SIEMENS

BACnet PTEC Unit Conditioner Controller

Fan Coil Unit 2-Stage Cooling and Electric Heat, Application 6552

Application Note

140-0948T
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Building Technologies

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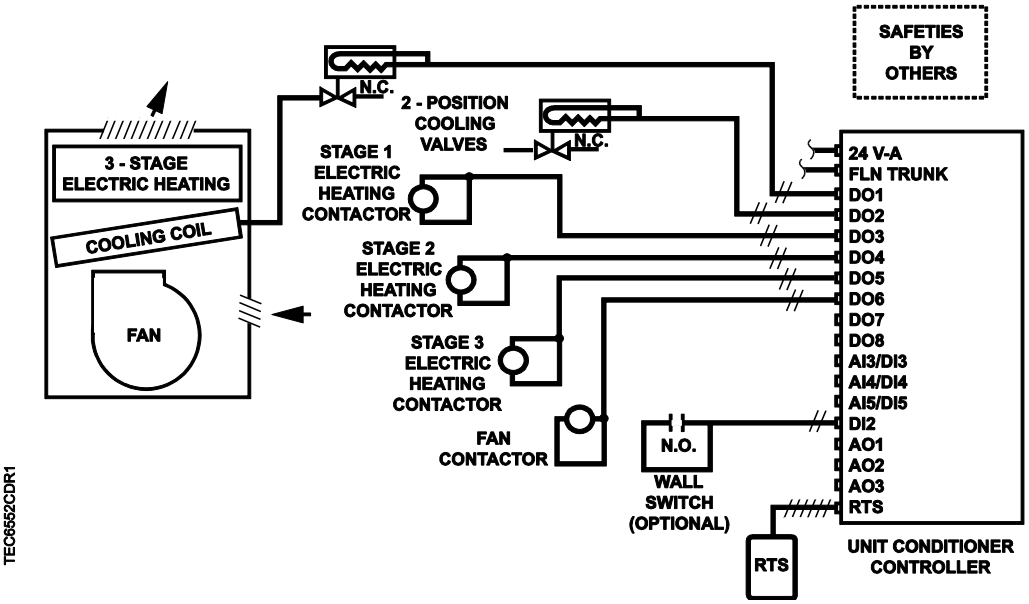
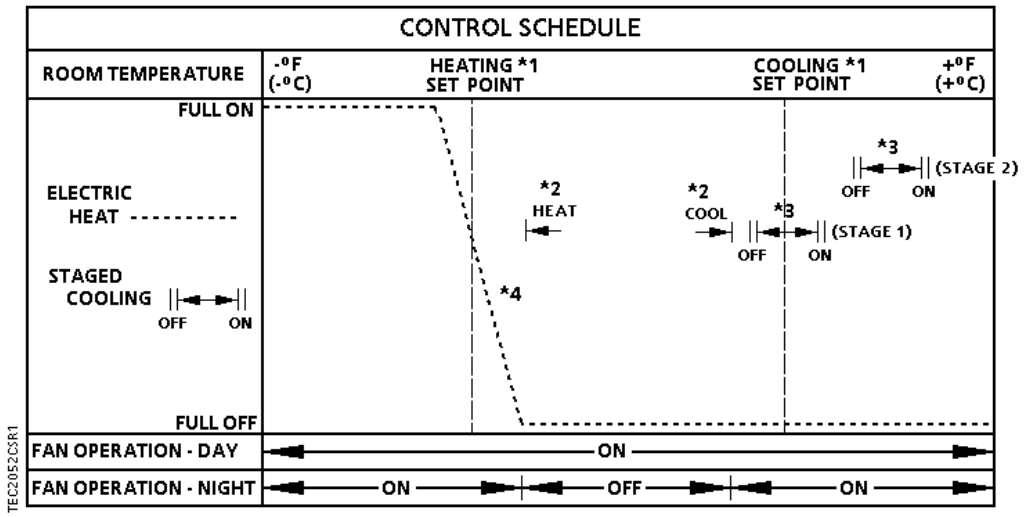
Overview

NOTE:
For information on applications with Firmware Revision B*x*40 or earlier, see InfoLink and/or Asset Portal for documentation.

