Modular Box
AMC-1DMBx Series
User Manual

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1 INTRODUCTION

1.1 OVERVIEW

This manual has been prepared to assist you in becoming familiar with the Armstrong AMC-1DMBx Modular Box. This manual contains the information necessary to install and operate the AMC-1DMBx Modular Box and is intended for personnel who are responsible for installing and operating this equipment.

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 equipment.

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.**

1.3 OTHER DOCUMENTS

Refer to the following documents for additional and amplifying information when using and interfacing with the AMC-1DMBx Modular Box:

- AMC-1DBx Digital Monitor User Manual
- AMC Manager User Manual
- AMC-1DBx BAS Interface Manual
- AMC400 Series User Manual

These additional manuals may be requested from Armstrong Monitoring Corp.

2 GENERAL INFORMATION

2.1 WARRANTY

The 1DMBx Modular Box is warranted against defects in material and workmanship for a period of one (1) year 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. If returned products fall under warranty, they will be returned to the client freight collect.

Service Department contact information:

Web: www.armstrongmonitoring.com
North America toll free: 1 (800) 465-5777

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.
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.
DCS	Distributed Control System. The control system is a computerized, intelligent network of electronic devices designed to monitor and control the mechanical and lighting systems in a building.
EMT and EMI	Electrical Metal Tube conduit also adds an added degree of electrical shielding against EMI (Electro Magnetic Interference) from devices such as RF (Radio Frequencies) radio sources.
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 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.
MODULAR BOX	AMC-1DMBx is a series of Armstrong products used as remote accessories to accompany AMC-1DBx Digital Monitors. They include relays, repeaters, Analog I/O, and power supplies.
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.
PLC	A Programmable Logic Controller (PLC) or programmable controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures.
UART	A Universal Asynchronous Receiver/Transmitter, abbreviated UART, is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with communication standards such as EIA RS-232, RS-422 or RS-485. The universal designation indicates that the data format and transmission speeds are configurable and that the actual electric signalling levels and methods (such as differential signalling etc.) typically are handled by a special driver circuit external to the UART.
Analogs I/O	Reference to separate modules that can read an analog input signal or provide an analog output signal.
UI	User Interface, the space where interaction between humans and machines occurs.
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.
RS-485	Rs-485 is a standard defining the electrical characteristics of drivers and receivers for use in balance digital multipoint systems. The standard is published by the Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA).
EOL	End Of Line refers to the last module on a lane which needs to be terminated. The RS-485/modbus standard requires the bus to be terminated at its ends. This termination is accomplished by using termination resistors.

3 PRODUCT INFORMATION

The following information is provided for the AMC-1DMBx Modular Box Series. The Modular Box AMC-1DMBx Series consists of several optional assemblies. The product information for those assemblies, if provided, is found in the following sections:

- AMC-1DMB–RL Relay module, 8ch, DPDT, 24VDC, RS-485
- AMC-1DPS–7A power supply, 24VDC, 7A output
- AMC-1DMB–PS-R power supply, 24VDC, 7A output, 4 port RS-485 repeater
- AMC-1DMB–AI Analog In, 8ch, 0-20mA, 24VDC, RS-485
- AMC-1DMB-RL-AO 8 relays, w analog out, 8ch, 0-20mA, 24VDC, RS-485

This following section provides information about part numbers and serial numbers.

3.1 AMC-1DMB –RL 8CH Relay Module

Part Number	AMC-1DMB-RL
Warranty Period	1 Year
Power Supply Requirement	24VDC +/- 10%, 450mA (with all relays energized)
Enclosure	NEMA1(Metal)
Dimensions	304.8mm L x 304.8mm W x 101.6 mm H, (12” x 12” x 6”)
Weight	5.26 kg, (11.6 lbs)
Operating Temperature	-10 °C to +50 °C (14 °F to + 122 °F)
Operating Pressure	Ambient atmospheric pressure
Relative Humidity	0 – 95% non-condensing
Signaling	MODBUS RTU over RS-485 9600 Baud, 8bit Even Parity
Relay Contacts	DPDT
Relay Ratings	Maximum Rated current A 10 Maximum Rated voltage DC/AC V DC/AC 30/240 Single phase motor rating (230 V AC) kW 0.37 Breaking capacity DC1: 30V A 10

3.2 AMC-1DPS 24VDC, 7A, Power Supply

Part Number	AMC-1DPS-7A
Warranty Period	1 Year
Power Requirement	120VAC, 60Hz, 5.3A
Input Fuse	4A 120V , Slow Blow
Output Fuse	10A 120V , Slow Blow
Secondary Power	24VDC, 7A
Enclosure	NEMA1(Metal)
Dimensions	304.8mm L x 304.8mm W x 101.6 mm H, (12” x 12” x 6”)
Weight	5.26 kg, (11.6 lbs)
Operating Temperature	0 °C to +40 °C (32 °F to + 104 °F)
Operating Pressure	Ambient atmospheric pressure
Relative Humidity	0 – 90% non-condensing

3.3 AMC-1DMB –PS-R Power Supply w Repeater

Part Number	AMC-1DMB-PS-R
Warranty Period	1 Year
Power Requirement	120VAC, 60Hz, 5.3A
Input Fuse	4A 120V , Slow Blow
Output Fuse	10A 120V , Slow Blow
Secondary Power	24VDC, 7A
Enclosure	NEMA1(Metal)
Dimensions	304.8mm L x 304.8mm W x 101.6 mm H, (12” x 12” x 6”)
Weight	5.26 kg, (11.6 lbs)
Operating Temperature	0 °C to +40 °C (32 °F to + 104 °F)
Operating Pressure	Ambient atmospheric pressure
Relative Humidity	0 – 90% non-condensing
Repeater/Isolator Power Requirement	9 – 30VDC 30 mA
Optical Isolation	2500Vrms (AC, 1 min)

3.4 AMC-1DMB-AI 8CH 0-20mA Analog Input

Part Number	AMC-1DMB-AI
Warranty Period	1 Year
Power Requirement	12-24VDC, 250mA
Enclosure	NEMA1(Metal)
Dimensions	304.8mm L x 304.8mm W x 101.6 mm H, (12” x 12” x 6”)
Weight	5.26 kg, (11.6 lbs)
Operating Temperature	-10 °C to +50 °C (14 °F to + 122 °F)
Operating Pressure	Ambient atmospheric pressure
Relative Humidity	0 – 90% non-condensing
Signaling	MODBUS RTU over RS-485 9600 Baud, 8bit Even Parity
Channel Input Resistance	250 ohms

3.5 AMC-1DMB-RL-AO 8CH relay and analog out module

Part Number	AMC-1DMB-RL-AO
Warranty Period	1 Year
Power Requirement	24VDC +/- 10%, 700mA (with all relays energized)
Enclosure	NEMA1(Metal)
Dimensions	304.8mm L x 304.8mm W x 101.6 mm H, (12” x 12” x 6”)
Weight	5.26 kg, (11.6 lbs)
Operating Temperature	-10 °C to +50 °C (14 °F to + 122 °F)
Operating Pressure	Ambient atmospheric pressure
Relative Humidity	0 – 90% non-condensing
Signaling	MODBUS RTU over RS-485 9600 Baud, 8bit Even Parity
Relay Contacts	DPDT
Relay Ratings	Maximum Rated current A: 10 Maximum Rated voltage DC/AC V DC/AC: 30/240 Single phase motor rating (230 V AC) kW: 0.37 Breaking capacity DC1: 30V A: 10
Channel Output Resistance	500 ohms MAX

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.

4 PRODUCT DESCRIPTION

This section provides a general product description about the AMC-1DMBx Modular Box.

4.1 GENERAL DESCRIPTION

The AMC-1DMBx Modular Box series provides power, isolation, and remote modules complimenting the AMC Digital Monitor series.

Communications with the remote modules are via digital highways employing RS-485/MODBUS-RTU. Actions such as remote relay activation and remote analog I/O manipulation result from information from the AMC-1DBx Digital Monitor.

The AMC-1DMBx Modular Box series may contain the following functionality, refer to Section 3: PRODUCT INFORMATION:

- 8 remote analog 0-20mA inputs
- 8 remote analog 0-20mA outputs
- 8 remote DPDT 10A relays per module
- 7A power supply with repeater/isolator

4.1.1 RS-485

The AMC-1DMBx Modular Box RS-485 interfaces are provided through terminal blocks, termination resisters are provided where applicable. RS-485 lanes must be terminated as proper procedure. Relay and Analog Modules are factory configured to industry standard communication: 9600 Baud, 8bit Even Parity. Changing AMC-1DMBx communication settings requires a qualified technician, or factory return for re-programming, contact Armstrong Monitoring if required.

4.1.1.1 RS-485 Termination

Terminate through on boards resistors or install required 120Ω resistor.

4.1.2 Shield Termination

The RS-485 communication 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.

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, see applicable section in 5.2 WIRING.

4.1.3 Repeater /Isolator

AMC offers a rugged, industrial-grade, optically-isolated RS-485 Hub / Splitter /Repeater, available with or without a power supply.

An AMC-1DMB-PS-R can be used to expand RS-485 networks, while also offering power for nodes on the RS-485 network. It was designed to isolate the data coming from the RS-485 input and transmit to a four loop, expanded, RS-485 network.

4.1.4 Relay Modules

The AMC-1DBx Digital Monitor is capable of supporting up to 256 relays programmable by AMC Manager.

The AMC-1DMB-RL Modular Box provides 8 remote DPDT 10A relays. Each relay is user selectable to be linked to any combination of alarm or fail source, for all 988 sensors or 128 zones.

A shielded cable is employed to wire the signal to the target system. Power and RS-485 connections are made via DIN rail mounted terminal blocks. The terminal blocks support wire gauges from 16 to 22 AWG.

4.1.5 Analog Outputs

The AMC-1DBx Digital Monitor is capable of supporting up to 128 zones, controlling analog outputs, programmable by AMC Manager.

Additional analog outputs are available via external remote devices. These external devices are attached to the RS485 Lanes and include the AMC-1DMB-RL-AO and the AMC-1DMB-AO Modular Box.

The signal on the analog output is a function (sensor average or peak, averaged over time) of the detected gas levels found on the sensors within a zone.

An analog output can be configured for two ranges; 4-20mA or 0-20mA. The maximum load for an analog output is 500 ohms.

Analog outputs are available on the Analog Module terminal block provided. The terminal block supports wire gauges from 16 to 22 AWG.

4.1.6 Analog Inputs

There is support for 4-20mA Sensor inputs with external remote analog input devices. The 4-20mA Sensor Inputs are connected to the external devices inputs. These external

devices are attached to the RS485 Lanes of the AMC-1DBx Digital Monitor and include the AMC-1DMB-AI Modular Box.

The AMC-1DBx Digital Monitor is capable of supporting up to 988 sensors programmable by AMC Manager.

A shielded cable is employed to wire the signal to the target system. Power and RS-485 connections are made via DIN rail mounted terminal blocks. The terminal blocks support wire gauges from 16 to 22 AWG.

4.1.7 Power Supply

The AMC-1DMBx Modular Box features power supply options. The module provides sufficient power for powering additional units and external modules.

Manufacturing options allow for the following power supply configurations:

- 120VAC
  - Input source requirement
- 24VDC
  - 7A output provided for power inputs to feed the transmitters, etc.,
  - No Isolation is provided between power inputs that feed the transmitters.
- 24VDC with Repeater/Isolator
  - 7A output provided for power inputs to feed the transmitters, etc.,
  - Isolation provided by opto-isolator/repeater
    - Repeater /Isolator requires isolated power source for valid isolation

DIN rail mounted terminal blocks are provided for connecting power at the power entry point. (16 to 22 AWG wiring)

A ground DIN rail mounted terminal block is provided to connect safety ground to the chassis ground of the enclosure. (16 to 22 AWG wiring)

5 INSTALLATION

Follow the guidelines in this section for proper locations and installation of the AMC-1DMBx Modular Box series. In addition to these instructions, ensure installation is compliant with local building and electrical codes. This section covers topics related to installation location, mounting, cable selection, wiring instructions and monitor function programming for the following products:

- AMC-1DPS/MBx

5.1 MOUNTING INSTRUCTIONS

Follow the guidelines in this section for proper locations and installation of the AMC-1DMBx Modular Box Series. In addition to these instructions, ensure installation is compliant with local building and electrical codes. This section covers topics related to installation location, mounting, cable selection, wiring instructions and monitor function programming for the Digital Monitor AMC-1DBx series monitor.

