Digital Gas Monitor 1DBx
BAS Interface Manual

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1 INTRODUCTION

1.1 OVERVIEW

This manual has been prepared to assist you in becoming familiar with the Armstrong 1DBx BAS (Building Automation System) Interface***. This manual contains the information necessary to install and operate the Digital Gas Monitor 1DBx BAS interface and is intended for personnel who are responsible for installing and operating this equipment. BACnet and MODBUS knowledge is required to use this manual.***

1.2 SAFETY CONVENTIONS

The following safety conventions are used in this manual to indicate safety practices that should be adhered to when installing or operating the BAS interface.

ELEMENT	CONVENTION
NOTE	Used to highlight additional information pertinent to the process being described.
CAUTION	Used to highlight processes that should be performed with care and to obtain the best result.
WARNING	**USED TO HIGHLIGHT PROCESSES THAT MUST BE PERFORMED WITH CARE TO AVOID POSSIBLE DANGEROUS SITUATIONS TO EQUIPMENT OR PERSONNEL.**

2 GENERAL INFORMATION

2.1 WARRANTY

The Digital Gas Monitor 1DBx BAS Interface is warranted against defects in material and workmanship for a period of two (2) years from date of shipment. During the warranty period, *The Armstrong Monitoring Corporation* (AMC) will repair or replace components that prove to be defective in the opinion of AMC. AMC is not liable for auxiliary interfaced equipment, or consequential damage. This warranty shall not apply to any product, which has been modified in any way, which has been repaired by any other party other than a qualified technician or authorized AMC representative, or when such failure is due to misuse or conditions of use.
Any equipment deemed to be defective by the user should be returned to The Armstrong Monitoring Corporation for evaluation. For information about returning products, refer to the PRODUCT RETURN section in this manual.

2.2 LIABILITY

CAUTION All AMC products must be installed and maintained according to instructions to ensure proper operation. Only qualified technicians should install and maintain the equipment.

AMC shall have no liability arising from auxiliary interfaced equipment, for consequential damage, or the installation and operation of this equipment. AMC shall have no liability for labor or freight costs, or any other costs or charges in excess of the amount of the invoice for the products.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SPECIFICALLY THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF.

WARNING **USE THE PROPER SAFETY PRECAUTIONS AND CHECK TO ENSURE THE WORKING AREA IS FREE FROM HAZARDS DURING INSTALLATION OR WHEN PERFORMING MAINTENANCE.**

2.3 MODIFICATIONS AND SUBSTITUTIONS

Due to an ongoing development program, AMC reserves the right to substitute components and change specifications at any time without incurring any obligations.

2.4 PRODUCT RETURN

All products returned for warranty service will be by prepaid freight. Please obtain a Return Material Authorization (RMA) number from AMC prior to shipping and ensure this RMA number is clearly visible on the outside of the shipping container. Material shipped without a RMA number issued by AMC will be rejected and returned. All products returned to the client will be freight collect.

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2.5 GLOSSARY

Term	Description
BACnet	Building Automation and Control networks. BACnet is a communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol. BACnet allows communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the particular building service they perform.
BAS	Building Automation System. The control system is a computerized, intelligent network of electronic devices designed to monitor and control building mechanical and lighting systems.
BBMD	BACnet/IP Broadcast Management Device. Used to receive and forward broadcast messages for discovery of routers in IP networks.
Bps	Bits per Second. In telecommunications and computing, bit rate (sometimes written bitrate, data rate or as a variable R) is the number of bits that are conveyed or processed per unit of time.
COV	Change-Of-Value. Refers to the duration of an event being shorter than the interval between polls
FD	Foreign Device. A BACnet device that has an IP subnet address different from those comprising the BACnet/IP network to which it wants to join.
FDR	Foreign Device Registration. To fully participate in the activities of a B/IP network, a foreign device must register itself with a BBMD serving one of the IP subnets comprising that network.
IP	The Internet Protocol (IP) is the principal communications protocol used for relaying datagrams (also known as network packets) across an internetwork using the Internet Protocol Suite. Responsible for routing packets across network boundaries, it is the primary protocol that establishes the Internet.
IP Address	An IP address consists of four numbers, each of which contains one to three digits, with a single dot (.) separating each number or set of digits. Each of the four numbers can range from 0 to 255. An example IP address is: 78.125.0.209.
MODBUS	Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). Simple and robust, it has since become one of the de-facto standard communications protocols in the industry, and it is now amongst the most commonly available means of connecting industrial electronic devices.
MODBUS ASCII	Modbus ASCII is used in serial communication and makes use of ASCII characters for protocol communication. The ASCII format uses a longitudinal redundancy check checksum. Modbus ASCII messages are framed by leading colon (‘:’) and trailing newline (CR/LF).
MODBUS RTU	Modbus RTU is used in serial communication and makes use of a compact, binary representation of the data for protocol communication.

	The RTU format follows the commands/data with a cyclic redundancy check checksum as an error check mechanism to ensure the reliability of data. Modbus RTU is the most common implementation available for Modbus. A Modbus RTU message must be transmitted continuously without inter-character hesitations. Modbus messages are framed (separated) by idle (silent) periods.
Parity	A parity bit is a bit that is added to ensure that the number of bits with the value one in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting code. There are two variants of parity bits: even parity bit and odd parity bit. When using even parity, the parity bit is set to 1 if the number of ones in a given set of bits (not including the parity bit) is odd, making the number of ones in the entire set of bits (including the parity bit) even. If the number of on-bits is already even, it is set to a 0. When using odd parity, the parity bit is set to 1 if the number of ones in a given set of bits (not including the parity bit) is even, keeping the number of ones in the entire set of bits (including the parity bit) odd. If the number of set bits is already odd, the odd parity bit is set to 0. In other words, an even parity bit will be set to "1" if the number of 1's + 1 is even, and an odd parity bit will be set to "1" if the number of 1's +1 is odd.
Router	A network device that forwards packets from one network to another. Based on internal routing tables, routers read each incoming packet and decide how to forward it. The destination address in the packets determines which line (interface) outgoing packets are directed to. In large-scale enterprise routers, the current traffic load, congestion, line costs and other factors determine which line to forward to.
UDP	User Diagram Protocol – see IETF RFC 768
Zone	An area which is being monitored for which an alarm anywhere in the zone will cause the same result – i.e. if there are three sensors in “Zone 1” and if any of those sensors goes into alarm “Fan A” will turn on. If there were only one sensor per zone, each would turn on its own fan.

3 PRODUCT INFORMATION

The Gas Monitor 1DBx can be accessed via an RS-485 link using the MODBUS-RTU digital communication protocol and via Ethernet using BACnet-IP

3.1 BAS NETWORK DIAGRAM

Figure 3-1 shows a basic diagram of the BAS network.

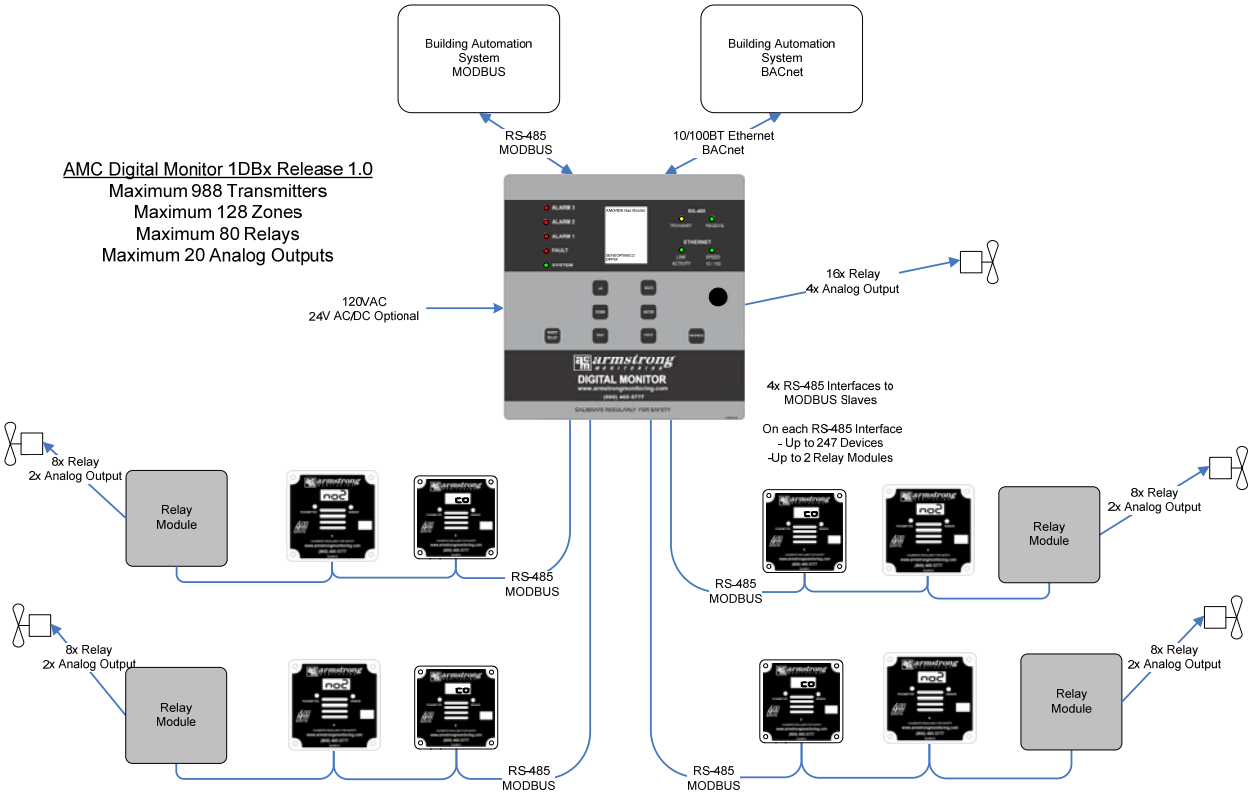


Figure 3-1: BAS Network Diagram

3.2 RECORD INDENTIFICATION DATA

Before BACnet and MODBUS can be set up, identification data must be recorded.

BACnet

BACnet Transport	**BACNET IP** (Default) _____ (BACNET IP) (BACNET_MSTP not currently available)
IP Address	**10.0.0.103** (Default) ____.____.____.____
IP NetMask	**255.255.255.0** (Default) ____.____.____.____
IP Router	**10.0.0.1** (Default) ____.____.____.____
BACnet IP Time to Live (Seconds)	**00060** (Default) _____ (0-65535)
Device ID	**677003** (Default) _____ (0-4194303)
Network Address	**0** (Default) _____ (0-65535)
UDP Port	**47808** (Default) _____ (47808-47823)
Bacnet Name	**AMC-1DBX BACnet Name** _____ (20 or less characters)
BACnet BBMD IP Address	**000.000.000.000** (Default; BBMD disabled)

	____.____.____.____
ASHRAE VENDOR ID	**677** (Fixed; Armstrong Monitoring Corporation)

MODBUS

Slave MODBUS Protocol	**Slave MODBUS RTU** (Default) _____ (Slave MODBUS RTU) (Slave MODBUS TCP not currently available)
RS485 Protocol	**MODBUS RTU** (Default) _____ (MODBUS RTU) (MODBUS ASCII and BACNET MSTP not currently available)
RS485 BAUD	**9600** (Default) _____ (1200,2400,4800,9600,19200,38400,76800,115200)
RS485 Character Length	**8 Bits** (Default) _____ (8 Bits)
RS485 Parity	**Even** (Default) _____ (Even, Odd, None)
RS485 Stop Bits	**1 Bit** (Default) _____ (1 Bit, 1.5 Bits, 2 Bits)
Slave Address	**1** (Default) ____ (1-247)
Slave MODBUS Lockcode	**00000** (Default) _____ (0-65535)

4 BAS COMMUNICATION

This section contains information about the building automation communications protocol including connections and setup.

4.1 BAS Connection

The BAS connection support MODBUS RTU, MODBUS TCP, BACnet IP.

4.1.1 BAS MODBUS RTU Wiring Connections

A single RS-485 interface to a Building Automation System is provided.

The upstream RS-485 interface is provided on a dual-row, 4-pin terminal block. Pins on the upper row are wired in parallel to the lower row to facilitate placing the monitor in the middle of the bus, thereby requiring two wires per connection. The terminal block supports wire gauges from 14 to 30 AWG. Silk screening is provided on the PCB to identify each pin, by function.

Table 4.1.1-1 shows the pin-out for the dual-row 4-pin terminal block.

Table 4.1.1-1: Dual-Row 4-Pin Terminal Block Pin-out

Signal	Terminal Block Pin #
Cable Shield	1
RS-485 A Signal	2
RS-485 B Signal	3
Ground	4

To facilitate field replacement, the RS-485 driver IC is mounted in a socket.

CAUTION Power down the Digital Monitor before replacing any RS-485 driver ICs. Ensure proper ESD precautions are taken before handling ICs.

Table 4.1.1-2: RS-485 driver IC

Interface	IC Location
To Building Automation	J175

4.1.1.1 Termination

The upstream RS-485 interface, field configuration is provided. See Table 4.1.1-3

Table 4.1.1-3: RS-485 Field Configuration Table

Interface	Strap Location	Strap Position		
		Not at end of bus	End of Bus DC Termination	End of Bus AC Termination
To Building Automation	J16	remove	1-2	2-3

4.1.1.2 Shield Termination

The RS-485 cable is a shielded cable. The cable shield is terminated on the terminal block. How this shield is handled varies based upon the system wiring. A strap allows the user to select different among three options to select the best solution that works in their site.

The cable shield is shorted to chassis ground at only one point, in order to avoid ground loops with large currents. Typically, the Digital Monitor connects the cable shield of the MODBUS channel to chassis ground. The cable shield of the interface to the Build Automation System is typically not connected to chassis ground at the Digital Monitor; the Building Automation System would provide this connection.

The Digital Monitor provides interface strapping options for connecting the cable shield to ground;

- No connection to chassis ground
- Connected directly (shorted) to chassis ground
- Connected through a parallel resistor-capacitor network to chassis ground

Table 4.1.1-4: Cable Shield Termination

Interface	Strap Location	Strap Position		
		No Connection To Chassis Gnd	Shorted To Chassis Gnd	RC Network To Chassis Gnd
To Building Automation	J19	Remove (Typical)	2-3	1-2

4.1.1.3 Bias

For each of the downstream RS-485 interfaces, resistors are included in the design to pull the idle (un-driven) lines to the mark level.

4.1.2 MODBUS TCP and BACnet IP Wiring Connections

A 10/100 Base-T Ethernet connection is provided by the monitor. The Ethernet cable is terminated in an RJ-45 connector which is provided. The connector is mounted so that the cable is parrallel to the PCB assembly. The connector is mounted along the bottom edge of the printed circuit board.

The RJ-45 connector is displayed in Figure 4-1. It is a hybrid connector and has the USB interface integrated into it.

Figure 4-1: RJ-45 Connector

Table 4.1.2-1 shows the pin-out for the dual-row 4-pin terminal block.

Table 4.1.2-1: RJ-45 Connector Pin-out

Pin	Signal
1	Transmit Positive
2	Transmit Negative
3	Receive Positive
4	Connected to 5, unused, 75R AC termination to chassis ground
5	Connected to 4, unused, 75R AC termination to chassis ground
6	Receive Negative
7	Connected to 8, unused, 75R AC termination to chassis ground
8	Connected to 7, unused, 75R AC termination to chassis ground

4.1.3 Start-up Guide for AMC-1DBX BACnet

The following is the start-up guide for configuring the AMC-1DBX monitor. Consult your BAS IP administrator for specific BACnet settings:

1. Turn OFF all power to the monitor and its devices.
2. Connect the AMC-1DBX Monitor power to its Power Supply.
   Refer to the AMC-1DBX User Manual for details.

3. Initially disconnect the AMC-1DBX monitor Ethernet communication to the BAS network.
4. Turn On power to the monitor.
5. Configure the IP address, IP NetMask and IP Router starting from the Set Interface, IP Configuration and Set IP Address menus.
6. Continue the configuration by setting the BACnet BAS, Set Device Name and BACnet ID.
7. Set the BAC Network Number to 0 when communicating with a BACnet Controller locally without a BACnet gateway.
8. Set the transport to BACnet IP with default UDP port of 47808 (0xBAC0).
   Other UDP ports are possible when communicating with a BACnet Controller on ports 0xBAC1 to 0xBACF.
9. Set the BBMD Address to 000.000.000.000 when not communicating with a BACnet Broadcast Master Device.
10. Set the BAC IP TimetoLive parameter (60 seconds).
11. Connect the AMC-1DBX monitor Ethernet port to BACnet LAN.

5 BACNET IP Description

The BACnet objects listed below are all accessed at the Device ID over BACnet-IP. The BACnet Device ID is configured by the BACnet menu item under the Interface menu tree. Refer to the AMC 1DBx User Manual for configuration details.

WARNING **IT IS POSSIBLE THAT RECONFIGURATION OF IP OR BACNET ITEMS WILL CAUSE VALUES TO BE LOST. THIS SITUATION WILL LIKELY CAUSE COMMUNICATION PROBLEMS. A MISSING MONITOR OR A MONITOR NOT RESPONDING SHOULD BE PERCEIVED AS UNRELIABLE FOR AN ADDITIONAL PERIOD OF 120 SECONDS ONCE PROPER COMMUNICATION IS ACHIEVED.**

Additionally, the BACnet objects implemented do not currently provide configuration. This can be achieved with BAC MODBUS, AMC Manager or configuration menus.

The objects listed are described in detail as a group later in this section. The BACnet interface provides 4119 objects covering details about the 988 Sensors, 256 Relays, 128 Zones and 128 Analog Outputs. Discovering these objects can take a BACnet controller many minutes. Each object has important information, but an optimal operating sequence is best for limiting the number of utilized objects. Later in this chapter some possible operating sequences are described.

WARNING **IT MAY BE POSSIBLE THAT THE MONITOR'S CRITICAL INFORMATION IS MISSED. OBJECTS SUPPORTING CHANGE OF VALUE (COV) CAN SEND CONFIRMED MESSAGES. THERE IS A LIMITATION OF 255 SIMULTANEOUS CONFIRMED COV MESSAGES. ALSO, WHEN COV SUBSCRIPTION LISTS ARE GREATER THAN 31 IT IS POSSIBLE THE INTERFACE WILL ISSUE AN ABORT SEGMENTATION MESSAGE WHEN GATHERING THIS INFORMATION.**

Some objects support Out-Of-Service which provides an administrator the possibility to test interlocks and simulate alarms. When objects are forced into this mode they cannot reflect the monitor's actual state.

The following is a list of all the BACnet objects in the AMC 1DBx configuration:

- Device
- MultiState Input (MSI 0) System Status State
- OctetString (OS 0) System Status Info.
- Analog Input (AI 0 TO AI 987) Sensors Raw Input
- MultiState (MSI 1 to MSI 988) Sensor Cause State
- OctetString (OS 1 to OS 988) Sensor Status Info.
- Binary Input (BI 0 to BI 255) Relay Current Condition
- MultiState Input (MSI 989 to MSI 1244) Relay Cause State
- OctetString (OS 989 to OS 1244) Relay Status Info.
- MultiState Input (MSI 1245 to MSI 1372) Zone Cause State
- OctetString (OS 1245 to OS 1372) Zone Status Info.
- Analog Output (AI 988 to AI 1115) Analog Output Raw Output
- File (FIL 0 to FIL14) Filesystem Access

5.1.1 AMC 1DBX BACNET OBJECT DESCRIPTIONS

5.1.2 System Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation
System	Device	Read	Device Info.: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_SYSTEM_STATUS, PROP_VENDOR_NAME, PROP_VENDOR_IDENTIFIER, PROP_MODEL_NAME, PROP_FIRMWARE_REVISION, PROP_APPLICATION_SOFTWARE_VERSION, PROP_PROTOCOL_VERSION, PROP_PROTOCOL_REVISION, PROP_PROTOCOL_SERVICES_SUPPORTED, PROP_PROTOCOL_OBJECT_TYPES_SUPPORTED, PROP_OBJECT_LIST, PROP_MAX_APDU_LENGTH_ACCEPTED, PROP_SEGMENTATION_SUPPORTED, PROP_APDU_TIMEOUT, PROP_NUMBER_OF_APDU_RETRIES, PROP_MAX_MASTER, PROP_MAX_INFO_FRAMES, PROP_DEVICE_ADDRESS_BINDING, PROP_DATABASE_REVISION, PROP_DESCRIPTION, PROP_LOCAL_TIME, PROP_UTC_OFFSET, PROP_LOCAL_DATE, PROP_DAYLIGHT_SAVINGS_STATUS, PROP_LOCATION, PROP_ACTIVE_COV_SUBSCRIPTIONS.	
	Multistate Input 0	Read and OOS	System Status State: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_NUMBER_OF_STATES, PROP_DESCRIPTION, PROP_STATE_TEXT, PROP_RELIABILITY, PROP_DEVICE_TYPE.	**Integer 32,1-31:** %bbbbbb=[All Clear, Failed,HourGlass,Relay,Acknowledge,PowerUp].

	OctetString 0	Read Only	System Status Info. PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_DESCRIPTION, PROP_RELIABILITY.	(9 Bytes) **Byte1:** System State[4:0]; %bbbbb=[Failed,HourGlass,Relay,Acknowledge,PowerUp]. **Byte2:** Language[7:6], Audible Alarm Disable[5], Zero Buffer Disable[4], Min Run Disable[3], Cal Mode Enable[2], Post Run Disable[1], Sensor Activation Delay Disable[0]. **Byte3:** Power Up Delay Minutes Remaining [7:0]; 0xFF=infinite. **Byte4:** Acknowledge Time Minutes Remaining[7:0]; 0xFF=infinite. **Byte 5:** Number of Sensors available High [9:8]; Max. 988 at [9:0]. **Byte 6:** Number of Sensors available Low[7:0]; Max. 988 for [9:0]. **Byte 7:** Number of Relays available; Max. 256. **Byte8:** Number of Analog available; Max. 128. **Byte9:** Number of Zones available; Max. 128.

5.1.2.1 Device

This device object is read only and contains many properties that are either configured or hard coded by the monitor's software. Some properties like ACTIVE_COV_SUBSCRIPTIONS are dynamically created based on administration from BAS. The SYSTEM_STATUS property always indicates *STATUS_OPERATIONAL* and does not represent the monitor's alarm or runtime state. The monitor's primary state information is available in the MSI 0 object.

5.1.2.2 MultiState Input (MSI 0) System Status State

This object is a read only value unless configured as Out-Of-Service (OOS). It contains the primary state of the monitor.

The present value represents 32 states represented in a 6-bit mask for the monitor's state. A value of 32 represents All Clear state; indicating bit field [5:0] is all zero.

The FAILED bit has significant importance as it indicates if the system device interfaces are communicating properly with configured devices (Sensors, remote Relays and remote Analog Outputs). The RELAY bit will indicate an ALARM state or other Relay event currently in progress. Further relay object interrogation or COV messages from relay objects must occur to understand the event. See MSI 989 to MSI 1244 Relay Cause State.

5.1.2.3 OctetString (OS 0) System Status Info.

This object contains the system status information in a byte array representing different system entities. The first entry contains the System Status State as described by MSI 1. The other entities contain information about system disables, power up delay, number of available sensors, relays, analog outputs and zones in the system. The system disables represent the system's DIP switch. See the AMC 1DBx User Manual for further details.

The number of sensors entry requires two bytes to compose the value. The number of available devices can be used to guide the number objects to interrogate when a relay event occurs. Further relay object interrogation or COV (Change Of Value) messages from relay objects must occur to understand cause. See MSI 989 to MSI 1244 Relay Cause State.

5.1.3 Sensor Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation
Sensor	Analog Input 0 to 987	Read and OOS	Sensor 001 to 988 Raw Input: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_UNITS, PROP_DESCRIPTION, PROP_RELIABILITY, PROP_DEVICE_TYPE, PROP_COV_INCREMENT.	**Real** 0.0-4000.0 mV (0-100% is 800-4000mV).
	Multistate Input 1 to 988	Read and OOS	Sensor 001 to 988 Fail/Alarm3-1 Cause State: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_NUMBER_OF_STATES, PROP_DESCRIPTION, PROP_STATE_TEXT, PROP_RELIABILITY, PROP_DEVICE_TYPE.	**Integer 32,1-31:** %bbbbbb=[All Clear,Delay Timer,Fail,Alarm3,Alarm2,Alarm1].