In Application 6552, the controller energizes a maximum of two stages of cooling and a maximum of three stages of electric heat in the fan coil unit. The fan coil unit also has a fan to circulate room air.



Application 6552 Fan Unit Two-Stage Cooling and Electric Heat Control Diagram.



Application 6552 Control Schedule.

BACnet

The controller communicates using BACnet MS/TP protocol for open communications on BACnet MS/TP networks.

Product	Supported BIBBs	BIBB Name
BTEC/PTEC	DS-RP-B B	Data Sharing-Read Property-B
	DS-RPM-B	Data Sharing-Read Property Multiple-B
	DS-WP-B	Data Sharing-Write Property-B
	DM-DDB-B	Device Management-Dynamic Device Binding-B
	DM-DOB-B	Device Management-Dynamic Object Binding-B
	DM-DCC-B	Device Management-Device Communication Control-B
	DM-RD-B	Device Management-Reinitialize Device-B
	DM-BR-B	Device Management-Backup and Restore-B
	DM-OCD-B	Device Management-Object Creation and Deletion-B

Hardware Inputs

Analog

- Room temperature sensor
- *(Optional)* Room temperature setpoint dial

Digital

- *(Optional)* Night mode override
- *(Optional)* Wall switch

Hardware Outputs

Analog

- Spare AO 1, AO 2 and AO 3 (0-10V)

Digital

- Fan (switched 24 Vac, pilot duty)
- Stage 1 cooling (2-position valve actuator or cooling compressor)
- Stage 2 cooling (2-position valve actuator or cooling compressor)
- Stage 1 electric heat
- Stage 2 electric heat
- Stage 3 electric heat

Ordering Notes

550-496P BACnet PTEC Unit Conditioner Controller

Sequence of Operation

The following paragraphs present the sequence of operation for the BACnet PTEC Unit Conditioner Controller.

Control Temperature Setpoints

This application has a number of different room temperature setpoints (DAY HTG STPT, NGT CLG STPT, RM STPT DIAL, and so on.). The application actually controls using the CTL STPT. CTL STPT is set to different values depending on its override status, the time of day, whether or not a temperature deadband (zero energy band) has been configured, and the type of RTS used.

CTL STPT is Overridden

If CTL STPT is overridden, that value is used regardless of any other settings. This disables the setpoint deadband feature.

CTL STPT in Night Mode:

The controller is in Night mode if DAY.NGT = NGT and NGT OVRD = NGT.

When the controller is in Night mode, CTL STPT holds the value of NGT CLG STPT or NGT HTG STPT depending on the value of HEAT.COOL. When the controller is in Night mode the value of RM STPT DIAL is ignored.

CTL STPT in Day Mode:

The controller is in Day mode if DAY.NGT = DAY or NGT OVRD = DAY.

Without setpoint dial:

When the controller is in Day mode and STPT DIAL = NO, CTL STPT holds the value of DAY CLG STPT or DAY HTG STPT depending on the value of HEAT.COOL.

With setpoint dial:

When the controller is in Day mode and STPT DIAL = YES. CTL STPT is set based on the value of the setpoint dial and the setpoint deadband.

The setpoint deadband exists to allow the controller to provide a separation of the heating and cooling temperature setpoints when a setpoint dial is enabled.

The setpoint deadband is the difference between the cooling and heating day setpoints (DAY CLG STPT - DAY HTG STPT). The setpoint deadband can be disabled by setting DAY HTG STPT equal to DAY CLG STPT. When DAY HTG STPT does not equal DAY CLG STPT, a setpoint deadband (or zero energy band) is used.

