Greentrol Automation, Inc.

Installation, Operation and Maintenance Technical Manual

GS-300-N/CO2/RH/T

CO_2, Relative Humidity and Temperature Sensor for RS-485 BACnet and Modbus RTU Applications

Document Name: TM_GS-300-N/CO2/RH/T_R1C

Part Number: 960-0400

TM_GS-300-N/CO2/RH/T_R1C

LIST OF EFFECTIVE AND CHANGED PAGES

Insert latest changed pages (in bold text); remove and dispose of superseded pages.
Total number of pages in this manual is **22.**

Page	Rev *	Description of Change	Date
1,2	**R1C**	**Updated to revision R1C**	**11/28/2011**
1,4, 15	**R1C**	**Removed OEM references**	**11/28/2011**
19	R1B	Added Modbus Data detail (8/1/No parity)	09/26/2011
1 - 22	R1A	Initial Document Release	04/19/2010

* R1A indicates an original page without change

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Figure 1. *GreenTrol* GS-300 - CO_2/RH/Temperature Wall Mount BACnet/Modbus RTU Sensor

OVERVIEW

GreenTrol's GS-300-N/CO2/RH/T is an innovative wall mount CO_2/relative humidity (RH)/temperature sensor that provides precision measurement and BACnet® MS/TP or Modbus® RTU communications interface in a single device packaged for interoperability with modern building automation systems (BAS). The GS-300 is ideal for maintenance of IAQ in variable occupancy spaces where direct occupant counting is not well suited. The GS-300 is key in the acquisition of LEED®[1] credit points for densely occupied spaces to satisfy the Ventilation Rate Procedure (VRP) of ASHRAE®[2] Standard 62.1-2007, and in reducing overall energy consumption.

At the heart of the GS-300 is ***GreenTrol***'s proprietary microcontroller based sensor package featuring a patented, extremely stable CO_2 measurement system that requires no maintenance or calibration during its normal service life. The patented self-calibration feature virtually eliminates manual calibration in applications where indoor CO_2 levels drop to normal outdoor background levels during unoccupied periods (e.g. during evening hours).

The integral RS-485 BACnet MS/TP and Modbus RTU compatible communications interface includes options for setting address, device instance and baud rate. Coupled with complementary precision relative humidity and temperature sensors, the GS-300 provides an economical, simple and intelligent alternative to harnessing and coordinating the network operation of individual CO_2, humidity and temperature sensor devices.

Simple field configuration is accomplished by DIP switches on the main circuit board and via the BACnet and Modbus RTU interface.

ADVANCED TECHNOLOGY

- Single BACnet/Modbus RTU device features integrated complement of precision sensing elements for CO_2, RH and Temperature measurement.
- Continuous CO_2 self-calibration feature eliminates routine maintenance.
- Integral RS-485 BACnet MS/TP and Modbus RTU interface for interoperability with common BAS devices.
- Microprocessor-based electronics with industrial grade integrated circuits.
- Convenient DIP switch user interface for simple field configuration.

Network Connectivity Solutions

BACnet®

Modbus®

TM_GS-300-N/CO2/RH/T_R1C

[1] LEED®: Leadership in Energy and Environmental Design - a Green Building Rating System that is a nationally accepted benchmark for the design, construction, and operation of high performance "green" buildings.

[2] ASHRAE®: American Society of Heating, Refrigerating and Air Conditioning Engineers - an international technical society for heating, ventilation, air-conditioning, and refrigeration.

SPECIFICATIONS

Sensor Complement
- Advanced precision sensing elements for CO_2, relative humidity and temperature measurement via RS-485 BACnet MS/TP and Modbus RTU communication interface

CO_2 Sensor Performance
- Technology: Non Dispersive Infrared (NDIR), gold plated optics,diffusion sampling with patented self- calibration algorithm
- CO_2 Range: 400-2,000 ppm (factory default)
  Adjustable to 10,000 ppm
- CO_2 Accuracy: 500ppm ±35ppm
  800ppm ±60ppm
  1000ppm ±75ppm
  1200ppm ±90ppm

  *Accuracy shown at 77°F (25°C)
- CO_2 Stability: <2% of FS over life of sensor
  (15 years typical)

Relative Humidity Sensor Performance
- Technology: Planar Capacitive Polymer
- RH Range: 0 to 100% RH, non condensing
- RH Accuracy: ±2% @ 20% to 80% RH, 77°F (25°C)
  ±3%: <20% to >80% RH, 77°F (25°C)
- RH Resolution: 0.4% RH

Temperature Sensor Performance
- Technology: Integral band gap PTAT
- Range: –58°F to 302°F (–50°C to 150°C)
- Accuracy: ±1.08°F at 77°F (±0.6°C at 25°C)
- Resolution: 0.36°F (0.2°C)

Signal Processing: Microprocessor-based

Power Supply Performance
- Technology: Integral power supply powered by external 24 VAC (22.8-26.4VAC), 50/60 Hz source.
- Brownout Watchdog protection reset circuit
- Overvoltage, overcurrent, and surge protection

Enclosure
- Attractive low profile wall mount enclosure compatible with standard single-gang electrical box, and surface mount applications.

Dimensions
- 4.650 x 3.250 x 1.090 in (118.11 x 82.55 x 27.69 mm)

User Interface
- Simple DIP switch selection

Output to Host Controls
- RS-485 BACnet MS/TP or Modbus RTU
- Baud rate: Selectable 76,800, 38,400, 19,200, 9,600
  Default: RS-485 BACnet MS/TP 76,800
  Default: Modbus RTU: 19,200

System Diagnostics
- On board LED status indicator

Environmental Limits
- Operating Temperature: 32° F to 122° F
  (0° C to 50° C)
- Moisture: 0 to 95% RH, noncondensing

Limited Warranty
- *GreenTrol* products are warranted for 12 months from shipment as described in the Terms and Conditions of Sale.

ORDERING GUIDE

Order *GreenTrol* model number **GS-300-N/CO2/RH/T**.

TM_GS-300-N/CO2/RH/T_R1A

GS-300 PLACEMENT CONSIDERATIONS

Figure 2 details the mechanical outline dimensions of the GS-300. The location selected for the GS-300 is important to ensure accurate readings that are representative of the area to be monitored. Preferred mounting locations are:

- On an interior wall that has no direct sunlight exposure and is near (but not directly in the airstream of) a return air duct. In areas with multiple return air ducts, locate the sensor at a point between them, observing the same precautions. Avoid areas with poor air circulation, such as behind doors or in alcoves where temperature fluctuations and moisture accumulation can affect sensor performance. Also, avoid areas that may expose the GS-300 to direct occupant breathing (e.g. water coolers, coffee machines, etc.).
- At a height of 4 to 6 feet from floor level, and at least 3 feet from a corner and 2 feet from an open doorway.
- Away from the direct airflow of windows, doorways, halls or other heating and cooling sources.
- Away from other equipment that could affect the temperature of the sensor.

