AMC-400 Series

Digital Transmitter
with Smart Sensor 2

USER MANUAL

IMPORTANT:

Please read the installation and operating instructions completely and carefully before starting.

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TABLE OF CONTENTS

Section Title **Page**

1 GENERAL INFORMATION 1
1.1 WARRANTY 1
1.2 LIABILITY 1
1.3 PRODUCT RETURN 1
1.4 CONTACT INFORMATION 1
1.5 MODIFICATIONS AND SUBSTITUTIONS 2
1.6 GLOSSARY 3
2 PRODUCT INFORMATION 5
2.1.1 AMC-400 DIGITAL TRANSMITTER SPECIFICATION 6
2.1.2 SMART SENSOR 2 MODULE(S) SPECIFICATION 6
3 PRODUCT DESCRIPTION 10
3.1 OVERVIEW 10
3.2 FRONT LID OVERVIEW 11
3.3 REAR LID OVERVIEW 12
3.4 SMART SENSOR 2 MODULE WITH ELECTROCHEMICAL SENSOR OVERVIEW 14
3.5 SMART SENSOR 2 MODULE WITH CATALYTIC SENSOR OVERVIEW 15
3.6 CATALYTIC SENSOR CHARACTERISTICS 16
3.6.1 CONTAMINANTS 16
3.6.2 CROSS SENSITIVITY 16
3.6.3 MAXIMUM RANGE 17
3.6.4 ALARM RECOMMENDATIONS 17
4 INSTALLATION 18
4.1 LOCATION AND MOUNTING 18
4.1.1 ENCLOSURE MOUNTING AND ORIENTATION 19
4.2 WIRING 20
4.2.1.1 AMC-1DBx Digital Monitor Wiring Details 23
4.2.1.2 POWER SUPPLY 24
4.2.1.3 COMMUNICATION 26
5 OPERATION AND CALIBRATION 27
5.1 OPERATION 27
5.1.1 TRANSMITTER JUMPER 27
5.1.2 TRANSMITTER AND SMART SENSOR 2 27
5.1.3 TRANSMITTER STATUS LED 30
5.1.4 TROUBLESHOOTING MODBUS USING THE TRANSMITTER STATUS LED 31
5.1.5 SENSOR STATUS LED 32
5.2 INITIAL CONFIGURATION 33
5.3 CALIBRATION 34
5.3.1 REQUIRED EQUIPMENT; EXCHANGE PROGRAM 36
5.3.2 REQUIRED EQUIPMENT; ON-SITE CALIBRATION 36
5.3.3 CALIBRATION PROCEDURE 36
5.3.4 GAS TEST AND SERVICE MODES 38
5.4 SPECIAL CONFIGURATION FOR SERVICE 39
6 MAINTENANCE 41

6.1 GENERAL 41
6.2 SCHEDULED CALIBRATION 41
6.3 SMART SENSOR 2 MODULE REPLACEMENT 41
6.4 VERIFICATION OF OPERATION 41
7 APPENDIX: DIGITAL TRANSMITTER CONFIGURATION MENU FLOW 42
8 APPENDIX: DIGITAL TRANSMITTER CALIBRATION MENU FLOW 43
9 APPENDIX: USER SUPPORTED MENU GUIDE 44
10 APPENDIX: MODBUS REGISTER MAP 50

LIST OF FIGURES

Figure Title **Page**

Figure 3-1 Front Lid View 11
Figure 3-2 Rear Lid View 12
Figure 3-3 Smart Sensor 2 Module with Electrochemical Sensor View 14
Figure 3-4 Smart Sensor 2 Module with Catalytic Sensor View 15
Figure 4-1 Enclosure Mounting and Orientation ..... **Error! Bookmark not defined.**
Figure 4-2 Example of Electrical Wiring of Digital Transmitter(s) 21
Figure 4-3 Example of connections to a 120VAC AMC-1DB1-1XXXXX Digital Monitor 22
Figure 4-4 5 Example of connections to a 24VDC AMC-1DB1-2XXXXX configuration 25
Figure 5-1 Front Panel User Interface 29

LIST OF TABLES

Table 3-1 Cross Sensitivity 17
Table 4-1 Maximum number of sensor on a string limited by drop out voltage 24

1 GENERAL INFORMATION

1.1 WARRANTY

The AMC-400 Digital Transmitter is warranted against defects in material and workmanship for a period of two years from date of delivery. Maintenance items are not warranted. During the warranty period, *The Armstrong Monitoring Corporation* will repair or replace components that prove to be defective in the opinion of AMC. Any equipment deemed to be defective by the user should be returned to *The Armstrong Monitoring Corporation* for evaluation (see product return below). Site visits by Armstrong personnel, to evaluate/repair equipment, are not covered by this warranty unless covered under site contract. AMC is not liable for auxiliary interfaced equipment, nor for 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 failure is due to misuse or conditions of use.
Note: extended warranty mail in calibration programs are available (please call 1-800-465-5777) or through contacts at www.armstrongmonitoring.com

1.2 LIABILITY

All AMC products must be installed and maintained according to instructions. Only qualified personnel should install and maintain the equipment. The AMC-400 Digital Transmitter must not be located in hazardous locations where combustible gases could exceed 100% LEL.

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.

1.3 PRODUCT RETURN

All products returned for warranty or service should be shipped by prepaid freight and will be accepted only with RMA or repair number issued by AMC. All products returned to the client will be shipped by freight collect.

1.4 CONTACT INFORMATION

For information please call 1-800-465-5777 or through contacts at www.armstrongmonitoring.com or through email directly at support@armstrongmonitoring.com.

1.5 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.

1.6 GLOSSARY

Alarm	Alarm is an audible, visual, or physical presentation designed to warn the instrument user that a specific level of a dangerous gas/vapor concentration has been reached or exceeded.
Calibration	Calibration is the procedure used to adjust the instrument for proper response.
Calibration Gas	Calibration Gas is a gas of known concentration(s) used to set the instrument span. Catalytic needs air for calibration.
DT	Digital Transmitter
Gas Concentration	Gas Concentration is measured in: • PPM • %LEL (Lower Explosive Limit)
LEL	Lower explosive limit is the lowest concentration (percentage) of a gas or a vapor in air capable of combusting in the presence of an ignition source (arc, flame, heat).
PPM	Parts Per Million (1% volume = 10,000PPM)
Percent by volume	Concentration of gas in a mixture expressed as a percentage of total volume.
RS-485	Superseded with EIA-485 or TIA-485. This standard defines the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems.
Span	Full range of a sensor i.e. a CO sensor with a full range of 0-100 PPM has a 100 PPM span.
T90	Response Time in seconds to achieve 90% gas concentration reading. This a typical calibration point that allows for sensor aging, but tends to be less accurate than a T99 calibration,
T99	Response Time in seconds to achieve 99% gas concentration reading. This is a more accurate calibration point.
Zero Buffering	Zero buffering is transmitter function which forces the gas concentration reading to zero when sensor is exposed to low concentration of a gas. The zero buffer is indicated in the sensor specification.
Zero Gas	Zero gas is gas in which the target gas is not present. The presence of oxygen is required. Clean air is an excellent source for zero calibration. A known gas concentration can be entered during zero calibration.

