

# Basyx VAV / VVR

## Variable Air Volume Controller

### Programming & Operation Manual

VAV/VVR-POM Revision 4.2

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## OVERVIEW

The BASYX VAV controller is a self-contained unit which provides pressure-independent operation of variable air boxes or volume dampers. The unit is designed for cooling only, standard reheat or fan-powered reheat style boxes. The unit is also available in the VVR configuration, which is used in retrofit applications where existing 3-wire floating motors are available for use.

## SEQUENCE of OPERATION

The VAV/VVR controls space temperature through a combination of damper and fan/reheat control. Individual cooling and heating setpoints allow for deadbands to be implemented to increase comfort, as well as reduce energy consumption. Pressure differential sensing of air flow velocities insures accurate damper control to maintain the optimum air flow for space conditions.

## TIME SCHEDULING

The VAV/VVR will honor one (1) time schedule from the first (address 1) PSC board in a complete BASYX automation and temperature control system. The VAV/VVR controllers will access any one (1) of the 12 time schedules, and will operate every day of the week under the selected time frame. If weekend, or daily changes are required, a logic program may be entered into the PSC to manipulate various time schedule arrangements (contact TMS for further details on this function).

## UNOCCUPIED SETPOINT OPERATION

The VAV/VVR system may be controlled through unoccupied setpoints on systems where it is desirable for the air handling equipment to run 24 hours per day. Systems which are marginal in air capacity may severely limit recovery after an extended shutdown, and the VAV/VVR will increase the cooling setpoint and reduce the heating setpoint for energy savings during unoccupied hours. When utilizing the unoccupied setpoint function, the box remains in the occupied mode, with setpoint control changing to the unoccupied values.

## DAMPER CONTROL

### Damper Occupied Mode

During the occupied mode the VAV/VVR constantly monitors the space conditions, and a sophisticated PID algorithm resets the required CFM air flow required to maintain the desired cooling setpoint. This reset is based on the user defined minimum air / maximum air flow setpoints, where the damper control is applied to maintain the CFM setpoint as determined by the controller. This type of control eliminates the hunting, and the eventual full stroke of the damper with systems using direct space temperature control only.

If desired, a reverse mode heating setpoint may be entered on systems which have heating available in the air handler or rooftop unit, typically used for morning warmup. If the entering air to the box rises above this setpoint, the logic of the damper will be reversed so that the damper operates as a heating device (open for warmer, close for cooler). If using the reverse mode, a user defined reverse mode cooling setpoint is entered to return the damper to normal cooling operation (open for cooler, close for warmer).

## Damper Unoccupied Mode

During unoccupied hours, and without the unoccupied setpoint control utilized, the damper will close. If using the unoccupied setpoint control, the normal logic will control the damper to maintain the unoccupied cooling setpoint.

## HEATING CONTROL

### Heating Occupied Mode

During occupied modes the VAV/VVR monitors the space temperature and will enable up to four (4) stages of fan/heat to maintain the heating setpoint. Each of the stages has an offset setpoint, and will enable the desired stage if the space temperature falls below the heating setpoint minus the particular offset. The output will disable if the temperature rises above the previous stage offset. Typically output 1 is used for fan control on a fan-powered reheat box, which will attempt to use plenum air as the first stage of heating. On standard non-fan powered boxes, a minimum air setpoint of approximately 40% of the box maximum air flow must be used to insure sufficient air flow across the heating coils.

**IT IS IMPORTANT TO NOTE THAT NO REFERENCE TO AIR FLOW IS APPLIED TO HEATING LOGIC. HEAT STAGES WILL OPERATE BASED ON SPACE TEMPERATURE CONDITIONS ONLY. INSURE THAT ALL SAFETY CONTROLS ARE OPERATING PROPERLY ON THE REHEAT BOX.**

The VAV/VVR also contains one (1) analog output which will control a modulating reheat valve to maintain the heating setpoint. The hardware supports normally closed or open valves, and allows setup for direct or reverse acting operation.

### Heating Unoccupied Mode

During unoccupied hours, and without unoccupied setpoint control utilized, the heating stages will be disabled and the reheat valve will close. If using the unoccupied setpoint control, the normal logic will control the heat stages or reheat valve to maintain the unoccupied heating setpoint.

