

MicroTech™
Unit Ventilator Controller
Sequences of Operation

AAF-HermanNelson Classroom Unit Ventilator
Model AVS, AVV, Floor Mounted
Model AVF, AHV, Ceiling Mounted

Program UV6: Chilled Water Cooling and Steam or
Hot Water Heating (4-Pipe)

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Introduction

This manual describes the sequences of operation for MicroTech controlled AAF-HermanNelson Unit Ventilators equipped with steam or hot water (“wet”) heating and chilled water cooling (separate coils). Unit Ventilators with this heating and cooling configuration could be AAF-HermanNelson models AVS, AVV or AHF, or AHV. Regardless

of the AAF model type, the Unit Ventilator Controller (UVC) provided with these units uses program UV6***.

For more information on the MicroTech Unit Ventilator Controller, refer to Bulletin No. IM613, “MicroTech Unit Ventilator Controller.”

General Information

Software ID

The Unit Ventilator Controller software must be compatible with the Unit Ventilator heating and cooling configuration. The software is identified by a program code and “software model” number printed on a label attached to the controller. Models AVS, AVV, AHF or AHV with separate wet heating and cooling coils (4-pipe) use program UV6***. The first wild card character defines the UVC communication type as follows: S = stand-alone, M = master/slave, and N = network code. The last two wild card characters denote the software version (numeric) and revision level (alphabetical) respectively. Program UV6*** comprises two software models: MDL13 is for valve controlled heating and cooling and MDL14 is for face-and-bypass damper controlled heating and cooling.

Setpoints

Most UVC setpoints are either “hardware” or “software” adjustable. Hardware adjustable means there is an on-board potentiometer used for adjustment. Software adjustable means a PC equipped with Monitor software and proper cable connection is required to make an adjustment. Default software adjustable values are shown on the sequence charts. Hardware adjustable values shown on the charts are for example only. Several UVC setpoints are defined by offsets relative to other setpoints. Table 1 summarizes these setpoints and offsets.

Table 1. UVC Setpoints

Setpoint		Defined By	Label	Default Value
Description	Abbreviation			
Occupied cooling setpoint	OCS	Hardware setpoint	Room Setpoint	--
Ventilation cooling setpoint	VCS	Software offset (below OCS)	Vent Clg Offset	2°F
Occupied heating setpoint	OHS	Software offset (below OCS)	Occ RmT Spt Diff	6°F
Unoccupied heating setpoint	UHS	Hardware offset (below OHS)	Unocc Offset	--
Unoccupied cooling setpoint	UCS	Hardware offset (above OCS)		
Ventilation cooling lockout	VCLO	Software setpoint	OAT Vent Clg Lkout	64°F
Heating EOC valve setpoint	HEOC	Not adjustable	OAT EOC Vlv Lo	40°F
Ventilation cooling discharge air low limit	VCLL	Software setpoint	DAT Vent Clg Low	55°F
Chilled water cooling discharge air low limit	CWLL	Software setpoint	DAT CW Clg Low	45°F
Discharge air high limit	DAHL	Not adjustable		150°F
Outdoor air lockout	OALO	Software setpoint	OALO Setpoint	35°F

4-Pipe Heating and Cooling, Valve Control

Description of Operation

Definitions

Control Temperature

In order to maintain more stable room temperature control, the MicroTech Unit Ventilator Controller (UVC) uses the concept of a “Control Temperature.” During the occupied or tenant override operating modes, the Control Temperature is a weighted value equal to 19/20 room temperature and 1/20 discharge air temperature. During the unoccupied operating mode, the Control Temperature is set equal to the room temperature.

Setpoint Abbreviations

OCS	Occupied cooling setpoint
VCS	Ventilation cooling setpoint
OHS	Occupied heating setpoint
UHS	Unoccupied heating setpoint
UCS	Unoccupied cooling setpoint
VCLO	Ventilation cooling outdoor air lockout setpoint
VCLL	Ventilation cooling discharge air low limit setpoint
CWLL	Chilled water cooling discharge air low limit setpoint
OALO	Outdoor air lockout setpoint

Software ID

Program: UV6***

Software Model: MDL13

Occupied or Tenant Override Operating Mode

The supply fan will run continuously in the occupied or tenant override operating modes.