	OctetString 1 to 988	Read Only	Sensor 001 to 988 Status Info. PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_DESCRIPTION, PROP_RELIABILITY.	(6 Bytes) **Byte1:** Availability[0:0] 0=unavailable,1=available. **Byte2:** SensorX State[4:0]; %bbbbb=[Delay Timer,Fail,Alarm3,Alarm2,Alarm1]. **Byte3:** SensorX Fail Relay (based from 1). **Byte4:** SensorX Alarm3 Relay (based from 1). **Byte5:** SensorX Alarm2 Relay (based from 1). **Byte6:** SensorX Alarm1 Relay (based from 1).

5.1.3.1 Analog Input (AI 0 TO AI 987) Sensors Raw Input

This object is a read only value unless configured as Out-Of-Service. The range of objects covers all 988 possible sensors. It represents the sensor raw value. A sensor gas concentration whether digital or analog is represented with a value of 800-4000mV for 0-100% full scale value. This is also equivalent to 4-20mA for 0-100% FS into a 200ohm load. A raw value less than the sensor's fail threshold will trigger a sensor fail state. The sensor fail threshold and other alarm thresholds are currently not available through the BACnet objects, but can be achieved through BAS MODBUS, AMC Manager or configuration menus. The sensor's state; FAIL, ALARM3, ALARM2 and ALARM1 can be achieved through MSI 1 to MSI 988 Sensor Cause State.

5.1.3.2 MultiState (MSI 1 to MSI 988) Sensor Cause State

This object is a read only value unless configured as Out-Of-Service. The range of objects covers all 988 possible sensors.

The present value represents 32 states represented in a 6-bit mask of the Sensor cause state. A value of 32 represents All Clear state; indicating bit field [5:0] is all zero.

Each bit position indicates the sensor has reached an active or delayed sensor alarm threshold. The causes are Timer, FAIL, ALARM3, ALARM2 and ALARM1. A delayed sensor threshold state will not cause a related relay event unless gas concentration has persisted at the threshold for the delay time period. The delay value is not currently available in the BACnet objects, but is available through BAS MODBUS, AMC Manager or configuration menus. The alarm thresholds are indicated in OS 1 to OS 988 Sensor Status Info.

5.1.3.3 OctetString (OS 1 to OS 988) Sensor Status Info.

This object contains the sensor status information in a byte array. The range of objects covers all 988 possible sensors. The first byte indicates if the sensor is available or not. The second byte represents the sensor's cause state as described in MSI 1 to MSI 988. The next four bytes represent the relays assigned for FAIL, ALARM3, ALARM2 and ALARM1. The information can be used to determine the appropriate relay object to interrogate for further alarm information.

5.1.4 Relay Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation
Relay	Binary Input 0 to 255	Read and OOS	Relay 001 to 256 Current Condition: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_POLARITY, PROP_DESCRIPTION, PROP_RELIABILITY, PROP_DEVICE_TYPE.	**Boolean:** 0 with Polarity Normal is Off or Inactive, 1 with Polarity Normal is On or Active, 0 with Polarity Reverse is On or Active, 1 with Polarity Reverse is Off or Inactive.
	Multistate Input 989 to 1244	Read and OOS	Relay 001 to 256 Dew/Schedule/Zone/Sensor Cause State: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_UNITS, PROP_DESCRIPTION, PROP_RELIABILITY, PROP_DEVICE_TYPE, PROP_COV_INCREMENT.	**Integer 32,1-31:** %bbbbbb=[All Clear,Run Timer,Dew,Schedule,Zone,Sensor].
	OctetString 989 to 1244	Read Only	Relay 001 to 256 Status Info.: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_DESCRIPTION, PROP_RELIABILITY.	(8 Bytes) **Byte1:** Availability[0:0] 0=unavailable,1=available. **Byte2:** Relay State[4:0]; %bbbbb=[Run Timer,Dew,Schedule,Zone,Sensor]. **Byte3:** Non-Zone Sensor Alarm Count High [15:8] (Includes Dew Point). **Byte4:** Non-Zone Sensor Alarm Count Low[7:0] (Includes Dew Point). **Byte5:** Zone Sensor Alarm Count High [15:8] (Excludes Dew Point and Sensors). **Byte6:** Zone Sensor Alarm Count Low [7:0] (Excludes Dew Point and Sensors). **Byte7:** Run Time Minutes Remaining. **Byte8:** Post Run Time Minutes Remaining.

5.1.4.1 Binary Input (BI 0 to BI 255) Relay Current Condition

This object contains the relay current condition. The range of objects covers all 256 possible relays. The current condition is based on the following rules:

- Boolean 0 with Polarity Normal is Off or Inactive,
- Boolean 1 with Polarity Normal is On or Active,
- Boolean 0 with Polarity Reverse is On or Active,
- Boolean 1 with Polarity Reverse is Off or Inactive.

The Polarity property must be used; it reflects the relay's configuration type;

- Reverse = "normally energized", or
- Normal = "normally de-energized".

Relay configuration is available through BAS MODBUS, AMC Manager or configuration menus.

The actual relay cause is shown in objects MSI 989 to MSI 1244.

5.1.4.2 MultiState Input (MSI 989 to MSI 1244) Relay Cause State

This object is a read only value unless configured as Out-Of-Service. The range of objects covers all 256 possible relays.

The present value represents 32 states represented in a 6-bit mask of the Relay cause state. A value of 32 represents All Clear state; indicating bit field [5:0] is all zero.

Each bit position indicates a difference source (cause) and whether or not a timer has been enacted. There are two relay timers; minimum run and post run. A minimum run timer enacts a minimum activation time regardless of the sensor's gas concentration once triggered, while the post run timer enacts an active time after the relay cause has been removed. The relay sources are Dew, Schedule, Zone and Sensor. Objects OS 989 to OS 1244 contain specific information about the cause.

5.1.4.3 OctetString (OS 989 to OS 1244) Relay Status Info.

This object contains the relay status information in a byte array. The range of objects covers all 256 possible relays. The first byte indicates if the relay is available or not. The second byte represents the relay's cause state as described in MSI 989 to MSI 1244. The next bytes are the causing sensor count for non-zone and zone situations. The counts are represented in two bytes. Several sensors can be assigned to the same relay through the sensor or zone configuration. Zone or sensor interrogation can be performed to determine the gas concentration associated with this relay.

5.1.5 Zone Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation

Zone	Multistate Input 1245 to 1372	Read and OOS	Zone 001 to 128 Schedule/Fail/Alarm3-1 Cause State: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_NUMBER_OF_STATES, PROP_DESCRIPTION, PROP_STATE_TEXT, PROP_RELIABILITY, PROP_DEVICE_TYPE.	**Integer 32,1-31**: %bbbbbb=[All Clear,Schedule,Fail,Alarm3,Alarm2,Alarm1].
	OctetString 1245 to 1372	Read Only	Zone 001 to 128 Status Info.: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_DESCRIPTION, PROP_RELIABILITY.	(7 Bytes) **Byte1:** Availability[0:0] 0=unavailable,1=available. **Byte2:** Zone State[4:0]; %bbbbb=[Schedule,Fail,Alarm3,Alarm2,Alarm1]. **Byte3:** ZoneX Fail Relay (based from 1). **Byte4:** ZoneX Alarm3 Relay (based from 1). **Byte5:** SensorX Alarm2 Relay (based from 1). **Byte6:** ZoneX Alarm1 Relay (based from 1). **Byte7:** Zone X Analog Output (based from 1); Max. 128.

5.1.5.1 MultiState Input (MSI 1245 to MSI 1372) Zone Cause State

This object is a read only value unless configured as Out-Of-Service. The range of objects covers all 128 possible zones.

The present value represents 32 states represented in a 6-bit mask of the Zone cause state. A value of 32 represents All Clear state; indicating bit field [5:0] is all zero.

Each bit position indicates a difference cause. The Zone causes are Schedule, FAIL, ALARM3, ALARM2 and ALARM1. A zone schedule relay event must be programmed by BAS MODBUS, AMC Manager or configuration menus. Each zone can contain up to 128 different sensors in that zone. The BACnet zone objects do not list these sensors; this information can be achieved with BAS MODBUS, AMC manager or configuration menus. Objects OS 1245 to OS 1372 contain specific information about the zone cause state.

5.1.5.2 OctetString (OS 1245 to OS 1372) Zone Status Info.

This object contains the zone status information in a byte array. The range of objects covers all 128 possible zones. The first byte indicates if the zone is available or not. The second byte represents the zone's cause state as described in MSI 1245 to MSI 1372. The next four bytes represent the relays assigned for FAIL, ALARM3, ALARM2 and ALARM1. The last byte indicates the analog output associated with this zone. The analog output raw level is available in AI 988 to AI 1115.

5.1.6 Analog Output Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation
Analog Output	Analog Inputs 988 to 1115	Read and OOS	Analog Output 001 to 128 Raw Output: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_PRESENT_VALUE, PROP_STATUS_FLAGS, PROP_EVENT_STATE, PROP_OUT_OF_SERVICE, PROP_UNITS, PROP_DESCRIPTION, PROP_RELIABILITY, PROP_DEVICE_TYPE, PROP_COV_INCREMENT.	Real 0.0-4000.0 mV (0-100% is 800-4000mV).

5.1.6.1 Analog Output (AI 988 to AI 1115) Analog Output Raw Output

This object is a read only value unless configured as Out-Of-Service. The range of objects covers all 128 possible zone assigned outputs. It represents the raw gas concentration output value for a zone. The gas concentration output span is 0.0-4000.0; in mV into a 200ohm load. There are two ranges; 4-20mA and 0-20mA and are configured and accessible through BAS MODBUS, AMC Manager or configuration menus. Additionally, the analog output can be configured with a scale multiplier.

1. A 4-20mA type with 1.0 times Scale for 0-100% will span 800-4000mV.
2. A 0-20mA type with 1.0 times Scale for 0-100% will span 000-4000mV.

5.1.7 FileSystem Access Group

Group	BACnet Object and Instance	Access	Description and Properties	Data explanation
File	File 0 to 13	Read and Write	File FILE0 to FILE13: PROP_OBJECT_IDENTIFIER, PROP_OBJECT_NAME, PROP_OBJECT_TYPE, PROP_FILE_TYPE, PROP_FILE_SIZE, PROP_MODIFICATION_DATE, PROP_ARCHIVE, PROP_READ_ONLY, PROP_FILE_ACCESS_METHOD, PROP_DESCRIPTION.	FILE 000 RAM1:\\push.fw, FILE 001 RAM1:\\pull.db, FILE 002 RAM1:\push.db, FILE 003 RAM1:\\10aquila.elf.csum, FILE 004 RAM1:\\10aquila.elf.rbin, FILE 005 RAM1:\\amc-1db.adf, FILE 006 C:\\system.log, FILE 007 C:\\sensor.log, FILE 008 C:\\relay.log, FILE 009 C:\\alarm.log, FILE 010 C:\\admin.log, FILE 011 C:\\security.log, FILE 012 C:\\comm.log, FILE 013 C:\\print.log.

5.1.7.1 File (FILE 0 to FILE 13) FileSystem Access

This object is read and writes representation of files on the RAM1 or USB media. These file objects can be read or written. They contain a file size property. The modification date of any file object is the current date and time. Files containing a 0 byte file size property are not available for read access. These include “push.fw”, “pull.db” and “push.db”. These three files are command files which signal the operating environment to update Firmware, get database and save database respectively.

When using the “push.fw” command file the user must write the firmware image file “10aquila.elf.rbin” and the correct image checksum file “10aquila.elf.csum” to the RAM1 media prior to writing the “push.fw” file. The “push.fw” file must contain the filename on the first line. This file is deleted upon detection by the operating environment. When detected the operating environment will attempt to upgrade the firmware and reboot the system.

When using the “push.db” command file the user must write the database file “amc-1db.adf” to the RAM1 media prior to writing the “push.db” file. The “push.db” file must contain the filename on the first line. This file is deleted upon detection by the operating environment. When detected the operating environment will attempt to upgrade the database and activate it.

When using the “pull.db” command file the user command the operating environment to write the database file “amc-1db.adf” to the RAM1 media. The user can then read the database file “amc-1db.adf”. This file is deleted upon detection by the operating environment. When detected the operating environment will extract the database into the “amc-1db.adf” file.

There are eight other logfiles are available for reading from the USB media. User should not write these files as it will cause lost of logging information.

Transferring large files can take several minutes. Using these file object with BACnet-MSTP transport is not recommend as file integrity cannot be assured.

5.2 AMC-1DBX BACNET SEQUENCE OF OPERATION

The sequence of operation examples were developed using a 1DBX Monitor and BACBeat tool from PolarSoft. Use BACBeat to ensure device discovery. Discovery of all objects and their properties with this tool can be quite lengthy as BACnet segmentation is not supported so lists containing all objects or properties are not possible. These tools must use an object index method which polls a device one by one instead of in a single message. The Device Object list discovered should agree and reflect the objects in the AMC-1DBX BACnet Object List.

A gas monitor can have several zones with several gas concentration alarm set points for controlling several relays and analog outputs. The AMC-1DBX monitor is acting autonomously on the sensors. Locally the AMC-1DBX monitor is configured with alarm set points for a gas type. Each gas label in the AMC-1DBX monitor has their own ALARM1, ALARM2, ALARM3 and FAIL thresholds and cannot be changed by any BACnet objects, but can be configured through BAC MODBUS, AMC Manager and the configuration menus. Refer to the AMC-1DBX User Manual, the AMC Manager User Manual and this manual for details.

A BACnet Controller can create objects such as Analog Outputs (AI 988-AI 1115) and Interlocks which can complement the AMC-1DBX monitor. These interlocks are added to control objects that can be mapped to outputs with definition and actions for controlling items like fans, sounders and beacons. The interlocks can have their own alarm set points for different levels of gas concentrations. The sequence examples do not preclude how the BACnet objects should be used by a BACnet Controller.

5.3 SEQUENCE OF OPERATION FOR SENSOR, RELAY AND ZONE STATE CHANGE

The following is an example sequence to demonstrate Sensor, Relay and Zone State changes:

1. Configure the AMC-1DBX monitor for one CO AMC-400 sensor, 8 relays and one zone.
   - Assign relays 1-4 to sensor 1; ALARM1=25% Full Scale, ALARM2=50%, ALARM3=95% and FAIL=2mA.
   - Assign sensor 1 to zone 1 with relays 5-8 for ALARM1, ALARM2, ALARM3 and FAIL.
   - Assign analog output 1 to zone 1.

     Analog output should be configured with range 4-20mA, 1X scale and 1 second sample.

2. Ensure the monitor is communicating properly with the sensor and no failure indicator is lit. Also ensure the BACBeat object list has been found for all objects.

3. Using the BACBeat tool and the SubscribeCOV dialog, subscribe to Object Type Multistate, Object Instances 0, 1, 989, 992 and 1245.

   These objects represent System Status State, Sensor 1 Cause State, Relay 1 Cause State and Zone 1 Cause State. Subscribe with a long timeout of 10000 seconds. Note that Object Instances are based 0. See Figure 5-1 for an example of subscription with a long timeout.

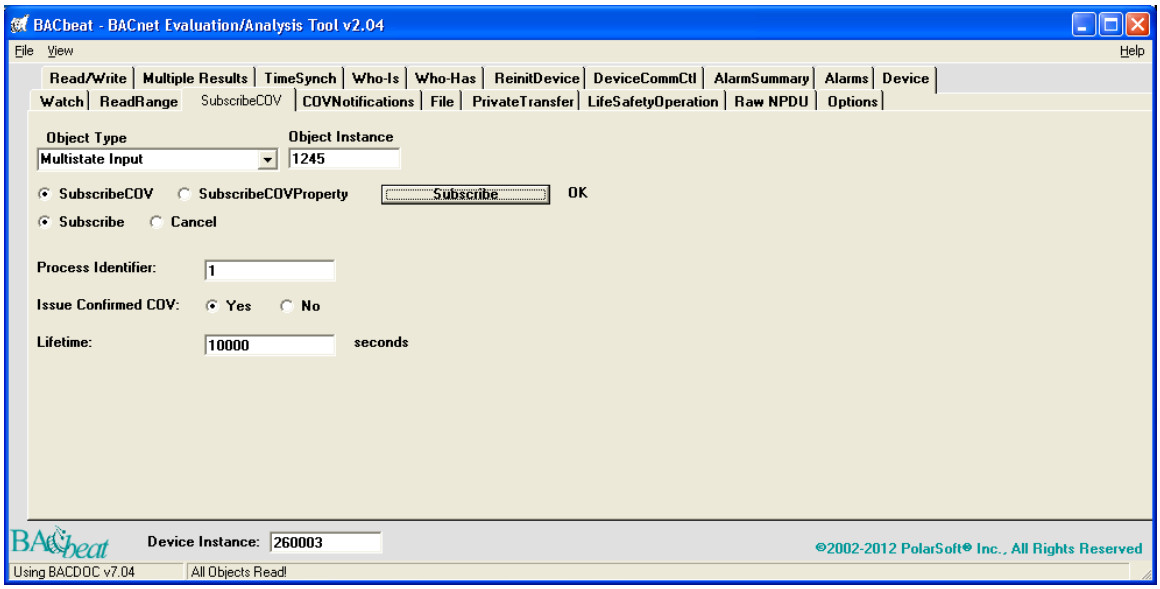


Figure 5-1: Subscribe with Long Timeout

4. From the BACBeat COVNotifications list view the device, objID, process identifier and time remaining for MSI0 with a PRESENT VALUE=32.

5. From the AMC-400 CO Sensor Configuration enter SE2 (service mode 2) and simulate the gas concentration of 25PPM.

   Refer to the AMC-400 User Manual for details about configuring SE2. This should light the ALARM1 LED and activate Relay 1 and Relay 5.

   From the BACBeat COVNotifications list view the following (note that the order may vary):

   - MSI 0 PRESENT VALUE=4
   - MSI 1 PRESENT VALUE=1
   - MSI 989 PRESENT VALUE=1
   - MSI 1245 PRESENT VALUE=1

   The System Status State has notified that a RELAY event has taken place.

   - Sensor 1 Cause State is indicating ALARM1.
   - Relay 1 Cause State is indicating SENSOR.
   - Zone 1 Cause State is indicating ALARM1.

   See Figure 5-2 for an example of entering service mode 2.

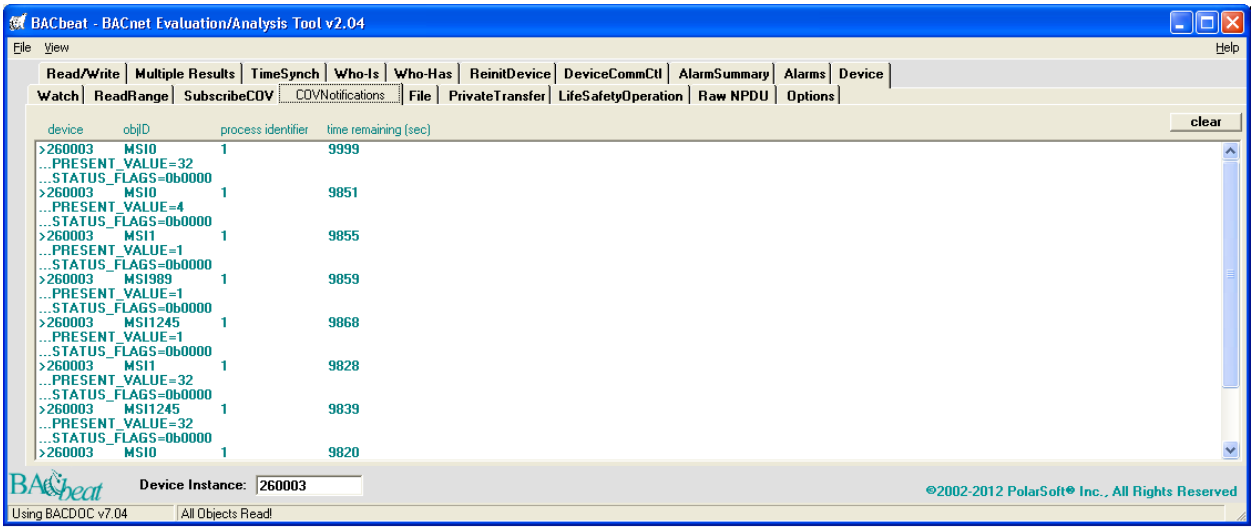


Figure 5-2: COVNotifications Enter SE2

6. From the AMC-400 CO Sensor exit SE2.

   From the BACBeat COVNotifications list view the following (note that the order may vary):

   - MSI 0 PRESENT VALUE=32
   - MSI 1 PRESENT VALUE=32
   - MSI 989 PRESENT VALUE=32
   - MSI 1245 PRESENT VALUE=32

   The System Status State has notified a return to no event.

   - Sensor 1 Cause State is indicating no cause.
   - Relay 1 Cause State is indicating no cause.
   - Zone 1 Cause State is indicating no cause.

7. Disconnect the power to the AMC-400 CO sensor.

   From the BACBeat COVNotifications list view the following (note that the order may vary):

   - MSI 0 PRESENT VALUE=20
   - MSI 1 PRESENT VALUE=8
   - MSI 992 PRESENT VALUE=1
   - MSI 1245 PRESENT VALUE=8

   The System Status State has notified a FAIL and RELAY event.

   - Sensor 1 Cause State is indicating FAIL.
   - Relay 4 Cause State is indicating SENSOR.
   - Zone 1 Cause State is indicating FAIL.

See Figure 5-3 for an example of COVNotifications as a result of disconnecting power to the sensor.

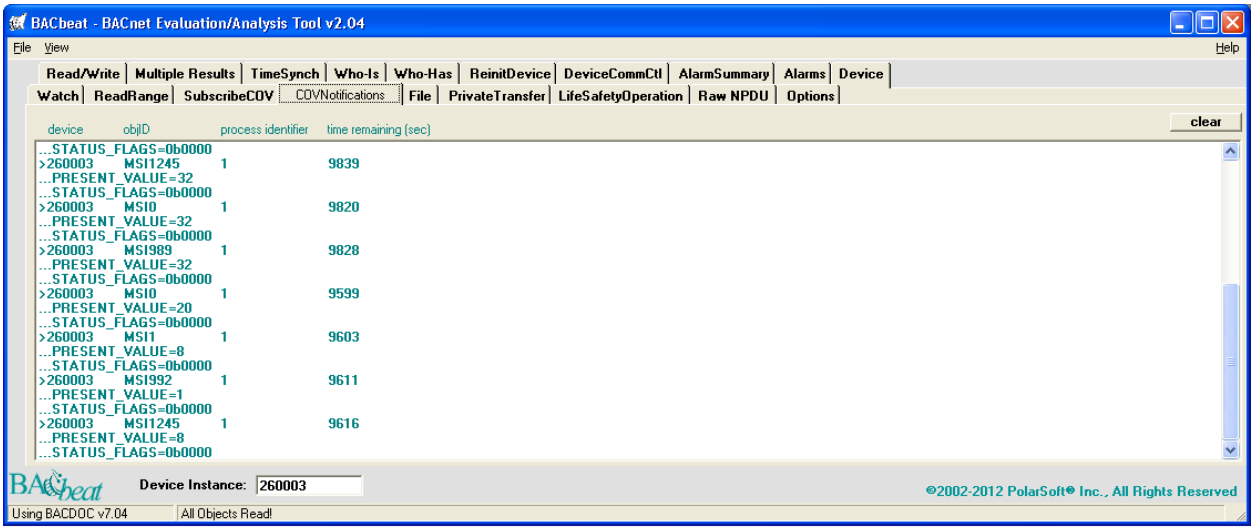


Figure 5-3: COVNotifications Disconnect Sensor Power

8. Connect the power to the AMC-400 CO sensor.

   From the BACBeat COVNotifications list view the following (note that the order may vary and MSI1 Sensor 1 Cause State may toggle in and out of FAIL.):

   - MSI 0 PRESENT VALUE=32
   - MSI 1 PRESENT VALUE=32
   - MSI 992 PRESENT VALUE=32
   - MSI 1245 PRESENT VALUE=32

The System Status State has notified return to no event.

- Sensor 1 Cause State is indicating no cause.
- Relay 4 Cause State is indicating no cause.
- Zone 1 Cause State is indicating no cause.