5.1.1 AMC-1DMBx Modular Box Mounting

Securely fasten the AMC-1DMBx Modular Box on a solid, non-vibrating surface or structure. Install the unit where it is not exposed to rain or water spray. Install in an area where the local concentration of gas is unaffected by the presence of ventilation systems and away from sources of interference gases. Mount the monitor where the unit can be observed periodically.

For most applications the monitor should be mounted at eye level (1.2 -1.8 m (4-6 ft) from the floor) using the mount provided on the enclosure.

WARNING	**ALL CABLE ENTRY MUST BE MADE THROUGH THE BOTTOM OF THE MONITOR ENCLOSURE ONLY. OTHER ENTRY LOCATIONS COULD ALLOW FOREIGN MATERIAL TO ENTER THE ENCLOSURE, CAUSING POSSIBLE DAMAGE TO THE INTERNAL COMPONENTS.**

WARNING	**MOUNT ALL EQUIPMENT AWAY FROM ANY SOURCE OF ELECTRO-MAGNETIC INTERFERENCE (EMI) OR RADIO FREQUENCY INTERFERENCE (RFI) SUCH AS POWER TRANSFORMERS, ELECTRONIC MOTORS, ETC.**

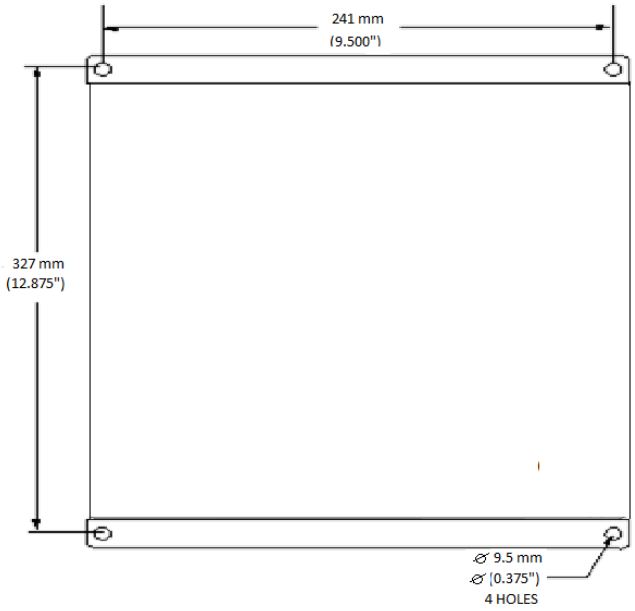


Figure 5-1: Location of Mounting Holes for AMC-1DPS/MBx

5.1.2 TRANSMITTER/SENSOR MOUNTING

Mount sensor/transmitter(s) on a solid, non-vibrating surface or structure in an area where the ambient concentration of gas is not directly affected by the presence of clean air supply, ventilation systems, or blockage by surrounding articles and sources of interference gases. Please, refer to local codes for sensor/transmitter installation information. The installer is required to provide any mounting hardware that may be required. The recommended mounting height is specified in the SENSOR MODULE(S) SPECIFICATION. The conduit entry is from bottom of box to avoid moisture flow into box through conduit.

5.2 WIRING

See Sect 4.1GENERAL DESCRIPTION for specific wire gauges supported by connectors.

5.2.1 Modular Box Wiring

WARNING	**ENSURE TO TAKE ALL RELANT SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE POWER SOURCES.**

The AMC-1DMBx Modular Box Series requires a 120V, 60 Hz AC source or a 24VDC powering option. Terminal blocks are provided for the power entry connections.

Modular Boxes that require an AC source contain a 24VDC, 7A output switching power supply. An AMC-1DMBx that requires a 24VDC source could contain relays, analog I/O, or a repeater. Except for the power supply, Modular Boxes contain one or several RS-485 Devices.

There is a 32 Device limit per RS-485 bus segment. Devices include:

- 1DBX Monitor
- AMC-400 Transmitters
- AMC-DTR Dual Sensor System
- AMC-1DMBx Modular Box Series Devices
    - AMC-1DMB-PS-R, power supply with repeater/isolator
    - AMC-1DMB-AI, 8CH Analog In
    - AMC-1DMB-RL, 8CH Relay Module
- AMC-1DMB-RL-AO, 8CH Relay/Analog Out Module
    - The AMC-1DMB-RL-AO counts as two devices

Repeaters expand the MODBUS capacity by creating additional RS-485 segments. Refer to section 5.2.5 1DMBx Repeater Connections.

5.2.2 1DPS/MBx Power Supply Wiring

A minimum of one AMC-1DPS-7A 24VDC Power Supply is required to power both the 24VDC AMC-1DB1-2XXXXX Digital Monitor and all the MODBUS devices (Digital Transmitters, etc). Note that the Digital Transmitters are powered from the Power supply and **NOT** the Digital Monitor. See Figure 5-2. The Monitor's 24VDC output has a DC voltage less than 24V when powered by the 24VDC power supply which is the reason why the AMC-1DPS-7A 24VDC Power Supply should be used to provide transmitter power for this configuration. The AMC-1DPS-7A 24VDC Power Supply will provide 7A for the transmitters and other MODBUS devices. If this current is exceeded an additional AMC-1DPS-7A Power Supply should be employed.

Caution:

For the 24VDC AMC-1DB1-2XXXXX configurations both the SGND and +24VDC outputs from the 1DBx Monitor connectors (ex. J34-3 or J34-4) should not be used.

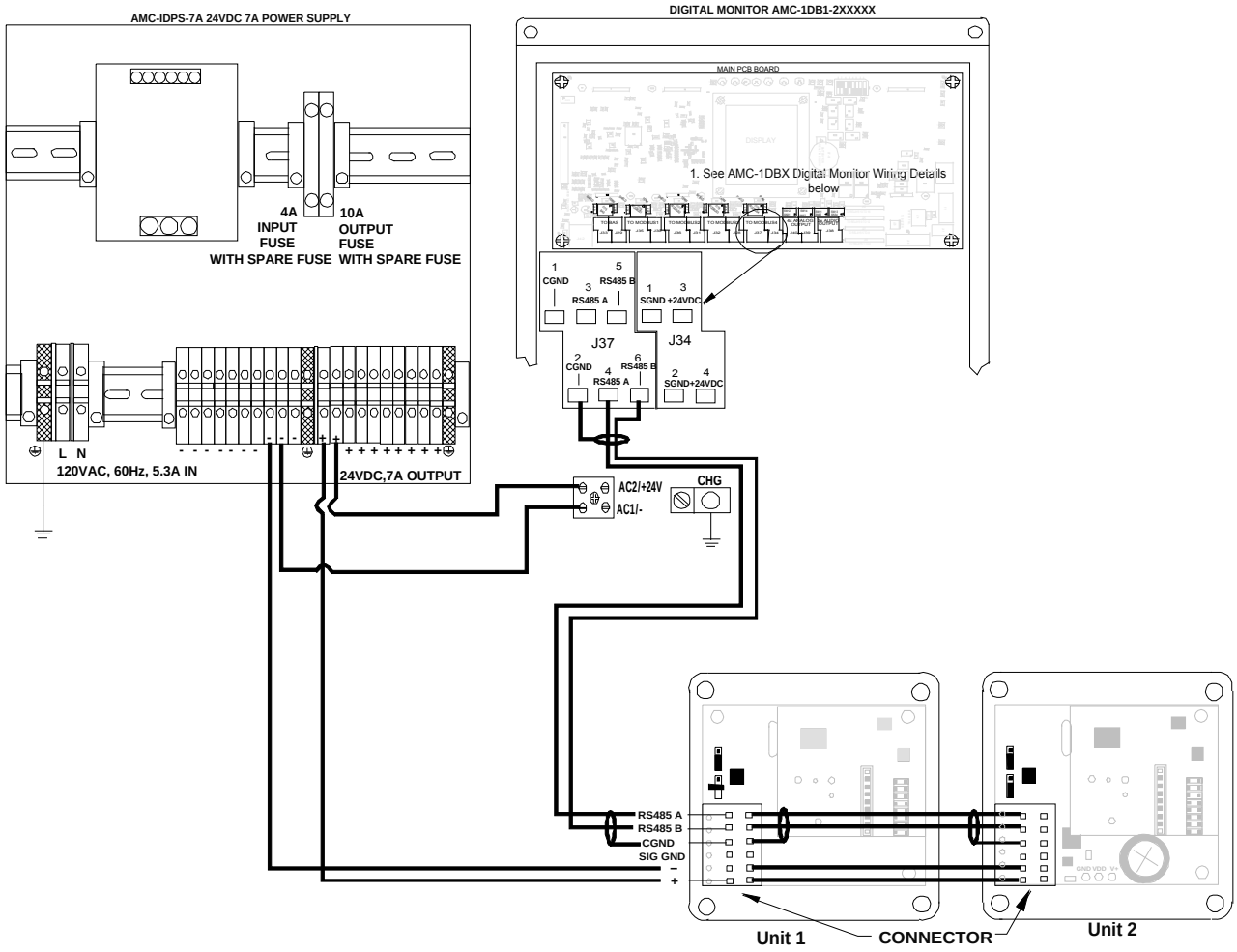


Figure 5-2 Example of 24VDC Powered Digital Monitor

5.2.3 External Power Supply Wiring

Users must connect the AMC-1DPS/MBx Power Supply ground to the Monitor's SGND if the monitor is powered by isolated 120VAC Power Supply and a AMC-1DPS/MBx Power Supply is used to power transmitters/sensors/relay modules. The 24VDC terminal block for the AMC-1DPS/ MBx supports wire gauges from 16 to 22 AWG. Figure 5-3 details a 120VAC Digital Monitor powering one RS485 lane with an AMC-1DPS/MBx Power Supply powering another RS485 lane.

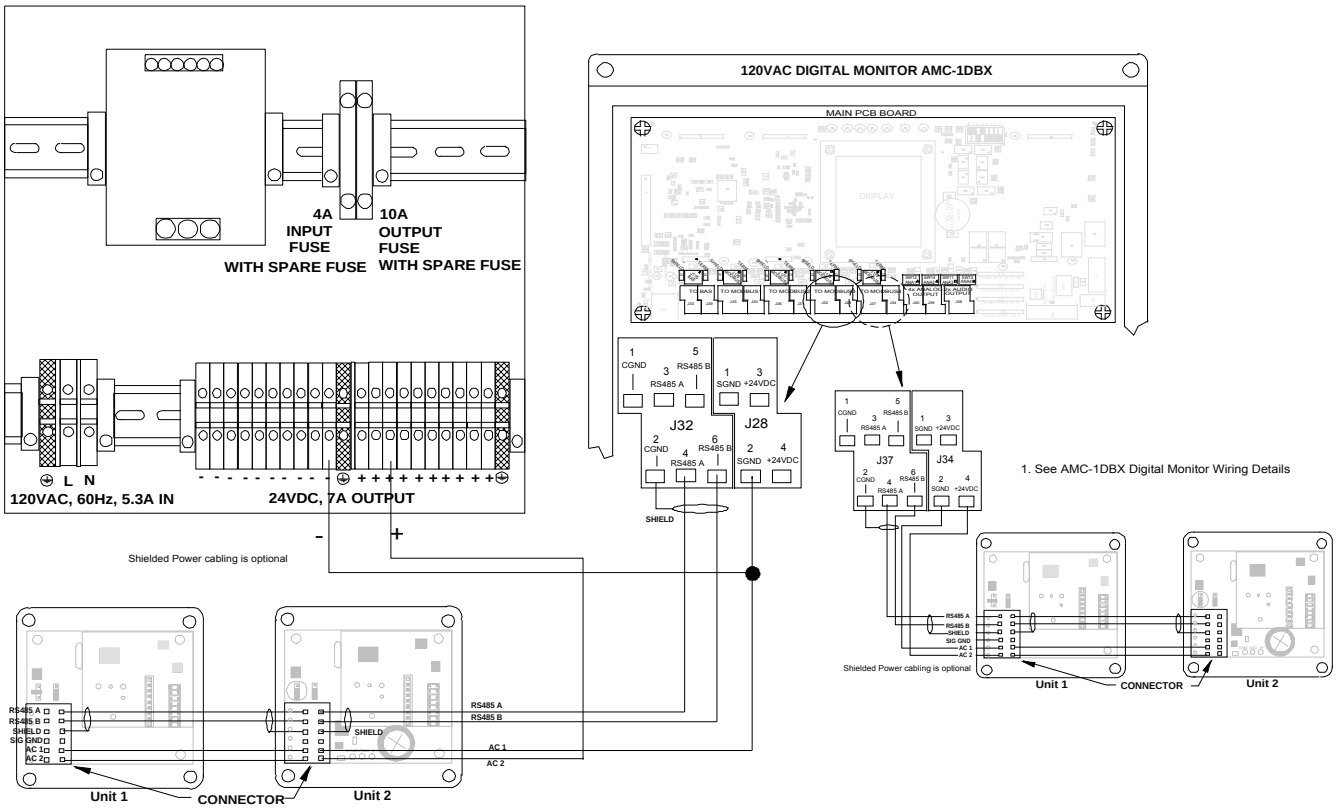


Figure 5-3 Example of External Supply with 120VAC Powered Digital Monitor

5.2.4 Minimum Voltage

The AMC-1DPS-7A Power Supply and AMC-1DMBx Modular Box have the ability to drive a number of remote devices. The maximum number of devices is determined by what other devices are being driven (relay modules, analog modules, transmitters, etc.), the AWG of wire selected, and the length of cable being powered. The cable length must not exceed a distance that prevents the device from obtaining its minimum operating voltage.

