SIEMENS

BACnet VAV with Reheat, Demand Control Ventilation (CO2), and optional Chilled Beam

Start-up Procedures

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Before You Begin

Verify that the controller has power and that the “Basic Sanity Test” (BST) LED (Figure 1) flashes once per second. If the BST LED does not flash ON/OFF once per second, see *Infolink > Automation > Technical Reference > Network Setup and Troubleshooting.*

Do not perform an update command on a BACnet MS/TP TEC from the Field Panel or Insight workstation. This feature is not currently supported.

WinCIS version 2.1.4 or later must be used to configure Siemens Building Technologies BACnet controllers.

The default HMI baud rate is 1200. If WinCIS does not communicate (through the HMI port/RTS sensor), try a different HMI baud rate.

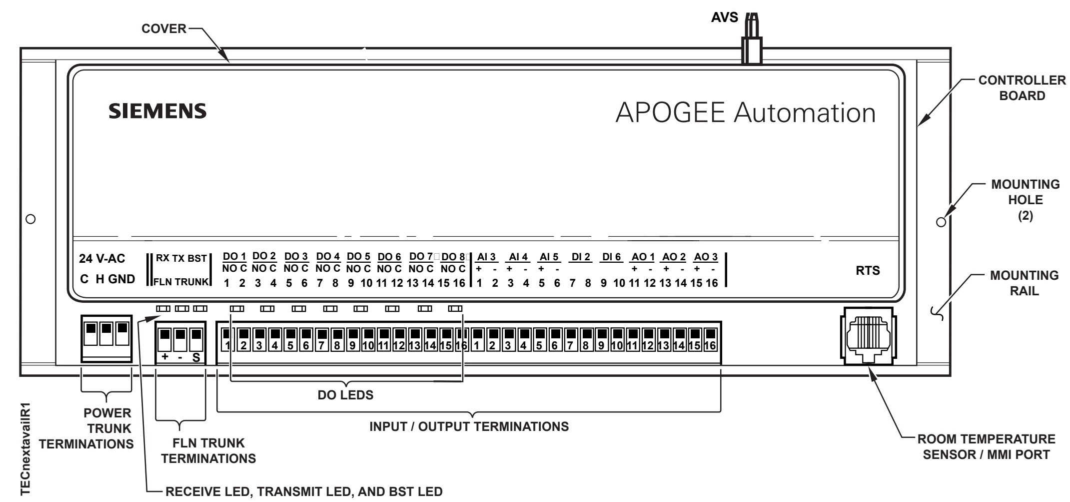

Figure 1. BACnet VAV with Reheat, Demand Control Ventilation (CO2), and optional Chilled Beam.

Enabling Actuators

CAUTION:

The controller’s DOs control only 24 Vac loads. The maximum rating is 12 VA for each DO.

1. Use Table 1 and Table 2 to set run times for the actuators used by your application. The run time setup points are DMPR TIMING (Point 51), H VLV TIMING (Point 102), and C VLV TIMING (Point 103).
2. For a damper actuator rotation angle other than 90°, set DMPR ROT ANG (Point 110) as appropriate. (PTS4 rotation angle is 90°.)

Table 1. Damper Actuator Run Time.

Damper Actuator	Setting (seconds)	
	50 Hz	**60 Hz**
GDE131.1 (floating control)	108	90
GLB131.1 (floating control)	150	125
GDE161.1 (0 to 10V control)	108	90
GLB161.1 (0 to 10V control)	150	125
PTS4 electronic-to-pneumatic transducer from ACT	–	90

Table 2. Valve Actuator Run Time.

Valve Actuator	Setting (seconds)	
	50 Hz	**60 Hz**
SSB81U, floating control fail in place	180	150
SSC81U, floating control fail in place	150	125
SSC81.5U, floating control fail-safe	125	125
SQS85.53U, floating control spring return	35	30
SSB61U, 0-10V proportional fail in place	75	75
SSC61U, 0-10V proportional fail in place	30	30
SSC61.5U, 0-10V proportional fail safe	25	25
SQS65U, 0-10V proportional fail in place	35	30
SQS65.5U, 0-10V proportional fail safe (SR)	35	30
PTS4 electronic-to-pneumatic	–	90

Specifying Motor Setup

When MTR SETUP is changed, all enabled actuators will calibrate. Wait until each actuator has completed its calibration before continuing to the next section.