5.4 SEQUENCE OF OPERATION FOR SENSOR, RELAY AND ANALOG OUTPUT CHANGE

The following is an example sequence to demonstrate Sensor, Relay and Analog Output changes:

1. Configure the AMC-1DBX monitor for one CO AMC-400 sensor, 8 relays and one zone.
   - Assign relays 1-4 to sensor 1; ALARM1=25% Full Scale, ALARM2=50%, ALARM3=95% and FAIL=2mA.
   - Assign sensor 1 to zone 1 with relays 5-8 for ALARM1, ALARM2, ALARM3 and FAIL.
   - Assign analog output 1 to zone 1.

     Analog output should be configured with range 4-20mA, 1X scale and 1 second sample.

2. Use the BACBeat tool and the SubscribeCOV dialog to cancel previous subscriptions (MultiState Input 0, 1, 989, 992 and 1245).

   See Figure 5-4 for an example of a COVNotifications Cancel Subscription dialog box.

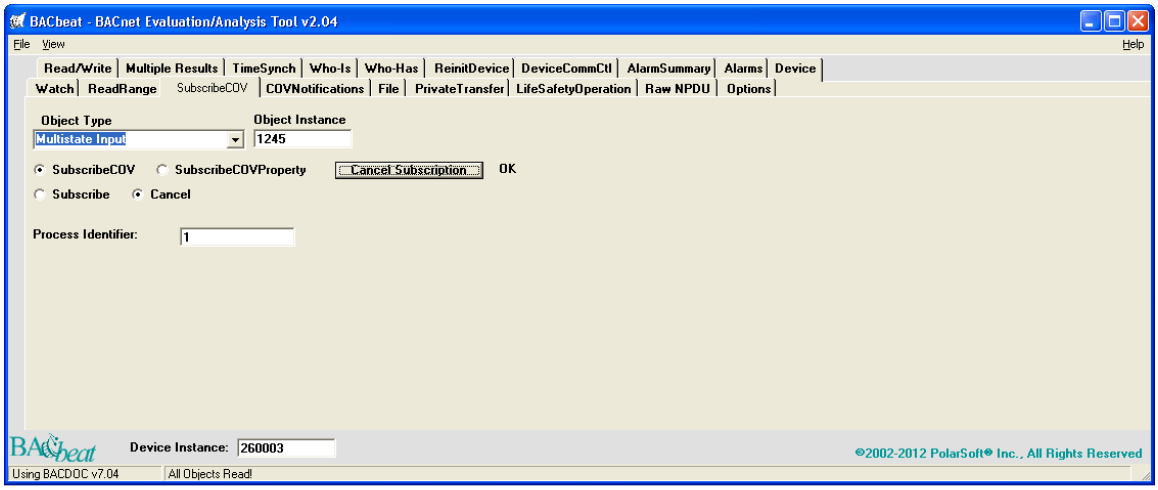


Figure 5-4: COVNotifications Cancel Subscriptions

3. Using the BACBeat tool and the SubscribeCOV dialog, subscribe to Object Type Analog Input, Object Instances 0 and 988.

   These objects represent Sensor 1 Raw Input and Analog Output 1 Raw Output.

4. Subscribe with a long timeout of 10000 seconds.

   Note that Object Instances are based 0.

5. Using the BACBeat tool and the SubscribeCOV dialog, subscribe to Object Type Binary Input, Object Instances 0 to 7.

   These objects represent Relay 1 to 8 Current Condition.

6. Subscribe with a long timeout of 10000 seconds.

   Note that Object Instances are based 0.

7. From the BACBeat COVNotifications list view the device, objID, process identifier and time remaining for AI0 and AI988 with PRESENT VALUE=800.

   The sensor gas concentration whether digital or analog is represented with a value of 800-4000mV for 0-100% full scale value. An Analog Output of 4-20mA range with 1.0 times Scale for 0-100% will span 800-4000mV. In this case both should have a PRESENT VALUE of 800 representing 0% FS or 0ppm.

   From the BACBeat COVNotifications list view the device, objID, process identifier and time remaining for BI0 and BI8 with PRESENT VALUE=1. In this case the relays are normal polarity and are energized.

   See Figure 5-5 for an example of an Analog Input Subscription dialog.

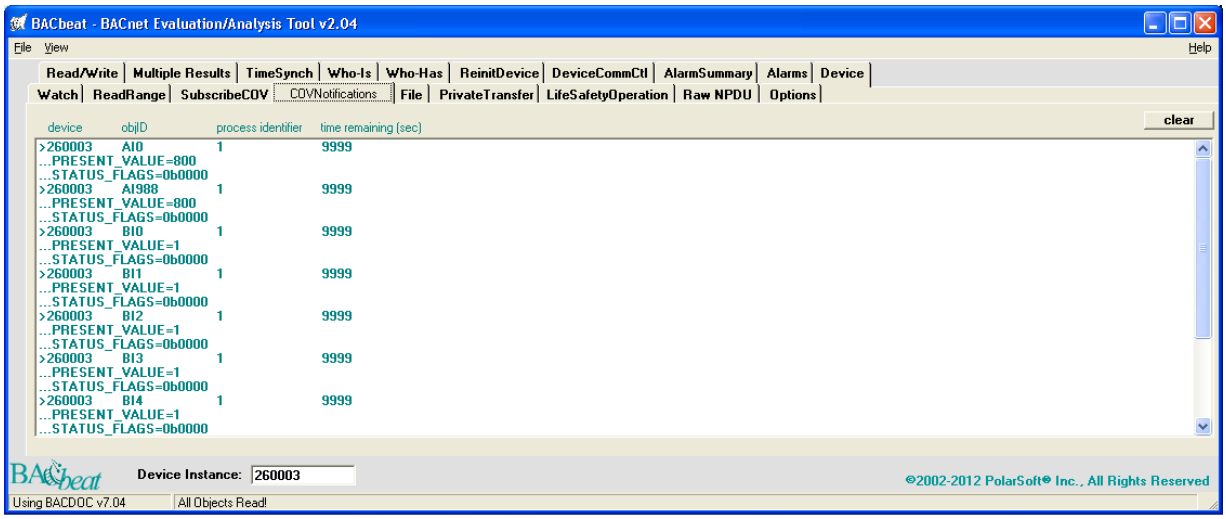


Figure 5-5: Analog Input Subscription Dialog

8. From the AMC-400 CO Sensor Configuration enter SE2 (service mode 2) and simulate the gas concentration of 25PPM.

   Refer to the AMC-400 User Manual for details on configuring SE2.
   This should light the ALARM1 LED and activate Relay 1 and Relay 4.

   From the BACBeat COVNotifications list view the following (note that the order may vary):

   - AI 0 PRESENT VALUE=1600
   - AI 988 PRESENT VALUE=1600

- BI 0 PRESENT VALUE=0
- BI 4 PRESENT VALUE=0

On both AI objects; Sensor 1 and Analog Output 1 the PRESENT VALUE of 1600 is 25% FS or 25ppm. In this case Relay 1 and Relay 4 have a PRESENT VALUE of 0. With normal polarity they are de-energized.

See Figure 5-6 for an example of Sensor Configuration SE2 (service mode 2).

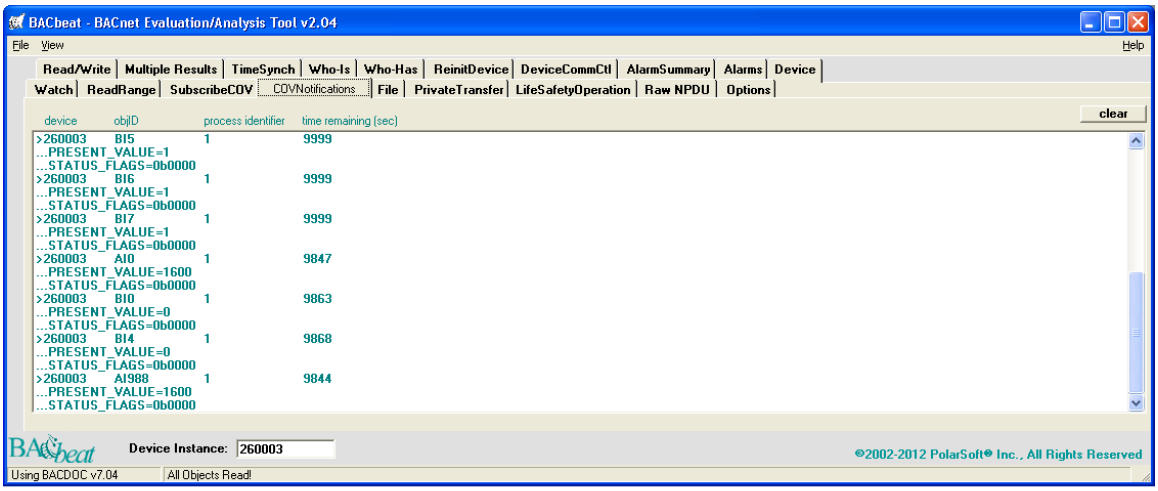


Figure 5-6: COVNotifications Sensor Configuration SE2

9. From the AMC-400 CO Sensor exit SE2.

   From the BACBeat COVNotifications list view the following (note that the order may vary):

   - AI 0 PRESENT VALUE=800
   - A I988 PRESENT VALUE=800
   - BI 0 PRESENT VALUE=1
   - BI 4 PRESENT VALUE=1

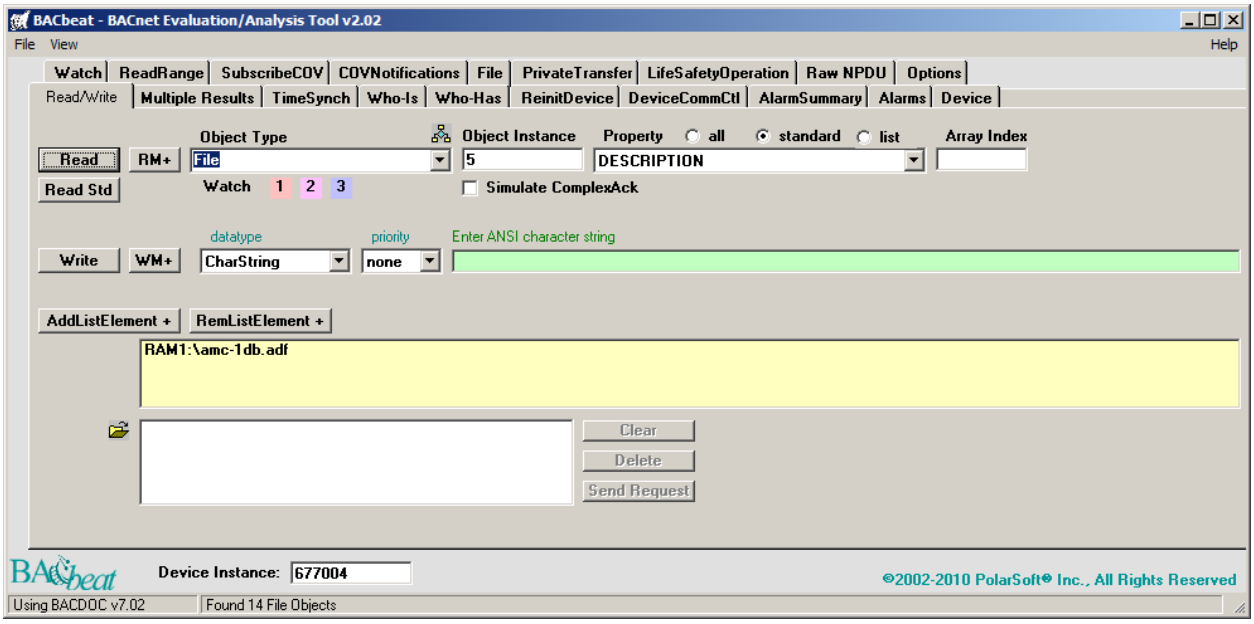
Both AI objects; Sensor 1 and Analog Output 1 have their PRESENT VALUE of 800 which is 0% FS or 0ppm. Both BI objects; Relay 1 and Relay 4 have a PRESENT VALUE of 1. With normal polarity this is energized.

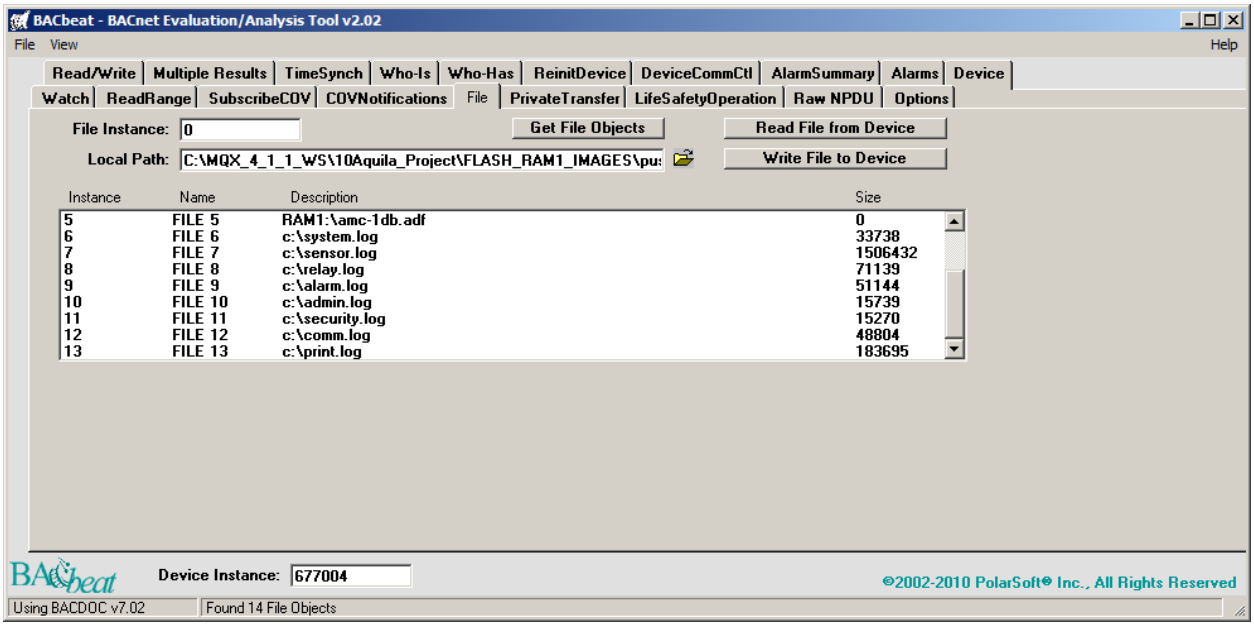
5.5 SEQUENCE OF OPERATION FOR DATABASE RETRIEVE AND RESTORE

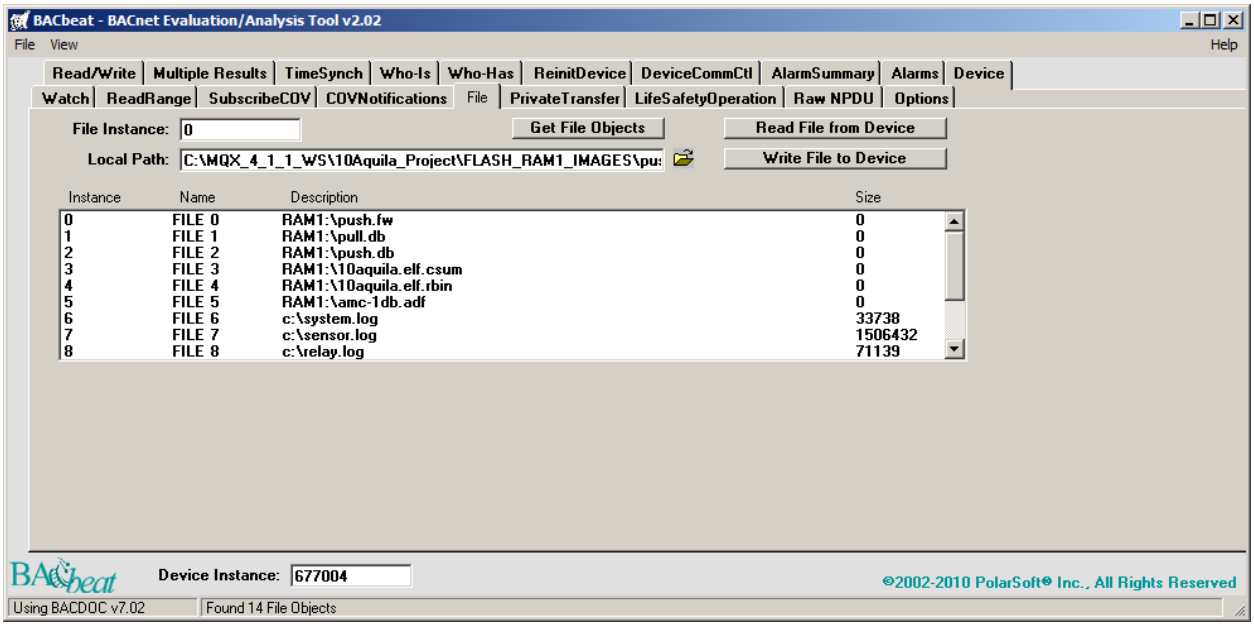
The following is an example sequence to demonstrate how to retrieve and restore database using BACnet File Objects:

1. It is recommended to use only BACnet-IP transport when retrieving or restoring the database for improve file integrity.

2. Using the BACBeat tool and the File dialog press the Get File Object button. This action can take several minutes as the tool searches through thousands of objects looking for the file object properties. Knowing the file objects and their description names can save this time. Alternatively you can read the file description for any file objects 1 through 13 using the Read/Write dialog. Below is a list of file objects and their descriptions:







3. From a notepad editor create a local file called C:\pull.db. In that file place the text “pull.db” and save. Using the File dialog select this local object path and enter the File Instance: 1 and press the Write File to Device button. This will cause the monitor runtime environment to pull the database from its Battery back-up database storage memory into its file system.

4. From the File dialog enter a local path to a filename you use wish to write the pulled database (i.e. C:\amc-1db.adf). Enter the File Instance: 5 and press the Read File from Device button. This will transfer the pulled database to the local path filename. The bottom line shows the progress of this transfer.

5. The local path database file can now be imported into AMC Manager for viewing and modification. Export the database to local path filename once modifications are complete.

6. From the File dialog enter a local path to a filename you use wish to write the modification database (i.e. C:\amc-1db.adf). Enter the File Instance: 5 and press the Write File from Device button. This will transfer the modification database to the runtime environment. The bottom line shows the progress of this transfer.

7. From a notepad editor create a local file called C:\push.db. In that file place the text “push.db” and save. Using the File dialog select this local object path and enter the File Instance: 2 and press the Write File to Device button. This will cause the monitor runtime environment to push the database from its file system to Battery back-up database storage memory.

8. Wait a minute and the database modification will be saved and activated.

5.6 SEQUENCE OF OPERATION FOR FIRMWARE UPGRADES

The following is an example sequence to demonstrate how to upgrade the firmware using BACnet File Objects:

1. It is recommended to use only BACnet-IP transport when transferring firmware image for improve file integrity.

2. From the File dialog enter a local path to the firmware image filename you obtained from Armstrong Monitoring (i.e. C:\10aquila.elf.rbin). Enter the File Instance: 4 and press the Write File from Device button. This will transfer the firmware image to the runtime environment. The bottom line shows the progress of this transfer.

3. From the File dialog enter a local path to the firmware image filename you obtained from Armstrong Monitoring (i.e. C:\10aquila.elf.csum). Enter the File Instance: 3 and press the Write File from Device button. This will transfer the firmware image checksum file to the runtime environment.

4. From a notepad editor create a local file called C:\push.fw. In that file place the text “push.fw” and save. Using the File dialog select this local object path and enter the File Instance: 0 and press the Write File to Device button. This will cause the monitor runtime environment to push the firmware from its file system to the FLASH bootstrap memory.

5. Once firmware image is transferred the system will automatically reboot activating the new firmware.

6 MODBUS RTU/TCP DESCRIPTION

The BAS MODBUS Uplink interface is useful for monitoring the state of the AMC-1DBx monitor. Unlike BACnet it requires a constant refreshing of its BAS MODBUS registers to determine the monitor state. The MODBUS uplink is useful for debugging a running system; many details of a failing system are only available through the BAS MODBUS registers. This interface is also useful for some remote configuration.

6.1 AMC-1DBX BAS MODBUS RTU/TCP REGISTER LIST

The BAS MODBUS register list provided in this section are all accessible at the Slave Address using MODBUS-RTU on the Uplink RS-485 interface or MODBUS-TCP on Ethernet IP. The BAS MODBUS Slave Address is configured by the MODBUS BAS menu item under the Set Interface menu tree. Please refer to the AMC-1DBx User Manual for configuration details.

The BAS MODBUS registers implemented can be used to change configuration. Configuration changes are also achieved with AMC Manager or configuration menus. Care must be given as changing BAS MODBUS configuration can result monitor entering FAIL state or loss of BAS communication. A simple write protection feature is available through the Set Interface, BAS MODBUS, Un-Lock Code menu item. Write access to the MODBUS register map is only possible when BAS MODBUS lock code register 500 contains a matching value set during menu configuration of the Un-Lock Code item.

The objects listed are described below and are grouped as follows:

- Monitor Status,
- Monitor Configuration,
- Device and Zone Status (Sensor, Relay, Analog Output and Zone),
- Monitor BAS Configuration,
- Device and Zone Information (Sensor, Relay, Analog Output and Zone),
- Device and Zone Control (Sensor, Relay, Analog Output and Zone).

The MODBUS Registers listed are based starting at 1; actual MODBUS addresses are referenced at 1 less. As example; BAS MODBUS lock code register 500 has a MODBUS address of 499.

Each object has important information and applying an optimal operating sequence is best for limiting the number of utilized registers. Further in this chapter some possible operating sequences are described. See AMC-1DBX BAS MODBUS SEQUENCE OF OPERATION.

The following is a list of all the BAS MODBUS registers in the AMC-1DBX configuration.

6.2 AMC-1DBX BAS MODBUS REGISTER DESCRIPTIONS

6.2.1 Monitor Status (Block Address 0-15)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
1	Monitor Status	**Read Only**	System Status	Fail Status[15:15]	Language[8:7] Audible Alarm Disabled[6:6] Zero Buffer Disabled[5:5] Minimum Run Timer Disabled[4:4] Cal Mode Enable[3:3] Hourglass Timer Active[2:2] Post Run Timer Disabled[1:1] Sensor Activation Delay Disabled[0:0]
2	Monitor Status	**Read Only**	Power Up Delay in seconds remaining	Power Up Delay[9:0]	
3	Monitor Status	**Read Only**	Acknowledge Timer in seconds remaining	Acknowledge Timer[7:0]	
4	Monitor Status	**Read Only**	System Type Name Character 1 and 2	Character 1[15:8]	Character 2[7:0]
5	Monitor Status	**Read Only**	System Type Name Character 3 and 4	Character 3[15:8]	Character 4[7:0]
6	Monitor Status	**Read Only**	System Type Name Character 5 and 6	Character 5[15:8]	Character 6[7:0]
7	Monitor Status	**Read Only**	System Type Name Character 7 and 8	Character 7[15:8]	Character 8[7:0]
8	Monitor Status	**Read Only**	Firmware Version	Major Version[11:8]	Minor Version[6:0]
9	Monitor Status	**Read Only**	Number of Sensors available **(Enabled and Discovered)**	Number of Sensors available[9:0]	
10	Monitor Status	**Read Only**	Number of Relays available **(Enabled and Discovered)**	Number of Relays available[7:0]	
11	Monitor Status	**Read Only**	Number of Analog available **(Enabled and Discovered)**	Number of Analog available[6:0]	
12	Monitor Status	**Read Only**	Number of Zones available **(Enabled and Discovered)**	Number of Zones available[6:0]	
13	Monitor Status	**Read Only**	System Sensors allowed **(Application Maximum)**	System Sensors allowed[9:0]	
14	Monitor Status	**Read Only**	System Relays allowed **(Application Maximum)**	System Relays allowed[7:0]	

15	Monitor Status	**Read Only**	System Analog Outputs allowed **(Application Maximum)**	System Analog Outputs allowed[6:0]	
16	Monitor Status	**Read Only**	System Zones allowed **(Application Maximum)**	System Zones allowed[6:0]	

6.2.1.1 System Status, Power-Up Delay, Acknowledge Timer

These registers contain the system status, seconds remaining on power-up, and acknowledge timers. The system status contains the system FAIL indicator which is set when the sensor raw value falls below the fail threshold or there are missing devices (Sensors, remote Relays and remote Analog Outputs). This occurs when the monitor loses communication with a digital sensor over the applicable downlink MODBUS interface. The other entities in the system status contain information about system disables. The system disables represent the system's DIP switch. See the 1DBx User Manual for further details.