AMC-400 Digital Transmitter	This refers to a complete AMC-400 unit including the Smart Sensor 2 module
Smart Sensor 2 Module (SS2)	This refers to a Smart Sensor 2 Card with one of the following sensor mounted: CO, NO2, CH4, C3H8, H2
AMC-1DA-RPT4 and AMC-1DA-RPT	4 Port and 1 port Repeaters used to expand system and provide extra device distance.

2 PRODUCT INFORMATION

The AMC-400 Series Digital Transmitter with Smart Sensor 2 consists of 2 circuit card assemblies which are the Transmitter card and the Smart Sensor 2 card. Both cards have Microcontroller (MCUs) to manage and communicate the information in a digital format. The Transmitter communicates with a monitor (i.e. AMC-1DBx) and carries the Smart Sensor 2 module. The monitor and transmitter communicate to each other over RS-485 using MODBUS/RTU. The Smart Sensor 2 module acquires data from either an electrochemical gas sensor or a catalytic sensor and communicates its gas concentration to the transmitter. The Smart Sensor 2 module consists of the Smart Sensor 2 card and a sensor and is replaced as a unit. This module is designed for EZ-CAL calibration exchange program.

Note:

All Armstrong Monitoring systems must be installed and maintained according to instructions to assure proper operation. Only qualified personnel should install and maintain the equipment. For exchange, re-calibration or extended warranty programs information please call 1-800-465-5777 or through contacts at www.armstrongmonitoring.com

2.1.1 AMC-400 DIGITAL TRANSMITTER SPECIFICATION

AMC-400 Digital Transmitter Order Number...	AMC-400-CO, AMC-400-NO2, AMC-400-CH4, AMC-400-C3H8, AMC-400-H2
Power Supply Requirement…Electrochemical Catalytic	12-24 VDC 50mA 12-24 VDC 55-90mA
Warranty……	2 Years
Operating Temperature ……Electrochemical Catalytic	-20° to 40° C
Operating Pressure ……	0.9 to 1.1 atm
Relative Humidity ……	15 to 90% RH, non-condensing
Signaling……	MODBUS RTU over RS-485 9600 Baud, 8bit Even Parity.

*Note 1:

To ensure proper operation of the AMC-400 Digital Transmitter, the voltage at the V+ test point shown in Fig 3-2 must be between 9.8 and 42 Volts for electrochemical sensors and 10.5 to 42 Volts for Catalytic Sensors. This V+ Test Point is to be used by service technicians only. Typical Power Supply recommended is 24V DC. Since Catalytic sensors draw higher currents with lower operating voltage to improve system performance place catalytic sensors as close to the power supply as possible.

2.1.2 SMART SENSOR 2 MODULE(S) SPECIFICATION

Gas Type……..	CARBON MONOXIDE (CO)
Smart Sensor 2 Module Order Number…….	AMC-91JGF
Operating Temperature ……	-20° to 40° C
Sensor Height Above Finished Floor (as part of AMC-400 Digital Transmitter)	4-6 Feet (1.22-1.52m)
Sensor Life……	Greater than 6 Years
Sensor Warranty……..	3 Years
Range ……..……	0-100ppm
Zero Buffering of Display……..	<5ppm
Calibration Kit Part Number……..	AMC-C1-FK1 (See note)
Default Calibration Gas……	100ppm CO

Gas Flow Rate……..	.5L/min.

Gas Type……..	CARBON MONOXIDE (CO) HC
Smart Sensor 2 Module Order Number…….	AMC-91JGG
Operating Temperature ……	-20° to 40° C
Sensor Height Above Finished Floor (as part of AMC-400 Digital Transmitter)	4-6 Feet (1.22-1.52m)
Sensor Life……	Greater than 6 Years
Sensor Warranty……..	3 Years
Range ……..……	0-200ppm
Zero Buffering of Display……..	<5ppm
Calibration Kit Part Number……..	AMC-C1-FK1 (See note)
Default Calibration Gas……	100ppm CO
Gas Flow Rate……..	.5L/min.

Gas Type……..	NITROGEN DIOXIDE (NO_2)
Smart Sensor 2 Module Order Number…….	AMC-98JCC
Operating Temperature ……	-20° to 40° C
Sensor Height Above Finished Floor(as part of AMC-400 Digital Transmitter)	4-6 Feet (1.22-1.52m)
Sensor Life……	Greater than 2 Years
Sensor Warranty……..	1 Years
Range ……	0-10ppm
Zero Buffering of Display……..	<0.8ppm
Calibration Kit Part Number…….	AMC-C1-FK2 (See note)
Default Calibration Gas……	3 ppm NO2
Gas Flow Rate……..	.5L/min.

Gas Type……..	Methane(CH4)
Smart Sensor 2 Module Order Number…….	AMC-60JAF
Operating Temperature ……	-20° to 40° C
Sensor Height	Place 18” (20.32 cm) down from the top of the ceiling **Do not mount directly to ceiling.**
Sensor Life……	2 Years
Sensor Warranty……..	1 Year
Range ……..…….	0 to <100% LEL (<5% vol.)
Zero Buffering of Display……..	<5% LEL
Calibration Kit Part Number……	AMC-C1-FK2 (See note)
Default Calibration Gas……	50% LEL CH4
Gas Flow Rate……..	.5L/min.

Gas Type……..	Propane(C3H8)
Smart Sensor 2 Module Order Number…….	AMC-61JAF
Operating Temperature ……	-20° to 40° C
Sensor Height	Place 18” (20.32 cm) up from the bottom of the floor **Do not mount directly to floor.**
Sensor Life……	2 Years
Sensor Warranty……..	1 Year
Range ……..…….	0 to <100% LEL (<2.0% vol.)
Zero Buffering of Display……..	<5% LEL
Calibration Kit Part Number……	AMC-C1-FK2 (See note)
Default Calibration Gas……	50% LEL C3H8
Gas Flow Rate……..	.5L/min.