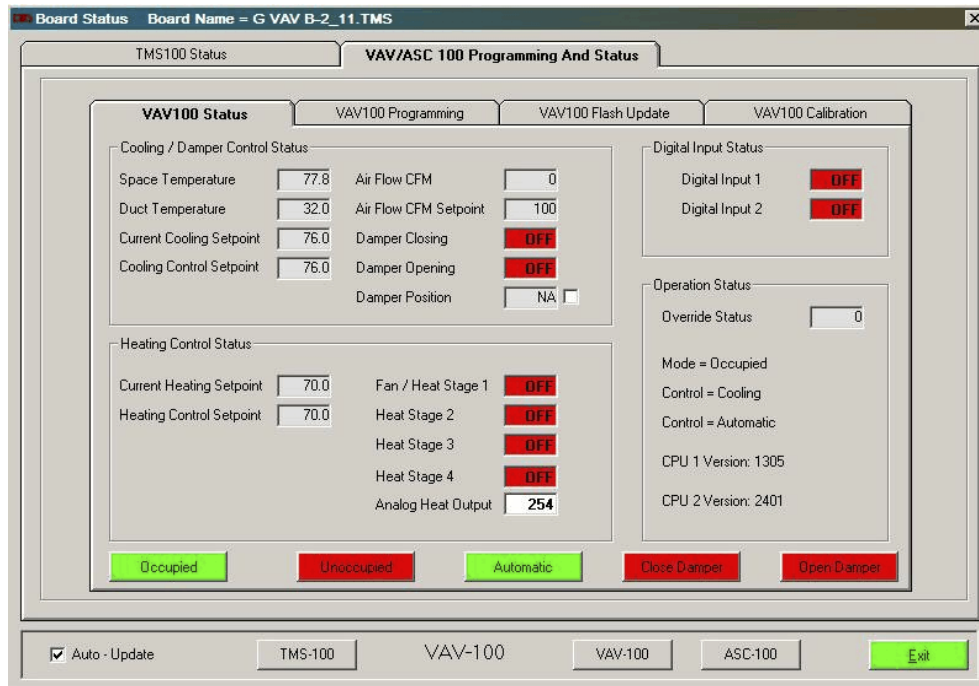
## CONTROLLER STATUS

The TriComm software will automatically detect the presence of the VAV100, and will display the VAV status screen. Unlike the standard TMS150 or 100 controllers, all programming and setup is performed through the VAV screen. After selecting the board from the status menu, the display shows four (4) control tabs across the top of the screen:

<b>VAV/VVR Status</b>	Shows current operation status of the controller
<b>VAV/VVR Programming</b>	All programming of setpoints are set through this screen
<b>VAV/VVR Flash Update</b>	Allows flash downloading of operating firmware
<b>VAV/VVR Calibration</b>	Displays velocity sensor calibration figures

## VAV/VVR STATUS TAB

To view the controller status screen, click the "VAV/VVR Status" tab along the top of the screen.



### Cooling / Damper Control Status Section:

Space Temperature:	Indicates current space temperature.
Duct Temperature:	Indicates current supply air temperature at inlet of box.
Current Cooling Setpoint:	Displays the current damper occupied / unoccupied control setpoint.
Cooling Control Setpoint:	Displays the current damper operating setpoint for the box. This is the cooling base setpoint plus/minus adjustment through the slidebar on the space sensor and will reflect any manual adjustment of the setpoint up or down 2 degrees.
Air Flow CFM:	Shows the current air flow through the box in cubic feet per minute (CFM).
Air Flow CFM Setpoint:	Indicates the current operating CFM setpoint as calculated by the controller.
Damper Closing:	Shows that the current status of the damper is closing if ON.
Damper Opening:	Shows that the current status of the damper is opening if ON.
Damper Position:	Shows the actual position of the damper actuator. This is only available if an optional 0-10k feedback is available on the actuator (special order).

## Heating Control Status Section

Current Heating Setpoint:	Displays the current occupied or unoccupied heating control setpoint.
Heating Control Setpoint:	Displays the current heating operating setpoint for the box. This is the heating base setpoint plus/minus adjustment through the slidebar on the space sensor and will reflect any manual adjustment of the setpoint up or down 2 degrees.
Fan/Heat Stage 1:	Displays the current status of digital output 1, which is used for fan or stage 1 heating.
Heat Stage 2:	Displays the current status of digital output 2, or stage 2 heating.
Heat Stage 3:	Displays the current status of digital output 3, or stage 3 heating.
Heat Stage 4:	Displays the current status of digital output 4, or stage 4 heating.
Analog Heat Output:	Displays the current value of the analog output (0-255), which is used for a 0-10vdc modulating reheat valve.