These registers are read only and will return an exception if written.

6.2.1.2 System Name and Firmware Revision

There are four registers containing the 8-character system name string AMC-1DB which is hard coded by firmware. The revision register contains a composite of the major and minor revision of the firmware. It is also displayed on the top line of the LCD user display.

These registers are read only and will return an exception if written.

6.2.1.3 Number of Enabled and Discovered Devices and Zones

These registers contain the number of enabled/discovered sensors, relays, analog outputs and zones in the system. Use this information for debug when polling and interrogating the system. Configured devices may not be unique in nature and may have duplicate MODBUS address and instance settings. Any settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be counted here, nor will devices on a RS-485 MODBUS interface that are disabled.

When the System Status indicates FAIL due to a missing sensor(s) the number of enabled and discovered sensors will indicate a lower sensor count than what is expected. The available sensor(s) can be found by dumping the Sensor Status registers at 100-161 containing a Boolean 1 for each availability sensor. Each sensor status register holds availability for 16 sensors, but knowing which sensors are enabled is important. The sensor enables can be achieved by reading sensor control 1 register starting at 10000 for sensor 1.

Alternatively, use AMC Manager with the currently upload database to clearly show which sensors and RS-485 interfaces are enabled.

These registers are read only and will return an exception if written.

6.2.1.4 Number of Devices and Zones Allowed

These registers contain the absolute limit of Sensors, Relays, Analog Outputs and Zones. These are hard coded in the firmware and are 988 Sensors, 256 Relays, 128 Analog Outputs and 128 Zones.

These registers are read only and will return an exception if written.

6.2.2 Monitor Configuration (Block Address 19-85)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
		Write Access only available when BAS MODBUS Lockcode valid			
20	Monitor Configuration	**Read/Write**	Time Year	Time Year[15:0]	
21	Monitor Configuration	**Read/Write**	Time Month and Day	Time Month[11:8]	Day[4:0]
22	Monitor Configuration	**Read/Write**	Time Hour and Minute	Time Hour[12:8]	Minute[5:0]
23	Monitor Configuration	**Read/Write**	Time Second	Time Second[5:0]	
24	Monitor Configuration	**Read/Write**	Ethernet IP Address High and Midhi Segments	High Segment[15:8]	Midhi Segment[7:0]
25	Monitor Configuration	**Read/Write**	Ethernet IP Address Midlo and Low Segments	Midlo Segment[15:8]	Low Segment[7:0]
26	Monitor Configuration	**Read/Write**	Ethernet IP Mask High and Midhi Segment	High Segment[15:8]	Midhi Segment[7:0]
27	Monitor Configuration	**Read/Write**	Ethernet IP Mask Midlo and Low Segment	Midlo Segment[15:8]	Low Segment[7:0]
28	Monitor Configuration	**Read/Write**	Ethernet IP Gateway High and Midhi Segment	High Segment[15:8]	Midhi Segment[7:0]
29	Monitor Configuration	**Read/Write**	Ethernet IP Gateway Midlo and Low Segment	Midlo Segment[15:8]	Low Segment[7:0]
30	Monitor Configuration	**Read/Write**	MODBUS1 RS485 Configuration	Enable[15:15]	Baud Rate[10:8] Stop_Bits[7:6] Parity[5:4] Length[3] Protocol[1:0]
31	Monitor Configuration	**Read/Write**	MODBUS2 RS485	Enable[15:15]	Baud Rate[10:8] Stop_Bits[7:6]

			Configuration		Parity[5:4] Length[3] Protocol[1:0]
32	Monitor Configuration	**Read/Write**	MODBUS3 RS485 Configuration	Enable[15:15]	Baud Rate[10:8] Stop_Bits[7:6] Parity[5:4] Length[3] Protocol[1:0]
33	Monitor Configuration	**Read/Write**	MODBUS4 RS485 Configuration	Enable[15:15]	Baud Rate[10:8] Stop_Bits[7:6] Parity[5:4] Length[3] Protocol[1:0]
34	Monitor Configuration	**Read/Write**	Default Fail Threshold in tenths of mA	Default Fail Threshold in tenths of mA[4:0]	
35	Monitor Configuration	**Read/Write**	Power Up Delay in seconds	Power Up Delay in seconds[9:0]	
36	Monitor Configuration	**Read/Write**	Acknowledge Timer in minutes	Acknowledge Timer in minutes[7:0]	
37	Monitor Configuration	**Read/Write**	Zero Buffering in tenth of % of Full Scale	Zero Buffering in tenth of % of Full Scale[5:0]	
38	Monitor Configuration	**Read/Write**	Alarm Hysteresis in tenth of % of Full Scale	Alarm Hysteresis in tenth of % of Full Scale[5:0]	
39	Monitor Configuration	**Read/Write**	Log File Enables	Log File Enables[9:0]	
40	Monitor Configuration	**Read/Write**	Misc. Control	Dew Point Alarm Enable[9:9]	Serial Mode[8:8] Backlight_Choice[7:7] Audible Alarm Mode[6:5] Audio Cadence[4:4] Enable Location Labels[3:3] Display Mode[2:0]
41	Monitor Configuration	**Read/Write**	Dew Point Relay	Dew Point Relay[7:0]	
42	Monitor Configuration	**Read/Write**	User Label1 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
43	Monitor Configuration	**Read/Write**	User Label1 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
44	Monitor Configuration	**Read/Write**	User Label1 Character 5	Character 5[15:8]	Spare[7:0]
45	Monitor Configuration	**Read/Write**	User Label2 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
46	Monitor Configuration	**Read/Write**	User Label2 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
47	Monitor Configuration	**Read/Write**	User Label2 Character 5	Character 5[15:8]	Spare[7:0]
48	Monitor	**Read/Write**	User Label3	Character 1[15:8]	Character 2[7:0]

	Configuration		Character 1 and 2		
49	Monitor Configuration	**Read/Write**	User Label3 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
50	Monitor Configuration	**Read/Write**	User Label3 Character 5	Character 5[15:8]	Spare[7:0]
51	Monitor Configuration	**Read/Write**	User Label4 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
52	Monitor Configuration	**Read/Write**	User Label4 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
53	Monitor Configuration	**Read/Write**	User Label4 Character 5	Character 5[15:8]	Spare[7:0]
54	Monitor Configuration	**Read/Write**	User Label5 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
55	Monitor Configuration	**Read/Write**	User Label5 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
56	Monitor Configuration	**Read/Write**	User Label5 Character 5	Character 5[15:8]	Spare[7:0]
57	Monitor Configuration	**Read/Write**	User Label6 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
58	Monitor Configuration	**Read/Write**	User Label6 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
59	Monitor Configuration	**Read/Write**	User Label6 Character 5	Character 5[15:8]	Spare[7:0]
60	Monitor Configuration	**Read/Write**	User Label7 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
61	Monitor Configuration	**Read/Write**	User Label7 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
62	Monitor Configuration	**Read/Write**	User Label7 Character 5	Character 5[15:8]	Spare[7:0]
63	Monitor Configuration	**Read/Write**	User Label8 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
64	Monitor Configuration	**Read/Write**	User Label8 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
65	Monitor Configuration	**Read/Write**	User Label8 Character 5	Character 5[15:8]	Spare[7:0]
66	Monitor Configuration	**Read/Write**	User Label9 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
67	Monitor Configuration	**Read/Write**	User Label9 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
68	Monitor Configuration	**Read/Write**	User Label9 Character 5	Character 5[15:8]	Spare[7:0]

69	Monitor Configuration	**Read/Write**	Engineering Label1 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
70	Monitor Configuration	**Read/Write**	Engineering Label1 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
71	Monitor Configuration	**Read/Write**	Engineering Label2 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
72	Monitor Configuration	**Read/Write**	Engineering Label2 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
73	Monitor Configuration	**Read/Write**	Engineering Label3 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
74	Monitor Configuration	**Read/Write**	Engineering Label3 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
75	Monitor Configuration	**Read/Write**	Engineering Label4 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
76	Monitor Configuration	**Read/Write**	Engineering Label4 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
77	Monitor Configuration	**Read/Write**	Engineering Label5 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
78	Monitor Configuration	**Read/Write**	Engineering Label5 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
79	Monitor Configuration	**Read/Write**	Engineering Label6 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
80	Monitor Configuration	**Read/Write**	Engineering Label6 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
81	Monitor Configuration	**Read/Write**	Engineering Label7 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
82	Monitor Configuration	**Read/Write**	Engineering Label7 Character 3 and	Character 3[15:8]	Character 4[7:0]

			4		
83	Monitor Configuration	**Read/Write**	Engineering Label8 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
84	Monitor Configuration	**Read/Write**	Engineering Label8 Character 3 and 4	Character 3[15:8]	Character 4[7:0]
85	Monitor Configuration	**Read/Write**	Engineering Label9 Character 1 and 2	Character 1[15:8]	Character 2[7:0]
86	Monitor Configuration	**Read/Write**	Engineering Label9 Character 3 and 4	Character 3[15:8]	Character 4[7:0]

6.2.2.1 Current Date and Time

These registers contain the current date and time. Setting these registers will immediately change the system time. This will impact schedule events and logging timestamps. The years must be between 2011 and 2100, and the months, days, hours, minutes and seconds must be valid otherwise a MODBUS exception result is returned.

6.2.2.2 IP Address, Netmask and Gateway

These registers contain three IP entities; IP address, IP Netmask and IP Gateway information in subnet dot notation www.xxx.yyy.zzz where each component is a number between 0-255. Each of these three entities is composed in two MODBUS registers. Each register contains two subnet components.

The first of two registers contains the highest portion (www) is in bit field [15:8] while the middle high portion (xxx) is in bit field [7:0]. The middle low (yyy) and low portion (zzz) are composed in the second of the two registers.

6.2.2.3 MODBUS 1-4 RS-485 Configuration

These four registers contain the MODBUS configuration for the 4 downlink RS-485 interfaces; MODBUS 1, MODBUS2, MODBUS3 and MODBUS4. The configuration includes bit fields for administration enable, baud rate, stop bits, parity, length and protocol.

The enable is located in bit [15]. The baud rate bit field [10:8] is decoded as follows; 0=1200, 1=2400, 2=4800, 3=9600, 4=19200, 5=38400, 6=76800 and 7=115200. Values above 7 will return a MODBUS exception result.

The stop bits field [7:6] is decoded as follows; 0=1 bit, 1=1.5 bits and 2=2 bits (Values above 2 will return a MODBUS exception result).

The parity bit field [5:4] is decoded as follows; 0=None, 1=Even and 2=Odd (Values above 2 will return a MODBUS exception result).

The length bit [3] is decoded as 0=7 bit and 1=8-bit length.

The protocol bit field [1:0] is decoded as follows; 0=RTU, 1=ASCII and 2=BACNET MSTP. Currently only the RTU setting is supported. Values above 2 will return a MODBUS exception result.

6.2.2.4 Default Fail Threshold, Power Up and Acknowledge Delay, Zero Buffer, Alarm Hysteresis, Log Enables

These six registers contain various configuration settings.
The default fail threshold has the value in tenths of mA used when a new gas label is selected from the configuration menus. It has no meaning when the sensor threshold is configured from BAS MODBUS as the absolute FAIL threshold value is used instead. Values above 40 will return a MODBUS exception result.

The Power-Up delay contains the number of seconds the monitor will run after power-up prior to activating ALARM/FAIL relays. Values above 999 will return a MODBUS exception result.

The Acknowledge delay contains the number of minutes the monitor will run while an ALARM condition exists before re-activating the ALARM/FAIL relays that are configured with Ackn to Reset. Values above 60 and not 255 will return a MODBUS exception result. A value of 255 represents infinite time.
The Zero buffer and Alarm hysteresis are tenth % full scale represented values for filtering low background and transient gas concentration for all sensors. Values above 50 will return a MODBUS exception result.

The Log Enables has a bit field representing the 10 logging filters that can be disabled or enabled; 0=Sensor Log, 1=Relay Log, 2=Alarm Log, 3=System Log, 4=Administrator Log, 5=Security Log, 6=Communication Log, 7=Display Log, 8=Printer Log and 9= Console Log.

6.2.2.5 Misc. Control

This register contains bit fields packed into a 16-bit wide register for controlling miscellaneous control features. The following misc. controls are supported:

Dew Point Alarm Enable 0=disable, 1=enable,
Serial Mode 0=Remote (AMC Manager), 1=Printer,
Backlight Control 0=Power Save, 1=Always on,
Audible Alarm Mode 0=All ALARMS/FAIL, 1=All ALARMS, 2=High ALARMS,
Audio Cadence 0=continuous, 1=pulse,
Location Enable 0=disable, 1=enable,
Display Mode 0=Display All Data, 1=Display All Alarms, 2=Display New Alarms, 3=Display Sensor Raw values, 4=Display All Relays.

Other values will return a MODBUS exception result.

6.2.2.6 Dew Relay

This register contains the Dew Relay number which is base 0. Values above 255 will always represent relays 0-255.

6.2.2.7 User Labels 1 to 9

These registers hold the 5-character string for user-definable gas labels. There are 9 labels of which each label is composed from a set of 3 registers. The default user strings are “USER1” through “USER9”. Only displayable ASCII characters are accepted on write transactions.

Other values will return a MODBUS exception result.

6.2.2.8 Engineer Units 1 to 9

These registers hold the 4-character string for user-definable engineering units. There are 9 possible units and each is composed from a set of 2 registers. The default user strings are “ENG1” through “ENG9”. Only displayable ASCII characters are accepted on write transactions.

Other values will return a MODBUS exception result.

6.2.3 Devices and Zone Status (Block Address 99-406)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
100	Sensors Status	**Read Only**	Sensors 016 to 001 Availability (Enabled and Discovered)	Bit Array 01[15:0]	
101	Sensors Status	**Read Only**	Sensors 032 to 017 Availability (Enabled and Discovered)	Bit Array 02[15:0]	
102	Sensors Status	**Read Only**	Sensors 048 to 033 Availability (Enabled and Discovered)	Bit Array 03[15:0]	
103	Sensors Status	**Read Only**	Sensors 064 to 049 Availability (Enabled and Discovered)	Bit Array 04[15:0]	
104	Sensors Status	**Read Only**	Sensors 080 to 065 Availability (Enabled and Discovered)	Bit Array 05[15:0]	
105	Sensors Status	**Read Only**	Sensors 096 to 081 Availability (Enabled and Discovered)	Bit Array 06[15:0]	
106	Sensors Status	**Read Only**	Sensors 112 to 097 Availability (Enabled and Discovered)	Bit Array 07[15:0]	
107	Sensors Status	**Read Only**	Sensors 128 to 113 Availability (Enabled and Discovered)	Bit Array 08[15:0]	
108	Sensors Status	**Read Only**	Sensors 144 to 129 Availability (Enabled and Discovered)	Bit Array 09[15:0]	
109	Sensors Status	**Read Only**	Sensors 160 to 145 Availability (Enabled and Discovered)	Bit Array 10[15:0]	
110	Sensors Status	**Read Only**	Sensors 176 to 161 Availability (Enabled and Discovered)	Bit Array 11[15:0]	
111	Sensors Status	**Read Only**	Sensors 192 to 177 Availability (Enabled and Discovered)	Bit Array 12[15:0]	
112	Sensors Status	**Read Only**	Sensors 208 to 193 Availability (Enabled and Discovered)	Bit Array 13[15:0]	
113	Sensors Status	**Read Only**	Sensors 224 to 209 Availability (Enabled and Discovered)	Bit Array 14[15:0]	
114	Sensors Status	**Read Only**	Sensors 240 to 225 Availability (Enabled and Discovered)	Bit Array 15[15:0]	
115	Sensors Status	**Read Only**	Sensors 256 to 241 Availability (Enabled and Discovered)	Bit Array 16[15:0]	
116	Sensors Status	**Read Only**	Sensors 272 to 257 Availability (Enabled and Discovered)	Bit Array 17[15:0]	

117	Sensors Status	**Read Only**	Sensors 288 to 273 Availability (Enabled and Discovered)	Bit Array 18[15:0]	
118	Sensors Status	**Read Only**	Sensors 304 to 289 Availability (Enabled and Discovered)	Bit Array 19[15:0]	
119	Sensors Status	**Read Only**	Sensors 320 to 305 Availability (Enabled and Discovered)	Bit Array 20[15:0]	
120	Sensors Status	**Read Only**	Sensors 336 to 321 Availability (Enabled and Discovered)	Bit Array 21[15:0]	
121	Sensors Status	**Read Only**	Sensors 352 to 337 Availability (Enabled and Discovered)	Bit Array 22[15:0]	
122	Sensors Status	**Read Only**	Sensors 368 to 353 Availability (Enabled and Discovered)	Bit Array 23[15:0]	
123	Sensors Status	**Read Only**	Sensors 384 to 369 Availability (Enabled and Discovered)	Bit Array 24[15:0]	
124	Sensors Status	**Read Only**	Sensors 400 to 385 Availability (Enabled and Discovered)	Bit Array 25[15:0]	
125	Sensors Status	**Read Only**	Sensors 416 to 401 Availability (Enabled and Discovered)	Bit Array 26[15:0]	
126	Sensors Status	**Read Only**	Sensors 432 to 417 Availability (Enabled and Discovered)	Bit Array 27[15:0]	
127	Sensors Status	**Read Only**	Sensors 448 to 433 Availability (Enabled and Discovered)	Bit Array 28[15:0]	
128	Sensors Status	**Read Only**	Sensors 464 to 449 Availability (Enabled and Discovered)	Bit Array 29[15:0]	
129	Sensors Status	**Read Only**	Sensors 480 to 465 Availability (Enabled and Discovered)	Bit Array 30[15:0]	
130	Sensors Status	**Read Only**	Sensors 496 to 481 Availability (Enabled and Discovered)	Bit Array 31[15:0]	
131	Sensors Status	**Read Only**	Sensors 512 to 497 Availability (Enabled and Discovered)	Bit Array 32[15:0]	
132	Sensors Status	**Read Only**	Sensors 528 to 513 Availability (Enabled and Discovered)	Bit Array 33[15:0]	
133	Sensors Status	**Read Only**	Sensors 544 to 529 Availability (Enabled and Discovered)	Bit Array 34[15:0]	
134	Sensors Status	**Read Only**	Sensors 560 to 545 Availability (Enabled and Discovered)	Bit Array 35[15:0]	
135	Sensors Status	**Read Only**	Sensors 576 to 561 Availability (Enabled and Discovered)	Bit Array 36[15:0]	
136	Sensors Status	**Read Only**	Sensors 592 to 577 Availability (Enabled and Discovered)	Bit Array 37[15:0]	
137	Sensors Status	**Read Only**	Sensors 608 to 593 Availability (Enabled and Discovered)	Bit Array 38[15:0]	
138	Sensors Status	**Read Only**	Sensors 624 to 609 Availability (Enabled and Discovered)	Bit Array 39[15:0]	
139	Sensors Status	**Read Only**	Sensors 640 to 625 Availability (Enabled and Discovered)	Bit Array 40[15:0]	
140	Sensors Status	**Read Only**	Sensors 656 to 641 Availability (Enabled and Discovered)	Bit Array 41[15:0]	
141	Sensors Status	**Read Only**	Sensors 672 to 657 Availability (Enabled and Discovered)	Bit Array 42[15:0]	
142	Sensors Status	**Read Only**	Sensors 688 to 673 Availability (Enabled and Discovered)	Bit Array 43[15:0]	
143	Sensors Status	**Read Only**	Sensors 704 to 689 Availability (Enabled and Discovered)	Bit Array 44[15:0]	

144	Sensors Status	**Read Only**	Sensors 720 to 705 Availability (Enabled and Discovered)	Bit Array 45[15:0]	
145	Sensors Status	**Read Only**	Sensors 736 to 721 Availability (Enabled and Discovered)	Bit Array 46[15:0]	
146	Sensors Status	**Read Only**	Sensors 752 to 737 Availability (Enabled and Discovered)	Bit Array 47[15:0]	
147	Sensors Status	**Read Only**	Sensors 768 to 753 Availability (Enabled and Discovered)	Bit Array 48[15:0]	
148	Sensors Status	**Read Only**	Sensors 784 to 769 Availability (Enabled and Discovered)	Bit Array 49[15:0]	
149	Sensors Status	**Read Only**	Sensors 800 to 785 Availability (Enabled and Discovered)	Bit Array 50[15:0]	
150	Sensors Status	**Read Only**	Sensors 816 to 801 Availability (Enabled and Discovered)	Bit Array 51[15:0]	
151	Sensors Status	**Read Only**	Sensors 832 to 817 Availability (Enabled and Discovered)	Bit Array 52[15:0]	
152	Sensors Status	**Read Only**	Sensors 848 to 833 Availability (Enabled and Discovered)	Bit Array 53[15:0]	
153	Sensors Status	**Read Only**	Sensors 864 to 849 Availability (Enabled and Discovered)	Bit Array 54[15:0]	
154	Sensors Status	**Read Only**	Sensors 880 to 865 Availability (Enabled and Discovered)	Bit Array 55[15:0]	
155	Sensors Status	**Read Only**	Sensors 896 to 881 Availability (Enabled and Discovered)	Bit Array 56[15:0]	
156	Sensors Status	**Read Only**	Sensors 912 to 897 Availability (Enabled and Discovered)	Bit Array 57[15:0]	
157	Sensors Status	**Read Only**	Sensors 928 to 913 Availability (Enabled and Discovered)	Bit Array 58[15:0]	
158	Sensors Status	**Read Only**	Sensors 944 to 929 Availability (Enabled and Discovered)	Bit Array 59[15:0]	
159	Sensors Status	**Read Only**	Sensors 960 to 945 Availability (Enabled and Discovered)	Bit Array 60[15:0]	
160	Sensors Status	**Read Only**	Sensors 976 to 961 Availability (Enabled and Discovered)	Bit Array 61[15:0]	
161	Sensors Status	**Read Only**	Sensors 988 to 977 Availability (Enabled and Discovered)	Bit Array 62[15:0]	
350	Relays Status	**Read Only**	Relays 016 to 001 Availability (Enabled and Discovered)	Bit Array 01[15:0]	
351	Relays Status	**Read Only**	Relays 032 to 017 Availability (Enabled and Discovered)	Bit Array 02[15:0]	
352	Relays Status	**Read Only**	Relays 048 to 033 Availability (Enabled and Discovered)	Bit Array 03[15:0]	
353	Relays Status	**Read Only**	Relays 064 to 049 Availability (Enabled and Discovered)	Bit Array 04[15:0]	
354	Relays Status	**Read Only**	Relays 080 to 065 Availability (Enabled and Discovered)	Bit Array 05[15:0]	
355	Relays Status	**Read Only**	Relays 096 to 081 Availability (Enabled and Discovered)	Bit Array 06[15:0]	
356	Relays Status	**Read Only**	Relays 112 to 097 Availability (Enabled and Discovered)	Bit Array 07[15:0]	
357	Relays Status	**Read Only**	Relays 128 to 113 Availability (Enabled and Discovered)	Bit Array 08[15:0]	
358	Relays Status	**Read Only**	Relays 144 to 129 Availability (Enabled and Discovered)	Bit Array 09[15:0]	

359	Relays Status	**Read Only**	Relays 160 to 145 Availability (Enabled and Discovered)	Bit Array 10[15:0]	
360	Relays Status	**Read Only**	Relays 176 to 161 Availability (Enabled and Discovered)	Bit Array 11[15:0]	
361	Relays Status	**Read Only**	Relays 192 to 177 Availability (Enabled and Discovered)	Bit Array 12[15:0]	
362	Relays Status	**Read Only**	Relays 208 to 193 Availability (Enabled and Discovered)	Bit Array 13[15:0]	
363	Relays Status	**Read Only**	Relays 224 to 209 Availability (Enabled and Discovered)	Bit Array 14[15:0]	
364	Relays Status	**Read Only**	Relays 240 to 225 Availability (Enabled and Discovered)	Bit Array 15[15:0]	
365	Relays Status	**Read Only**	Relays 256 to 241 Availability (Enabled and Discovered)	Bit Array 16[15:0]	
380	Analog Outputs Status	**Read Only**	Analog Outputs 016 to 001 Availability (Enabled and Discovered)	Bit Array 01[15:0]	
381	Analog Outputs Status	**Read Only**	Analog Outputs 032 to 017 Availability (Enabled and Discovered)	Bit Array 02[15:0]	
382	Analog Outputs Status	**Read Only**	Analog Outputs 048 to 033 Availability (Enabled and Discovered)	Bit Array 03[15:0]	
383	Analog Outputs Status	**Read Only**	Analog Outputs 064 to 049 Availability (Enabled and Discovered)	Bit Array 04[15:0]	
384	Analog Outputs Status	**Read Only**	Analog Outputs 080 to 065 Availability (Enabled and Discovered)	Bit Array 05[15:0]	
385	Analog Outputs Status	**Read Only**	Analog Outputs 096 to 081 Availability (Enabled and Discovered)	Bit Array 06[15:0]	
386	Analog Outputs Status	**Read Only**	Analog Outputs 112 to 097 Availability (Enabled and Discovered)	Bit Array 07[15:0]	
387	Analog Outputs Status	**Read Only**	Analog Outputs 128 to 113 Availability (Enabled and Discovered)	Bit Array 08[15:0]	
400	Zones Status	**Read Only**	Zones 016 to 001 Availability (Enabled and Discovered)	Bit Array 01[15:0]	
401	Zones Status	**Read Only**	Zones 032 to 017 Availability (Enabled and Discovered)	Bit Array 02[15:0]	
402	Zones Status	**Read Only**	Zones 048 to 033 Availability (Enabled and Discovered)	Bit Array 03[15:0]	
403	Zones Status	**Read Only**	Zones 064 to 049 Availability (Enabled and Discovered)	Bit Array 04[15:0]	
404	Zones Status	**Read Only**	Zones 080 to 065 Availability (Enabled and Discovered)	Bit Array 05[15:0]	
405	Zones Status	**Read Only**	Zones 096 to 081 Availability (Enabled and Discovered)	Bit Array 06[15:0]	
406	Zones Status	**Read Only**	Zones 112 to 097 Availability (Enabled and Discovered)	Bit Array 07[15:0]	
407	Zones Status	**Read Only**	Zones 128 to 113 Availability (Enabled and Discovered)	Bit Array 08[15:0]	

6.2.3.1 Sensor Status 1 to 988Availablity

These registers hold the availability status for sensors 1 through 988. Each register contains a bit mask for 16 sensors; 0=not available, 1=available.
MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.