Gas Type……..	Hydrogen(H2)
Smart Sensor 2 Module Order Number……	AMC-62JAF
Operating Temperature ……	-20° to 40° C
Sensor Height	Place 18” (20.32 cm) down from the top of the ceiling **Do not mount directly to ceiling.**
Sensor Life……	2 Years
Sensor Warranty……..	1 Year
Range ……..…….	0 to <100% LEL (<4% vol.)
Zero Buffering of Display……..	<5% LEL
Calibration Kit Part Number……	AMC-C1-FK2 (See note)
Default Calibration Gas…….	50% LEL H2
Gas Flow Rate……..	.5L/min.

Note: The calibration kit consists of a Cal Kit case, a calibration adapter, and a regulator. The calibration gas is ordered separately.

3 PRODUCT DESCRIPTION

The AMC-400 Digital Transmitter is designed to provide continuous, reliable monitoring of ambient air for the target gas listed in the SMART SENSOR 2 MODULE(S) SPECIFICATION (Section 2.1.2). The AMC-400 Digital Transmitter is hot pluggable and is powered by a DC power source. It provides a digital representation of the gas concentration detected. A digital representation of the gas concentration is displayed, which may be configured to remain blank. Each AMC-400 Digital Transmitter is factory calibrated, and is ready for field installation and operation.

Each AMC-400 Digital Transmitter features alarm indicators and connection terminal blocks, as listed and described herein.

3.1 OVERVIEW

The AMC-400 Digital Transmitter consists of three main components;

- PC-ABS Enclosure,
- Moisture Barrier
- Smart Sensor 2 Module.

3.2 AMC-400 Components

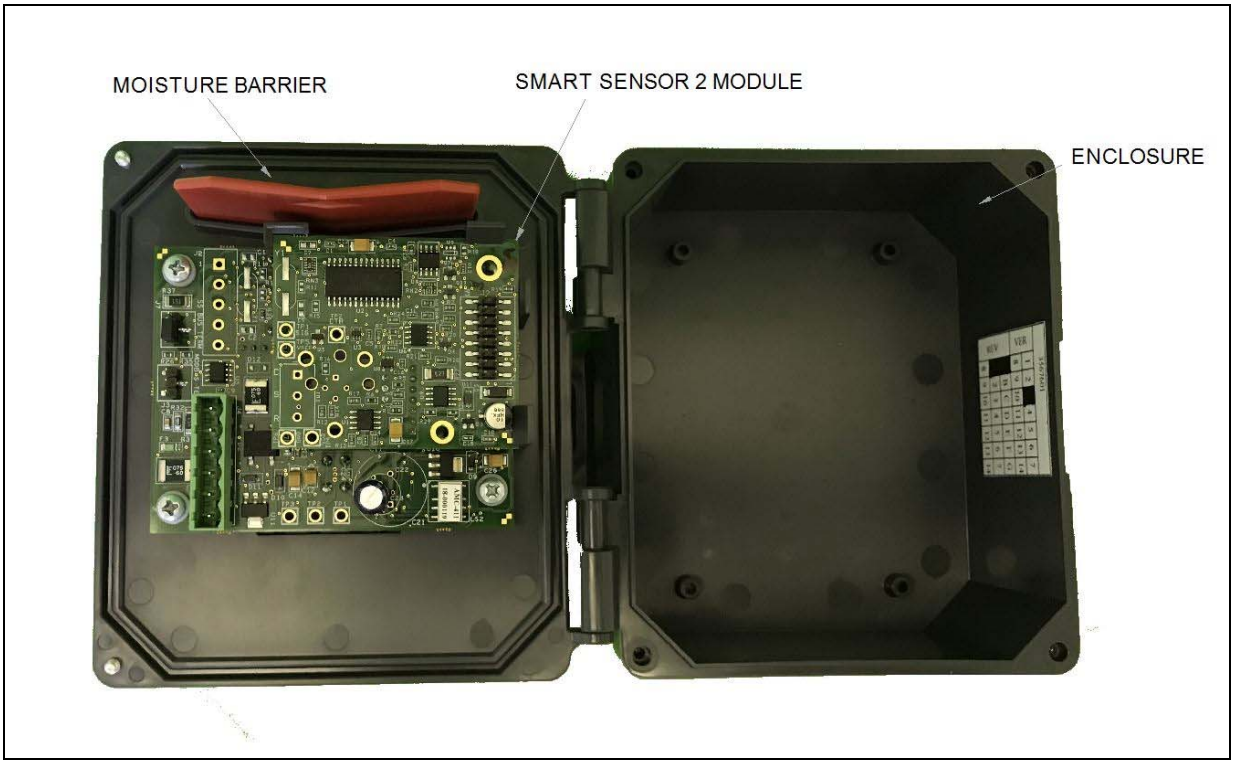


Figure 3-1 AMC-400 Components

3.3 FRONT LID OVERVIEW

Figure 3-2 Front Lid View

1. Enclosure: Enclosure and Lid Assembly, PC-ABS blend, 5.45 length by 6.14”width” Wall mount with two mount points. Option for Pole Mount.
2. Digital Display: Displays gas concentration & Status information, 3 Digit User Interface for configuration
3. Transmitter Status LED: Red/Green LED
   Indicates status of Transmitter.
4. Smart Sensor 2 Status LED: Red/Green LED
   Indicates status of integral Smart Sensor 2.
5. MODBUS Address: This is a write on area matching the MODBUS device ID (Address). The indication here may be factory set and can be changed as needed.
6. Sensor & Vent: This vent allows target gas to flow into the sensor. The vent is also used for gas calibration.
7. Pushbutton: Momentary On/Off Pushbutton
   User Interface for Configuration.

