Application Guide

Symbio™ 700 Controller

with Voyager 3 Packaged Rooftop Air Conditioners

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

April 2024

BAS-APG048C-EN

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

⚠ WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

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Revision History

- Updated Supply Air Tempering (VVDA).
- Updated Modulating Gas Heat - Thermostat Control chapter.
- Updated Dehumidification - Hot Gas Reheat chapter.
- Updated Modulating Gas Heat chapter.
- Updated and added Modulating Gas Heat diagnostics table in Troubleshooting chapter.
- Updated Diagnostics and Alarm Indicator Status table.
- Added Refrigerant Detection and Mitigation chapter.
- Added services test step for High Speed Fan Econ Open.
- Added Symbio 700 Configuration (Appendix B).

Table of Contents

Introduction

The Symbio™ 700 installed on Voyager™ 3 rooftop units is a factory installed and programmed controller, providing digital control and protection of the equipment.

The Symbio 700 has two model options:

- **Standard controller** — provides advanced troubleshooting and access to the Symbio Service and Installation mobile app.
- **Advanced controller** — Building Automation System interface via BACnet® (ANSI/ASHRAE Standard 135-2016), Modbus™, Air-Fi®, or LonTalk®. Also allows TPG2 and up to eight additional I/O via XM30 or XM32 expansion modules.

The Symbio 700 offers multiple equipment configuration options regardless of controller model. The Voyager rooftop unit can be configured as the following system types:

- Conventional Thermostat Control (T-Stat)
- Constant Volume Zone Temperature Control (CVZT)
- Variable Volume Zone Temperature Control (VVZT)
- Variable Volume Discharge Air (VVDA)

These configurations can be used with standard cooling systems.

This guide provides information about the configuration, control capabilities and troubleshooting of the Voyager system with Symbio 700 controller.

Additional Documentation

- *Quick Start Guide, Symbio™ Service and Installation App* (BAS-SVN043*-EN)
- *User Guide, Symbio™ 700* (BAS-SVU054*-EN)
- *Integration Guide, BACnet® and Modbus™ Integration to Voyager 3 Packaged Rooftop Air-Conditioners with Symbio™ 700 Controls* (BAS-SVP066*-EN)
- *Integration Guide, LonTalk® Integration to Voyager Packaged Rooftop Air-Conditioners with Symbio™ 700 Controls* (BAS-SVP067*-EN)
- *Installation, Operation, and Maintenance, Packaged Rooftop Air Conditioners, Voyager™ Cooling and Gas/Electric, Standard Efficiency* (RT-SVX034*-EN)

Symbio 700 Overview

Field Connection

The Symbio™ 700 controller optimizes inputs and outputs (I/O) for multiple applications. For initial installation of a Voyager 3 with Symbio 700, the field landed inputs are outlined below.

Figure 1. Symbio 700 field connections

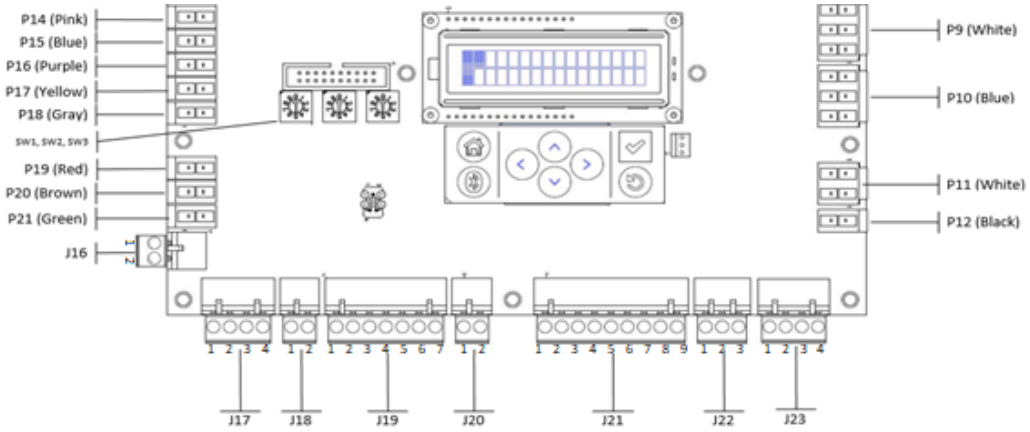


Table 1. Field Connections

Connector	Function	Pin #	Signal
J16	Demand Shed/Demand Limit Connection	1	24VAC
		2	Demand Shed/Demand Limit Input
J17	BACnet Communication Connections	1	BACnet +
		2	BACnet -
		3	BACnet +
		4	BACnet -
J18	Equipment Shutdown Input Connections	1	24VAC
		2	Equipment Shutdown Input
J19	Zone Sensor Connections	1	Zone Temperature
		2	GND
		3	Cool Setpoint
		4	Mode
		5	Heat Setpoint
		6	GND
		7	24VAC
J20	Occupancy Connections	1	24VAC
		2	Occupancy Switch

Table 1. Field Connections (continued)

Connector	Function	Pin #	Signal
J21	Thermostat Connections	1	24VAC
		2	Y1
		3	W1/O
		4	G
		5	W2
		6	Y2
		7	X2
		8	1.5K Ohms Pull-down
		9	GND
J22	Space CO_2	1	24VDC
		2	0-10 VDC input
		3	GND
J23	Space Relative Humidity	1	24VDC
		2	4-20 mA input
		3	GND

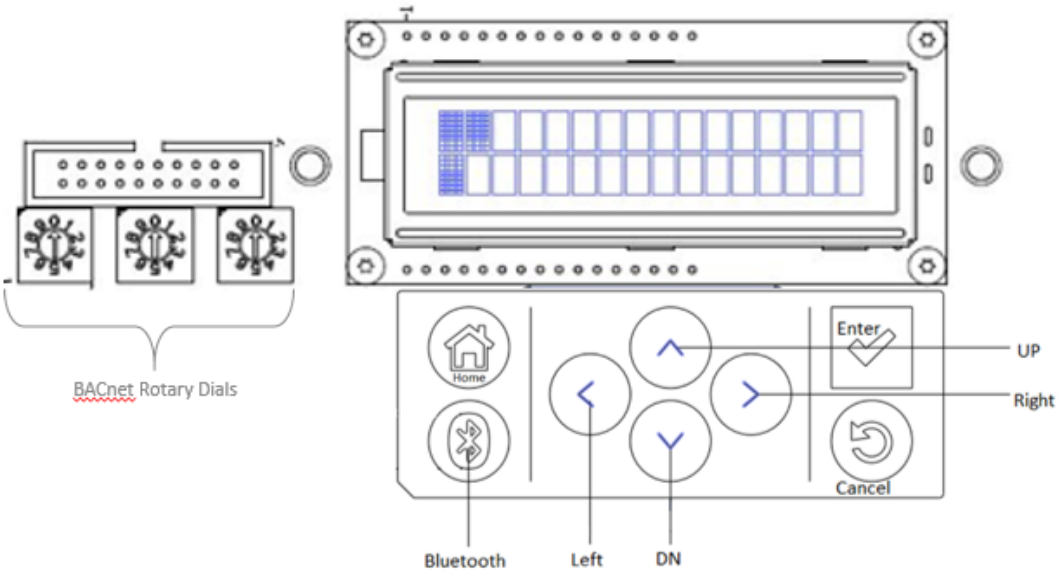
Unit Configuration

The Voyager 3 system can be configured via an onboard user interface or via the Symbio Service and Installation mobile app, see “Voyager 3 Configuration,” p. 81 for configuration options and descriptions.

Onboard User Interface

The onboard user interface provides a 2 x 16 Backlit LCD display and navigational buttons. This allows the user to view status, configure, and troubleshoot the unit without additional tools.

Figure 2. Symbio 700 onboard user interface



The interface provides an intuitive menu structure: alarms, status, service, settings, and utilities. Configuration of the unit is accomplished under the utilities menu item. A complete list of functions is outlined in *User Guide, Symbio™ 700* (BAS-SVU054*-EN).

To configure the unit, navigate to the utilities menu and press **Enter**. Once in the utilities menu the user has additional submenu options. This allows the user to navigate and configure the appropriate setting quickly and easily.

Mobile App

The Trane Symbio™ Service and Installation mobile app is required to setup, edit, and confirm the communication protocol and associated settings.

The free download of Trane Symbio Service and Installation mobile app is available on the App Store® for iOS, and on Google Play® for Android™.

Figure 3. Trane Symbio service and installation mobile app

Bluetooth Pairing

Quick Connection Instructions

Follow these instructions to quickly connect the mobile app to the Symbio™ 700 controller:

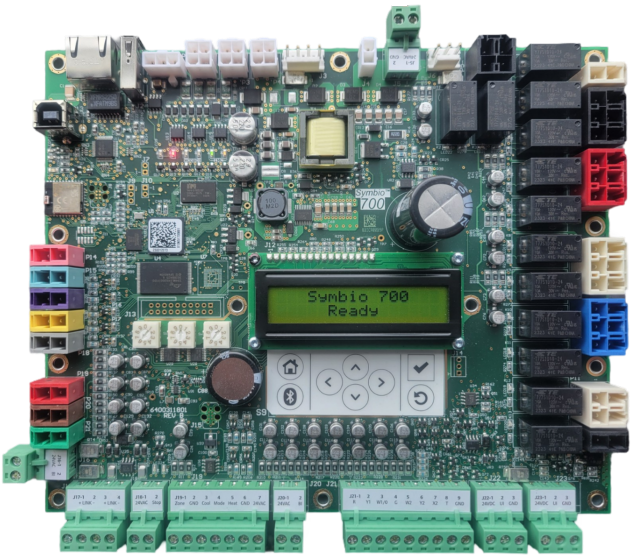
1. Turn on Bluetooth®[1].
2. Tap  .
3. Start the app. Tap **View Available Devices**.
4. Select the controller.
5. Tap **OK** to pair.
6. Tap  .

Connecting to the Symbio™ 700 controller

1. Enable Bluetooth®[1] on your smart device.
2. Access the Symbio 700 controller in the low voltage portion of the equipment.

1. *The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by the company is under license.*

Figure 4. Symbio 700 controller

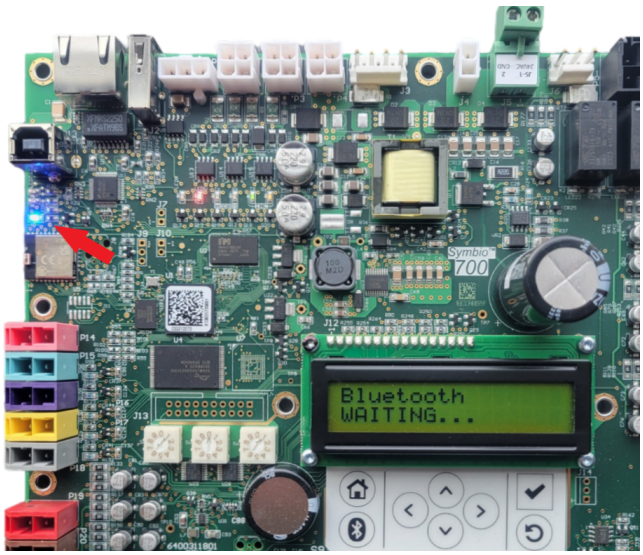


3. Tap  on Symbio 700 keyboard/display to turn on Bluetooth.
4. Confirm the status of Bluetooth communications. A solid blue LED indicates a successful pairing.

Table 2. Bluetooth communication status

	Blue LED	Display	Description
Tap for On/Off	Off	NOT CONNECTED	Bluetooth Off
	Blinking	WAITING...	Bluetooth On — Not Paired
	On Solid	CONNECTED	Bluetooth On — Connected/ Paired

Figure 5. Symbio 700 bluetooth status



5. Start the mobile app on your smart device.

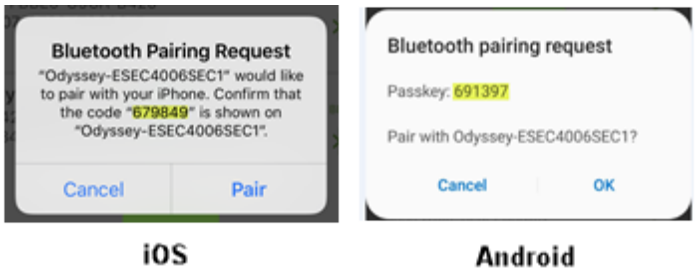
Figure 6. Login screen

6. On the login screen, tap **View Available Devices** in the lower section of the screen. Or Trane personnel can login using their Trane Connect username and password.
7. On the Unit List page, select the Symbio 700 controller to which you want to pair. If the controller is not listed, tap the refresh arrow in the upper right-hand corner of the screen.

Note: *If a Symbio 700 is not the original Symbio controller as shipped with the equipment, the Bluetooth equipment list will list the controller serial number, instead of the equipment serial number.*

8. When prompted, pair the app to the Symbio 700 controller. A popup message displays a 6-digit random number. The same number is shown on the display of the Symbio™ 700 controller until the pairing is complete, allowing the user to confirm connection to the intended controller.

Figure 7. Bluetooth pairing



9. Tap ✔ on the Symbio 700 on-board keyboard/display to complete the connection.

When the LED light is a solid blue and the display reads Bluetooth Connected, the Bluetooth pairing and connection is complete.

Important: *To keep the list of previously-connected devices manageable, the Bluetooth smart devices list is limited to 10 devices. When 10 or more Bluetooth devices are defined on the smart device, connection to the Symbio 700 controller is not allowed.*

- ***iOS devices*** *- delete any unused devices until there are less than 10 items.*
- ***Android devices*** *- the devices list is automatically limited to 10 items.*

The Symbio Installation and Service tool is required to view, manage, and configure the following:

- Building Automation System configuration (Advanced Controller Configuration)
  - BACnet® over Zigbee® (Air-Fi® Wireless)
  - BACnet IP (Internet Protocol)
  - BACnet MS/TP
  - LonTalk®
  - Modbus RTU
  - Modbus TCP
- Historical Alarms
- Firmware Update (includes both the Symbio 700 Module and the Options Modules)
- Backing up and Restoring the database
- Transfer Settings from one controller to another
- Return the Symbio 700 to its Factory Default configuration by using the Factory Default Database (if available)

For more detailed information on the Symbio Service and Installation Mobile Application, refer to *Quick Start Guide, Symbio Service and Installation App* (BAS-SVN043*-EN).

Options Module

The Symbio 700 extends its control capabilities through the use of additional hardware modules. These modules are installed, wired, and tested in the unit when ordered from the factory. The modules can also be field installed. The following table summarizes the Symbio 700 functions that require an additional hardware module.

Table 3. Symbio 700 options

Symbio 700 Function	Customer Options Module	Indoor Options Module	Fresh Air Options Module	Stepper Motor Module
Humidistat	X			
External Auto/Stop	X			
Ventilation Override	X			
Alarm Output	X			
Remote Minimum Position	X			
Condensate Overflow		X		
Electric Heat		X		
VFD Bypass		X		
Duct Static Pressure Control		X		
0 to 100% Economizer			X	
0 to 100% Econoimizer w/Traq			X	
StatiTrac – Building Pressure Control			X	
Relief Fan			X	

Table 3. Symbio 700 options (continued)

Symbio 700 Function	Customer Options Module	Indoor Options Module	Fresh Air Options Module	Stepper Motor Module
Air Filter Status			X	
Dehumidification – Hot Gas Reheat	X	X		X

Start-Up Sequence

Under normal conditions, the Symbio™ 700 will start-up in approximately 60 seconds once power is applied to the system. During this process, the controller checks that a valid system configuration is present and proceeds to normal control operation. After start-up, the system will begin to respond to operational requests.

Conventional Thermostat Sequence of Operation

When the Voyager system is configured to operate with a conventional thermostat, the controller provides protection for the system (see General Support Sequence section) and continues to provide insight to operating conditions. A conventional thermostat can be applied with CVZT and single zone VAV configured systems. While not recommended, a conventional thermostat can be applied to single zone variable volume configured systems, but the system is limited to staged fan control instead of a fully variable sequence.

When under conventional thermostat control, the equipment responds directly to operating requests from the thermostat device. Each thermostat input corresponds to a specific unit function, as described in the following tables. Equipment protection functions and compressor minimum on/off timers remain in-control, even when under conventional thermostat control.

Table 4. Cooling only, without outside air

Inputs						Outputs				
X	**Y1**	**Y2**	**W1/O**	**W2**	**G**	**Supply Fan On/Off Request**	**Supply Fan Speed Request [a]**	**Compressor Cool Stage Request**	**Auxiliary Heat Stage Request**	**Heat Cool Mode Status**
NA	OPEN	OPEN	OPEN	OPEN	CLOSED	ON	Min	None	None	Fan Only
NA	OPEN	OPEN	CLOSED	OPEN	X	ON	Min	None	Stage 1	Heat
NA	OPEN	OPEN	X	CLOSED	X	ON	Min	None	Full Stage	Heat
NA	CLOSED	OPEN	OPEN	OPEN	X	ON	Min	Stage 1/2/3/4	None	Cool
NA	OPEN	CLOSED	OPEN	OPEN	X	ON	Min	Stage 1/2/3/4	None	Cool
NA	CLOSED	CLOSED	OPEN	OPEN	X	ON	Max	Full Stage	None	Cool
NA	X	X	X	X	X	OFF	0	None	None	OFF

Notes:

1. X = Ignored by controller
2. Table priority is left to right, top to bottom.
3. All combinations of inputs not defined in the above table will cause all outputs to be OFF and the Unit Mode to be OFF.
4. For part load Y1 or Y2 cooling requests, Symbio 700 controls will stage the compressors based on Discharge Air Temperature to meet the cooling demand.

[a] Supply Fan Speed Request is used for 2-speed fan and VVZT configured units. VVZT units with thermostat will operate the supply fan as a 2-speed fan unit.

Table 5. Cooling only, with outside air

Inputs								Outputs					
Economizer System Status	X	Y1	Y2	W1/O	W2	G	DCV Fan ON Request	Supply Fan On/Off Request	Supply Fan Speed Request [a]	OA Damper Position Request	Compressor Cool Stage Request	Auxiliary Heat Stage Request	Heat Cool Mode Status
X	NA	OPEN	OPEN	OPEN	OPEN	CLOSED	X	ON	Min	Min	None	None	Fan Only
X	NA	OPEN	OPEN	CLOSED	OPEN	X	X	ON	Min	Min	None	Stage 1	Heat
X	NA	OPEN	OPEN	X	CLOSED	X	X	ON	Min	Min	None	Full Stage	Heat
Enabled	NA	CLOSED	OPEN	OPEN	OPEN	X	X	ON	Min/Max	Econ	0	None	Cool
Enabled	NA	OPEN	CLOSED	OPEN	OPEN	X	X	ON	Min/Max	Econ	0	None	Cool
Enabled	NA	CLOSED	CLOSED	OPEN	OPEN	X	X	ON	Max	Full	Stage 1/2/3/4	None	Cool
Disabled	NA	CLOSED	OPEN	OPEN	OPEN	X	X	ON	Min	Min	Stage 1/2/3/4	None	Cool
Disabled	NA	OPEN	CLOSED	OPEN	OPEN	X	X	ON	Min	Min	Stage 1/2/3/4	None	Cool
Disabled	NA	CLOSED	CLOSED	OPEN	OPEN	X	X	ON	Max	Min	Full Stage	None	Cool
X	NA	X	X	X	X	X	ON	ON	Min	Min	None	None	Fan Only
X	NA	X	X	X	X	X	X	OFF	0	0	None	None	OFF

Notes:

1. X = Ignored by controller
2. Table priority is left to right, top to bottom.
3. All combinations of inputs not defined in the above table will cause all outputs to be OFF and the Unit Mode to be OFF.
4. For part load Y1 or Y2 cooling requests, Symbio 700 controls will stage the compressors based on Discharge Air Temperature to meet the cooling demand.

[a] Supply Fan Speed Request is used for 2-speed fan and VVZT configured units. VVZT units with thermostat will operate the supply fan as a 2-speed fan unit.

Modulating Gas Heat - Thermostat Control

When the Symbio 700, Space Controller is configured for Conventional TStat and modulating gas heat is installed, a discharge air temperature sensor is required for modulating control. On a W1, W2 or W1 +W2 call, gas heat is modulated to deliver discharge air at the Discharge Air Heating Setpoint BAS setpoint (default 100°F).

If the discharge air temperature is invalid, the control will revert to staged control with W1 calling 50% modulating heat capacity and W2 or W1+W2 calling 100% capacity.