These registers are read only and will return an exception if written.

6.2.3.2 Relay Status 1 to 256Availablity

These registers hold the availability status for relay 1 through 256. Each register contains a bit mask for 16 relays; 0=not available, 1=available.
MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.

These registers are read only and will return an exception if written.

6.2.3.3 Analog Output Status 1 to 128Availablity

These registers hold the availability status for analog output 1 through 128. Each register contains a bit mask for 16 analog outputs; 0=not available, 1=available.
MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.

These registers are read only and will return an exception if written.

6.2.3.4 Zone Status 1 to 128Availablity

These registers hold the availability status for zone 1 through 128. Each register contains a bit mask for 16 zone; 0=not available, 1=available.

These registers are read only and will return an exception if written.

6.2.4 Monitor BAS Configuration (Block Address 499-521)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
		Write Access only available when BAS MODBUS Lockcode valid			
500	Monitor BAS Configuration	**Write Only**	BAS MODBUS LockCode	[15:0]	
501	Monitor BAS Configuration	**Read/Write**	BAS MODBUS TCP Port	[15:0]	

502	Monitor BAS Configuration	**Read/Write**	BAS MODBUS RS485 Configuration	Enable[15:15]	Baud Rate[10:8] Stop_Bits[7:6] Parity[5:4] Length[3:3] Protocol[1:0]
503	Monitor BAS Configuration	**Read/Write**	BACNET Configuration/High ID	Transport[15:15]	ID[5:0]
504	Monitor BAS Configuration	**Read/Write**	BACNET Low ID	ID[15:0]	
505	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 1 and 2	Character 1[15:8]	Character 2[7:0]
506	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 3 and 4	Character 3[15:8]	Character 4[7:0]
507	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 5 and 6	Character 5[15:8]	Character 6[7:0]
508	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 7 and 8	Character 7[15:8]	Character 8[7:0]
509	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 9 and 10	Character 9[15:8]	Character 10[7:0]
510	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 11 and 12	Character 11[15:8]	Character 12[7:0]
511	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 13 and 14	Character 13[15:8]	Character 14[7:0]
512	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 15 and 16	Character 15[15:8]	Character 16[7:0]
513	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 17 and 18	Character 17[15:8]	Character 18[7:0]
514	Monitor BAS Configuration	**Read/Write**	BACNET Name Characters 19 and 20	Character 19[15:8]	Character 20[7:0]
515	Monitor BAS Configuration	**Read/Write**	BACNET Network Number	Number[15:0]	
516	Monitor BAS Configuration	**Read/Write**	BACNET IP UDP Port	Port[15:0]	
517	Monitor BAS Configuration	**Read/Write**	BACNET IP TimeToLive	TimeToLive[15:0]	
518	Monitor BAS Configuration	**Read/Write**	BACNET BBMD Address High and Midhi Segment	High Segment[15:8]	Midhi Segment[7:0]
519	Monitor BAS Configuration	**Read/Write**	BACNET BBMD Address Midlo and Low Segment	Midlo Segment[15:8]	Low Segment[7:0]
520	Monitor BAS Configuration	**Read/Write**	BACNET MSTP Configuration	Address[15:8]	MSTP Maximum Masters[6:0]
521	Monitor BAS Configuration	**Read/Write**	BAS MODBUS Address/Protocol and BACNET MSTP Timeout Register	BAS MODBUS Address[15:8]	BAS MODBUS Protocol[7] BACnet-MSTP Timeout[6:0]

6.2.4.1 BAS MODBUS LockCode

This is a unique register for unlocking write access to all possible MODBUS registers. The code written to this register must match the code configured in the Set Interface, BAS MODBUS, and Un-Lock Code menu item. Write access to the MODBUS register map is only possible when the

BAS MODBUS lock code for this register contains a matching value set during menu configuration of the Un-Lock Code item.

This register can only be written and will return a MODBUS exception if read.

6.2.4.2 BAS MODBUS TCP

This register holds the MODBUS TCP UDP port number for MODBUS communication over TCP.

6.2.4.3 BAS MODBUS RS-485 Configuration

This register contains the MODBUS configuration for the uplink RS-485 interface. The configuration includes bit fields for administration enable, baud rate, stop bits, parity and protocol.

The enable field [15] is for the BAS RS-485 Interface can be enabled for MODBUS-RTU or BACnet-MSTP. The BAS MODBUS can be defined to use RS-485 Interface or Ethernet Interface with the protocol bit [7] in the BAS MODBUS Address/Protocol and BACnet-MSTP Timeout register.

The baud rate bit field [10:8] is decoded as follows; 0=1200, 1=2400, 2=4800, 3=9600, 4=19200, 5=38400, 6=76800 and 7=115200. Writing values above 7 will return a MODBUS exception result.

The stop bits field [7:6] is decoded as follows; 0=1 bit, 1=1.5 bits and 2=2 bits (writing values above 2 will return a MODBUS exception result).

The parity field [5:4] is decoded as follows; 0=None, 1=Even and 2=Odd (writing values above 2 will return a MODBUS exception result).

The length bit [3] is decoded as 0=7 bit and 1=8-bit length.

The protocol field [1:0] is decoded as follows; 0=RTU, 1=ASCII, 2=MSTP. Writing values above 2 will return a MODBUS exception result. Currently ASCII protocol is not supported and when set to ASCII the MODBUS operating environment will remain as RTU. When protocol is set to MSTP the MODBUS operating environment will also remain as RTU for use with MODBUS-TCP.

6.2.4.4 BACnet Configuration/Device High ID

This register contains the upper portion of the BACnet Device ID and the transport choice; 0=BACnet-MSTP, 1=BACnet-IP. Currently only BACnet-IP is supported. The most significant bit of this register is the transport choice. The Device ID is composed from the bit field [5:0] of this register and the 16 bits [15:0] of the BACnet Device Low ID register. The composition [5:0] [15:0] forms a BACnet Device ID which will range from 0-4194303.

Valid values for this register range from 0-63 and 32768-32831.

Writing other values will return a MODBUS exception result.

6.2.4.5 Device Low ID

This register contains the lower portion of the BACnet Device ID.
The Device ID is composed from the bit field [5:0] of the Configuration/Device High ID register and the 16 bits [15:0] of this register. The composition [5:0] [15:0] forms a BACnet Device ID which will range from 0-4194303.

6.2.4.6 BACnet Name Characters 1-20

These registers contain the BACnet name string composed in the 10 registers holding two characters each. The first character of the name string begins at register 505. The bit field [15:8] of this register has this first character. The bit field [7:0] of this same register has the second character. The subsequent consecutive registers carry the rest of the string.
Only displayable ASCII characters are accepted on write transactions. BACnet names less than 20 characters in length can be padded with space character(s).

Writing other values will return a MODBUS exception result.

6.2.4.7 BACnet-IP Network, UDP, TimeToLive Numbers

These registers contain the three BACnet-IP parameters; Network Number, UDP port and TimeToLive. The network number must be between 0-65534. The UDP ports supported are 0xBAC0 (47808) to 0xBACF (47823). The TimeToLive must be between 0-65535 seconds.

Writing other values will return a MODBUS exception result.

6.2.4.8 BACnet-IP BBMD Address

These registers contain the BACnet Broadcast Master Device IP address information in subnet dot notation www.xxx.yyy.zzz where each component is a number between 0-255. This entity is composed in two MODBUS registers. Each register contains two subnet components.

The first of two registers contains the highest portion (www) is in bit field [15:8] while the middle high portion (xxx) is in bit field [7:0]. The middle low (yyy) and low portion (zzz) are composed in the second of the two registers.

6.2.4.9 BACnet-MSTP Configuration

These registers contain the BACnet-MSTP configuration data and timeout value.

The BACnet-MSTP configuration address is stored in bit field [15:8] while the maximum number of masters is located in bit field [6:0]. The acceptable range is 1-247 and 1-127 respectively.

Writing other values will return a MODBUS exception result.

6.2.4.10 BAS MODBUS Address/Protocol and BACnet-MSTP Timeout Register

The BAS MODBUS Address bit field [15:8] is used for MODBUS-RTU RS-485 packets when the protocol bit [7] is set MODBUS-RTU.

The protocol bit field [7] is set for MODBUS-RTU or cleared for MODBUS-TCP.

The BACnet-MSTP Timeout is stored in bit field [6:0] and its acceptable range is 20-100 in mSec.

Writing other values will return a MODBUS exception result.

6.2.5 Devices and Zone Information (Block Address 999-9726)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
1000	Sensor Input Info.	**Read Only**	Sensor 001 Status	Availability[15:15]	Sensor Threshold Type/Alarms [14:12] %000=Disabled %001=Increasing 1 Alarm %010=Increasing 2 Alarms %011=Increasing 3 Alarms %100=Windowing 2 Alarms %101=Decreasing 1 Alarm %110=Decreasing 2 Alarms %111=Decreasing 3 Alarms Last Raw Input[11:0] (4-20mA;d800 to d4000)
to					
1987	Sensor Input Info.	**Read Only**	Sensor 988 Status	Availability[15:15]	Sensor Threshold Type/Alarms [14:12] %000=Disabled %001=Increasing 1 Alarm %010=Increasing 2 Alarms %011=Increasing 3 Alarms %100=Windowing 2 Alarms %101=Decreasing 1 Alarm %110=Decreasing 2 Alarms %111=Decreasing 3 Alarms Last Raw Input[11:0] (4-20mA;d800 to d4000)
2000	Sensor Alarm/Fail Info.	**Read Only**	Sensor 004 to 001 Fail/Alarm3-1 Indicator Nibbles Array	Sensor4 Fail/Alarm3/Alarm2/Alarm1[15:12]	Sensor3 Fail/Alarm3/Alarm2/Alarm1[11:8] Sensor2 Fail/Alarm3/Alarm2/Alarm1[7:4] Sensor1 Fail/Alarm3/Alarm2/Alarm1[3:0]
to					
2246	Sensor Alarm/Fail Info.	**Read Only**	Sensor 988 to 985 Fail/Alarm3-1 Indicator Nibbles Array	Sensor988 Fail/Alarm3/Alarm2/Alarm1[15:12]	Sensor987 Fail/Alarm3/Alarm2/Alarm1[11:8] Sensor986 Fail/Alarm3/Alarm2/Alarm1[7:4] Sensor985 Fail/Alarm3/Alarm2/Alarm1[3:0]
2500	Relay Info.	**Read Only**	Relay 001 Sensor Alarm Count	Non-Zone Sensor Alarm Count[15:0]	
to					
2755	Relay Info.	**Read Only**	Relay 256 Sensor Alarm Count	Non-Zone Sensor Alarm Count[15:0]	
3000	Relay Info.	**Read Only**	Relay 001 Dew/Zone	Dew Alarm[15]	Zone Sensor Alarm Count[14:0]

			Sensor_Alarm Count		
to					
3255	Relay Info.	**Read Only**	Relay 256 Dew/Zone Sensor Alarm Count	Dew Alarm[15]	Zone Sensor Alarm Count[14:0]
3500	Relay Output Info.	**Read Only**	Relay 001 Status	Availability[15:15]	Minimum Run Time Periods Remaining14:9] Post Run Time Periods Remaining[8:3] Zone Event Bits[2:1] Current Relay Out[0:0] (where Period=15seconds)
to					
3755	Relay Output Info.	**Read Only**	Relay 256 Status	Availability[15:15]	Minimum Run Time Periods Remaining[14:9] Post Run Time Periods Remaining[8:3] Zone Event Bits[2:1] Current Relay Out[0:0] (where Period=15seconds)
3800	Analog Output Info.	**Read Only**	Analog Output 1 Status	Availability[15:15]	Last output in the tenth percentage[9:0]
to					
3927	Analog Output Info.	**Read Only**	Analog Output 128 Status	Availability[15:15]	Last output in the tenth percentage[9:0]
4000	Zone Info.	**Read Only**	Zone 001 Status	Availability[15:15]	Analog OutputID[14:8] Alarm/Fail Indicator[3:0]
to					
4127	Zone Info.	**Read Only**	Zone 128 Status	Availability[15:15]	Analog OutputID[14:8] Alarm/Fail Indicator[3:0]
5000	Sensor Fail Relay Info.	**Read Only**	Sensor 001 Fail Relay Array	Availability[15:15]	Fail Status[14:14] Sensor1 Fail Relay [7:0]
to					
5987	Sensor Fail Relay Info.	**Read Only**	Sensor 988 Fail Relay Array	Availability[15:15]	Fail Status[14:14] Sensor988 Fail Relay [7:0]
6000	Sensor Alarm3 Relay Info.	**Read Only**	Sensor 001 Alarm3 Relay Array	Availability[15:15]	Alarm3 Status[14:14] Sensor1 Alarm3 Relay [7:0]
to					
6987	Sensor Alarm3 Relay Info.	**Read Only**	Sensor 988 Alarm3 Relay Array	Availability[15:15]	Alarm3 Status[14:14] Sensor988 Alarm3 Relay [7:0]
7000	Sensor Alarm2 Relay Info.	**Read Only**	Sensor 001 Alarm2 Relay Array	Availability[15:15]	Alarm2 Status[14:14] Sensor1 Alarm2 Relay [7:0]
to					
7987	Sensor Alarm2	**Read Only**	Sensor 988 Alarm2 Relay	Availability[15:15]	Alarm2 Status[14:14] Sensor988 Alarm2 Relay [7:0]

	Relay Info.		Array		
8000	Sensor Alarm1 Relay Info.	**Read Only**	Sensor 001 Alarm1 Relay Array	Availability[15:15]	Alarm1 Status[14:14] Sensor1 Alarm1 Relay [7:0]
to					
8987	Sensor Alarm1 Relay Info.	**Read Only**	Sensor 988 Alarm1 Relay Array	Availability[15:15]	Alarm1 Status[14:14] Sensor988 Alarm1 Relay [7:0]
9000	Zone Fail Relay Info.	**Read Only**	Zone 001 Fail Relay Array	Availability[15:15]	Fail Status[14:14] Zone1 Fail Relay [7:0]
to					
9127	Zone Fail Relay Info.	**Read Only**	Zone 128 Fail Relay Array	Availability[15:15]	Fail Status[14:14] Zone128 Fail Relay [7:0]
9200	Zone Alarm3 Relay Info.	**Read Only**	Zone 001 Alarm3 Relay Array	Availability[15:15]	Alarm3 Status[14:14] Zone1 Alarm3 Relay [7:0]
to					
9327	Zone Alarm3 Relay Info.	**Read Only**	Zone 128 Alarm3 Relay Array	Availability[15:15]	Alarm3 Status[14:14] Zone128 Alarm3 Relay [7:0]
9400	Zone Alarm2 Relay Info.	**Read Only**	Zone 001 Alarm2 Relay Array	Availability[15:15]	Alarm2 Status[14:14] Zone1 Alarm2 Relay [7:0]
to					
9527	Zone Alarm2 Relay Info.	**Read Only**	Zone 128 Alarm2 Relay Array	Availability[15:15]	Alarm2 Status[14:14] Zone128 Alarm2 Relay [7:0]
9600	Zone Alarm1 Relay Info.	**Read Only**	Zone 001 Alarm1 Relay Array	Availability[15:15]	Alarm1 Status[14:14] Zone1 Alarm1 Relay [7:0]
to					
9727	Zone Alarm1 Relay Info.	**Read Only**	Zone 128 Alarm1 Relay Array	Availability[15:15]	Alarm1 Status[14:14] Zone128 Alarm1 Relay [7:0]

6.2.5.1 Sensor 1-998 Raw Input Information

These registers contain individual sensor availability, sensor threshold type and raw input information for sensors 1 to 988.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available. MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.

The threshold type is held in the bit field [14:12] and has the following definition:

- 0=Disabled,
- 1=Increasing 1 Alarm,
- 2=Increasing 2 Alarms,
- 3=Increasing 3 Alarms,
- 4=Windowing 2 Alarms,
- 5=Decreasing 1 Alarm,

- 6=Decreasing 2 Alarms,
- 7=Decreasing 3 Alarms.

The sensor raw input value is held in the bit field [11:0]. A sensor dynamic range is from 800 to 4000 for 0-100 % full scale. This raw value is represented by mV for 4-20mA into a 200ohm load. A value less than the sensor's fail threshold value (typically 2mA or 400mV) will trigger a monitor FAIL state and FAIL relay.

These registers are read only and will return an exception if written.

6.2.5.2 Sensor 1-998 ALARM/FAIL Information

Each register contains the ALARM/FAIL indicators for four sensors. The first register in this series is a composite of four bit fields; [15:12], [11:8], [7:4], and [3:0] representing sensors 4, 3, 2, and 1 respectively. Each subsequent register will hold the next four sensors in this series.
Each 4-bit field represents a bit for the sensor's FAIL, ALARM3, ALARM2 and ALARM1 indicators from most significant to least significant.

These registers are read only and will return an exception if written.

6.2.5.3 Relay 1-256 Non-Zone Sensor Count

Each register contains the number of triggered sensor events assigned to that relay excluding Zone sensor triggered assignments. The Zone sensor alarm counts are represented in another series of registers. The triggered events will be related be sensor gas concentrations meeting or exceeding FAIL, ALARM3, ALARM2 or ALARM1 thresholds related to non-zone assignments. This count may also include a DEW Alarm trigger.

These registers are read only and will return an exception if written.

6.2.5.4 Relay 1-256 Dew and Zone Sensor Count

Each register contains the number of triggered sensor events assigned to that relay for DEW and zone sensor triggered assignments. The non-Zone sensor alarm counts are represented in another series of registers. The triggered events will be related be sensor gas concentrations meeting or exceeding FAIL, ALARM3, ALARM2 or ALARM1 thresholds related to zone assignments.
This register also includes a DEW Alarm trigger flag. Bit 15 contains this DEW alarm trigger flag while bits [14:0] contain the Zone triggered sensor count

These registers are read only and will return an exception if written.

6.2.5.5 Relay 1-256 Output Information

These registers contain individual relay availability, minimum run time remaining, post run time remaining, scheduled zone event bits and current relay output information for relays 1 to 256.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available. MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.

The minimum run time remaining is available in the bit field [14:9]. It represents the time remaining after any assigned sensor trigger event has occurred to meet the minimum activation

time for that relay. It is represented in 15-second increments and its value can range from 0-63 representing 0-945seconds. The post run time remaining is available in the bit field [8:3]. It represents the time remaining after all assigned sensor trigger events have cleared to meet the post event activation time for that relay. It is represented in 15-second increments and its value can range from 0-63 representing 0-945seconds.

The schedule zone event bit is in bit field [2] and is decoded as:

0= no Zone relay event in progress,
1= Zone relay event in progress.

Schedule zone event can have two actions; Timed Enable or Timed Disable; this action is defined in the zone menu configuration.

The current relay output state is also available in bit field [0]. It is a Boolean; 0=OFF or 1=ON for a normally de-energized device currently inactive or active respectively. It will be 1=ON or 0=OFF for a normally energized device currently inactive or active respectively. This normal relay state is defined by the relay menu configuration; set relay, set normal state.

- A relay defined with normal state:energized, currently not active during a scheduled event with Timed Enable option will now indicate 1=ON. The same relay during a scheduled event with Timed Disable option will remain indicated as 0=OFF.

- A relay defined with normal state:de-energized, currently not active during a scheduled event with Timed Enable option will now indicate 0=OFF. The same relay during a scheduled event with Timed Disable option will remain indicated as 1=ON.

- A relay currently active during a schedule event may not change state. This can occur when the Timed option (Enable or Disable) results in the relay's current state.

These registers are read only and will return an exception if written.

6.2.5.6 Analog Output 1-128 Output Information

These registers contain individual analog output availability and last output value in tenths of a percentage for analog output 1 to 128.

The availability is located in bit 15 and is Boolean; 0=not available, 1=available. MODBUS address or instance settings that conflict with another device are not unique and are not available. Devices that are discovered but are not unique in nature will not be flagged as available, nor will devices on a RS-485 MODBUS interface that are disabled.
The last output tenth of percentage value is present in the bit field [9:0] of this register. The value can range from 0 to 1000 indicating 0.0 to 100.0%.

These registers are read only and will return an exception if written.

6.2.5.7 Zone 1-128 Information

These registers contain individual zone availability, the analog output ID and the Alarm/Fail status for zones 1 to 128. The availability is located in bit 15 and is Boolean; 0=not available, 1=available. The analog output ID is the Base 0 and indicates the analog output assigned to this zone. It is located in the bit field [14:8].

The Alarm/Fail status is a four-bit field [3:0] and represents a bit for the sensor's FAIL, ALARM3, ALARM2 and ALARM1 indicators respectively. These bits are applicable only to the assigned sensors in the zone.

These registers are read only and will return an exception if written.

6.2.5.8 Sensor 1-988 FAIL Relay Information

These registers contain a summary of FAIL relays assigned to each available sensor.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not failed, 1=failed.
The base 0 failed relay ID assigned to the sensor is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.9 Sensor 1-988 ALARM3 Relay Information

These registers contain a summary of the ALARM3 relay assigned to each available sensor.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM3, 1=ALARM3.
The base 0 ALARM3 relay ID assigned to the sensor is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.10 Sensor 1-988 ALARM2 Relay Information

These registers contain a summary of the ALARM2 relay assigned to each available sensor.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM2, 1=ALARM2.
The base 0 ALARM2 relay ID assigned to the sensor is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.11 Sensor 1-988 ALARM1 Relay Information

These registers contain a summary of the ALARM1 relay assigned to each available sensor.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM1, 1=ALARM1.
The base 0 ALARM1 relay ID assigned to the sensor is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.12 Zone 1-128 FAIL Relay Information

These registers contain a summary of the FAIL relay assigned to each available zone.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not failed, 1=failed.
The base 0 failed relay ID assigned to the zone is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.13 Zone 1-128 ALARM3 Relay Information

These registers contain a summary of ALARM3 relay assigned to each available zone.