3.4 REAR LID OVERVIEW

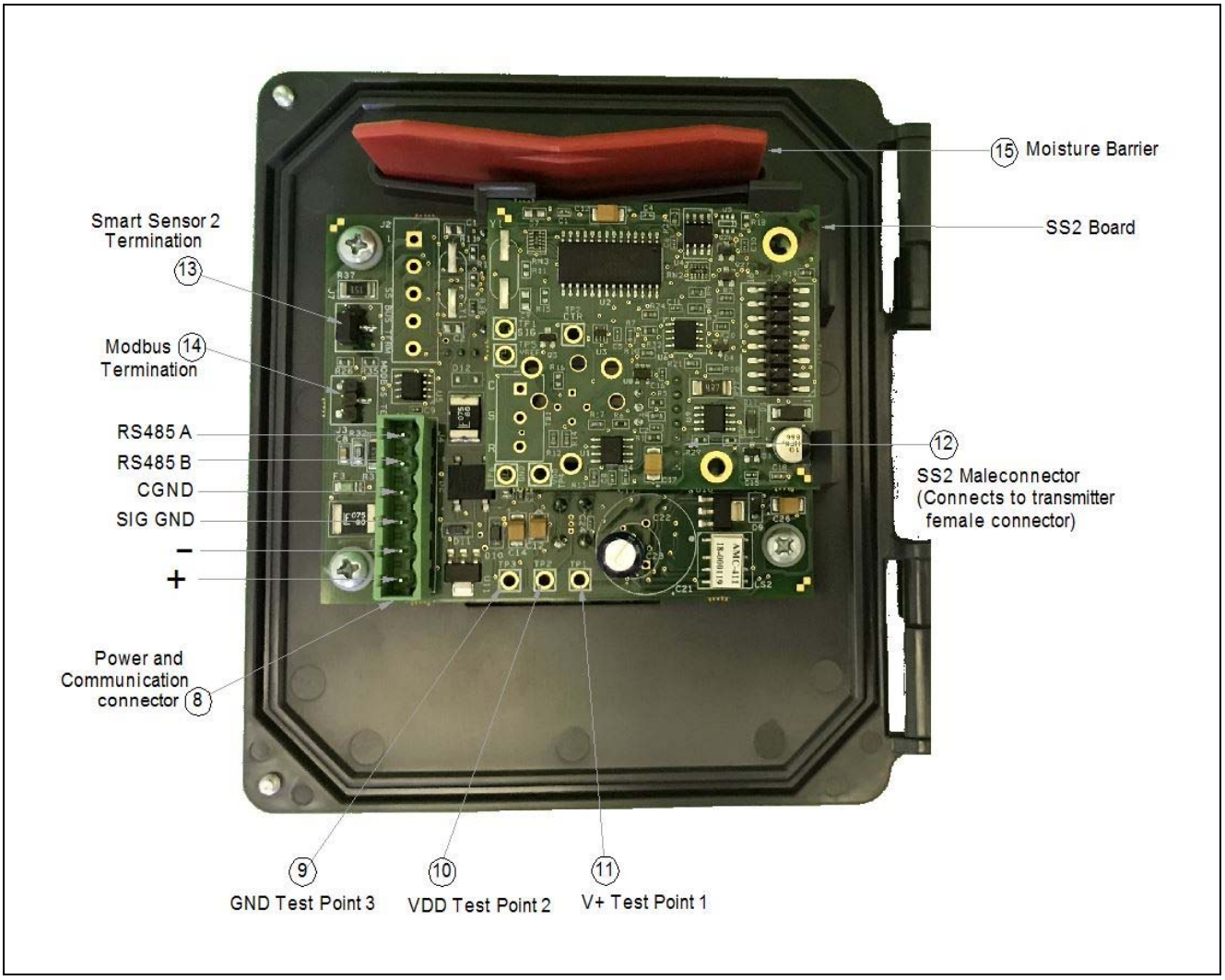


Figure 3-3 Rear Lid View

Note:

When connecting the Smart Sensor 2 module, assure its male header pins are aligned to mate the receptacle of the Digital transmitter.

Warning:

Care must be taken when connecting services to Power and Communication Connector. Do not use SIG GND on AMC-400 for powering. Cable shield(s) are to be connected to CGND. Mixing power and communication connections can cause permanent damage. Consistent polarity of RS-485 wire is required throughout network for proper system operation.

8. Power and Communication Connector:	This 6 pin male plug connector contains both power and communication network connection points. The power is normally 24VDC and the communication network is MODBUS over RS-485.
9. GND Test Point:	This GND Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the signal reference point for the digital transmitter control logic.
10. VDD Test Point:	This VDD Test Point is to be used by service technicians only. It is the digital transmitter control logic supply voltage and must be 5+/-5% Volts DC.
11. V+ Test Point:	This V+ Test Point is to be used by service technicians only. It is the digital transmitter rectified unregulated power input and meet the range specified in 2.1.1 AMC-400 DIGITAL TRANSMITTER SPECIFICATION.
12. SS2 Female Connector:	This 7 pin connector mates with the Smart Sensor 2 Module male connector. This connector carries the power and communication for Smart Sensor 2.
13. Smart Sensor 2 Termination:	Default position: AC Termination (Pins 1-2, bottom). This termination allows AC or DC Termination for the Smart Sensor 2 RS-485 signaling.
14. MODBUS Termination:	Default position: No Termination (Pin 2) as shown in Figure 3-3. This termination allows AC or DC Termination for the MODBUS RS-485 signaling. Use AC Termination (Pin 1-2, bottom) when transmitter is an end point on bus.
15. Moisture Shield:	This mounting hole contains two standoffs to support the Smart Sensor 2 Module. One standoff is a stud the other is nylon press-fit.