Space Temperature Control

System Types of VVZT and CVZT operate to provide space comfort heating and cooling. A system mode wired input or Heat Cool Mode Request input determines the heating or cooling mode of operation. If a heat cool system mode input is not provided, the Symbio™ 700 operates per Heat Cool Mode Request default value, Auto is the default setting. In Auto, the controller will automatically determine it is appropriate to heat or cool based on space temperature, setpoints, and heating/cooling configured for the unit. The space temperature and space temperature setpoints determine a space heating or cooling demand. If space temperature is above the cooling setpoint, this represents a space cooling demand.

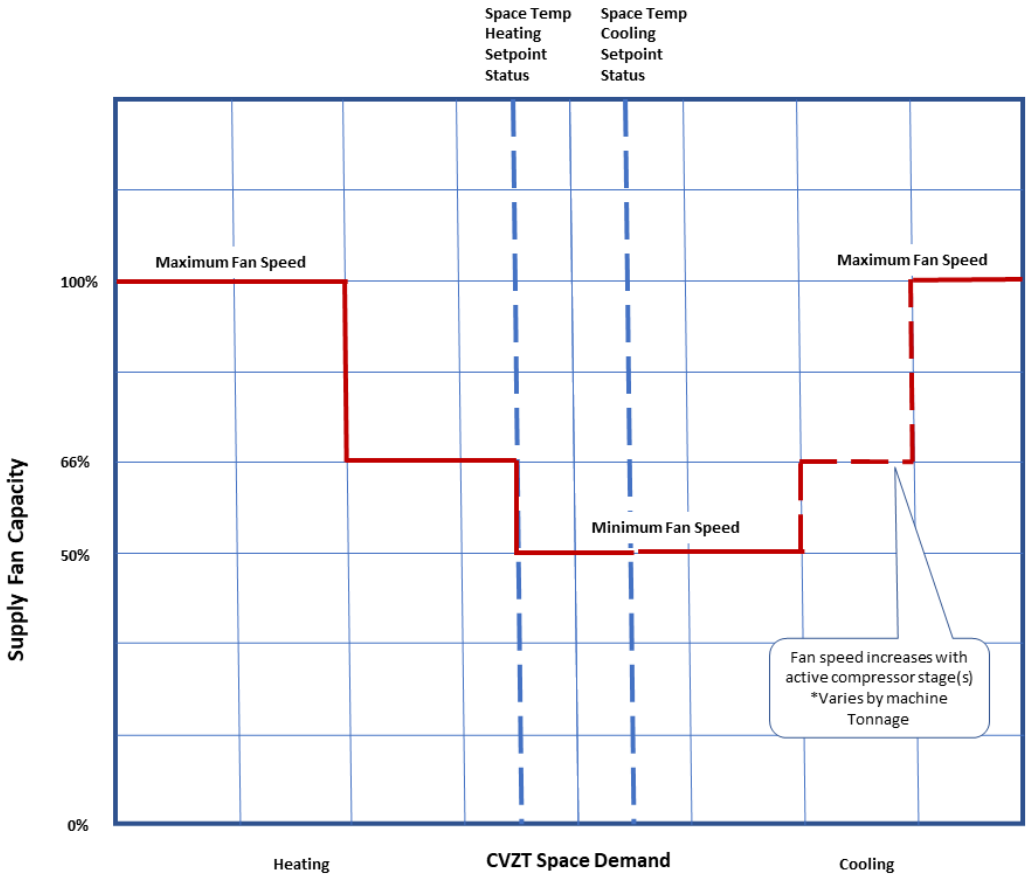
Symbio 700 supports two types of space temperature control: Single Loop Space Temperature Control and Single Zone Variable Air Volume.

Single Loop Space Temperature Control

Configured VVZT and CVZT System Types operate in Single Loop Space Temperature Control when only a space temperature input is provided the Symbio™ 700 control (no discharge air temperature sensor installed). In heating modes, with staged gas heat or staged electric heat installed, the supply fan will operate at maximum speed. In cooling modes, the supply fan will operate at the lowest speed allowed for the stage of cooling capacity and 100% when all compressor stages are on. When space temperature is between the heating and cooling setpoint, the supply fan operates at a minimum speed. Alternately, the supply fan can be setup to cycle off when there is no demand for heating or cooling via Supply Fan Configuration Command setting.

Cooling capacity increases as space temperature increases above the cooling setpoint. Heat capacity increases when space temperature decrease below the heating setpoint. Capacity decreases has space temperature approaches the desired space setpoint.

Figure 8. Multi-speed fan sequence of operation



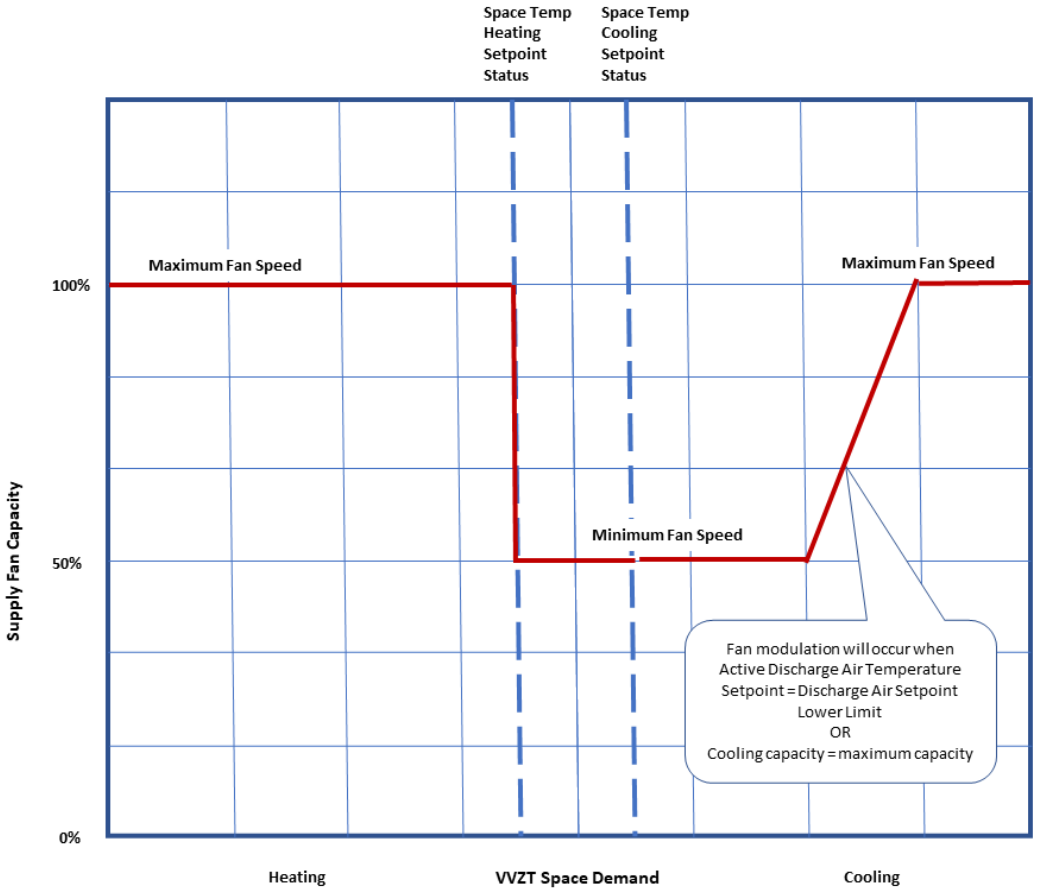
Single Zone Variable Air Volume

Single Zone VAV operates in DX and economizer cooling modes of operation when configured for System Type: VVZT (variable speed indoor fan type) or CVZT (multi speed indoor fan type). A valid space temperature and discharge air temperature sensor are required input. If the discharge air temperature input becomes invalid, the control automatically reverts to Single Loop Space Temperature Control. Symbio™ 700 operates in Single Loop Space Temperature Control in heating modes when staged gas heat and staged electric heat are configured.

Single Zone VAV is a control method of space temperature control that operates the supply fan at the lowest allowed for the cooling capacity required to satisfy the load in the space. As cooling capacity increases, the supply fan speed will increase accordingly until it reaches 100% of its allowed range of operation.

When there is no demand for heating or cooling the supply fan operates at the minimum speed setting while providing ventilation according to occupancy setpoints, see the following figure. Alternately, the supply fan can be setup to cycle off when there is no demand for heating or cooling via Supply Fan Configuration Command setting.

Figure 9. Supply fan sequence of operation



Single Zone VAV — Cooling

Cool

When there is a space cooling demand, DX cooling will initialize and increase to satisfy space temperature. The supply fan will continue to operate at a low, fixed speed at low cooling capacities until the cooling capacity requires additional airflow to keep compressor operation optimal. The supply fan speed will increase as the demand for cooling capacity increases. The minimum supply fan speed is calculated by DX cooling capacity. As the space requires additional cooling capacity, Space Temperature Control will calculate a lower discharge air temperature setpoint increasing DX cooling which in turn increases the supply fan speed. Cooling capacity and supply fan speed both can increase to 100%.

If the unit discharge air temperature reduces to the Discharge Air Temperature Minimum Cool Limit setting or DX cooling reaches 100% capacity, cooling capacity increases will hold while the supply fan speed will continue to increase to 100% or modulate to manage space comfort cooling.

Cool — Economizer

If the unit is configured for a modulating outdoor air damper and conditions are suitable for economizer cooling, the supply fan will operate at minimum speed while the economizer damper modulates between the Outdoor Air Damper Minimum Position Setpoint and 100% to satisfy the discharge air temperature setpoint. If the economizer damper reaches 100% open and additional cooling capacity is required, the supply fan will increase toward 100% to provide additional cooling to the space.

Cool — Economizer + DX

Economizer Cooling + DX is a mode of operation when both economizer and DX cooling are active. If actively economizing, outdoor air damper is 100% and supply fan speed reaches 100% then DX cooling will be added if the unit is not satisfying space cooling requirements.

If DX cooling is active and economizer cooling enables, the control will transition to increase economizer damper above minimum position to 100% to satisfy space cooling while decreasing DX cooling. DX cooling will steadily be removed as long as economizer cooling is able to satisfy the cooling load. The supply fan operates to the lowest speed possible during the transition.

Supply Air Tempering — Space Temperature Control

If the Supply Air Tempering function is configured and the Discharge Air Temperature local sensor is valid, this function prevents excessively cold discharge air from being supplied to the space. Supply Air Tempering is an option for VVZT and multi-speed supply fan units when auxiliary heat is installed.

Supply Air Tempering is not supported when a Conventional TStat is configured.

The following requirements must be met to allow Supply Air Tempering on a Staged Heat unit:

- The unit is in any heating mode, including Heat, Emergency Heat, Morning Warmup, Max Heat but is not actively heating OR
- The unit is in any cooling mode except night purge, but not actively cooling and cooling capacity has been OFF for 5 minutes.

If the discharge air temperature drops to the Discharge Air Temperature Minimum Cool Limit - Active and the Space Temperature is less than the Active Space Temp Cooling Setpoint Status – 0.5°F, the Supply Air Tempering function will bring ON one stage of auxiliary heat.

Supply Air Tempering terminates if the Discharge Air Temperature rises to 10°F ABOVE the Discharge Air Temperature Minimum Cool Limit - Active, or the Space Temperature rises to the Space Temp Cooling Setpoint Status. Additionally, if the Space Heat Control function determines that one or more stages of Heat are required to meet the Space Temp Heating Setpoint Status, Supply Air Tempering will terminate and the unit will stage heating to meet the current space demand.

Unoccupied Cooling

Unoccupied mode is used when the building is unoccupied, and the space conditions are exceeding temperature limits. The unit is normally off in unoccupied mode, but unoccupied operation is allowed in any heat cool mode except OFF.

If a valid space temperature input rises above the Unoccupied Cooling Setpoint, unit operation starts unoccupied cooling to manage space temperature. The controller operates in Single Loop Space Temperature Control with ventilation disabled. DX or economizer cooling will steadily increase to 100 percent capacity. The supply fan will follow capacity control until it reaches 100 percent fan speed. Cooling continues until space temperature is 4°F less than the Unoccupied Cooling Setpoint, the unit will then cycle off.

Unoccupied Heating

When the unit is in unoccupied mode and the valid space temperature input falls below the Unoccupied Heating Setpoint, unit operation starts unoccupied heating to manage space temperature. The controller operates in Single Loop Space Temperature Control with ventilation disabled. The supply fan starts increases with heating capacity unit both reach 100 percent. Heating continues until space temperature is 4°F greater than the Unoccupied Heating Setpoint, the unit will then cycle off.

Variable Volume Discharge Air Control Sequence of Operation

Variable Volume Discharge Air (VVDA) control uses available heating and cooling capacity to deliver the required temperature at the discharge of the unit. A discharge air temperature sensor is required for operation.

In cooling modes, the control uses cooling sources to deliver air temperature as required by the Discharge Air Cooling Setpoint. In heating modes, the control uses heat sources to deliver air temperature as required by the Discharge Air Heating Setpoint. Primary heat is never used in conjunction with mechanical cooling.

Symbio™ 700 operates in Discharge Air Temperature Control in all heat, cool, and occupancy modes of operation. The typical operating mode is Cooling delivering conditioned air to multiple zones of a building. These units have duct work to supply VAV terminal units. The VAV units modulate to control space comfort.

VVDA units also change over to provide heat (when installed). A building automation system or the VAV Box Relay Output can be used when the heat source requires full airflow. See Heat Types for more information. A valid space temperature input must be provided to perform heating modes such as Daytime Warm Up and Morning Warm Up (when enabled).

Supply Air Tempering

Supply Air Tempering is disabled by default but can be enabled if modulating heating capacity is configured. Supply air tempering initiates if discharge air temperature falls 1°F below the Discharge Air Cooling Setpoint Status setpoint and cooling capacity is 0% for 5 minutes and heating capacity is required to maintain discharge air cooling control. Heat is controlled with a 2°F dead band to the discharge air cooling setpoint. The control will transition back to normal cooling when heat capacity is 0% for 5 minutes or there is a compressor demand to manage the discharge air cooling control. Supply air tempering will also terminate if dehumidification initiates or if the controller effective occupancy is unoccupied.

Changeover Input

Variable Volume Discharge Air units include a binary Changeover Input. An open input requests discharge air cooling operation. A closed input will request the unit to change to discharge air heating. This local input is arbitrated with building management Heat Cool Mode Request commands to determine the active mode of operation.

VAV Box Relay Output

This binary output is provided by the controller to be optionally wired to VAV units in a Multi Zone-VAV system to coordinate system changeover to full airflow heating. The binary output is de-energized when the controller is operating in cooling modes. The binary output energizes when the heat type installed requires full airflow. See Maximum Heat for more details.

Discharge Air Reset

Discharge Air Reset is a method to save energy by resetting the discharge air temperature as heating and cooling building loads increase and decrease.

When enabled, the controller can independently reset the Discharge Air Heating Setpoint Active and/or Discharge Air Cooling Setpoint Active based on Zone (space temperature), Outdoor Air temperature or Return Air Temperature. The new target setpoints are reported as Discharge Air Setpoint Heating Status and Discharge Air Cooling Setpoint Status. The controller provides settings for the reset type (Outdoor Air, Zone, Return Air), temperature range to apply the reset, and reset amount. For example: the discharge air temperature cooling setpoint shall increase 5°F over an outdoor air temperature range of 90°F to 70°F. If Discharge Air Cooling Setpoint Active is 50°F and Outdoor Air Temperature is 80°F, the reset function calculates and reports Discharge Air Cooling Setpoint Status = 52.5°F. The controller will provide discharge air at 52.5°F.

Duct Static Pressure Control

Multi Zone-VAV equipment have variable speed supply fans and are often used in Variable Air Volume (VAV) systems consisting of ductwork serving multiple building zones and VAV boxes that control space comfort independent of the rooftop air handler. VAV boxes modulate air volume by a damper that opens and closes to maintain space comfort. In response, duct static pressure increases and decreases. The controller will modulate supply fan speed to maintain Duct Static Pressure relative to the Duct Static Pressure Setpoint.

Duct Static Pressure High Limit

The controller operates the supply fan to maintain duct static pressure below the Duct Static Pressure High Limit setpoint. In the event that duct static pressure approaches the high limit setpoint, the controller will reduce and limit the supply fan speed.

Unoccupied Cooling

Unoccupied Cooling mode is used when the building is unoccupied and the space conditions are exceeding temperature limits. The unit is normally off in unoccupied mode. If a valid space temperature input rises above the Unoccupied Cooling Setpoint, unit operation starts unoccupied cooling to manage space temperature. The controller operates in Discharge Air Control with ventilation disabled while DX or economizer cooling capacity increases to satisfy the Discharge Air Cooling Setpoint. VVDA System Type operate the supply fan under duct static pressure control. Cooling continues until space temperature is 4°F less than the Unoccupied Cooling Setpoint, the unit will then cycle off.

Unoccupied Heating

When the unit is in unoccupied mode and the valid space temperature input falls below the Unoccupied Heating Setpoint, unit operation starts unoccupied heating to manage space temperature. The controller operates in Discharge Air Control with ventilation disabled while heating capacity increases to satisfy the Discharge Air Heating Setpoint. The supply fan operates according to heat type installed, see Heat Types for more information. Heating continues until space temperature is 4°F greater than the Unoccupied Heating Setpoint, the unit will then cycle off.

Heat Cool Modes

Heat Cool Mode Status reports the unit mode of operation. The Symbio™ 700 can receive mode inputs from different external and local input sources that are arbitrated; however, the control active operating mode represents the capacity being delivered to the building and reported via Heat Cool Mode Status. The following modes of operation are supported. All other, unsupported modes are managed as an Auto mode request.

Heat

In this mode, the controls provide heating capacity per heat type installed, heat setpoint, and occupancy. Application requirements such as full or modulating air flow are also considered in heating mode. All forms of cooling capacity are effectively disabled.

If Heat is the requested mode when the unit does not have heat capacity configured or heat is disabled, Heat is reported as Heat Cool Mode Status. If the unit cannot provide heat, the supply fan is enabled to operate (as configured) to provide ventilation during occupied modes of operation.

Cool

Cool mode is reported when the control objective is to provide cooling to maintain building comfort. Direct expansion cooling is the primary cooling source. Cool mode is also reported when Economizer and Dehumidification cooling modes of operation are active.

Fan Only

This mode disables all forms of heating and cooling capacity but operates the fan continuously at minimum speed or modulates to maintain duct static pressure. The outdoor air damper modulates to damper minimum position setpoint to provide ventilation.

Fan Only is also reported in Emergency Override and Ventilation Override Modes. Heat Cool Mode Request can also command the control into Fan Only mode.

Off

Off is the reported mode when unit operation is shutdown due to diagnostics, equipment protections, overrides or normal unit operation when the supply fan is cycled off.

Test

When Service Test is active, Heat Cool Mode Status reports Test.

Maximum Heat

Maximum Heat is a full airflow mode of heating operation with the supply fan operating at maximum speed. The controller does not provide maximum heat; instead, the controller provides heat capacity per the Operating Mode and unit type.

VVDA

Variable Volume Discharge Air control units will transition to Maximum Heat operation in heating modes (for example Occupied Heat, Morning Warm Up, Daytime Warm Up) when the installed heating capacity requires full air flow. Maximum Heat can also be a Heat Cool Mode Request command, which Symbio™ 700 will remain in the mode until the mode is released.

On the transition to Maximum Heat the Symbio 700 will reduce the supply fan to minimum speed, energize the VAV Box Relay and wait the duration of the VAV Box Stroke Time (adjustable). The VAV Box Stroke Time allows the VAV boxes in the system to open. The supply fan speed will then increase to 100 percent or the maximum speed subject to high duct static pressure limit. Once the supply fan reaches its allowed maximum speed, Symbio 700 will enable heating capacity control to Discharge Air Heating Setpoint Active. Ventilation is managed per the operating mode

The transition from Maximum Heat back to modulating air flow control modes is as follows:

1. Heat capacity terminates (if active), a 90 second post heat timer begins.
2. Supply fan speed slows to minimum speed, a 3 minute minimum speed timer begins.
3. VAV Box Relay de-energizes.
4. When the 90 second post heat and 3 minute minimum speed timer expire, modulating air flow control is enabled, operating mode transitions, and capacity control enables.

Space Temperature Control

Space Temperature control units will also accept a Maximum Heat command via Heat Cool Mode Request. On this command the Symbio™ 700 will transition to a heat mode while operating the supply fan at 100 percent capacity. Heat Cool Mode Status will report Maximum Heat to indicate the mode is active.

