Quest Controls
Smart Control Solutions for Buildings

Model 600
User's Manual

Rev 1.0 01/11/24

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CRITICAL APPLICATIONS DISCLAIMER

QUEST PRODUCTS ARE NOT INTENDED OR AUTHORIZED FOR USE IN ANY APPLICATION THAT REQUIRES FAIL-SAFE OPERATION, OR ANY SYSTEM THAT IS RESPONSIBLE FOR PROVIDING DETECTION, MONITORING OR CONTROL OF CRITICAL SAFETY, LIFESAVING OR LIFE-SUPPORT CONDITIONS, FUNCTIONS OR OPERATIONS (INCLUDING BUT NOT LIMITED TO FIRE DETECTION, ALARMING, OR SUPPRESSION), OR ANY APPLICATION WHEREIN A FAILURE OR MALFUNCTION OF THE PRODUCT MAY LEAD TO SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE, PERSONAL INJURY OR DEATH.

Revision History

Date	Rev #	Modifications	By:
05/12/23	1.0	Initial release of manual	K. Nickel

Specifications are subject to change without notice.

1 Overview

The Quest Controls Model 600 is designed to control two HVAC systems for lead/lag operation. The system supports heat pumps, single stage and two stage mechanical cooling systems that use a standard 24VAC control interface. The Model 600 will control HVAC units with built in economizers using control using Quest's patented Economizer Control Algorithm. The system is an easy-to-use lead/lag controller for small to medium-sized mission-critical facilities such as telecommunications, cable/broadband, and Utility facilities.

The Quest Controls Model 600 provides functionality and configurability to accommodate most conventional HVAC & heat pump applications. The application-specific approach ensures that commissioning is straightforward and hassle-free. The Model 600 contains internal programming logic to operate independently and can be configured to lock out local access to ensure programming integrity and ongoing correct control. The Model 600 remotely communicates through Modbus RTU to Quest's ESB2, MP2 and MP3 systems or any Modbus polling agent.

1.1 Features and Benefits

- Controls two HVAC systems for Lead/Lag or Lead/Standby operation.
- Stand-alone or network operation to control HVAC systems.
- Modbus RTU communications
- Control based on one or two remote zone temperature sensors or both choosing the average or highest reading.
- Monitor zone temp, humidity, HVAC lockout, and control voltage present.
- Use industry-standard 10k type 3 thermistor.
- Backlight display - 2-line 16-character display for ease of use
- Adjustable Min & Max run time for stages
- 5 button keypad and display for easy programming plus keys for Lead Switch and Comfort Mode
- Lockout or limit user access via password on the front display
- Temperature displayed in F or C

2 Installation

The Model 600 is designed to be wall-mounted inside the controlled and monitored facility. This section will provide basic guidelines for installing the system. Refer to specific installation drawings for your particular application or contact Quest Controls, Inc. for assistance if your application is not covered in this section. All local and national electrical safety standards must be followed when installing the Model 600. If there is any contradiction in this manual and those standards, then the installer must follow the local and national standards. Use copper conductors only.

2.1 Mounting

Mount the Model 600 on an interior wall in a location that is accessible for wiring and attainable to the color touchscreen on the front of the system. It is recommended to mount the controller no higher than six feet above the finished floor so that the touchscreen is easily accessible. Use appropriate mounting hardware (screws, anchors etc.) based on the wall material to properly secure the Model 600 to the wall. Knockouts are provided on all sides for conduit and routing of wires into the enclosure.

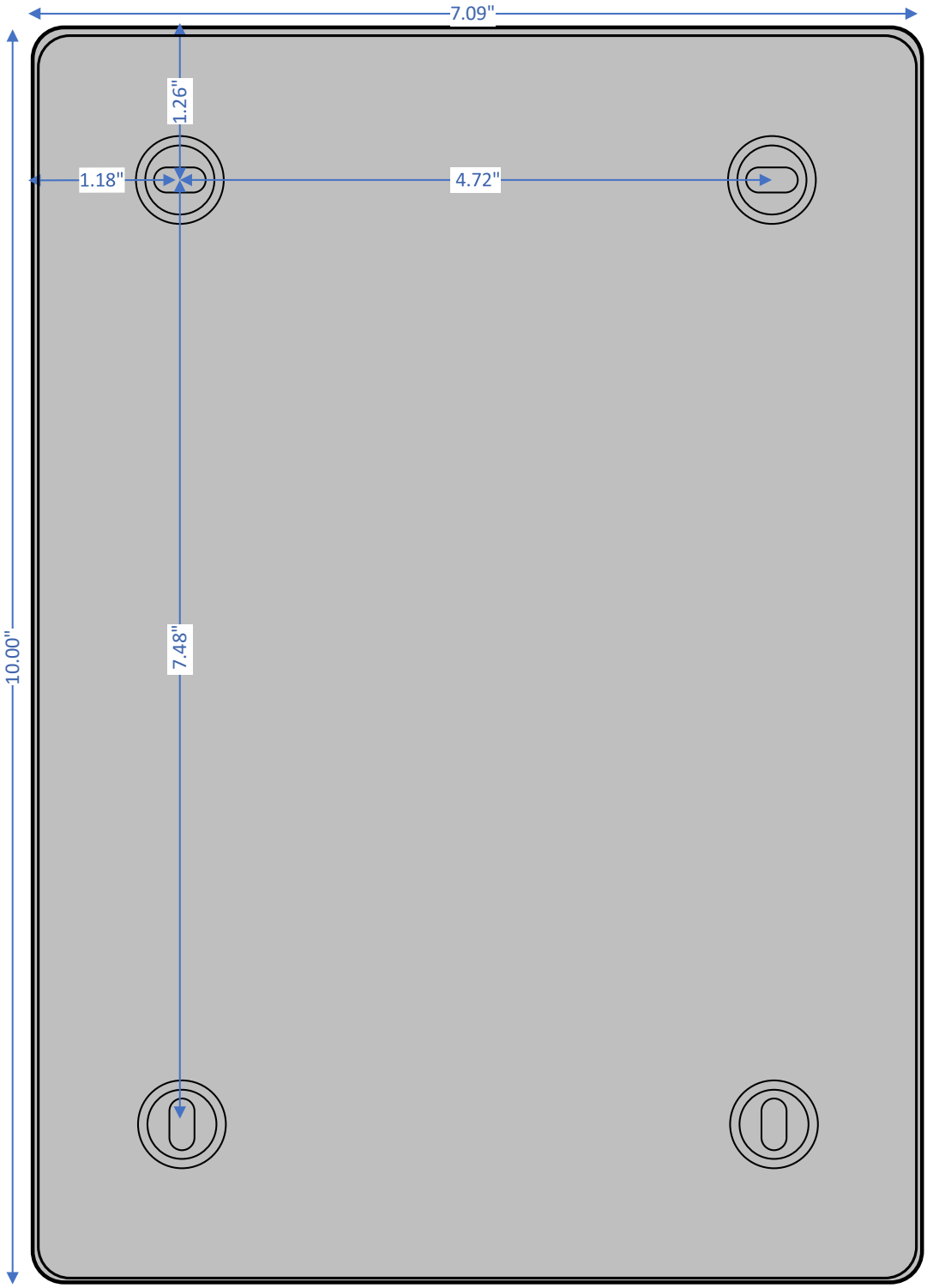


Figure 1 - Enclosure Mounting Holes

2.2 Powering the System

The Model 600 has three sources for powering the system. All three can be used simultaneously to provide redundancy to the system. The Model 600 gets 24VAC power from each HVAC system being controlled when the R (24vac hot) and C (24VAC common) terminals are connected to the system. The system monitors the presence of the 24VAC voltage from the HVAC unit to determine if power is lost, requiring a switch of the lead HVAC system. Additionally, there is a separate 18-65 VDC input on the upper left corner of the IO board for connection to the facilities DC plant. The DC power takes precedence over the power from the HVAC systems, but if any source should fail, the system will switch seamlessly to the next available source and continue to operate. The system monitors the presence of the 24VAC voltage from the HVAC unit to determine if power is lost, requiring a switch of the lead HVAC system.

2.3 Wiring Inputs and Outputs

See Figure 2- Model 600 Wiring Diagram for wiring the monitoring and control points for your application. Temperature sensors are thermistor devices and are not polarity sensitive. For the Humidity sensor, make sure you wire the power and input terminals to the appropriate terminals. Follow the directions that come with the sensor. The alarm outputs are energized under normal condition and de-energize when an alarm occurs. The diagram shows the outputs in their “normal” or non-alarm condition.

Monitoring inputs for HVAC fail, econ on, generator running, hydrogen gas and smoke detector are wired between their respective input and common terminal. The points are defined through the system setup and/or alarm setup (depending on input) for normally open or normally closed operation. The default is “disabled” and must be changed if the points are wired and are being used.