In Application 2558, the value of MTR SETUP (Point 58) determines the *type*, not the number, of output control signals generated by the application. The output signals for H VLV COMD and C VLV COMD can be floating or 0 to 10V analog. Use the **additive values** in Table 3, along with the output signal logic in Table 4, to arrive at the MTR SETUP value needed for your job.

The MTR SETUP values in Table 3 are **additive**. For example, if you needed Motor 1 (DOs 1 and 2) enabled, Motor 2 (DOs 3 and 4) enabled, and Motor 3 (DOs 5 and 6) disabled, you would set MTR SETUP equal to 5. This is because the Motor 1 (for the damper) enable value is 1, the Motor 2 enable value is 4, and the Motor 3 disable value is 0. 1 + 4 + 0 = 5. In this case, you would have a floating signal for heating (DOs 3 and 4), and a 0 to 10V analog signal for cooling (AOV1). See Table 4.

Table 3. Motor Enable/Reverse Values for MTR SETUP (Point 58).

	MTR SETUP (Point 58) Value[a]		
	Disabled	**Enabled**	**Enabled and reversed**
Motor 1	0	1	3
Motor 2	0	4	12
Motor 3	0	16	48

[a] The values in this table are additive and must be added per the requirements of the job. (Note that Motor 1 is reserved for the damper and therefore must not be disabled.)

Table 4. MTR SETUP Values and Corresponding Output Signals in Application 2558.

MTR SETUP (Point 58)[a,b]	**H VLV COMD (Point 52)**	**C VLV COMD (Point 53)**
Motors 1 and 2 Enabled, Motor 3 Disabled (MTR SETUP = 5)	Motor 2 (DO 3 and DO 4)	AOV1
Motor 1 Enabled, Motor 2 Disabled, Motor 3 Enabled (MTR SETUP = 17)	AOV2	Motor 3 (DO 5 and DO 6)
Motors 1, 2, and 3 Enabled (MTR SETUP = 21)	Motor 2 (DO 3 and DO 4)	Motor 3 (DO 5 and DO 6)
Motor 1 Enabled, Motors 2 and 3 Disabled (MTR SETUP = 1)	AOV2	AOV1

[a] Motor 1 is reserved for the damper and is assumed always to be enabled.

[b] The MTR SETUP values given in this table assume none of the actuators are reverse acting. If any actuators must be reverse acting, use the additive values in Table 3 to arrive at the correct value for MTR SETUP.

If Motor 2 (DOs 3 and 4) is being used for floating control of a valve for heating, then AOV2 (Point 38) is spare. In this case, although AOV2 is spare, AOV2 OPEN (Point 114) and AOV2 CLOSE (Point 115) are not usable, because H VLV COMD (Point 52) is being sent to Motor 2. Likewise, if Motor 3 is being used for Floating Control of cooling, AOV1 (Point 60) would be spare but AOV1 OPEN (Point 112) and AOV1 CLOSE (Point 113) would not be usable.

If AOs are used for modulating heating/cooling devices, the associated DOs are spare but unavailable for motor control.

Setting Voltages that Open and Close 0 to 10V Actuators

If AOV control is used for modulating valve instead of floating control, the open/close voltages need to be set. Otherwise this section can be skipped.

Set AOV1 OPEN (Point 112) to the voltage that fully opens the modulating cooling device connected to AOV1.

Set AOV1 CLOSE (Point 113) to the voltage that completely closes the modulating cooling device connected to AOV1.

Set AOV2 OPEN (Point 114) to the voltage that fully opens the modulating heating device connected to AOV2. (If an SCR is connected to AOV2, then AOV2 OPEN is the voltage that causes the SCR to be fully on.)

Set AOV2 CLOSE (Point 115) to the voltage that completely closes the modulating heating device connected to AOV2. (If an SCR is connected to AOV2, then AOV2 CLOSE is the voltage that causes the SCR to be fully off.)

The maximum voltage output for an AO is 10V. The controller will not control the modulating heating device beyond 10V.

Controller Address and Application

Set CTLR ADDRESS to the BACnet MS/TP MAC address. (0–127 = Master; 128–254 = Slave).

Set APPLICATION to 2558. The controller will go through a shut-down/load sequence as it switches from slave mode to Application 2558.

Air Velocity Sensor Calibration

The air velocity sensor calibration cycle takes from 2 to 5 minutes to complete. The air damper closes during calibration. At the start of the calibration cycle, the controller automatically sets the point CAL AIR (number 94) to YES. When the cycle is complete, it sets CAL AIR to NO.