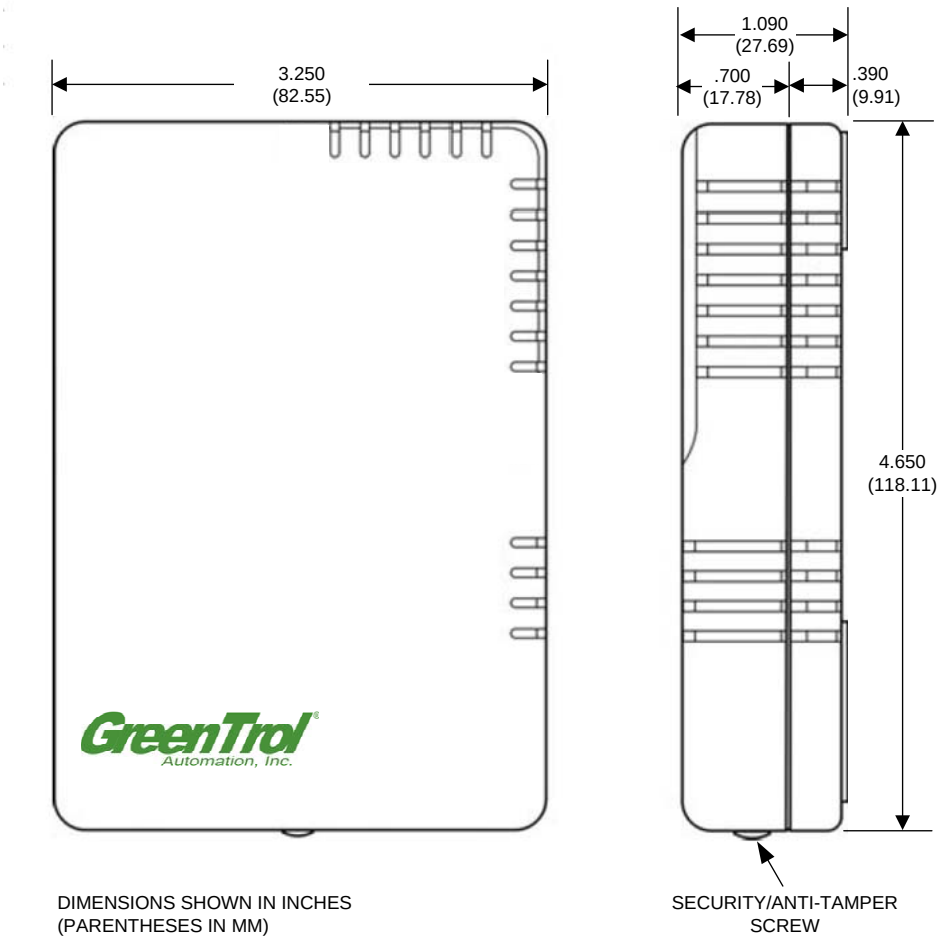

Figure 2. GS-300 Outline Dimensions

TM_GS-300-N/CO2/RH/T_R1A

GS-300 INSTALLATION

Read and understand all installation instructions prior to installing the GS-300. The GS-300 is designed for surface mount installation, or for installation onto a standard (field supplied) single gang electrical junction box. Installation and wiring of the GS-300 must be accomplished in accordance with all local electrical and mechanical codes to ensure safety and compliance. Refer to Figure 2 for GS-300 outline dimensions, and Figure 3 for mounting hole locations.

CAUTION

Deactivate 24 VAC power source until all connections to the GS-300 are complete.

When multiple devices are powered from a common 24VAC power source, ensure that all devices are wired in phase with 24VAC power at L1, and 24VAC return at L2! Damage will occur to the GS-300 and/or other devices if this caution is not observed.

The GS-300 contains electrostatic discharge (ESD) sensitive components. To prevent damage, observe ESD precautions when handling the instrument. Failure to comply can result in equipment damage.

The installed location of the GS-300 is critical for proper performance. Refer to the previous GS-300 PLACEMENT CONSIDERATIONS section of this document for additional recommendations.

Ensure that adequate clearance exists to permit installation and wiring of the GS-300, and to allow for access to the board mounted instrument configuration switches.

1. Carefully open the GS-300 package and inspect for damage. If any damage is noted, immediately file a claim with carrier.
2. Determine the GS-300 installation location as indicated on the engineer's plans, or determine placement using the previous guidelines.
3. Install GS-300 wiring to the desired location, observing the previous placement considerations. Wiring may be routed directly through wall for surface mounting of the GS-300, or may be brought through a junction box depending upon local requirements. All wiring must be accomplished in accordance with local regulations and national codes.
4. Carefully remove the cover of the GS-300. Depress the enclosure tab at the bottom of the enclosure, and swing the cover upward to disengage it from the base. The GS-300 includes two mounting screws for standard electrical junction box installations, and one security/tamper resistant screw to secure the cover. After GS-300 installation and configuration is complete, this screw may be installed at the bottom of the enclosure to prevent inadvertent or unauthorized opening of the enclosure.
5. Using the GS-300 base as a template, mark the location for the wiring pass-through slot and for the mounting screws as shown in Figure 3. For mounting directly to a single-gang electrical junction box, proceed to step 8.
6. Drill holes sized for suitable wall anchors at the mounting locations marked, and install the wall anchors.
7. Drill another hole suitable to pass the GS-300 wiring through the wall at the marked wiring pass-through slot location. Pull wiring through hole, and allow 6 inches for wiring of the GS-300.
8. Pass GS-300 wiring through the rear pass-through opening of the GS-300 base and mount the instrument at the desired location using appropriate hardware for the mounting method selected. Refer to the proceeding sections of this document for initial instrument set up and normal operation.