Morning Warm-up

Morning Warm-up is an optional feature when heat is configured and can be Enabled or Disabled. Morning Warm-up is a mode often used during building unoccupied periods and optimal start applications to rapidly increase the space temperature, as efficiently as possible, before building occupancy. The outdoor air damper minimum position setpoint will be overridden to 0 percent, ventilation air is not provided during Morning Warm-up

For Morning Warm-up to initiate on a transition from Unoccupied to Occupied, Space temperature control units must be in Heat, Max Heat, Emergency Heat or Auto. Discharge air control units can also initiate Morning Warm Up on an Off to Occupied transition.

For all equipment types: On a transition from Unoccupied to Occupied or Occupied-Standby, and with a valid space temperature 1.5° F below the Morning Warm-up Setpoint, morning warm-up operation initiates. Heat Cool Mode Status reports Maximum Heat if the heat type requires full airflow and VAV Box Relay binary output will energize (see Maximum Heat for details). Otherwise, heat types that allow modulating airflow will report Morning Warm Up via Heat Cool Mode Status.

VVDA

The Symbio™ 700 operates in a discharge air control mode delivering heating capacity per Discharge Air Heating Setpoint Active; this provides flexibility when 100 percent heat capacity in not desired. Variable air volume discharge air control units will operate the supply fan per Duct Static Pressure Setpoint if the installed heat type allows; otherwise, the supply fan operates in a full airflow mode and Maximum Heat is reported via Heat Cool Mode Status. When 60 minutes expires or when space temperature equals or exceeds the Morning Warmup Setpoint, Morning Warm Up mode will terminate.

Morning Warm-up mode can also be commanded via Heat Cool Mode Request from a building automation system or external control. In this case, the unit remains in Morning Warm-up mode indefinitely until the commanded mode is removed or changed. When the space temperature exceeds the Morning Warm-up Setpoint, heating capacity is disabled but the supply fan operation continues to circulate air until the Morning Warm-up command is removed. Heat capacity will re-enable if space temperature falls 1.5°F below Morning Warm-up Setpoint.

Space Temperature Control

The Symbio™ 700 operates in a space temperature control mode controlling heating capacity to manage space temperature at the Morning Warm-up Setpoint. The supply fan operates at maximum speed.

When 60 minutes expire or when space temperature equals or exceeds the Morning Warm-up Setpoint, Morning Warm-up mode will terminate.

Morning Warm-up mode can also be commanded via Heat Cool Mode Request from a building automation system or external control. The Symbio 700 controller will continuously control space temperature to the morning warm-up setpoint until the mode is released or changed.

Pre-Cool

Pre-Cool is a mode often used during building unoccupied periods and optimal start applications to rapidly decrease the space temperature, as efficiently as possible, before building occupancy. Pre-Cool

mode of operation can be enabled and disabled via Pre-Cool Enable Command. Pre-Cool is reported via Heat Cool Mode Status when active. Ventilation air is not provided during Pre-Cool operation.

VVDA

VVDA equipment types, a transition from Unoccupied to Occupied mode or Off/Shutdown to Occupied, if a valid space temperature input is above the Pre-Cool Setpoint + 1.5°F Pre-Cool Mode will initiate. Symbio™ 700 operates in a discharge air control mode providing discharge air per Discharge Air Cooling Setpoint Active until space temperature drops equal or below the Pre-Cool Setpoint. In this cooling mode the outdoor air damper minimum position is 0%, but the controller will use compressor and/or economizer cooling when suitable. VVDA units will modulate fan speed and manage to the duct static pressure setpoint.

Pre-Cool mode can also be commanded via Heat Cool Mode Request. In this case, the Symbio 700 remains in Pre-Cool indefinitely until the commanded mode is removed. When space temperature is equal or less than Pre-Cool Setpoint, cooling capacity is disabled but the supply fan continues to circulate air until the Pre-Cool command is removed. Cooling capacity control will enable if space temperature rises above Pre-Cool Setpoint + 1.5°F.

Space Temperature Control

Space temperature control units must be in Cool or Auto mode to allow Pre-Cool operation. A transition from Unoccupied to Occupied mode, the controls will initiate Pre-Cool if a valid space temperature input is above the Pre-Cool Setpoint + 1.5°F. The Symbio™ 700 operates in a space temperature control mode controlling space temperature to the Pre-Cool Setpoint. The supply fan operates at maximum speed. When 60 minutes expires or when space temperature is equal or below the Pre-Cool Setpoint, Pre-Cool mode will terminate.

Pre-Cool mode can also be commanded via Heat Cool Mode Request from a building automation system or external control. The Symbio 700 controller will continuously control space temperature to the Pre-Cool setpoint until the mode is released or changed.

Night Purge

Night Purge mode is typically applied in building unoccupied periods when conditions are suitable for economizer cooling; all other forms of cooling capacity are disabled. This mode is only supported via a commanded Heat Cool Mode Request. The controller will not use local inputs and assume outdoor air is suitable for economizing. The outdoor air damper minimum position setpoint will be overridden to 0 percent.

Night Purge operation is terminated when the Night Purge, Heat Cool Mode Request is removed.

VVDA

When active, the Symbio™ 700 operates in a discharge air control mode, modulating the outdoor air damper to provide cooling capacity per Discharge Air Cooling Setpoint Active.

Space Temperature Control

Space temperature control equipment modulates the outdoor air damper to control space temperature to the Space Temp Cooling Setpoint Status setpoint. If space temperature is greater than the space cooling setpoint + 1.5°F the outdoor air damper will be at 100 percent with supply fan at maximum speed. If space temperature is less than the space cooling setpoint -1.5°F the outdoor air damper will be closed with supply fan at minimum speed. Constant volume units, the supply fan operates at 100 percent while Night Purge is active.

Daytime Warm-up

Daytime Warm-up is a feature of VVDA units that can be Enabled, or Disabled. Daytime Warm-up is available with any heat type installed. Daytime Warm-up is a mode used during building occupied periods to recover a critical zone that is too cold. Ventilation air is provided while in Daytime Warm-up mode.

When the Heat Cool Mode Request is Cool (the unit is providing cooling), if a valid space temperature is 3°F below the adjustable Daytime Warm-up Setpoint, daytime Warm-up operation initiates. The unit will

operate in a discharge air control mode delivering heating capacity per Discharge Air Heating Setpoint Active. The supply fan operates at max speed on Constant Volume Units. Variable air volume discharge air control units will operate the supply fan to the duct static pressure setpoint and report Heat Cool Mode Status as Heat, if the installed heat type allows modulating air flow. Else if the heat type requires full air flow, Maximum Heat is reported. (See Heat Types and Maximum Heat section for more information).

When the space temperature is equal to or above the Daytime Warm-up Setpoint, daytime Warm-up operation terminates and the Symbio™ 700 will transition back to Cool mode. See Maximum Heat for details. If the requested operating mode is no longer Cool, Daytime Warm-up terminates.

Dehumidification - Hot Gas Reheat

Dehumidification control is a mode of Cooling when hot gas reheat is configured with a modulating reheat valve. Symbio™ 700 supports three configurable dehumidification methods: Dew Point (default), Relative Humidity, or Humidistat control for occupied and unoccupied operation. Only a discharge air temperature sensor is required for Humidistat dehumidification control. Relative Humidity control requires a valid space relative humidity, space temperature and discharge air temperature sensor for dehumidification operation. Dew Point control additionally requires outdoor air temperature and outdoor air humidity.

Dehumidification is allowed when outdoor air temperature is between 40 and 100°F, but it is disabled outside this range. Dehumidification can be enabled and disabled directly via the Occupied Dehumidification Enable and Unoccupied Dehumidification Enable points.

Dehumidification Control

Dew Point — Initiation

Occupied dehumidification Dew Point control initiates when the follow conditions exist:

- Space Dew Point is greater than the Space Dew Point Setpoint and
- Outdoor Air Dew Point is greater than the Outdoor Air Dew Point Setpoint

Unoccupied dehumidification Dew Point control initiates when:

- Space Dew Point is greater than the Space Dew Point Unoccupied Setpoint and
- Outdoor Air Dew Point is greater than the Outdoor Air Dew Point Setpoint and
- [Space has been unoccupied for less than Unoccupied Dehumidification Timer and relative humidity is greater than 65% or
- Space has been unoccupied for greater than or equal to Unoccupied Dehumidification Timer]

The Unoccupied Dehumidification Timer is default to 12 hours. Setting the timer to 0 effectively disables the timer and, unoccupied dehumidification initiates only according to Space and Outdoor Dew Point.

Relative Humidity — Initiation

Occupied dehumidification control initiates when the Space Humidity is greater than the Space Dehumidification Setpoint. Unoccupied dehumidification control initiates when the Space Humidity is greater than the Space Dehumidification Unoccupied Setpoint.

Humidistat — Initiation

The Humidistat binary input on the Customer Options Module is active. If a Space Humidity sensor is installed, the Humidistat input will be ignored.

Operation – CVZT/VVZT

For CVZT and VVZT units, the supply fan operates at the minimum speed defined for the compressor stage, see “Compressor Staging,” p. 73. When the dehumidification control mode becomes active Dehumidification Status reports Active and compressor operation will initially increase one stage. Additional compressor stages are added to achieve evaporator dew point.

Space temperature is managed by modulating the hot gas reheat valve. The reheat valve will not open until the space temperature is below the space cooling setpoint minus 1.5° F and modulates to Discharge Air Temperature Setpoint - Active calculated by the Symbio 700 to maintain space temperature control. Dehumidification Control Status reports the position of the reheat valve. The reheat valve can also open if discharge air temperature decreases rapidly and drops before the Discharge Air Reheating Setpoint Low Limit – Active (default 50°F). Reheat modulates to keep the discharge air temperature above Discharge Air Reheating Setpoint Low Limit – Active.

Anytime during occupied modes of operation, if the space temperature falls 3° F below the cooling setpoint for five minutes, dehumidification control terminates.

During unoccupied dehumidification, the reheat valve modules to hold the space temperature at a fixed 73° F. If space temperature falls below 60° F and the reheat valve is at maximum position for five minutes, dehumidification control terminates.

Operation – VVDA

Variable Volume Discharge Air units continue to modulate the supply fan to maintain duct static pressure control. Compressors will increasingly stage to 100% capacity. The reheat valve modulates to control discharge air temperature to the Discharge Air Cooling Setpoint Status setpoint.

If a value is written to Discharge Air Reheat Setpoint BAS, this setpoint will be used for reheat control when dehumidification is active. When dehumidification mode terminates, the control will revert to Discharge Air Cooling Setpoint Status for sensible cooling control.

Unoccupied dehumidification, if space temperature is greater than the unoccupied cooling setpoint, the control will satisfy the sensible cooling demand first. If the space has a dehumidification demand, compressors will stage to 100% capacity and discharge air will be reheated to a fixed 70° F until the dehumidification demand terminates.

Dew Point — Termination

Occupied dehumidification Dew Point control terminates when:

- Calculated Space Dew Point is less than the Space Dew Point Setpoint minus the Dew Point Setpoint Offset or
- Outdoor Air Dew Point is less than the Outdoor Air Dew Point Setpoint minus the Dew Point Setpoint Offset

Unoccupied dehumidification Dew Point control terminates when:

- Space Dew Point is less than the Space Dew Point Unoccupied Setpoint – Dew Point Setpoint Offset or
- Outdoor Air Dew Point is less than the Outdoor Air Dew Point Setpoint – Dew Point Setpoint Offset or
- [Space has been unoccupied for less than Unoccupied Dehumidification Timer and Space Relative Humidity is less than 65% minus Space Dehumidification Setpoint Offset]

Relative Humidity — Termination

Occupied modes of operation, Space Dehumidification control terminates when the Space Humidity is less than the Space Dehumidification Setpoint minus the Space Dehumidification Setpoint Offset. Unoccupied mode, Space Unoccupied Dehumidification control terminates when the Space Humidity is less than the Space Dehumidification Unoccupied Setpoint minus the Space Dehumidification Setpoint Offset.

Humidistat — Termination

The Humidistat binary input on the Customer Options Module is inactive.

Dehumidification Purge Cycle

During dehumidification, a three–minute compressor cooling purge cycle initiates according to the Reheat Purge Interval (120 minutes adjustable). The modulating hot gas reheat valve moves to a fixed position and compressors go to full capacity.

Comfort Purge Cycle

During active mechanical cooling operation, a three-minute purge cycle will be initiated when the compressors cumulative run time reaches the Condenser Coil Purge Interval timer (90 minutes adjustable). During this purge cycle, the modulating hot gas reheat valve and cooling valve moves to a fixed position and compressors go to full capacity.

Dehumidification — Thermostat Control

Dehumidification control can be initiated utilizing a Space Humidity input or a Humidistat input. If Space Humidity input is used for control, dehumidification initiates when Space Humidity exceeds the Space Dehumidification Setpoint. Dehumidification terminates when Space Humidity is less than Space Dehumidification Setpoint minus the Space Dehumidification Setpoint Offset.

Utilizing a Humidistat, dehumidification becomes active when the Humidistat input is active. Dehumidification terminates when the Humidistat is no longer active.

When dehumidification is initiated all compressor outputs energize. The reheat valve will open and modulate to the Discharge Air Reheat Setpoint (default 70°F). Dehumidification terminates with any Y1 or Y2 call.

Heat Types

Three heating types are supported:

- Staged gas
- Modulating gas heat
- Staged electric

Single zone VAV and multi-speed constant volume units will increase supply fan speed with increased heating capacity. Multi-Zone VAV units will operate the supply fan at full airflow when staged heating is configured, see Maximum Heat for details. The supply operates in duct static pressure control when modulating heat is configured.

All heat types, when the control terminates heating capacity or exists a heating mode, a post heat timer is enforced. This keeps supply fan On to remove heat from the unit before transitioning to a cooling mode or cycling the supply fan off.

Staged Gas Heat

Symbio 700 supports two stages of gas heat as primary heat capacity with a Modbus interface to a VB1287 staged ignition controller. The Modbus interface provides operating details and diagnostics to the Symbio 700 controller.

- **Gas heat capacity (350, 400 MBH) —** has one manifold with one burner with a 2-stage gas valve.
- **Gas heat capacity (600 MBH) —** has a split manifold and two, 2-stage gas valves.
- **Gas heat capacity with two 400 MBH furnaces in series (800 MBH) —** the first furnace has a VB1287 staged ignition controller with a 2-stage gas valve and the second furnace has a second VB1287 staged ignition controller with a two-stage gas valve.

All 2-stage valves in the system are controlled the same: all driven off, low-fire, or high-fire. The first stage, low-fire, is approximately 75% of total heat capacity. Except 600 MBH, low-fire is approximately 66% of total heat capacity.

Sequence of Operations

1. An initial call for heat the Symbio 700 creates a heat demand via Modbus to the gas heat ignition controller(s)
2. A draft inducer is energized, an air pressure switch closes, and a pre-purge initiates for 15 seconds.
3. At end of pre-purge period, the ignition source is activated with two-stage gas valve(s) at minimum fire, and the main gas valve opens for trial for ignition
4. Burners ignite (and cross light) and flame is sensed.
5. After a warm-up period of 10 seconds, gas heat is managed under Symbio 700 control at stage (low fire) on all burners (Running state).
6. With increasing heating demand, Symbio 700 will command the ignition controller(s) to high fire, stage 2 full capacity.
7. Symbio 700 enforces a three-minute period between increasing or decreasing gas heat stages. The three-minute interstage timer is not applicable to conventional thermostat-controlled units.

As heat demand decreases:

1. Gas heat will be commanded from high fire to low fire.
2. If there is no heat demand, gas heat is staged off.
3. The draft inducer will remain on for a post purge time of 30 seconds.

The 800 MBH gas heat, two furnace configuration has added redundancy. If the first staged furnace is not available or locked out, the Symbio 700 will control the second staged furnace to satisfy the heating demand. Likewise, if the second staged furnace is not available or locked out, first staged furnace is controlled to satisfy heating demand.

Modulating Gas Heat

Symbio 700 supports modulating gas heat for primary heat with a Modbus interface to a VB1285 modulating ignition controller. The Modbus interface provides operating details and diagnostics to the Symbio 700 controller.

- **Gas heat capacity (350, 400, 600 MBH) with a single furnace —** has a main gas valve, modulating gas valve (burner 1) and a single-stage gas valve (burner 2) on a single split manifold.
- **Gas heat capacity with two 400 MBH furnaces in series (800 MBH) —** the first furnace has a VB1285 modulating ignition controller with a modulating gas valve and the second furnace has a VB1287 staged ignition controller with a two-stage gas valve.

Sequence of Operation

1. An initial call for heat the Symbio 700 creates a heat demand via Modbus to the gas heat ignition controller(s).
2. A draft inducer is energized, an air pressure switch closes for the initial pre-purge for 30 seconds.
3. The modulating gas valve opens to approximately 35%, depending on gas heat size.
4. At end of pre-purge period, the ignition source is activated, and the main gas valve opens for the trial for ignition period (up to 8 seconds).
5. The modulating burner ignites, and flame is sensed.
6. After a warm-up period of 10 seconds, “run” is displayed on the VB1285 ignition controller and gas heat is managed under Symbio 700 control

Single furnace (350, 400, 600 MBH)

1. The Symbio 700 commands the modulating burner open with increasing heat demand until Heat Capacity Primary Status = 50%.
2. At this capacity, if there is a continued demand for heat, the staged gas valve opens on burner 2. Symbio 700 enforces a three-minute period between adding or subtracting a stage on the split manifold (burner 2).
3. When flame is sensed on burner 2, the modulating gas valve reverts to minimum fire and Heat Capacity Primary Status will report 60% (natural gas) or 67% (liquid propane). If flame is not sensed on the split manifold burner 2, gas heat will continue on the primary burner and continue to call for heat on the split burner as required.
4. The modulating gas valve will again open with increasing heat demand.

As heat demand decreases:

1. The modulating burner will decrease capacity.
2. At Heat Capacity Primary Status = 60% (natural gas) or 67% (liquid propane), the second staged burner is turned off.
3. The modulating burner will increase to full capacity before decreasing with decreasing heat demand.
4. If there is no heat demand, gas heat is staged off.
5. The draft inducer will remain on for a post purge time of 30 seconds.

Dual furnace (800 MBH)

1. The Symbio 700 commands the VB1285 modulating burner open with increasing heat demand until Heat Capacity Primary Status = 47%.
2. At this capacity, if there is a continued demand for heat, the VB1287 staged gas valve is commanded to low fire on furnace 2.
3. When flame is sensed on burner 2, the VB1285 modulating gas valve reduces its firing rate to a minimum position.
4. The modulating gas valve will resume opening with increasing heat demand until 74% (natural gas) or 76% (liquid propane).
5. If there is a continued demand for heat, the VB1287 staged gas valve opens to high fire on furnace 2.

6. The VB1285 modulating gas valve position reduces the firing rate, but the valve will continue to open with increasing heat demand to 100% heat capacity.
7. Symbio 700 enforces a three-minute period between adding or subtracting stages of heating on the VB1287 staged ignition controller.

As heat demand decreases:

1. The modulating burner will decrease capacity and the staging process is reversed.
2. When Primary Heating Capacity Status = 75% (natural gas) or 77% (liquid propane), if heat demand continues to decrease, the VB1287 staged burner is commanded from high fire to low fire.
3. In response, the modulating burner will increase in capacity.
4. The modulating burner will then decrease with reduced heat demand.
5. At Primary Heating Capacity Status = 48% (natural gas) or 55% (liquid propane), if heat demand continues to decrease, the VB1287 staged burner is commanded Off.
6. The modulating burner will increase in capacity before decreasing with heat demand.
7. If there is no heat demand, the modulating gas valve and main gas valve is command off.
8. The draft inducer will remain on for a post purge time of 30 seconds.

The 800 MBH gas heat, two furnace configuration has added redundancy. If the first modulating furnace is not available or locked out, the Symbio 700 will control the second staged furnace to satisfy the heating demand. Likewise, if the staged furnace is not available or locked out, modulating furnace is controlled to satisfy heating demand.

Supply Fan Operation

VVZT/CVZT

The supply fan operates at a minimum speed of 58% when gas heat is less than 15% capacity. When gas heat capacity is 15% or greater the supply fan speed will increase with capacity on a defined supply fan curve. If Discharge air temperature reaches the heating maximum setpoint before the supply fan is at 100%, the supply fan speed will increase to provide additional heating capacity.

VVDA

The supply fan operates under duct static pressure control.

Electric Heat - Staged

When staged electric heat is configured in the unit, the controller manages two binary outputs to provide 2-stages of heat control; depending on size of the electric heat installed. When 2 stages of electric heat are installed each stage of electric heat is 50% of available heating capacity.