The following values are used in the calculation of CTL STPT:

- *Dial value* is the value of RM STPT DIAL limited between the value of RM STPT MIN and RM STPT MAX.
- *Deadband* is the value of the difference between DAY CLG STPT and DAY HTG STPT, half of which is applied to establish the current heating and cooling setpoints.
  - *Deadband* = (DAY CLG STPT – DAY HTG STPT)

CTL STPT is calculated as follows:

With Deadband disabled:

CTL STPT = *Dial value*

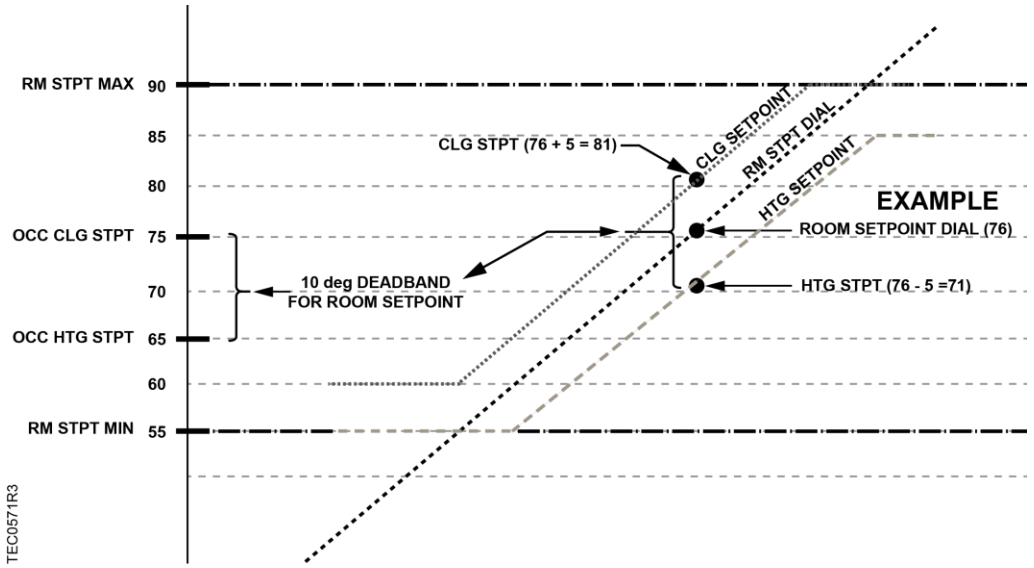
With Deadband enabled in Heat Mode:

CTL STPT = *Dial value* – 0.5 * *Deadband* (limited between the value of RM STPT MIN and RM STPT MAX)

With Deadband enabled in Cool Mode:

CTL STPT = *Dial value* + 0.5 * *Deadband* (limited between the value of RM STPT MIN and RM STPT MAX)

NOTE:
If RM STPT DIAL is failed, it maintains the last known value.



Room Temperature, Room Temperature Offset and CTL TEMP

ROOM TEMP is the temperature that is being sensed by the room temperature sensor (RTS).

RMTMP OFFSET (or TEMP OFFSET) is a user-adjustable offset that compensates for deviations between the value of ROOM TEMP and the actual room temperature.

CTL TEMP is the room temperature that is used for control purposes. In other words, the application is trying to maintain CTL TEMP at the control setpoint.

When CTL TEMP is not overridden, CTL TEMP and ROOM TEMP are related by the following equation:

CTL TEMP = ROOM TEMP + RMTMP OFFSET (or TEMP OFFSET)

If CTL TEMP is not overridden then,

- The current value of ROOM TEMP (normal or overridden) determines the value of CTL TEMP.
- If ROOM TEMP has a status of Failed, then the last known good value of ROOM TEMP determines the value of CTL TEMP.

Day and Night Modes

The day/night status of the space is determined by the status of DAY.NGT. The control of this point differs depending on whether the controller is monitoring the status of a wall switch or if the controller is connected to a field panel.

When a wall switch is physically connected to the termination strip on the controller DI 2 (see the *Control Diagram* in the *Overview* section), and WALL SWITCH = YES, the controller monitors the status of DI 2.) When the status of DI 2 is ON (the switch is closed), then DAY.NGT is set to DAY indicating that the controller is in day mode. When the status of DI 2 is OFF (the switch is open), then DAY.NGT is set to NIGHT indicating that the controller is in night mode.

When WALL SWITCH = NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, if the controller is operating stand-alone, then the controller stays in day mode all the time. If the controller is operating with centralized control (that is, it is connected to a field panel), then the field panel can send an operator or PPCL command to override the status of DAY.NGT. See *Powers Process Control Language (PPCL) User's Manual* (588-583) and *BACnet Field Panel User's Manual* (588-580) for more information.