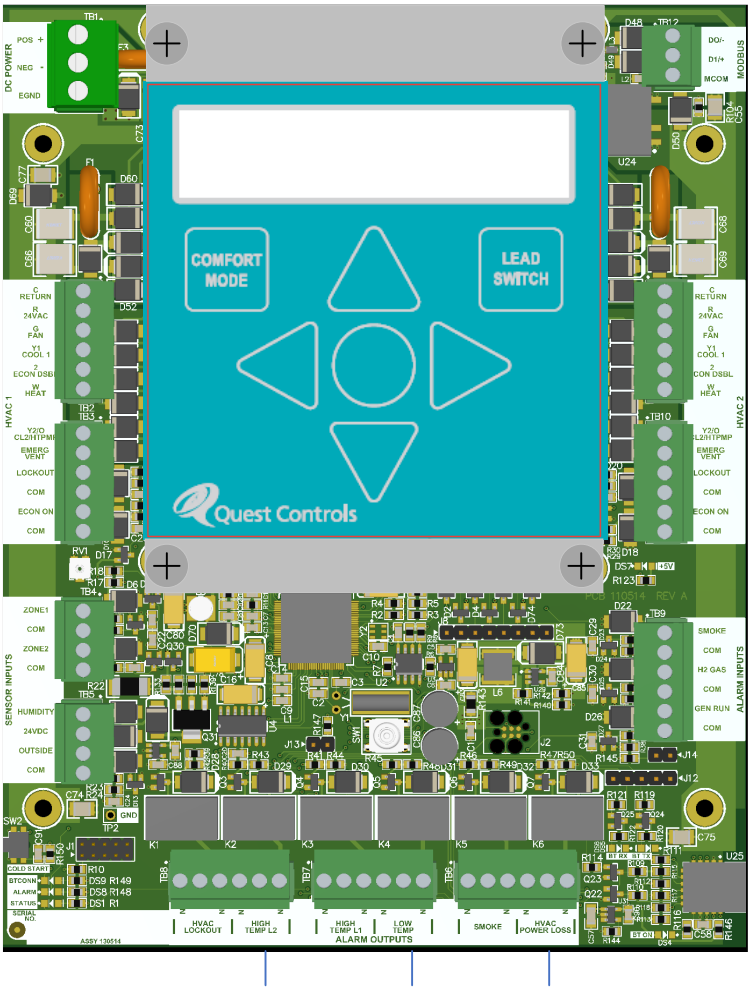


Figure 2- Model 600 Wiring Diagram

2.4 Input/Output Function

The following matrix describes each input and output and what they are used for. Use this guide to determine how you want to wire your Model 600 system.

2.4.1 Input Definitions

Name	Description
Zone 1	Temperature sensor used for control and monitoring of the HVAC system and facility
Zone 2	An optional second zone sensor used for control and monitoring. Can be used with the Zone 1 senor to control based on the highest reading or average reading
Humidity	4-20mA humidity sensor to monitor relative humidity in the facility and make control and alarm decisions.

Outside	Outside air sensor used for determining when to enable econ mode when using the Quest Econ control method
Smoke	Smoke detector input used to disable HVAC operation when active and to generate an alarm condition
H2 Gas	Hydrogen gas monitoring. Used to vent the facility and generate an alarm when active.
Gen Run	Generator Running input. Used to determine if econ should be disabled when active
Lockout	Lockout alarm for each HVAC unit. Causes system to switch the lead and generate an alarm condition
Econ On	Economizer active input for each HVAC unit. Use to indicate that the HVAC unit is in econ mode.

2.4.2 Control Output Definitions

Name	Description
G Fan	Supply Fan – On when call for heating or cooling. Also on if defined to run continuous
Y Cool1	Turns on when there is a call for cooling whether that be economizer or mechanical cooling
2 Econ DSBL	Turns on when the Model 600 is forcing mechanical cooling to be on.
W Heat	Turns on when there is a call for heating
Y2/O CL2/HTPMP	Stage two cooling if the Model 600 is defined to control two stage HVAC units. Also turns on, if the HVAC system type is defined as heat pump, when there is a call for cooling.
HVAC Lockout	Alarm output relay to indicate if either HVAC unit is in lockout mode.

2.5 Remote Communication

The Model 600 supports Modbus RTU to communicate status and to allow for remote program changes. Use a three-wire cable to connect the Model 600 to the Modbus polling agent. The D0/D1 terminals should be wired using a twisted pair and the third wire will be used for a ground reference between the devices. Multiple Model 600 units can be daisy chained together for larger sites. Be sure that each Model 600 has a unique Modbus address and they are all configured for the same baud rate.

2.6 RS485 End of Line resistor

RS485 networks require an end of line resistor (EOL) to be present on the end devices of a daisy chain network. For a Model 600 at the end of the network, add a 120-ohm EOL resistor between D0 - and D1+ terminals.

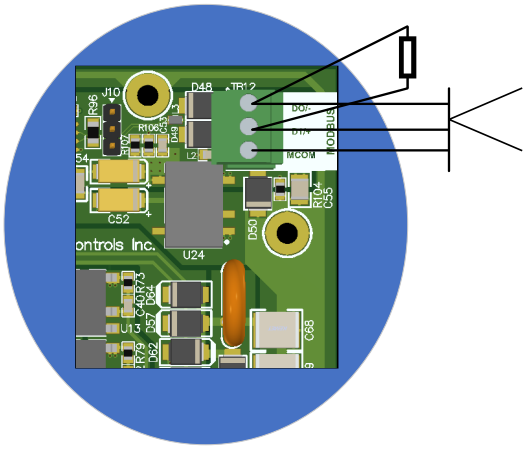


Figure 3 – End of Line Resistor

2.7 Wiring Types

The following chart contains the recommended wire types for the inputs and outputs.

WIRE MATRIX		
Description	**Cable Part Number**	**Usage**
Cable, 2 Cond, 18 AWG, Unshld, Strnd (RED, BLACK)	Belden 6300UE	Power Supply to Model 600 and digital input monitor points
Cable, 2 Cond, 22 AWG, Shld, Solid (RED, BLACK)	Belden 6520FE	Temperature sensor and humidity inputs
Cable, 4 Cond, 20 AWG, Shld, Strnd 9 (RED, BLACK, WHITE, GREEN)	Belden 6402FE	Zone 1 combination temperature and humidity sensor.
Cable, 4 Pair, 24 AWG, Unshld, Solid	Belden 1245A2	Alarm outputs
Cable, 8 Cond, 18 AWG, Unshld, Sld, T-Stat	Coleman 55308	HVAC control wiring
Cable, 2 Pair, 24 AWG, Shld, Strand (WHT/BLU, BLU/WHT, WHT/ORG, ORG/WHT)	Belden 88102	Modbus Cable

Table 1: Wire Matrix

2.8 Typical installation drawings

Below are some typical installation drawings for HVAC systems with Integrated Economizer control and when the Model 600 is controlling the economizer damper directly. Please contact Quest Controls for assistance if your application differs from these examples.