Outdoor Air Damper Control

Economizer Cooling

Symbio™ 700 supports a 0 to 100 percent economizer damper which requires a discharge air temperature sensor to be installed for economizer cooling. There are four configurable economizer types: fixed dry bulb, differential dry bulb, reference enthalpy, and comparative enthalpy. Each type, enable, and the high limit disable criteria are defined as follows.

Table 6. Economizer types

Type	Econo-mizer Status	Calculation
Fixed Dry Bulb	Enable	Outdoor Air Temperature < Economizer Outdoor Air Enable Setpoint – Economizer Dry Bulb Enable Offset
	Disable	Outdoor Air Temperature > Economizer Outdoor Air Enable Setpoint
Differential Dry Bulb	Enable	Outdoor Air Temperature < (Return Air Temperature - Economizer Dry Bulb Enable Offset - Economizer Dry Bulb Disable Return Air Offset)
	Disable	Outdoor Air Temperature < (Return Air Temperature - Economizer Dry Bulb Disable Return Air Offset)
Reference Enthalpy	Enable	Outdoor Air Enthalpy < (Economizer Outdoor Air Enthalpy Enable Setpoint – Economizer Cooling Reference Enthalpy Offset) AND Outdoor Air Temperature < (Economizer Outdoor Air Enable Setpoint – Economizer Dry Bulb Enable Offset)
	Disable	Outdoor Air Enthalpy > Economizer Outdoor Air Enthalpy Enable Setpoint OR Outdoor Air Temperature > Economizer Outdoor Air Enable Setpoint
Comparative Enthalpy	Enable	Outdoor Air Enthalpy < (Return Air Enthalpy – Economizer Cooling Reference Enthalpy Hysteresis Offset) AND Outdoor Air Temperature < (Economizer Outdoor Air Enable Setpoint - Economizer Dry Bulb Enable Offset)
	Disable	Outdoor Air Enthalpy > Return Air Enthalpy OR Outdoor Air Temperature > Economizer Outdoor Air Enable Setpoint

While the configuration parameters will be used to determine which method of economizer control will be utilized, the table below describes the needed sensor data for each control method.

Table 7. Sensor data

Economizer Enable Method	Required Sensor Data
Comparative Enthalpy	Outdoor Air Temperature
	Outdoor Air Humidity
	Return Air Temperature
	Return Air Humidity
Reference Enthalpy	Outdoor Air Temperature
	Outdoor Air Humidity

Table 7. Sensor data (continued)

Economizer Enable Method	Required Sensor Data
Dry Bulb	Outdoor Air Temperature
Differential Dry Bulb	Outdoor Air Temperature
	Return Air Temperature

When conditions are suitable for economizer operation, the outdoor air damper modulates between a calculated outdoor air damper minimum position (based on Supply Fan Compensation and Demand Controlled Ventilation) and 100 percent open. Economizing will not allow additional mechanical cooling until the damper position is 100 percent and supply fan has reached 100 percent capacity for 5 minutes. If economizer cooling becomes disabled, the damper will revert to minimum position control, and transition to mechanical cooling.

A building automation system can directly command economizer operation via Economizer Airside Enable (auto, enable, disable). If commanded Enable, the controller will start economizer cooling, regardless of outdoor air conditions. If commanded Disable, economizer cooling will be disabled (except if a mode of Night Purge is commanded to the controller). If commanded Auto, the controller will use the configured Economizer high limit method and input values to determine if economizer cooling is available.

Ventilation Control

On equipment installed with a 0 to 100% Economizer or 0 to 100% Economizer w/Traq, the Symbio™ 700 will control the outdoor air damper to provide minimum ventilation requirements based on the specific options installed, enabled features and mode of operation. During normal occupied periods of heating and cooling modes of operation, the outdoor air damper maintains ventilation requirements. However, the following modes of operation will override the damper minimum position setpoint to 0%.

- Morning Warm Up
- PreCool
- Night Purge
- Unoccupied Heat
- Unoccupied Cool
- Off

0 to 100% Economizer

The following sections describe all the options and functions that can be installed and enabled with a 0 to 100% Economizer damper. Tables are provided at the bottom of this section to summarize the setpoints and settings used for all combinations.

Supply Fan Compensation

The outdoor air damper minimum position is modulated to provide outdoor air based on supply fan speed. When the supply fan increases speed, the outdoor air damper minimum position is reduced to prevent over ventilation. When the supply fan decreases speed the outdoor air damper minimum position is increased to maintain design outdoor air requirements. There are three user editable design minimum settings to linearize damper position with the fan curve during Occupied and Occupied Bypass modes of operation.

- Design Minimum OA Damper Position at Min Fan Capacity (25 percent default)
- Design Minimum OA Damper Position at Mid Fan Capacity (15 percent default)
- Design Minimum OA Damper Position at Full Fan Capacity (10 percent default)

There are three additional user editable design minimum settings for Occupied-Standby mode of operation.

- Standby Minimum OA Damper Position at Min Fan Capacity (25 percent default)
- Standby Minimum OA Damper Position at Mid Fan Capacity (15 percent default)
- Standby Minimum OA Damper Position at Full Fan Capacity (10 percent default)

Outdoor Air Minimum Position Control

Available only when supply fan compensation is disabled, this function provides a fixed damper position for minimum outdoor air requirements. The damper is controlled to a position determined by Economizer Minimum Position Setpoint.

Remote Minimum Position Control

With an installed Customer Connection Module and Remote Minimum Position is configured in the Symbio™ 700, a wired potentiometer can be used to adjust the outdoor air damper minimum position setpoint in the range of 0 to 50%. The setting is reported via Remote Minimum Position. If Remote Minimum Position input and Demand Controlled Ventilation is installed, the Remote Minimum Position provides the minimum damper position setpoint at full fan capacity. Tables below provide details of when the Remote Minimum Position input is utilized in minimum ventilation control.

When Remote Minimum Position is installed with Demand Controlled Ventilation, the Remote Minimum Position input is used in place of Design Minimum OA Damper Position at Full Fan Capacity setpoint. See tables below for more details.

Demand Controlled Ventilation (DCV)

Demand controlled ventilation reduces energy consumption by reducing the outdoor air damper below design minimum ventilation based on space CO_2. When Demand Controlled Ventilation is configured and Supply Fan Compensation is enabled, DCV resets the outdoor air damper minimum position based on space CO_2 and supply fan speed. Decreasing CO_2 levels will decrease damper position below the Design Minimum toward the DCV minimum damper position setpoint. Increasing CO_2 level will increase damper position toward design minimum setpoint. DCV requires a valid space CO_2 value from a building management system or wired sensor. If Space CO_2 value is invalid or Supply Fan Compensation is disabled, the Symbio™ 700 will revert to Outdoor Air Minimum Position Control.

Demand controlled ventilation setpoints used in all methods.

- Space CO_2 High Limit
- Space CO_2 Low Limit

Occupied and Occupied-Bypass mode. If the supply fan is at 100 percent and CO_2 is at the Space CO_2 High Limit (1500 ppm default), the outdoor air damper will be positioned at Design Minimum OA Damper Position at Full Fan Capacity (10 percent default). As CO_2 in the space reduces below the high limit, the outdoor air damper will close. If CO_2 falls below the Space CO_2 Low Limit, the damper position will be at DCV Minimum OA Damper Position at Full Fan Capacity (5 percent default).

Occupied-Standby mode. The damper will reset, based on CO_2, between the Standby Minimum OA Damper Position at Full/Mid/Min Fan Capacity and DCV Minimum OA Damper Position at Full/Mid/Min Fan Capacity.

The following tables define the Symbio 700 setpoints for Demand Controlled Ventilation control, which depend on the features enabled and configuration options installed. Each table is based on the supply fan and damper type installed. Supply Fan Compensation is a feature that can be enabled or disabled. Demand Controlled Ventilation and Remote Minimum Position are Symbio 700 configurations.

Table 8. 0 to 100 percent economizer – variable speed supply fan

Supply Fan Compensation	Demand Controlled Ventilation	Remote Minimum Position	Occupancy Status	Outdoor Air Damper Controlling Setpoints
Enabled	Installed	Installed	Occupied, Occupied Bypass	Remote Minimum Position (Full Fan Capacity) Design Minimum OA Damper Position at Mid Fan Capacity Design Minimum OA Damper Position at Min Fan Capacity DCV Minimum OA Damper Position at Full Fan Capacity DCV Minimum OA Damper Position at Mid Fan Capacity DCV Minimum OA Damper Position at Min Fan Capacity
Enabled	Installed	Not Installed	Occupied, Occupied Bypass	Design Minimum OA Damper Position at Full Fan Capacity Design Minimum OA Damper Position at Mid Fan Capacity Design Minimum OA Damper Position at Min Fan Capacity DCV Minimum OA Damper Position at Full Fan Capacity DCV Minimum OA Damper Position at Mid Fan Capacity DCV Minimum OA Damper Position at Min Fan Capacity
Enabled	Not Installed or Disabled	Installed	Occupied, Occupied Bypass	Remote Minimum Position (Full Fan Capacity) Design Minimum OA Damper Position at Mid Fan Capacity Design Minimum OA Damper Position at Min Fan Capacity
Enabled	Not Installed or Disabled	Not Installed	Occupied, Occupied Bypass	Design Minimum OA Damper Position at Full Fan Capacity Design Minimum OA Damper Position at Mid Fan Capacity Design Minimum OA Damper Position at Min Fan Capacity

Table 8. 0 to 100 percent economizer – variable speed supply fan (continued)

Supply Fan Compensation	Demand Controlled Ventilation	Remote Minimum Position	Occupancy Status	Outdoor Air Damper Controlling Setpoints
Enabled	Installed	Installed or Not Installed	Occupied Standby	Design Minimum OA Damper Position at Full Fan Capacity Design Minimum OA Damper Position at Mid Fan Capacity Design Minimum OA Damper Position at Min Fan Capacity Standby Minimum OA Damper Position at Full Fan Capacity Standby Minimum OA Damper Position at Mid Fan Capacity Standby Minimum OA Damper Position at Min Fan Capacity
Disabled	Installed or Not Installed	Installed or Not Installed	Occupied, Occupied Bypass, Occupied Standby	Economizer Minimum Position Setpoint

Table 9. 0 to 100 percent economizer – multi-speed supply fan (2–speed)

Supply Fan Compensation	Demand Controlled Ventilation	Remote Minimum Position	Occupancy Status	Outdoor Air Damper Controlling Setpoints
Enabled	Installed	Installed	Occupied, Occupied Bypass	**Supply Fan at 100%:** Remote Minimum Position DCV Minimum OA Damper Position at Full Fan Capacity **Supply Fan at minimum speed:** Design Minimum OA Damper Position at Min Fan Capacity DCV Minimum OA Damper Position at Min Fan Capacity
Enabled	Installed	Not Installed	Occupied, Occupied Bypass	**Supply Fan at 100%:** Design Minimum OA Damper Position at Full Fan Capacity DCV Minimum OA Damper Position at Full Fan Capacity **Supply Fan at minimum speed:** Design Minimum OA Damper Position at Min Fan Capacity DCV Minimum OA Damper Position at Min Fan Capacity
Enabled	Not Installed or Disabled	Installed	Occupied, Occupied Bypass	**Supply Fan at 100%:** Remote Minimum Position **Supply Fan at minimum speed:** Design Minimum OA Damper Position at Min Fan Capacity
Enabled	Not Installed or Disabled	Not Installed	Occupied, Occupied Bypass	**Supply Fan at 100%:** Design Minimum OA Damper Position at Full Fan Capacity **Supply Fan at minimum speed:** Design Minimum OA Damper Position at Min Fan Capacity

Table 9. 0 to 100 percent economizer – multi-speed supply fan (2–speed) (continued)

Supply Fan Compensation	Demand Controlled Ventilation	Remote Minimum Position	Occupancy Status	Outdoor Air Damper Controlling Setpoints
Enabled	Installed	Installed or Not Installed	Occupied Standby	**Supply Fan at 100%:** Standby Minimum OA Damper Position at Full Fan Capacity DCV Minimum OA Damper Position at Full Fan Capacity **Supply Fan at minimum speed:** Standby Minimum OA Damper Position at Min Fan Capacity DCV Minimum OA Damper Position at Min Fan Capacity
Enabled	Not Installed or Disabled	Installed or Not Installed	Occupied Standby	**Supply Fan at 100%:** Standby Minimum OA Damper Position at Full Fan Capacity **Supply Fan at minimum speed:** Standby Minimum OA Damper Position at Min Fan Capacity
Disabled	Installed or Not Installed	Installed or Not Installed	Occupied, Occupied Bypass, Occupied Standby	Economizer Minimum Position Setpoint BAS

0 to 100% Economizer with TRAQ

The outdoor air damper is modulated to provide outdoor air flow (cfm) required by the Outdoor Air Minimum Flow setpoint. See Table 10, p. 42 for addition information and settings.

The provided air flow measurement capabilities include periodic, automatic calibration; however, air flow gain and offset settings are also provided for field adjustment.

Demand Controlled Ventilation with TRAQ

When Demand Controlled Ventilation (DCV) and 0 to 100% Economizer with Traq are installed, DCV calculates the Minimum OA Flow Target (setpoint) based on space CO_2. When Space CO_2 is at or above the Space CO_2 High Limit, the Minimum OA Flow Target will be at Design Min Outdoor Air Flow setpoint. When Space CO_2 reduces and is below the high limit, Minimum OA Flow Target is calculated to a lower setpoint. When Space CO_2 is at or below the Space CO_2 Low Limit, the Minimum OA Flow Target will be at DCV Min Outdoor Air Flow setpoint. The following table summarizes the setpoints and settings when Demand Control Ventilation is installed or not installed.

If Demand Controlled Ventilation is installed but is disabled because a Space CO_2 Sensor failure (for example), Traq damper control will revert to Outdoor Air Minimum Flow Setpoint BAS.

Table 10. 0 to 100% Economizer with TRAQ

Demand Control Ventilation	Description	Outdoor Air Damper Controlling Setpoints
Not installed or disabled	Damper controls to outdoor air minimum flow setpoint	**Flow Setpoints:** Outdoor Air Minimum Flow Setpoint BAS Outdoor Air Minimum Flow Setpoint BAS - Active
Installed	Outdoor Air Flow setpoint reset based on space CO_2.	**Flow Setpoint:** Minimum OA Flow Target **Settings:** Design Min Outdoor Air Flow Setpoint DCV Min Outdoor Air Flow Setpoint

0 to 50 percent Motorized Damper

When a 0 to 50 percent motorized damper is installed, with any supply fan type, the outdoor air damper is controlled to a setpoint from a Remote Minimum Position (wired input), Motorized Damper Position Setpoint, or Economizer Minimum Position Setpoint BAS. The following table summarizes which setpoint is in control of the damper position based on options installed and enabled.

Table 11. 0 to 50 percent motorized damper

Supply Fan Compensation	Remote Minimum Position	Occupancy Status	Outdoor Air Damper Controlling Setpoints
Enabled	Installed	Any	Remote Minimum Position
Enabled	Not Installed	Any	Motorized Damper Position Setpoint
Disabled	Installed or Not Installed	Any	Economizer Minimum Position Setpoint BAS

Demand Controlled Ventilation (DCV) — Thermostat Control

When the Symbio™ 700 is configured for Conventional Thermostat Control, 0 to 100 percent Economizer Damper and Demand Controlled Ventilation (Installed), the controller provides an Occupancy binary input that can be used to control Occupied and Unoccupied modes of operation. In Unoccupied mode, DCV is disabled, and the outdoor air damper minimum position is effective 0 percent. In Occupied mode, DCV will control the outdoor air damper based on Space CO_2 while the supply fan is On, as described in the previous sections.

In Occupied mode, if the supply fan cycles Off, the controller will continue to monitor Space CO_2. If Space CO_2 exceeds the Space CO_2 High Limit setpoint for 15 minutes, the supply fan will turn On and operate at minimum speed and outdoor air damper at the Design Minimum OA Damper Position. If Space CO_2 falls below the Space CO_2 High Limit – 200 ppm, the supply fan will cycle Off. The supply fan will also cycle off if occupancy changes to Unoccupied.

Relief Damper Control - Statitrac

Symbio™ 700 Statitrac control is a highly accurate and efficient method of maintaining building pressure control with a large rooftop HVAC unit. To maintain a desired building pressure, Statitrac uses a pressure transducer to measure Space Static Pressure and compare that value to two user adjustable setpoints.

Setpoint Name	Description	Range and Default
Space Static Pressure Setpoint	Desired building pressure setpoint	-0.2 to 0.36 iwc; 0.08 iwc
Space Static Pressure Setpoint Deadband	Deadband around the Space Static Pressure Setpoint used by the controls for proper Relief Damper operation	0.02 to 0.2 iwc; 0.04 iwc

Relief Fan control turns the relief fan on based on the Relief Enable Position Setpoint (user selected setpoint based on Outdoor Air Damper position) and the relief dampers are then modulated in response to Space Static Pressure as shown in the below table.

Condition	Statitrac Response
Space Static Pressure < Space Static Pressure Setpoint – Space Static Pressure Setpoint Deadband	Relief Dampers modulates close
Space Static Pressure Setpoint – Space Static Pressure Setpoint Deadband ≤ Space Static Pressure ≤ Space Static Pressure Setpoint + Space Static Pressure Setpoint Deadband	Relief Damper holds current position
Space Static Pressure ≥ Space Static Pressure Setpoint + Space Static Pressure Setpoint Deadband	Relief Damper modulates open

Economizer and return air dampers are modulated independent relief dampers based on ventilation control and economizer cooling requests.

Statitrac function will provide and output signal from the Indoor Options Module every 60 seconds for the purpose of calibrating the transducer.

If a ventilation override mode is active with Statitrac, the relief fan will turn on and the relief damper will open to 100%.

If the Space Pressure Sensor fails, a diagnostic will be annunciated in the “Active Alarm” and the unit will revert to using Fresh Air Damper Tracking. If the failure on the Space Pressure Sensor clears, Statitrac Space Pressure Control will become active again.

Relief Damper Control – Fresh Air Damper Tracking

The Symbio™ 700 controller offers Relief Fan with Fresh Air Damper Tracking as an option for controlling building pressure with Voyager 3 large commercial rooftop HVAC unit. To keep the space pressure from getting high, the relief damper will track the position of the outdoor air damper anytime the relief fan is energized.

Relief Fan control turns the relief fan on based on the Outdoor Air Damper ≥ Relief Enable Position Setpoint (user selected setpoint based on Outdoor Air Damper position). The relief damper is then modulated to track the position of the outdoor air damper.

When the Outdoor Air Damper < Relief Enable Position Setpoint, the relief fan will de-energize and the relief damper will close.

If a ventilation override mode is active with Fresh Air Damper Tracking, the relief fan will turn on and the relief damper will open to 100%.

General Support Sequences

Supply Fan Speed Setpoint Adjustment

The Symbio™ 700 provides a Supply Fan Maximum Speed Setpoint and a Supply Fan Minimum Speed Setpoint that adjust the maximum and minimum settings provided from the VFD. The details of how the setpoints affect supply fan operation are provided as follows:

- Supply Fan Maximum Speed Setpoint
  - Range: 50 to 100%
  - Operation: This setpoint “trims” the maximum fan speed, based on the configured maximum frequency within the VFD parameter.
  - Example: maximum frequency = 60Hz
    - Supply Fan Maximum Speed Setpoint @ 75% yields a maximum allowed frequency of 45Hz VFD output.
- Supply Fan Minimum Speed Setpoint
  - Range: 0-100%
  - Operation: This setpoint adjusts the minimum allowed frequency based on the maximum allowed frequency. This cannot drive the fan lower than the minimum frequency set within the VFD parameters.
  - Example: VFD Maximum Frequency = 60Hz; VFD Minimum Frequency = 22Hz
    - Supply Fan Maximum Speed Setpoint @ 75% yields a maximum allowed frequency of 45Hz VFD output.
    - Supply Fan Minimum Speed Setpoint @ 75% yields a minimum allowed frequency of 34Hz VFD output (75% of 45Hz).
- Minimum and Maximum Speed Setpoints interact to ensure that the minimum defined fan speed at a given equipment operating condition is maintained.

Supply Fan VFD Bypass

All units have an option to provide Supply Fan VFD Bypass control. This option allows for emergency fan operation if the VFD drive were to fail or become inoperative. The VFD bypass option consists of Contactor VFD Run and Bypass Contactor, which are controlled from the Indoor Options Module. During normal operation, Contactor VFD Run (VRC) is energized for VFD control of the supply fan motor. When VFD Bypass is enabled, the Contactor VFD Run will de-energize, disconnecting the VFD drive output to the supply fan motor. The Bypass Contactor will then be energized or de-energized to control the supply fan On (at line frequency) and Off.