3.5 SMART SENSOR 2 MODULE WITH ELECTROCHEMICAL SENSOR OVERVIEW

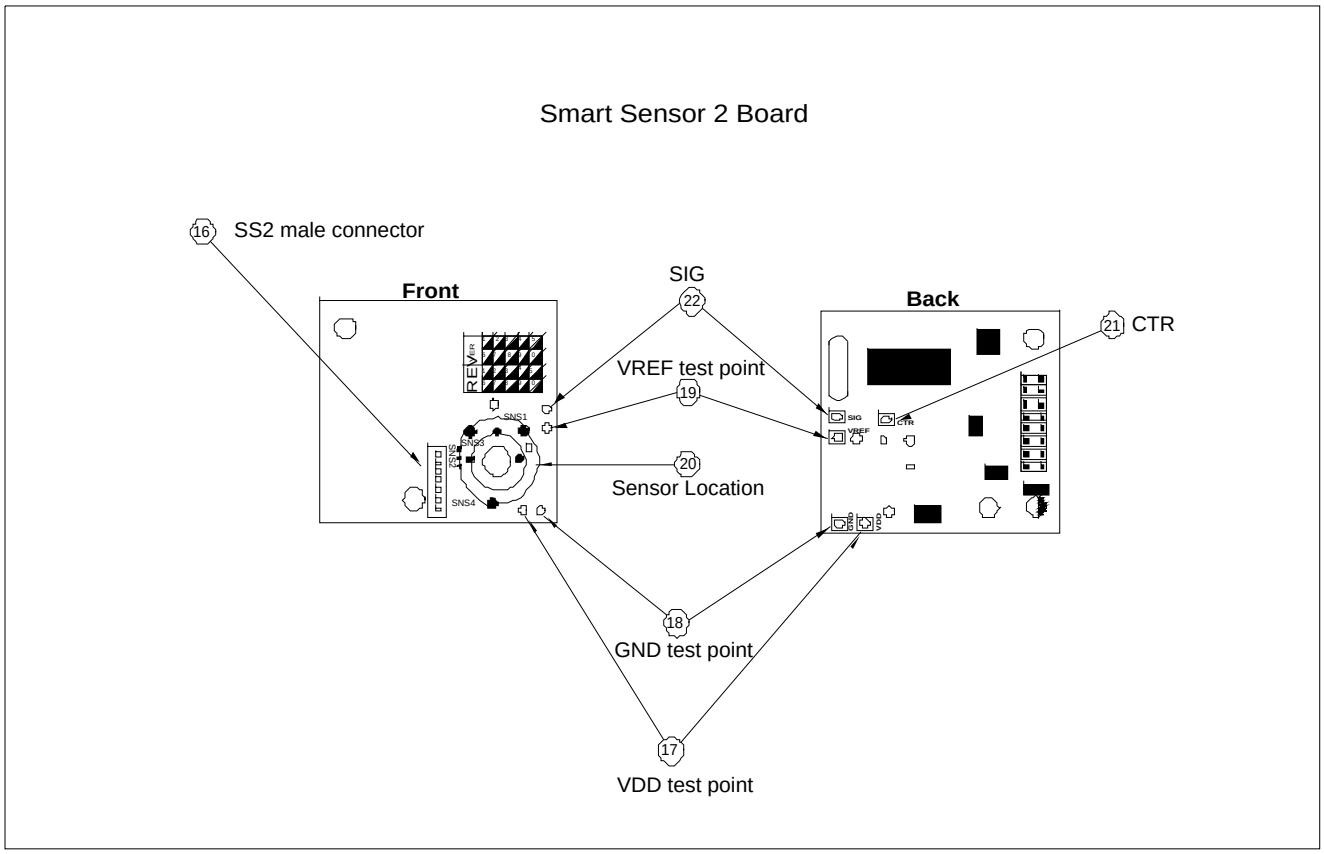


Figure 3-4 Smart Sensor 2 Module with Electrochemical Sensor View

16. SS2 Male Connector: This 7 pin connector mates with the Digital Transmitter female connector. This connector carries the power and communication.

17. VDD Test Point: This VDD Test Point is to be used by service technicians only. It is the Smart Sensor 2 control logic supply voltage and must be 5+/-5% Volts DC.

18. GND Test Point: This GND Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the signal reference point for the Smart Sensor 2 control logic.

19. VREF Test Point: This VREF Test Point is to be used by service technicians only. It is the potentiostat sensor reference and must be 1.8 Volts DC.

20. Sensor: This component may be a variety of 2 or 3 pin electrochemical sensors. This component is permanently fastened to the Smart Sensor 2 Module.

21. CTR Test Point: This CTR Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the potentiostat counter output used by a 3 pin electrochemical sensor. Under ideal operation zero gas situation it is normally 1.8 Volts DC VREF.

22. SIG Test Point: This Sig Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the potentiostat sensor output used. Under normal operation zero gas situation it tracks the 1.8 Volts DC VREF. When CO gas is applied this SIG Test Point increases toward 3.6 Volts DC. When NO2 gas is applied this SIG Test Point decreases towards 0 Volts DC.

3.6 SMART SENSOR 2 MODULE WITH CATALYTIC SENSOR OVERVIEW

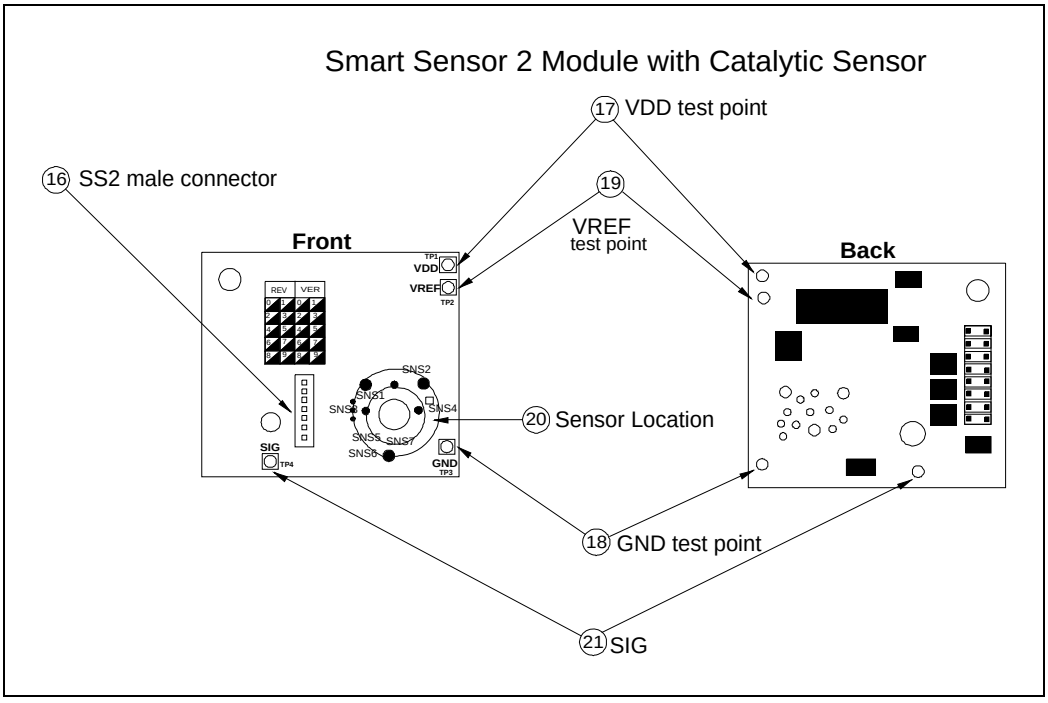


Figure 3-5 Smart Sensor 2 Module with Catalytic Sensor View

16.SS2 Male Connector:	This 7 pin connector mates with the Digital Transmitter female connector. This connector carries the power and communication.
17.VDD Test Point:	This VDD Test Point is to be used by service technicians only. It is the Smart Sensor 2 control logic supply voltage and must be 3.45+/-5% Volts DC.
18.GND Test Point:	This GND Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the signal reference point for the Smart Sensor 2 control logic.
19.VREF Test Point:	This VREF Test Point is to be used by service technicians only. It must be 1.8 Volts DC.
20.Sensor:	This component is a 3 pin Catalytic sensor. This component is permanently fastened to the Smart Sensor 2 Module.
21.SIG Test Point:	This Sig Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the amplified sensor output as seen by the analog to digital converter. Under normal operation zero gas situation it tracks the 1.8 +/- 0.4 Volts DC VREF. When a combustible gas is applied this SIG Test Point increases toward 3.45 Volts DC.