Night Mode Override Switch

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into OVRD TIME, pressing the override switch resets the controller to DAY operational mode for the time period that is set in OVRD TIME. The status of NGT OVRD changes to DAY. After the override time elapses, the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

The override switch on the room sensor only affects the controller when it is in Night mode.

Heating/Cooling Switchover

The heating/cooling switchover determines whether the controller is in Heating or Cooling mode by monitoring the room temperature and the demand for heating and cooling (as determined by the temperature control loops).

If the following conditions are met for the length of time set in SWITCH TIME, the controller switches from Heating or Cooling mode by setting HEAT.COOL to COOL:

- HTG LOOPOUT < SWITCH LIMIT.
- CTL TEMP > CTL STPT by at least the value set in SWITCH DBAND.
- CTL TEMP > the appropriate cooling setpoint minus SWITCH DBAND.

If the following conditions are met for the length of time set in SWITCH TIME, the controller switches from Cooling to Heating mode by setting HEAT.COOL to HEAT:

- CLG LOOPOUT < SWITCH LIMIT.
- CTL TEMP < CTL STPT by at least the value set SWITCH DBAND.
- CTL TEMP < the appropriate heating setpoint plus SWITCH DBAND.

Control Loops

The BACnet PTEC Unit Conditioner Controller is controlled by two Proportional, Integral, and Derivative (PID) temperature loops.

The two temperature loops are a cooling loop and a heating loop. The active temperature loop maintains room temperature at the value in CTL STPT. See Control Temperature Setpoints [→ 6].

Cooling Operation

In cooling mode, the controller uses CTL STPT and CTL TEMP as inputs for the cooling loop.

The cooling loop controls up to two stages of cooling as defined by the value of CLG STG CNT.

The staged cooling operates as follows:

- CLG STG 1 will turn ON when CLG LOOPOUT > CLG 1 ON , provided that CLG STG 1 has been OFF for at least the time set in CLG MIN OFF .
- CLG STG 2 will turn ON when CLG LOOPOUT > CLG 2 ON , provided that CLG STG 2 has been OFF for at least the time set in CLG MIN OFF.
- CLG STG 2 will turn OFF, when CLG LOOPOUT < CLG 2 OFF , provided that CLG STG 2 has been ON for at least the time set in CLG MIN ON .
- CLG STG 1 will turn OFF, when CLG LOOPOUT < CLG 1 OFF , provided that CLG STG 1 has been ON for at least the time set in CLG MIN ON.
- HTG LOOPOUT = 0%.

When in heating mode, both stages of cooling are OFF.

Heating Operation

In heating mode, the controller uses CTL STPT and CTL TEMP as inputs for the heating loop.

The output of the heating loop, HTG LOOPOUT, modulates the electric reheat in order to warm up the space. CLG LOOPOUT is set to 0%.

When in cooling mode, all stages of heating are OFF.

Staged Heating Coil

⚠ CAUTION

Verify that the equipment is supplied with safeties by others.

Ensure that there is airflow across the heating coils when they are to be energized.

The heating loop controls up to three stages of electric reheat to warm up the room. The electric reheat is time modulated using a duty cycle as shown in the following example. When the controller is in cooling mode, the electric heat is OFF at all times.

Example

If the duty cycle is 10 minutes (HTG STG TIME = 10 minutes) and the heating loop is calling for 60% of heating (HTG LOOPOUT = 60%) for every 10-minute period, the stages of electric auxiliary heat cycle are as follows:

	Stage 1: minutes ON OFF	Stage 2: minutes ON OFF	Stage 3: minutes ON OFF
With 1 stage of electric heat:	6 4	- -	- -
With 2 stages of electric heat:	10 0	2 8	- -
With 3 stages of electric heat:	10 0	8 2	0 10

Fan Operation

NOTE:
If this application is controlling a damper instead of a cooling valve, the fan operation is not applicable because there is no fan.

Day Mode – The fan may be set to stay ON at all times or to cycle to save energy. If CYCLE FAN = NO, the fan will be ON during the day. If CYCLE FAN = YES, the fan will cycle according to the following conditions:

1. If the first heating stage, the first cooling stage, or the second cooling stage is ON, the fan will turn ON.
2. If the first heating stage is OFF and has been OFF for a complete duty cycle, HTG STG TIME, and the first and second cooling stages are OFF and have been OFF for the minimum off time, the fan will turn OFF.
3. If neither of the above two conditions is met, the condition of the fan remains unchanged.