Enabling VFD Bypass Mode

Supply Fan VFD Bypass Mode can be enabled at any time. The unit will remain in VFD Bypass mode until manually terminated. VFD bypass mode will persist over a power failure. No supply fan proving is provided when VFD Bypass is enabled. For VVDA units, Duct Static Pressure High Limit remains active and will cause an immediate supply fan shutdown if the duct static pressure exceeds the maximum limit.

Supply Fan VFD Bypass is enabled via the Symbio Service and Installation Mobile App or the onboard user interface by selecting **Utilities** | **Start VFD Bypass Sequences**.

1. The supply fan and all unit operation is commanded Off. A 40 second timer starts to ensure the supply fan is off and has coasted down to a complete stop.
2. Contactor VFD Run (VRC) de-energizes, disconnecting the VFD output to the supply fan motor.
3. Diagnostic — Supply Fan Bypass Enable diagnostic is active
4. VVDA units — The VAV Box Relay is commanded ON (energized) to indicate full airflow mode to the system, Heat Cool Mode Request will be report Max Heat for all modes of operation, and the VAV Box Stroke Time will count down. All unit operation is disabled until the VAV Box Stroke Time has timed out.

5. VFD Bypass is now active, and the supply fan control logic will turn the Supply Fan Bypass Contactor (BC) On and Off to run and stop the supply fan. All other equipment cooling, heating, ventilation operation and safeties remain active during VFD Bypass.

Disabling VFD Bypass Mode

Supply Fan VFD Bypass Mode can be disabled at any time. Supply Fan VFD Bypass is disabled via the Symbio Service and Installation Mobile App or the onboard user interface by selecting **Utilities** | **Stop VFD Bypass Sequences**.

1. The supply fan is commanded Off by de-energizing the Bypass Contactor (BC). A 40 second timer starts to ensure the supply fan is off and has coasted to a complete stop.
2. VVDA units — The VAV Box Relay is commanded Off (de-energized) and Heat Cool Mode Status will report Off.
3. All unit operation remains Off for 40 seconds.
4. Diagnostic — Supply Fan Bypass Enable diagnostic is inactive
5. Contactor VFD Run (VRC) will energize, connecting the VFD output to the supply fan motor.
6. VFD Bypass is now inactive and the Symbio 700 will resume supply fan control by communicating commands to the VFD.

Compressor Minimum Runtime

Under all normal running conditions, a 3–minute minimum ON and OFF timer is maintained for each compressor. Once a compressor is turned ON, it remains on for a minimum of 3 minutes. Once a compressor is turned OFF, it remains off for a minimum of 3 minutes. System overrides that require immediate shutdown of the equipment, test modes, and compressor diagnostics/protection functions can override these 3–minute timers. However for normal temperature and thermostatic-based control, these minimum ON/OFF timers are maintained.

Compressor Proof of Operation

For each compressor. a Compressor Proving binary input is used to monitor the state of an auxiliary switch that is used to indicate compressor motor contactor status. Under normal operation, detected operation indicates that all safety devices within the compressor safety circuit are in their normal state. The switch operates as OPEN when the compressor motor is OFF and CLOSED when the compressor motor is ON.

Refer to the Diagnostics section for specific diagnostics generated based on the Compressor Proving signals.

Compressor Low Pressure Cutout Control

For each compressor/circuit, a normally CLOSED low pressure cutout input is monitored for equipment protection on the Symbio™ 700. When a low pressure event is active, the input becomes OPEN and diagnostics are generated as described below. Refer to the Diagnostics section below for specific diagnostics that are generated based on the circuit Low Pressure Cutout inputs.

Evaporator Defrost Control

To prevent frost build-up on the indoor coil during low ambient conditions, compressor operation is monitored and controlled accordingly, relative to outdoor air temperature.

Evaporator Defrost Control can be initiated through two means, based on the FroStat input.

FroStat Installed (default):

- A FroStat input can also be used to directly request the Evaporator Defrost Control function
- When the unit is running in an effective **Cool** mode, the FroStat input will directly control the FroStat diagnostic. If the FroStat input CLOSES, the diagnostic will be annunciated.
- When the unit is running in an effective **Heat** mode, and the Refrigeration System = Heat Pump, the FroStat diagnostic will be controlled **Inactive** until the following are true:
  - FroStat input is CLOSED
  - One or More Compressors have been active for Heat Pump Heating for more than 30 seconds.

Once the above two conditions are met, the FroStat Diagnostic will become Active.

- The FroStat diagnostic is an Auto-Reset diagnostic such that it will be reset when the FroStat input is OPEN in either effecting unit mode.
- If the FroStat diagnostic becomes active, the Compressor Output(s) will de-energize until the FroStat diagnostic is cleared. The supply fan continues to operate during the FroStat diagnostic, so long as it is still requested by a heating or cooling function.

Refrigerant Leak Detection System

Equipment with R-454B refrigerant may require a refrigerant leak detection system (LDS) based on the refrigerant charge. The refrigerant detection system consists of a refrigerant detection sensor that communicates information to the Symbio 700 controller. When the refrigerant detection sensor is in a normal operating state, the equipment provides normal heating, cooling, and ventilation. The refrigerant sensor creates an alarm signal when the sensed refrigerant concentration has exceeded a predetermined threshold.

When the refrigerant detection system is in an alarm state, the Symbio 700 mitigates the refrigerant leak alarm condition for a minimum of 5 minutes after the refrigerant detection system has reset to a normal state.

Mitigation actions:

- All compressor operation is disabled.
- The supply fan operates continuously at or above a defined minimum speed.
- After the supply fan operation is proven; electric heat, gas heat, economizer cooling and ventilation operate normally.
- Alarm output energizes on the Customer Options Module (if installed).

The following Symbio 700 points are available on BACnet or Modbus. The points are not available on LonTalk.

Table 12. Refrigerant Detection System points

Point Reference	Description
Refrigerant Leak Detection System Input	The Active state maintained for the duration of the refrigerant detection system alarm state.
Refrigerant Mitigation Active	Active when the Symbio controller is in a refrigerant mitigation state. This point is also for coordination of building multi-zone VAV systems.
Diagnostic: Refrigerant Concentration Sensor A	Active when Refrigerant Leak Sensor is in the alarm state. Resets, inactive when the Refrigerant Leak Sensor alarm has reset; refrigerant concentration has reduced below the lower concentration threshold.
Diagnostic: Refrigerant Leak Sensor Failure Sensor A	Diagnostic point that shall be active when the refrigerant sensor reports a fault.
Refrigerant LFL Concentration Sensor A	Concentration reported by the refrigerant leak sensor, expressed in percent of LFL (Lower Flammability Limit).
Refrigerant LFL Concentration Alarm Threshold Sensor A	0-100% of LFL (Lower Flammability Limit), value represents the percent of refrigeration concentration level the refrigerant detection sensor will alarm.
Refrigerant Leak Sensor Communication Status Sensor A	Communication status of the Modbus communicating refrigerant detection system. Loss of communication shall initiate refrigerant mitigation actions.

A Multi-Zone VAV application with the supply fan off, the supply fan operation is delayed for the duration of the VAV Box Stroke Time (default 6 minutes, editable) to allow time for VAV boxes to open. The Symbio controller energizes the VAV Box Relay Output and the Refrigerant Mitigation Active point will be active to signal building systems to drive VAV boxes open. When using LON communications, the VAV Box Relay Output must be used to coordinate with building multi-zone VAV system.

In the event the control system detects the refrigerant sensor has failed, become disconnected or unpowered; the controls will respond with a Diagnostic: Refrigerant Leak Sensor Failure, Refrigerant Mitigation Active, and the Alarm Output are active. The Symbio controller provides all mitigation actions (outlined above) for the duration of the sensor failure mode.

Building fire and smoke systems utilizing Ventilation Override or Emergency Override will override the refrigerant detection system. Service Test mode and the Emergency Stop input will also override the refrigerant detection system.

After mitigation actions are completed and the condition triggering mitigation actions are no longer active, the unit will return back to normal operation.

Building Automation System Support Sequences

Occupancy Mode

During expected occupied periods, the system will control to the user selected cooling and heating setpoints.

- The unoccupied setpoint temperatures are often adjusted higher for cooling (setup) and lower for heating (setback) to reduce building operating cost.
- Regardless of how the (occupied) fan mode is set, the supply fan mode is forced to AUTO during unoccupied periods to reduce supply fan operating costs.

There are two mechanisms available to control when units should switch between occupied and unoccupied modes:

- Building controllers provide signals to the unit to request occupied or unoccupied operation. Time-of-day scheduling within building controllers typically determine when the switching should occur.
- Stand Alone Unoccupied control is initiated by a contact closure that causes the unit to begin unoccupied control. In this mode, the controller will use the Unoccupied Cooling and Heating setpoints to determine capacity control needs. Stand Alone Unoccupied control is only applicable when the unit is not being controlled by a conventional thermostat interface.

Timed Override

Exceptions to the time-of-day scheduling are required when unusual or difficult to schedule events cause a space to become occupied during a scheduled unoccupied period. The Timed Override function provides a mechanism for an occupant to signal the system that the space is actually occupied and override the time-of-day schedule to provide occupied control for some limited time period. It also provides a mechanism to return the system to unoccupied mode when the space is no longer occupied.

There are two methods of requesting or terminating timed override on a Symbio™ 700 control system:

- BAS
  - Timed Override Request value can be set to three discrete values:
    - **Idle [1]**— Controller will not override Unoccupied Mode.
    - **On [2]**— When the value is changed from Idle to On, the controller overrides Unoccupied Mode and the unit operates in Occupied Mode. The Occupied Bypass Timer and the Timed Override Timer is Active is set to ‘Active’. The controller remains in Timed Override for the duration of the Occupied Bypass Time.
    - **Cancel [3]**— When value is changed from On to Cancel, the unit’s unoccupied status is no longer overridden and the Occupied Bypass Timer will be set to 0.
- Zone Sensor Initiate/Terminate buttons – Some zone sensors have a Timed Override Initiate and Terminate buttons.

When Timed Override is initiated by any of the above methods, the controller starts a timer using the user selected Occupied Bypass Time to control the duration of the Timed Override event. The range for Occupied Bypass Time is 0-240 minutes with a default of 120 minutes.

When the unit is operating in Occupied Bypass mode, the Occupied Bypass Timer duration can be extended by initiating a Timed Override Request again. This extends the Occupied Bypass Timer duration by the value of the user selected Occupied Bypass Time.

When Timed Override is terminated by any of the above methods, the controller will exit Occupied Bypass and will again begin to use unoccupied control setpoints.

Unit Stop

The Unit Stop feature allows for immediate shutdown of all devices in the equipment when initiated. When a Unit Stop request is received, the following actions are taken:

- All equipment control binary outputs are de-energized
  - Indoor fan

  - Compressors
  - Condenser fans
  - Unloader solenoids
  - Heat stages
- All equipment control analog outputs are set to their minimum/off command values.
- All communicating devices, such as supply fans, are commanded to their off state.
- All control algorithms are initialized to their normal startup values and held until the stop request is released.

The Unit Stop request can be initiated from the following sources:

- Unit Stop Command
- Equipment Shutdown Input
- Emergency Override BAS
- Phase Monitor

If a Unit Stop is initiated, the source of the Unit Stop can be determined by the Unit Stop Source Point and other status/diagnostic points.

Capacity Limit Control

The Symbio™ 700 provides the following capabilities to lockout or limit heat and cool capacity installed in the equipment (these capabilities interact):

- Capacity Lockout points have highest priority.
- When Heat Lockout Command and Cooling Lockout BAS are false (not locked out); the control will limit capacity based on Cooling Capacity Enable and Primary Heat Enable.
- Last in priority is Demand Limit Request BAS which enables independent limits on cooling and heating capacity.

See the following sections for more details of each.

Priority	Cooling Limits	Heating Limits
1	Cooling Lockout BAS	Heat Lockout Command
2	Cooling Capacity Enable	Primary Heat Enable BAS
3	• Demand Limit Request BAS • Demand Limit Input (binary input) • Cooling Demand Limit Capacity Enable Setpoint	• Demand Limit Request BAS • Demand Limit Input (binary input) • Heating Demand Limit Capacity Enable Setpoint

Capacity Lockouts

Capacity Lockout points are available to the building automation to provide a method to override or lockout DX Cooling, Gas Heating, and Electric Heating. Cooling Lockout BAS will disable all DX cooling capacity while economizer operation is allowed. Heat Lockout Command disables all forms of installed primary heating capacity.

Cooling Capacity Enable

Cooling Capacity Enable is a building automation interface point used to limit the DX cooling capacity of the equipment. It will not limit economizer cooling. The 0-100% value limits the amount of cooling capacity; default is 100%. The cooling stages allowed = (Limit % * number of stages), round down to the nearest integer.

Heat Primary Enable

Primary Heat Enable BAS is a building automation interface point used to limit all forms of primary and secondary (gas, electric, compressor) heat installed in the equipment. The 0-100% value limits the

amount of heating capacity; default is 100%. Staged heating stages allowed = (Heat Primary Enable * number of stages), round down to the nearest integer. Modulating heat allowed = Heat Primary Enable (%).

Demand Limit

When Demand Management is configured for Demand Limit, demand limits can be applied via building management points or the Demand Limit Input (Symbio 700 J16-1 and J16-2). The primary purpose of this function is to limit power consumption of heating and cooling capacities installed in the equipment. Demand Limit does not apply to economizer cooling nor hot gas reheat.

If no building management is writing to the Demand Limit Request BAS point, demand limit can be enabled or disabled by the Demand Limit Input (hardware binary input). Otherwise, if Demand Limit Request BAS is being commanded, it will have priority over the hardware binary input. The result of the arbitration between Demand Limit Request BAS and the Demand Limit Input is reported via Demand Limit Request BAS – Active point.

When Demand Limit Request BAS – Active point is Limit (true), Cooling Demand Limit Capacity Enable Setpoint (0-100%) and Heating Demand Limit Capacity Enable Setpoint (0-100%) apply limits to cooling and heating capacity, respectively. The power consumption result will depend on number of heating and cooling stages installed and how each map to the capacity calculation. Cooling Demand Limit Capacity Enable Setpoint limits compressor stages of operation however will not limit economizer cooling. Heating Demand Limit Capacity Enable setpoint limits the stages of electric heat; however, Heating Demand Limit Capacity Enable will not limit gas heat.

Calculation: Number of heating or cooling stages allowed = (Limit % * number of stages), round down to the nearest integer.

Example: 5-stage Cooling Only unit with 2-stage primary heat

When Demand Limit Request BAS – Active is Limited and Heating Demand Limit Capacity Enable setpoint is 60%, 2-stage primary heat installed, limits operation to 1-stage of heat.

(60% * 2) = 1.2, round down to nearest integer = 1.

When Demand Limit Request BAS – Active is Limited and Cooling Demand Limit Capacity Enable setpoint is 90%, 5-stages cooling installed, limits operation to 4-stages of cooling.

(90% * 5) = 4.5, round down to nearest integer = 4.

Remote Capacity Control

The Symbio™ 700 controls support the Remote Capacity Control function for all system types except VVDA. This function allows a user to directly control the unit capacity rather than allowing the internal algorithm to provide control.

The following features/functions can be requested directly via points, rather than relying on internal temperature or thermostat control sequences:

- Supply Fan Speed
- Cooling Capacity
- Heating Capacity

For Thermostat Controlled equipment, the Thermostat Inputs must be **OPEN** i.e. requesting **OFF** mode before the Cooling or Heating Capacity requests will be honored.

For Space Temperature controlled equipment, the Heat Cool Mode Request must be set to **Fan Only** before the Cooling or Heating Capacity requests will be honored.

For each entity, there is an **Enable** point to enable or disable the remote capacity control, and an analog value point to allow the user to request an analog capacity value. The analog value is translated to the appropriate value per function.

Supply Fan Speed Command overrides will be honored in all non-Heat or Off modes. When Supply Fan Speed Command is enabled, and the Supply Fan Speed Command value is 0 percent, the system will interpret as an **OFF** mode request, and all active capacity will be set to **OFF**; fan, heating, and cooling.

All equipment safeties and limitations will be in-place while the Remote Capacity Control functions are being leveraged:

- Minimum fan speeds as defined per active capacity will be maintained
- Compressor Minimum ON/OFF times will be maintained
- All system diagnostics will be maintained.

Emergency and Ventilation Override

This feature has two options for initiating an override request, either through the optional hardwired Ventilation Override terminals via Customer Connection Module, or by initiating a request through the Emergency Override point. Ventilation Override via the hard-wired binary inputs has priority over Emergency Override.

Ventilation Override

When configured for the Ventilation Override option, applying 24 volts to one of the three Ventilation Override inputs manually activates Ventilation Override. Three inputs are provided on the Customer Option Module supporting Ventilation Override functionality:

- Pressurize mode
- Purge mode
- Exhaust mode

If more than one mode is requested at the same time, the Pressurize request will have priority followed by Purge, and then Exhaust. When Any Ventilation Override mode is active, all heating and cooling is turned off. For the case where the unit is required to turn Off via hardwired interface, the Equipment Shutdown binary input is used.

Emergency Override

All units with Symbio™ 700 support the remote Emergency Override command functionality. Within this point, there are addition enumerations versus the hardware Ventilation Override interface:

- 1 = EMERG_NORMAL
- 2 = EMERG_PRESSURIZE
- 3 = EMERG_DEPRESSURIZE
- 4 = EMERG_PURGE
- 5 = EMERG_SHUTDOWN
- 6 = EMERG_FIRE

Pressurize, Depressurize, and Purge map to their respective Ventilation Override Modes directly. , Emerg_Shutdown and Emerg_Fire are unique to Emergency Override. Both of those are treated as a remote shutdown request for the equipment.

Equipment Operation

Emergency and Ventilation Override requests/actions will take priority over normal equipment timing events, such as compressor minimum ON/OFF/Inter-stage timers.

During an Emergency or Ventilation Override sequence, all temperature control algorithms are initialized to an inactive state until the Emergency or Ventilation Override request is cleared. For each override request, the unit will operate in a pre-determined state until override requests are cleared.

For detailed unit operation during Emergency or Ventilation Override, refer to the Appendix section of this document.

Service Test Mode

Service Test Mode can be used to initiate certain operating modes of the equipment. Refer to the following sections for more details associated with this feature.

Service Test Timeout

Service Test Timeout (Minute) is a user selected time value. Once Service Test Mode has been initiated, and this timer expires, the controls are forced to leave Service Test Mode and return to normal unit operation.

- **Minimum value** - 1 minute
- **Maximum value** - 120 minutes
- **Default value** - 60 minutes

Timer Initiate: When any value for Service Test State Request is chosen other than Inactive, the controller sets the Service Test Timeout to the user selected value and the unit begins to operate as described in the tables below. It continues in operation until the Service Test Timeout Timer reaches 0 **OR** until the user chooses a different Service Test State Request.

Timer Terminate: if the Service Test Timeout timer has reached 0, the controls sets the Service Test Stage Request to Inactive and the unit returns to normal unit operation. If the Service Test Timeout Timer has not reached 0, the user can set the Service Test Stage Request to Inactive to exit the active Service Test State Request and return to normal unit operation.

Timer Reset: if the Service Test Timeout timer has not reached 0, the user can select the Service Test Stage Request to any value other than Inactive. The controller resets the Service Test Timeout Timer to the user selected value and the unit operates as describe in the tables below for the new request.

Leaving Service Test Mode

There are three ways to leave Service Test Mode:

- When the Service Test Timeout timer expires, the unit will leave Service Test Mode.
- Service Test State Request is set to **Inactive**.
- The controller goes through a power cycle or reset.

Service Test Mode — CVZT, VVZT, and VVDA

The table below provides unit operation for each stage of service test depending on the unit configuration. The table describes the service test mode states and expected unit response. For all service test mode operations, “IN CONTROL” refers to Symbio™ 700 algorithms controlling the unit. For instance, in all service test mode states, the condenser fan will be controlled as needed to ensure safe unit operation.