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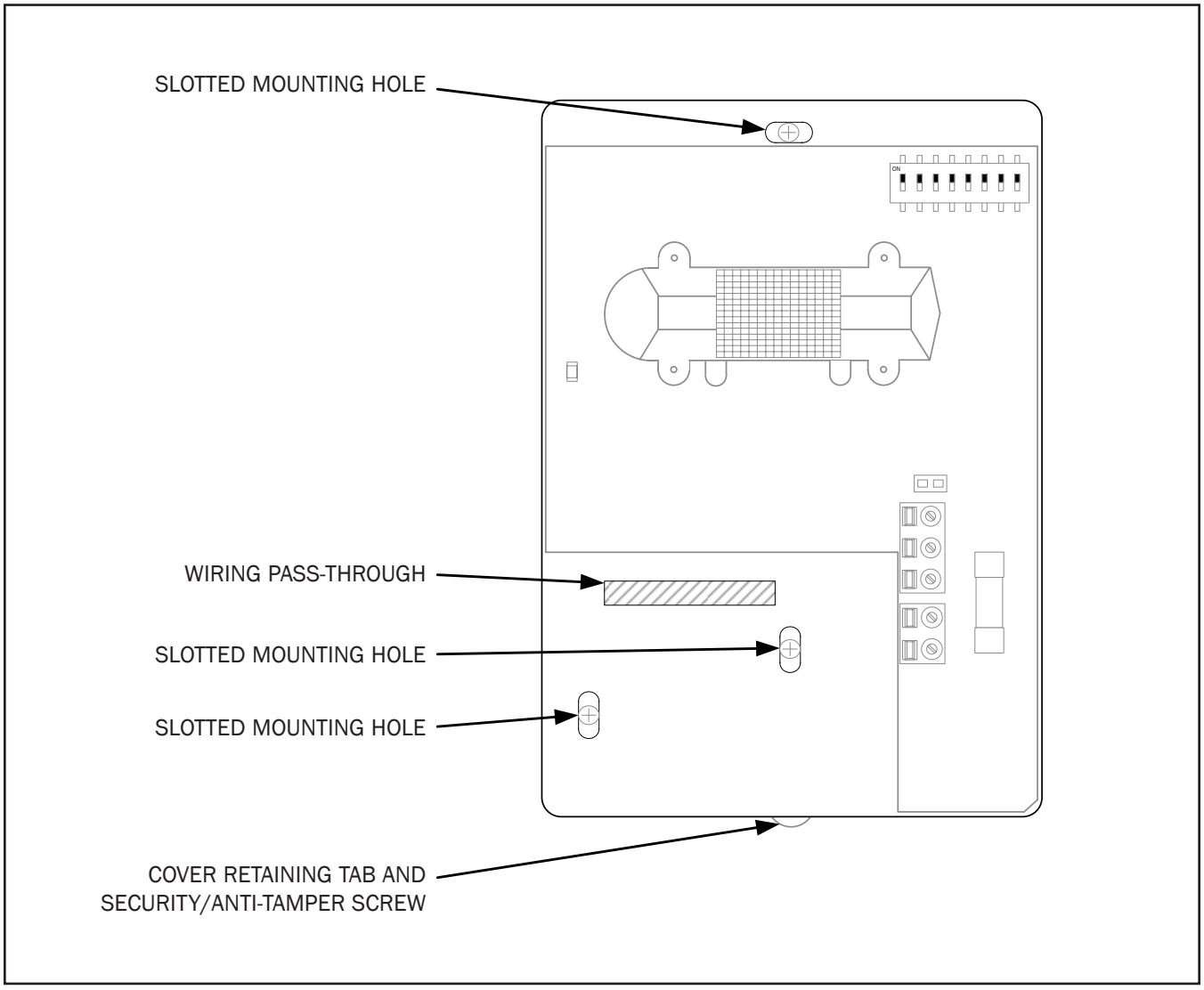

Figure 3. Marking Locations for Installation

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GS-300 INTERCONNECTIONS

CAUTION

Deactivate 24 VAC power source until all connections to the GS-300 are complete.

When multiple devices are powered from a common 24VAC power source, ensure that all devices are wired in phase with 24VAC power at L1, and 24VAC return at L2! Damage will occur to the GS-300 and/or other devices if this caution is not observed.

The GS-300 contains electrostatic discharge (ESD) sensitive components. Observe ESD precautions when handling the instrument to prevent damage. Failure to comply can result in equipment damage.

All connections are accomplished on the GS-300 circuit board at terminal blocks J2 and J3 as shown in Figures 4 and 5.

1. Connect 24VAC power to the GS-300 at terminal block J3 terminals L1 and L2. When powering multiple network devices from a common source, observe 24VAC phasing (24VAC to L1, return at L2 - see Caution above).

2. The L2 post of the 24VAC J3 terminal block can be connected to earth ground according to the following:

CAUTION

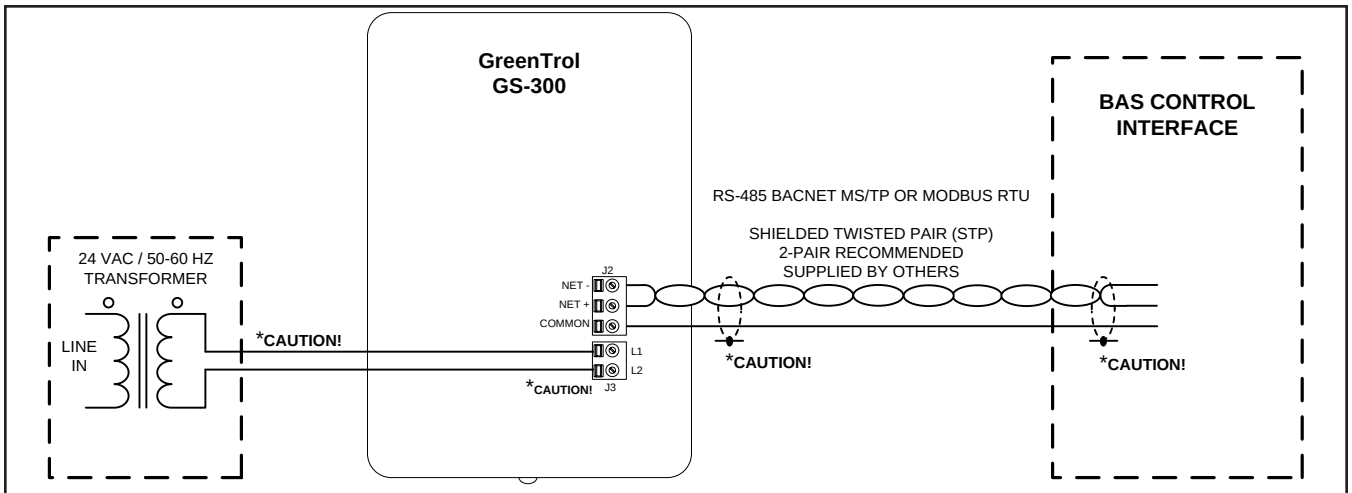
Damage to network devices may occur if L2 of the 24VAC J3 terminal block is connected to earth ground and the RS485 network is not earth grounded.

a) If the RS485 network connection for the GS-300 is ground referenced to earth, the L2 post of the 24VAC J3 terminal block can also be connected to a wire that is ground referenced to earth.

b) If the RS485 network connection for the GS-300 is not ground referenced to earth, then the L2 post of the 24VAC J3 terminal block must not be connected to a wire ground referenced to earth, as damage to other network devices may occur.