The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM3, 1=ALARM3.
The base 0 ALARM3 relay ID assigned to the zone is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.14 Zone 1-128 ALARM2 Relay Information

These registers contain a summary of ALARM2 relay assigned to each available zone.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM2, 1=ALARM2.
The base 0 ALARM2 relay ID assigned to the zone is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.5.15 Zone 1-128 ALARM1 Relay Information

These registers contain a summary of ALARM1 relay assigned to each available sensor.
The availability is located in bit 15 and is Boolean; 0=not available, 1=available.
The fail indicator is located in bit 14 and is Boolean; 0=not ALARM1, 1=ALARM1.
The base 0 ALARM1 relay ID assigned to the zone is located in bit field [7:0].

These registers are read only and will return an exception if written.

6.2.6 Devices and Zone Control (Block Address 9999-58430)

MODBUS Registers	Group and Type	Access	Description	Bit Field Data	Additional Bit Field Data
		Write Access only available when BAS MODBUS Lockcode valid			
10000	Sensor 001 Control	**Read/Write**	Sensor 001 Control1	Enable[15:15]	SensorID[9:0]
10001	Sensor 001 Control	**Read/Write**	Sensor 001 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
10002	Sensor 001 Control	**Read/Write**	Sensor 001 Control3	Device Registration[15:8]	Gas Label[7:0]
10003	Sensor 001 Control	**Read/Write**	Sensor 001 Control4	Location Label Character 1[15:8]	Character 2[7:0]
10004	Sensor 001 Control	**Read/Write**	Sensor 001 Control5	Location Label Character 3[15:8]	Character 4[7:0]
10005	Sensor 001 Control	**Read/Write**	Sensor 001 Control6	Location Label Character 5[15:8]	Character 6[7:0]
10006	Sensor 001 Control	**Read/Write**	Sensor 001 Control7	Location Label Character 7[15:8]	Character 8[7:0]
10007	Sensor 001 Control	**Read/Write**	Sensor 001 Control8	Eng Unit[15:8]	Sensor_threshold_type[3:2] num_alarms_enabled[1:0]

10008	Sensor 001 Control	**Read/Write**	Sensor 001 Control9	Zero high word[15:0]	
10009	Sensor 001 Control	**Read/Write**	Sensor 001 Control10	Zero low word[15:0]	
10010	Sensor 001 Control	**Read/Write**	Sensor 001 Control11	Span high word[15:0]	
10011	Sensor 001 Control	**Read/Write**	Sensor 001 Control12	Span low word[15:0]	
10012	Sensor 001 Control	**Read/Write**	Sensor 001 Control13	Alarm1 Threshold high word[15:0]	
10013	Sensor 001 Control	**Read/Write**	Sensor 001 Control14	Alarm1 Threshold low word[15:0]	
10014	Sensor 001 Control	**Read/Write**	Sensor 001 Control15	Alarm2 Threshold high word[15:0]	
10015	Sensor 001 Control	**Read/Write**	Sensor 001 Control16	Alarm2 Threshold low word15:0]	
10016	Sensor 001 Control	**Read/Write**	Sensor 001 Control17	Alarm3 Threshold high word[15:0]	
10017	Sensor 001 Control	**Read/Write**	Sensor 001 Control18	Alarm3 Threshold low word[15:0]	
10018	Sensor 001 Control	**Read/Write**	Sensor 001 Control19	Fail Threshold[15:8]	Spare[7:0]
10019	Sensor 001 Control	**Read/Write**	Sensor 001 Control20	Spare[15:0]	
10020	Sensor 001 Control	**Read/Write**	Sensor 001 Control21	Alarm1 Relay[15:8]	Alarm2 Relay[7:0]
10021	Sensor 001 Control	**Read/Write**	Sensor 001 Control22	Alarm3 Relay[15:8]	Fail Relay[7:0]
10022	Sensor 001 Control	**Read/Write**	Sensor 001 Control23	Alarm1 Delay[15:8]	Alarm2 Delay[7:0]
10023	Sensor 001 Control	**Read/Write**	Sensor 001 Control24	Alarm3 Delay[15:8]	Fail Delay[7:0]
10024	Sensor 001 Control	**Read/Write**	Sensor 001 Control25	Spare[15:0]	
to					
34675	Sensor 988 Control	**Read/Write**	Sensor 988 Control1	Enable[15:15]	SensorID[9:0]
34676	Sensor 988 Control	**Read/Write**	Sensor 988 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
34677	Sensor 988 Control	**Read/Write**	Sensor 988 Control3	Device Registration[15:8]	Gas Label[7:0]
34678	Sensor 988 Control	**Read/Write**	Sensor 988 Control4	Location Label Character 1[15:8]	Character 2[7:0]
34679	Sensor 988 Control	**Read/Write**	Sensor 988 Control5	Location Label Character 3[15:8]	Character 4[7:0]
34680	Sensor 988 Control	**Read/Write**	Sensor 988 Control6	Location Label Character 5[15:8]	Character 6[7:0]
34681	Sensor 988 Control	**Read/Write**	Sensor 988 Control7	Location Label Character 7[15:8]	Character 8[7:0]
34682	Sensor 988 Control	**Read/Write**	Sensor 988 Control8	Eng Unit[15:8]	Sensor_threshold_type[3:2] num_alarms_enabled[1:0]
34683	Sensor 988 Control	**Read/Write**	Sensor 988 Control9	Zero high word[15:0]	
34684	Sensor 988	**Read/Write**	Sensor 988	Zero low word[15:0]	

	Control		Control10		
34685	Sensor 988 Control	**Read/Write**	Sensor 988 Control11	Span high word[15:0]	
34686	Sensor 988 Control	**Read/Write**	Sensor 988 Control12	Span low word[15:0]	
34687	Sensor 988 Control	**Read/Write**	Sensor 988 Control13	Alarm1 Threshold high word[15:0]	
34688	Sensor 988 Control	**Read/Write**	Sensor 988 Control14	Alarm1 Threshold low word[15:0]	
34689	Sensor 988 Control	**Read/Write**	Sensor 988 Control15	Alarm2 Threshold high word[15:0]	
34690	Sensor 988 Control	**Read/Write**	Sensor 988 Control16	Alarm2 Threshold low word15:0]	
34691	Sensor 988 Control	**Read/Write**	Sensor 988 Control17	Alarm3 Threshold high word[15:0]	
34692	Sensor 988 Control	**Read/Write**	Sensor 988 Control18	Alarm3 Threshold low word[15:0]	
34693	Sensor 988 Control	**Read/Write**	Sensor 988 Control19	Fail Threshold [15:8]	Spare[7:0]
34694	Sensor 988 Control	**Read/Write**	Sensor 988 Control20	Spare[15:0]	
34695	Sensor 988 Control	**Read/Write**	Sensor 988 Control21	Alarm1 Relay[15:8]	Alarm2 Relay[7:0]
34696	Sensor 988 Control	**Read/Write**	Sensor 988 Control22	Alarm3 Relay[15:8]	Fail Relay[7:0]
34697	Sensor 988 Control	**Read/Write**	Sensor 988 Control23	Alarm1 Delay[15:8]	Alarm2 Delay[7:0]
34698	Sensor 988 Control	**Read/Write**	Sensor 988 Control24	Alarm3 Delay[15:8]	Fail Delay[7:0]
34699	Sensor 988 Control	**Read/Write**	Sensor 988 Control25	Spare[15:0]	
35000	Relay 001 Control	**Read/Write**	Relay 001 Control1	Enable[15:15]	Alarm Count[14:8] RelayID[7:0]
35001	Relay 001 Control	**Read/Write**	Relay 001 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
35002	Relay 001 Control	**Read/Write**	Relay 001 Control3	Minimum Run Time Minutes[15:8]	Post Run Time Minutes[7:0]
35003	Relay 001 Control	**Read/Write**	Relay 001 Control4	Device Registration[15:8]	Relay Configuration bits[2:0]
35004	Relay 001 Control	**Read/Write**	Relay 001 Control5	Spare[15:0]	
to					
36275	Relay 256 Control	**Read/Write**	Relay 256 Control1	Enable[15:15]	Alarm Count[14:8] RelayID[7:0]
36276	Relay 256 Control	**Read/Write**	Relay 256 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
36277	Relay 256 Control	**Read/Write**	Relay 256 Control3	Minimum Run Time Minutes[15:8]	Post Run Time Minutes[7:0]
36278	Relay 256 Control	**Read/Write**	Relay 256 Control4	Device Registration[15:8]	Relay Configuration bits[2:0]
36279	Relay 256 Control	**Read/Write**	Relay 256 Control5	Spare[15:0]	
38000	Analog Output 001	**Read/Write**	Analog Output 001	Enable[15:14]	Analog OutputID[6:0]

	Control		Control1		
38001	Analog Output 001 Control	**Read/Write**	Analog Output 001 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
38002	Analog Output 001 Control	**Read/Write**	Analog Output 001 Control3	Scale in tenth of unit[15:8]	Range[7:7] Type[6:6] Samples Per Minutes[5:0]
38003	Analog Output 001 Control	**Read/Write**	Analog Output 001 Control4	Device Registration[15:8]	Spare[7:0]
38004	Analog Output 001 Control	**Read/Write**	Analog Output 001 Control5	Spare[15:0]	
to					
38635	Analog Output 128 Control	**Read/Write**	Analog Output 128 Control1	Enable[15:14]	Analog OutputID[6:0]
38636	Analog Output 128 Control	**Read/Write**	Analog Output 128 Control2	Interface[15:13]	Instance[12:8] Remote Address[7:0]
38637	Analog Output 128 Control	**Read/Write**	Analog Output 128 Control3	Scale in tenth of unit[15:8]	Range[7:7] Type[6:6] Samples Per Minutes[5:0]
38638	Analog Output 128 Control	**Read/Write**	Analog Output 128 Control4	Device Registration[15:8]	Spare[7:0]
38639	Analog Output 128 Control	**Read/Write**	Analog Output 128 Control5	Spare[15:0]	
40000	Zone 001 Control	**Read/Write**	Zone 001 Control1	Enable[15:15]	Time Schedule[11:8] ZoneID[6:0]
40001	Zone 001 Control	**Read/Write**	Zone 001 Control2	Zone Label Character 1[15:8]	Character 2[7:0]
40002	Zone 001 Control	**Read/Write**	Zone 001 Control3	Zone Label Character 3[15:8]	Character 4[7:0]
40003	Zone 001 Control	**Read/Write**	Zone 001 Control4	Zone Label Character 5[15:8]	Character 6[7:0]
40004	Zone 001 Control	**Read/Write**	Zone 001 Control5	Zone Label Character 7[15:8]	Character 8[7:0]
40005	Zone 001 Control	**Read/Write**	Zone 001 Control6	Zone Label Character 9[15:8]	Character 10[7:0]
40006	Zone 001 Control	**Read/Write**	Zone 001 Control7	Zone Label Character 11[15:8]	Character 12[7:0]
40007	Zone 001 Control	**Read/Write**	Zone 001 Control8	Zone Label Character 13[15:8]	Character 14[7:0]
40008	Zone 001 Control	**Read/Write**	Zone 001 Control9	Zone Label Character 15[15:8]	Character 16[7:0]
40009	Zone 001 Control	**Read/Write**	Zone 001 Control10	Zone Label Character 17[15:8]	Character 18[7:0]
40010	Zone 001 Control	**Read/Write**	Zone 001 Control11	Zone Label Character 19[15:8]	Character 20[7:0]
40011	Zone 001 Control	**Read/Write**	Zone 001 Control12	Start Time Hour[12:8]	Start Time Minutes[5:0]
40012	Zone 001 Control	**Read/Write**	Zone 001 Control13	End Time Hour[12:8]	End Time Minutes[5:0]

40013	Zone 001 Control	**Read/Write**	Zone 001 Control14	Analog OutputID[6:0]	
40014	Zone 001 Control	**Read/Write**	Zone 001 Control15	Alarm1 State RelayID[15:8]	Alarm2 State RelayID[7:0]
40015	Zone 001 Control	**Read/Write**	Zone 001 Control16	Alarm3 State RelayID[15:8]	Fail State RelayID[7:0]
40016	Zone 001 Control	**Read/Write**	Zone 001 Index Control1	Sensor Index 001 SensorID[9:0]	
to					
40143	Zone 001 Control	**Read/Write**	Zone 001 Index Control128	Sensor Index 128 SensorID[9:0]	
to					
58288	Zone 128 Control	**Read/Write**	Zone 128 Control1	Enable[15:15]	Time Schedule[11:8] ZoneID[6:0]
58289	Zone 128 Control	**Read/Write**	Zone 128 Control2	Zone Label Character 1[15:8]	Character 2[7:0]
58290	Zone 128 Control	**Read/Write**	Zone 128 Control3	Zone Label Character 3[15:8]	Character 4[7:0]
58291	Zone 128 Control	**Read/Write**	Zone 128 Control4	Zone Label Character 5[15:8]	Character 6[7:0]
58292	Zone 128 Control	**Read/Write**	Zone 128 Control5	Zone Label Character 7[15:8]	Character 8[7:0]
58293	Zone 128 Control	**Read/Write**	Zone 128 Control6	Zone Label Character 9[15:8]	Character 10[7:0]
58294	Zone 128 Control	**Read/Write**	Zone 128 Control7	Zone Label Character 11[15:8]	Character 12[7:0]
58295	Zone 128 Control	**Read/Write**	Zone 128 Control8	Zone Label Character 13[15:8]	Character 14[7:0]
58296	Zone 128 Control	**Read/Write**	Zone 128 Control9	Zone Label Character 15[15:8]	Character 16[7:0]
58297	Zone 128 Control	**Read/Write**	Zone 128 Control10	Zone Label Character 17[15:8]	Character 18[7:0]
58298	Zone 128 Control	**Read/Write**	Zone 128 Control11	Zone Label Character 19[15:8]	Character 20[7:0]
58299	Zone 128 Control	**Read/Write**	Zone 128 Control12	Start Time Hour[12:8]	Start Time Minutes[5:0]
58300	Zone 128 Control	**Read/Write**	Zone 128 Control13	End Time Hour[12:8]	End Time Minutes[5:0]
58301	Zone 128 Control	**Read/Write**	Zone 128 Control14	Analog OutputID[6:0]	
58302	Zone 128 Control	**Read/Write**	Zone 128 Control15	Alarm1 State RelayID[15:8]	Alarm2 State RelayID[7:0]
58303	Zone 128 Control	**Read/Write**	Zone 128 Control16	Alarm3 State RelayID[15:8]	Fail State RelayID[7:0]
58304	Zone 128 Control	**Read/Write**	Zone 128 Index Control1	Sensor Index 001 SensorID[9:0]	
to					
58431	Zone 128 Control	**Read/Write**	Zone 128 Index Control128	Sensor Index 128 SensorID[9:0]	

6.2.6.1 Sensor 1-988 Control 1 (Enable)

These sensor Control 1 registers contain the enable bit along with a base 0 sensor ID for the applicable sensor.
The enable is located in bit 15 and is Boolean; 0=disabled, 1=enabled.

Only the enable bit can be changed. Writing the sensor ID has no effect.

6.2.6.2 Sensor 1-988 Control 2 (Interface)

These sensor Control 2 registers contain the interface, instance and remote address (when applicable) for the applicable sensor. The following is the interface choice which is a bit field [15:13] defining the sensor's interface:

0=LOCAL,
1=MODBUS1,
2=MODBUS2,
3=MODBUS3,
4=MODBUS4.

Currently LOCAL sensors are not supported. The instance choice is a bit field [12:8] defining the sensor's instance. Currently this field can range from 0-3 for instance 1 to 4 on MODBUS interface devices. The remote address choice is a bit field [7:0] defining the sensor's remote address. Currently this field can range from 1-247 for devices on MODBUS interfaces.

Writing other values will return a MODBUS exception result.

6.2.6.3 Sensor 1-988 Control 3 (Device Registration and Gas Label)

These sensor control 3 registers contain the device registration and gas label for the applicable sensor. The following is the device registration bit field [15:8]. It contains product registered information obtained upon discovery:

x0=Unregistered,
x1=AMC411 SW RevA,
x2=AMC411 SW RevB,
x3=AMC-1D-8R(ENMET),
x4=ENMEECGOLD,
x5=DTR CH1,
x6=DTR CH2,
x21-x24=AMC-1D-2R 2/4/6/8 Inputs respectively,
x26-x30=AMC-1D-4R 2/4/6/8 Inputs respectively,
x2B-x2E=AMC-1D-8R 2/4/6/8 Inputs respectively,

Writing the device registration has no effect.

The following is the gas label choice which is a bit field [7:0] defining the sensor's gas type:

0=UNDEF,
1=CL2,
2=CLO2,
3=CO,
4=HF,
5=ETO,

6=HCL,
7=H2S,
8=HCN,
9=MERCA,
10=MH3,
11=NO,
12=NO2,
13=O3,
14=SO2,
15=PH3,
16=SIH4,
17=GEH4,
18=F2,
19=COCL2,
20=EXP,
21=C3H8,
22=CH4,
23=H2,
24=CO2,
25=O2_IN,
26=O2_DE,
27=O2_WN,
28=PRESS,
29=VACUM,
30=AMBT,
31=SURFT,
32=RELHU,
33=DIFFP,
34=C2H2,
35=FUEL,
36=VOC,
37=N2O,
38=OTHER,
201=USER1,
202=USER2,
203=USER3,
204=USER4,
205=USER5,
206=USER6,
207=USER7,
208=USER8,
209=USER9.

Writing other values will return a MODBUS exception result.

6.2.6.4 Sensor 1-988 Control 4-7 (Location Label)

These sensor control 4-7 registers contain the location label for the applicable sensor. They consist of a packed string in four registers each containing 2 characters. The first character of the string begins at control 4. The bit field [15:8] of this register has this first character. The bit field [7:0] of this same register has the second character. The subsequent consecutive registers

carry the rest of the string. Only displayable ASCII characters are accepted on write transactions. Location labels with less than 8 characters can be padded with space character(s).

Writing other values will return a MODBUS exception result.

6.2.6.5 Sensor 1-988 Control 8 (Unit, Threshold and Alarms)

These sensor control 8 registers contain the engineering units, sensor threshold type and number of alarms. The following is the engineering unit definition found in bit field [15:8]:

0=PPM,
1=PPB,
2=LEL,
3=VOL,
4=PPM_BG,
5=LEL_BG,
6=EXTI,
7=EXTV,
8=PSI,
9=KPA,
10=DEGC,
11=PERCENT_RH,
12=WATER_COLUMN,
100=ENG1,
101=ENG2,
102=ENG3,
103=ENG4,
104=ENG5,
105=ENG6,
106=ENG7,
107=ENG8,
108=ENG9.

The following is the sensor threshold type found in bit field [3:2]:

0=disabled,
1=increasing,
2=decreasing,
3=windowing.

The sensor number of alarms is found in bit field [1:0]. It has a range of 0-3 alarms.

Writing other values will return a MODBUS exception result.

6.2.6.6 Sensor 1-988 Control 9 and 10 (Dew Zero Level)

These sensor control 9 and 10 registers contain the zero value in tenths of units for the applicable sensor. The zero level is a 32-bit composite of two 16-bit registers; Reg9 [15:0], Reg10 [15:0]. Currently Zero level value is only applied to DEW Alarms associated for DEGC and WATER_COLUMN engineering units and are not applied to digital acquisition. During DEW Alarm calculations, the Zero level is used as well as the span level to scale and offset the sensor’s concentration. Most engineering units do not allow a zero level and thus these

registers must be set to zero. The engineering unit for the applicable sensor will be used to qualify the zero level write entry.

The following engineering unit will only accept a zero level in tenth of units=-1000 to 20:

DEGC.

The following engineering unit will only accept a zero level in tenth of units=-100 to 0:

WATER_COLUMN.

The following engineering units will only accept a zero level in tenth of units=-2500 to 200:

ENG1,
ENG2,
ENG3,
ENG4,
ENG5,
ENG6,
ENG7,
ENG8,
ENG9.

Writing other values will return a MODBUS exception result.

6.2.6.7 Sensor 1-988 Control 11 and 12 (Span Level)

These sensor control 11 and 12 registers contain the span value in tenths of units for the applicable sensor. The span level is a 32-bit composite of two 16-bit registers; Reg11 [15:0], Reg12 [15:0]. During digital sensor acquisition of gas level, the span level is used to convert the sensor's input into a raw range of 800 to 4000 for 100% full scale gas concentration. A 1000 span value represents 100ppm so a raw sensor input with 100% full scale will be 4000. When actual sensor and sensor span configuration differ, a scaling affect occurs.
The engineering unit for the applicable sensor will be used to qualify the span level write entry.

The following engineering unit will only accept specific range of span level in tenths of units:

PPM=10 to 50000,
PPB=1000 to 50000,
LEL=10 to 3000,
VOL=10 to 1000,
PSI=10 to 1000,
KPA=10 to 50000,
DEGC=10 to 2100,
PERCENT_RH=10 to 1000,
WATER_COLUMN=10 to 100.

The ENG1 to ENG9 engineering unit will only accept specific range of span level in tenths of units of 0 to 500000.

Writing other values will return a MODBUS exception result.

6.2.6.8 Sensor 1-988 Control 13 and 14 (ALARM1 Threshold Level)

These sensor control 13 and 14 registers contain the ALARM1 threshold value in tenths of units for the applicable sensor. The threshold level is a 32-bit composite of two 16-bit registers; Reg13 [15:0], Reg14 [15:0]. During digital sensor acquisition of gas level, the span level is used to convert the sensor's input into a raw range of 800 to 4000 for 100% full scale gas concentration.
During ALARM trigger calculation, the acquisition gas level is checked against the ALARM threshold level. The ALARM1 threshold level must be in the range of 32-3200 representing 1 to 100% Full Scale. A fixed offset of 800 is added to the alarm threshold level to give it a range of 800 to 4000 which matches the sensor raw input.

Writing other values will return a MODBUS exception result.

6.2.6.9 Sensor 1-988 Control 15 and 16 (ALARM2 Threshold Level)

These sensor control 15 and 16 registers contain the ALARM2 threshold value in tenths of units for the applicable sensor. The threshold level is a 32-bit composite of two 16-bit registers; Reg15 [15:0], Reg16 [15:0]. During digital sensor acquisition of gas level, the span level is used to convert the sensor's input into a raw range of 800 to 4000 for 100% full scale gas concentration.
During ALARM trigger calculation, the acquisition gas level is checked against the ALARM threshold level. The ALARM2 threshold level must be in the range of 32-3200 representing 1 to 100% Full Scale. A fixed offset of 800 is added to the alarm threshold level to give it a range of 800 to 4000 which matches the sensor raw input.

Writing other values will return a MODBUS exception result.

6.2.6.10 Sensor 1-988 Control 17 and 18 (ALARM3 Threshold Level)

These sensor control 17 and 18 registers contain the ALARM3 threshold value in tenths of units for the applicable sensor. The threshold level is a 32-bit composite of two 16-bit registers; Reg17 [15:0], Reg18 [15:0]. During digital sensor acquisition of gas level, the span level is used to convert the sensor's input into a raw range of 800 to 4000 for 100% full scale gas concentration.
During ALARM trigger calculation, the acquisition gas level is checked against the ALARM threshold level.

The ALARM3 threshold level must be in the range of 32-3200 representing 1 to 100% Full Scale. A fixed offset of 800 is added to the alarm threshold level to give it a range of 800 to 4000 which matches the sensor raw input.

Writing other values will return a MODBUS exception result.

6.2.6.11 Sensor 1-988 Control 19 (Fail Threshold Level)

These sensor control 19 registers contain the FAIL threshold value in tenths of units for the applicable sensor. The fail threshold level is represented by 10 times the mA setting and stored in the bit field at reg19 [15:8]. The lower bit field reg [7:0] is currently ignored.

A sensor dynamic range is from 800 to 4000 for 0-100% full scale. The sensor's raw value is represented by mV for 4-20mA into a 200ohm load. A value less than the sensor's FAIL threshold value (typically 2mA or 400mV or value=20) trigger a monitor FAIL state and FAIL

relay.

The value must be less than 40. Writing other values will return a MODBUS exception result.