When the UVC is first energized it will perform a self-calibration procedure upon the OA damper and valve actuators. The calibration procedure will take approximately 5-minutes to perform during which time the supply fan will not operate.

An outdoor air lockout setpoint has been provided to force the OA damper closed when the OA temperature goes below the OALO setpoint (software adjustable). The OALO setpoint must not be set below the freeze point of the liquid being used within the building water loop. In order to lower the OALO setpoint below the default value glycol must be added to the building water loop in sufficient concentration to ensure freezing will not occur. However, the OALO setpoint can be lowered if steam heat is used.

If provided, the optional exhaust fan output will energize when the OA damper opens and de-energize when the OA damper closes.

If provided, the optional ventilation lockout feature can override UVC temperature control and keep the OA damper closed as required.

If provided, the optional auxiliary heat output will operate a normally open device. The auxiliary output will energize (close the device) when the Control Temperature is above the OHS. The auxiliary output will de-energize (open the device) when the Control Temperature is 3°F below the OHS.

The same UVC output is used for both the auxiliary heat output feature and the exhaust fan output feature. Therefore, both features cannot be used together.

Note: When switching from unoccupied-to-occupied mode the OA damper will remain closed for the first 5-minutes of occupied operation.

Morning Start

If the space is cool and heating is required, the unit will operate as described in "Heating Operation" below. The outdoor air (OA) damper will remain closed until the Control Temperature rises to within 3°F of the OHS setpoint. Then it will be opened to minimum position.

If the space is warm and cooling is required, the unit will operate as described in "Cooling Operation" below. If the outdoor air is not suitable for free cooling, the OA damper will remain closed until the Control Temperature falls to within 3°F of the OCS setpoint. Then it will be opened to minimum position.

Cooling Operation

When the Control Temperature is greater than the OHS setpoint and less than the VCS setpoint, the OA damper will be held at its minimum position setpoint (hardware adjustable). As the Control Temperature rises and cooling becomes necessary, the UVC will decide whether the outdoor air is suitable for free cooling by comparing the outdoor air temperature (dry bulb) to the VCLO setpoint.

If the OA temperature is less than or equal to the VCLO setpoint, the economizer will modulate as required to maintain the VCS setpoint (default = 2°F less than OCS). The Control Temperature will rise if the outdoor air is too warm to satisfy the cooling load. If the OA damper is more than 85% open, the chilled water valve will modulate as required to maintain the OCS setpoint.

If the OA temperature is warmer than the VCLO setpoint, the chilled water valve will modulate as required to maintain the OCS setpoint. The OA damper will be held to the minimum position setpoint, except when the Control Temperature is 3°F or more above the OCS. In this unlikely situation, the OA damper will be closed.

As the Control Temperature falls, the chilled water valve will modulate closed. If the valve is less than 15% open when the Control Temperature falls below the VCS setpoint, the OA damper will modulate closed.

Note: Regardless of the economizer state, its operation is subject to discharge air low limit control.

Heating Operation

When the Control Temperature is greater than the OHS setpoint and less than the VCS setpoint, the OA damper will be held at its minimum position setpoint. As the Control Temperature falls and heating becomes necessary, the heating valve (steam or hot water) will modulate as required to maintain the OHS setpoint.

The OA damper will maintain its minimum position when the Control Temperature is within 3°F of the OHS. If the Control Temperature falls to 3°F or more below the OHS, the OA damper will be closed.

Unoccupied Operating Mode

The outdoor air damper will always be closed when the unit is in the unoccupied operating mode. The indoor fan will remain off when the unit is in the unoccupied operating mode unless heating or cooling are required (see note below).

Note: During the unoccupied mode, if the fan remains off continually for 60-minutes, it will start and run for 5-minutes.

Cooling Operation

If the Control Temperature rises to the UCS setpoint, the chilled water valve will be fully opened and the fan will be energized.

When the Control Temperature falls 2°F below the UCS setpoint, the valve will be closed and the fan will be de-energized.

Heating Operation

If the Control Temperature falls to the UHS setpoint, the heating valve will be fully opened and the fan will be energized. The valve will modulate as required to prevent the discharge air temperature from exceeding the discharge air high limit setpoint.