Night Mode – The fan cycles using the same three conditions described in the day mode section above, regardless of the setting of CYCLE FAN. If NGT OVRD = DAY (indicating that the night mode override button has been pressed), the fan is controlled as in day mode.

Calibration

The controller regularly calibrates the valve(s) based on the value of CAL TIMER. A value of 12 indicates that the controller will calibrate the valve(s) once every 12 hours.

The calibration consists of driving the valve(s) closed, and then resetting the value of VLV 1 POS to 0. If a second valve is used, VLV 2 POS is also set to 0. The actuators are then released to normal control.

Floating Control Actuation Auto-correct

In addition to the existing options for floating control actuator full stroke actions, all floating control actuators are provided with additional logic to fully drive open or closed when commanded to 100% or 0%.

AI 4/AI 5 OFFSET (Optional)

AI 4 OFFSET works like RMTMP OFFSET. It can be used to calibrate AI 4 aux temp sensor input if necessary. The actual temperature plus AI 4 OFFSET will equal AI 4 display temperature.

AI 5 OFFSET works the same as AI 4 OFFSET.

Room Unit Operation

Stat Supervision

STAT SUPV is a configurable, enumerated point (values are additive). This point tells the controller how to handle loss of data when used with a digital room unit.

Room Temperature

- When the digital room unit (Series 2200/2300) is used, STAT SUPV enables loss of communication indication:
  - Temperature sensing with a value of 1.
  - Relative humidity sensing with a value of 2.
  - CO2 sensing with a value of 4.
- Communication for Series 2200 sensor baud rate must be set to 1200.
- When the analog room unit (Series 1000/2000) is used, default temperature sensing (0) is enabled (relative humidity and CO2 sensing are not available and should not be selected).

Other Inputs (only available on Digital Room Unit)

- Use the following table to enable communications supervision of room temperature, relative humidity or CO2 for additive values of 2 or 4.

STAT SUPV Value * (additive)	Description (include values to enable feature)
1	Room temperature sensing
2	Relative Humidity (RH) sensing
4	CO_2 sensing

⚠ CAUTION

Digital Room Units that have the RH and/or the CO2 feature will always update the present value and put the associated points (RM TEMP, RM RH, and RM CO2) in override mode, preventing external (or PPCL) commands from being used. STAT SUPV is only provided to allow these points to report a FAIL mode when the room unit fails to update these points.

If an alternative source is selected you must ensure that the room unit is not provided with the same sensor option.

See *Sensors and Transducers Configuration and Sizing* for part numbers and ordering information.

Room CO2

RM CO2 displays the CO_2 value in units of parts-per-million (PPM). RM CO2 can be used with PPCL in the PTEC controller or unbundled for control or monitoring purposes.

Room RH

RM RH displays the relative humidity value in percent. RM RH can be used for PPCL in the PTEC or unbundled for control or monitoring purposes.

Fail Mode Operation

If the room temperature sensor fails, the controller operates using the last known temperature value.