3. Connect the RS485 network connections at terminal block J2 as follows:

J2 Terminal Block	Network Connection
-	NET -
+	NET +
COM	NETWORK COMMON



*** CAUTION!**

When multiple devices are powered from a common 24VAC power source, ensure that all devices are wired in phase with 24VAC power at L1, and 24VAC return at L2! Damage will occur to the GS-300 and/or other devices if this caution is not observed.

On RS-485 networks that are ground referenced to earth, GS-300 terminal L2 **may** also be connected to a wire ground referenced to earth. However, on RS-485 networks that are **not** ground referenced to earth, terminal L2 **must not** be connected to a wire ground referenced to earth. Damage may occur to the GS-300 or other network devices if this caution is not observed.

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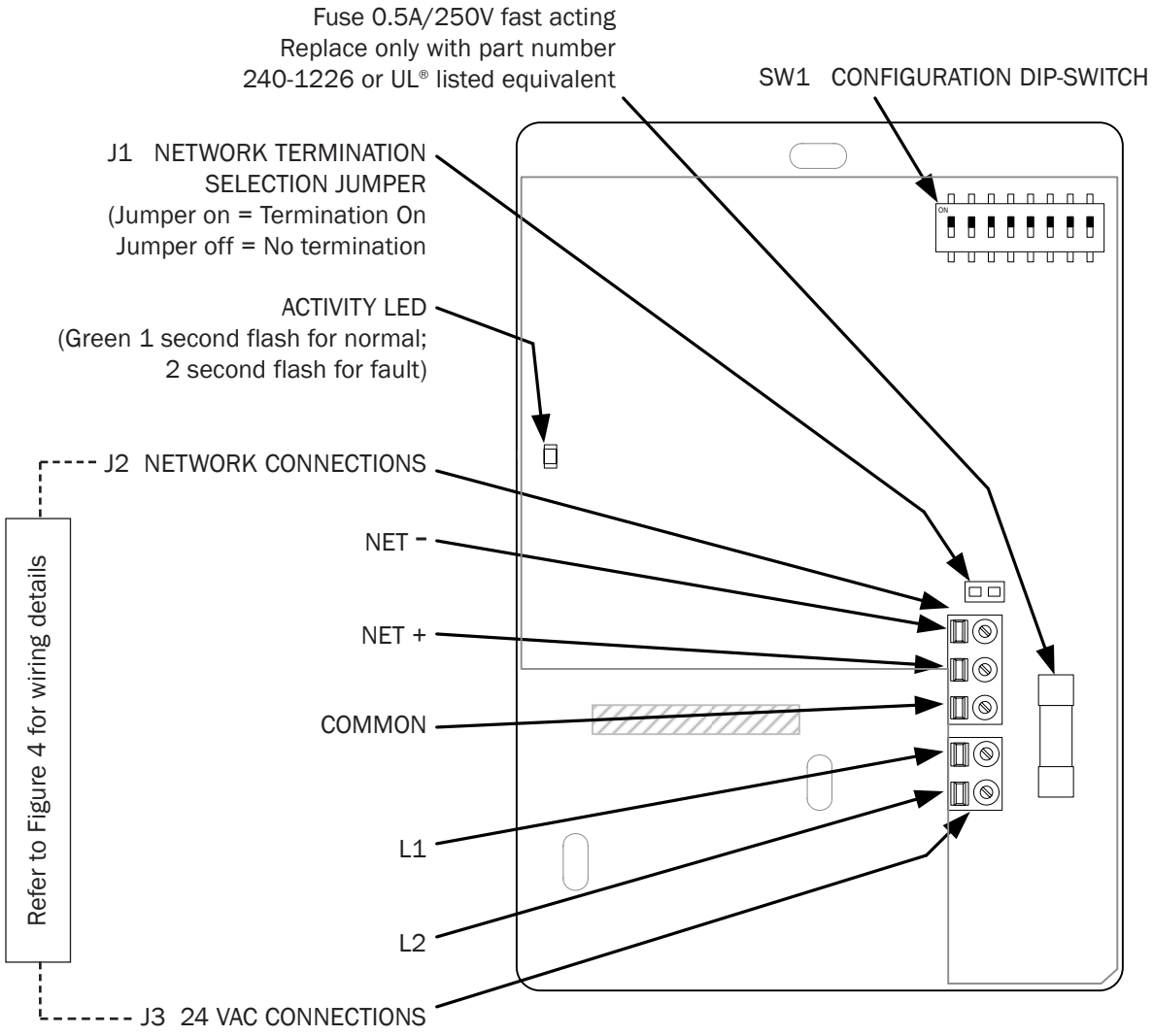
Figure 4. GS-300 Typical Wiring Diagram to BAS Control Interface



CAUTION

When multiple devices are powered from a common 24VAC power source, ensure that all devices are wired in phase with 24VAC power at L1, and 24VAC return at L2! Damage will occur to the GS-300 and/or other devices if this caution is not observed.

Figure 5. GS-300 Interior Detail View

TM_GS-300-N/CO2/RH/T_R1A

GS-300 SET UP

The GS-300 is shipped from the factory for BACnet operation. If Modbus operation is desired, proceed to the **GS-300 MODBUS CONFIGURATION** section of this document.

GS-300 BACnet CONFIGURATION

The following paragraphs detail the initial set up instructions for the GS-300 when using BACnet device operation. Refer to Appendix A - GS-300 BACnet Device Operating Parameters for additional detail.

J1 - GS-300 RS485 Network Termination Selection

The GS-300 includes a network termination selection jumper at J1 (shown in Figure 4) to permit device installation at any point on an RS-485 network. When the GS-300 is located at either end of an RS-485 network or segment, it is recommended that the jumper at J1 be installed across both pins of J1. When the GS-300 is located at any other point on the RS-485 network, no termination is recommended, and the jumper should not be installed across J1.

Setting GS-300 Time

The internal GS-300 clock must be set prior to placing the instrument in operation, or in the event of loss of power to the instrument. The GS-300 clock is used to establish the lowest CO_2 level.

Note:

When initially powered on (or following an interruption of 24 VAC power), the GS-300 internal time is set at 00:00:00 (midnight). The GS-300 will begin recording CO_2 PPM levels based on a 24-hour period starting at 00:00:00 and ending at 23:59:59. In order for the CO_2 sensor to record CO_2 levels accurately, the correct time must be entered.