When the Control Temperature rises to 2°F greater than the UHS setpoint, the valve will be closed and the fan will be de-energized.

Note: The UVC will modulate the heating valve to prevent the discharge air temperature from falling below the VCLL setpoint during the unoccupied mode when the fan is off.

Discharge Air Low Limit Control

There are two discharge air low limit functions: the "CW cooling" low limit and the "vent cooling" low limit. The vent cooling low limit function prevents the discharge air (DA) temperature from falling below the VCLL setpoint whenever chilled water cooling is not necessary; when chilled water cooling is necessary, the vent cooling low limit function is disabled. The CW cooling low limit function prevents the DA temperature from falling below the lower CWLL setpoint whenever the unit is in the chilled water cooling mode (chilled water valve > 15% open).

Vent Cooling Low Limit (CW Cooling Inactive)

If the DA temperature falls below the VCLL setpoint, the following sequence will occur:

1. Occupied Mode Only: The OA damper modulates toward fully closed
2. If the actual OA damper position is less than or equal to the minimum setpoint, the heating valve modulates open

If the DA temperature rises to the VCLL setpoint at any time during this sequence, normal operation will resume.

CW Low Limit (CW Cooling Active)

If the DA temperature falls below the CWLL setpoint, the chilled water valve will be closed.

If the DA temperature rises above the CWLL setpoint before the actual valve position is less than 15% open, normal operation will resume.

If the DA temperature remains below the CWLL setpoint until the actual valve position is less than 15% open (unlikely), the vent cooling low limit function will be enabled (see above).

Safeties

Low Water Coil Leaving Air Temperature

A normally closed low temperature switch is provided to detect low leaving air temperature conditions on the indoor air coil. The low temperature switch cut out is 38°F +/- 2 and the cut in is 45°F +/- 2. When the UVC detects the possibility of low leaving air temperatures for longer than 5-seconds (fixed), the following will occur:

- The OA damper is closed
- The chilled water valve is closed
- If the DA temperature is less than VCLL then the heating valve is positioned to 100% open to the coil; if the DA temperature is equal to or greater than VCLL then the heating valve is positioned to a minimum of 25% open to the coil
- The "Low Water Coil Temperature" fault will be indicated by the UVC

When the alarm conditions are gone, the fault will automatically reset.

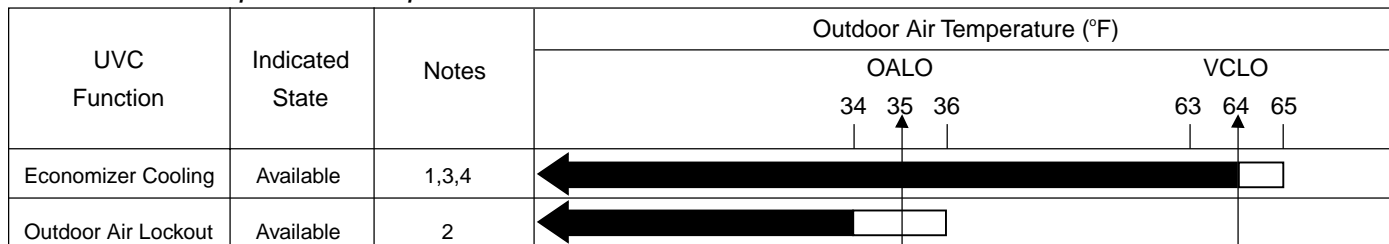
Sequence Charts

The following charts graphically summarize the expected sequences of operation for this Unit Ventilator configuration. The charts are all based upon factory default setpoints. The output states indicated on the charts will typically exist for a particular control temperature, however, exceptions will occur when other control features are active or when alarm conditions

exist or when factory defaults are changed. Brief descriptions of the control feature exceptions are noted on the charts. Refer to bulletin No. IM613, "MicroTech Unit Ventilator Controller" for more information.