3.7 CATALYTIC SENSOR CHARACTERISTICS

3.7.1 CONTAMINANTS

The performance of the catalytic combustion type gas sensors may be affected by exposure to substances known as poisons and inhibitors. Inhibitors are present in volatile substances containing halogens or sulphur compounds. Sensors may recover their sensitivity characteristics after exposure to inhibitors has ceased. Some substances produce a permanent poisoning effect on the catalyst. These poisons include silicone oils, greases and petroleum additives such as tetraethyl lead and phosphate esters. Always be cautious of by products that may evolve from the thermal decomposition of materials such as plastics.

3.7.2 CROSS SENSITIVITY

The catalytic sensor is also sensitive to other combustible gases. See Table 3-1. As a result the sensor will provide protection for some of these gases as well.

Gas	Relative Sensitivity	LEL (%vol)
Methane	100	5
Hydrogen	97	4
Ethylene	83	3
Propane	80	2
Butane	83	1.5
n-Pentane	71	1.5
Hexanes	63	1.2

Table 3-1 Cross Sensitivity

3.7.3 MAXIMUM RANGE

Although the sensor output is linear to 100%LEL, the use of catalytic sensors is not recommended over that range. Above the LEL value there may be insufficient oxygen to catalyze all of the combustible gas: the output may decrease and indicate a concentration of less than 100% LEL, causing an ambiguity in the instrument reading.

3.7.4 ALARM RECOMMENDATIONS

The 400 Digital Transmitter equipped with a combustible catalytic sensor is designed for non hazardous location with the primary purpose of initiating ventilation when low concentration of combustible gases are detected (20-40%LEL). However, due to the dangers associated with combustible gases we recommend setting an ‘ultra high’ latching alarm at level approaching the LEL ie. 80% LEL.

4 INSTALLATION

The installation of the AMC-400 Digital Transmitter is very important as the operational quality is a direct result of the quality of the installation. The following sections provide guidelines for installation; location and mounting, wiring, and cable selection.

4.1 LOCATION AND MOUNTING

Mount the AMC-400 Digital Transmitter 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. If the main objective is the fastest possible leak detection, mount the sensor near the potential leak sources. Please, refer to local codes for installation information. The installer is required to provide any mounting hardware that may be required. The cover with attached transmitter and smart card is removable from the enclosure for ease of installation. The recommended mounting height is specified in the SMART SENSOR 2 MODULE(S) SPECIFICATION (Section 2.1.2).

4.1.1 Mounting

1. Remove cover.
2. Mount housing using defines mounting holes. See Figure 4-1 or Figure 4-2.
3. Drill holes for conduit and then install conduit. See Warning below.
4. Reattach cover and bracket.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot plugging of the Smart Sensor 2 Module. Please completely disconnect power from Digital Transmitter before replacing Smart Sensor 2 Module.

Conduit should enter the housing from the bottom to ensure best protection against ingress of condensation.

Conduit entry from the top from the top of the housing is Not Recommended. However, if conduit entry through the top is the only available option, a Condensation Drip Shield is provided to help protect the electronics from water ingress due to condensation from the EMT conduit. If conduit entry is through the top of the housing, a drain hole must be drilled into the bottom side of the housing to allow the condensation to exit the housing. Any water damage related to conduit entry from the top will not be covered under warranty.

Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Insure correct cabling practices are implemented.

Mount all equipment away from any source of electro-magnetic interference (EMI) or radio frequency interference (RFI) such as power transformers, electric motors, 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 risk of water damage.

Ensure a balanced layout of sensors to cover the intended area. As defined in section 4.1 try to mount catalytic based sensor versions as close to the power source as possible.

If water spraying or splashing could be an issue an AMC-400 Series weather shield is recommended. Example location, parking garage with a wash bay.

Notes:

Mount enclosure as shown in Error! Reference source not found.**. This will ensure correct orientation.**