The GS-300 time setting must be re-synchronized with the network following a power loss or interruption. For BACnet applications, a timesync command (see Appendix A) must be sent to the GS-300 using appropriate network software. For Modbus applications, the current time (in hours and minutes) must be reset using appropriate network software at registers 30025 and 30026 respectively (see Appendix B).

SW1 - GS-300 Configuration DIP Switch Settings

The configuration DIP switch contains eight separate dual-position switches in a dual inline package (DIP) as shown in Figures 5 and 6. These switches allow for setting the following GS-300 network parameters:

- Setting the MAC Address/Slave ID - using Switches 1 through 7
- Setting BACnet Device Object Instance Number (if the same as the MAC Address) - using Switch 8
- Setting BACnet Baud Rate - using Switches 1 through 4
- Restoring Defaults - using Switches 1-8
- Enabling Modbus network operation - using Switches 1 through 4
- Performing CO_2 Calibration - using Switches 1-8

NOTE:

Prior to initializing the GS-300, the MAC address and the baud rate parameters must be assigned.

The following paragraphs provide detail for setting the network parameters using Configuration DIP Switch SW1.

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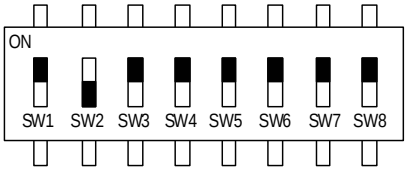

Figure 6. SW1 - Configuration DIP Switch Detail View

Setting the MAC Address

The default GS-300 MAC Address is set at the factory for a value of 2. If it is necessary to change the MAC address use switches 1 through 7 of SW1 to set the MAC Address to set any network address between 1 and 127 as follows:

1. Deactivate 24VAC power to the GS-300.
2. Set SW1 switches 1-7 to the desired address as shown in Figure 7. Record the new MAC address value for future reference.
3. Reapply 24VAC power to the GS-300. After a short delay (approximately 20 seconds) the new MAC address is now active.

MAC ADDRESS SETTINGS

SW1 DIP Switches 1-7

DIP Switch Number and Position								Network
1	2	3	4	5	6	7	8	Address
off	off	off	off	off	off	off	off	0
on	off	off	off	off	off	off	off	1
off	on	off	off	off	off	off	off	2
on	on	off	off	off	off	off	off	3
⬇	⬇	⬇	⬇	⬇	⬇	⬇	off	⬇
on	on	on	on	on	on	on	off	127

Only SW1 Switches 1 through 7 are used to set the MAC Address - See text for detail.

Figure 7. MAC Address Selection Settings

NOTE:

When GS-300 configuration is completed, confirm that the new MAC address has been set correctly using appropriate BACnet software

Changing BACnet Device Object Instance Number

The BACnet Device Object Instance Number is set at the factory to match the factory default address of 2. If necessary, the BACnet Device Object Instance Number can be set to match the user assigned MAC address as follows:

1. Deactivate 24VAC power to the GS-300.
2. Slide DIP Switch 8 to the ON position.
3. Restore 24VAC power to the GS-300. Allow a short delay (approximately 20 seconds) for the new BACnet Device Object Instance Number to be recognized.
4. Restore DIP Switch 8 to the OFF position.

The BACnet Device Object Instance Number can also be set to another value that does not match the MAC address by using suitable BACnet software to write to the Device Object Identifier property of the Device Object. Refer to Appendix A for additional detail.

Setting the MS/TP Baud Rate

The GS-300 is shipped from the factory for BACnet operation with a baud rate of 76,800bps. The baud rate can be changed to 38,400, 19,200 or 9,600bps. Changes can be accomplished remotely over the network using BACnet Analog Value AV4 (Table A3), or locally at the GS-300 by using internal DIP Switch SW1 as follows:

1. Record the currently assigned MAC Address (SW1 switches 1 through 7 - See Figure 7).
2. Set the desired baud rate using Address Switches 1 through 4 as shown in Figure 8.

Baud Rate Selection
SW1 DIP Switches 1-4

ADDRESS DIP Switch Number/Position								MS/TP
1	2	3	4	5	6	7	8	Baud Rate
on	off	off	off	X	X	X	X	76,800
off	on	off	off	X	X	X	X	38,400
off	off	on	off	X	X	X	X	19,200
off	off	off	on	X	X	X	X	9,600

Only SW1 Switches 1 through 4 are used to set the Baud Rate - See text for detail.

Figure 8. Baud Rate Selection Settings

3. Set DIP Switch 8 to the ON position. Allow a short delay (approximately 20 seconds) for the new baud rate to be recognized.
4. Restore DIP Switch 8 to the OFF position.
5. Restore DIP switches 1-7 to the MAC address recorded in step 1.

Restoring Factory Default Settings

The following procedure can be used to restore the factory default settings to the GS-300:

1. If the current MAC Address will be reused, record the currently assigned address (SW1 switches 1 through 7 - see Figure 7).
2. Deactivate 24VAC power to the GS-300.
3. Set all 8 of the DIP switches (1-8) to the ON position.
4. Restore 24VAC power to the GS-300. Allow a short delay (approximately 20 seconds) for the factory default settings to be recognized.
5. Deactivate 24VAC power to the GS-300.
6. Set all 8 of the DIP switches (1-8) to the OFF position.
7. Restore DIP switches 1-7 to the MAC address recorded in step 1.
8. Restore 24VAC power to the GS-300 to return it to service with factory default settings.

GS-300 MODBUS CONFIGURATION

The GS-300 is preset at the factory for BACnet network operation. To set the GS-300 for Modbus network operation, perform the following steps. Refer to Appendix B - GS-300 MODBUS Device Operating Parameters for available register values and settings.

1. The default network address is set at the factory for a value of 2. Any value between 1 and 127 can be assigned for the GS-300 using Configuration DIP Switch SW1 as outlined in the **Setting the MAC Address** paragraph of this document. If the current network address will be reused, record the current settings of DIP switches 1 through 7.
2. With the GS-300 powered on, set Configuration DIP switches 1 through 4 to the ON position.
3. Toggle DIP switch 8 to the ON position for 5 seconds, and then back to OFF.
4. Restore DIP switches 1-7 to the network address recorded in step 1.
5. The GS-300 is now set for Modbus operation with a baud rate of 19,200bps. If necessary, the baud rate can be changed as outlined previously in the **Setting the Baud Rate** paragraph of this document.
6. Configure the necessary Modbus register values as outlined in Appendix B.

GS-300 START-UP

The following procedure is intended for initial start up of the instrument.