Software ID
Program: UV6***
Software Model: MDL013

Outdoor Air Temperature Dependent Functions

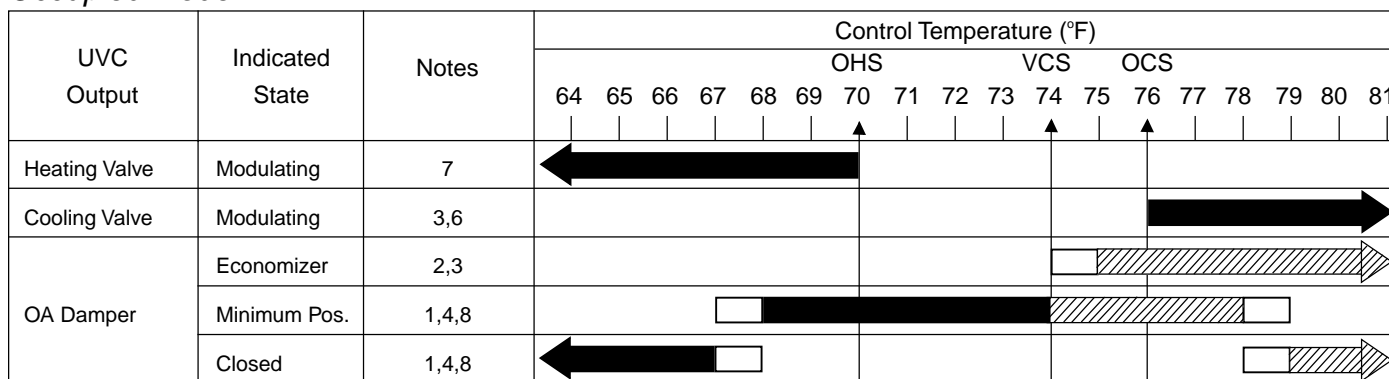


Indicated state (default setpoints) Indicated state dependent on differential (default setpoints)

Outdoor Air Temperature Dependent Function Notes:

1. Economizer cooling will be unavailable when OA is above VCLO
2. OA lockout feature is enabled from the factory in UV Model 13, when enabled the OA damper will be forced closed if OA temperature is below OALO
3. In very humid locations VCLO can be lowered to limit the economizer function
4. In locations where humidity is of no concern, VCLO can be raised slightly to allow additional economizer cooling

Occupied Mode

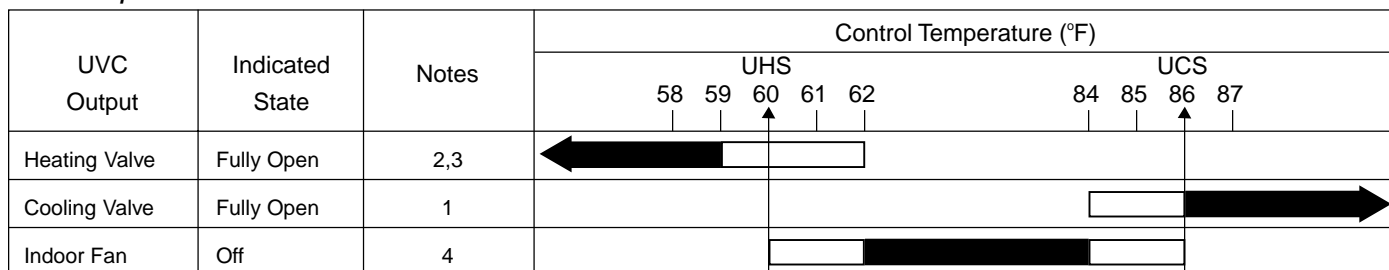


Indicated state (default setpoints) Indicated state dependent on differential (default setpoints) Indicated state dependent on OA temperature (default setpoints)

Occupied Mode Notes:

1. The vent cooling discharge air low limit function can affect OA damper position
2. Economizer cooling will be unavailable when OA is above VCLO
3. In economizer mode, when cooling is required, the OA damper must be greater than 85% open before hydronic cooling is enabled
4. Control temperature can affect OA damper operation
5. In cooling mode, valve must be less than 15% open before OA damper will begin closing
6. Valve operation can be affected by the CW low limit function
7. Valve operation can be affected by the vent cooling discharge air low limit
8. The outdoor air lockout option, if enabled, can affect OA damper position