4.1.2 ENCLOSURE MOUNTING AND ORIENTATION

Figure 4-1 Standard Enclosure Mounting Dimensions and Orientation

4.1.3 POLE MOUNTING

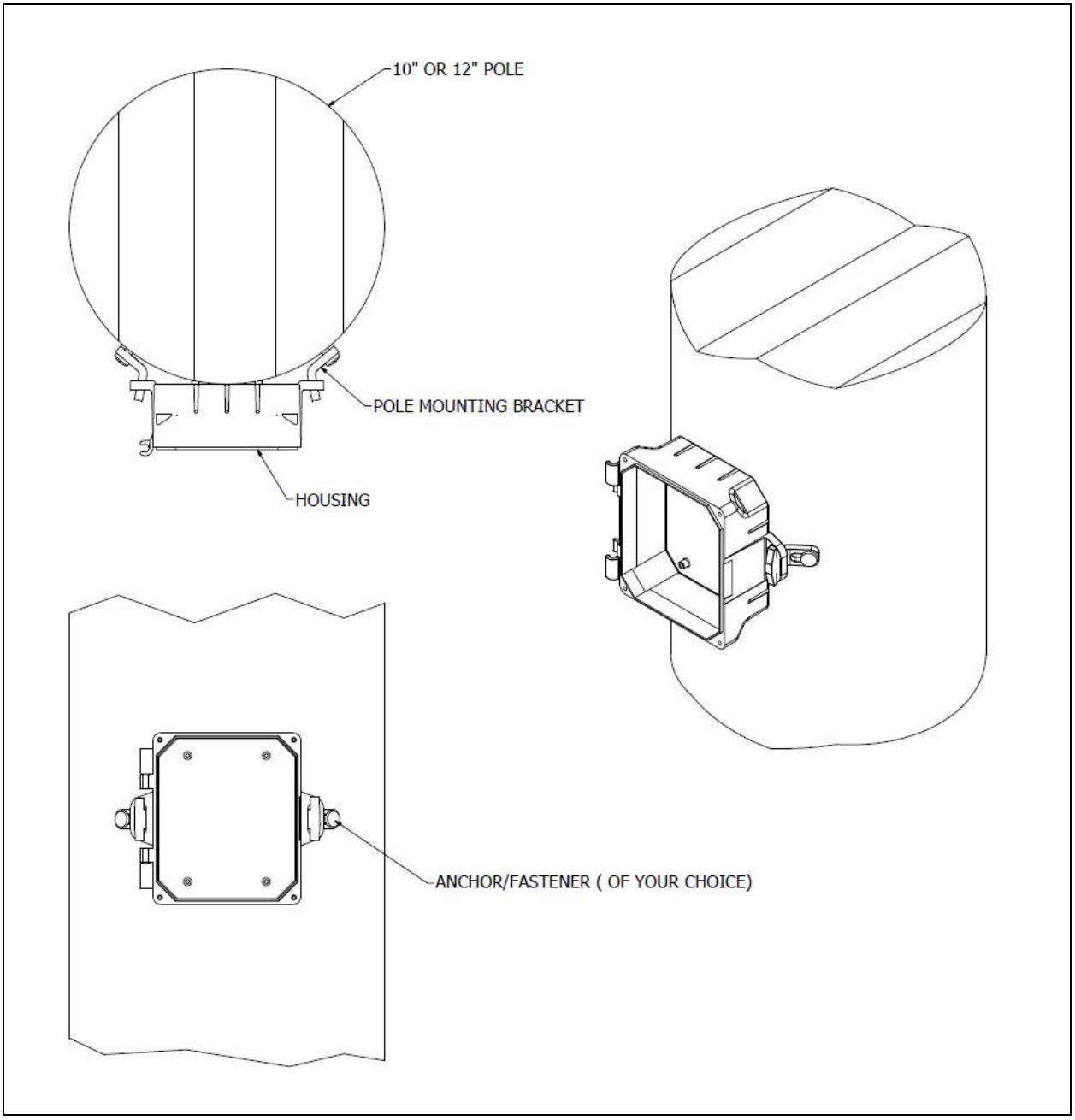


Figure 4-2 Enclosure Pole Mounting

4.2 WIRING

- The AMC-400 Digital Transmitter employs a four wire system which has two main wiring systems: the monitor communication (two wires) and power supply wiring (two wires).
- A two conductor, 20-24 AWG shielded cable is used to connect the RS-485 signals from the AMC-400 Digital Transmitter to the monitor. The cable characteristics required are an impedance of 120 ohms and a low capacitance: ~13pf/ft conductor to conductor and ~ 23pf/ft conductor to shield.

- For best signal transmission and maximum noise rejection, it is recommended to connect the cable shields to chassis ground at the monitor. The shield is wired to the T-connector at each transmitter, to maintain end to end continuity.
- A two conductor 12-18 AWG cable is recommended to connect the power from the AMC-400 Digital Transmitter to the DC power source. The selected cable must meet application and/or local regulatory requirements.
- Wire gauge will affect maximum distance between transmitters and power supply. Thicker wire required for greater distance.
- For wiring taps the derivations must be short (never more than 20m). If multiple taps are used with n derivations, the sum of all taps must not exceed a maximum of 40m. See Figure 4-3 Example of Electrical Wiring of Digital Transmitter(s)
- 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.
- Cabling should enter the sensors and monitors from the bottom to ensure best 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 the communication cabling is voltage free prior to connecting the cabling to either the AMC-400 Digital Transmitter or the monitor.

The next pages are example of electrical wiring diagrams for an application where the monitor supplies both power and communication.

Warning:

Installing monitor communication without shield will produce unreliable system wide failure. Armstrong Monitoring Corporation will not support this type of installation.

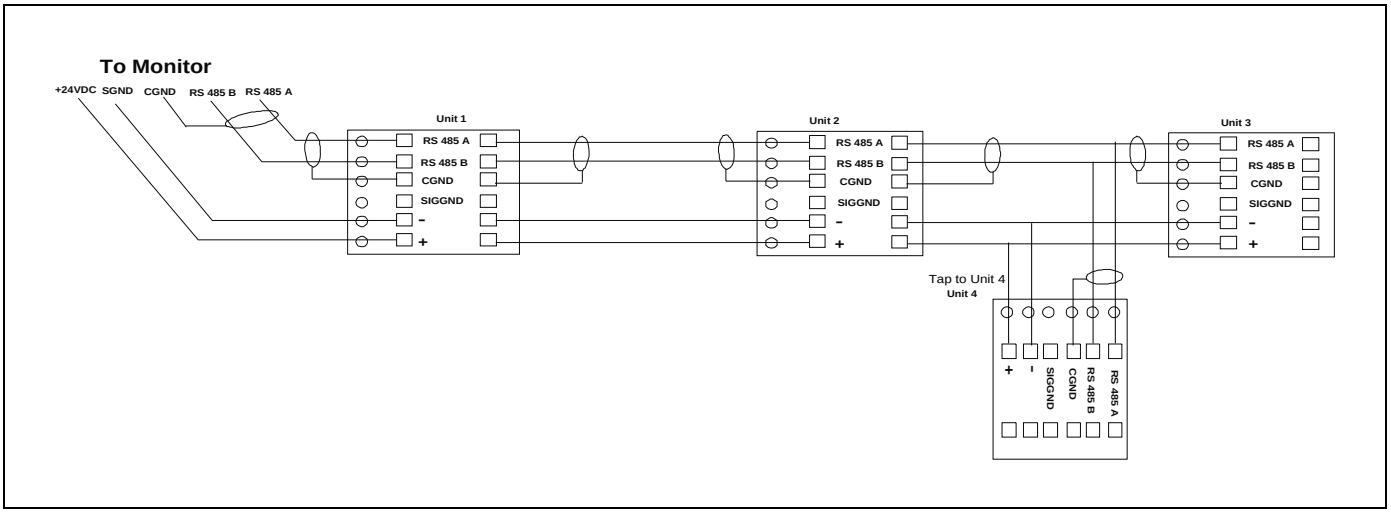


Figure 4-3 Example of Electrical Wiring of Digital Transmitter(s)