## Digital Input Status Section

Digital Input 1:	Shows the current status of digital input 1 which is used for the manual override option provided by the button on the room sensor. If override is not used, the point is for user reference only and does not perform any specific control function.
Digital Input 2:	Shows the status of digital input 2. This point is for user reference only, and does not perform any specific control function.

## Operation Status Section

Override Status:	This indicates the current override status of the box, and is reserved for future enhancements to the system.
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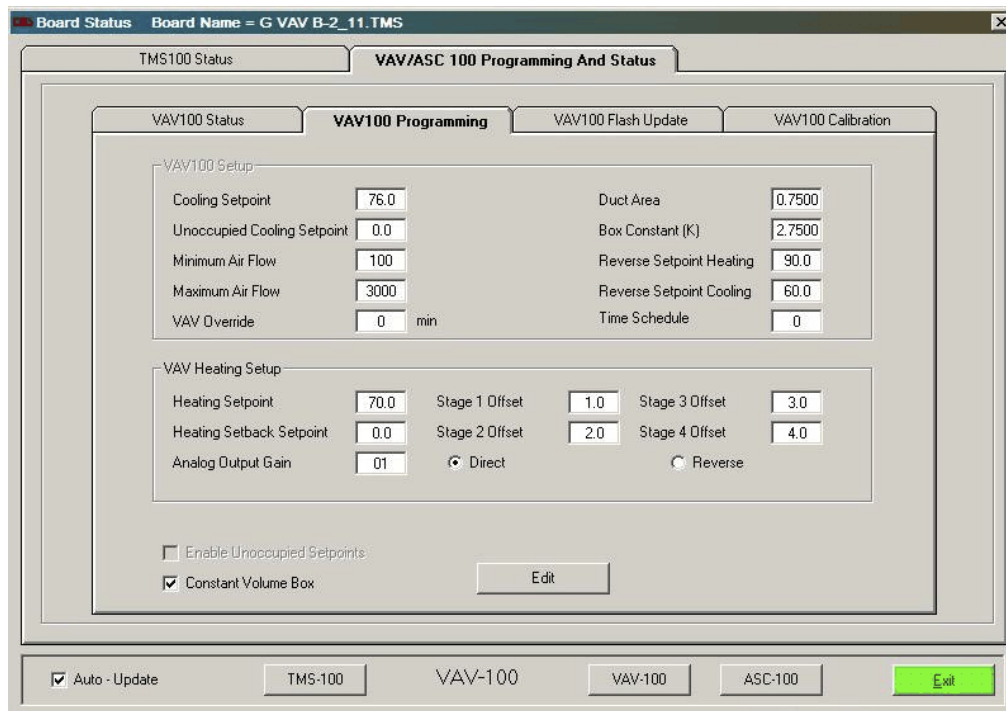
This section also indicates the current operation mode of the controller and indicates the CPU firmware version.

## Status and Control Buttons (Across Bottom of Screen)

Occupied:	Will display green if the system is occupied, and red if the system is unoccupied. Clicking on this button will manually set the controller to the occupied mode.
Unoccupied:	Will display green if the system is unoccupied, and red if the system is occupied. Clicking on this button will manually set the controller to the unoccupied mode.
Automatic:	Will display green if the system is in automatic mode. Clicking this button will return the controller to automatic control.
Close Damper:	Clicking this button will manually drive the damper motor to the closed position.
Open Damper:	Clicking this button will manually drive the damper actuator open.

## VAV/VVR PROGRAMMING TAB

To enter the controller programming mode, click the “VAV/VVR Programming” tab along the top of the screen.



### VAV/VVR Setup Section

- Cooling Setpoint:** Sets the desired occupied cooling setpoint for the space. This setpoint controls the operation of the damper actuator.
- Unoccupied Cooling Setpoint:** Sets the desired cooling setpoint for the space during unoccupied periods, and controls the operation of the damper actuator.
- Minimum Air Flow:** Sets the desired minimum CFM air flow for the box. The algorithm will always maintain at least this much air flow regardless of space conditions.
- Maximum Air Flow:** Sets the desired maximum CFM air flow for the box. The system limits the amount of air flow to this value regardless of space conditions.
- VAV Override Time:** Sets the override time in minutes used with the override button on the room sensor.
- Duct Area (sq ft):** Sets the box duct size - Refer to Addendum 1 for typical box manufacturers and corresponding box size. May be manually calculated by using the following formula:  
$$3.1415 \times R^2 / 144$$
- Box Constant (K):** Sets the manufacturers flow constant - Refer to Appendix 2 of the VAV/VVR installation manual.
- Reverse Setpoint Heating:** Sets the incoming duct supply air temperature at which the box will reverse damper operation to heating mode.
- Reverse Setpoint Cooling:** Sets the incoming duct supply air temperature at which the box will return to normal damper cooling mode operation.
- Time Schedule (1-12):** Sets which time schedule in the TMS150 address 1 that the box will use for occupied/unoccupied mode.