6.2.6.12 Sensor 1-988 Control 21-22 (ALARM/FAIL Relays)

These sensor control 21 and 22 registers contain the ALARM1, ALARM2, ALARM3, and FAIL relay IDs for the applicable sensor. The relay IDs are base 0 and the located in two bit fields per register across the two registers.

Reg21 [15:8] =ALARM1 Relay ID,
Reg21 [7:0] =ALARM2 Relay ID,
Reg22 [15:8] =ALARM3 Relay ID and
Reg22 [7:0] =FAIL Relay ID.
The value in each bit field is 0-255.

6.2.6.13 Sensor 1-988 Control 23-24 (ALARM/FAIL Delay)

These sensor control 21 and 22 registers contain the ALARM1, ALARM2, ALARM3, and FAIL delays for the applicable sensor. These delay values represent a value of 0 to 3600 seconds encoded into numbers between 0-254. Numbers less than 16 are represented in seconds. When the value is greater then 15, it represents time in 15-second intervals. The values are located in two bit fields per register across the two registers.

Reg23 [15:8] =ALARM1 Delay,
Reg23 [7:0] =ALARM2 Delay,
Reg24 [15:8] =ALARM3 Delay and
Reg24 [7:0] =FAIL Delay.

6.2.6.14 Relay 1-256 Control 1 (Enable)

These relay control 1 registers contain the enable, alarm count along with a base 0 relay ID for the applicable relay. The enable is located in bit 15 and is Boolean; 0=disabled, 1=enabled.
The alarm count is located in bit field [14:8]. It determines the number of sensors needed to trigger this relay. It must be a value in the range of 1-99.

Writing other values will return a MODBUS exception result.

Changing the relay ID has no effect.

6.2.6.15 Relay 1-256 Control 2 (Interface)

These relay control 2 registers contain the interface, instance and remote address (when applicable) for the applicable relay. The following is the interface choice which is a bit field [15:13] defining the relay's interface:

0=LOCAL,
1=MODBUS1,
2=MODBUS2,
3=MODBUS3,
4=MODBUS4.

The instance choice is a bit field [12:8] defining the relay's instance. Currently this field can range from 0-31 for instance 1-32 on local interface, and 0-7 for instance 1-8 on MODBUS

interface devices. The remote address choice is a bit field [7:0] defining the relay's remote address. Currently this field can range from 1-247 for devices on MODBUS interfaces.

Writing other values will return a MODBUS exception result.

6.2.6.16 Relay 1-256 Control 3 (Minimum Run and Post Run Times)

These relay control 3 registers contain the minimum run and post run times for the applicable relay. The minimum run timer is used to set the minimum time in minutes a relay will remain activated once a sensor ALARM/FAIL event has been met. The value is located in bit field [15:8] and must be a value between 0-60.

The post run timer is used to set the time in minutes a relay will remain activated after all ALARM/FAIL events have cleared. The value is located in bit field [7:0] and must be a value between 0-60.

Writing other values will return a MODBUS exception result.

6.2.6.17 Relay 1-256 Control 4 (Device Registration and Relay Configuration Bits)

These relay control 4 registers contain the device registration and relay configuration bits for the applicable relay. The following is the device registration bit field [15:8] that has product registered information obtained upon discovery:

0=Unregistered,
1=AMC411,
2=AMC412,
3=AMC-1D-8R(ENMET),
4=AMC-1D-2R,
5=ENMECGOLDRAB.

Writing the device registration has no effect.

The following are the relay configuration bit definitions which mapped in bit field [2:0]:

Bit 0: 0=Normally De-energized Relay, 1=Normally Energized Relay,
Bit 1: 0=Relay is not latched and will de-activate when ALARM/FAIL event and minimum run and post run timers have elapsed, 1=Relay is latched and must be manually reset with Manual Reset pushbutton.
Bit 2: 0=ACKN pushbutton will not reset relay activation, 1=ACKN pushbutton will reset relay activation.

Manual reset and relay acknowledge are deferred until minimum run and post timers have elapsed.

Writing other values will return a MODBUS exception result.

6.2.6.18 Analog Output 1-128 Control 1 (Enable)

These analog output control 1 registers contain the enable along with a base 0 analog output ID for the applicable analog output. The enable is located in bits 15:14 and is 0=disabled, 1=enabled and 2=service mode. Service mode allows the remote device to be enabled but set to 0% full scale (0mA or 4mA when configured for 0-20mA or 4-20mA respectively).

Writing other values will return a MODBUS exception result.

Changing the analog output ID has no effect.

6.2.6.19 Analog Output 1-128 Control 2 (Interface)

These analog out control 2 registers contain the interface, instance and remote address (when applicable) for the applicable analog output. The following is the interface choice which is a bit field [15:13] defining the relay's interface:

0=LOCAL,
1=MODBUS1,
2=MODBUS2,
3=MODBUS3,
4=MODBUS4.

The instance choice is a bit field [12:8] defining the analog output instance. Currently this field can range from 0-3 for instance 1-4 on local interface, and 0-3 for instance 1-4 on MODBUS interface devices. The remote address choice is a bit field [7:0] defining the analog output's remote address. Currently this field can range from 1-247 for devices on MODBUS interfaces.

Writing other values will return a MODBUS exception result.

6.2.6.20 Analog Output 1-128 Control 3 (Configuration)

These analog out control 3 registers contain the configuration; scale in tenths of units, range, type and samples for the applicable analog output.
The scale is a bit field [15:8] containing the scale in tenths of units. The scale acts as gain increasing the analog output. The range is bit [7] defining whether the analog output will range between 4-20mA and 0-20mA with a value of 0 or 1 respectively.
The type is bit [6] defining whether the analog output is average or peak with a value of 0 or 1 respectively.
The sample is a bit field [5:0] containing the number of samples (1 per second) used to smooth the output. The sample value must be in the range of 1 to 60.

Writing other values will return a MODBUS exception result.

6.2.6.21 Analog Output 1-128 Control 4 (Device Registration)

These analog output control 4 registers contain the device registration for the applicable analog output. The following is the device registration bit field [15:8] which contains product registered information obtained upon discovery:

0=Unregistered,
1=AMC411,
2=AMC412,
3=AMC-1D-8R(ENMET),
4=AMC-1D-2R,
5=ENMECGOLDRAB.

Writing the device registration has no effect.

6.2.6.22 Zone 1-128 Control 1 (Enable)

These analog output control 1 registers contain the enable time schedule along with a base 0 zone ID for the applicable zone. The enable is located in bit 15 and is Boolean; 0=disabled, 1=enabled. The time schedule is a bit field [11:8] defined as:

0=Zone Relay event are scheduled for Sunday's,
1=Zone Relay event are scheduled for Monday's,
2=Zone Relay event are scheduled for Tuesday's,
3=Zone Relay event are scheduled for Wednesday's,
4=Zone Relay event are scheduled for Thursday's,
5=Zone Relay event are scheduled for Friday's,
6=Zone Relay event are scheduled for Saturday's,
7=Zone Relay event are scheduled for Monday's to Friday's,
8=Zone Relay event are scheduled for Monday's to Sunday's,
9=Zone Relay event are never scheduled.

Writing other values will return a MODBUS exception result.
Changing the zone ID has no effect.

6.2.6.23 Zone 1-128 Control 2-11 (Zone Label)

These zone control 2-11 registers contain the zone label for the applicable zone. It is a packed string in 10 registers each containing 2 characters. The first character of the string begins at control 4. The bit field [15:8] of this register contains this first character. The bit field [7:0] of this same register contains the second character. The subsequent consecutive registers carry the rest of the string. Only displayable ASCII characters are accepted on write transactions. Location labels less than 20 characters in length can be padded with space character(s).

Writing other values will return a MODBUS exception result.

6.2.6.24 Zone 1-128 Control 12 (Schedule Start Time)

These zone control 12 registers contain the zone schedule relay event start time for the applicable zone. The schedule relay event start time hour is located in bit field [12:8] and must be in the range 0-23 for 00:00am to 11:00pm.

The schedule relay event start time minutes are located in bit field [5:0] and must be in the range 0-59 for 00:00 to 00:59 for the hour previously defined.

Writing other values will return a MODBUS exception result.

6.2.6.25 Zone 1-128 Control 13 (Schedule End Time)

These zone control 13 registers contain the zone schedule relay event end time for the applicable zone. The schedule relay event end time hour is located in bit field [12:8] and must be in the range 0-23 for 00:00am to 11:00pm.

The schedule relay event end time minutes are located in bit field [5:0] and must be in the range 0-59 for 00:00 to 00:59 for the hour previously defined. If the end time is before the start time, the schedule relay event will bridge through the next day.

Writing other values will return a MODBUS exception result.

6.2.6.26 Zone 1-128 Control 14 (Analog ID)

These zone control 14 registers contain the assigned base 0 analog output ID for the applicable zone. The Analog output ID can be in the range of 0-127.

Writing other values will return a MODBUS exception result.

6.2.6.27 Sensor 1-127 Control 15-16 (ALARM/FAIL Relays)

These zone control 15 and 16 registers contain the ALARM1, ALARM2, ALARM3, and FAIL relay IDs for the applicable zone. The relay IDs are base 0 and are located in two bit fields per register across the two registers.

Reg15 [15:8] =ALARM1 Relay ID,
Reg15 [7:0] =ALARM2 Relay ID,
Reg16 [15:8] =ALARM3 Relay ID and
Reg16 [7:0] =FAIL Relay ID.

The value in each bit field is 0-255.

6.2.6.28 Sensor 1-127 Index Control 1-128 (Assigned Sensor IDs)

These zone sensor index control 1-128 registers contain the sensor IDs assigned to the zone. Each zone can have up to 128 sensors assigned to it. The sensor IDs can range from 0 to 987 for sensors 1 to 988, but a sensor ID of 988 can be used to indicate zone sensor index control is not used.

Writing other values will return a MODBUS exception result.

6.3 AMC-1DBX BAS MODBUS RTU SEQUENCE OF OPERATION

The following sequence of operation examples were developed using a 1DBX Monitor and Modbus Rev 4.00 tool from Calta Computer Systems Limited.

The sequence used has 99 CO sensors, 8 relays and 2 analog outputs on MODBUS1 interface and 248 CO sensors on MODBUS2 interface. The monitor is configured for Zone 1 and 2 with sensor 6 assigned to each with analog output 1 and analog output 2 respectively. Relays 1 to 4 are assigned to all sensors and relays 5 to 8 are assigned to all zones.

The zones have scheduled relay for Wednesday at 23:59 to 00:01 and the time is initially set to Wednesday Feb29/2012 at 23:58:25pm.

Figure 6-1 shows the Monitor Status Area (1-16) screen. Values are shown in hexadecimal format. A hexadecimal calculator is required to help convert the bit fields. Using the MODBUS register map and descriptions see the following:

- The Hour Glass timer is active indicating 37 seconds left in power up delay with acknowledge time=0.
- The name of the system is AMC-1DB with version 0.62
- The system has 346 sensors, 8 relays, 2 analog outputs and 2 zones.
- The system can support 988 sensors, 256 relays, 128 analog outputs and 128 zones.

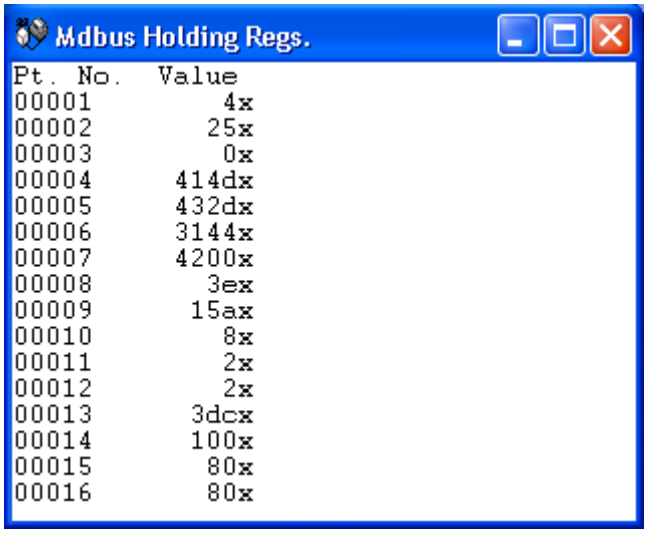


Figure 6-1: Monitor Status Area (1-16)

Figure 6-2 displays the Monitor Configuration Area (20-66) screen. It shows:

- The data and time is 2012 Feb 29 23:57:11pm.
- The IP address is 10.0.0.103 with netmask of 255.255.255.00 and gateway of 10.0.0.1.
- MODBUS 1 and MODBUS2 are enabled with 9600Baud, 1 stop bit, even parity, 8bit length, RTU protocol. MODBUS3 and MODBUS4 are disabled.
- Default FAIL threshold=2.0 mA, power up delay=60 seconds, Acknowledge time=0minutes (disabled), zero buffer=2.0%, hysteresis=2.5% and all logs disabled.

- The Misc. Control and Dew Point relay indicates:
    - Dew Point Alarm disabled with relay 2,
    - Serial Mode 0=Remote (AMC Manager),
    - Backlight Control Always on,
    - Audible Alarm Mode 0=All ALARMS/FAIL,
    - Audio Cadence 0=continuous,
    - Location Enable 0=disable,
    - Display Mode 0=Display All Data.

- User gas labels; “USER1”, “USER2”, “USER3”, “USER4”, “USER5”, “USER6”, “USER7”, “USER8”, “USER9”.
- User engineering units; “ENG1”, “ENG2”, “ENG3”, “ENG4”, “ENG5”, “ENG6”, “ENG7”, “ENG8”, “ENG9”.

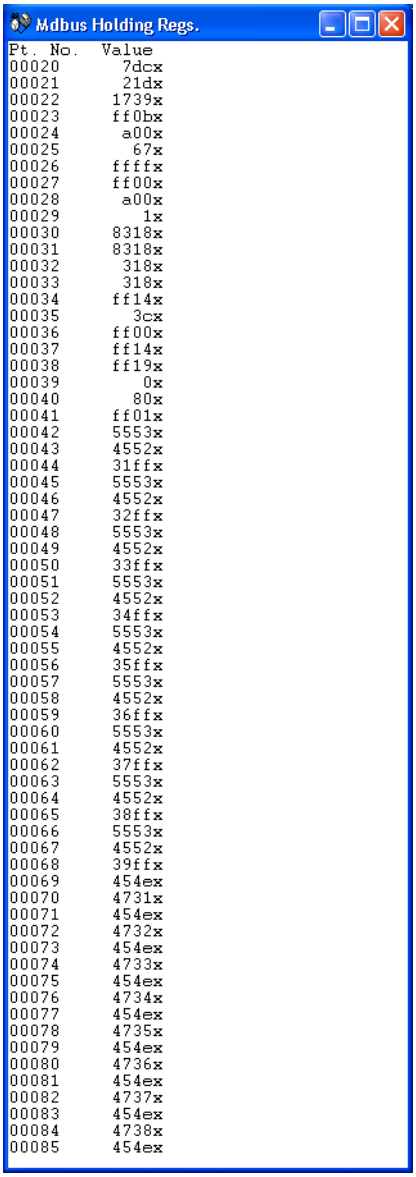


Figure 6-2: Monitor Configuration Area (20-66)

Figure 6-3 displays the Sensor Status Area (100-161) screen. It indicates that sensors 1-99 and 248-494 are available.

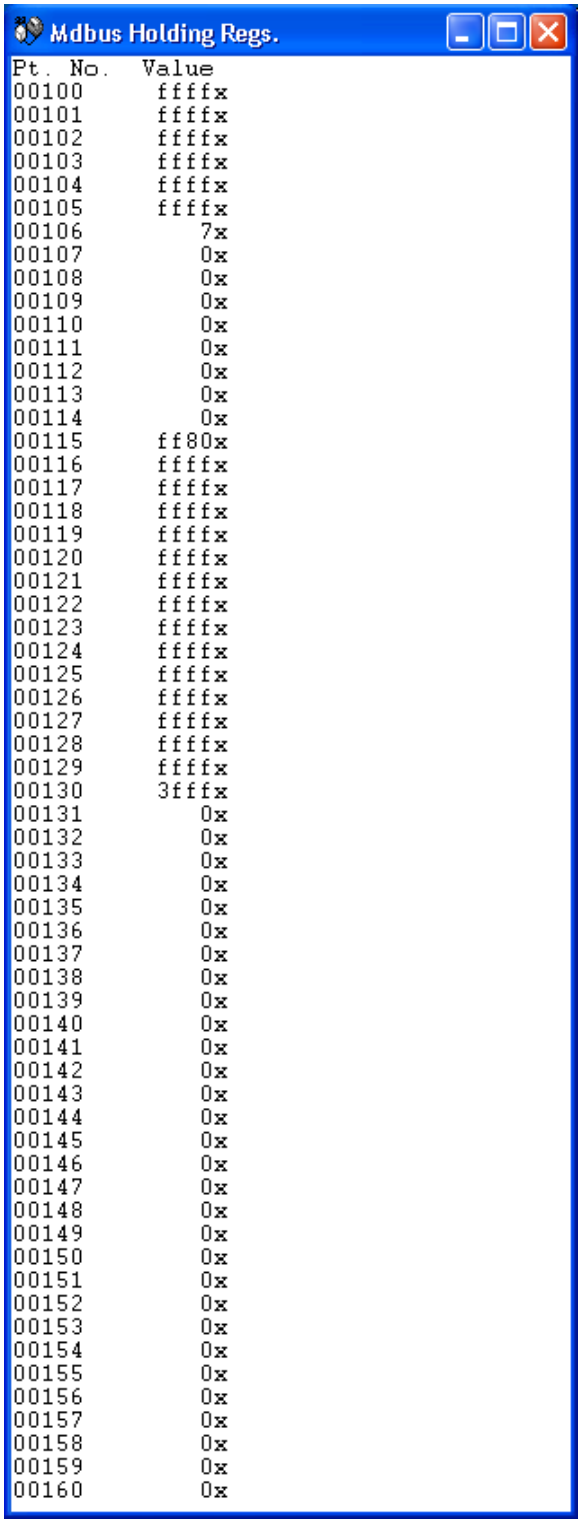


Figure 6-3: Sensor Status Area (100-161)

Figure 6-4 displays the Relay Status Area (350-365) screen. It indicates that relays 1-8 are available.

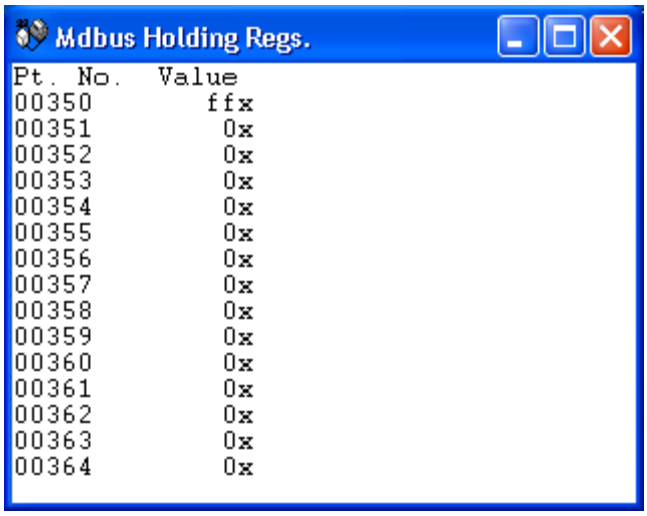


Figure 6-4: Relay Status Area (350-365)

Figure 6-5 displays the Analog Output Status Area (380-387) screen. It indicates that Zones 1 and 2 are available.

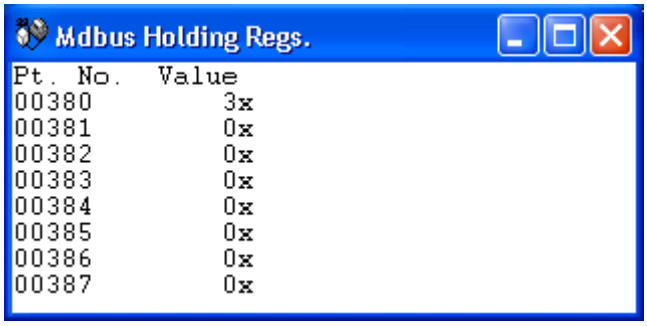


Figure 6-5: Analog Output Status Area (380-387)

Figure 6-6 displays the Zone Status Area (400-407) screen. It indicates that Zones 1 and 2 are available.

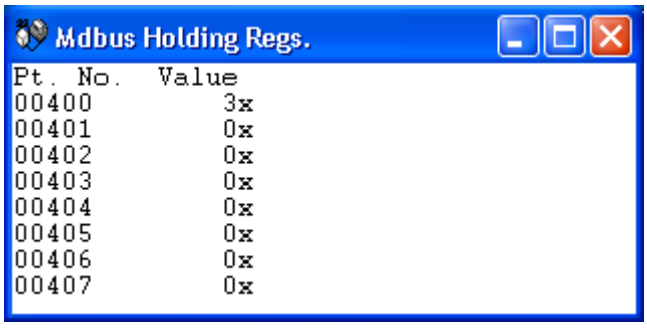


Figure 6-6: Zone Status Area (400-407)

Figure 6-7 displays the Monitor BACnet Configuration Area (501-521) screen.

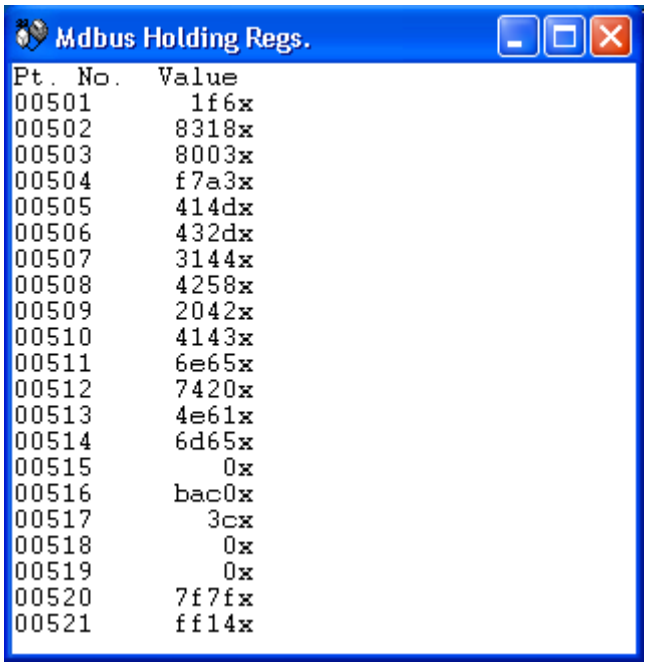


Figure 6-7: Monitor BACnet Configuration Area (501-521)

Register 500 BAS MODBUS LockCode is write only. It indicates:

- TCP UDP port=502
- BAS MODBUS is enabled with 9600Baud, 1 stop bit, even parity, 8-bit length, RTU
- protocol.
- BACnet-IP with DEVICE ID=260003, Name="AMC-1DBX BACnet Name", Network number =0, UDP Port=0xBAC0, TTL=60seconds and no BBMD.
- BACnet-MSTP with address=127, maximum master = 127 and 20mS.

Figure 6-8 displays the Sensor Input Information Area (1-99) screen and Figure 6-9 displays the Sensor Input Information Area (248-494) screen. They indicate that sensors 1-99 and 248-494 are available with two increasing alarm set points and 0ppm gas concentration.

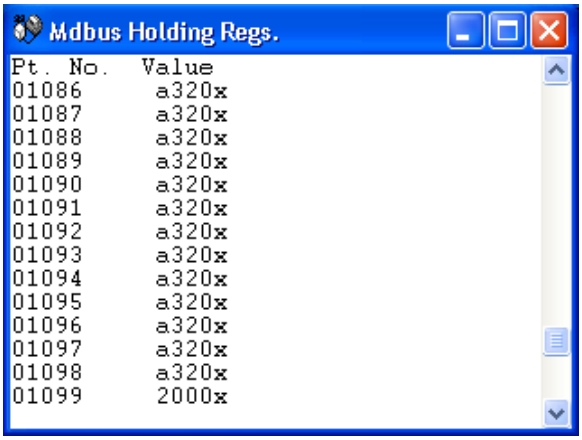


Figure 6-8: Sensor Input Information Area (1-99)

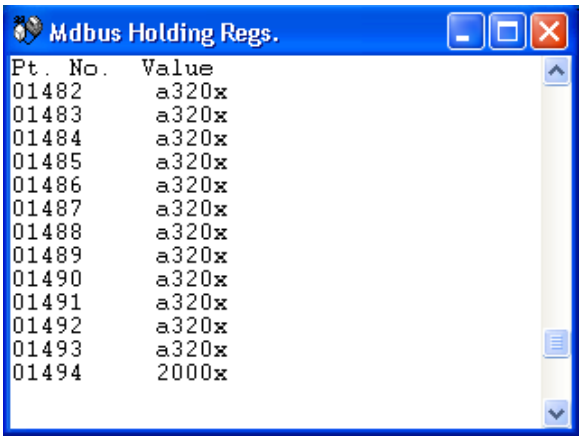


Figure 6-9: Sensor Input Information Area (248-494)

Figure 6-10 displays the Sensor Alarm/FAIL Information Area (2000-2246).