5.2.5 1DMBx Repeater Connections

The following details extending an AMC-1DBx Monitor RS485 lane by using an AMC-1DMB-PS-R. The AMC-1DMB-PS-R is used to inject power into the isolated, repeated RS-485 data stream.

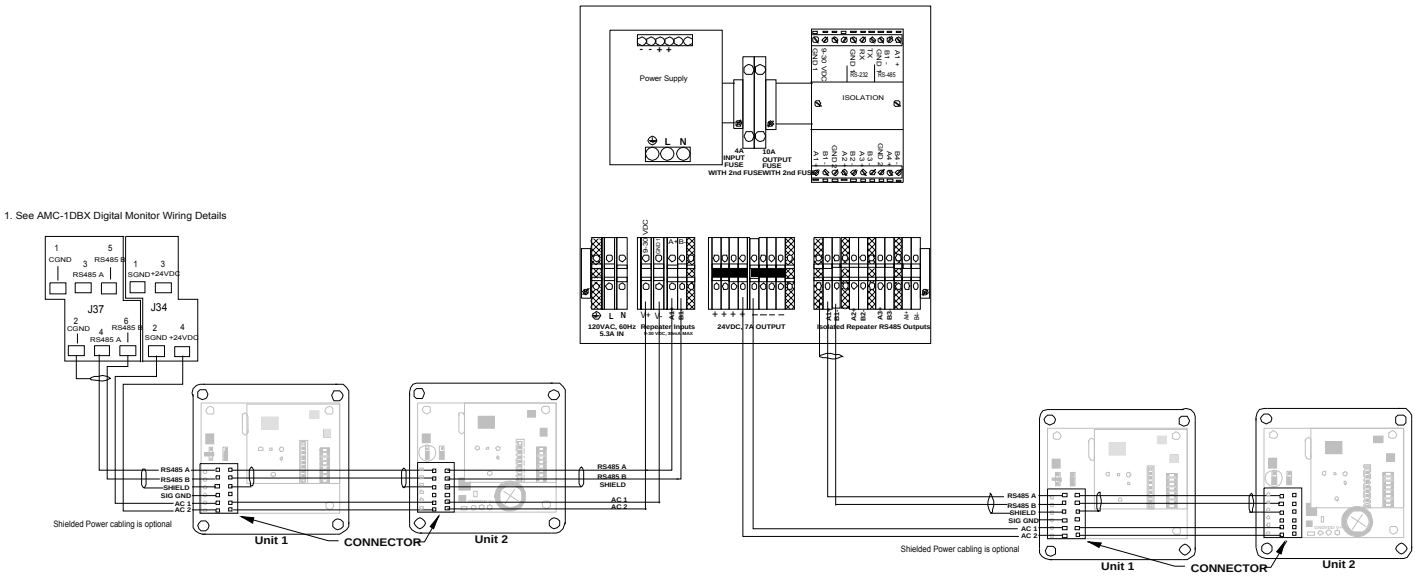


Figure 5-4 AMC-1DMB-PS-R Wiring

5.2.6 1DMBx Relay Connections

RELAYS:	There are up to 8 DPDT relays available which operate as programmed with alarms. For the relay socket terminal connections, see Figure 5-5 Relay Terminal Connections. The relay contacts are available for activating a remote alarm and/or, blower motors and pumps or lighting circuits.

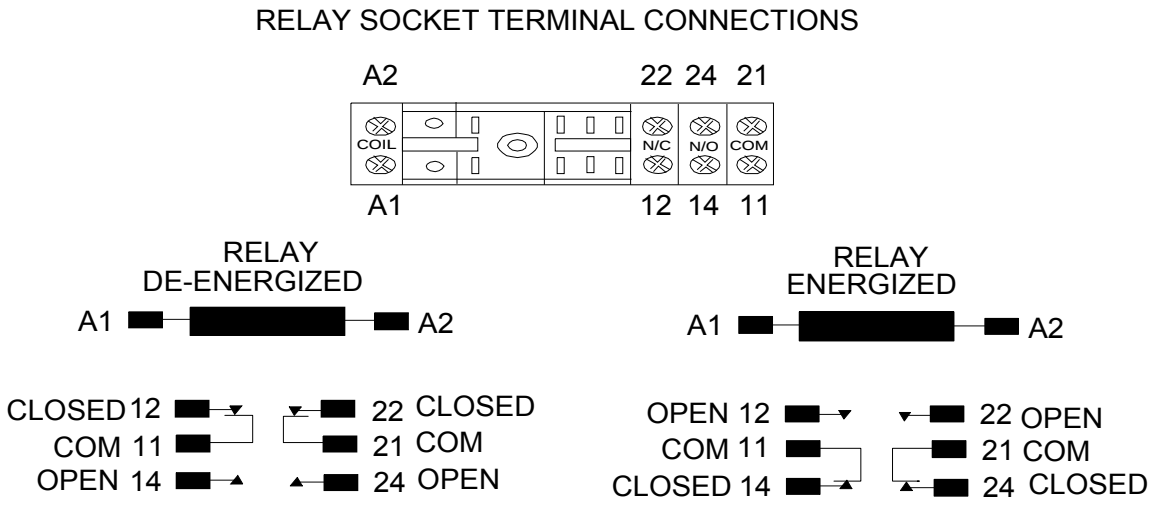


Figure 5-5 Relay Terminal Connections

Figure 5-6 AMC-1DMB-RL Connections shows the layout of the AMC-1DMB-RL Modular Box. This device requires 24VDC, the RS-485 termination resister is jumper enabled on the relay module. The Modules termination resister jumper must be installed if unit is at the end of line. The RS-485 input/output terminal blocks allow easy connections to the network and are wired in parallel.

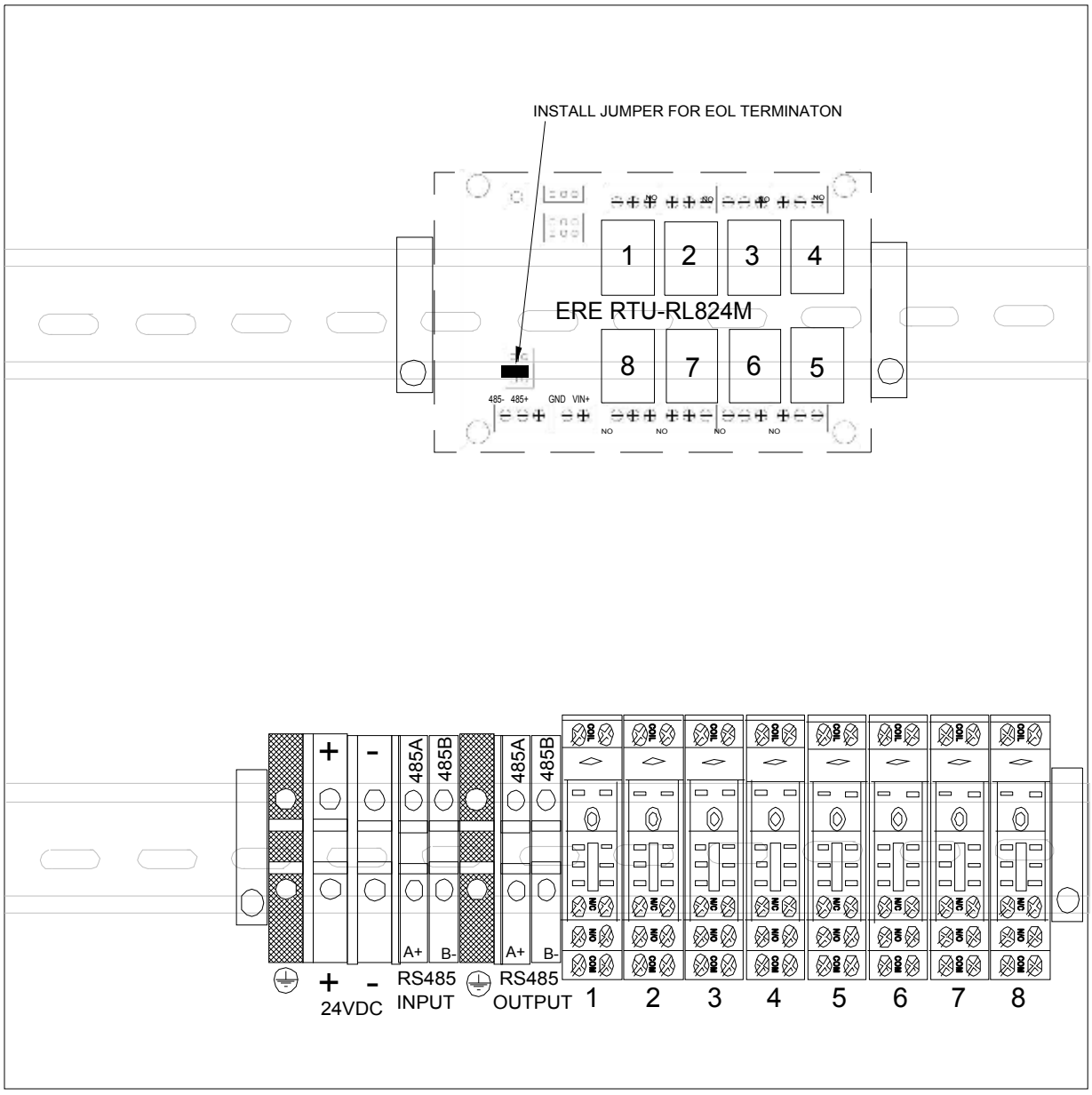


Figure 5-6 AMC-1DMB-RL Connections

5.2.7 1DMBx Analog Input Connections

Figure 5-7 Analog In Transmitter Connections shows the layout of the AMC-1DMB-AI Modular Box. The analog in Modular Box requires 24VDC, the RS-485 termination resister is installed

into the RS-485 terminal block. The Modules termination resister must be installed if modular box is at the end of line. The RS-485 input/output terminal blocks allow easy connections to the network and are wired in series parallel.

ANALOG INPUT:	There's up to 8 channels available which operate as 0-20mA analog inputs. The contacts are available via DIN rail mounted Terminal Blocks.