For a controller used without an Autozero Module, the damper is commanded closed to get a zero airflow reading during calibration. For a controller used with an Autozero Module, calibration occurs without closing the damper.

Wait until the calibration cycle is complete (CAL AIR is set to NO) before continuing with this startup procedure.

Selecting Automatic Calibration Option

1. Using Table 5, set CAL SETUP (Point 95) to the value that best meets your job requirements.

2. If appropriate, change CAL TIMER (Point 96) from the default of 12 hours. This setting applies only if your choice for CAL SETUP includes Option 4.

The air velocity sensor must be calibrated at least once every 24 hours. Make sure that the sensor has been calibrated before balancing takes place, as this will affect the balancer's results.

Table 5. CAL SETUP Options.

CAL SETUP (Point 95)	Description
0	Calibration occurs ONLY when the point CAL AIR (Point 94) is set to YES.
1	Calibration occurs when the field panel commands a day/night mode changeover. Actual calibration is subject to a time delay of 0, 1, 2, or 3 minutes. This delay is determined by the point CTLR ADDRESS (Point 1) divided by 4. The remainder is the time delay in minutes. **Example:** If CTLR ADDRESS = 11, then the controller will wait 3 minutes (11 ÷ 4 = 2 **R3**) after it receives the day/night mode changeover command before beginning the calibration routine.
2	Calibration occurs immediately after the override switch is depressed.
4 (factory default value)	Calibration occurs on the time interval set in the point CAL TIMER (Point 96). For example, if CAL TIMER = 12, then the calibration period is 12 hours. Actual calibration is subject to a time delay based on the value of CTLR ADDRESS. See the example in Option 1. This is the recommended option when using a controller with an Autozero Module.

Options can be combined by summing their numbers. For example, to calibrate as in Options 1 and 2, set CAL SETUP to **3**.

Setting Room Temperature Setpoints

Points 6, 7, 8, and 9 are the room temperature setpoints. The following list shows the function of each point (point names vary per application):

- Point 6: DAY (or OCC) cooling setpoint.
- Point 7: DAY (or OCC) heating setpoint.
- Point 8: NGT (or UOC) cooling setpoint.
- Point 9: NGT (or UOC) heating setpoint.

1. If the room temperature sensor has a setpoint dial that will be used, set STPT DIAL (Point 14) to **YES**. Otherwise, set STPT DIAL to **NO**
2. Set Points 6 through 9 to desired values. If STPT DIAL is set to YES, Points 6 and 7 are not used as setpoints by the application; the value of RM STPT DIAL (Point 13) is used instead. (Points 6 and 7 will still need to be set to determine the size of the temperature deadband (If any) around RM STPT DIAL.
3. Set RM STPT MIN (Point 11) and RM STPT MAX (Point 12) for the minimum and the maximum allowable room temperature setpoint values respectively. Valid values range from 55°F to 95°F (13°C to 35°C). Default values are 55°F (13°C) for RM STPT MIN and 90°F (32°C) for RM STPT MAX.

If STPT DIAL is set to YES and DAY CLG STPT is equal to DAY HTG STPT, then DAY HTG STPT and DAY CLG STPT will not be used. Only the value of RM STPT DIAL will be used, and CTL STPT (Point 92) will be set equal to RM STPT DIAL.

However, if STPT DIAL is set to YES and DAY CLG STPT is not equal to DAY HTG STPT, then DAY CLG STPT and DAY HTG STPT will be used to set up a temperature deadband (or zero energy band) around RM STPT DIAL. (This deadband can help reduce energy use.) When HEAT.COOL (Point 5) equals HEAT, CTL STPT will be set equal to RM STPT DIAL – 0.5 * (DAY CLG STPT – DAY HTG STPT) and when HEAT.COOL equals COOL, CTL STPT will be set equal to RM STPT DIAL + 0.5 * (DAY CLG STPT – DAY HTG STPT).

Whether or not there is a temperature deadband around RM STPT DIAL, the application limits CTL STPT to the temperature range of RM STPT MIN to RM STPT MAX.

Setting HC.ENDIS

HC.ENDIS HC.ENDIS (Point 22) determines whether the application is heating only, cooling only, or if it uses both heating and cooling modes. The default value for HC.ENDIS is 3, both heating and cooling are enabled. 1 = heating only; 2 = cooling only. Set HC.ENDIS to the desired value.

