKDAYS [MON-FRI]
WEEKEND [SAT-SUN]
ENTIRE WEEK [MON-SUN]
INDIVIDUAL DAYS
HOLIDAYS
```

To select the desired schedule, press:

1. *Up/Down* to move among entries.
2. *Enter* to select.
3. *Left* to go back one page.

```
WEEKDAYS
1: 7:30:00 AM ON
2: 5:15:00 PM OFF
3:
4:
5:
6:
[→] DELETES ENTRY
```

To enter weekly schedules for occupied (ON) and unoccupied (OFF) times, press:

1. *Right/Left* to move among days and *Enter* to select.
2. *Up/Down* to move among entries and *Enter* to select and edit.
3. *Right/Left* to move among value fields.
4. *Up/Down* to increment/decrement value.
5. *Enter* to exit value editing.
6. *Left* to move back to days or back one page.

```
HOLIDAYS
HOL1: JAN 1 2009
HOL2: MAR 21 2009
HOL3: MAY 26 2009
HOL4: JULY 4 2009
HOL5: SEPT 1 2009
HOL6: NOV 27 2009
HOL7: NOV 28 2009
```

The Holiday entries will override the normal occupied weekly schedule entries and keep those days' settings at their setback values. Setback values are entered in the Setpoints section of the Main Menu. (See also the maximum and minimum setpoint values in the Limits section of the Advanced Menu.)

To enter upcoming holidays, press:

1. *Up/Down* to move among entries.
2. *Enter* to select.
3. *Right/Left* to move among value fields.
4. *Up/Down* to increment/decrement value.

Bldg C Conference HP8 3.0 Tons Cooling Capacity Alerton VLD

Making Schedule Adjustments: See the Alerton Installation and Operations guide (Appendix H), page 29
Making Setpoint Adjustments: See the Alerton Installation and Operations guide (Appendix H), page 21
Accessing Setup Information & setpoints:
To set field service codes:
1. Press SYSTEM.
2. Press and hold the center bottom key (blank) for about five seconds.
The field service screen appears.
4. Press the left up or down arrows until the desired code appears.
Field service codes appear in the order shown in the Table below. After fixed codes are exhausted, custom codes (if enabled) display in the order entered in DDC.
5. Press the right up or down arrows to adjust the value associated with the code.
6. Press the left up or down arrows to accept the change and scroll to a different code.
7. Press DONE to exit Field Service mode.

Service codes are as follows:

Code	DDC Point	Decription
Standard Codes		
SP	AV-90	**Occupied SP**
LO	AV-92	**SP Low Limit**
HI	AV-91	**SP High Limit**
AL	AV-97	**Afterhours Limit**
HS	AV-100	**Current Htg SP**
CS	AV-99	**Current Clg SP**
HO	AV-94	**Htg SP Offset**
CO	AV-93	**Clg SP Offset**
UH	AV-96	**Unocc. Htg SP**
UC	AV-95	**Unocc Clg SP**
Custom Codes		
EP	AV-10	**Economizer Position**
PP	AV-60	**Kp**
ii	AV-61	**Ki**
AL	AV-77	**Aux. htg Lockout Temp**
bo	AV-78	**Standby Mode SP Offset**
Cd	AV-40	**CoolSPdr (77°)**
CP	AV-41	**CoolSPp (70°)**
oP	AV-66	**OAareaPos (2%)**
oF	AV-67	**OAfullPos (5%)**
on	AV-68	**OAmaxPos (40%)**
AP	AV-88	**AQset (1000ppm)**
cL	AV-81	**CoolLock**
bu	BV-0	**Bad Space Sensor**
Ed	AV-58	**EconDATsp**
dL	AV-59	**DAT Low Limit**

hP	AV-86	**HeatSPmax (72F)- override temp**
cr	AV-87	**CoolSPmin (73F)**
dr	AV-89	**Damper Test**
C2	AV-28	**CO2 Level**