## VAV/VVR Heating Setup Section

Heating Setpoint:	Sets the desired occupied mode heating setpoint for the space. This setpoint is used for the four (4) staged outputs as well the analog heating output.
Heating Setback Setpoint:	Sets the desired unoccupied setpoint for the space, and will control the four (4) staged outputs and analog heating output.
Analog Output Gain:	Sets the gain value for the modulating reheat valve (analog heating output).
Stage 1 Offset:	Sets the space temperature offset from the Heating Setpoint that the first digital output will turn ON. Output 1 will go OFF when the space temperature rises to the Heating Setpoint.
Stage 2 Offset:	Sets the space temperature offset from the Heating Setpoint that digital output 2 will turn ON. Output 2 will go OFF if the space temperature rises to the Stage 1 Offset.
Stage 3 Offset:	Sets the space temperature offset from the Heating Setpoint that digital output 3 will turn ON. Output 3 will go OFF if the space temperature rises to the Stage 2 Offset.
Stage 4 Offset:	Sets the space temperature offset from the Heating Setpoint that digital output 4 will turn ON. Output 4 will go OFF if the space temperature rises to the Stage 3 Offset.

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Programming Note: The digital heating outputs do NOT link to the current CFM air flow and can operate regardless of box air flow. Make sure that all box safety devices (air flow switch, klixon type heat switch, etc.) air working properly before activating the box operation.

**Damage to heater elements and a potential fire hazard may occur if safeties are disconnected or non-operational.**

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## Programming Check Boxes

Direct / Reverse:	Sets operation mode of the heating analog output. If Direct button is checked, the output increases upon a space temperature increase (normally open valve). If the Reverse button is selected, the output decreases on a rise in space temperature (normally closed valve).
Constant Volume Box:	If this button is checked, the fan output (DO #1) will run constantly during occupied mode. <b>Remember that if unoccupied setpoints are used, the fan output will be activated during occupied or unoccupied operation.</b>

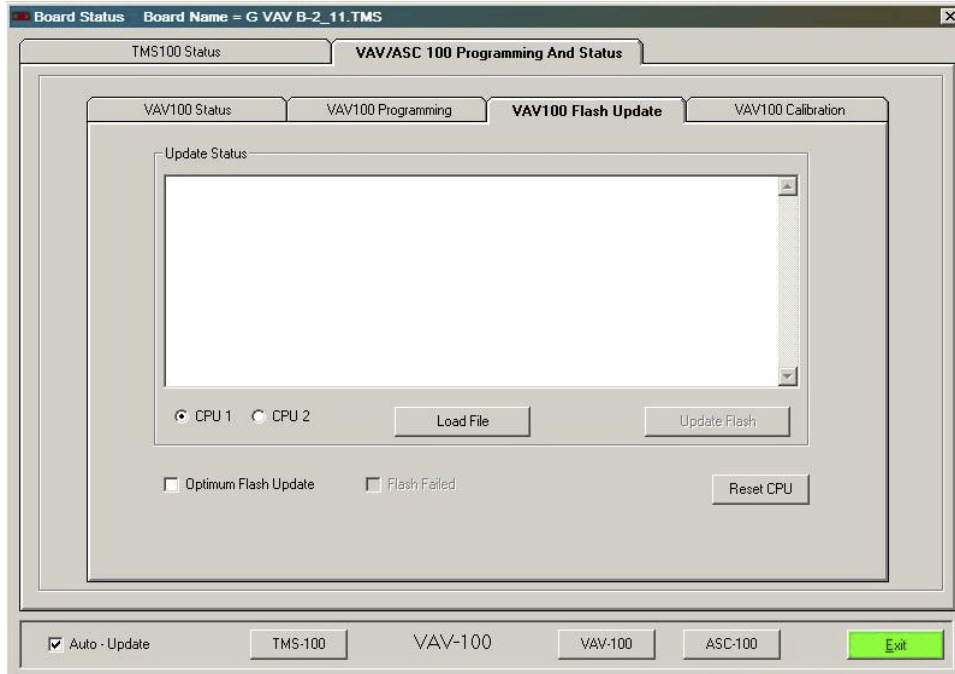
## Modifying System Setpoints

To modify any of the setpoints under the VAV/VVR Programming Tab, click the **EDIT** button at the bottom of the page, you will notice that the text in the button will change to **SEND TO CONTROLLER**.