Unoccupied Mode



Indicated state (default setpoints) Indicated state dependent on differential (default setpoints)

Unoccupied Mode Notes:

1. Valve operation can be affected by the CW low limit function
2. Valve will modulate open to maintain the vent cooling discharge air low limit when the fan is off
3. Valve will modulate closed to maintain discharge air high limit
4. The indoor fan will remain off in unoccupied mode when heating and cooling are not required

4-Pipe Heating and Cooling, Damper Control

Description of Operation

Definitions

Control Temperature

In order to maintain more stable room temperature control, the MicroTech Unit Ventilator Controller (UVC) uses the concept of a "Control Temperature." During the occupied or tenant override operating modes, the Control Temperature is a weighted value equal to 19/20 room temperature and 1/20 discharge air temperature. During the unoccupied operating mode, the Control Temperature is set equal to the room temperature.

Setpoint Abbreviations

OCS	Occupied cooling setpoint
VCS	Ventilation cooling setpoint
OHS	Occupied heating setpoint
UHS	Unoccupied heating setpoint
UCS	Unoccupied cooling setpoint
VCLO	Ventilation cooling outdoor air lockout setpoint
HEOC	Heating end-of-cycle valve outdoor air setpoint
VCLL	Ventilation cooling discharge air low limit setpoint
CWLL	Chilled water cooling discharge air low limit setpoint
OALS	Outdoor air lockout setpoint

Software ID

Program: UV6***
Software Model: MDL14

End-of-Cycle Valves

Spring-return, two-position "end-of-cycle" (EOC) valves are used to prevent overheating or overcooling when the face-and-bypass damper is in the full bypass position. The heating EOC valve is normally open, and the cooling EOC valve is normally closed. The following descriptions of EOC valve operation are applicable to all operating modes.

Heating EOC Valve

If the outdoor air (OA) temperature is less than or equal to the HEOC setpoint, the heating EOC valve will always be open, regardless of the Control Temperature.

If the OA temperature is above the HEOC setpoint, the heating EOC valve will be open when the Control Temperature is at or below the heating setpoint (OHS or UHS). It will be closed when the Control Temperature rises to 2°F or more above the heating setpoint.

Cooling EOC Valve

If the Control Temperature is at or above the cooling setpoint (OCS or UCS), the cooling EOC valve will be open. It will be closed when the Control Temperature falls to 2°F or more below the cooling setpoint.

Occupied or Tenant Override Operating Mode

The supply fan will run continuously in the occupied or tenant override operating modes. When the UVC is first energized it will perform a self-calibration procedure upon the OA damper and the face and bypass damper actuators. The calibration procedure will take approximately 5-minutes to perform during which time the supply fan will not operate

If enabled, an outdoor air lockout setpoint has been provided to force the OA damper to close when the OA temperature goes below the OALS setpoint (software adjustable). This feature is typically used only on valve control hydronic heat and/or hydronic cool units, This feature is disabled by default in UV Model 14.

If provided, the optional ventilation lockout feature can override UVC temperature control and keep the OA damper closed as required.

If provided, the optional exhaust fan output will energize when the OA damper opens and de-energize when the OA damper closes.

If provided, the optional auxiliary heat output will operate a normally open device. The auxiliary output will energize (close the device) when the Control Temperature is above the OHS. The auxiliary output

will de-energize (open the device) when the Control Temperature is 3°F below the OHS.

The same UVC output is used for both the auxiliary heat output feature and the exhaust fan output feature. Therefore, both features cannot be used together.

Note: When switching from unoccupied-to-occupied mode the OA damper will remain closed for the first 5-minutes of occupied operation.

Morning Start

If the space is cool and heating is required, the unit will operate as described in "Heating Operation" below. The outdoor air (OA) damper will remain closed until the Control Temperature rises to within 3°F of the OHS setpoint. Then it will be opened to minimum position.

If the space is warm and cooling is required, the unit will operate as described in "Cooling Operation" below. If the outdoor air is not suitable for free cooling, the OA damper will remain closed until the Control Temperature falls to within 3°F of the OCS setpoint. Then it will be opened to minimum position.