Setting Override Time

If using night/unoccupied override, set OVRD TIME (Point 20) to the number of whole hours that an override should last. If OVRD TIME equals 0 (default), this feature is disabled.

Setting Duct Area

If provided, enter the duct area (sq ft or sq m) into Point 97 (and also into Point 60 in applications where Point 60 is named HTGDUCT AREA) and continue to *Setting Flow Coefficient*.

If you do not know the duct area, use the following table:

Area	Round Duct	Rectangular Duct
Area in square feet (Dimensions in inches)	$(\pi \, x R^2)/144$	Length x Height ⁄ 144
Area in square meters (Dimensions in centimeters)	$(\pi \, x R^2)/10,000$	Length x Height ⁄ 10,000

Setting Flow Coefficient

1. Set FLOW COEFF (Point 36) to the appropriate value found in Table 6. This value is a starting point for the air balancer.

2. To fine tune the flow coefficient use the following formula:

   The actual volume is the actual value obtained from the balancer's measurements. The TEC volume is the value obtained from AIR VOLUME (Point 35).

3. If the TEC volume is not within 5% of the actual volume, repeat the procedure until it is within 5%.

Table 6. Box Manufacturer Flow Coefficients.

Manufacturer	Sensor Type	Value
Anemostat	2-pipe without orifice 2-pipe with orifice Spider without orifice Spider with orifice	0.79 0.59 0.73 0.39
Carnes	2-pipe Flow cross	0.66 0.59

continued on next page...

Table 6. Box Manufacturer Flow Coefficients. ***(continued)***

Manufacturer	Sensor Type	Value
Carrier		0.59
E.H. Price / Siemens Building Technologies Lab Terminal Boxes		0.78
Environmental Technologies		0.79
Krueger		0.68
Metal Aire		0.72
Nailor Industries		0.69
Titus		0.60
Trane		0.66

Setting Airflow Setpoints

Maximum flow(s) must be set ≥ minimum flow(s).

1. Set CLG FLOW MIN (Point 31) to the desired minimum cooling airflow setpoint.
2. Set CLG FLOW MAX (Point 32) to the desired maximum cooling airflow setpoint.
3. Set HTG FLOW MIN (Point 33) to the desired minimum heating airflow setpoint.
4. Set HTG FLOW MAX (Point 34) to the desired maximum heating airflow setpoint.
5. Set VENT FLOW MAX (Point 71) to the desired maximum ventilation setpoint.

CAUTION:

If using electric heat, enter a value for HTG FLOW MIN. Equipment damage may occur at 0 cfm with electric heat ON.

As a safety feature, application 2558 includes MODHTG FLOW (Point 120) to ensure that adequate airflow is present before an electric heating element is energized. Since application 2558 will typically not have electric heat, the default for MODHTG FLOW is 0, no safety. If the application does use electric heat, MODHTG FLOW **must** be configured to an appropriate value to ensure adequate airflow is present before an electric heating element is energized. Setting MODHTG FLOW to 20 will ensure airflow is at least 20% of max heating flow before H VLV COMD will turn on.

Enabling Wall Switch

If a wall switch is used for day/night (occ/unocc) control, enable it by setting WALL SWITCH (Point 18) to **YES**.

Enabling Autozero Module

If an Autozero Module is used, enable it by setting CAL MODULE (Point 87) to **YES**.

For a controller without an Autozero Module, the damper is commanded closed to get a zero airflow reading during calibration. For a controller with an Autozero Module, the damper is closed only for the first calibration after controller initialization or power up.

Room Temperature Offset (optional)

When the room has stabilized (within 5°F) take a precision temperature reading at the room temperature sensor. Record the difference between this reading and the value of ROOM TEMP in TEMP OFFSET (Point 66). (CTL TEMP = ROOM TEMP + TEMP OFFSET)

EXAMPLE: If the actual room temperature is 72.0°F, and the value of ROOM TEMP is 73.0°F, then the value entered into TEMP OFFSET is –1.0. In this case, the value of ROOM TEMP would read 73.0°F, but the value of CTL TEMP would read 72.0°F.

Heating/Cooling – Start and End

The following configuration points establish whether the flow should ramp up before, during, or in parallel with the ramping of the temperature valves. If necessary, see the application documentation (0198p08) *Sequencing Logic* sections for additional information.