1. Confirm that the GS-300 is installed and wired properly as outlined in **GS-300 INSTALLATION** and GS-300 **INTERCONNECTIONS** sections of this document.
2. Confirm that network termination, address, baud rate and device object instance number (as applicable) have all been properly set as outlined previously in the **GS-300 BACnet CONFIGURATION** or **GS-300 MODBUS CONFIGURATION** sections of this document.
3. Apply 24VAC power to the GS-300. After a brief initialization (approximately 20 seconds) observe that the green Activity LED flashes on for 1 second, then OFF for one second indicating normal operation.
4. Install GS-300 cover by engaging the small molded hinges at the top of the cover with the base, and then gently swinging the cover downward into the closed position. The cover will latch via the tab located at the bottom of the enclosure. If required, install Security/Tamper resist screw at the bottom of the GS-300 enclosure (as shown in Figure 3).
5. Using suitable software, set current GS-300 Time (refer to Appendices A and B for BACnet and Modbus network details).
6. Confirm network device settings and operation using Appendices A and B for BACnet and Modbus applications respectively.
7. The GS-300 is now ready for normal network operation.

GS-300 NORMAL OPERATION

During normal operation of the GS-300, no further user activity is required.

The GS-300 features a green “Activity” light emitting diode (LED - see Figure 5) that flashes to indicate the operating status of the instrument. Following application of 24VAC power and a brief instrument initialization of approximately 20 seconds, the LED will begin to flash.

During normal GS-300 operation the Activity LED will continuously flash ON for 1 second, then OFF for 1 second.

During GS-300 fault conditions, the LED will continuously flash ON for 2 seconds, and then OFF for 2 seconds.

Refer to Appendix A and Appendix B for BACnet and Modbus device network values available during operation of the GS-300.

GS-300 MAINTENANCE

In most HVAC environments, periodic maintenance and calibration are not required or recommended. If calibration of the CO_2 sensor is required, refer to the applicable procedures that follow for BACnet or Modbus CO_2 Sensor Calibration.

The GS-300 features a patented ABC Logic™ (Automatic Background Calibration) CO_2 self-calibration system that virtually eliminates the need for manual calibration in applications where indoor CO_2 level drop to outside ambient conditions (approximately 400 ppm) at least three times in a 14 day period, typically during unoccupied periods. ABC Logic™ ensures that the CO_2 sensor will typically reach its operational accuracy after 25 hours of continuous operation at a condition that it was exposed to ambient reference levels of air at 400 ppm ±10 ppm CO_2. With ABC Logic enabled, the CO_2 sensor will perform to specified accuracy, provided it is exposed to the reference value at least four times in 21 days, and the reference value is the lowest concentration to which the sensor is exposed. All GS-300 sensors are set at the factory with the ABC Logic™ self calibration feature turned ON. In facilities that are continuously occupied for 24 hours per day, or where there could be significant sources of non-occupant related CO_2 such as greenhouses, breweries and other industrial and food processing applications, the ABC Logic™ should be turned OFF. Refer to Appendices A and B for the specific BACnet and Modbus network command options to disable the ABC Logic feature.

BACnet CO_2 Sensor Calibration

It is not necessary to recalibrate the CO_2 sensor after installation. The ABC Logic algorithm will begin recording C02 data immediately, and after 24 hours will adjust sensor measurements to ensure accurate and consistent readings. If desired, the CO_2 sensor may be calibrated at a single point using a pre-mixed reference CO_2 gas, or using ambient air with CO_2 measured by a reference sensor at CO_2 levels of 0-10,000PPM. Perform calibration in a stable room temperature environment where there are no significant air drafts or temperature variations during the procedure.

CAUTION

A suitable pressure regulator must be provided to ensure that reference gas supply is maintained at 7 PSI. Damage to the CO_2 sensor will occur if excessive pressure is applied to the sensor ports.

1. Ensure that 24VAC power is applied to the GS-300 during calibration of the instrument.
2. Set the reference gas regulator adjustment knob to the fully OFF position.
3. Remove the port covers from the GS-300 CO_2 calibration ports (Figure 9) and attach suitable tubing from the reference gas regulator to either port.
4. Check all reference gas connections to ensure there are no leaks, and no kinks in the tubing to the GS-300 port.
5. Record the current network address of the GS-300 (SW1 DIP switches 1-7).
6. Apply 24VAC power to the GS-300 and allow it to stabilize.
7. Set DIP switches 1-4 to OFF, and switches 5-8 to the ON position. The GS-300 is now in Calibration mode.
8. Set reference gas supply flow ON and ensure that pressure of 7PSI is applied to the GS-300 sensor port.
9. Allow the reference gas to flow for 1 minute.
10. Using BACnet software, write the value of the reference gas CO_2 level in PPM to AV5 (Single Point PPM).
11. During the next 3 minutes, as the GS-300 continues calibration, observe the GS-300 CO_2 AV5 value as follows:
    a) An AV5 value of -1 value indicates that the new calibration value has been successfully written.
    b) An AV5 value of -2 value indicates that calibration has been accomplished successfully.
    c) An AV5 value of -3 value indicates that calibration was not successful. If this occurs, restart the calibration procedure at step 9.
12. After the calibration has been completed successfully, restore the network address settings at DIP switches 1-7 to the values recorded in Step 5, and then, set switch 8 to the OFF position to restore GS-300 normal operation.
13. Re-install the port covers on the GS-300 CO_2 sensor module.

This completes BACnet CO_2 sensor calibration for the GS-300.

Modbus CO_2 Sensor Calibration

Calibration of the CO_2 sensor in a Modbus network environment is the same as previously described for BACnet, however use suitable Modbus software to permit access and modification of register 30023 for the CO_2 Sensor Calibration 2-byte register value.