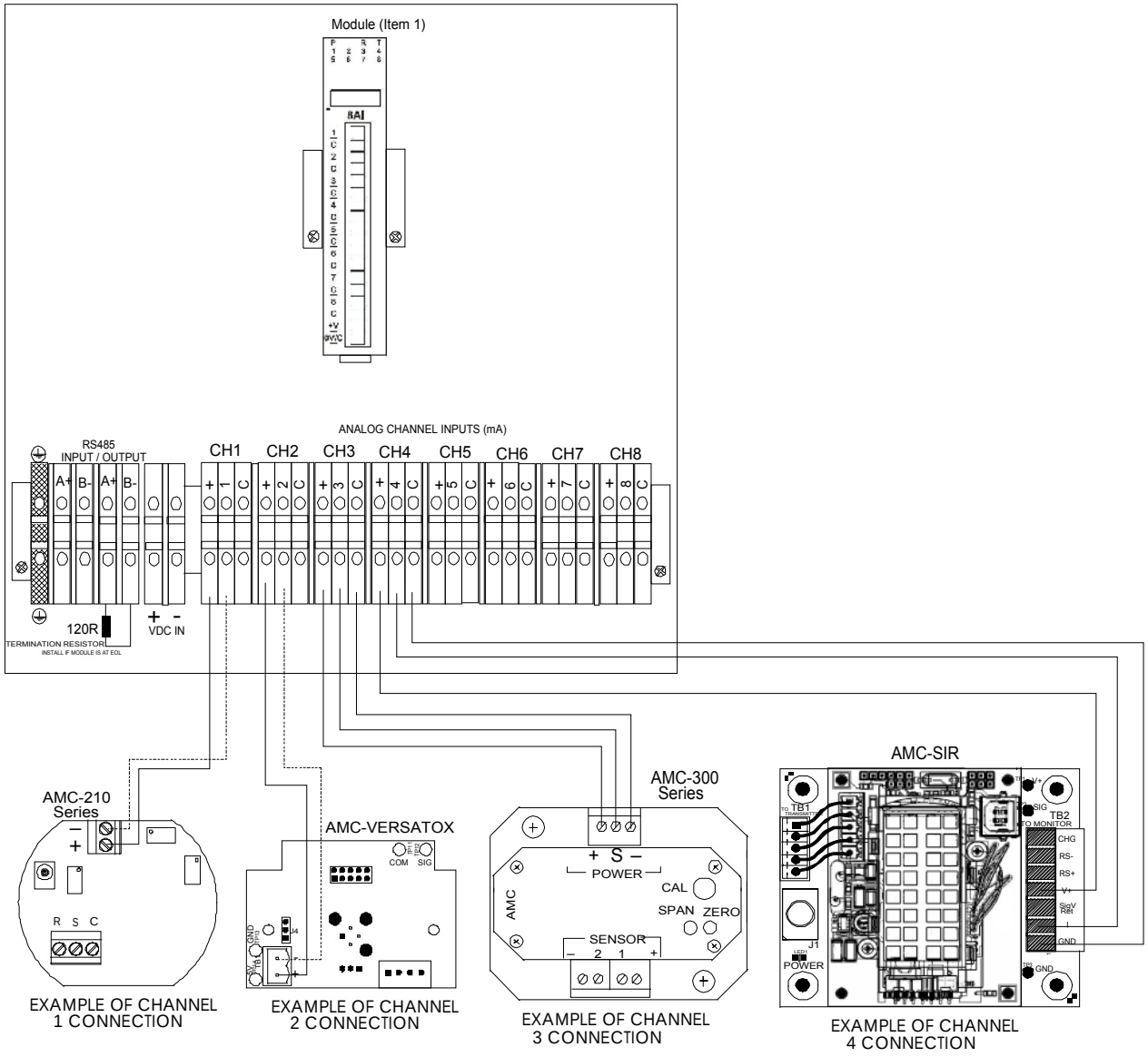


Figure 5-7 Analog In Transmitter Connections

5.2.7.1 External Power Supply Wiring

Users must connect the External Power Supply ground to the AMC-1DMB-AI ground if the module is powered by an isolated VDC Power Supply and an external power supply is used to power transmitters. The terminal blocks for the AMC-1DPS/ MBx supports wire gauges from 16 to 22 AWG. Figure 5-8 details an external power supply powering transmitters connected to an AMC-1DMB-AIN.

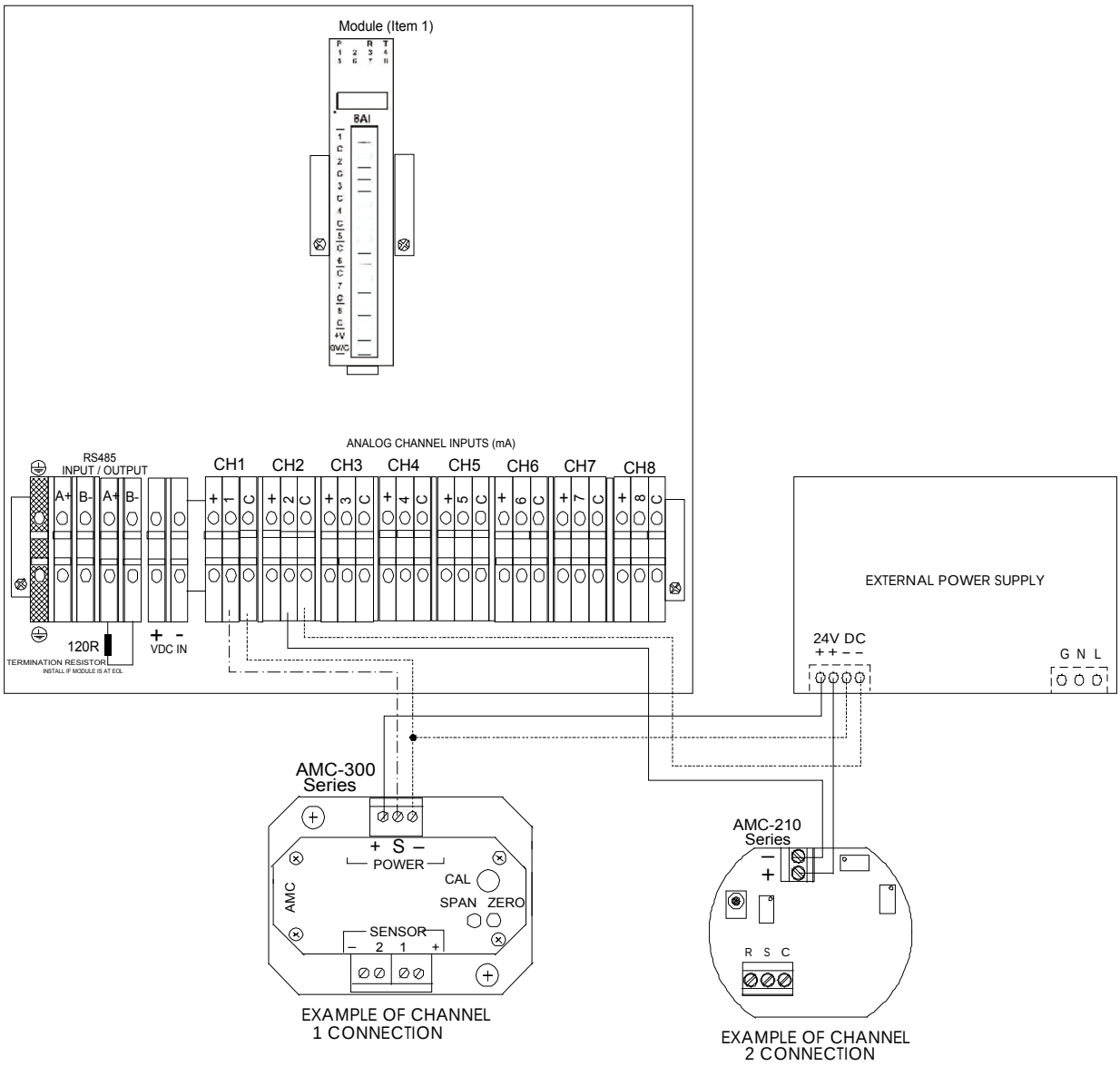


Figure 5-8 Externally Powered Analog In Connections

5.2.8 1DMBx Analog Output Connections

Figure 5-10 AMC-1DMB-RL-AO Connections shows the layout of the AMC-1DMB-RL-AO Modular Box. The analog out Modular Box also contains a Relay Module. This device requires 24VDC, the RS-485 termination resister is jumper enabled on the relay module. The Modules termination resister jumper must be installed if modular box is at the end of line. The RS-485 input/output terminal blocks allow easy connections to the network and are wired in series between the two modules.

ANALOG OUTPUT:	There's up to 8 channels available which operate as 0-20mA analog outputs. 500Ω load MAX. The contacts are available via onboard Terminal Block.