SINGLE STAGE NO ECON

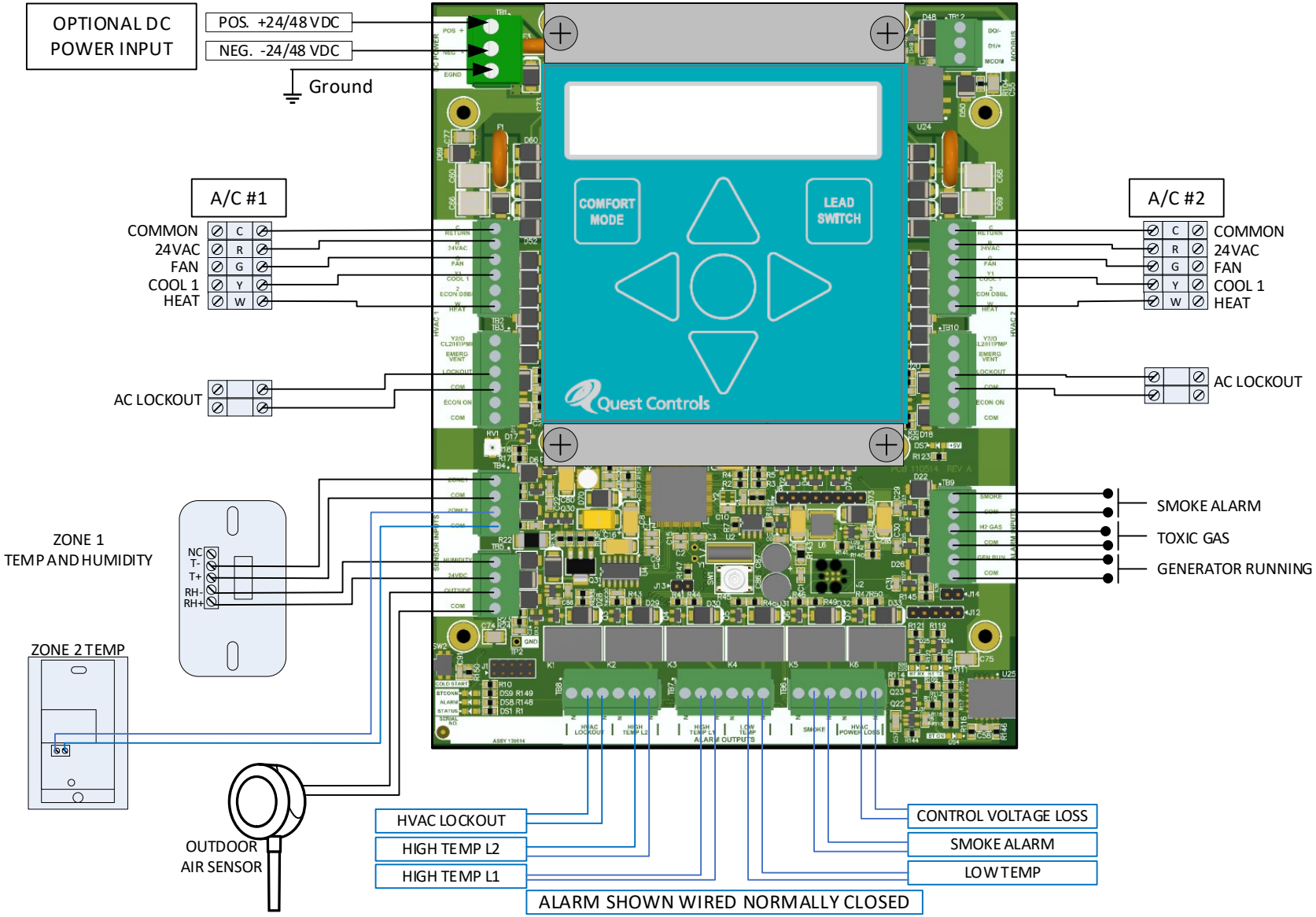


Figure 4 – Single Stage HVAC Typical Installation

TWO STAGE NO ECON

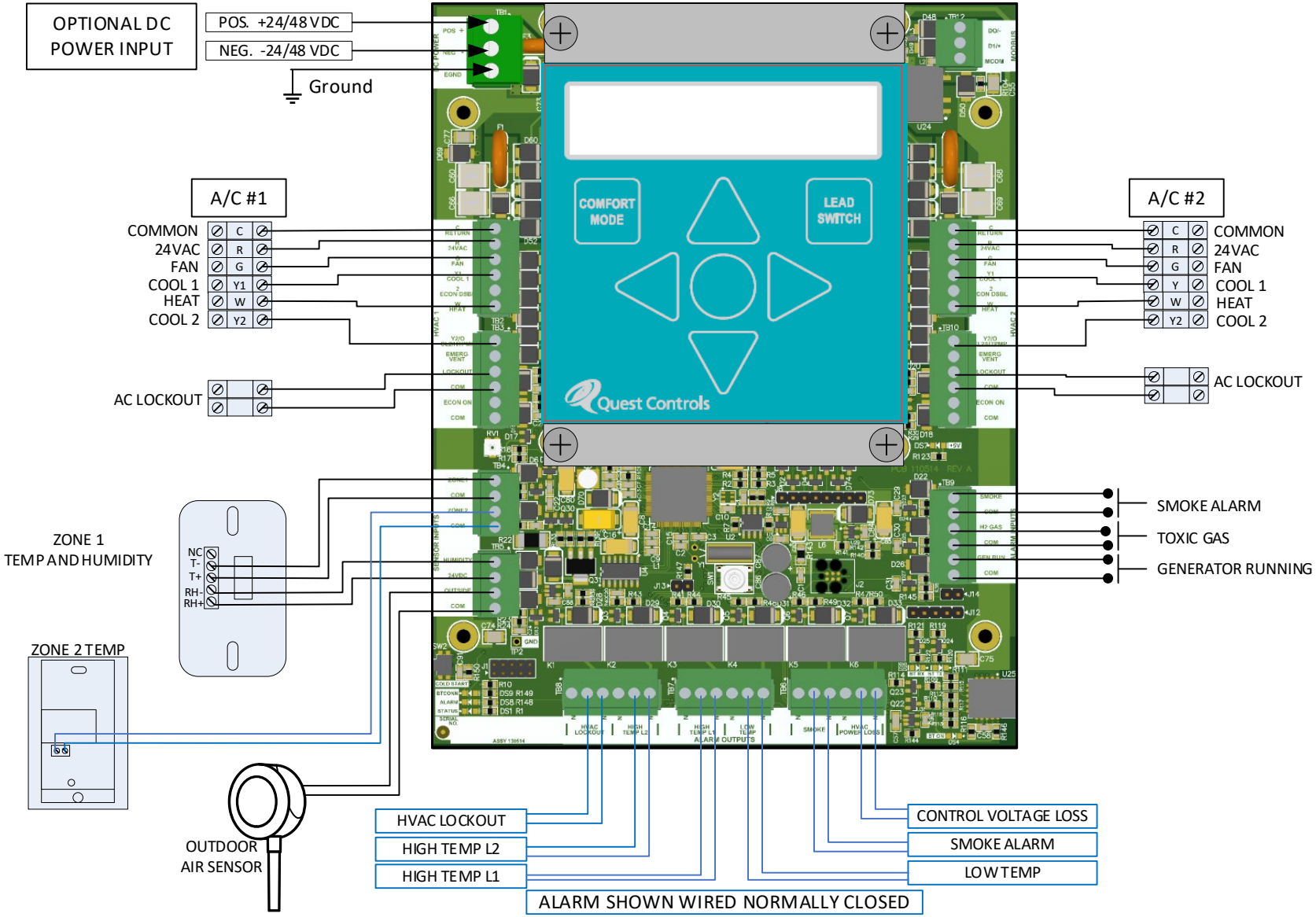


Figure 5 – Two Stage HVAC Typical Installation

MARVAIR HVESA 30-60 ACA 00 KW ICM VZ
ENABLE ECONOMIZER CONTROL
REFERENCES ARE TO MARVAIR DRAWING HVESA3660A0-ICM-VZ

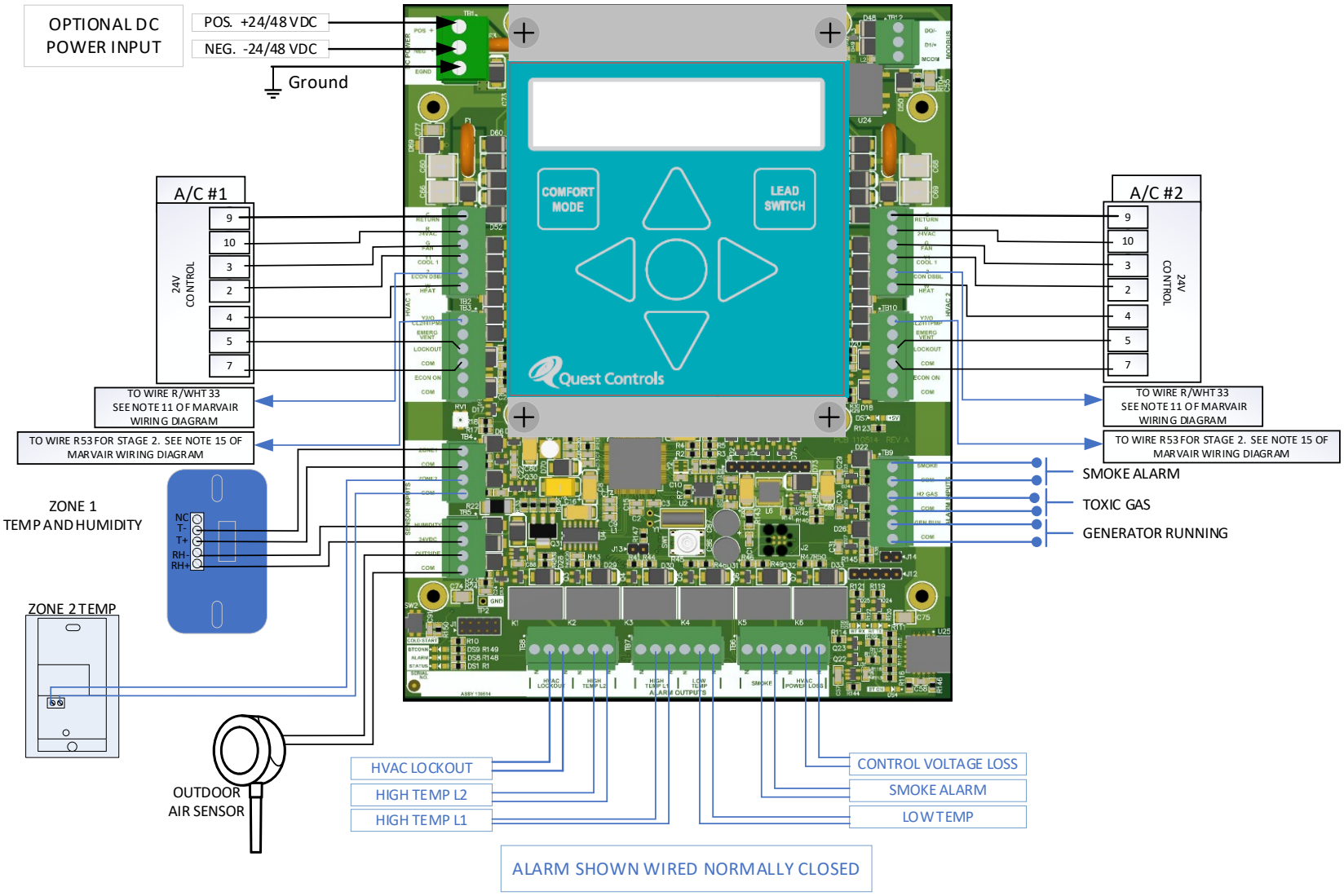
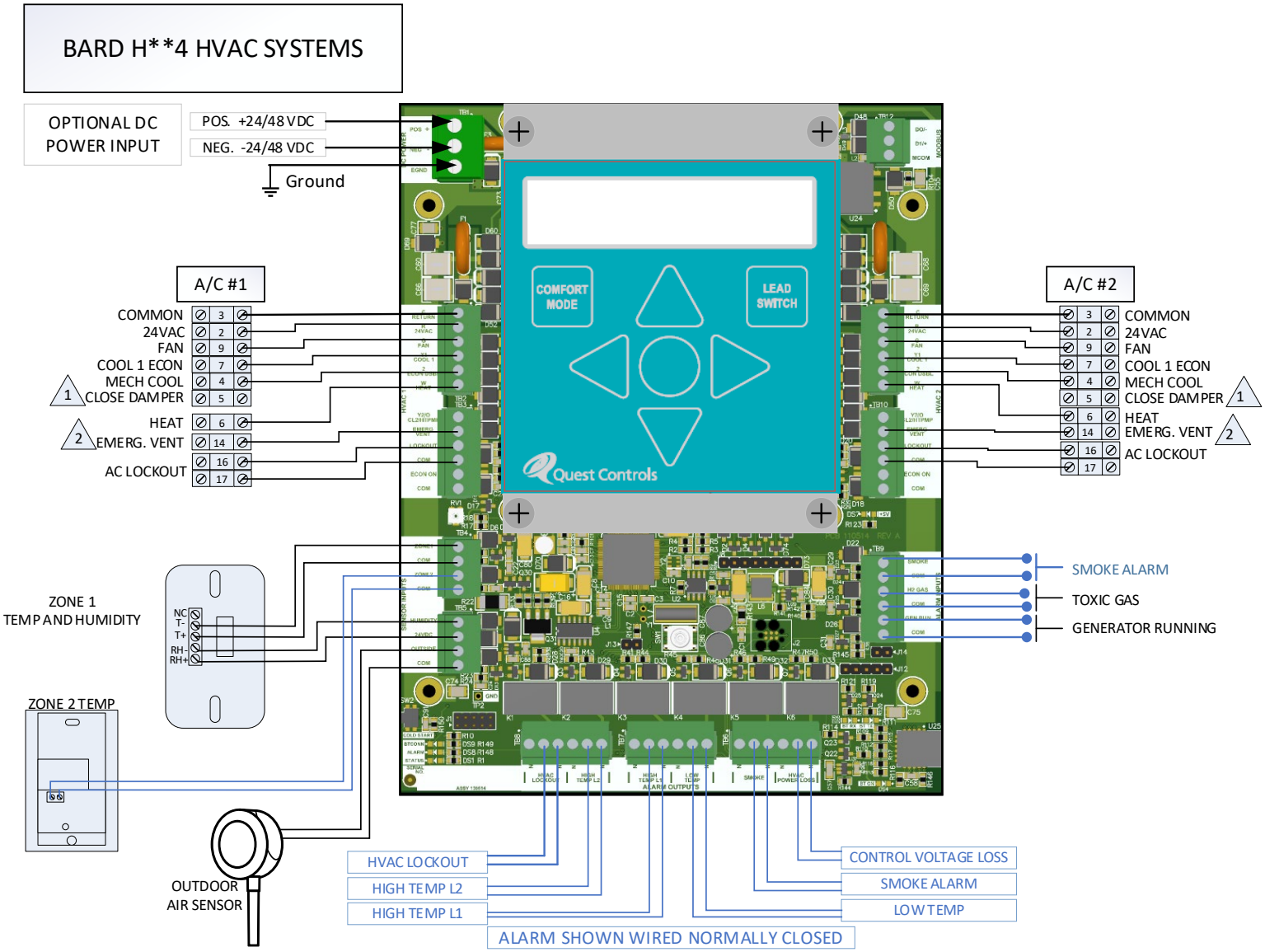