The second stage of cooling can be delayed. This is done by making sure the START of the second stage of cooling is greater than the END of the first stage of cooling. For example, setting CHW START greater than C FLOW END means that the chilled water valve will not begin to modulate open until a time after the airflow has stopped modulating open. In this case, the time between cooling stages will not be less than the number of seconds in CLG STG DLY (adjustable).

1. Set C FLOW START to the value of CLG LOOPOUT (0 -100) at which the flow will begin to modulate up from CLG FLOW MIN.

2. Set C FLOW END to the value of CLG LOOPOUT (0 -100) at which the flow will reach CLG FLOW MAX.

3. Set CHW START to the value of CLG LOOPOUT (0 -100) at which the chilled water valve will begin to modulate open from fully closed.

4. Set CHW END to the value of CLG LOOPOUT (0 -100) at which the chilled water valve will be fully open.

5. Set H FLOW START to the value of HTG LOOPOUT (0 -100) at which the flow will begin to modulate up from HTG FLOW MIN.

6. Set H FLOW END to value of HTG LOOPOUT (0 -100) at which the flow will reach HTG FLOW MAX.

7. Set REHEAT START to the value of HTG LOOPOUT (0 -100) at which the hot water valve will begin to modulate open from fully closed.

8. Set REHEAT END to the value of HTG LOOPOUT (0 -100) at which the hot water valve will be fully open.

Setting the CO_2 Parameters

For additional background information, see the application documentation (0198p08) *Ventilation Control* section.

➤ Set CO2 SCALE (Point 10) to the value, in PPM, represented by a sensor reading of 10V or 20 mA. (Default is 2000)

For the following configuration points, “CO2 differential” means the difference between room and outdoor CO2 concentrations as measured in parts per million.

1. Set CO2DIFF STPT to the targeted CO2 differential to be controlled to when the application is in the ventilation mode. (The default is 100 PPM.)

2. Set CO2DIFF HLIM to the CO2 differential which when exceeded causes the application to enter the ventilation control mode. (The default is 500 PPM.)

3. Set CO2DIFF LLIM to the CO2 differential which when subceeded (becomes less than) causes the application to exit ventilation mode and return to temperature control mode. (The default is 400 PPM.)

4. Set CO2 ALM DLY to the desired number of minutes that must elapse before an alarm will occur. (The default is 10 minutes.) CO2 ALARM is set to ALARM state when the CO2 differential (CO2DIFF, Point 74) has been greater than CO2DIFF HLIM for longer than the time in CO2 ALM DLY.

5. Set CO2 ALM DLY to the number of minutes that the CO2 differential must be below CO2DIFF LLIM before FLO CTL MODE switches from ventilation control mode (VENT) to temperature control mode (TEMP).

6. Set OUTDOOR CO2 (Point 50).

For the most accurate representation of CO2 differential, OUTDOOR CO2 should receive its value via PPCL from a CO2 sensor that is measuring the outdoor CO2 concentration level in parts per million (PPM). The signal may need filtering to reduce fluctuation in the sent value. If the value fluctuates needlessly, it will cause unstable control. If there is no outdoor sensor, OUTDOOR CO2 should be set to a typical outdoor CO2 concentration level in PPM. The default is 450 PPM which should be good for most situations.

7. Set CO2 CONFIG to the type of operation required. See Table 7.

Table 7. CO2 CONFIG values for Demand Control Ventilation.

CO2 CONFIG value	Application Operation
0	Demand Control Ventilation feature is disabled.
1	CO2 based demand control ventilation is enabled. AI3 and AI4 are both spare. The value of ROOM CO2 that is used for CO2 control is set via PPCL from a field panel.
2	Not used (reverts to 0).
3	CO2 based demand control ventilation is enabled. AI3 is the input used for calculating ROOM CO2. AI4 is spare.
4	CO2 based demand control ventilation is enabled. AI4 is the input used for calculating ROOM CO2. AI3 is spare.

If ROOM CO2 is overridden while in modes 1, 3 or 4, the overridden value is used for CO2 control purposes. If ROOM CO2 is overridden while in mode 0, there will be no CO2 control, even with large values.

If AI3 or AI4 is used for CO2 sensing, set the associated DIP switch (located on circuit board) to indicate the sensor type, either current or voltage. Voltage is default.