Cooling Operation

When the Control Temperature is greater than the OHS setpoint and less than the VCS setpoint, the OA damper will be held at its minimum position setpoint (hardware adjustable). As the Control Temperature rises and cooling becomes necessary, the UVC will decide whether the outdoor air is suitable for free cooling by comparing the outdoor air temperature (dry bulb) to the VCLO setpoint.

If the OA temperature is less than or equal to the VCLO setpoint, the economizer will modulate as required to maintain the VCS setpoint (default = 2°F less than OCS). The Control Temperature will rise if the outdoor air is too warm to satisfy the cooling load. If the OA damper is more than 85% open, the face-and-bypass damper will modulate as required to maintain the OCS setpoint.

If the OA temperature is warmer than the VCLO setpoint, the face-and-bypass damper will modulate as required to maintain the OCS setpoint. The OA damper will be held to the minimum position setpoint, except when the Control Temperature is 3°F or more above the OCS. In this unlikely situation, the OA damper will be closed.

As the Control Temperature falls, the face-and-bypass damper will modulate toward bypass. If the face-and-bypass damper is less than 15% open to face when the Control falls below the VCS setpoint, the OA damper will closed.

Note: Regardless of the economizer state, its operation is subject to discharge air low limit control.

Note: Chilled water cooling (face-and-bypass damper) will be disabled when the OA temperature is less than or equal to the HEOC setpoint.

Heating Operation

When the Control Temperature is greater than the OHS setpoint and less than the VCS setpoint, the OA damper will be held at its minimum position setpoint. As the Control Temperature falls and heating becomes necessary, the face-and-bypass damper will modulate as required to maintain the OHS setpoint.

The OA damper will maintain its minimum position when the Control Temperature is within 3°F of the OHS. If the Control Temperature falls to 3°F or more below the OHS, the OA damper will be closed.

Unoccupied Operating Mode

The outdoor air damper will always be closed when the unit is in the unoccupied operating mode.

The indoor fan will remain off when the unit is in the unoccupied operating mode unless heating or cooling are required (see note below).

Note: During the unoccupied mode, if the fan remains off continually for 60-minutes, it will start and run for 5-minutes.

Cooling Operation

If the Control Temperature rises to the UCS setpoint, the face-and-bypass damper will be fully opened to face and the fan will be energized.

When the Control Temperature falls 2°F below the UCS setpoint, the face-and-bypass damper will be closed to face and the fan will be de-energized.

Heating Operation

If the Control Temperature falls to the UHS setpoint, the face-and-bypass damper will be fully opened to face and the fan will be energized. The face-and-bypass damper will modulate as required to prevent the discharge air temperature from exceeding the discharge air high limit setpoint.

When the Control Temperature rises to 2°F greater than the UHS setpoint, the face-and-bypass damper will be closed to face and the fan will be de-energized.

Note: If the OA temperature is at or below the HEOC setpoint, the UVC will modulate the face-and-bypass damper to prevent the discharge air temperature from falling below the VCLL setpoint during the unoccupied mode when the fan is off.

Discharge Air Low Limit Control

There are two discharge air low limit functions: the "CW cooling" low limit and the "vent cooling" low limit. The vent cooling low limit function prevents the discharge air (DA) temperature from falling below the VCLL setpoint whenever chilled water cooling is not necessary; when chilled water cooling is necessary, the vent cooling low limit function is disabled. The CW cooling low limit function prevents the DA temperature from falling below the lower CWLL setpoint whenever the unit is in the chilled water cooling mode (OA temperature > 40°F and face-and-bypass damper > 15% open to face).

Vent Cooling Low Limit (CW Cooling Inactive)

If the DA temperature falls below the VCLL setpoint, the following sequence will occur:

- Occupied Mode Only:** The OA damper modulates toward fully closed
- If the actual OA damper position is less than or equal to the minimum setpoint and the heating EOC valve is open temperature < 40°F, fixed), the face-and-bypass damper modulates open to face

If the DA temperature rises to the VCLL setpoint at any time, during this sequence, normal operation will resume.

CW Low Limit (CW Cooling Active)

If the DA temperature falls below the CWLL setpoint, the face-and-bypass damper will be closed to face.

If the DA temperature rises above the CWLL setpoint before the actual face-and-bypass damper position is less than 15% open to face, normal operation will resume.