Figure 6 - Marvair HVESA Typical Installation



1 JUMPER TERMINAL 4 TO 5 TO CLOSE DAMPER WHEN IN MECHANICAL COOLING. THIS ASSUMES JADE CONTROLLER IS CONFIGURED TO CLOSE DAMPER WITH AUX2 INPUT. JUMPER CAN BE LEFT OFF IF IT IS ACCEPTABLE TO HAVE DAMPERS OPEN WHEN IN MECHANICAL COOLING

2 ASSUMES JADE CONTROLLER IS CONFIGURED FOR 100% OSA WHEN THE OCCUPIED INPUT IS ACTIVE

NOTES:

1. SET JADE CONTROLLER TO ECONOMIZE AT 74 DEGREE OSA
2. CONFIGURE SETUP FOR SINGLE STAGE INTEGRATED OR QUEST MODE ECONOMIZER.
3. OSA SENSOR MUST BE CONNECTED FOR QUEST MODE

Figure 7 – Bard H4 System Wiring Diagram**

3 Front Panel Display/Keypad Operation

The Quest Model 600 has a 2X16 character backlit LCD and five buttons for status review and programming. Additionally, there are separate keys for lead switch and comfort mode operation. The backlight is normally off but will turn on when any key is pressed. The backlight will turn off after a few seconds of no keys being pressed. The first press of the keypad will turn on the backlight and tell the Model 600 to be ready for additional key presses. All keypad operation described below is after you press and release any key to enable the backlight.

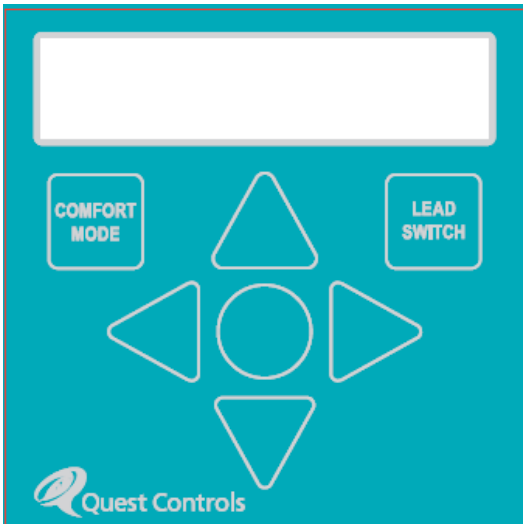


Figure 8 - Model 600 Keypad

3.1 Run Mode

The display will show the controlling temperature reading, Which unit is the lead system and the HVAC control mode on the top line. The second line will show any active alarm condition or the message “NO ACTIVE ALARMS”. Press the up and down arrow keys to cycle through the various status screens to obtain current readings for all defined sensors and functionality.

3.1.1 Additional displays:

Press the up and down arrow keys to cycle through the status screens to obtain current readings for all defined sensors. The screens will show in the following order using the down arrow:

Screen	Description
Z <reading> Z2 <reading> H <reading> OSA <reading>	Shows the current reading of both zone sensors on line 1 and the humdity sensor and outside air sensor on line 2. A value of OER will be displayed if no sensor is connected to the input. If there is a sensor connected then OER would indicate an open reading. Check for broken wires. A reading of SER indicates a short to ground. The humidity sensor will show ERR% if there is an open or no sensor connected.
SPTS E <value> C <value> H <value>	This screen will show the current setpoints for Econ, Cooling and Heating. Being used. Note the values shown are the active value and can change based on comfort mode or being remotely set through Modbus. The Econ setpoint will only be show if the Model 600 is defined to use Econ Mode.
Econ Ctrl Mode <value>	THe value will either be NONE, INTEGRATED or show the L1 and L2 econ setpoints for Quest Mode.
HVAC 1 <status> HVAC 2 <status>	The status of each HVAC unit showing what control mode the Model 600 is setting each HVAC to such as ECON 1, COOL1 etc.
HVAC 1 FAIL <ON|OFF> HVAC 2 FAIL <ON|OFF>	The on/off status of the HVAC lockout input for each unit.
HVAC 1 ECON <ON|OFF> HVAC 2 ECON <ON|OFF>	The on/off status of the Econ feedback input when the unit is defined for Econ control.
SMOKE INP <ON|OFF> HYDROGEN <ON|OFF>	The on/off status of the smoke detector input and the hydrogen gas input.
GEN RUN <ON|OFF>	The on/off status of the generator running input.

3.2 Comfort Mode

Press the comfort mode button to change the cooling and heating setpoints to a predefined value for a user defined timer period. The default time period is one hour. The display will display “Comfort Mode On” on the first line and resume normal status. When the unit is in comfort mode the message “COMFORT MODE ON” will be on the second line and will rotate with any active alarm messages.

Pressing the Comfort Mode button while in comfort mode will terminate comfort mode. The display will display “Comfort Mode Off” on the first line momentarily when the button is pushed.

3.3 Lead Switch

Pressing the Lead Switch button will manually switch which HVAC unit is the lead unit. The display will show “Lead to HVAC# where # = 1 or 2. The system will switch the lead provided the lag unit is not in an

alarm condition that prevents the unit from operating such as control voltage lost or lock out alarm active. The unit switched to lead will remain in the lead position until the lead switch timer elapses or an alarm condition that causes a lead switch.

3.4 Programming the Model 600

Press and hold the left and right arrow simultaneously until the display shows the enter password option. The default password is 11. Use the up/down arrow keys to change the password value and press the center button to log in. Passwords can be turned off or changed to any value from 11 to 99 via Modbus and the front panel System menu. From this menu use the up/down arrows to navigate to the available choices of: System, Setpoints, Economizer, Alarms, Bypass & Run. Choosing one of these options will present the available choices. Use the up/down arrows to cycle through the choices for each field and the center button to accept the change and move to the next choice. Once you start in one of the program menus, you must step through all choices until the end to accept your changes. Press the center button to accept the current program value and go on to the next choice.

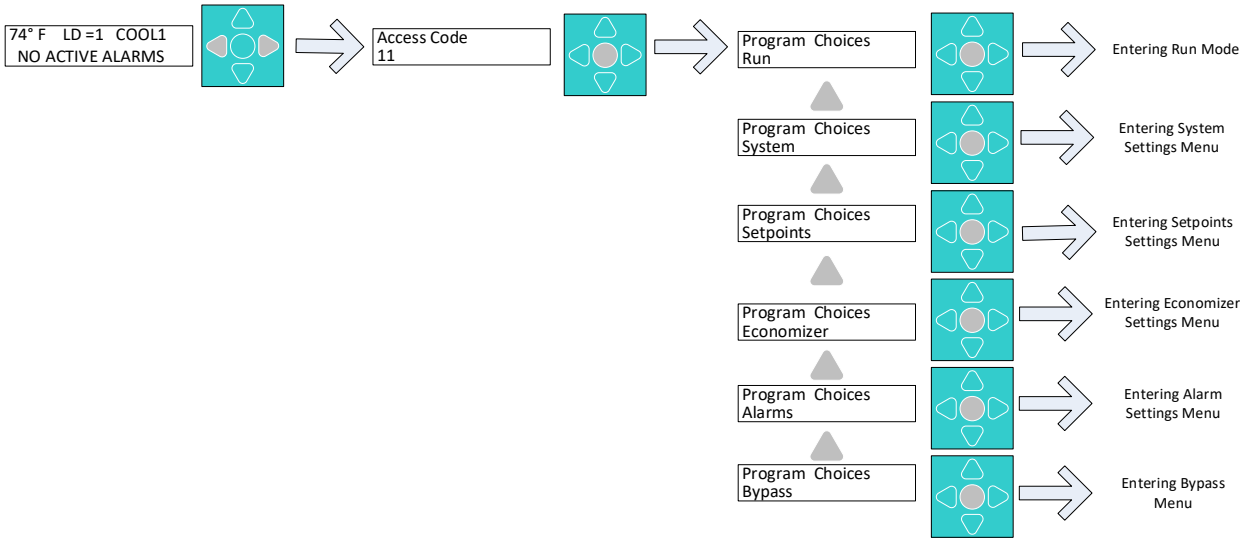


Figure 9 - Programming Flow

3.5 Program Menus

This section shows the program menus and available options. Items underlined indicate the default setting. All temperature values are shown in Fahrenheit.