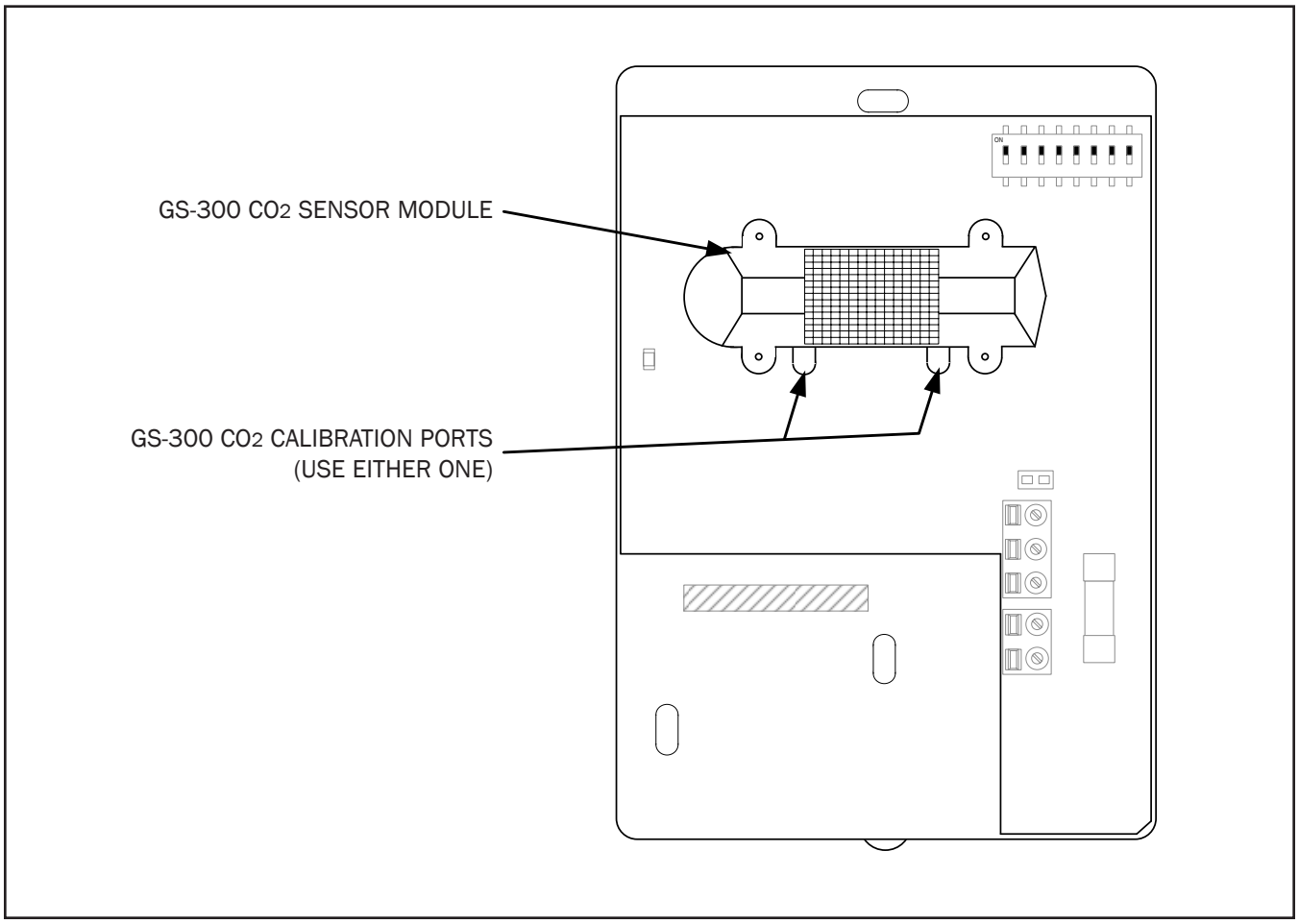

Figure 9. GS-300 CO_2 Calibration Ports

BACnet NETWORK DEVICE OPERATING PARAMETERS

Appendix A contains a detailed listing of all GS-300 BACnet network variables and values.

MODBUS NETWORK DEVICE OPERATING PARAMETERS

Appendix B contains a detailed listing of all GS-300 Modbus network variables and values.

GREENTROL STANDARD LIMITED PARTS WARRANTY

Greentrol products are warranted for 12 months from shipment. Product will be repaired/replaced free of charge as described in the Terms and Conditions of Sale.

APPENDIX A - BACnet NETWORK DEVICE OPERATING PARAMETERS

GS-300 BACNET OVERVIEW

The BACnet objects associated with the GS-300 permit display of current values, device configuration, and calibration of the CO_2 sensor. The BACnet object categories for the GS-300 (below) are described in the following paragraphs.

BACnet Device Object
BACnet Analog Input (AI) Objects
BACnet Analog Value (AV) Objects
BACnet Binary Value Objects

BACnet Device Object

The device object allows configuration of the GS-300. Object properties can be specified as shown in Table A1.

Table A1. BACnet Device Object

BACnet Object	Description
GS-300	This object allows the operator to specify the following: Device name Device location Time and Date Universal Time Coordinated Offset APDU properties MS/TP properties Object Identifier

BACnet Analog Input (AI) Objects

The analog input BACnet objects permit display of the present values for the items detailed in Table A2. In addition, analog input change of value (AI COV) subscriptions for these objects can be configured as follows:

AI COV: A confirmed or unconfirmed COV (Change of Value) notification can be subscribed to for each analog input object (below). The COV increment value can be set through each AI.

Table A2. BACnet Analog Input (AI) Objects

BACnet Object	Default Present-Value	Range	Description
CO2 PPM (AI1)	Display Only	NA	Displays the present value of CO_2 in parts per million.
RH (AI2)	Display Only	NA	Displays the present value of relative humidity in percent.
Temperature (AI3)	Display Only	NA	Displays the present value of ambient room temperature in degrees F (can be changed to degrees C if desired).
Lowest PPM (AI4)	Display Only	NA	Displays the lowest CO2PPM value for the past 24 hour period. Any value written to this object will reset the lowest PPM to the present CO_2 reading.

BACnet Analog Value Objects

The analog value BACnet objects allow for configuration of variables that affect instrument operation and individual sensor measurement accuracy.

Table A3. BACnet Analog Value Objects

BACnet Object	Default Present-Value	Range	Description
Elevation (AV1)	0 feet	0-5000 feet	This object allows specifying the elevation that the GS-300 is installed in feet above sea level.
CO2 Sample Rate (AV2)	10 seconds	1-600 seconds	This register specifies how often the CO_2 sensor is sampled in seconds.
Baud Rate (AV3)	76,800	Optional	This object allows specifying the RS485 Baud rate.
Single Point PPM (AV4)	-1	0 to 10000 ppm	This object allows calibration of the CO_2 sensor.
ABC Logic Status (AV5)	1	Either 1 or 2	Writing a '1' to this will turn the ABC Logic™ on, writing a 2 will turn it off. This data is non-volatile and saved by the CO_2 module.
CO2 Gain (AV6)	1	0 - 100	This object allows specifying a gain to the raw CO_2 sensor reading or to the GreenTrol factory calibration gain adjustment setting.
Relative Humidity Gain (AV7)	1	0 - 100	This object allows specifying a gain to the raw Relative Humidity sensor reading or to the GreenTrol factory calibration gain adjustment setting.
Temperature Gain (AV8)	1	0 - 100	This object allows specifying a gain to raw Temperature sensor reading or to the GreenTrol factory calibration gain adjustment setting.
CO2 Offset (AV9)	0	+/-10,000	This object allows specifying an offset to raw CO_2 sensor reading or to the GreenTrol factory calibration offset adjustment setting.
Relative Humidity Offset (AV10)	0	+/-100	This object allows specifying an offset to raw Relative Humidity sensor reading or to the GreenTrol factory calibration offset adjustment setting.
Temperature Offset (AV11)	0	+/-200	This object allows specifying an offset to raw Temperature sensor reading or to the GreenTrol factory calibration offset adjustment setting.