If the DA temperature remains below the CWLL setpoint until the actual face-and-bypass damper position is less than 15% open to face (unlikely), the OA damper will be closed by the vent cooling low limit function (see above).

Sequence Charts

The following charts graphically summarize the expected sequences of operation for this Unit Ventilator configuration. The charts are all based upon factory default setpoints. The output states indicated on the charts will typically exist for a particular control temperature, however, exceptions will occur when other control features are active or when alarm conditions exist or when factory defaults are changed. Brief descriptions of the control

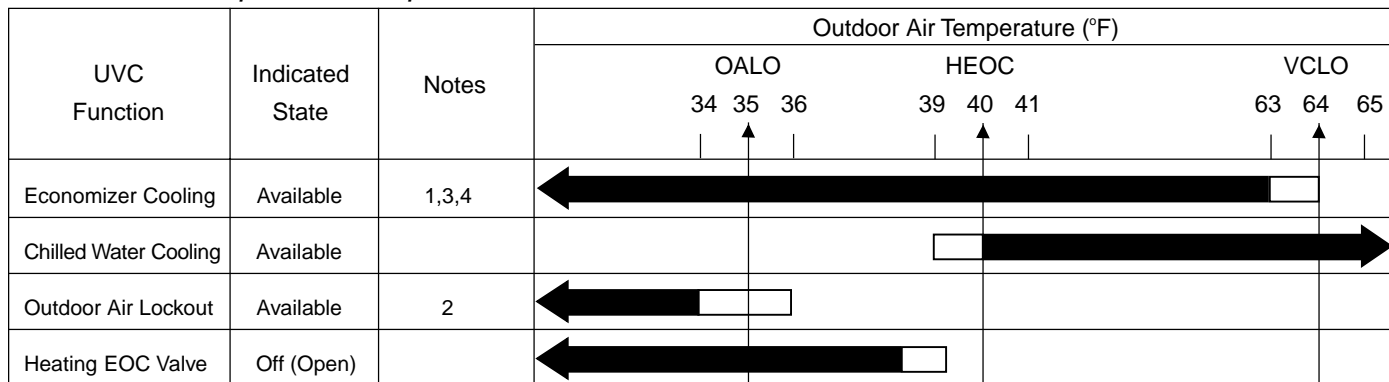
feature exceptions are noted on the charts. Refer to bulletin No. IM613, "MicroTech Unit Ventilator Controller" for more information.