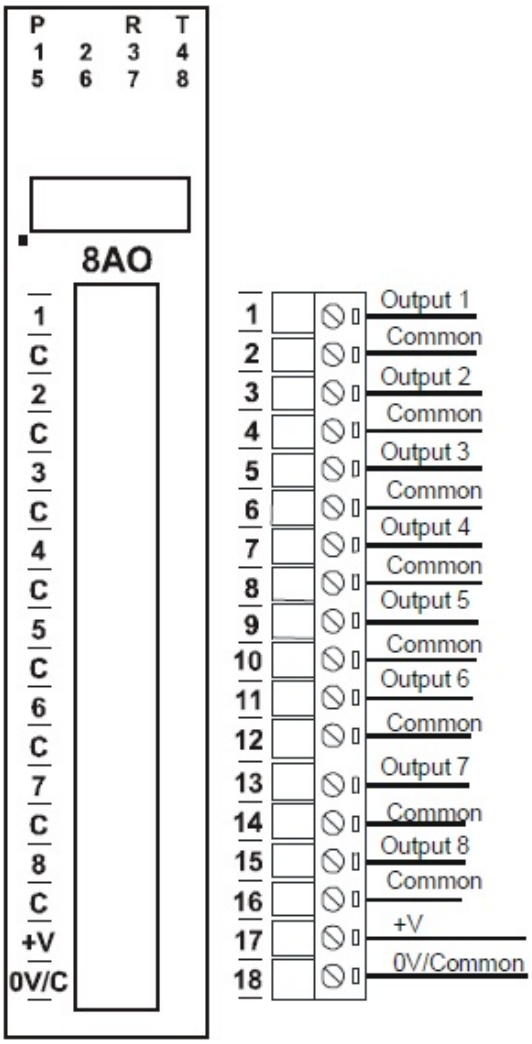


Figure 5-9 AMC-1DMB Analog Out Connections

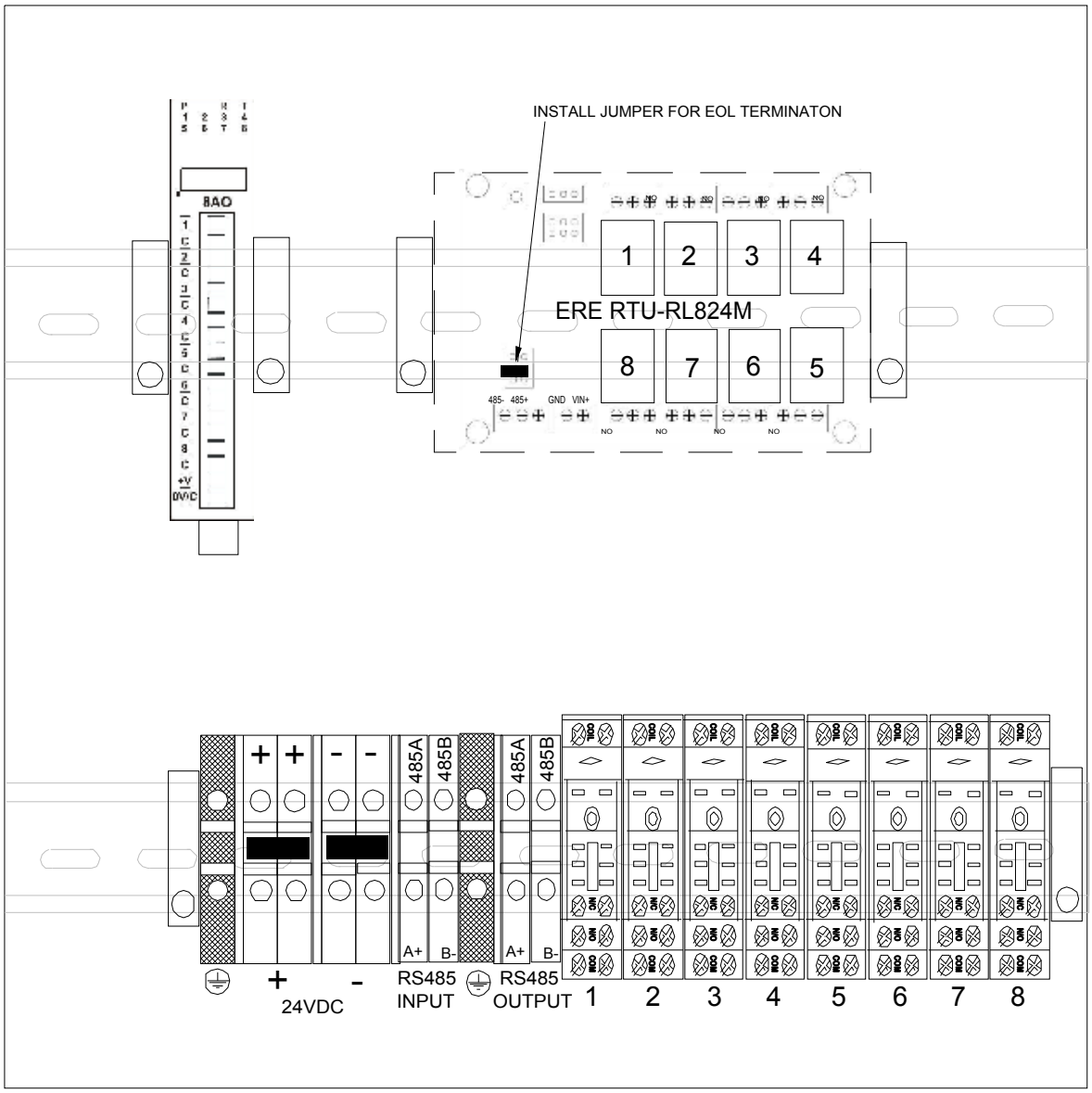


Figure 5-10 AMC-1DMB-RL-AO Connections

5.2.9 Cable Selection

The wiring consists of two subsystems:

- the monitor communication
- power supply wiring

A cable is used to connect the RS-485 signals from the digital monitor to digital transmitters in a bus topology. It is required that shielded, twisted pair, cable, 120 ohm impedance, and low

capacitance is used for the communications wiring. This bus can be up to 1 Km (1092 yards) in length. A repeater is required to extend beyond this distance.

Power supply wiring requires two conductors (+VDC and GND). The length of the power supply wiring is dictated by the voltage drop in the wiring. Using thicker wire results in longer distances.

For best signal transmission and maximum noise rejection, run the cable through a steel conduit (the cable shield must be grounded at the monitor only).

WARNING	**ALL CABLES MUST PASS THROUGH CONDUIT SEALS INSTALLED BETWEEN THE HAZARDOUS (CLASS I, DIVISION 1 OR 2) AND NON-HAZARDOUS AREAS FOR SAFETY REASONS AND TO COMPLY WITH THE LOCAL MUNICIPAL, PROVINCIAL, STATE, OR FEDERAL ELECTRICAL REGULATIONS.** **FOR UL ONLY (U.S.), FOLLOW THE NATIONAL ELECTRICAL CODE (NFPA 70) AND THE AUTOMOTIVE & MARINE SERVICE STATION CODE (NFPA 30A).**

5.3 ALARM ACCESSORIES

Alarm accessories can be wired through AMC-1DMBx Modular Boxes for remote or local activation.

5.3.1 Remote Alarm Module AMC-RAM

The AMC-RAM3/RAM4 series are connected through relays, the relays are programmed as per customer requirements. They can be powered or controlled by the AMC-1DMBx Modular Box series. Refer to appropriate manual for reference.

5.3.2 Audio Visual Alarm AMC-AV3-AUD

The AMC-AV3-AUD are connected through relays, the relays are programmed as per customer. They can be powered or controlled by the AMC-1DMBx Modular Box series. Refer to appropriate manual for reference.

6 OPERATION AND CALIBRATION

This section provides information about the operation procedures for the AMC-1DMBx Modular Box series.

6.1 OPERATION

The AMC-1DMBx Modular Box series can extend RS-485 networks; provide power, isolation, and remote modules. Remote AMC-1DMBx devices can add analog I/O and additional relays to the AMC-1DBx Gas Monitor network. It communicates with the monitor via digital highways employing RS-485\MODBUS RTU.

Since AMC-1DMBx Modular Box devices add functionality to the AMC-1DBx Gas Monitor, the monitor must be configured to define the devices. There are several methods to configure the monitor:

- Using AMC Manager PC Application,
- Using BAS MODBUS-RTU Interface,
- Using Monitor's Menu System.

The AMC-1DBx Gas Monitor menu system is password protected for making changes. When the operator is not logged in, they are limited to inspecting the configuration. When the user is logged in, then they can make changes to the configuration.

The table below shows the configuration references for the AMC-1DMBx Modular Box series.

1DMBx Modular Box	**Relay** Configuration Part Reference choices		**Sensor** Configuration Part Reference choices		**Analog Out** Configuration Part Reference choices	
	1DBx Monitor User Interface	AMC Manager Application	1DBx Monitor User Interface	AMC Manager Application	1DBx Monitor User Interface	AMC Manager Application
Relay Module	ERERM8 Instance 1-8	AMC-ER8RM_8 Instance 1-8	n/a	n/a	n/a	n/a
Analog In Module	n/a	n/a	BCI8 Instance 1-8	AMC-1DBCI_8 Instance 1-8	n/a	n/a
Analog Out Module	n/a	n/a	n/a	n/a	BCO8 Instance 1-8	AMC-1DBCO_8 Instance 1-8

Table 1 Modular Box programming cross reference

Once modules are detected user display and status LEDS will show no faults, errors, or missing sensors, relays, or analog I/O. Care must be taken not to power off the system until changes are secure in the data base storage device.

Refer to Digital Monitor AMC-1DBx Series User Manual - MENU SYSTEM AND FEATURES for programming the Gas Monitor AMC-1DBx.

Note: Updating the RS-485, Ethernet and BACnet-IP subsystem will cause outages on remote devices. Due to conflicting nature of implementing incomplete data base changes the operator should use the System Configuration DIP Switches to alleviate people's concerns and protect equipment.

6.1.1 Relay Module

This section provides information about the operation and procedures for the remote relays added by the AMC-1DMBx Modular Box series.

The AMC-1DMBx Modular Box provides 8 remote DPDT 10A relays. The AMC-1DBx Digital Monitor is capable of supporting up to 256 programmable relays.

Each relay is highly customizable, as per customer requirements, for activation source. Typically the "normally de-energized" position is employed, activating the relay when an alarm condition is detected. The "normally energized" position is selected when failsafe operation is required. For example, the requirement is that when power to the Gas Monitor is lost, the load connects to a power source via contacts of this, normally energized relay.

Since the AMC-1DMBx Modular Box communicates with the monitor via digital highways employing RS-485\MODBUS, proper installation and termination must be employed. Refer to Figure 5-6 AMC-1DMB-RL Connections for wiring and termination.

The AMC-1DMBx Modular Box Relay modbus address is factory preconfigured. Changing AMC-1DMBx communication settings requires a qualified technician, or factory return for re-programming, contact Armstrong Monitoring if required.

Figure 6-1 Relay Module UI Layout shows the upper left section of the Relay Module, which sits inside the AMC-1DMBx Modular Box. The UI contains a 'Reset' switch for rebooting the Relay Module, a 'RUN/INIT/LOAD' selector, and two LEDs. The 'PW' LED is red and indicates the device has power. The 'LINK' LED is green and flashes when there's RS-485/Modbus traffic.

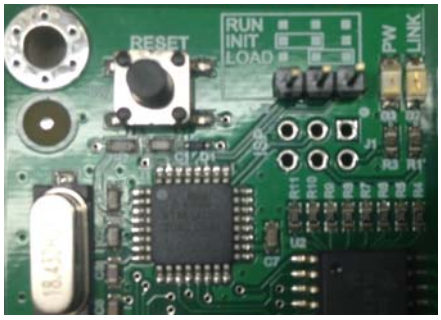


Figure 6-1 Relay Module UI Layout

Note: The jumper to select 'RUN/INIT/LOAD' is factory set and must be removed for proper operation.

6.1.2 Analog Modules

The AMC-1DMBx Modular Box is capable of supporting up to:

- 8 remote analog 0-20mA inputs
- 8 remote analog 0-20mA outputs

The Analog modules are factory pre-configured to industry standard communication 9600 Baud, 8bit, Even Parity. Changing AMC-1DMBx communication settings requires a qualified technician, or factory return for re-programming, contact Armstrong Monitoring if required.

Figure 6-2 Analog Modules UI Layout, describes the UI of the Analog modules.

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.

Input Status: "ON" when the input is zero.
"OFF" when the input is greater than zero and less than 4095.
"Flashing" when the input is over range, greater or equal to 4095

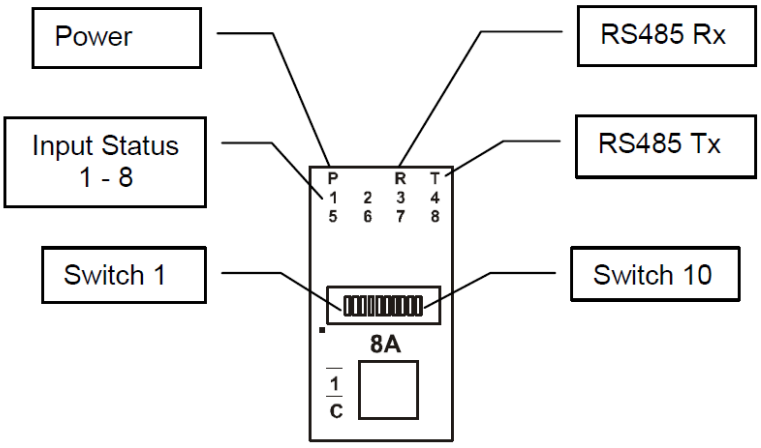


Figure 6-2 Analog Modules UI Layout

The Address of the Analog module is factory preconfigured. If the Address needs to be changed in the field switch 1-7 configures the address, or node. APPENDIX B Analog Module Node ID can be used for reference to input the required address into switches 1-7. Switch 8-10 are factory pre-configured.

6.1.2.1 Analog Outputs

The AMC-1DBx Digital Monitor is capable of supporting up to 128 zones, controlling analog outputs, programmable by AMC Manager.

The AMC-1DMB-RL-AO contains 8 analog outputs which add additional remote analog outputs for MODBUS channels.

An analog output can be configured for two ranges; 4-20mA or 0-20mA. The maximum load for an analog output is 500 ohms.

The analog output is assigned to a Zone. An analog output can be configured for peak or average operation and this is known as ***type*** in the database configuration context. The peak operation provides the highest gas concentration for the sensors assigned in that zone while the average provides a sum gas concentration over the number of sensors.

The analog output can provide a running averaging of up to 60 samples over a period of 60 seconds to allow output smoothing over the sampling period. This Analog Output Sampling Period is set from 1 to 60 seconds.

Caution:

The sampling period can introduce latency into a system, Validate any time dependencies for analog out applications.

6.1.2.2 Analog Inputs

There is support for 4-20mA sensor inputs with external remote analog input devices. The 4-20mA sensor inputs are connected to the AMC-1DMB-AI.

The AMC-1DBx Digital Monitor is capable of supporting up to 988 sensors programmable by AMC Manager.

A shielded cable is employed to wire the signal to the target system. Power and RS-485 connections are made via DIN rail mounted terminal blocks. The terminal blocks support wire gauges from 16 to 22 AWG.

6.1.3 Repeater

AMC offers a rugged, industrial-grade, optically-isolated RS-485 Hub / Splitter /Repeater, which can be used to expand RS-485 networks by splitting one RS-485 network into four, in turn increasing the maximum number of nodes and the distance covered by an RS-485 network. It was designed so that data coming from the input (RS-485) will transmit to all four loops of RS-485 networks. However, each loop of RS-485 devices will transmit data back to the input only, thus reducing any possible interference between each loop of the RS-485 devices. Also, the failure of any individual loop will not affect other loops, making the RS-485 networks more robust and reliable.