BACnet Binary Value Objects

The binary value BACnet objects allow for application of the GreenTrol factory calibration values for individual sensor gain and offset factors.

Table A4. BACnet Binary Value Objects

BACnet Object	Default Present-Value	Range	Description
Factory CO2 Gain/Offset Status (BV1)	Active	Active/ Inactive	When this object is set to Active, the CO_2 sensor will operate with the GreenTrol factory calibration values for gain and offset.
Factory Relative Humidity Gain/Offset Status (BV2)	Active	Active/ Inactive	When this object is set to Active, the Relative Humidity sensor will operate with the GreenTrol factory calibration values for gain and offset.
Factory Temperature Gain/Offset Status (BV3)	Active	Active/ Inactive	When this object is set to Active, the Temperature sensor will operate with the GreenTrol factory calibration values for gain and offset.

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APPENDIX B -
MODBUS NETWORK DEVICE OPERATING PARAMETERS

GS-300 Modbus Register Overview

For Modbus, all communication is 8 Data Bits, 1 Stop Bit and no parity. The Modbus registers associated with the GS-300 permit display of current values, device configuration, and calibration of the CO_2 sensor. They are grouped into the following categories:

Read-only registers consisting of three 4-byte floats (high word/low word) detailed in Table B2.
Read/write registers consisting of seven 4-byte floats (high word/low word) detailed in Table B3.
Read/write 2-byte registers detailed in Table B4.

Table B1 identifies the GS-300 supported standard Modbus command functions.

Table B1. GS-300 Supported Standard Modbus Command Functions

Command	Description
04	Read input registers (refer to Tables B2 through B4).
06	Write registers (refer to Tables B2 through B4).
16	Write multiple registers (refer to Tables B2 through B4).

Modbus 4-Byte Floats - Read Only Properties

The 4-byte floats with read only properties permit display of each of the three sensors values in the GS-300 as detailed in Table B2.

Table B2. Modbus 4-Byte Floats - Read-Only Properties

Name	Address	Default Register Value	Range	Description
Present CO2 PPM	30001 - 30002	Display Only	NA	These paired registers contain the present CO_2 parts per million.
Present Relative Humidity	30003 - 30004	Display Only	NA	These paired registers contain the present relative humidity percentage.
Present Temperature	30005 - 30006	Display Only	NA	These paired registers contain the present ambient room temperature in degrees F.

Modbus 4-Byte Floats - Read/Write Properties

The 4-byte floats with read and write properties detailed in Table B3 allow the configuration of gain and offset variables that affect the measurement accuracy of the three sensors.

Table B3. Modbus 4-Byte Floats - Read/Write Properties

Name	Address	Default Register Value	Range	Description
Lowest CO2PPM	30007 - 30008	Present Value	Any Value	These paired registers allow the display of (or change to) the lowest CO_2PPM value in the past 24 hour period. Any value written to this object will reset the Lowest CO_2 PPM to the Present CO2 PPM value.
CO2 Gain	30009 - 30010	1	0 - 100	These paired registers allow specifying a gain value to the raw CO_2 sensor reading or to the GreenTrol factory gain adjustment setting.
Relative Humidity Gain	30011 - 30012	1	0 - 100	These paired registers allow specifying a gain value to the raw Relative Humidity sensor reading or to the GreenTrol factory gain adjustment setting.
Temperature Gain	30013 - 30014	1	0 - 100	These paired registers allow specifying a gain value to the raw Temperature sensor reading or to the GreenTrol factory gain adjustment setting.
CO2 Offset	30015 - 30016	0	+/-10,000	These paired registers allow specifying an offset value to the raw CO_2 sensor reading or to the GreenTrol factory offset adjustment setting.
Relative Humidity Offset	30017 - 30018	0	+/-100	These paired registers allow specifying an offset value to the raw Relative Humidity sensor reading or to the GreenTrol factory offset adjustment setting.
Temperature Offset	30019 - 30020	0	+/-200	These paired registers allow specifying an offset value to the raw Temperature sensor reading or to the GreenTrol factory offset adjustment setting.

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Modbus 2-Byte Registers - Read/Write Properties

The 2-byte registers with read and write properties detailed in Table B4 allow configuration of the variables that affect the accuracy of the three sensors.

Table B4. Modbus 2-Byte Registers - Read/Write Properties

Name	Address	Default Register Value	Range	Description
Elevation of GS-300	30021	0 feet	0-5000 feet	This register allows specifying the elevation that the GS-300 is installed in feet above sea level.
CO2 Sample Rate	30022	10 seconds	1-600 seconds	This register specifies how often the CO_2 sensor is sampled in seconds.
CO2 Sensor Calibration	30023	-1	0 to 10000 ppm	This register allows calibration of the CO_2 sensor.
CO2 Sensor ABC Logic Disable	30024	1	Either 1 or 2	Writing a 1 to this register will turn the ABC Logic™ on; writing a 2 will turn it off. This data is non-volatile and is saved by the CO_2 module.
GS-300 Time: Hours	30025	0	0 - 23	This register allows setting the current hour of time.
GS-300 Time: Minutes	30026	0	0 - 59	This register allows setting the current minute of time.
Float Invert	30027	0	0 or 1	This register allows change to the order of register that is read or written first in the 4-byte floats. When this register is set to 0 (default) the high word is read or written first; when it is set to 1 the low word is read or written first.
Factory CO2 Gain/Offset Status	30028	1	1 or 0	When this register is set to 1 (default) the CO_2 sensor will operate with the GreenTrol factory gain and offset adjustment. When this register is set to 0, the CO_2 sensor will operate without the GreenTrol factory gain and offset adjustment.
Factory Relative Humidity Gain/Offset Status	30029	1	1 or 0	When this register is set to 1 (default) the Relative Humidity sensor operates with GreenTrol factory gain and offset adjustment. When this register is set to 0, the Relative Humidity sensor operates without factory gain and offset adjustment.
Factory Temperature Gain/Offset Status	30030	1	1 or 0	When this register is set to 1 (default) the Temperature sensor operates with GreenTrol factory gain and offset adjustment. When this register is set to 0, the Temperature sensor operates without GreenTrol factory gain and offset adjustment.
Temperature Units of Measurement Units	30031	0	0 or 1	This register allows setting the temperature measurement units of register 30005/30006 to Fahrenheit or Celsius. When this register is set to 0 (default) the unit of temperature measurement is Fahrenheit. When set to 1, the unit of temperature measurement is Celsius.

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