Software ID

Program: UV6***

Software Model: MDL014

Outdoor Air Temperature Dependent Functions

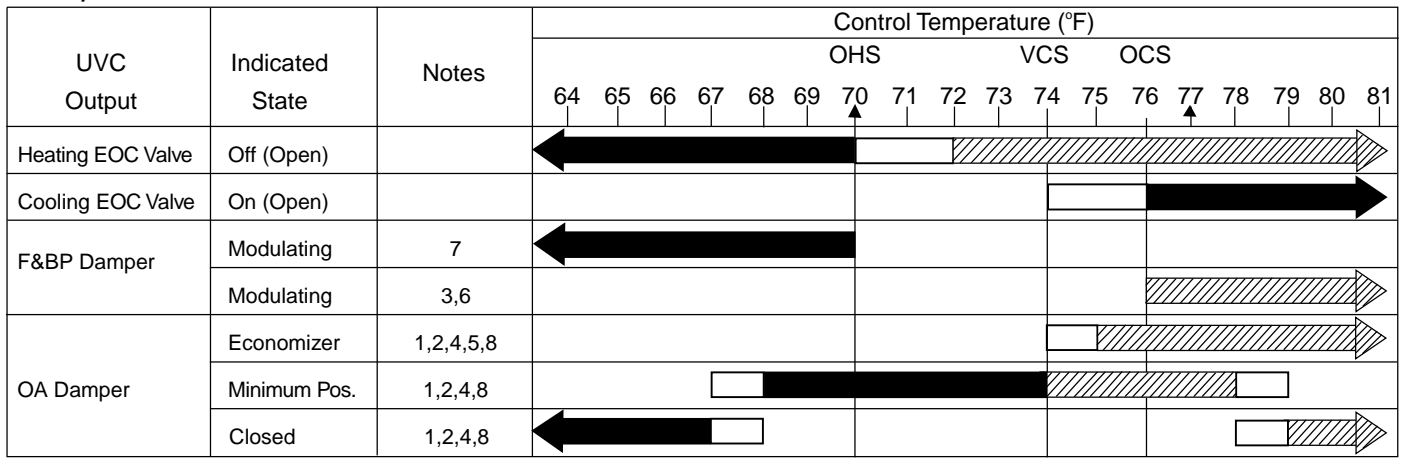


Indicated state (default setpoints)
 Indicated state dependent on differential (default setpoints)

Outdoor Air Temperature Dependent Function Notes:

- Economizer cooling will be unavailable when OA is above VCLO
- OA lockout feature is enabled from the factory in UV Model 14, when enabled the OA damper will be forced closed if OA temperature is below OALO
- In very humid locations VCLO can be lowered to limit the economizer function
- In locations where humidity is of no concern, VCLO can be raised slightly to allow additional economizer cooling

Occupied Mode

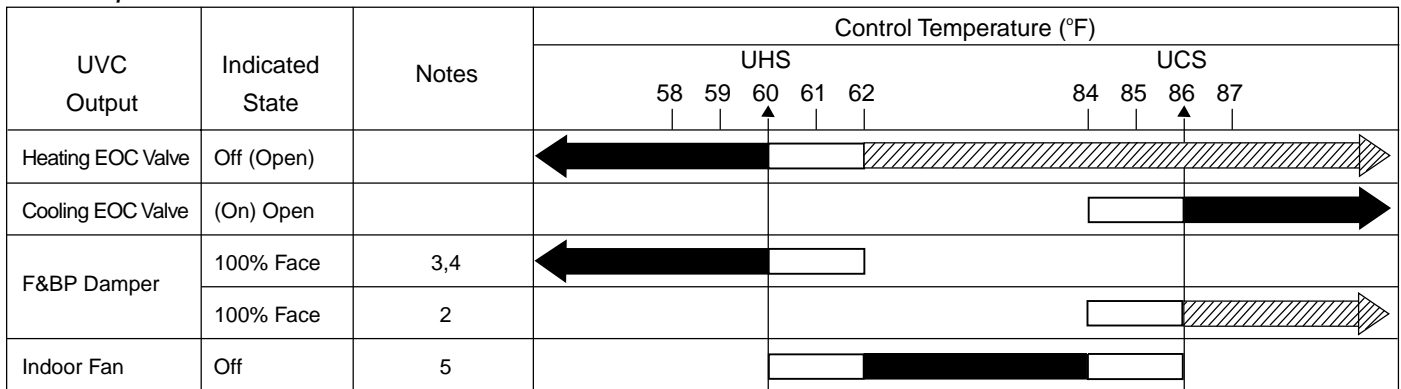


Indicated state (default setpoints)
 Indicated state dependent on differential (default setpoints)
 Indicated state dependent on OA temperature (default setpoints)

Occupied Mode Notes:

1. The vent cooling discharge air low limit function can affect OA damper position
2. Economizer cooling will be unavailable when OA is above VCLO
3. In economizer mode, when cooling is required, the OA damper must be greater than 85% open before hydronic cooling is enabled
4. Control temperature can affect OA damper operation
5. In cooling mode, F&BP damper must be less than 15% open before OA damper will begin closing
6. F&BP damper operation can be affected by the CW low limit function
7. F&BP damper operation can be affected by the vent cooling discharge air low limit
8. The outdoor air lockout option, if enabled, can affect OA damper position

Unoccupied Mode



Indicated state (default setpoints)
 Indicated state dependent on differential (default setpoints)
 Indicated state dependent on OA temperature (default setpoints)

Unoccupied Mode Notes:

1. The OA damper remains closed in unoccupied mode
2. F&BP damper operation can be affected by the CW low limit function
3. F&BP damper will modulate closed to maintain discharge air high limit
4. F&BP damper will modulate open to maintain the vent cooling discharge air low limit when the fan is off
5. The indoor fan will remain off in unoccupied mode when heating and cooling are not required

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