3.5.1 System Menu*

System Option	Available Choices	Description
Temp Units	Fahrenheit, Celsius	Select the engineering units for displaying temperature and temperature setpoints
Control Sensor	Zone 1, Zone 2, High Zone 1 & 2, Avg Zone 1 & 2	Select the sensor to be used for control and alarming decisions. High will select the highest reading of the two and AVG will average the two sensors. This value will be shown on the main status screen as the controlling temperature.

System Option	Available Choices	Description
HVAC type	Single Stage DX, Dual Stage DX, Heat Pump	The type of HVAC system being controlled. Single stage cooling, two stage cooling or single stage heat pump.
Lead/Lag Type	Lead/Lag, Lead/Standby	Lead/Lag allows both HVAC units to operate to maintain temperature. Lead/Standby will only allow one HVAC unit to operate at a given time.
Economizer	None, Integrated, Quest	Integrated assumes the HVAC unit has a built-in enthalpy controller that determines econ or mechanical cooling. Quest mode assumes the same but must also have an OSA sensor connected to take advantage of advanced functionality.
Econ Status	None, Normally Open, Normally Closed	Used as a feedback input to indicate the HVAC unit is in econ mode. Normally open = OFF when the input is open and ON when the inputs is closed. Normally Closed = OFF when the input is closed and ON when the input is open
Gen Run Mode	All Auto, Econ Disable	All Auto = do nothing to HVAC when gen is running. Econ Disable will disable econ control mode. Gen Run input needs to be defined under Alarms for this operation to take effect.
Smoke Detect Mode	All Off, Econ Disable	Either turn off all HVAC or disable Econ Mode when the smoke detector is active. The smoke input needs to be defined under Alarms for this operation to take effect.
Fan Mode	Auto, Lead On, Both On	Auto = Fan is on with call for cooling or heating. Lead on = the lead unit's fan to constantly run Both on = both HVAC fans to run constantly.
Residual Fan Delay	0-180 seconds (30)	If a fan is defined as auto, then this is the delay after a call for cooling or heating before the fan turns off.
Restart Delay	0-900 seconds (0)	After a power failure to the Model 600 the system will wait this delay time before starting control operations.
Modbus Address	0-247 (0)	A value of 0 turns off Modbus communications
Baud Rate	9,600, 19200, 38400, 57600, 76800	The baud rate required to communicate with a Modbus polling agent. Comm settings are fixed at 8n1.
Access Code	11-99 (11)	The access code to enter the program menus on the front panel
Prog Menu Access	Allow, Don't Allow	Allow access to the program menus on the front panel or lock out local access to programming. All changes are done remote through Modbus.

*Changes made in the System Menu will cause the system to write to non-volatile flash memory and restart the Model 600 so it can operate with the new functionality.

3.5.2 Setpoint Menu

Setpoint Option	Available Choices	Description
Cool SPT	60-110 (80)	The setpoint value used for mechanical cooling
Econ SPT	60-110 (75)	The setpoint value used when econ mode is enabled.
CMFT Cool Delta	1-20 (5)	The number of degrees subtracted from the cool and econ setpoint when in comfort mode.
Cool Off Delta	1-20 (2)	The number of degrees below the cooling SPT (or econ spt if enabled) before turning off cooling.
Heat SPT	30-70 (55)	The setpoint value used for heating
CMFT Heat Delta	1-20 (10)	The number of degrees added to the heat setpoint when in comfort mode.
Heat Off Delta	1-20 (2)	The number of degrees the control temperature is above the heating setpoint to turn off heating.
RH Control SPT	20-100 (0)	When the %RH is above this setting, the system will go into dehumidification mode and use the dehumid setpoints for cooling and heating. A value of 0 disables this function.
RH Ctrl Off Delta	2-50 (20)	When using RH dehumid control the humidity sensor has to be below the RH Control SPT minus this value to disable Dehumid control mode
Dehumid Cool SPT	60-110 (65)	The cooling setpoint to use when in Dehumid mode.
Dehumid Heat SPT	30-70 (65)	The heating setpoint to use when in Dehumid mode.
Cool Stg 2 Delta	1-20 (2)	The number of degrees above the cool SPT to enter cool 2 mode.
Cool Stg 3 Delta	1-20 (2)	The number of degrees above the cool SPT plus stage 2 delta to enter cool 3 mode.
Cool Stg 4 Delta	1-20 (2)	The number of degrees above the cool SPT plus stage 2 and stage 3 deltas to enter cool 4 mode.
Heat Stg 2 Delta	1-20 (2)	The number of degrees below the heat setpoint to enter heat 2 mode.
Lead Swtch Hours	0-336 (168)	The number of hours before switching the lead system. 0 = disable and will not switch leads based on time.
Comfort Minutes	0-240 (60)	The number of minutes for comfort mode to be active when the button is pressed. 0 disables comfort mode function
Stg Min On Time	30-600 (120)	The number of seconds that a cooling or heating stage must be on before it can be turned off to prevent short cycling.
Stg Min Off Time	30-600 (120)	The number of seconds to wait once a stage or cooling or heating is off before it can come back on.

3.5.3 Economizer Menu

Econ Option	Available Choices	Description
OSA L2 Setpoint	45-90 (65)	Quest mode – OSA above L2 disables econ mode.
OSA L1 Setpoint	45-90 (65)	Quest mode – OSA between L1 and L2 will enable both HVAC units in Econ mode (lead/lag mode only). OSA below L1 will enable the lead unit first and then if the inside temp rises will enable the lag unit in econ mode.
OSA Fload Maxchg	0-10 (5)	The maximum amount L1 and L2 can change up or down to automatically adjust based on success of econ mode.
OSA Dwell Time	60-900 (60)	How long to wait for the OSA temp reading to be above/below L1 and L2 to determine econ mode operation.
RH Disable SPT	0-100 (0)	The system will disable econ mode when the humidity is greater than this value. A value of 0 disables this function.

3.5.4 Alarm Menu

Alarm Option	Available Choices	Description
Hitemp2 Alarm SP	70-140 (90)	Alarm threshold for the High Temp alarm level 2 output. Level 2 alarm will cause a lead switch.
Hitemp1 Alarm SP	70-140 (85)	Alarm threshold for the High Temp alarm level 1 output.
Lowtemp Alarm SP	20-60 (50)	Alarm threshold for the low temperature alarm output.
Hihumid Alarm SP	0-100 (0)	Alarm threshold for a high humidity alarm condition. This alarm is available on display and Modbus only. A value of 0 = disable.
Lockout Alarm	Disable, Normally Closed, Normally Open	HVAC lockout alarm. Select option based on how lockout alarm inputs are wired. Disable prevents the alarm condition from functioning.
Smoke Alarm	Disable, Normally Closed, Normally Open	Smoke alarm input. Select option based on the smoke detector input is wired. Disable prevents the alarm condition from functioning.
Hydrogen Alarm	Disable, Normally Closed, Normally Open	Hydrogen Sensor input. Select option based on how the input is wired. Disable prevents the alarm condition from functioning. This alarm is available on display and Modbus only.
Gen Run Alarm	Disable, Normally Closed, Normally Open	Generator Run input. Select option based on how the input is wired. Disable prevents the alarm condition from functioning. This alarm is available on display and Modbus only.

3.5.5 Bypass Menu

The bypass function under the programming menu choices will allow for a temporary bypass condition of the HVAC systems to allow for testing and verification. Bypass overrides the current control mode and will force both HVAC units to the chosen control mode. The options are:
Heat1 – Turns on heat plus the supply fan for both units.
Cool2 – Turns on cool stage 1 and 2 plus the supply fan for both units.
Cool1– Turns on cool stage 1 plus the supply fan for both units.
Econ - Turns on the econ mode plus the supply fan for both units.
Off – turn both units off including the supply fan.

Select the control mode you want to bypass the system into and press the center button. The system will then allow you to use the up/down arrows to select the number of minutes for the bypass to take effect. The system will return to normal operation after the time expires or the operator can enter the bypass function again, select a bypass mode and leave the minutes at 0 and press the center button to cancel any bypass.

3.5.6 Run Option

Selecting Run puts the Model 600 back in run mode. Note: some changes require a restart. The Display will show “Restarting Soon” to indicate it is storing changes to flash and will reboot with the new configuration.

4 Sequence of operations

This section will focus on the local control functions for the controller. Please see section 6 - Remote Communications for control functions when the unit exists in a network.

4.1 Lead/Lag vs. Lead/Standby control

The Model 600 will support two control methods which are Lead/Lag and Lead/Standby. The difference between the two is that Lead/Lag will allow both HVAC units to operate simultaneously whereas Lead/standby will only allow the lead unit to operate. The standby unit will only operate when it is switched to the lead unit based on the conditions identified in section 4.1.1.

4.1.1 Lead Switch

The system will not switch the lead system if the lag/standby unit is in a failed condition such as Lockout alarm or loss of control voltage. The system will switch the lead HVAC unit and clear the lead time remaining timer under the following conditions:

- The lead time hours has exceeded the lead time defined by the user.
- A user has pressed the Lead switch button.
- A Modbus write has occurred to the lead switch Modbus point.
- The current lead system has a lockout alarm.

- The current lead system has a control voltage loss alarm.
- The controlling temperature has exceeded the L2 high temperature alarm level.

4.2 Controlling temperature

The system will make all control for the HVAC system based upon the “controlling temperature”. The controlling temperature is defined in the system setup to be either zone sensor 1, zone sensor 2, the average of both sensors, or the highest reading of the two sensors. If one of either the zone 1 or 2 sensor is selected, the system will use that sensor provided there is a valid reading (between -25-150°F). If there is no valid reading then the system will report a sensor error on the display, turn both supply fans on and turn off heating and cooling.

When using the average or high of the two sensors, the system will use that function provided both sensors have valid readings. If one sensor is in error, then the Model 600 Controller will only use the sensor with valid readings. If there is no valid reading from either sensor then the system will report a sensor error on the display, turn the supply fans on and turn off heating and cooling.