Make any required changes, then click the **SEND TO CONTROLLER** button. Once the data has been sent to the controller, and the computer board file has been updated, the button will return to **EDIT**.

## VAV/VVR FLASH UPDATE TAB

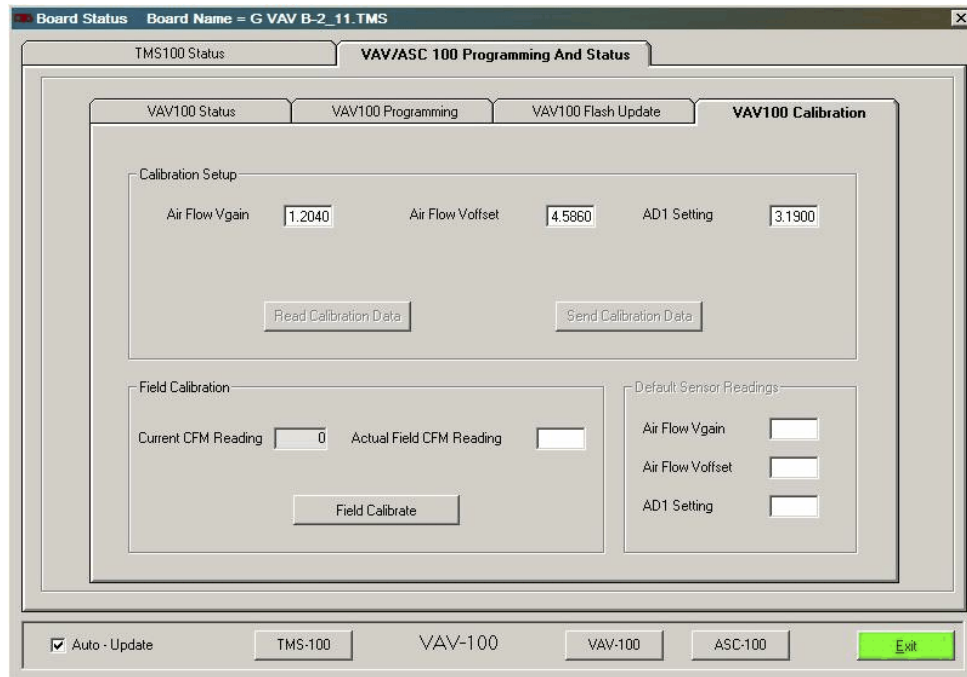
This section allows firmware upgrades to be performed through a telephone connection or direct computer connection.



*This is a factory/distributor use area only, and requires no access during normal system setup.*

Please consult your local distributor or Triangle MicroSystems for additional information about firmware updates and other operation details for this section.

## VAV/VVR CALIBRATION TAB



### Calibration Setup Section

This section contains the calibration values for the on-board velocity sensor, and are factory calibrated. No changes are normally required under this section. See the FIELD CALIBRATION section for details on calibrating the sensor to match actual air balance readings.

### Field Calibration Section

This section is used by installation personnel or air balance technicians to calibrate the velocity sensor to match actual air flow readings.

**Current CFM Reading:** Indicates the current air flow CFM as read by the velocity sensor

- To calibrate the sensor:
- (1) Highlight the Actual Field CFM Reading box and enter the actual air flow as determined by the air balance readings.
  - (2) Left-Click on the FIELD CALIBRATE button at the bottom of the section.
  - (3) The button will indicate calibration in process, and will return to Field Calibrate when finished. The calibration numbers in the Calibration Setup Section will be adjusted to provide the sensor calibration as required.

## ABOUT THE BASYX PRODUCT LINE

The VAV/VVR is one product in a line of BASYX control products. The TriComm interface software package is a Windows based human interface used with the BASYX automation and control system. TriComm will operate on any personal computer with the Windows 95,95,ME,NT,2000 or XP operating system.

The program provides a simple interface through direct connect, modem or internet to setup, operate and modify the operating parameters of the BASYX system, using easy to understand point-and-click commands. The drop-down system menus allow access to all system functions, and requires minimal computer experience for normal daily interaction with the system.

The BASYX system is designed specifically to meet today's building automation, facility and energy management needs. Triangle MicroSystems, Inc. develops and provides application support for control systems around the world. The company has a continuing commitment to research and development in order to provide new and improved products to the building automation market.

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