Application Notes

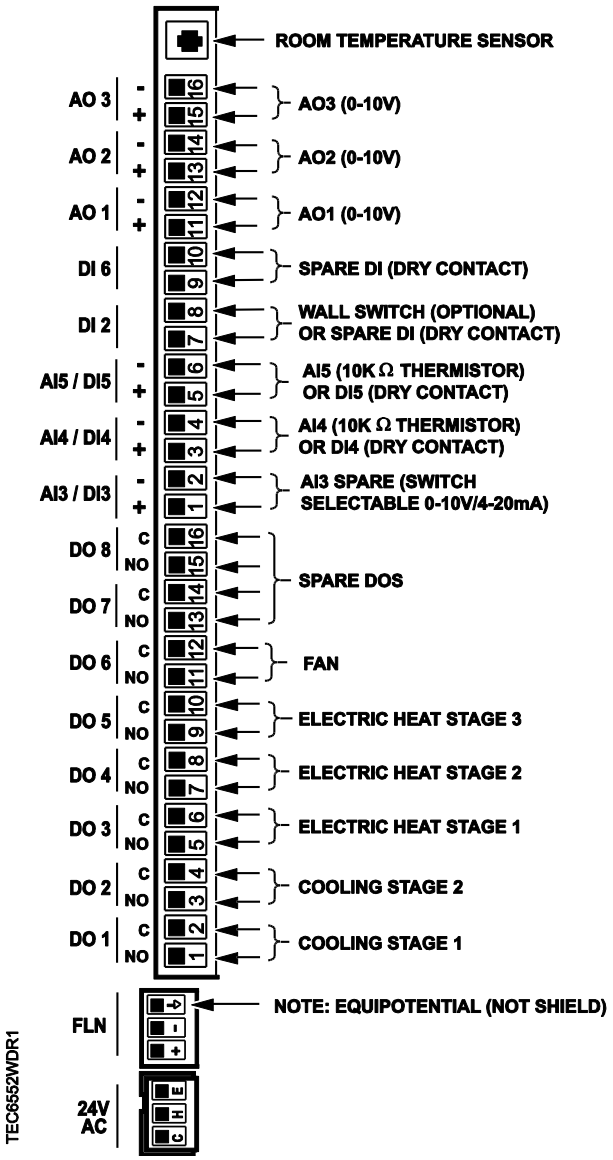
- The controller keeps all associated equipment OFF.
- Spare DOs can be used as auxiliary points that are controlled by the field panel after being defined in the field panel's database. DO 3, DO 4, and DO 5 control the stages of electric heat. If less than three stages are being controlled by the application, the DOs that are not used will be spare.

For more information, contact your local Siemens Solution Partner, Authorized TALON Dealer.

Wiring Diagram

NOTE:
The controller's DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. An external interposing relay is required for any of the following:

- VA requirements higher than the maximum
- 110 or 220 Vac requirements
- DC power requirements
- Separate transformers used to power the load
(for example, part number 540-147, Terminal Equipment Controller Relay Module)



Application 6552 - Fan Coil Unit 2-Stage Cooling and Electric Heat.

Application 6552 Point Database

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	1	CTLR ADDRESS	99	--	0-255	--	--
AO	2	APPLICATION	6591	--	0-32767	--	--
AO	3	RMTMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-63.75	--	--
AI	{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
BO	{05}	HEAT.COOL	COOL	--	Binary	HEAT	COOL
AO	6	DAY CLG STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	7	DAY HTG STPT	70.0 (21.20888)	DEG F (DEG C)	48-111.75	--	--
AO	8	NGT CLG STPT	82.0 (27.92888)	DEG F (DEG C)	48-111.75	--	--
AO	9	NGT HTG STPT	65.0 (18.40888)	DEG F (DEG C)	48-111.75	--	--
AO	11	RM STPT MIN	55.0 (12.80888)	DEG F (DEG C)	48-111.75	--	--
AO	12	RM STPT MAX	90.0 (32.40888)	DEG F (DEG C)	48-111.75	--	--
AI	{13}	RM STPT DIAL	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
BO	14	STPT DIAL	NO	--	Binary	YES	NO
AI	{15}	AUX TEMP	74.0 (23.495556)	DEG F (DEG C)	37.5-165	--	--
BO	18	WALL SWITCH	NO	--	Binary	YES	NO
BI	{19}	DI OVRD SW	OFF	--	Binary	ON	OFF
AO	20	OVRD TIME	0	HRS	0-255	--	--
BO	{21}	NGT OVRD	NIGHT	--	Binary	NIGHT	DAY
BI	{24}	DI 2	OFF	--	Binary	ON	OFF
BI	{25}	DI 3	OFF	--	Binary	ON	OFF
BI	{26}	DI 4	OFF	--	Binary	ON	OFF
BI	{27}	DI 5	OFF	--	Binary	ON	OFF
BI	{28}	DI 6	OFF	--	Binary	ON	OFF
BO	{29}	DAY.NGT	DAY	--	Binary	NIGHT	DAY
AI	{30}	AI 3	0	PCT	0-102	--	--
AI	{31}	AI 4	74.0 (23.495556)	DEG F (DEG C)	37.5-165	--	--