The controlling temperature point will have write capability to allow the ESB2 (remote controller) to write a value to the point. The Model 600 Controller will use the written value for control unless a communications fault is detected. When a communications fault occurs, the controller will default back to the defined controlling temperature sensor mode. See section 6 for additional information on remote communications.

4.3 Fan control

The supply fan outputs are programmable from the display for continuous run for the lead system, both fans continually run or automatic mode. Automatic operation means the fan output is turned on when there is a call for heating, economization or cooling. For automatic mode, the fan will stay on until a user-definable delay after heating, econ or cooling is turned off. The Residual Fan Delay default is 30 seconds but is user selectable from 0-300 seconds.

4.4 Cooling Mode

Once a stage of cooling is turned on, it must remain on until the controlling temperature is below the cooling off setpoint (cool spt – cool off delta).

There are minimum on and minimum off time delays for each stage. These timers must elapse before there can be a change of state on the output relays. For example, if a mechanical cooling stage is off, it must be off for the minimum delay time before it allowed to be turned on. Once it is running, the cooling must continue to run for at least the minimum on time. The only exception is if there is an alarm condition that requires the cooling to be turned off such as a smoke alarm.

The Model 600 won’t “jump” a cooling stage based on controlling temperature. As in, if the unit is off and calculations would like the unit to be in cool2, the unit will first try cool1 (or even econ if calculations allow) for the minimum on time before moving to cool2.

4.5 Heating Mode

The Model 600 Controller has two setpoints for heating mode. Heating stage 1 will be enabled when the controlling temperature is below the heating setpoint. If the temperature continues to lower to where the controlling temperature is below the heat 2 threshold (heating spt – heat 2 delta) then heat stage 2 will be enabled. Once a stage of heating is active, it must stay on until the controlling temperature is greater than the heating setpoint + heat off delta.

The same minimum on and minimum off time delays apply for heating stages. These timers must elapse before there can be a change of state on the output relays. For example, if heating stage 1 is off, it must be off for the minimum delay time before it is turned on. Once it is turned on, it must continue to stay in the on state for at least the minimum on time. The only exception is if there is an alarm condition that requires the heating to be turned off such as a smoke alarm.

Also, note that the unit won't ever "jump" a heating stage based on controlling temperature. As in, if the unit is off and calculations would like the unit to be in heat2, the unit will first try heat1 for the normal on time before moving to heat2.

4.6 Economizer Control

The unit supports two types of economization plus the option for no economizers. The options are "Quest" which requires an Outside air sensor connected to the Model 600 and integrated. Integrated will rely solely on the settings of the economizer controller inside the HVAC unit. When "Quest" mode is selected, the HVAC economizers (enthalpy controller) should be set to max OSA value so that the Model 600 can operate properly in econ mode. In Quest mode, the controller will use the outside air temperature reading and compare to setpoints that can automatically adjust based on successfully cooling with outside air.

The outside air temperature Modbus point will have write capability to allow the ESB2 (remote controller) to write a value to the point. This way a single Outside air sensor can be used and shared amongst multiple controllers when Modbus is deployed. The Model 600 Controller will use the written value for control unless a communications fault is detected. When a communications fault occurs, the controller will default back to the defined controlling temperature sensor mode.

4.6.1 Quest Econ Mode

The Model 600 Controller will use Quest's patented economizer control algorithm to maximize the amount of time outside air can be used for cooling the facility and will automatically adjust based upon changes to the facility or HVAC equipment. OSA temperature greater than L2 setting for the dwell delay will disable economization. OSA temperature between L1 and L2 for the dwell delay will enable econ mode in both the lead and lag unit at the same time when there is a call for econ stage 1 mode. The reason for this is assuming both units are required to provide necessary airflow for cooling when the outside air is at a higher value. OSA temperature below L1 for the dwell delay will allow the economizer for the lead system to be active when in Econ stage 1 and then will bring on the lag unit in econ mode if the inside temperature is above the econ setpoint plus the value in the stage 2 cooling delta. Floating of OSA setpoints is only available with Quest Econ mode and a valid OSA sensor reading.

4.6.1.1 Adjusting OSA Setpoints

The Model 600 Controller will float/adjust the economizer OSA setpoint by using the Quest patented algorithm. Successfully cooling with OSA will move the L1 and L2 setpoints up. Failure to cool the zone with OSA only will cause the setpoints to adjust down. It is recommended that the differential between L1 and L2 be 3 to 5 degrees. The default is three degrees. An additional setting is provided called L1/L2 Max Change. This is the maximum allowable degrees that L1 and L2 will be allowed to move up or down. Both settings move together to maintain the differential.

4.6.2 Integrated Econ Control

Integrated economizer control means the economizer is being controlled by the HVAC system. The Model 600 Controller will decide to turn on stage 1 of cooling. The HVAC system will then decide to use economization or mechanical cooling. If temperature continues to rise, the Model 600 Controller will turn on output 2 to force mechanical cooling. This will cause the HVAC system to switch to mechanical cooling.

4.6.3 No Economization

The system allows for the option of NONE for the economization question. Choosing this option will disable all economizer logic and will control the mechanical cooling based upon the cooling setpoints.

4.7 Dehumidification mode

The dehumidification mode will be used to reduce the humidity inside the facility. When the relative humidity is greater than the dehumidification setpoint, the controller will change the operational cooling and heating setpoints to the Dehumidify cooling and heating setpoints. A user will typically move the cooling setpoint way down so the air conditioning can take moisture out of the air. A user can also move the heating setpoint to facilitate dehumidification. Economization will be disabled during dehumidification mode.

5 Alarm Sequence of Operation

All alarm conditions in this section will cause a message about the alarm to be displayed on line 2 of the local display. The display will rotate through all alarm messages if there is more than one active alarm condition. In addition, there are six form C outputs used for specific alarms. The outputs are energized under normal conditions and de-energized when in alarm.

5.1 High Temperature Level 2

The Model 600 Controller will compare the controlling temperature to the high temperature alarm L2 setpoint and alarm if the controlling temperature is greater than the setpoint for one minute. The alarm will clear when the controlling temperature is below the high temp L2 setpoint minus 2 degrees for 1 minute. Alarm Output 2 is used for High Temp Level 2 alarms along with an alarm message on the front display and status via Modbus.

5.2 High Temperature Level 1

The Model 600 Controller will compare the controlling temperature to the high temperature alarm L1 setpoint and alarm if the controlling temperature is greater than the setpoint for one minute. The alarm

will clear when the controlling temperature is below the high temp L1 setpoint minus 2 degrees for 1 minute. Alarm Output 3 is used for High Temp Level 1 alarms along with an alarm message on the front display and status via Modbus.

5.3 Low Temperature

The Model 600 Controller will compare the controlling temperature to the low temperature alarm setpoint and alarm if the controlling temperature is less than the setpoint for one minute. The alarm will clear when the controlling temperature is above the low temp setpoint plus 2 degrees for 1 minute. Alarm Output 4 is used for Low temp along with an alarm message on the front display and status via Modbus.

5.4 High Humidity Alarm

The Model 600 Controller will compare the humidity sensor reading to the High Humidity alarm setpoint and alarm if the humidity is greater than the setpoint for one minute. The alarm will clear when the humidity is below the humidity alarm setpoint minus 5 (%rh) for 1 minute. This alarm condition will display on the front panel as well as have a Modbus register indicating an alarm.

5.5 HVAC Lockout

The Model 600 Controller will monitor the lockout alarm input based on the system configuration for both HVAC units. The system will enter the HVAC lockout alarm mode when the input is active for 5 seconds on either HVAC unit. When this input is active, the controller will turn off the mechanical cooling of the affected unit. In addition, if the affected unit is the lead, the Model 600 will switch the lead unit. Alarm Output 1 is used to indicate a control voltage alarm has occurred on either unit along with an alarm message on the front display and status via Modbus.

If both HVAC units are in lockout then the controller will turn on the Emergency Vent output(s) of each HVAC unit, along with the supply fan(s) to initiate emergency vent mode.

5.6 HVAC Control Voltage Lost

The Model 600 Controller will monitor the 24VAC control voltage for both HVAC units. The system will enter the Control Voltage Lost alarm mode when the voltage is not present for 5 seconds on either HVAC unit. When this input is active, the controller will turn off the mechanical cooling of the affected unit. In addition, if the affected unit is the lead, the Model 600 will switch the lead unit. Alarm Output 6 is used to indicate a control voltage alarm has occurred on either unit along with an alarm message on the front display and status via Modbus.

5.7 Smoke Alarm

The system will enter smoke alarm mode when the input is active for 5 seconds. When this input is active, the controller will do the action defined under the system program menu which is to disable econ mode only on both units or to turn off both HVAC units completely. Alarm Output 5 will be used to indicate a smoke alarm along with an alarm message on the front display and status via Modbus.

5.8 Hydrogen Alarm

The system will enter hydrogen gas alarm mode when the input is active for 5 seconds. When this input is active, the controller will enable emergency vent mode on both HVAC units. Both units will remain in vent mode until the hydrogen gas alarm input is off and then will return to normal operation mode. An alarm message will be displayed on the front panel along with status via Modbus.

5.9 Generator Running

The system will monitor the generator for running and display an alarm message if the generator running input is on for 5 seconds along with status via Modbus. When the alarm is active, the Model 600 will disable operation of the HVAC systems based on the system defined function. The option is to disable econ mode for both HVAC units or operate both units normally.

5.10 Communications Loss

If the Model 600 is defined for Modbus communications by changing the Modbus address from 0 then it will monitor for communications on the serial port. If no communications have been received for two minutes, then any remote commands previously sent will be ignored and the system will go back to local operation. A message will be on the display indicating communications loss.

6 Remote Communications

The Model 600 may be programmed using either the keypad and display or through the Modbus serial interface. The keypad can also be locked out to require remote programming only. Before programming remotely, you must set the address and baud rate of the Model 600.

Review the Modbus map (appendix A) for the available registers and functionality.