Since CO2 sensors may have an accuracy of + or – 50 PPM, some CO2 default values may need adjustment. Ventilation mode default values are: 500 PPM for entering the Demand Control Ventilation mode; 400 PPM for leaving the Demand Control Ventilation mode; 100 PPM is the default CO2DIFF STPT. Refer to the appropriate industry standards and guidelines when configuring the CO2 differential levels and setpoints.

DCV Modes

Demand Control Ventilation can operate in two basics modes: threshold monitoring and PID control (proportional control only).

DCV Mode 1 – Threshold Monitoring

This is the factory default. In this mode, when the CO2 measurement for the indoor air becomes greater than the CO2 measurement for the outdoor air by a configurable amount, the damper will move to the ventilation maximum until the differential CO2 level drops below a second lower configurable limit. When the differential CO2 level has been at or below the lower limit for a specified number of minutes, the application returns to normal temperature control. If the CO2 differential rises again, the process repeats. With factory default settings, as the differential between indoor and outdoor CO2 concentrations rises above 500 ppm, the damper will open to the ventilation maximum until the CO2 differential level drops below 400 ppm for 10 minutes.

To operate in this mode:

- Set CO2 P GAIN equal to or greater than 1
- Set CO2DIFF STPT to a value at least 100 ppm below CO2DIFF LLIM

DCV Mode 2 – with PID Loop Proportional Control only
In this mode the user adjusts CO2 P GAIN and CO2DIFF STPT to establish a desired CO2 steady state level. For example, CO2DIFF STPT could be set to 250 and the gain set to .33. With these settings, a CO2 steady state level would establish itself somewhere between an indoor/outdoor differential of 250 and 550 ppm. In this example, the upper limit CO2DIFF HLIM should be set to slightly above 550 ppm to avoid alarms when the controller is controlling near the upper limit of its PID range.

The use of I gain (CO2 I GAIN) is not recommended in this application.

The following table shows the relationship between gain and proportional band. Due to the tendency of CO2 levels to drift, the lowest gain possible is recommended when using proportional control.

Table 8. Proportional P Gain Values.

CO2 P GAIN	Proportional Band
1	Control range will be from setpoint to 100 ppm above setpoint
.33	Control range will be from setpoint to 300 ppm above setpoint
.2	Control range will be from setpoint to 500 ppm above setpoint

To operate in DCV Mode 2 (PID Loop – Proportional Control only):

- Set CO2 P GAIN and CO2DIFF STPT as desired according to the above guidelines.

DCV Used/Not Used

DCV Used — When DCV is enabled (CO2 CONFIG = 1, 3, or 4), set CLG FLOW MIN and HTG FLOW MIN to values that assure adequate ventilation for the building component. This is typically about 30% of a ventilation flow rate based on full occupancy. If 400 cfm was min flow based on occupancy, 120 cfm (30% of 400) might be used for the CLG FLOW MIN and HTG FLOW MIN values. The number of occupants will be inferred by measuring the level of CO2. In this case, as occupancy goes from no occupancy to full occupancy the ventilation would ramp from 120 to 400 cfm.

DCV Not Used — Setting CO2 CONFIG (Point 57) to zero disables the DCV feature. If CO2 CONFIG = 0, set CLG FLOW MIN and HTG FLOW MIN to values that will assure adequate ventilation based on full occupant capacity and the square footage of the space. Consult ASHRAE or other appropriate guidelines.

Always refer to the appropriate industry standards and design guides for selecting minimum ventilation levels. ASHRAE guidelines base ventilation needs on a building component and an occupant component.

Condensate Control

Set DI6 TYPE to NOPEN (default) if the type of condensate sensor used is normally open, and **closes when condensation is present**.

Set DI6 TYPE to NCLOSE if the type of condensate sensor used is normally closed, and **opens when condensation is present**.

Configuring BACnet Parameters

WinCIS version 2.1.4 or later must be used to configure Siemens BACnet MS/TP TECs.

1. Using WinCIS, from the Device menu select Device Properties to configure BACnet parameters.
    - Object Name – unique to BACnet network (12 character limit)
    - Object ID – unique to BACnet network (valid values = 0 to 4,194,303)
    - Description – description of controller (60 character limit)
    - Location – physical location of controller (60 character limit)
    - Baud Rate – options: 9600, 19200, 38400 or 76800 (default = 19200)
2. Press the ’Write’ button — the controller accepts the configuration values and then resets.

When the controller is successfully installed, the RX and TX LEDs flash rapidly and continuously.

The startup is complete.