Table 13. Service test mode states — cooling only

Service Test Step	Supply fan On/Off	Supply fan speed (VVZT, CVZT)	Supply fan speed (VVDA)[a]	VAV box relay request (VVDA)	Outdoor air damper position	Compr cool stage	Aux heat stage	Relief fan On/Off	Reheat pumpout solenoid On/Off[b]	Reheat valve 1	Heat cool mode status (VVZT, CVZT)	Heat cool mode status (VVDA)[c]
Inactive	In Control	In Control	In Control	In Control	In Control	In Control	In Control	In Control	In Control	In Control	In Control	In Control
Fan On	ON	Min	Min	Open	Min	0	0	In Control	OFF	0	Test	Maximum Heat
Fan On Econ Open	ON	Min	Min	Open	100	0	0	In Control	OFF	0	Test	Maximum Heat
High Fan Speed Econ Open	ON	100	100	Open	100	0	0	In Control	OFF	0	Test	Maximum Heat
Ventilation Low Fan Speed	ON	Min	Min	Open	Design Min	0	0	In Control	OFF	0	Test	Maximum Heat
Ventilation Mid Fan Speed	ON	Effective Mid[d]	Effective Mid[d]	Open	Design Mid	0	0	In Control	OFF	0	Test	Maximum Heat
Ventilation High Fan Speed	ON	100	100	Open	Design Max	0	0	In Control	OFF	0	Test	Maximum Heat
Cool 1	ON	Min for Capacity	100	Open	Min	1	0	In Control	ON	0	Test	Maximum Heat
Cool 2	ON	Min for Capacity	100	Open	Min	2	0	In Control	ON	0	Test	Maximum Heat
Cool 3	ON	Min for Capacity	100	Open	Min	3	0	In Control	ON	0	Test	Maximum Heat
Cool 4	ON	Min for Capacity	100	Open	Min	4	0	In Control	ON	0	Test	Maximum Heat
Cool 5	ON	Min for Capacity	100	Open	Min	5	0	In Control	ON	0	Test	Maximum Heat
Reheat	ON	Min for Capacity	100	Open	Min	5	0	In Control	OFF	50	Test	Maximum Heat
Heat 1	ON	Min for Capacity[e]	100	Open	Min	0	1	In Control	OFF	0	Test	Maximum Heat
Heat 2	ON	100	100	Open	Min	0	2	In Control	OFF	0	Test	Maximum Heat

Table 13. Service test mode states — cooling only (continued)

Service Test Step	Supply fan On/Off	Supply fan speed (VVZT, CVZT)	Supply fan speed (VVDA)[a]	VAV box relay request (VVDA)	Outdoor air damper position	Compr cool stage	Aux heat stage	Relief fan On/Off	Reheat pumpout solenoid On/Off[b]	Reheat valve 1	Heat cool mode status (VVZT, CVZT)	Heat cool mode status (VVDA)[c]
Open Reheat Vavle	OFF	0	0	Open	0	0	0	In Control	OFF	85[f]	Test	Maximum Heat
Close Reheat Valve	OFF	0	0	Open	0	0	0	In Control	OFF	0	Test	Maximum Heat

(a) For VVDA units, Supply Fan Speed Request shall not be 100 before VAV boxes full open. If VAV box stroke timer has not expired, set fan speed to Min to avoid high duct static pressure trip.
(b) Reheat Pumpout Solenoid On/Off Request shall be ON whenever compressor cool or heat stage request is greater than 0, except during the "Reheat" step.
(c) For VVDA units, Heat Cool Mode Status shall be set to Maximum Heat to coordinate VAV Box Relay, when any service test step activated
(d) Supply Fan Speed Request "Effective Mid" equals to *(Effective Maximum Fan Speed + Effective Minimum Fan Speed) / 2*.
(e) For "Heat 1" , the supply fan speed shall run at min speed due to Staged Gas Heat supply fan requirements.
(f) Reheat Valve 1 Request is set to 85% in "Open Reheat Valve 1" step, because 85% is the max operating range during normal operation. Refer to the step motor reference docs for more detail information.

Diagnostics

Device Tracker

Symbio™ 700 will keep statistical data of the unit for component starts and component run times (in hours) for the following unit components:

- Compressor 1
- Compressor 2
- Compressor 3
- Condenser Fan 1
- Condenser Fan 2
- Condenser Fan 3
- Condenser Defrost
- Supply Fan
- Relief Fan
- Electric Heat Stage 1
- Electric Heat Stage 2
- Filter (Runtime only)
- Gas Heat Manifold 1 Burner 1
- Gas Heat Manifold 1 Burner 2
- Gas Heat Manifold 2 Burner 1

If the Filter Runtime hours exceed the value set by the user for the Filter Runtime Hours Setpoint, the Symbio 700 controller activates the Diagnostic: Maintenance Required point.

If for any reason it is required to reset the component statistical data, the Run Time Reset or Starts Reset points can be accessed through the Symbio Service and Installation mobile app. If the reset points are set to Reset, the Component Run Time and Starts are reset to 0 and the associated reset points are set back to inactive. In the case of the Diagnostic: Maintenance Required point, it will also be reset to Inactive if Filter Timer Reset point is set.

Compressor Proving Diagnostics

Three diagnostics can be generated based on the compressor proving input.

Diagnostic: Compressor X Proving Trip

When a compressor output is commanded ON and it has been running for more than 5 seconds, if the associated proving input opens, the controls generate the Diagnostic: Comp X Proving Trip and the following will occur:

- Command the associated compressor output OFF immediately.
- Command any compressor output OFF that is on the same refrigeration circuit as the compressor which had the proving input trip.
- The Circuit is disabled for 15 minutes.

After the 15 minute compressor proving timeout has expired, if the unit is not under a “Diagnostic: Compressor 1 Proving Lockout” event

- The Diagnostic: Comp X Proving Trip diagnostic is reset
- If the cooling stage is still requested ON, the circuit is allowed to stage again

Diagnostic: Compressor X Proving Lockout

There are two cases that can cause a Diagnostic: Compressor X Proving Lockout:

- If a refrigeration circuit accumulates 4 consecutive Diagnostic: Comp X Proving Trips during the same compressor operating cycle, a Diagnostic: Compressor X Proving Lockout is generated.

Note: *If the call for the compressor operation terminates, the counter is set to zero.*

- If a compressor associated proving input does not CLOSE within 5 seconds of the compressor startup.

If a Diagnostic: Compressor X Proving Lockout is generated the following will occur:

- All compressors on the associated circuit are de-energized immediately and they are locked out until a Reset Diagnostic action is initiated.
- The “Diagnostic: Compressor X Proving Lockout” diagnostic point is activated and the alarm output is activated.

Diagnostic: Compressor X Contactor Failure

If a compressor proving input becomes Active for 5 continuous seconds when the associated compressor command output is Inactive, a Diagnostic: Compressor X Contactor Failure is generated and the following occurs:

- All compressors on the associated circuit are de-energized immediately and they are locked out until a Reset Diagnostic is initiated.

The “Compressor X Contactor Failure” diagnostic point is activated and the alarm output is activated.

Diagnostics – Low Pressure Cutout

The following operation is enforced based on the state of the circuit’s LPC input:

Prior to Compressor Startup:

- If a compressor output is Off and its circuit’s LPC input is open, compressor operation is not inhibited, and the **Diagnostic: Circuit X LPC Trip** point will not be annunciated.

After Compressor Startup:

An LPC Bypass Delay function delays the setting of a low pressure cutout after compressor startup on a circuit until a pre-determined amount of time passes in low ambient conditions. The length of the delay is determined based on ambient temperature:

- If the Outdoor Air Temperature Active is less than 40°F, the LPC Bypass Delay is set to 60 seconds.
- If the Outdoor Air Temperature Active is between 40°F and 50°F, the LPC Bypass Delay is set to 30 seconds.
- If the Outdoor Air Temperature Active is greater than 50°F, the LPC Bypass Delay is 0 seconds.

There are two diagnostics that can be generated based on the Compressor Low Pressure Cutout input:

Diagnostic: Circuit X LPC Trip

- All compressors outputs on the effected circuit are commanded OFF.
- The Diagnostic: Circuit X LPC Trip point is annunciated.
- The circuit is disabled for 3 minutes.
- The circuit LPC trip counter is incremented.

After the 3 minute low pressure event timeout has expired, if the unit is not under a lockout event:

- The Diagnostic: Circuit X LPC Trip point is reset.
- If the stage is still requested ON, the circuit is allowed to stage again.
- If the Circuit runs for 3 minutes, its LPC Trip Count is reset to 0.

On heat pumps, if the Outdoor Air Temperature is less than 0° F or if the unit is in active defrost, the low pressure cutout input state is ignored.

Diagnostic: Circuit X LPC Lockout

If a circuit LPC trip counter accumulates 4 low pressure events without the circuit running for the 3 minute minimum on time (counter is not reset), a Diagnostic: Circuit X LPC Lockout is generated.

Once a Diagnostic: Circuit X LPC Lockout has been generated, the following occurs:

- All compressors on the associated circuit are de-energized immediately and they are locked out until a Reset Diagnostic is initiated.
- The Diagnostic: Circuit X LPC Lockout point is activated and the alarm output is activated.

Diagnostics – Alarm Indicator Status

Symbio™ 700 will support an Alarm Indicator Status point that if configured, drives the state of a relay output on the Customer Connection Module. This point is set to active when a failure occurs that functionally stops a critical component within the HVAC system.

For a list of all supported Symbio 700 Diagnostics and if it sets the Alarm Indicator, refer to the Appendix section of this document.

Reset Diagnostic

A Reset Diagnostic function is responsible for ensuring that the Reset Diagnostic point is set to the right value under normal application control. The below sections describes how the Reset Diagnostic point is set to Active and Inactive.

Power-Up Reset or Exception/Override Mode Transition

At power-up or after the unit leaves an Exception or Override mode, all diagnostics are cleared, and the application starts over.

Reset Diagnostic Point

Diagnostic Resets throughout the controller application are triggered by the state of the Reset Diagnostic Point. The Reset Diagnostic point is setup as a last-write-wins point type, so it can be controlled by the local UI on the Symbio™ 700 or can be communicated.

Heat Cool Mode Transition Reset

When the unit is controlled by a zone sensor, a transition from System Mode Switch Local = OFF to System Mode Switch Local ≠ OFF triggers a Reset Diagnostic request.

Reset Diagnostic Point – Active to Inactive Transition

When the diagnostic reset function detects the state of the Reset Diagnostic point is Active, after 5 seconds, the Diagnostic Reset function sets the Reset Diagnostic point to Inactive.

Troubleshooting

The Symbio™ 700 controller provides system shutdown, operational default operation, and communication error handling of the Voyager unit. The list of fault conditions below will stop normal operation or change the operation of the unit to a default condition. Faults are indicated in the Active Alarm menu of the onboard user interface and the Symbio Service and Installation mobile app.

Unit Communication Fault

The maximum time for the inter-module communications (IMC) bus is 15 seconds. If 15 seconds passes with no valid communications received from any of the Options modules, the Symbio™ 700 takes the following actions:

Module	Symbio 700 Response	Response Type
Symbio 700 Onboard I/O	• Set Diagnostic: Unit Communications Failure • On-Board I/O Communication Status = Not Communicating • All unit functions will be shut down and I/O will go to their comm. loss state	Auto Reset
Customer Options Module	• Set Diagnostic: Unit Communications Failure • Customer Options Module Communication Status = Not Communicating • All unit functions that have dependencies on data from other modules will be discontinued – Ventilation Override functionality is discontinued – Alarm Indicator function is discontinued after seven seconds	Auto Reset
Indoor Options Module	• Set Diagnostic: Unit Communications Failure • Indoor Options Module Communication Status = Not Communicating • All unit functions that have dependencies on data from other modules will be discontinued – All Electric Heat operation is discontinued – Discharge Air Temperature dependent control discontinued (SZVAV) – HGRH/Dehumidification control will be discontinued	Auto Reset
Fresh Air Options Module	• Set Diagnostic: Unit Communications Failure • Fresh Air Options Module Communication Status = Not Communicating • All unit functions that have dependencies on data from other modules will be discontinued – All economizing operation is discontinued • For units with Traq, the Traq control will be disabled	Auto Reset
Stepper Motor Module	• Set Diagnostic: Unit Communications Failure • Stepper Motor Module Communication Status = Not Communicating • All unit functions that have dependencies on data from other modules will be discontinued – All HGRH functionality will be discontinued – All Compressor related functionality will be discontinued	Auto Reset
Refrigerant Leak Sensor Communication Status Sensor A	Symbio 700 will initiate refrigerant leak mitigation actions	Auto Reset

Sensor Fault

On Symbio™ 700, if a sensor value goes outside of its minimum or maximum range, the point goes into an Alarm State. If the point in the Alarm State, we consider the sensor failed and take the following actions:

Fault	Symbio 700 Response	Response Type
Space Temperature Active	• Annunciated in the Active Alarm list. • For specific unit operational response, see Space Temperature Control (CVZT/VVZT) section of this document. • (VVDA) Loss of Space Temperature Active does not shutdown unit operation; rather, disables specific operating modes that require valid space temperature.	Auto Reset
Discharge Air Temperature Local	• Annunciated in the Active Alarm list. • For specific unit operational response, see Space Temperature Control (CVZT/VVZT) section of this document. • (VVDA) Loss of Discharge Air Temperature Sensor results in a loss of heating and cooling capacity.	Auto Reset
Outdoor Air Temperature Active	• Annunciated in the Active Alarm list. • Economizer cooling disabled.	Auto Reset
Coil Temperature Sensor 1	• Annunciated in the Active Alarm list. • If Outdoor Air Temperature < 52° F, Demand Defrost will be disabled and timed defrost will be used.	Auto Reset
Coil Temperature Sensor 2	• Annunciated in the Active Alarm list. • If Outdoor Air Temperature < 52°F, Demand Defrost will be disabled and timed defrost will be used.	Auto Reset
Space Humidity Sensor	• Annunciated in the Active Alarm list. • Space Dehumidification disabled. • Comparative Enthalpy disabled.	Auto Reset
Space CO2 Sensor	• Annunciated in the Active Alarm list. • Demand Controlled Ventilation disabled.	Auto Reset
Duct Static Pressure Local	VVDA: Loss of Duct Static Pressure Sensor shall result in a unit shutdown.	Auto Reset
Duct Static Pressure Local Lockout	VVDA: Loss of Duct Static Pressure Sensor three times within 1-hour shall result in a unit shutdown.	Manual Reset
Duct Static Pressure Limit Trip	VVDA: The supply air static pressure exceeded the Supply Air Static Pressure High Limit Setpoint. Supply fan shall turn off (immediate shutdown) for 3 minutes before being allowed to start.	Auto Reset
Duct Static Pressure Limit Lockout	VVDA: The supply air pressure has exceeded the Duct Static Pressure High Limit Setpoint for the 3rd consecutive time without the supply fan running for 3 continuous minutes. (If the fan runs for 3 continuous minutes the counter will be reset.)	Manual Reset

Fault	Symbio 700 Response	Response Type
Outdoor Airflow Pressure	TRAQ only • Annunciated in the Active Alarm list • TRAQ OA Minimum Position Request will be disabled and a static value of 10% will be utilized for minimum position at all times. • If failure clears, TRAQ Minimum Position Request will be released to algorithm control.	Auto Reset
Space Static Pressure Input Trip	Statitrac only • Annunciated in the Acitve Alarm list • Unit will revert to use Fresh Air Damper Tracking • If failure clears, Space Pressure Control will become active again.	Auto Reset

Compressor Fault

Symbio™ 700 supports compressor safety functionality to keep the compressors from operating in an undesirable condition. If a compressor safety failure occurs, the following actions occur:

Fault	Symbio 700 Response	Response Type
LPC Lockout	For specific operation associated with the LPC diagnostics, refer to the Compressor Protection section of this document.	Manual Reset
Proving Lockout	For specific operation associated with the proving diagnostics, refer to the Compressor Protection section of this document.	Manual Reset
Contactor Failure	For specific operation associated with the proving diagnostics, refer to the Compressor Protection section of this document.	Manual Reset

Refrigerant Leak Detection System Fault

The Refrigerant Detection System is a Modbus communicating sensor that will be used on units using R-454B refrigerant.

Failure	Symbio700 Response	Response Type
Diagnostic: Refrigerant Concentration Sensor A	Symbio 700 will initiate refrigerant leak mitigation actions for the duration of the alarm condition and continue for 5 minutes after Diagnostic: Refrigerant Concentration Sensor A is inactive.	Auto Reset
Diagnostic: Refrigerant Leak Sensor Failure Sensor A	Symbio 700 will initiate refrigerant leak mitigation actions for the duration of the alarm condition.	Auto Reset

Supply Fan Fault

The following failures are derived either through direct data monitoring from the Modbus™ device, or through a combination of data monitoring and additional failure criteria.

Failure	Failure Detection	Symbio700 Response	Response Type
Diagnostic: Supply Fan Failure	If while the Supply Fan VFD is requested to run, the VFD Running Status from the drive is set to False for 40 continuous seconds, this failure will be detected	• Diagnostic: Supply Fan Failure will be set to “Active” • All unit functions will be shut down immediately	Manual Reset
Diagnostic: VFD Fault Supply Fan – 1	When Active	All unit functions will be shut down immediately	Auto Reset
Diagnostic: VFD Supply Fan Ground Fault – 1	When Active	All unit functions will be shut down immediately	Auto Reset
Diagnostic: VFD Supply Fan Motor Current Overload – 1	When Active	All unit functions will be shut down immediately	Auto Reset
Diagnostic: VFD Supply Fan Short Circuit – 1	When Active	All unit functions will be shut down immediately	Auto Reset
Diagnostic: VFD Supply Fan Broken Belt – 1	When Active	All unit functions will be shut down immediately	Auto Reset

Economizer Fault

Table 14. Economizer cooling failure modes and system response

Economizer Control	Failure Mode	Economizer Cooling Response
Comparative Enthalpy	Return Air Humidity Sensor	Absolute (Reference) Enthalpy
	Return Air Temperature Sensor	Absolute (Reference) Enthalpy
	Outdoor Air Temperature Sensor	• Economizer Cooling Disabled • OA Damper Closes to Economizer Minimum Position Setpoint Control
	Outdoor Air Humidity Sensor	Absolute Temperature (Reference Dry Bulb)
Reference Enthalpy	Outdoor Air Temperature Sensor	• Economizer Cooling Disabled • OA Damper Closes to Economizer Minimum Position Setpoint Control
	Outdoor Air Humidity Sensor	Absolute Temperature (Reference Dry Bulb)
Dry Bulb	Outdoor Air Temperature Sensor	• Economizer Cooling Disabled • OA Damper Closes to Economizer Minimum Position Setpoint Control
Differential Dry Bulb	Outdoor Air Temperature Sensor	• Economizer Cooling Disabled • OA Damper Closes to Economizer Minimum Position Setpoint Control
	Return Air Temperature Sensor	Absolute Temperature (Reference Dry Bulb)
Fresh Air Options Module	Communications Failure	All economizing operation is discontinued

Outdoor Air Damper Fault Detection and Diagnostics (FDD)

The outdoor air damper fault will have two fault detection components, faults that are generated when operating in minimum ventilation mode and another set when the damper is being controlled by the economizer:

- **FDD: Excessive Outdoor Air**

  In minimum ventilation mode and the damper feedback position is >10% of the damper commanded value for 5 continuous minutes.

- **FDD: Outdoor Air Damper Not Modulating**

  In minimum ventilation mode and the damper feedback is <10% of the damper commanded value for 5 continuous minutes.

- **FDD: Unit Economizing When It Should Not**

  In economizer cooling mode and the damper feedback is >10% of the damper commanded value for 5 continuous minutes.

- **FDD: Unit Not Economizing When It Should**

  In economizer cooling mode and the damper feedback is <10% of the damper commanded value for 5 continuous minutes.

Modulating Gas Heat

The following failures are derived through direct data monitoring from the Modbus of the gas heat controllers. Note, the VB1285 modulating gas heat ignition controller has a segmented LED display. “A” codes are for alert conditions and “E” codes for more considerable error conditions.