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	{32}	AOV1	0	VOLTS	0-10.23	--	--
AO	{33}	AOV2	0	VOLTS	0-10.23	--	--
AO	{34}	AOV3	0	VOLTS	0-10.23	--	--
BO	{41}	CLG STG 1	OFF	--	Binary	ON	OFF
BO	{42}	CLG STG 2	OFF	--	Binary	ON	OFF
BO	{43}	HTG STG 1	OFF	--	Binary	ON	OFF
BO	{44}	HTG STG 2	OFF	--	Binary	ON	OFF
BO	{45}	HTG STG 3	OFF	--	Binary	ON	OFF
BO	{46}	FAN	OFF	--	Binary	ON	OFF
BO	{47}	DO 7	OFF	--	Binary	ON	OFF
BO	{50}	DO 8	OFF	--	Binary	ON	OFF
AO	58	MTR SETUP	0	--	0-255	--	--
AO	59	DO DIR. REV	0	--	0-255	--	--
BO	60	CYCLE FAN	NO	--	Binary	YES	NO
AO	63	CLG P GAIN	20.0 (36.0)	--	0-63.75	--	--
AO	64	CLG I GAIN	0.01 (0.018)	--	0-1.023	--	--
AO	65	CLG D GAIN	0 (0.0)	--	0-510	--	--
AO	66	CLG BIAS	0	PCT	0-102	--	--
AO	67	HTG P GAIN	10.0 (18.0)	--	0-63.75	--	--
AO	68	HTG I GAIN	0.01 (0.018)	--	0-1.023	--	--
AO	69	HTG D GAIN	0 (0.0)	--	0-510	--	--
AO	70	HTG BIAS	0	PCT	0-102	--	--
AO	71	CLG 1 ON	40	PCT	0-102	--	--
AO	72	CLG 1 OFF	20	PCT	0-102	--	--
AO	73	CLG 2 ON	80	PCT	0-102	--	--
AO	74	CLG 2 OFF	60	PCT	0-102	--	--
AO	75	CLG STG CNT	2	--	0-255	--	--
AO	76	CLG MIN ON	120	SEC	0-255	--	--
AO	77	CLG MIN OFF	120	SEC	0-255	--	--
AO	{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	{79}	CLG LOOPOUT	0	PCT	0-102	--	--
AO	{80}	HTG LOOPOUT	0	PCT	0-102	--	--
AO	{81}	AVG HEAT OUT	0	PCT	0-409.2	--	--
AO	82	HTG STG MAX	90	PCT	0-102	--	--
AO	83	HTG STG MIN	10	PCT	0-102	--	--

Object Type a)	Object Instance (Point Number)	Object Name (Descriptor)	Factory Default (SI Units) b)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	84	STAGE FAN	10	PCT	0-102	--	--
AO	85	SWITCH LIMIT	5.2	PCT	0-102	--	--
AO	86	SWITCH TIME	10	MIN	0-255	--	--
AO	88	HTG STG CNT	1	--	0-255	--	--
AO	89	HTG STG TIME	10	MIN	0-255	--	--
AO	90	SWITCH DBAND	1.0 (0.56)	DEG F (DEG C)	0-63.75	--	--
AO	{92}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	98	LOOP TIME	5	SEC	0-255	--	--
AO	{99}	ERROR STATUS	0	--	0-255	--	--
AO	122	AI 4 OFFSET	0.0 (0.0)	DEG F (DEG C)	-63.75	--	--
AO	123	AI 5 OFFSET	0.0 (0.0)	DEG F (DEG C)	-63.75	--	--
AO	124	STAT SUPV	0	--	0-255	--	--
AI	{125}	RM CO2	1000	PPM	0-8191	--	--
AI	{126}	RM RH	50	PCT	0-102	--	--
BO	{127}	PPCL STATE	EMPTY	--	Binary	LOADED	EMPTY

1) Object Types are; Analog Input (AI), Analog Output (AO), Binary Input (BI) and Binary Output (BO).

2) A single value in a column means that the value is the same in English units and in SI units.

3) Point numbers that appear in brackets { } may be unbundled at the field panel.

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