It indicates that sensors 249-494 are in ALARM1 and ALARM2.

(Sensors 248-494 have a gas concentration of 100ppm).

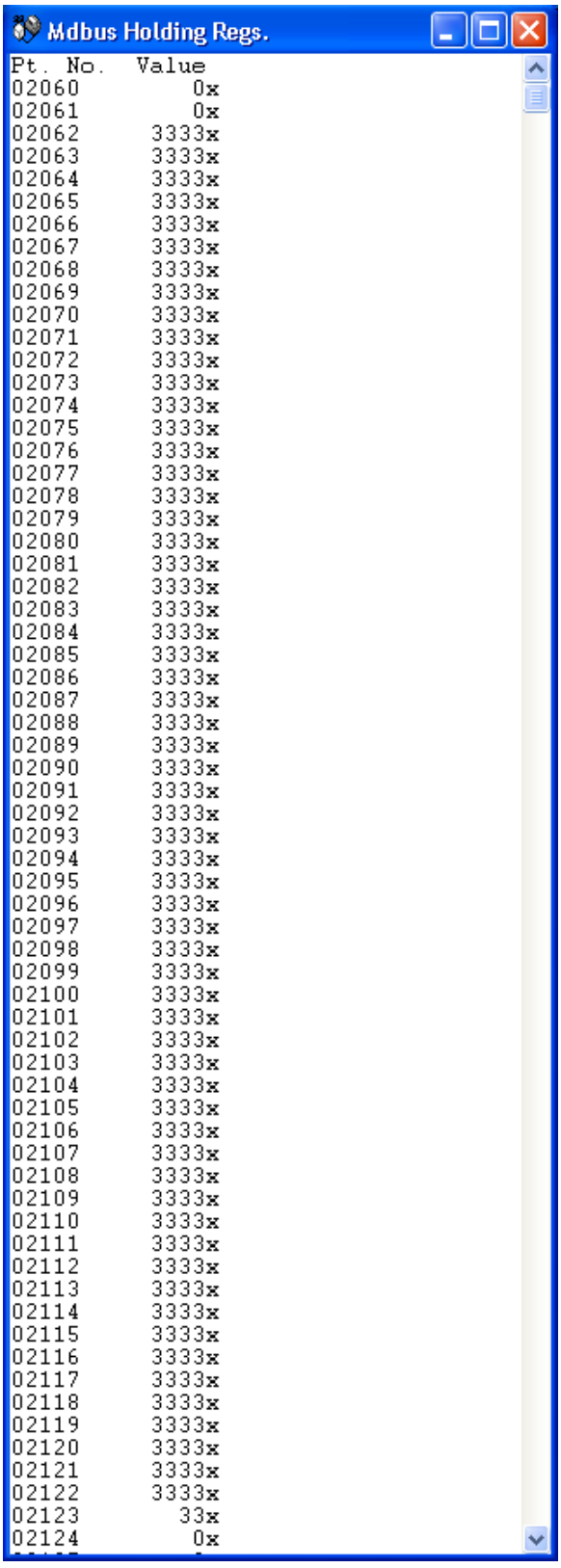


Figure 6-10: Sensor Alarm/FAIL Information Area (2000-2246)

Figure 6-11 displays the Relay Information Sensor Alarm Count Area1 (2500-2755) screen.

It shows sensors 249-494 have triggered relay 1 and relay 2 with 246 counts each.
(Sensors 248-494 have a gas concentration of 100ppm).

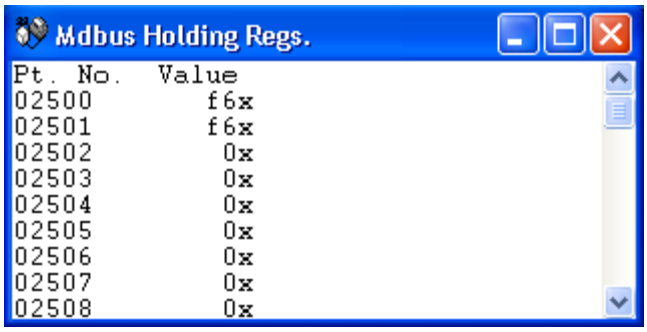


Figure 6-11: Relay Information Sensor Alarm Count Area1

Figure 6-12 displays the Relay Information Sensor Alarm Count Area2 (2500-2755) screen.

It shows sensors 1-99 have triggered relay 1 and relay 2 with 99 counts each.
(Sensors 1-99 have a gas concentration of 100ppm.)

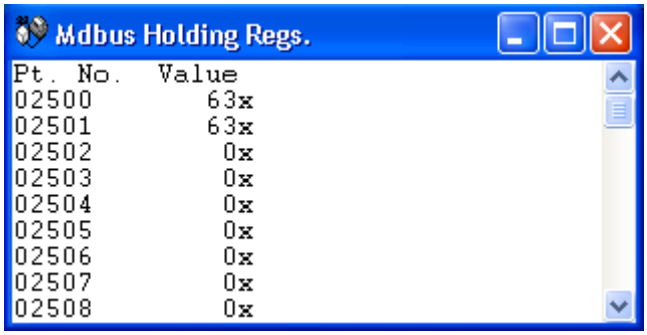


Figure 6-12: Relay Information Sensor Alarm Count Area2

Figure 6-13 displays the Relay Information Zone Sensor Alarm Count Area (3000-3255) screen.
It shows sensor 6 has triggered relay 5 and relay 6 with 2 counts each.

(Zones 1 and 2 have a gas concentration of 100ppm.)

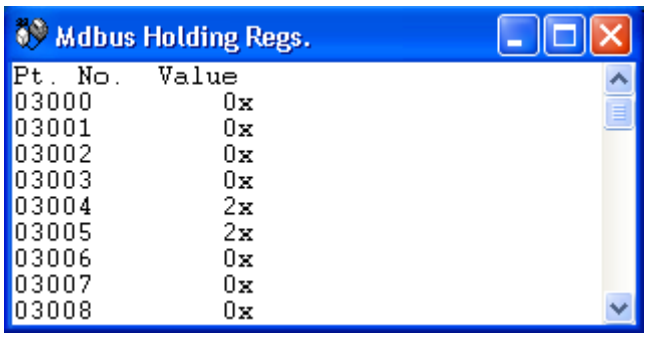


Figure 6-13: Relay Information Zone Sensor Alarm Count Area

Figure 6-14 displays the Relay Output Information Relay Status Area (3500-3755) screen.

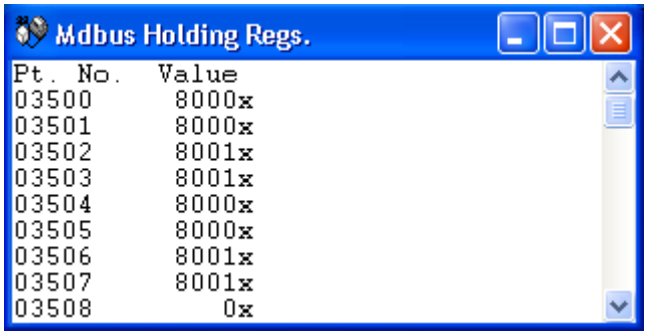


Figure 6-14: Relay Output Information Relay Status Area

It shows sensors have triggered relays 1, 2, 5 and 6. Also, relays 1 to 8 are available and there is no remaining time for minimum run and post run timers. All relays are normally energized.

(Sensors 1-99 and Zones 1 and 2 have a gas concentration of 100ppm).

Figure 6-15 displays the Analog Output Information Analog Output Status Area (3800-3927) screen.

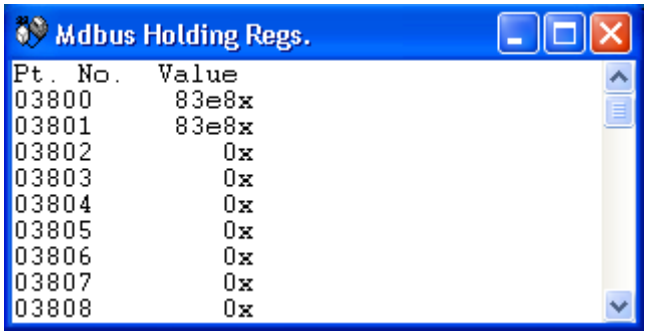


Figure 6-15: Analog Output Information Analog Output Status Area

It indicates that analog outputs 1 and 2 are available with 100% of full scale.
(Zones 1 and 2 have a gas concentration of 100ppm).

Figure 6-16 displays the Zone Information Zone Status Area (4000-4127) screen.

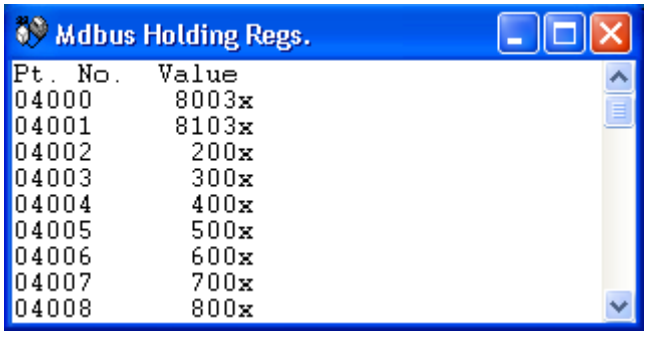


Figure 6-16: Zone Information Zone Status Area

It indicates that zone 1 and 2 are available with Analog Output 1 and 2 assigned to them respectively. Also zone 1 is indicating ALARM 1 and ALARM 2 event.

(Zones 1 and 2 have a gas concentration of 100ppm).

Figure 6-17 displays the Sensor Alarm 2 Relay Information (7000-7987) screen.

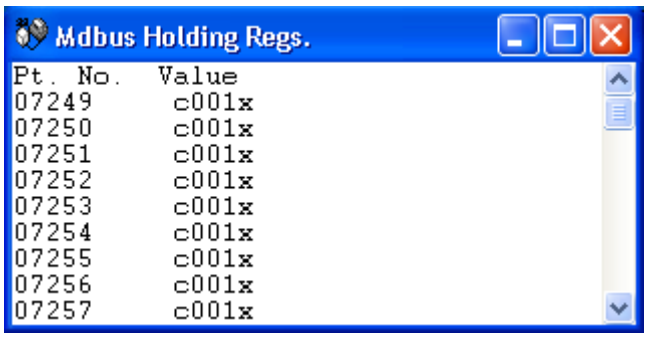


Figure 6-17: Sensor Alarm 2 Relay Information Area

It indicates that sensors 248-494 are available and in ALARM2 with RELAY 2.

(Sensors 248-494 have a gas concentration of 100ppm).

Figure 6-18 displays the Sensor Alarm 1 Relay Information (8000-8987) screen.

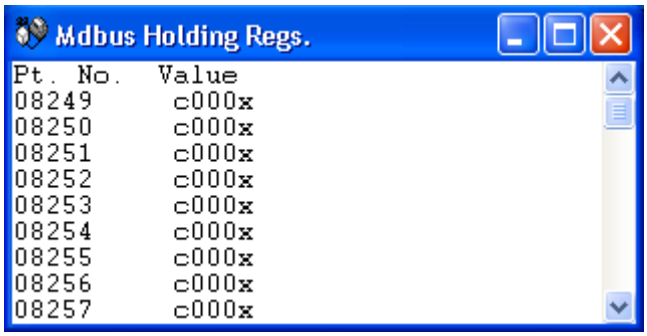


Figure 6-18: Sensor Alarm 1 Relay Information Area

It indicates that sensors 248-494 are available and in ALARM1 with RELAY 1.

(Sensors 248-494 have a gas concentration of 100ppm).

Figure 6-19 displays the Zone Alarm 1 Relay Information (9600-9727) screen.

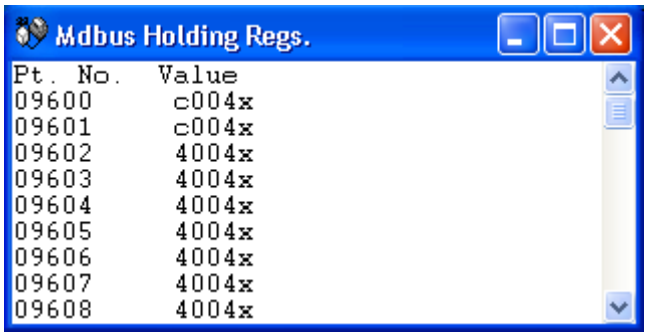


Figure 6-19: Zone Alarm 1 Relay Information Area

It indicates that zone 1-99 are available and in ALARM1 with RELAY 5.

(Sensors 1-99 have a gas concentration of 100ppm).

Figure 6-20 displays the Sensor 1 Control Information (1000-34699) screen.

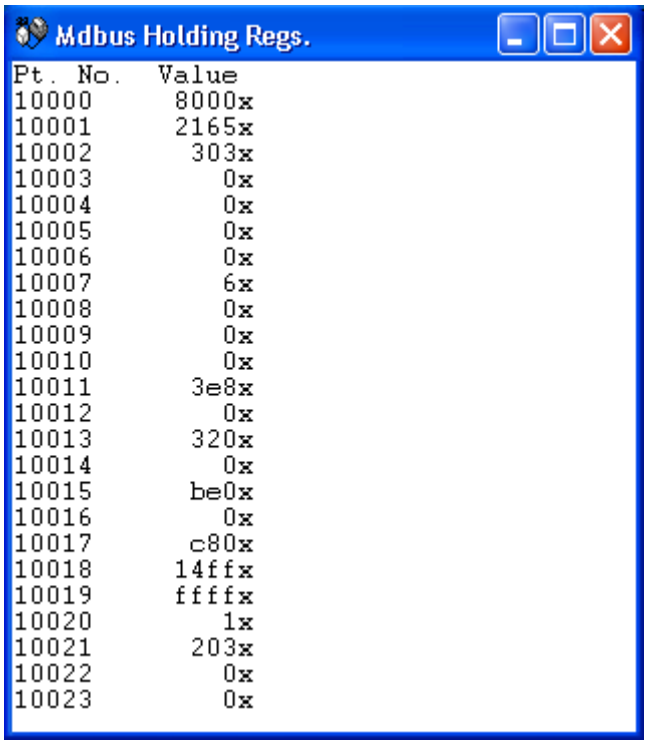


Figure 6-20: Sensor 1 Control Information Area

It shows the configuration for sensor 1 used by this sequence of operation example.

Figure 6-21 displays the Relay 1 Control Information (35000-36279) screen.

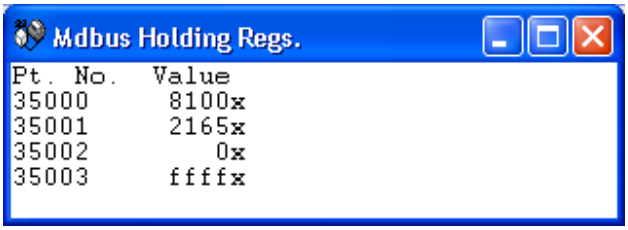


Figure 6-21: Relay 1 Control Information Area

It shows the configuration for relay 1 used by this sequence of operation example.

Figure 6-22 displays the Analog Output Control Information (38000-38639) screen.

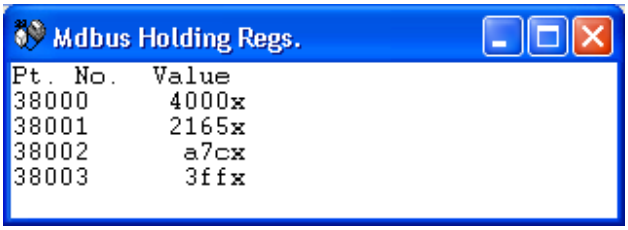


Figure 6-22: Analog Output Control Information Area

It shows the configuration for Analog Output 1 used by this sequence of operation example.

Figure 6-23 displays the Zone Control Information (40000-58431) screen.

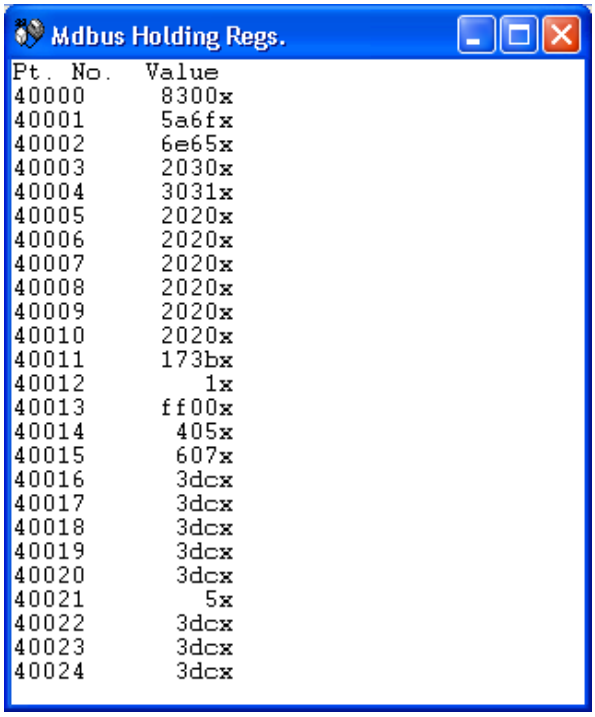


Figure 6-23: Zone Control Information Area

It shows the configuration for zone used by this sequence of operation example.

All sensor index control registers are set to 988 except index control 6 which has sensor 6 (base 0) assigned to the zone.

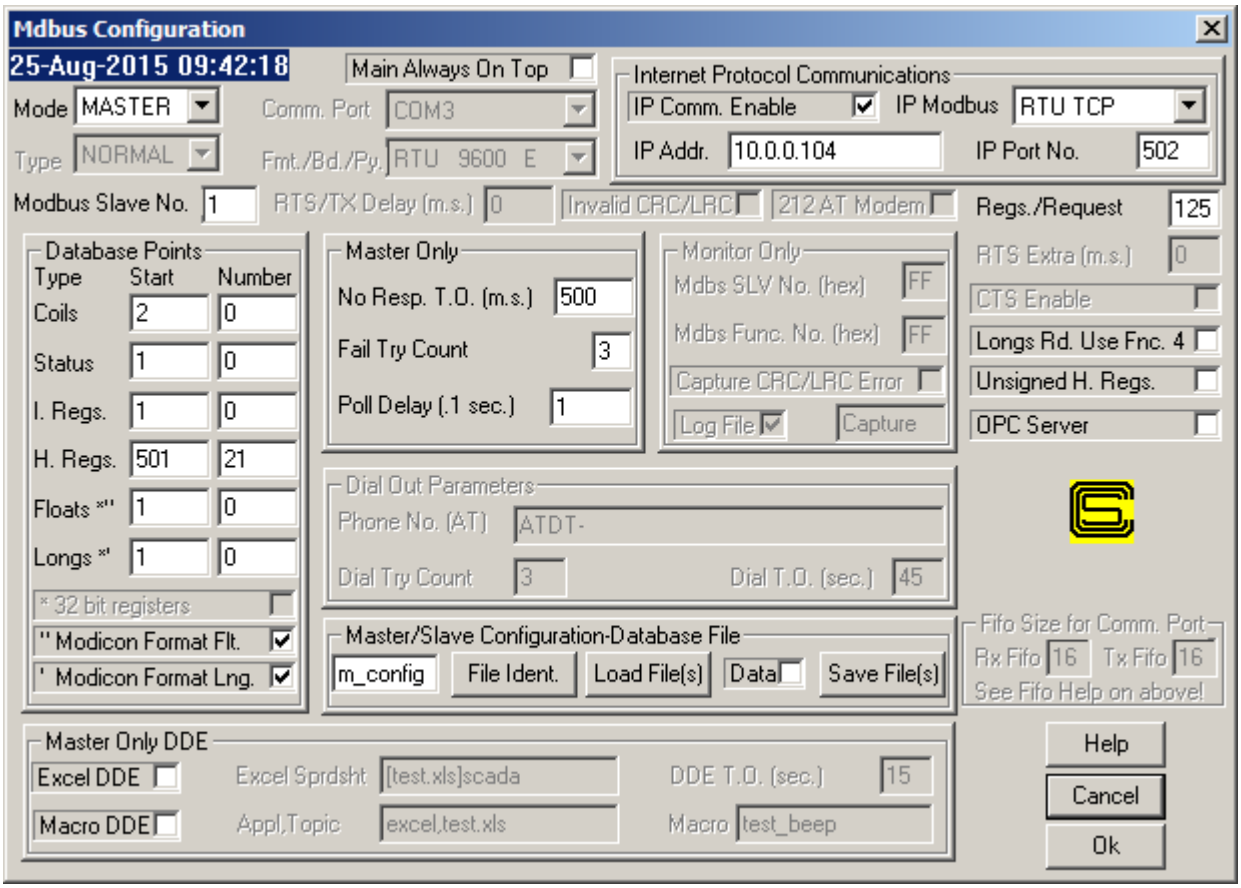
(A value of 988 indicates that the index control register is not used).

6.4 AMC-1DBX BAS MODBUS TCP SEQUENCE OF OPERATION

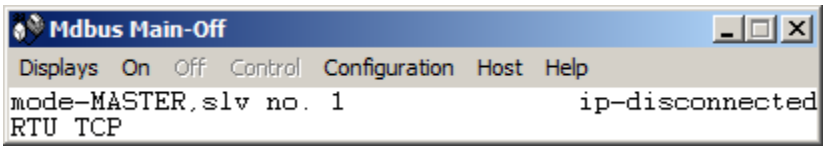
The following is sequence of operation example for the MODBUS-TCP operation using Modbus Rev 4.00 tool.

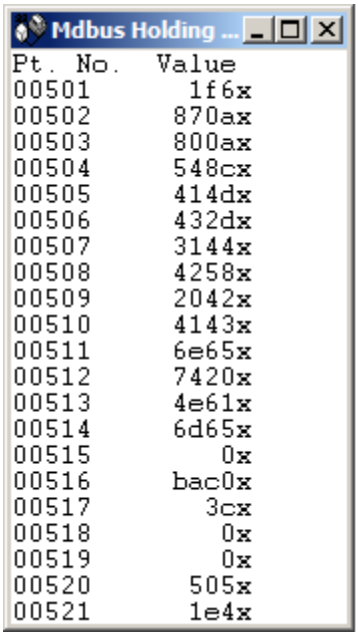
1. From the AMC-1DBx Monitor obtain its IP Address and BAS MODBUS TCP port number (i.e. 502).

2. From Modbus Tool configuration dialog check the IP Comm. Enable button and select the IP Modbus RTU TCP choice and enter the IP Addr. And IP Port No obtained from the AMC-1DBx Monitor. Additionally select the Mode to MASTER and the H. Regs. Start 501 and Number 21 and press Ok button. This dialog is show below.



3. From the Mdbus Main-Off dialog select the Displays and press the Hold Register. With the mouse over the Value column press the right mouse button to change the Value column to hex.





4. Press the On button from Mdbus Main-Off window. The tool will enter a continuous read IP address at the TCP port 502.

5. From the Mdbus Holding window you can see the MODBUS-TCP Port is indicated in Pt. No. 501 with a value of 1F6x (502 decimal).

6. From the AMC-1DBx monitor obtain the MODBUS un-LockCode. From the Mdbus Main-On window select the Control button. Enter the Holding Regs. Pt. No. 500 and the Value(s) un-LockCode (i.e. 0). Press Send to write this register to the monitor. This action will allow further writes to the Monitor BAS Configuration (Block Address 499-521).