The product features opto-isolation circuitry, which effectively protects your RS-485 devices from ground loops, transient surges, remote lightning and spikes. Opto-isolation also eliminates ground loop and noise problems. The unit supports data rates up to 115,200 bps and features data format auto-sensing and self-adjusting; therefore, no DIP switch or jumpers are required.

Three indicators (only visible when the enclosure door is open) are provided:

- Power Indicator
- Traffic on Slave Bus Indicator

- Traffic on Master Bus Indicator

6.2 AMC MANAGER PC Application

AMC Manager is a database configuration tool for the AMC-1DBx Gas Monitor. It facilitates the configuration of the database as an alternative to using the menu buttons located on the front panel.

AMC Manager allows quick and easy changes to the monitor's database including changes to options, sensors, relays, analog outputs and zoning.

The table in section 6.1 shows the configuration references for the AMC-1DMBx Modular Box series. APPENDIX C AMC Manager Screenshots shows screen captures of AMC-1DMBx Modular Box configurations in AMC Manager.

Please refer to the supplementary **AMC Manager User Manual** for details.

6.3 MODBUS-RTU INTERFACE

MODBUS-RTU is a RS-485 physical link using the MODBUS-RTU digital communication protocol that facilitates the monitoring of the system operation. The MODBUS-RTU interface can change register(s) related to the modules database

6.4 LATENCY

Latency is the interval period of delay between gas exposure and response for an action to be executed by the system. Network, Operational, and Mechanical Latency are all inherent in Digital Communications systems.

Latency can be imposed on the Digital Monitor by Sensor Activation Delays, Relay Activation Delays, and Alarm Activation Delays. For real-time monitoring validate delays are set to minimums.

Modules are factory pre-configured to industry standard communication 9600 Baud, 8bit, Even Parity. Consult Armstrong Monitoring for latency concerns or changing AMC-1DMBx communication settings.

6.5 MONITOR COMMISSIONING AND INSTALLATION SCENARIOS

6.5.1 System Startup

System startup begins at powering on the monitor, and/or external power supplies, remote modules, and continues until the monitor is in communication with the downstream peripherals and the upstream peers and masters.

Refer to the AMC-1DBx Digital Monitor User Manual for more detail.

6.5.2 Adding a New Transmitter/Analog In

New transmitters will be added to the monitor when customers increase the number of sensors required. Remote Analog Inputs are configured similar to a new transmitter.

Refer to 'Menu System and Features', 'Select Sensor' section in the AMC-1DBx Digital Monitor User Manual to add a new sensor. Alternatively AMC Manager can be used to configure sensors, refer to AMC Manager User Manual.

6.5.3 Adding a New Remote Relay

New relays will be added to the monitor when customers increase the number of relays required. Remote relays are configured similar to other relays attached to the Digital Monitor.

Refer to 'Menu System and Features', 'Select Relay' section in the AMC-1DBx Digital Monitor User Manual to add a new relay. Alternatively AMC Manager can be used to configure relays, refer to AMC Manager User Manual.

6.5.4 Downstream MODBUS Timeout

The MODBUS protocol provides error checking to ensure that messages that are received are verified to be intact and error free. However, errors can occur on the RS-485 interface, which cause the messages to fail the error checking by the receiver of the message. This results in either the transmitter not 'seeing' a message from the monitor, or the monitor does not 'see' the response to a message.

For this reason, when the monitor fails to receive a response from a transmitter, the message will be sent up to 3 times, - the original message plus two retries – before moving to the next transmitter.

- When the monitor discards frames due to error checking, the sensor will appear as fail in the sensor display and the monitor enters fail state.
- Considerations: disable a transmitter that requires too many retries.

6.5.5 Zone Operation

The Zone programming allows a group of sensors to be applied to a dedicated set of Alarm/Fail relays. This group could be located on a single floor of an underground parking facility where the group of sensors controls the same ventilation component. The sensors act as a group controlling these relays with the same thresholds set forth in their sensor configuration. Any sensor of the group meeting or exceeding its gas concentration threshold will trigger the assigned ventilation fan. If additional sensors have similar gas concentrations no change to the fan is experienced. The ventilation fan will not be turned off until all sensors in a group fall below their threshold. Additionally an analog output assigned to the zone will track the zone's average or peak gas concentration. A scenario for VFD fans is described in the Analog Output Operation content below. Additionally, the zone contains scheduled relay events whereby these fans can be activated during high use periods such

as a rush hour where fresh air is desirable. These scheduled relay events could also be used by the facility during routine inspections.

6.5.6 Analog Output Operation

The analog output is representative (average or peak) of the readings seen by all the transmitters in a zone. The analog output is intended to control devices such as variable frequency drive (VFD) fans, in which case the fans turn faster for higher gas concentrations.

6.5.6.1 Adding a New Remote Analog Out

New Analog Outputs will be added to the monitor when customers increase the number of Analog Outputs required. Remote Analog Outputs are configured similar to other Analog Outputs attached to the Digital Monitor.

Refer to ‘Menu System and Features’, ‘Set Analog Outputs’ section in the AMC-1DBx Digital Monitor User Manual to add a new Analog Output. Alternatively AMC Manager can be used to configure Analog Outputs, refer to AMC Manager User Manual.

7 PREVENTIVE MAINTENANCE

This section covers all preventive maintenance aspects of the AMC-1DMBx Modular Box series. First, a description of general maintenance is provided followed by a verification of operation

7.1 GENERAL

The monitor unit should be brushed or wiped clean, once a year or more, of any dust or dirt, depending on the accumulation.

An AMC-1DMBx Modular Box SHOULD NOT be submerged in water or other liquids. Also, hosing and other conditions that could cause a liquid to enter the enclosure should be avoided.

7.2 VERIFICATION OF OPERATION

Verification of operation should be performed at least once every 6 months. For highly demanding applications more frequent verification is recommended.

To verify the operation of the system, make sure LED indicators are on. If relay modules are employed, push and hold the test button, on the AMC-1DBx Digital Monitor, to verify the relays are operational.

8 INSTALLATION TIPS AND TRICKS

8.1 CABLING

- The Communications Cable must have the following characteristics;
  - Shielded, twisted pair, 16-26AWG
  - Characteristic Impedance:120ohms
  - Low Capacitance: ~13pf/ft conductor to conductor and ~ 23pf/ft conductor to shield
- The recommended Power Cable is 16-26 AWG
  - Selected cable must meet Application and/or local regulatory requirements.
  - Wire gauge will affect maximum distance between transmitters and power supply. Thicker wire, greater distance.
  - Route cabling in conduit to avoid damage to cabling.
- Route cabling in conduit to avoid damage to cabling.
- The communications cable shield must be grounded at the monitor end. The shield is wired to the T-connector at each transmitter, to maintain end to end continuity.
- Route cabling away from AC power cabling and any source of electro-magnetic interference (EMI) or radio frequency interference (RFI) such as power transformers, electric motors, etc.
- EMT (Electrical Metal Tube) conduit also adds an added degree of electrical shielding against EMI (Electro-Magnetic Interference) from devices such as RF (i.e. radio) sources.
- All cabling must enter the sensors and monitors from the bottom to ensure protection against water damage due to water inside the conduit from condensation or leaks.
- Ensure that there are no short or open circuits in the sensor cabling.
- Verify that there is no AC or DC voltage present on the sensor cabling prior to connecting the cabling to either the sensor or the monitor.

8.2 EQUIPMENT LOCATION

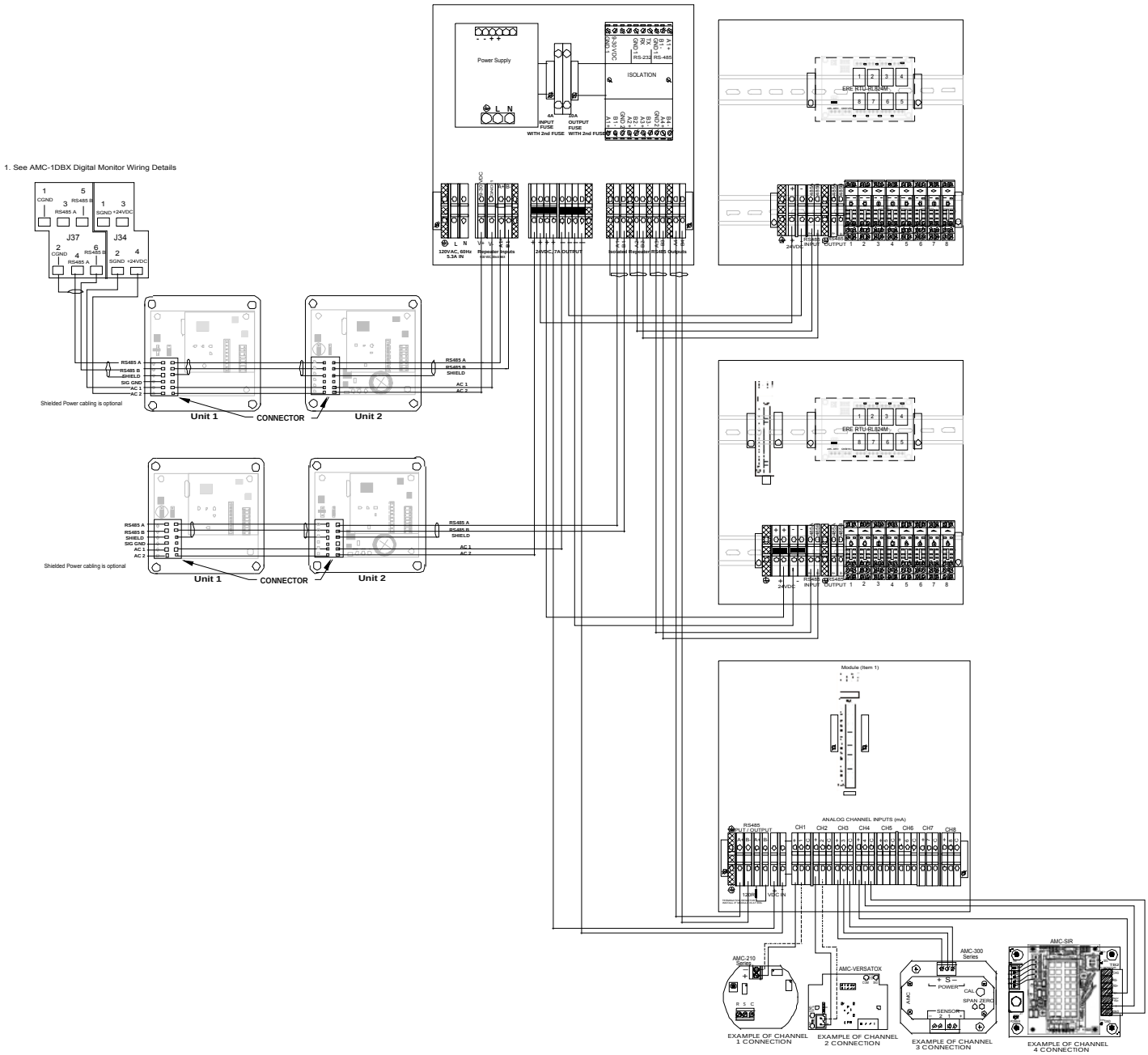
- Mount all equipment away from any source of electro-magnetic interference (EMI) or radio frequency interference (RFI) such as power transformers, electric motors, etc.
- Mount sensors in accordance with the installation guidelines for the specific species of gas to be detected; i.e. CO sensors should be mounted at breathing height etc.
- Equipment must be positioned such that the chance of water damage is minimized; i.e. away from fire suppression sprinkler heads, away from wet or damp locations where there would be a risk of water damage.
- Ensure a balanced layout of sensors in order to cover the intended area.
- Ensure that sensors are not in close proximity to clean air sources.

8.3 POWER AND GROUNDING

- All power and grounding connections to equipment must be made in accordance with applicable electrical and building codes.
- Use a separate, dedicated, noise free, 15 amp power circuit, with an appropriately labeled circuit breaker.