The Model 600 will accept writes to certain registers from a remote agent. Some of the registers being written to are only used while the unit is communicating. When communications are lost for two minutes, the Model 600 will revert to local control mode. This section will discuss those registers that can be set remotely but return to local default when the unit is reset or communications are lost.

6.1 Controlling Temperature

The controlling temperature register is holding register 100. This register will show the value of the sensor(s) being used to make control decisions. For example, if the Model 600 has two zone sensors and is configured to average those sensor readings, then the value of register 100 will be the average of those two sensors. This register can also be written to by a polling agent to change the value of the controlling temperature. An example of this function would be to calculate the average of multiple sensors connected to other devices and then set the controlling temperature based on that average.

6.2 Outside Air Temperature

Modbus holding register 101 is used to tell the Model 600 what the outside air temperature is so that the unit can determine if economizer mode can be used. This register would normally display the value of the outside air temperature on the Model 600, but this register can also be written to so that a single

OSA sensor can be used on one device and be sent to other Model 600 units by the Modbus polling agent.

6.3 Operational Cooling Setpoint

Modbus holding register 102 is used to display the current cooling setpoint. This will either be the locally stored value, or a polling agent can write a value to this register. Write the desired cooling setpoint to this register when you want to coordinate Lead/Lag operation between multiple units and or change the setting based on time or occupancy. Writing a value of 65535 will cause the Model 600 to use the locally stored value of Modbus register 1100.

6.4 Operational Econ Setpoint

Modbus holding register 103 is used to display the current economizer cooling setpoint. This will either be the locally stored value, or a polling agent can write a value to this register. Write the desired econ cooling setpoint to this register when you want to coordinate Lead/Lag operation between multiple units and or change the setting based on time or occupancy. Writing a value of 65535 will cause the Model 600 to use the locally stored value of Modbus register 1101.

6.5 Operational Heating Setpoint

Modbus holding register 104 is used to display the current heating setpoint. This will either be the locally stored value, or polling agent can write a value to this register. Write the desired heating setpoint to this register when you want to coordinate Lead/Lag operation between multiple units and or change the setting based on time or occupancy. Writing a value of 65535 will cause the Model 600 to use the locally stored value of Modbus register 1104.

6.6 Comfort Mode

Modbus holding register 107 is used to remotely set the unit into comfort mode. Write a 1 to enable comfort mode which will then timeout based up the defined comfort mode time. Write a 0 to disable comfort mode.

6.7 Lead Switch Request

Modbus holding register 108 is used to which HVAC unit is the current lead system. Writing a value greater than zero will switch the lead unit. Writing a 0 will resume local operation.

6.8 Econ Disable

Holding register 109 is used to disable the economizer mode on a Model 600. Writing a value greater than 0 will disable economizer operation. Writing a 0 to the register will allow the Model 600 to continue economizer operation as needed.

6.9 HVAC Shutdown

Holding register 110 is used to force both HVAC units to off mode. Writing a value greater than zero will force off the HVAC units. Writing a 0 will resume local operation.

6.10 HVAC Mode

Holding register 106 is used to enumerate the current control mode of the HVAC systems. For example, a value of 4 equals econ 1 mode. Writing to this register will override the current control mode and force the HVAC units to a specific control mode. Writing to this register requires two pieces of information. The high byte is the number of minutes for the bypass and the low byte is the desired mode. For example, if you want to bypass to cool 2 mode for 60 minutes then you would write the value 15366, which is calculated as follows:

High byte Hex value of minutes + low byte Hex value of mode = The register value in Hex. Then convert the value to decimal.
60 minutes = 3c hex + 06 for Cool 2 mode = 3c06 hex which equals decimal 15366.

Tip: you can use the built-in Windows calculator in programmer mode to do the calculations.

The Model 600 will countdown and return to automatic mode at the end of the bypass time. Alternatively, you can write a 0 to the register to clear the bypass.

6.11 Remote Alarm Monitoring

The Model 600 has built-in alarm monitoring functions to determine when an alarm condition is present and will display the alarm on the front panel as well as making the corresponding register have a value of 1. Registers 200-210 contain the available alarm status points. Writing any value to the register will clear the alarm condition which will change the register value to 0 and clear the message from the display. The alarm will not occur again until the problem clears and occurs again.

7 Troubleshooting

LCD Screen is dark and no characters are displayed	Verify power is present from each HVAC unit between the R and C terminals. Also verify the DC power input if being used.
Controlling Sensor reads OER or SER	The zone sensor(s) used for controlling the HVAC unit are either shorted to ground (SER) or are open (OER). Check the wiring and terminations for possible shorts or broken connections. Note if no sensor is terminated to Zone 2 (the remote sensor) then it is normal for the reading to be OER for the input. If the controlling sensor reads OER then make sure Z2 is not chosen as the sensor for control when it is not physically present.
Model 600 mode says Cool1, but the compressor does not engage	Verify the connection to HVAC unit. Ensure the short-cycle timer is not inhibiting the unit.

Model 600 won't communicate to the Modbus polling agent	Verify the wiring and polarity. Verify the Modbus address and baud rate. Verify that all Model 600s on the network have a unique address.
Buttons do not respond	Press buttons slowly, some functions may take pressing the button twice.
Display is corrupted	First, cycle power to the unit. If this does not correct the problem, reset the system. If the problem persists then do a cold start by pressing and holding in the cold start button (SW2 lower left of board) will pressing and releasing the reset button (SW1 below the keypad). The display will respond with "Cold Sense", continue holding the cold start button until you see Cold Start on the display. Release the buttons at this time. This action will reset the Model 600 and return all settings to their factory defaults. The Model 600 will then need to be reconfigured with the desired settings.

8 Model 600 Specifications

Specifications

Part Number	151112
Mounting	Wall mount
Enclosure	Color: Grey Material: Polycarbonate with knockouts on all sides
Inputs	Digital Inputs: (2) 24vac input from HVAC, (7) dry contact closures. Analog Inputs: Temperature sensors (3) Thermistors sensor ± 1°F (0.5°C) 4-20mA Input (1) – Relative Humidity Sensor
Outputs	Control Digital Outputs: (12) 30V AC max, 1A continuous, 3A in-rush Alarm Outputs: (6) Form C dry contracts. Supports 48VDC @ 0.5A
Power	24VAC from both HVAC units and separate 24/48VDC simultaneously
LCD Display	Type: Backlit LCD display Display Area: 2 rows of 16 characters each
Keypad	Four button directional arrows, enter button plus Comfort Mode and Lead Switch
Communication	RS485 Modbus RTU, Bluetooth
Environmental	Operating Temperature: 0°C to 50°C; 32°F to 122°F Storage Temperature: -30°C to 50°C; -22°F to 122°F Relative Humidity: 0 to 95% non-condensing
Dimensions	7.09" W x 10" H x 2.8" D (180 x 254 x 71 mm)
Weight	2.2 lb. (1 kg)
Warranty	1 year

Specifications are subject to change without notice.

Appendix A – Modbus Register Map

Any register that is defined as read/write (RW) and has a Y under the Non-Volatile column will cause a system restart when written to. This is a normal practice to ensure that any new configuration setting is saved to flash memory and then used by the system.

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
Analog Inputs							
Input Register (FC4)	0	Zone 1 Thermistor Temp	RO	sword	N/A	Integer value 327 to -327	N
	1	Zone 2 Thermistor Temp	RO	sword	N/A	Integer value 327 to -327	N
	2	Humidity sensor	RO	sword	N/A	Integer value 0 to 100	N
	3	Outside Air Sensor	RO	sword	N/A	Integer value 327 to -327	N
	100	Zone 1 Thermistor Temp (hundredths)	RO	sword	N/A	Integer value 32727 to -32727	N
	101	Zone 2 Thermistor Temp (hundredths)	RO	sword	N/A	Integer value 32727 to -32727	N
	102	Humidity sensor (hundredths)	RO	sword	N/A	Integer value 32727 to -32727	N
	103	Outside Air Sensor (hundredths)	RO	sword	N/A	Integer value 32727 to -32727	N
	200	Zone 1 Thermistor Temp	RO	float	N/A	IEEE754 Floating point (32 bits)	N
	202	Zone 2 Thermistor Temp	RO	float	N/A	IEEE754 Floating point (32 bits)	N
	204	Humidity sensor	RO	float	N/A	IEEE754 Floating point (32 bits)	N
	206	Outside Air Sensor	RO	float	N/A	IEEE754 Floating point (32 bits)	N
Digital Inputs							
Discrete Input (FC2)	0	HVAC 1 Lockout	RO	bit	N/A	0 = off and 1 = on based on Reg 1204	N
	1	HVAC 2 Lockout	RO	bit	N/A	0 = off and 1 =on based on Reg 1204	N
	2	HVAC 1 Control Voltage Loss	RO	bit	N/A	0 = off and 1 =on	N
	3	HVAC 2 Control Voltage Loss	RO	bit	N/A	0 = off and 1 =on	N
	4	HVAC 1 Econ Status	RO	bit	N/A	0 = off and 1 =on	N