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Locked Out Manifold 1	VB1285 on manifold 1 has a gas heat lock out diagnostic.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Unexpected Flame Manif 1 Burner 1	LED Display [E08] Unexpected flame on manifold 1, burner 1. VB1285 ignition controller lockout duration will remain in effect for 10 to 300 seconds after error condition is cleared or the power is cycled. Possible causes: Gas valve may be stuck open or malfunctioning. Flame rod maybe malfunctioning.	Call for heat is removed to the VB1285 ignition controller and supply fan operation stays On. Response Type = Auto Reset
Diagnostic: Gas Heat Unexpected Flame Manif 1 Burner 2	LED Display [E18] Unexpected flame on manifold 1, burner 2. VB1285 ignition controller lockout duration will remain in effect for 10 to 300 seconds after error condition is cleared or the power is cycled. Possible causes: Gas valve may be stuck open or malfunctioning. Flame rod maybe malfunctioning.	Call for heat is removed to the VB1285 ignition controller and supply fan operation stays On. Response Type = Auto Reset
Diagnostic: Modulating Gas Invalid ID Plug Manifold 1	LED Display [E id] VB1285 ignition controller ID Plug contains invalid data. Possible cause: Corrupt ID Plug. Plug not connected properly.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Configuration Invalid	LED Display [normal activity] VB1285 ignition controller functioning properly. Possible causes: Wrong ID Plug installed. Symbio 700 mis-configured.	The Symbio 700 configuration does not match the VB1285 ignition controller ID Plug heat configuration. All burners on the manifold are unavailable until the condition is corrected. Diagnostic also occurs when communication fails to the gas heat ignition module; Symbio 700 is unable to read the ignition module ID Plug heat configuration. Response Type = Auto Reset

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Weak Flame Manif 1 Burner 1	LED Display [A05] VB1285 ignition controller has detected a weak flame on manifold 1, burner 1. This diagnostic is an indication that the signal from the flame sensor is weak. Possible causes: Dirty flame rod. Improper flame rod installation/position. Improper gas valve pressure.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset
Diagnostic: Gas Heat Weak Flame Manif 1 Burner 2	LED Display [A15] VB1285 ignition controller has detected a weak flame on manifold 1, burner 2. This diagnostic is an indication that the signal from the flame sensor is weak. Possible causes: Dirty or weak flame rod. Improper flame rod installation/position. Improper gas valve pressure.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset
Diagnostic: Gas Heat Insufficient Combustion Air	LED Display [A03] VB1285 ignition controller has detected insufficient combustion air and will reduce heat capacity while the condition exists. Possible causes: Blocked vent, high vent temperatures, high elevation or the inducer fan is not able to run at the required speed. Note: At extreme elevations, an A03 code may be normal operation.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset
Diagnostic: Modulating Gas Primary Limit Open Manifold 1	LED Display [E02] VB1285 ignition controller has detected the roll out switch open, an open fuse, or the thermal cut out. All burners on the manifold are temporarily unavailable. Lockout duration will remain in effect for 10 to 300 seconds after error condition is cleared or the power is cycled. Possible causes: Roll out switch, open fuse, or the TCO (thermal cut out).	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Open Fuse Manifold 1	LED Display [E13] VB1285 ignition controller has detected a fuse is open. All burners on the manifold are unavailable.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Failed Ignition Manifold 1	LED Display [E01] VB1285 ignition controller has four failed ignition attempts and retries have been exhausted on the primary burner. Heat is locked out for 1-hour. The ignition controller will attempt to restart after the 1-hour lockout period. Power may be cycled to reset. Possible causes: Plugged vent on gas pressure regulator. Spark ignitor is bad. The high voltage wire is bad.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Modulating Gas Valve Failure Manifold 1	LED Display [E03] The VB1285 modulating gas valve actuator did not reach a Park or Full-On position. Lockout duration will remain in effect for 10 to 300 seconds after error condition is cleared or the power is cycled. Possible cause: Bad gas valve.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Modulating Gas Control Board Failure Manifold 1	LED Display [888] VB1285 Board Failure. Lockout duration will remain in effect for 10 to 300 seconds after error condition is cleared. Possible cause: Bad wiring. Board failure.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Failed Ignition Manifold 1 Burner 2	LED Display [A11] VB1285 ignition controller, manifold 1 split burner has four failed ignition attempts and retries have been exhausted. Split burner is locked out for 1-hour. The ignition controller will attempt to restart the split burner after the 1-hour lockout period. Power may be cycled to reset. Possible causes: Plugged vent on gas pressure regulator, failed flame rod. The high voltage wire is bad.	None, the Symbio 700 will continue call for heat on the primary burner and operate at limited 50% capacity. Response Type = Auto Reset
Diagnostic: Gas Heat Air Pressure Sensor Reading Low	Diagnostic Code 14 Display Code [E04] Air pressure switch failed to open during pre-purge calibration process. The inducer fan increases until the air pressure switch closes, then the inducer fan decreases until the air pressure switch opens (the switch failed to open). Possible cause: Incorrect ID Plug or incorrect air pressure switch installed. Insufficient air due to blocked vent, pneumatic tube between inducer fan static tap and the air pressure switch has an obstruction.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Air Pressure Sensor Reading High	Diagnostic Code 15 Display Code [E05] Air pressure switch failed to close during pre-purge calibration process. Possible cause: Pneumatic tubing connections or tubing is damaged. Verify pneumatic tubing is connected to VB1285 negative connection. Defective air pressure switch.	Call for heat is removed to the VB1285 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Loss of Inducer Motor Control	Diagnostic Code 33 (ALERT) Display Code [A07] The air pressure is not modulating down at minimum inducer drive. Possible cause: Pneumatic tubing. Connect a manometer and verify the pressure on the VB1285 display matches the manometer. If pressures do not match cycle control power on the VB1285. If problem still exists, the VB1285 ignition module and/or the inducer fan may need replacing.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset
Diagnostic: Gas Heat Air Sensor Null Pressure Check	Diagnostic Code 34 (ALERT) Display Code [A08] Air sensor pressure check out of tolerance. Possible cause: The VB1285 air pressure on-board sensor is out of tolerance. Cycle control power to the VB1285. If problem still exists, the VB1285 ignition module may need replacing.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset
Diagnostic: Gas Heat Limited Low Fire	Diagnostic Code 7 (ALERT) Display Code [A04] Flame loss at low fire results in an auto-adjustment that limits the burner turn down during the rest of the current call for heat. Possible cause: Wind caused loss of flame at low fire.	None, the Symbio 700 will continue call for heat. Response Type = Auto Reset

VB1285 Display Code Callout

On power up:

H-A	Heatco Model Series
600	Gas Heating Input (600 MBH)
-10, -5	10:1 modulation turndown, 5:1 modulation turndown
nat, LP	Natural Gas, Propane Gas

001	Version of ID Chip
OFF	Standby Mode – awaiting call for heat or increase in firing rate demand
Pur	Purge – 30 second purge period
IGn	Ignition sequence – 6 second trial for ignition and flame signal proving
HEA	Warm up – 10 second warm up period (ignores firing rate demand)
Run	Normal run operation

During normal run operation the display will cycle through multiple codes:

Run	Normal run operation
Fr=	Firing rate percentage
100	Numerical value of firing rate percentage (numerical values will change)
Air	Inducer fan pressure
1.80	Numerical value of inducer pressure (numerical values will change)

During abnormal operation the display will cycle through multiple codes:

A01	Alert Code (There are nine different alert functions)
Fr=	Firing rate percentage
100	Numerical value of firing rate percentage (numerical values will change)
Air	Inducer fan pressure
1.80	Numerical value of inducer pressure (numerical values will change)

Staged Gas Heat — Manifold 1

The following failures are derived through direct data monitoring from the Modbus of the gas heat controller(s). The VB1287 Ignition Controller has two multi-color LEDs [LED1, LED2]. Each LED has a designated flash pattern that indicates an operating status or diagnostic condition. For example: When LED code [1,2] is active, LED1 will flash Red 1-time, LED2 will flash Red 2-times.

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Locked Out Manifold 1	VB1287 on manifold 1 has a gas heat lock out diagnostic.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Flame Rod Aged Manifold 1	Ignition module LED code: Yellow [1,1][1] Warning, VB1287 detected the flame rod on manifold 1 is aged and may need replacement.	None. Continue call for heat.
Diagnostic: Gas Heat Unexpected Flame Manifold 1	Ignition module LED code: Red [1,1][1] VB1287 controlled detected an unexpected flame on manifold 1. Requires a power reset or the gas ignition controller will auto reset after 1-hour. Possible causes: Gas valve may be stuck open or malfunctioning. Flame rod maybe malfunctioning. Will continue to retry, lockout after 3-trials.	Call for heat is removed to the VB1287 ignition controller and supply fan operation stays On. Response Type = Auto Reset
Diagnostic: Gas Heat Invalid ID Plug Manifold 1	Ignition module LED code: Red [5,4][1] ID Plug contains invalid data. Ignition controller disables communication and goes into a hard lockout. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Configuration Invalid	Ignition module LED code [normal operation] VB1285 ignition controller functioning properly. Possible causes: Wrong ID Plug installed. Symbio 700 mis-configured.	The Symbio 700 configuration does not match the VB1285 ignition controller ID Plug heat configuration. All burners on the manifold are unavailable until the condition is corrected. Response Type = Auto Reset
Diagnostic: Gas Heat Primary Limit Open Manifold 1	Ignition module LED code: Red [5,1][1] VB1287 ignition controller detected the primary limit is open. Requires a power reset or the gas ignition controller will auto reset after 1-hour. Possible causes: This diagnostic is triggered when the cool down timer has expired, therefore indicates longer term failures, likely the roll out switch. Verify Primary Limit input.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Open Fuse Manifold 1	Ignition module LED code: Red [4,5][1] VB1287 ignition controller detected the fuse is open. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Heat Failed Ignition Manifold 1	Ignition module LED code: Red [1,2][1] Manifold 1 failed ignition 4 times. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Valve Failure Manifold 1	Ignition module LED code: Red [1,5][1] VB1287 has detected a manifold 1 valve failure. The failure indicates that gas valve state is low when it must be high, or high when it must be low. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Inducer High Pressure Manifold 1	Ignition module LED code: Red [4,2][1] or [4,4][1] VB1287 has detected an air pressure switch in the wrong open or closed state. Requires a power reset or the gas ignition controller will auto reset after 1-hour. Possible causes: The air pressure switch high is open when it is expected to be closed, or air pressure switch high is closed when inducer is off.	None. Continue call for heat.
Diagnostic: Gas Heat Valve Short Manifold 1	Ignition module LED code: Red [1,4][1] VB1287 ignition controller detected the burner gas valve is shorted to 24VAC. Requires a power reset or the gas ignition controller will auto reset after 1-hour. Possible causes: Control needs to be replaced. Faulty wiring.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Flame Loss Manifold 1	Ignition module LED code: Red [1,3][1] The burner on manifold 1, flame loss count is limited to 3, after which the VB1287 ignition controller will lockout. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Control Board Failure Manifold 1	Ignition module LED code: Red [5,5][1] VB1287 has detect an ignition board failure. Requires a power reset or the gas ignition controller will auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Start Failure Manifold 1	Ignition module LED code: Red [5,2][1] VB1287 safety checks at startup failed or flame circuitry idle state is incorrect.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset

Note: *VB1287 Ignition Controller has two multi-color LEDs [LED1, LED2]. Each LED has a designated flash pattern that indicates an operating status or diagnostic condition. For example: When LED code [1,2] is active, LED1 will flash Red 1-time, LED2 will flash Red 2-times.*

VB1287 LED Display Code Operation

The VB1287 ignition controller board has two multi-color LEDs, LED1 and LED2. Each LED has a designated flash and color indicating the VB1287 operating state:

- Normal operation (green color)

- Warning codes (yellow color)
- Failure codes (red color)

Table 15. Normal operation

Display Code [LED1, LED2]	Color	Description
1,1	Green	Ignition controller is idle.
1,2	Green	Call for heat. Burner state is PURGE.
1,3	Green	Call for heat. VB1287 prime burner is running. Burner states Gas-On, Warmup, Run.
3,3	Green	Call for heat. VB1287 prime and split burners are running.

Staged Gas Heat — Manifold 2 (800 MBH)

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Locked Out Manifold 2	VB1287 on manifold 2 has a gas heat lock out diagnostic.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Flame Rod Aged Manifold 2	Ignition module LED code: Yellow [1,1][1] Warning, VB1287 detected the flame rod on manifold 2 is aged and may need replacement.	None. Continue call for heat.
Diagnostic: Gas Heat Unexpected Flame Manifold 2	Ignition module LED code: Red [1,1][1] VB1287 controlled detected an unexpected flame on manifold 2. Requires power reset or auto reset after 1-hour. Possible causes: Gas valve may be stuck open or malfunctioning. Flame rod maybe malfunctioning. Will continue to retry, lockout after 3-trials.	Call for heat is removed to the VB1287 ignition controller and supply fan operation stays On. Response Type = Auto Reset
Diagnostic: Gas Heat Invalid ID Plug Manifold 2	Ignition module LED code: Red [5,4][1] ID Plug contains invalid data. Ignition controller disables communication and goes into a hard lockout on an ID Plug failure. Requires power reset or auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Configuration Invalid	Ignition module LED code [normal operation] VB1285 ignition controller functioning properly. Possible causes: Wrong ID Plug installed. Symbio 700 mis-configured.	The Symbio 700 configuration does not match the VB1285 ignition controller ID Plug heat configuration. All burners on the manifold are unavailable until the condition is corrected. Response Type = Auto Reset
Diagnostic: Gas Heat Primary Limit Open Manifold 2	Ignition module LED code: Red [5,1][1] VB1287 ignition controller detected the primary limit is open. Requires power reset or auto reset after 1-hour. Possible causes: This diagnostic is triggered when the cool down timer has expired, therefore indicates longer term failures, likely the roll out switch. Verify Primary Limit input.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Open Fuse Manifold 2	Ignition module LED code: Red [4,5][1] VB1287 ignition controller detected the fuse is open. Requires power reset or auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Heat Failed Ignition Manifold 2	Ignition module LED code: Red [1,2][1] Manifold 2 failed ignition 4 times. Requires power reset or auto reset after 1- hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset

Diagnostic	Failure Detection	Symbio 700 Response
Diagnostic: Gas Heat Valve Failure Manifold 2	Ignition module LED code: Red [1,5][1] VB1287 has detected a manifold 2 valve failure. The failure indicates that gas valve state is low when it must be high, or high when it must be low. Requires power reset or auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Inducer High Pressure Manifold 2	Ignition module LED code: Red [4,2][1] OR [4,4][1] VB1287 has detected an air pressure switch in the wrong open or closed state. Requires power reset or auto reset after 1-hour. Possible causes: The air pressure switch high is open when it is expected to be closed, or air pressure switch high is closed when inducer is off.	None. Continue call for heat. Response Type = Auto Reset
Diagnostic: Gas Heat Valve Short Manifold 2	Ignition module LED code: Red [1,4][1] VB1287 ignition controller detected the burner gas valve is shorted to 24VAC. Requires power reset or auto reset after 1-hour. Possible causes: Control needs to be replaced. Faulty wiring.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Flame Loss Manifold 2	Ignition module LED code: Red [1,3][1] The burner on manifold 2, flame loss count is limited to 3, after which the VB1287 ignition controller will lockout. Requires power reset or auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Control Board Failure Manifold 2	Ignition module LED code: Red [5,5][1] VB1287 has detect a ignition board failure. Requires power reset or auto reset after 1-hour.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset
Diagnostic: Gas Heat Start Failure Manifold 2	Ignition module LED code: Red [5,2][1] VB1287 safety checks at startup failed or flame circuitry idle state is incorrect.	Call for heat is removed to the VB1287 ignition controller. Response Type = Auto Reset

Note: *VB1287 Ignition Controller has two multi-color LEDs [LED1, LED2]. Each LED has a designated flash pattern that indicates an operating status or diagnostic condition. For example: When LED code [1,2] is active, LED1 will flash Red 1-time, LED2 will flash Red 2-times.*

Appendix A

Supply Fan

Multi-Speed/VFD

Table 16. Multi-speed supply fan speeds

Unit Operation	Supply Fan Speed (%)
Off	0
Fan Only	37
Cooling Stage 1	67
Cooling Stage 2	67
Cooling Stage 3	67
Cooling Stage 4	67
Cooling Stage 5	100
Electric/Gas Heat 1	100
Electric/Gas Heat 2	100
Modulating Gas Heat	100

Variable Speed/VFD — Space Temperature Control

Table 17. Variable speed space temperature control supply fan speeds

Unit Operation	Supply Fan Speed (%)
Off	0
Fan Only	37
Cooling Stage 1	37
Cooling Stage 2	58
Cooling Stage 3	67
Cooling Stage 4	75
Cooling Stage 5	75
Electric/Gas Heat 1	100
Electric/Gas Heat 2	100
Modulating Gas Heat	58

Variable Speed/VFD — Discharge Air Temperature Control

Table 18. Variable speed discharge temperature control supply fan speeds

Unit Operation	Supply Fan Speed (%)
Off	0
Fan Only	37
Cooling Stage 1	37
Cooling Stage 2	37
Cooling Stage 3	37

Table 18. Variable speed discharge temperature control supply fan speeds (continued)

Unit Operation	Supply Fan Speed (%)
Cooling Stage 4	37
Cooling Stage 5	37
Electric/Gas Heat 1	100
Electric/Gas Heat 2	100
Modulating Gas Heat	37
Daytime Warm-up	100
Morning Warm-up	100

Compressor Staging

Thermostat Staging

For equipment staging response to a conventional thermostat signals, refer to the Conventional Thermostat sequence of operation above.

Cooling Only Compressor Staging - CVZT, VVZT, and VVDA (Standard and High Efficiency)

Table 19. Cooling staging

Unit Operation	Unit Response
Cool Stage 1	Compressor 1 Output ON
Cool Stage 2	Compressor 2 Output ON
Cool Stage 3	Compressor 1 Output ON Compressor 2 Output ON
Cool Stage 4	Compressor 2 Output ON Compressor 3 Output ON
Cool Stage 5	Compressor 1 Output ON Compressor 2 Output ON Compressor 3 Output ON

Condenser Fan Operation

Thermostat, CVZT, VVZT, and VVDA

Table 20. 27.5-35 ton standard and high efficiency

Active CF Cool Stage	Outdoor Air Temperature Active	Dehumidification Status	Condenser Fan Output		
			Fan 1	Fan 2	Fan 3
0	X	X	OFF	OFF	OFF
1	< 75F	X	ON	OFF	OFF
1	> = 75F	X	ON	ON	OFF
1	> = 85F	X	ON	ON	ON
2	< 63F	X	ON	OFF	OFF
2	> = 63F	X	ON	ON	OFF
2	> = 75F	X	ON	ON	ON
3	< 65F	X	ON	OFF	OFF
3	> = 65F	X	ON	ON	OFF

Table 20. 27.5-35 ton standard and high efficiency (continued)

Active CF Cool Stage	Outdoor Air Temperature Active	Dehumidification Status	Condenser Fan Output		
3	> = 75F	X	ON	ON	ON
4	< 65F	X	ON	OFF	OFF
4	> = 65F	X	ON	ON	OFF
4	> = 75F	X	ON	ON	ON
5	< 45F	INACTIVE	ON	OFF	OFF
5	> = 45F	INACTIVE	ON	ON	OFF
5	> = 65F	INACTIVE	ON	ON	ON
5	<80F	ACTIVE	ON	OFF	OFF
5	>=85F	ACTIVE	ON	ON	OFF

Table 21. 40 ton standard and high efficiency

Active CF Cool Stage	Outdoor Air Temperature Active	Dehumidification Status	Condenser Fan Output		
			Fan 1	Fan 2	Fan 3 & 4
0	X	X	OFF	OFF	OFF
1	< 70F	X	ON	OFF	OFF
1	> = 70F	X	ON	ON	OFF
1	> = 85F	X	ON	ON	ON
2	< 70F	X	ON	OFF	OFF
2	> = 70F	X	ON	ON	OFF
2	> = 85F	X	ON	ON	ON
3	< 45F	X	ON	OFF	OFF
3	> = 45F	X	ON	ON	OFF
3	> = 80F	X	ON	ON	ON
4	< 45F	X	ON	OFF	OFF
4	> = 45F	X	ON	ON	OFF
4	> = 80F	X	ON	ON	ON
5	< 45F	INACTIVE	ON	OFF	OFF
5	> = 45F	INACTIVE	ON	ON	OFF
5	> = 70F	INACTIVE	ON	ON	ON
5	<80	ACTIVE	ON	ON	OFF
5	>=85	ACTIVE	ON	ON	ON

Table 22. 50 ton standard and high efficiency

Active CF Cool Stage	Outdoor Air Temperature Active	Dehumidification Status	Condenser Fan Output		
			Fan 1	Fan 2	Fan 3 & 4
0	X	X	OFF	OFF	OFF
1	< 65F	X	ON	OFF	OFF

Table 22. 50 ton standard and high efficiency (continued)

Active CF Cool Stage	Outdoor Air Temperature Active	Dehumidification Status	Condenser Fan Output		
1	> = 65F	X	ON	ON	OFF
1	> = 80F	X	ON	ON	ON
2	< 65F	X	ON	OFF	OFF
2	> = 65F	X	ON	ON	OFF
2	> = 80F	X	ON	ON	ON
3	< 40F	X	ON	OFF	OFF
3	> = 40F	X	ON	ON	OFF
3	> = 75F	X	ON	ON	ON
4	< 40F	X	ON	OFF	OFF
4	> = 40F	X	ON	ON	OFF
4	> = 75F	X	ON	ON	ON
5	< 40F	INACTIVE	ON	OFF	OFF
5	> = 40F	INACTIVE	ON	ON	OFF
5	> = 65F	INACTIVE	ON	ON	ON
5	<80	ACTIVE	ON	ON	OFF
5	>=85	ACTIVE	ON	ON	ON