APPENDIX A 1DMBx System Wiring

The following details wiring multiple 1DMBx units



APPENDIX B Analog Module Node ID

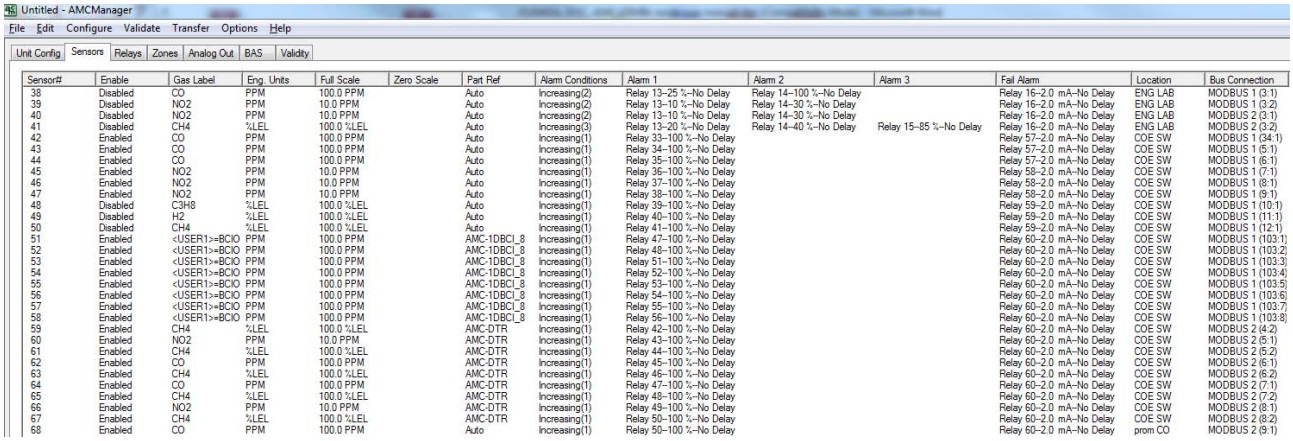
NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF
10	OFF	ON	OFF	ON	OFF	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF
12	OFF	OFF	ON	ON	OFF	OFF	OFF
13	ON	OFF	ON	ON	OFF	OFF	OFF
14	OFF	ON	ON	ON	OFF	OFF	OFF
15	ON	ON	ON	ON	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF
17	ON	OFF	OFF	OFF	ON	OFF	OFF
18	OFF	ON	OFF	OFF	ON	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF
20	OFF	OFF	ON	OFF	ON	OFF	OFF
21	ON	OFF	ON	OFF	ON	OFF	OFF
22	OFF	ON	ON	OFF	ON	OFF	OFF
23	ON	ON	ON	OFF	ON	OFF	OFF
24	OFF	OFF	OFF	ON	ON	OFF	OFF
25	ON	OFF	OFF	ON	ON	OFF	OFF
26	OFF	ON	OFF	ON	ON	OFF	OFF
27	ON	ON	OFF	ON	ON	OFF	OFF
28	OFF	OFF	ON	ON	ON	OFF	OFF
29	ON	OFF	ON	ON	ON	OFF	OFF
30	OFF	ON	ON	ON	ON	OFF	OFF
31	ON	ON	ON	ON	ON	OFF	OFF
32	OFF	OFF	OFF	OFF	OFF	ON	OFF
33	ON	OFF	OFF	OFF	OFF	ON	OFF
34	OFF	ON	OFF	OFF	OFF	ON	OFF
35	ON	ON	OFF	OFF	OFF	ON	OFF
36	OFF	OFF	ON	OFF	OFF	ON	OFF
37	ON	OFF	ON	OFF	OFF	ON	OFF
38	OFF	ON	ON	OFF	OFF	ON	OFF
39	ON	ON	ON	OFF	OFF	ON	OFF
40	OFF	OFF	OFF	ON	OFF	ON	OFF
41	ON	OFF	OFF	ON	OFF	ON	OFF
42	OFF	ON	OFF	ON	OFF	ON	OFF
43	ON	ON	OFF	ON	OFF	ON	OFF
44	OFF	OFF	ON	ON	OFF	ON	OFF

NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
45	ON	OFF	ON	ON	OFF	ON	OFF
46	OFF	ON	ON	ON	OFF	ON	OFF
47	ON	ON	ON	ON	OFF	ON	OFF
48	OFF	OFF	OFF	OFF	ON	ON	OFF
49	ON	OFF	OFF	OFF	ON	ON	OFF
50	OFF	ON	OFF	OFF	ON	ON	OFF
51	ON	ON	OFF	OFF	ON	ON	OFF
52	OFF	OFF	ON	OFF	ON	ON	OFF
53	ON	OFF	ON	OFF	ON	ON	OFF
54	OFF	ON	ON	OFF	ON	ON	OFF
55	ON	ON	ON	OFF	ON	ON	OFF
56	OFF	OFF	OFF	ON	ON	ON	OFF
57	ON	OFF	OFF	ON	ON	ON	OFF
58	OFF	ON	OFF	ON	ON	ON	OFF
59	ON	ON	OFF	ON	ON	ON	OFF
60	OFF	OFF	ON	ON	ON	ON	OFF
61	ON	OFF	ON	ON	ON	ON	OFF
62	OFF	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON	OFF
64	OFF	OFF	OFF	OFF	OFF	OFF	ON
65	ON	OFF	OFF	OFF	OFF	OFF	ON
66	OFF	ON	OFF	OFF	OFF	OFF	ON
67	ON	ON	OFF	OFF	OFF	OFF	ON
68	OFF	OFF	ON	OFF	OFF	OFF	ON
69	ON	OFF	ON	OFF	OFF	OFF	ON
70	OFF	ON	ON	OFF	OFF	OFF	ON
71	ON	ON	ON	OFF	OFF	OFF	ON
72	OFF	OFF	OFF	ON	OFF	OFF	ON
73	ON	OFF	OFF	ON	OFF	OFF	ON
74	OFF	ON	OFF	ON	OFF	OFF	ON
75	ON	ON	OFF	ON	OFF	OFF	ON
76	OFF	OFF	ON	ON	OFF	OFF	ON
77	ON	OFF	ON	ON	OFF	OFF	ON
78	OFF	ON	ON	ON	OFF	OFF	ON
79	ON	ON	ON	ON	OFF	OFF	ON
80	OFF	OFF	OFF	OFF	ON	OFF	ON
81	ON	OFF	OFF	OFF	ON	OFF	ON
82	OFF	ON	OFF	OFF	ON	OFF	ON
83	ON	ON	OFF	OFF	ON	OFF	ON
84	OFF	OFF	ON	OFF	ON	OFF	ON
85	ON	OFF	ON	OFF	ON	OFF	ON
86	OFF	ON	ON	OFF	ON	OFF	ON
87	ON	ON	ON	OFF	ON	OFF	ON
88	OFF	OFF	OFF	ON	ON	OFF	ON
89	ON	OFF	OFF	ON	ON	OFF	ON
90	OFF	ON	OFF	ON	ON	OFF	ON
91	ON	ON	OFF	ON	ON	OFF	ON
92	OFF	OFF	ON	ON	ON	OFF	ON
93	ON	OFF	ON	ON	ON	OFF	ON
94	OFF	ON	ON	ON	ON	OFF	ON
95	ON	ON	ON	ON	ON	OFF	ON
96	OFF	OFF	OFF	OFF	OFF	ON	ON

NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
97	ON	OFF	OFF	OFF	OFF	ON	ON
98	OFF	ON	OFF	OFF	OFF	ON	ON
99	ON	ON	OFF	OFF	OFF	ON	ON
100	OFF	OFF	ON	OFF	OFF	ON	ON
101	ON	OFF	ON	OFF	OFF	ON	ON
102	OFF	ON	ON	OFF	OFF	ON	ON
103	ON	ON	ON	OFF	OFF	ON	ON
104	OFF	OFF	OFF	ON	OFF	ON	ON
105	ON	OFF	OFF	ON	OFF	ON	ON
106	OFF	ON	OFF	ON	OFF	ON	ON
107	ON	ON	OFF	ON	OFF	ON	ON
108	OFF	OFF	ON	ON	OFF	ON	ON
109	ON	OFF	ON	ON	OFF	ON	ON
110	OFF	ON	ON	ON	OFF	ON	ON
111	ON	ON	ON	ON	OFF	ON	ON
112	OFF	OFF	OFF	OFF	ON	ON	ON
113	ON	OFF	OFF	OFF	ON	ON	ON
114	OFF	ON	OFF	OFF	ON	ON	ON
115	ON	ON	OFF	OFF	ON	ON	ON
116	OFF	OFF	ON	OFF	ON	ON	ON
117	ON	OFF	ON	OFF	ON	ON	ON
118	OFF	ON	ON	OFF	ON	ON	ON
119	ON	ON	ON	OFF	ON	ON	ON
120	OFF	OFF	OFF	ON	ON	ON	ON
121	ON	OFF	OFF	ON	ON	ON	ON
122	OFF	ON	OFF	ON	ON	ON	ON
123	ON	ON	OFF	ON	ON	ON	ON
124	OFF	OFF	ON	ON	ON	ON	ON
125	ON	OFF	ON	ON	ON	ON	ON
126	OFF	ON	ON	ON	ON	ON	ON
127	ON	ON	ON	ON	ON	ON	ON

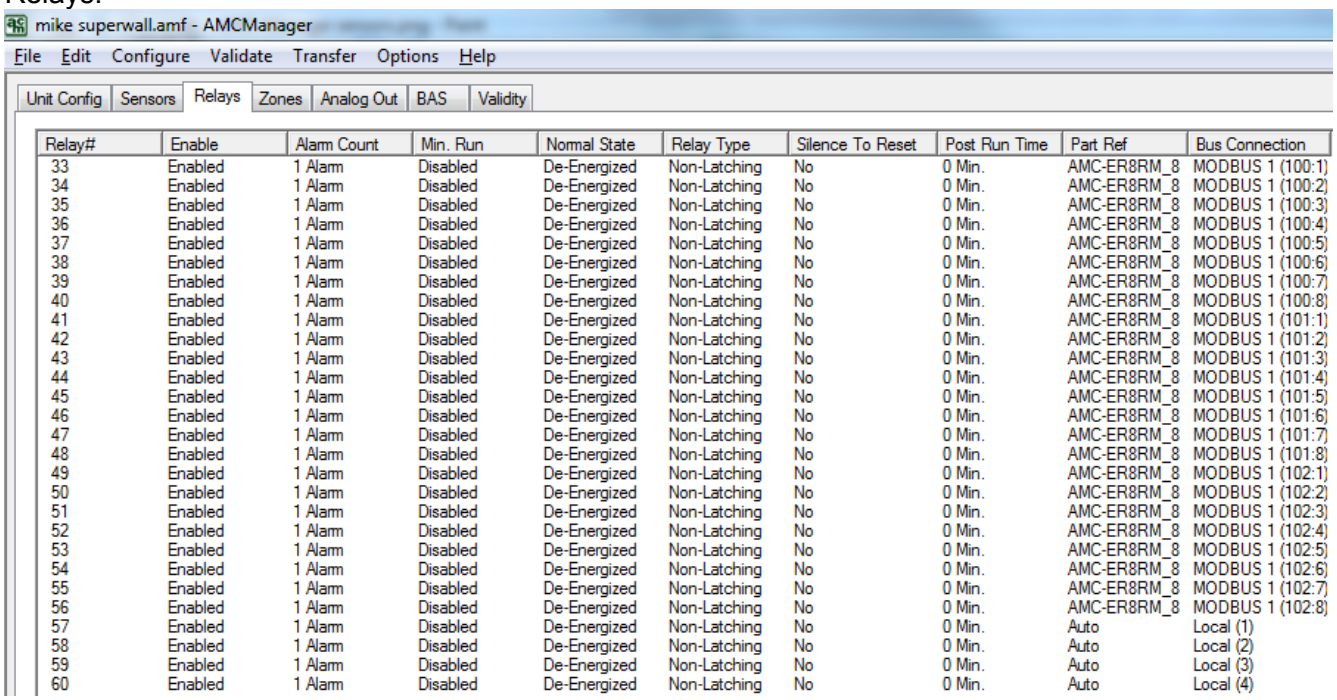
APPENDIX C AMC Manager Screenshots

Sensors:



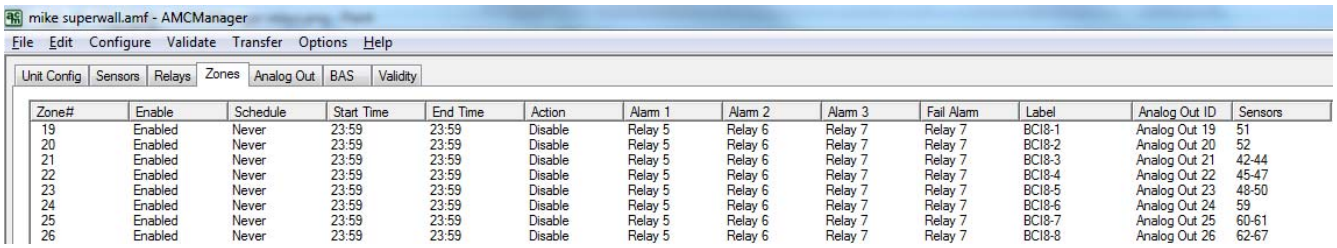
Sensor#	Enable	Gas Label	Eng. Units	Full Scale	Zero Scale	Part Ref	Alarm Conditions	Alarm 1	Alarm 2	Alarm 3	Fail Alarm	Location	Bus Connection
38	Disabled	CO	PPM	100.0 PPM		Auto	Increasing(2)	Relay 13–25 %–No Delay	Relay 14–100 %–No Delay		Relay 16–2.0 mA–No Delay	ENG LAB	MODBUS 1 (3:1)
39	Disabled	NO2	PPM	10.0 PPM		Auto	Increasing(2)	Relay 13–10 %–No Delay	Relay 14–30 %–No Delay		Relay 16–2.0 mA–No Delay	ENG LAB	MODBUS 1 (3:2)
40	Disabled	NO2	PPM	10.0 PPM		Auto	Increasing(2)	Relay 13–10 %–No Delay	Relay 14–30 %–No Delay		Relay 16–2.0 mA–No Delay	ENG LAB	MODBUS 2 (3:1)
41	Disabled	CH4	%LEL	100.0 %LEL		Auto	Increasing(3)	Relay 13–20 %–No Delay	Relay 14–40 %–No Delay	Relay 15–85 %–No Delay	Relay 16–2.0 mA–No Delay	ENG LAB	MODBUS 2 (3:2)
42	Enabled	CO	PPM	100.0 PPM		Auto	Increasing(1)	Relay 33–100 %–No Delay			Relay 57–2.0 mA–No Delay	COE SW	MODBUS 1 (34:1)
43	Enabled	CO	PPM	100.0 PPM		Auto	Increasing(1)	Relay 34–100 %–No Delay			Relay 57–2.0 mA–No Delay	COE SW	MODBUS 1 (5:1)
44	Enabled	CO	PPM	100.0 PPM		Auto	Increasing(1)	Relay 35–100 %–No Delay			Relay 57–2.0 mA–No Delay	COE SW	MODBUS 1 (6:1)
45	Enabled	NO2	PPM	10.0 PPM		Auto	Increasing(1)	Relay 36–100 %–No Delay			Relay 58–2.0 mA–No Delay	COE SW	MODBUS 1 (7:1)
46	Enabled	NO2	PPM	10.0 PPM		Auto	Increasing(1)	Relay 37–100 %–No Delay			Relay 58–2.0 mA–No Delay	COE SW	MODBUS 1 (8:1)
47	Enabled	NO2	PPM	10.0 PPM		Auto	Increasing(1)	Relay 38–100 %–No Delay			Relay 58–2.0 mA–No Delay	COE SW	MODBUS 1 (9:1)
48	Disabled	C3H8	%LEL	100.0 %LEL		Auto	Increasing(1)	Relay 39–100 %–No Delay			Relay 59–2.0 mA–No Delay	COE SW	MODBUS 1 (10:1)
49	Disabled	H2	%LEL	100.0 %LEL		Auto	Increasing(1)	Relay 40–100 %–No Delay			Relay 59–2.0 mA–No Delay	COE SW	MODBUS 1 (11:1)
50	Disabled	CH4	%LEL	100.0 %LEL		Auto	Increasing(1)	Relay 41–100 %–No Delay			Relay 59–2.0 mA–No Delay	COE SW	MODBUS 1 (12:1)
51	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 47–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:1)
52	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 48–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:2)
53	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 51–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:3)
54	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 52–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:4)
55	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 53–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:5)
56	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 54–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:6)
57	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 55–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:7)
58	Enabled	<USER1>=BCIO	PPM	100.0 PPM		AMC-1DBCI_8	Increasing(1)	Relay 56–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 1 (103:8)
59	Enabled	CH4	%LEL	100.0 %LEL		AMC-DTR	Increasing(1)	Relay 42–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (4:2)
60	Enabled	NO2	PPM	10.0 PPM		AMC-DTR	Increasing(1)	Relay 43–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (5:1)
61	Enabled	CH4	%LEL	100.0 %LEL		AMC-DTR	Increasing(1)	Relay 44–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (5:2)
62	Enabled	CO	PPM	100.0 PPM		AMC-DTR	Increasing(1)	Relay 45–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (6:1)
63	Enabled	CH4	%LEL	100.0 %LEL		AMC-DTR	Increasing(1)	Relay 46–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (6:2)
64	Enabled	CO	PPM	100.0 PPM		AMC-DTR	Increasing(1)	Relay 47–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (7:1)
65	Enabled	CH4	%LEL	100.0 %LEL		AMC-DTR	Increasing(1)	Relay 48–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (7:2)
66	Enabled	NO2	PPM	10.0 PPM		AMC-DTR	Increasing(1)	Relay 49–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (8:1)
67	Enabled	CH4	%LEL	100.0 %LEL		AMC-DTR	Increasing(1)	Relay 50–100 %–No Delay			Relay 60–2.0 mA–No Delay	COE SW	MODBUS 2 (8:2)
68	Enabled	CO	PPM	100.0 PPM		Auto	Increasing(1)	Relay 50–100 %–No Delay			Relay 60–2.0 mA–No Delay	prom CO	MODBUS 2 (9:1)

Relays:



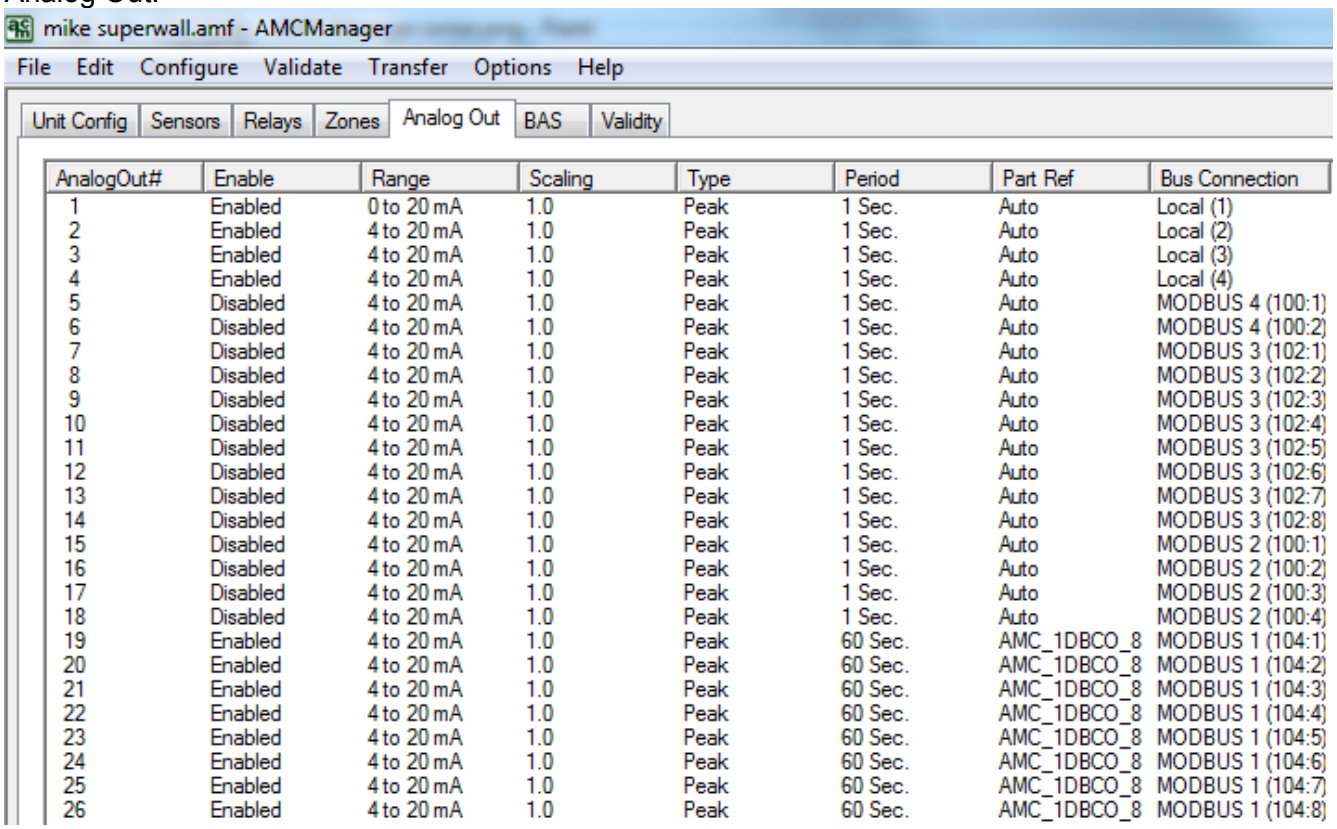
Relay#	Enable	Alarm Count	Min. Run	Normal State	Relay Type	Silence To Reset	Post Run Time	Part Ref	Bus Connection
33	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:1)
34	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:2)
35	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:3)
36	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:4)
37	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:5)
38	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:6)
39	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:7)
40	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (100:8)
41	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:1)
42	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:2)
43	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:3)
44	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:4)
45	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:5)
46	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:6)
47	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:7)
48	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (101:8)
49	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:1)
50	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:2)
51	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:3)
52	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:4)
53	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:5)
54	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:6)
55	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:7)
56	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	AMC-ER8RM_8	MODBUS 1 (102:8)
57	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	Auto	Local (1)
58	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	Auto	Local (2)
59	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	Auto	Local (3)
60	Enabled	1 Alarm	Disabled	De-Energized	Non-Latching	No	0 Min.	Auto	Local (4)

Zones:



Zone#	Enable	Schedule	Start Time	End Time	Action	Alarm 1	Alarm 2	Alarm 3	Fail Alarm	Label	Analog Out ID	Sensors
19	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-1	Analog Out 19	51
20	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-2	Analog Out 20	52
21	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-3	Analog Out 21	42-44
22	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-4	Analog Out 22	45-47
23	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-5	Analog Out 23	48-50
24	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-6	Analog Out 24	59
25	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-7	Analog Out 25	60-61
26	Enabled	Never	23:59	23:59	Disable	Relay 5	Relay 6	Relay 7	Relay 7	BCI8-8	Analog Out 26	62-67

Analog Out:



AnalogOut#	Enable	Range	Scaling	Type	Period	Part Ref	Bus Connection
1	Enabled	0 to 20 mA	1.0	Peak	1 Sec.	Auto	Local (1)
2	Enabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	Local (2)
3	Enabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	Local (3)
4	Enabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	Local (4)
5	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 4 (100:1)
6	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 4 (100:2)
7	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:1)
8	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:2)
9	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:3)
10	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:4)
11	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:5)
12	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:6)
13	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:7)
14	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 3 (102:8)
15	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 2 (100:1)
16	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 2 (100:2)
17	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 2 (100:3)
18	Disabled	4 to 20 mA	1.0	Peak	1 Sec.	Auto	MODBUS 2 (100:4)
19	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:1)
20	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:2)
21	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:3)
22	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:4)
23	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:5)
24	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:6)
25	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:7)
26	Enabled	4 to 20 mA	1.0	Peak	60 Sec.	AMC_1DBCO_8	MODBUS 1 (104:8)