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	5	HVAC 2 Econ Status	RO	bit	N/A	0 = off and 1 =on	N
	6	Smoke Detector Status	RO	bit	N/A	0 = off and 1 =on based on Reg 1205	
	7	Hydrogen Sensor Status	RO	bit	N/A	0 = off and 1 =on based on Reg 1206	
	8	Gen Run Status	RO	bit	N/A	0 = off and 1 =on based on Reg 1207	
Digital Outputs							
Read coil/output (FC1)	0	HVAC 1 Fan (G)	RO	bit	N/A	0 off, 1 on	N
	1	HVAC 1 Cooling (Y1)	RO	bit	N/A	0 off, 1 on	N
	2	HVAC 1 Force Mech Cooling (2)	RO	bit	N/A	0 off, 1 on	N
	3	HVAC 1 Heating (W)	RO	bit	N/A	0 off, 1 on	N
	4	HVAC 1 Cool2/Heat Pump (Y2/O)	RO	bit	N/A	0 off, 1 on	N
	5	HVAC 1 Emerg Ven Mode (MAR)	RO	bit	N/A	0 off, 1 on	N
	6	HVAC 2 Fan (G)	RO	bit	N/A	0 off, 1 on	N
	7	HVAC 2 Cooling (Y1)	RO	bit	N/A	0 off, 1 on	N
	8	HVAC 2 Force Mech Cooling (2)	RO	bit	N/A	0 off, 1 on	N
	9	HVAC 2 Heating (W)	RO	bit	N/A	0 off, 1 on	N
	10	HVAC 2 Cool2/Heat Pump (Y2/O)	RO	bit	N/A	0 off, 1 on	N
	11	HVAC 2 Emerg Ven Mode (MAR)	RO	bit	N/A	0 off, 1 on	N
	12	HVAC Lockout Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N
	13	High Building Temp L2 Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N
	14	High Building Temp L1 Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N
	15	Low Building Temp Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N
	16	Smoke Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	17	Control Voltage Lost Alarm	RO	bit	N/A	1 off, 0 on. Output energized when not in alarm.	N
Operation/Status							
Holding Register (FC3/6/16)	100	Controlling Temperature	RW	word		Write will override internally calculated value based on Reg 1001. Write of 65535 will resume local operation.	N
	101	Outside Air Temperature	RW	word		Write will override internally calculated value. Write of 65535 will resume local operation.	N
	102	Operational Cooling Setpoint	RW	word		Write will override internally calculated value. Write of 65535 will resume local operation.	N
	103	Operational Econ Setpoint	RW	word		Write will override internally calculated value. Write of 65535 will resume local operation.	N
	104	Operational Heating Setpoint	RW	word		Write will override internally calculated value. Write of 65535 will resume local operation.	N
	105	Model 600 Control Mode	R	word	N/A	Enumerated low byte: 1 = Heat 2, 2 = Heat 1, 3 = Off, 4 = Econ 1, 5 = Econ 2, 5 = Cool 1, 6 = Cool 2, 7 = Cool 3, 8 = Cool 4	N
	106	HVAC Bypass Mode	RW	word	N/A	Enumerated low byte: 1 = Heat 1, 2 = Off, 3 = Econ, 4 = Cool 1, 5 = Cool 2. High byte is the number of minutes for bypass or 0 for return to local operation.	N

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	107	Comfort Mode	RW	word	0	Not 0 = enable comfort mode 0 = disable comfort mode	
	108	Lead Switch	RW	word	0	not 0 = Switch 0 = resume local operation (reading gives 1 or 2)	N
	109	Econ Disable	RW	word	0	not 0 = Disable economizer, 0 = resume local operation	N
	110	HVAC Shutdown	RW	word	0	0 = Remove remote shutdown, not 0 = Enable remote shutdown	N
	111	Adjusted Outside Air L2 Setpoint	RO	word		Current L2 setpoint with adjustments	N
	112	Adjusted Outside Air L1 Setpoint	RO	word		Current L1 setpoint with adjustments	N
Alarm Status							
Holding Register (FC3/6/16)	200	High Level 2 temperature alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	201	High Level 1 temperature alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	202	Low temperature alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	203	High Humidity Alarm	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	204	HVAC 1 Lockout alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	205	HVAC 2 Lockout alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	206	HVAC 1 Control Voltage Loss	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	207	HVAC 2 Control Voltage Loss	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	208	Smoke alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	209	Hydrogen alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
	210	Generator running alarm status	RW	word	0	0 = inactive, 1 = active, any write clears active alarm	N
Configuration							
Holding Register (FC3/6/16)	1000	Temperature Units	RW	word	0	0 = F, 1 = C	Y
	1001	Control Sensor Scheme	RW	word	0	Enumerated: 0 = use onboard zone sensor, 1 = use remote zone sensor, 2 = use average of both sensors, 3 = use high of both sensors	Y
	1002	HVAC Type	RW	word	0	0 = dx1, 1 = dx2, 2 = hp	Y
	1003	HVAC Control	RW	word	0	0 = Lead/Lag, 1 = Lead/Standby	Y
	1004	Economizer Type	RW	word	0	0 = none, 1 = Quest, 2 = integrated	Y
	1005	Fan Mode	RW	word	0	0 = auto, 1 = Lead always on, 2 = both always on	Y
	1006	Residual Fan Delay	RW	word	30	0-300 seconds	Y
	1007	Restart Delay	RW	word	0	0-900 seconds	Y
	1008	Gen Run Mode	RW	Word	0	0= All Auto, 1 = Econ disabled.	Y
	1009	Smoke Detect Mode			0	0=ALL HVAC units OFF, 1=Econ mode disabled.	
	1010	Modbus Address	RW	word	0	0-247	Y
	1011	Baud Rate	RW	word	1	Enumerated: 0 – 9600, 1 – 19200, 2 – 38400, 3 – 57600, 4 – 76800	Y
	1012	Front Panel Access Code	RW	word	11	0 = disable, 11-99 to enable	Y

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	1013	Front Panel Program Menu Lockout	RW	word	0	0 = allow, 1 = don't allow	Y
Local Setpoints							
Holding Register (FC3/6/16)	1100	Cooling Setpoint	RW	word	80	60-110 degrees	Y
	1101	Econ Setpoint	RW	word	75	60-110 degrees	Y
	1102	Comfort Mode Cooling delta	RW	word	5	1-20 degrees	Y
	1103	Cooling off delta	RW	word	2	1-20 degrees	Y
	1104	Heating Setpoint	RW	word	55	30-70 degrees	Y
	1105	Comfort Mode Heating Delta	RW	word	10	1-20 degrees	Y
	1106	%RH control setpoint	RW	word	0	20-100%RH, 0= disabled	Y
	1107	%RH control off delta	RW	word	20	2-50%RH	Y
	1108	Dehumidify Cool SPT	RW	word	65	60-110	Y
	1109	Dehumidify Heat SPT	RW	word	65	30-70	Y
	1110	Cool stage 2 delta	RW	word	2	1-10 degrees	Y
	1111	Cool stage 3 delta	RW	word	2	1-10 degrees	Y
	1112	Cool stage 4 delta	RW	word	2	1-10 degrees	Y
	1113	Heat stage 2 delta	RW	word	2	1-10 degrees	Y
	1114	OSA L2 SPT	RW	word	65	45-90 degrees	Y
	1115	OSA L1 SPT	RW	word	62	45-90 degrees	Y
	1116	L1/L2 Max Change	RW	word	5	0-10 degrees	Y
	1117	OSA Dwell Seconds	RW	word	60	60-900 seconds	Y
	1118	RH Econ Disable SPT	RW	word	0	0-100 percent, 0 = disable	Y
	1119	Comfort Mode Minutes	RW	word	60	0-240 Minutes, 0 = disable	Y
	1120	Lead Switch Hours	RW	word	168	0-336 hours, 0 = disable	Y
	1121	Stage Min On Secs	RW	word	120	30-600 Seconds	Y

Function Code	Register	Description	Read/ Write	Type	Default	Notes	Non-volatile
	1122	Stage Min Off Secs	RW	word	120	30-600 Seconds	Y
Alarm Settings							
	1200	High temperature level 2	RW	word	90	70-140 = degrees	Y
	1201	High temperature level 1	RW	word	85	70-140 = degrees	Y
	1202	Low temperature level	RW	word	50	20-60 = degrees	Y
	1203	High Humidity Alarm	RW	word	0	0-100 = %RH (0 disables)	Y
	1204	HVAC Lockout	RW	word	0	Enumerated: 0 = disable, 1 = normally open (closure alarms), 2 = normally closed (open alarms)	Y
	1205	Smoke Alarm input	RW	word	0	Enumerated: 0 = disable, 1 = normally open (closure alarms), 2 = normally closed (open alarms)	Y
	1206	Hydrogen Gas Alarm Input	RW	word	0	Enumerated: 0 = disable, 1 = normally open (closure alarms), 2 = normally closed (open alarms)	Y
	1207	Generator Run Alarm Input	RW	word	0	Enumerated: 0 = disable, 1 = normally open (closure alarms), 2 = normally closed (open alarms)	Y
Misc.	1300	Product ID	RO	word	600	600	N
	1301	Firmware Revision	RO	word		A.B.C.D in 4-bit numbers	N
	1302	Reset	RW	word		Must write 57005 to data register for reset	N

Appendix B – Control Output Matrix

The following matrixes show which outputs are on for the various control modes displayed on the front panel and available through Modbus. The Econ control modes are only present when the System Setup has Integrated or Quest Econ mode enabled.

Single Stage DX				
	Lead/Lag Mode		Lead/Standby Mode	
Mode	Lead	Lag	Lead	Standby
ECON1	G, Y1		G, Y1	
ECON2	G, Y1	G, Y1		
COOL1	G, Y1, 2		G, Y1, 2	
COOL2	G, Y1, 2	G, Y1, 2		
HEAT1	G, W		G, W	
HEAT2	G, W	G, W		

Two Stage DX				
	Lead/Lag Mode		Lead/Standby Mode	
Mode	Lead	Lag	Lead	Standby
ECON1	G, Y1		G, Y1	
ECON2	G, Y1	G, Y1	G, Y1	
COOL1	G, Y1, 2		G, Y1, 2	
COOL2	G, Y1, 2, Y2		G, Y1, 2, Y2	
COOL3	G, Y1, 2, Y2	G, Y1, 2		
COOL4	G, Y1, 2, Y2	G, Y1, 2, Y2		
HEAT1	G, W		G, W	
HEAT2	G, W	G, W		

Heat Pump DX				
	Lead/Lag Mode		Lead/Standby Mode	
Mode	Lead	Lag	Lead	Standby
ECON1	G, Y1, O		G, Y1, O	
ECON2	G, Y1, O	G, Y1, O		
COOL1	G, Y1, 2, O		G, Y1, 2, O	
COOL2	G, Y1, 2, O	G, Y1, 2, O		
HEAT1	G, W		G, W	
HEAT2	G, W	G, W		

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