Electric Heat

Table 23. Electric heat staging

Unit Operation	Unit Response
Electric Heat Stage 1	Electric Heat Stage 1 Output ON
Electric Heat Stage 2	Electric Heat Stage 1 and 2 Outputs ON

Gas Heat

Table 24. Gas heat staging

Unit Operation	Unit Response
Gas Heat Stage 1	Gas Valve Stage 1 Running
Gas Heat Stage 2	Gas Valve Stage 2 Running

Diagnostics and Alarm Indicator Status

Table 25. Supported diagnostics and alarm relay functionality

Diagnostic/Alarm	Alarm Indicator
Communication	
Diagnostic: Unit Communications Failure	Y
On-Board I/O Communication Status	Y
Customer Options Module Communication Status	Y
Indoor Options Module Communication Status	Y

Table 25. Supported diagnostics and alarm relay functionality (continued)

Diagnostic/Alarm	Alarm Indicator
Heat Options Module Communication Status	Y
Fresh Air Options Module Communication Status	Y
Stepper Motor Module Communication Status	Y
Gas Heat Ignition Module 1 Communication Status	Y
Gas Heat Ignition Module 2 Communication Status	Y
Supply Fan VFD Communication Status	Y
Supply Fan 1 Communication Status	Y
Refrigerant Leak Sensor Communication Status Sensor A	Y
VFD Supply Fan	
Diagnostic: Supply Fan Failure	Y
Diagnostic: Supply Fan Proving Failure	Y
Diagnostic: VFD Fault Supply Fan - 1	Y
Diagnostic: VFD Supply Fan Ground Fault - 1	Y
Diagnostic: VFD Supply Fan Motor Current Overload - 1	Y
Diagnostic: VFD Supply Fan Short Circuit - 1	Y
Diagnostic: VFD Supply Fan Broken Belt - 1	Y
IGN3: Beckett Modulating Ignition Controller VB1285	
Diagnostic: Gas Heat Lockout Manifold 1	Y
Diagnostic: Gas Heat Unexpected Flame Manif 1 Burner 1	Y
Diagnostic: Gas Heat Unexpected Flame Manif 1 Burner 2	Y
Diagnostic: Modulating Gas Invalid ID Plug Manifold 1	N
Diagnostic: Modulating Gas Heat Configuration Invalid	N
Diagnostic: Gas Heat Weak Flame Manif 1 Burner 1	N
Diagnostic: Gas Heat Weak Flame Manif 1 Burner 2	N
Diagnostic: Gas Heat Insufficient Combustion Air	N
Diagnostic: Modulating Gas Primary Limit Open Manifold 1	Y
Diagnostic: Modulating Gas Heat Open Fuse Manifold 1	Y
Diagnostic: Gas Heat Failed Ignition Manifold 1	Y
Diagnostic: Gas Heat Failed Ignition Manifold 1 Burner 2	N
Diagnostic: Modulating Gas Valve Failure Manifold 1	Y
Diagnostic: Modulating Gas Control Board Failure Manifold 1	Y
Diagnostic: Gas Heat Air Pressure Sensor Reading Low	Y
Diagnostic: Gas Heat Air Pressure Sensor Reading High	Y
Diagnostic: Gas Heat Loss of Inducer Motor Control	N
Diagnostic: Gas Heat Air Sensor Null Pressure Check	N
Diagnostic: Gas Heat Limited Low Fire	N
IGN5: Beckett Staged Ignition Controller VB1287	

Table 25. Supported diagnostics and alarm relay functionality (continued)

Diagnostic/Alarm	Alarm Indicator
Diagnostic: Gas Heat Lockout Manifold 1	Y
Diagnostic: Gas Heat Unexpected Flame Manifold 1	Y
Diagnostic: Staged Gas Heat Invalid ID Plug Manifold 1	N
Diagnostic: Staged Gas Heat Configuration Invalid Manifold 1	N
Diagnostic: Staged Gas Heat Primary Limit Open Manifold 1	Y
Diagnostic: Staged Gas Heat Open Fuse Manifold 1	Y
Diagnostic: Heat Failed Ignition Manifold 1	Y
Diagnostic: Staged Gas Heat Valve Failure Manifold 1	Y
Diagnostic: Gas Heat Inducer High Pressure Manifold 1	Y
Diagnostic: Gas Heat Valve Short Manifold 1	Y
Diagnostic: Gas Heat Flame Loss Manifold 1	Y
Diagnostic: Staged Gas Heat Control Board Failure Manifold 1	Y
Diagnostic: Gas Heat Start Failure Manifold 1	Y
Diagnostic: Gas Heat Flame Rod Aged Manifold 1	N
IGN5: Beckett Staged Ignition Controller VB1287	
Diagnostic: Gas Heat Lockout Manifold 2	Y
Diagnostic: Gas Heat Unexpected Flame Manifold 2	Y
Diagnostic: Staged Gas Heat Invalid ID Plug Manifold 2	N
Diagnostic: Staged Gas Heat Configuration Invalid Manifold 2	N
Diagnostic: Staged Gas Heat Primary Limit Open Manifold 2	Y
Diagnostic: Staged Gas Heat Open Fuse Manifold 2	Y
Diagnostic: Heat Failed Ignition Manifold 2	Y
Diagnostic: Staged Gas Heat Valve Failure Manifold 2	Y
Diagnostic: Gas Heat Inducer High Pressure Manifold 2	Y
Diagnostic: Gas Heat Valve Short Manifold 2	Y
Diagnostic: Gas Heat Flame Loss Manifold 2	Y
Diagnostic: Staged Gas Heat Control Board Failure Manifold 2	Y
Diagnostic: Gas Heat Start Failure Manifold 2	Y
Diagnostic: Gas Heat Flame Rod Aged Manifold 2	N
Compressor	
Diagnostic: FroStat Trip	N
Diagnostic: Comp 1 Proving Trip	N
Diagnostic: Comp 2 Proving Trip	N
Diagnostic: Comp 3 Proving Trip	N
Diagnostic: Circuit 1 LPC Trip	N
Diagnostic: Compressor 1 Contactor Failure	Y
Diagnostic: Circuit 1 LPC Lockout	Y

Table 25. Supported diagnostics and alarm relay functionality (continued)

Diagnostic/Alarm	Alarm Indicator
Diagnostic: Compressor 1 Proving Lockout	Y
Diagnostic: Compressor 2 Contactor Failure	Y
Diagnostic: Circuit 2 LPC Lockout	Y
Diagnostic: Compressor 2 Proving Lockout	Y
Diagnostic: Compressor 3 Contactor Failure	Y
Diagnostic: Compressor 3 Proving Lockout	Y
Outdoor Air Damper	
FDD: Excessive Outdoor Air	Y
FDD: Outdoor Air Damper Not Modulating	Y
FDD: Unit Economizing When It Should Be	Y
FDD: Unit Not Economizing When It Should	Y
Refrigerant Detection System	
Diagnostic: Refrigerant Concentration Sensor A	Y
Diagnostic: Refrigerant Leak Sensor Failure Sensor A	Y
Refrigerant Leak Sensor Communication Status Sensor A	Y
Sensor and other	
Diagnostic: Maintenance Required	N
Diagnostic: Filter Change Required	N
Diagnostic: High Condensate Level Detected	N
Diagnostic: Condensate Overflow Lockout	Y
Diagnostic: Morning Warmup Mode Exceeded 120 Minutes	N
Diagnostic: Pre Cool Mode Exceeded 120 Minutes	N
Diagnostic: Night Purge Mode Exceeded 120 Minutes	N
Diagnostic: Duct Static Pressure Limit Lockout	Y
Diagnostic: Duct Static Pressure Local Trip	N
Diagnostic: Duct Static Pressure Local Lockout	Y
Diagnostic: Duct Static Pressure Limit Trip	N
Diagnostic: Supply Fan Bypass Enable	N
Diagnostic: Space Static Pressure Sensor	Y
Discharge Air Temperature Local	Y
Outdoor Air Temperature Active	Y
Outdoor Air Humidity Active	Y
Outdoor Air Flow Active	Y
Phase Monitor Status	Y
Space CO2 Concentration Active	N
Space Humidity Active	N
Space Temperature Active	Y

Table 25. Supported diagnostics and alarm relay functionality (continued)

Diagnostic/Alarm	Alarm Indicator
Space Static Pressure Input	Y
Reheat Valve 1	Y

Emergency and Ventilation Override

Table 26. Emergency and ventilation override

Inputs	Outputs					
Emergency Override BAS	**Supply Fan On/Off Request**	**Supply Fan Speed Request**	**Outdoor Air Damper**	**Relief Fan**	**VAV Box Relay[a]**	**Heat Cool Mode Status**
Point	**State**	**%**	**State**	**State**	**State**	**Point**
2 = EMERG_PRESSURIZE	ON	100	100%	Off	Energized	Fan Only
3 = EMERG_ DEPRESSURIZE	OFF	0	0%	On/100%	De-energized	Fan Only
4 = EMERG_PURGE	ON	100	100%	On/100%	Energized	Fan Only
5 = EMERG_SHUTDOWN	OFF	0	0%	Off	De-energized	OFF
6 = EMERG_FIRE	OFF	0	0%	Off	De-energized	OFF
1 = EMERG_NORMAL	Auto	Auto	Auto	Auto	Auto	Auto

[a] Variable Volume Discharge Air units

Space Setpoint Adjustment

Zone sensors with an internal or external setpoint adjustment provide the controller with a local setpoint (50 to 85°F or 10 to 29.4°C). The internal setpoint adjustment is concealed under the zone sensor cover. To access the setpoint adjustment, remove the zone sensor cover. Some external setpoints (when present) are displayed on the digital display zone sensor front cover. When the local setpoint adjustment is used to determine the setpoints, all unit setpoints are calculated based on the local setpoint value, the configured setpoints, and the active mode of the controller. The controller determines the effective space setpoint based on the following:

- Local wired setpoint input
- Occupancy mode
- Heating or cooling mode (space demand)
- Space setpoint high and low limits (configured)

Single Setpoint

Heat mode:

- Occupied mode: Space Temperature Setpoint Active = Space Temperature Setpoint (arbitrated) - Occupied Offset
- Occupied standby mode: Space Temperature Setpoint Active = Space Temperature Setpoint (arbitrated) - Standby Offset
- Unoccupied mode: Space Temperature Setpoint Active = Unoccupied Heating Setpoint Cool mode

Cool mode:

- Occupied mode: Space Temperature Setpoint Active = Space Temperature Setpoint (arbitrated) + Occupied Offset
- Occupied standby mode: Space Temperature Setpoint Active = Space Temperature Setpoint (arbitrated) + Standby Offset
- Unoccupied mode: Space Temperature Setpoint Active = Unoccupied Cooling setpoint

When a building automation system or other controller communicates a setpoint to the controller, the controller ignores the local setpoint input and uses the communicated value (default operation). The exception is when the system is in unoccupied mode and the controller always uses the unoccupied setpoints. After the controller completes all setpoint calculations, the calculated occupied setpoint is validated against the following configured space setpoint limits:

- Heating setpoint high limit
- Heating setpoint low limit
- Cooling setpoint high limit
- Cooling setpoint low limit

These setpoint limits apply only to the occupied and occupied standby, heating, and cooling setpoints. They do not apply to the unoccupied heating and cooling setpoints. When the controller is in the unoccupied mode, it always uses the unoccupied heating and cooling setpoints.

Dual Setpoint

When Symbio™ 700 is configured for system types CVZT or VVZT, the controls can be configured for Dual Setpoint control. Dual Setpoint provides independent space cooling setpoint and space heating setpoint inputs to the controller. It also allows an external source to write to independent the space cooling and heating setpoints.

Appendix B

Voyager 3 Configuration

The following table describes the Symbio 700 configuration and options available with reference to the Voyager 3 model number.

Symbio 700 Configuration Item	Symbio 700 Configuration Option	Equipment Model Number:	Description:
System Type	CVZT	Digit 16 = 8, E, F, G	Supply fan operation at 2-speeds, zone temperature control
	VVZT	Digit 16 = 6, 7, C, D	Variable speed supply fan zone temperature control (single zone vav).
	VVDA	Digit 16 = 4, 5, A, B	Variable volume discharge air control for multi-zone VAV systems.
Space Controller	Conventional TStat	Digit 16 = 8, E, F, G	Equipment is being controlled from a thermostat in the space.
	Dual Setpoint Zone Sensor	Digit 16 = 6, 7, 8, C, D, E, F, G	Heating and Cooling setpoint zone sensor installed. Applicable to CVZT and VVZT System Type.
	Single Setpoint Zone Sensor	Digit 16 = 6, 7, 8, C, D, E, F, G	Single setpoint zone sensor installed. Applicable to CVZT and VVZT System Type.
Refrigeration System	Cooling Only	Digit 1, 2 =	Direct expansion cooling unit with or without primary heating capacity.
		TC – DX Cooling No Heat	
		TE – DX Cooling, Electric Heat	
		YC – DX Cooling, Natural Gas Heat	
Refrigerant	R410A	Digit 7 = C	Equipment designed for R410A.
	R454B	Digit 7 = D	Equipment designed for R454B
Tonnage (60 Hz)	27.5	Digit 4, 5, 6 = 330	Designates the equipment capacity in tons of cooling.
	30	Digit 4, 5, 6 = 360	
	35	Digit 4, 5, 6 = 420	
	40	Digit 4, 5, 6 = 480	
	50	Digit 4, 5, 6 = 600	
Tonnage (50 Hz)	22.9	Digit 4, 5, 6 = 275	
	25.4	Digit 4, 5, 6 = 305	
	29.2	Digit 4, 5, 6 = 350	
	33.3	Digit 4, 5, 6 = 400	
	41.7	Digit 4, 5, 6 = 500	
Refrigeration Circuit	Single Manifold	Not applicable	Type of refrigeration circuit

Symbio 700 Configuration Item	Symbio 700 Configuration Option	Equipment Model Number:	Description:
Voltage	208/230/60	Digit 8 = E, F	208VAC or 230VAC, 60Hz
	380/415/50	Digit 8 = C, D	380VAC or 415VAC, 50Hz
	460/60	Digit 8 = 4	460VAC, 60Hz
	575/60	Digit 8 = 5	575VAC, 60Hz
Efficiency	Standard	Digit 29 = O, J	Standard Efficiency
	High	Digit 29 = K, L	High Efficiency
Hot Gas Reheat	Not Installed,	Digit 32 = 0	Not Installed
	Modulating	Digit 32 = T	Modulating Hot Gas Reheat installed
Dehumidification Control	Humidistat	Not applicable	Dehumidification will be initiated based on a Humidistat binary input when modulating hot gas reheat is installed.
	Relative Humidity	Not applicable	Dehumidification will be initiated based on a Space Relative Humidity when modulating hot gas reheat is installed.
	Dew Point	Not applicable (default setting)	Default setting when modulating hot gas reheat is installed. Dehumidification will be initiated based on a Space Dew Point and Outdoor Air Dew Point.
Primary Heating Source	Not Installed	Digit 1, 2 = TC	No primary heating installed.
	Electric	Digit 1, 2 = TE	Cooling only unit with primary electric heat installed.
	Gas	Digit 1,2 = YC	Cooling only unit with primary staged or modulating gas heat installed.
Primary Heating Type	Staged	Digit 1, 2 = TE or YC	Staged electric heat or staged gas heat installed.
		Digit 9 = L, H, J, K	
	Modulating	Digit 1, 2 = YC	Modulating gas heat installed.
		Digit 9 = M, P, R, T	
Primary Heating Capacity	350 MBH Low Heat	Digit 9 = L, J (staged low heat)	Options when gas heat is installed.
	400 MBH Low Heat	Digit 9 = H, K (staged high heat)	
	600 MBH High Heat	Digit 9 = M, R (modulating low heat)	
	800 MBH High Heat	Digit 9 = P, T (modulating high heat)	
Primary Heating Stages	1	Digit 9 = A, B	Electric heat installed.
	2	Digit 9 = C, D, E (electric heat)	Electric heat or staged gas heat installed.
		Digit 9 = L, H, J, K (staged gas heat)	

Symbio 700 Configuration Item	Symbio 700 Configuration Option	Equipment Model Number:	Description:
Outside Air	Not Installed	Digit 15 = A, B	No outdoor air damper installed, or 0-25% Manual Damper
	0 to 100% Economizer	Digit 15 = C, D, E, F, G, H, J, K, L	0 to 100% Economizer installed
	0 to 100% Economizer w/ TRAQ	Digit 15 = 1, 2, 3, 4, 5, 6, 7, 8, 9	0 to 100% Economizer with Traq damper installed
Economizer Type	Dry Bulb	Digit 15 = C	Economizer cooling operation enables based on outdoor air temperature (dry bulb).
	Differential Dry Bulb	Not applicable	Economizer cooling operation enables based on outdoor air temperature and space temperature difference.
	Reference Enthalpy	Digit 15 = D	Economizer cooling operation enables based on outdoor air temperature and outdoor air humidity.
	Comparative Enthalpy	Digit 15 = E	Economizer cooling operation enables based on outdoor air temperature and outdoor air humidity (enthalpy) vs. return air temperature and return air humidity (enthalpy).
Demand Controlled Ventilation	Disabled, Enabled	Not applicable	Demand Controlled Ventilation is a 0 to 100% economizer damper option when a Space CO2 sensor is installed.
Remote Minimum Position	Not Installed	Not applicable	Not installed
	Installed	Not applicable	Remote minimum position potentiometer installed
Space Pressure Control	Not installed	Digit 11 = 0, 1	Not installed, or Barometric Relief
	Relief Fan Only	Digit 11 = 2, 3, 7, 8	Power Exhaust Fan with 0 to 100% Economizer installed.
	Relief Fan with Fresh Air Damper Tracking	Digit 11 = 4, 5,	Fresh Air Damper Tracking Power Exhaust Fan with 0 to 100% Economizer installed.
	Relief Fan with StatiTrac	Digit 11 = 6, 9	Power Exhaust with Statitrac (space static pressure control) installed
Clogged Filter	Not Installed	Not applicable	Not installed
	Installed	Digit 31 = R	Clogged Filter switch installed
FroStat	Not Installed	Not applicable	Not installed
	Installed		FroStat installed
Condensate Overflow Switch	Not Installed	Digit 28 = 0, M	Condensate overflow switch not installed
	Installed	Digit 28 = 1, 2	Condensation switch installed
Humidistat	Not Installed	Not applicable	Not installed
	Installed	Not applicable	Humidistat installed.

Symbio 700 Configuration Item	Symbio 700 Configuration Option	Equipment Model Number:	Description:
Humidity Sensor	Not Installed	Not applicable	Not installed
	Installed	Not applicable	Space Humidity Sensor installed.
CO2 Sensor	Not Installed	Not applicable	Not installed
	Installed	Not applicable	Space CO2 Sensor installed.
Discharge Temperature Sensor	Not Installed	Not applicable	Not installed
	Installed	Digit 31 = P	Discharge Air Temperature Sensor installed
External Auto/Stop	Not Installed	Not applicable	Not installed
	Installed	Not applicable	External Auto/Stop binary input installed, requires a Customer Options Module.
Ventilation Override	Not Installed	Not applicable	Not installed
	Installed	Digit 23 = G	Ventilation Override installed, requires a Customer Options Module.
Alarm Indicator	Not Installed	Not applicable	Not installed
	Installed	Not applicable	An installed Alarm Indicator requires a Customer Options Module.
Demand Management	None	Not applicable	Symbio 700 Demand Shed/ Demand Limit binary input (J16) is disabled.
	Demand Limit	Not applicable	Symbio 700 binary input (J16) enables and disables energy Demand Limit function. See Demand Limit is this document.
	Demand Shed	Not applicable	Symbio 700 binary input (J16) enables and disables energy Demand Shed function. The Demand Shed is enabled, space heating and cooling setpoints will be offset 4°F (default setting).
Supply Air Tempering	Disabled	Not applicable	Disabled, Supply Air Tempering functional is disabled.
	Enabled	Not applicable	Enabled, Supply Air Tempering function is allowed.
VFD Bypass	Not Installed	Digit 16 = 8, F, 4, A, 6, C	Not installed
	Installed	Digit 16 = E, G, 5, B, 7, D	VFD Bypass is installed.
Airflow Path	Downflow	Digit 3 = D, R	Downflow Supply and Upflow Return, or Downflow Supply and Horizontal Return
	Horizontal	Digit 3 = H, F	Horizontal Supply and Horizontal Return, or Horizontal Supply and Upflow Return

Notes

Trane - by Trane Technologies (NYSE: TT), a global innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

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