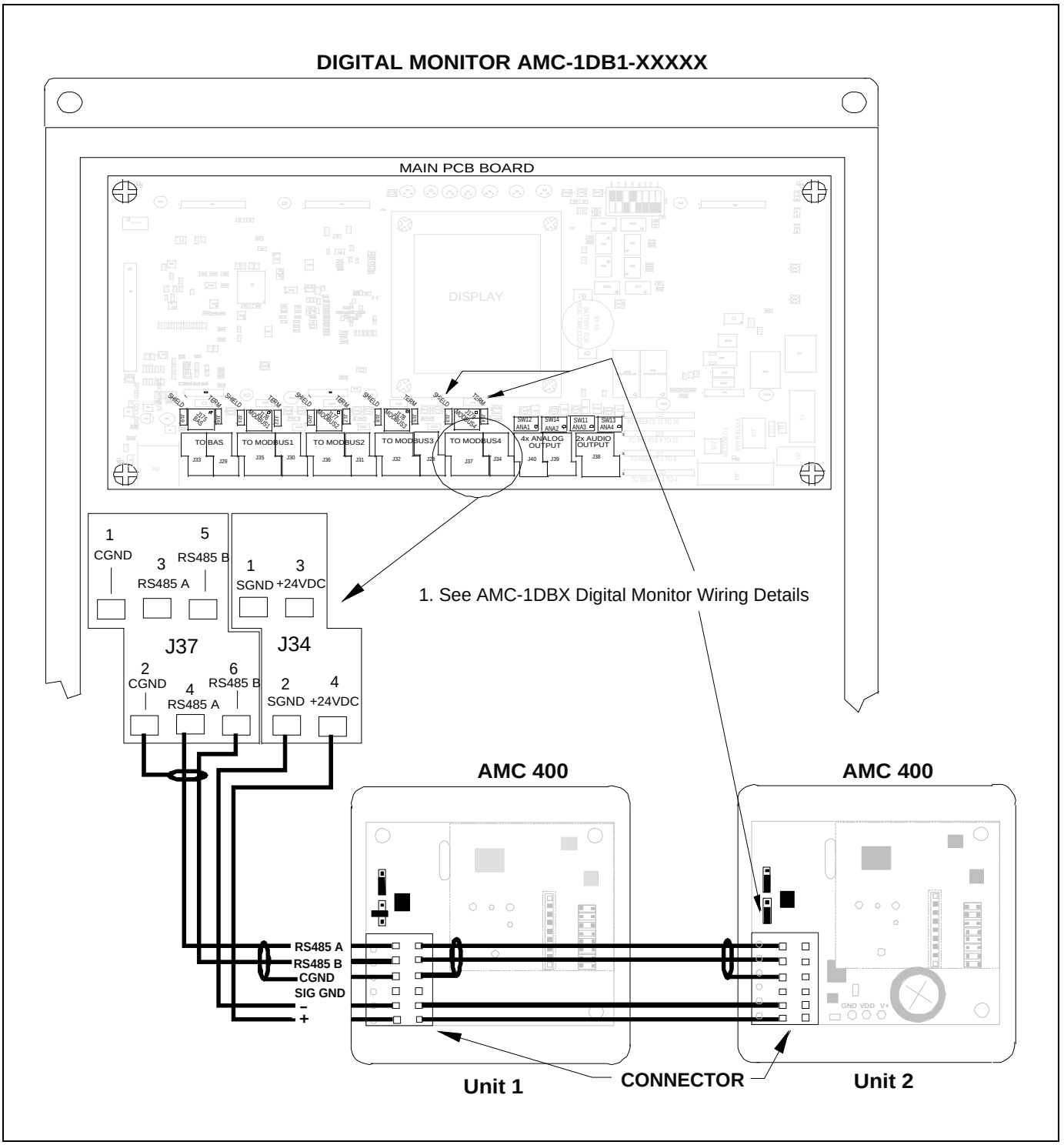


Figure 4-4 Example of connections to a 120VAC AMC-1DB1-1XXXXX Digital Monitor

Warning:

Care must be taken when connecting services to Power and Communication Connector. Do not use SIG GND on AMC- 400 for powering. Cable shield(s) are to be connected to CGND. Mixing power and communication connections can cause permanent damage. Consistent polarity of RS-485 wire is required throughout network for proper system operation.

4.2.1.1 AMC-1DBx Digital Monitor Wiring Details

1. MODBUS terminations are applied at both ends of an RS485 bus. For a wiring configuration such as shown in **Figure 4-4** the termination is applied to the last AMC-400 Digital Transmitter and another termination is applied at the AMC-1DBx Digital Monitor. A MODBUS Termination strap is available for each of the 4 MODBUS on the AMC-1DBx Digital Monitor. (See termination under Product Description section of Digital Monitor AMC-1DBx Series User Manual) For wiring configurations where the AMC-1DBx is situated in the middle of the RS485 bus, the termination on the AMC-1DBx Digital Monitor is not applied and termination is applied to both AMC-400 Digital Transmitters at each end of the RS485 bus.

2. The AMC-400 Digital Transmitter shield connections are connected to the CGND pin of the AMC-1DBx Digital Monitor. The AMC-1DBx Digital Monitor has a strapping option to connect this CGND to 3 possible connections.

    - Connects CGND to Chassis Ground.
    - Connects CGND through RC network to Chassis Ground.
    - Connects CGND to open.

    See Shield Termination under Product Description section of Digital Monitor AMC-1DBx Series User Manual for further details.

3. The AMC-1DBx Digital Monitor has Dual row connections. J37, J36, J35, J34, J32, J31, J30, and J28 connector top row is shorted to the bottom row.

Warning:

Care must be taken when connecting services to Power and Communication Connector. Do not use SIG GND on AMC- 400 for powering. Cable shield(s) are to be connected to CGND. Mixing power and communication connections can cause permanent damage. Consistent polarity of RS-485 wire is required throughout network for proper system operation.

4.2.1.2 POWER SUPPLY

The AMC-400 Digital Transmitter is 24VDC powered typically either by a 120VAC AMC-1DB1-1XXXXX Digital Monitor or a 24VDC AMC-1DB1-2XXXXX Digital Monitor.

The 120VAC AMC-1DB1-1XXXXX Digital Monitor should be used when a maximum of 1A of current is required from its 24VDC output for MODBUS devices (transmitters, etc). The Digital Monitor provides 4 x 24VDC power plus MODBUS channels. Each 24VDC power lane is limited to 1A with a resettable fuse (PTC) See Figure 4-4.

The 24VDC AMC-1DB1-2XXXXX should be used when the present or future system requirements need more than 1A for MODBUS devices. A minimum of one AMC-1DPS-7A 24VDC Power Supply is required to power both the Digital Monitor and all Transmitters. Note that the transmitters are powered from the Power supply and **NOT** the Digital Monitor. See Figure 4-5. 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 5A for the transmitters and other MODBUS devices. If this current is exceeded an additional AMC-1DPS-7A Power Supply should be employed.

The AMC-1DPS-7A Power Supply and AMC-1DBx Monitor ability to drive a maximum number of AMC-400's (each representing 55 mA load for Electrochemical or 80-130mA for Catalytic) is determined by what other devices are being driven (ex; relay cards), the AWG of wire selected, and the length of cable being powered. If the cable length exceeds a distance that prevents the Digital Transmitter from obtaining the minimum voltage at the V+ Test Point (as defined in Section 2.1.1.) then both an additional power supply and repeater would be required. See **Table 4-1** to aid in determining the maximum number of sensors that can 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.

Table 4-1 Maximum number of sensor on a string limited by drop out voltage

Sensor Type	Number of sensors vs *total current*					
Average distance between points	75ft		150 ft		200 ft	
	16AWG	18AWG	16AWG	18AWG	16AWG	18AWG
Electrochemical 400 CO/NO2	27 – 1.49A	21 – 1.16A	19 – 1.05A	15 - 0.83A	16 - 0.88A	13 - 0.72A
Catalytic	19-1.943A	15- 1.51A	13 - 1.28A	10 – 1.1A	12 - 1.16A	9 – 0.97A

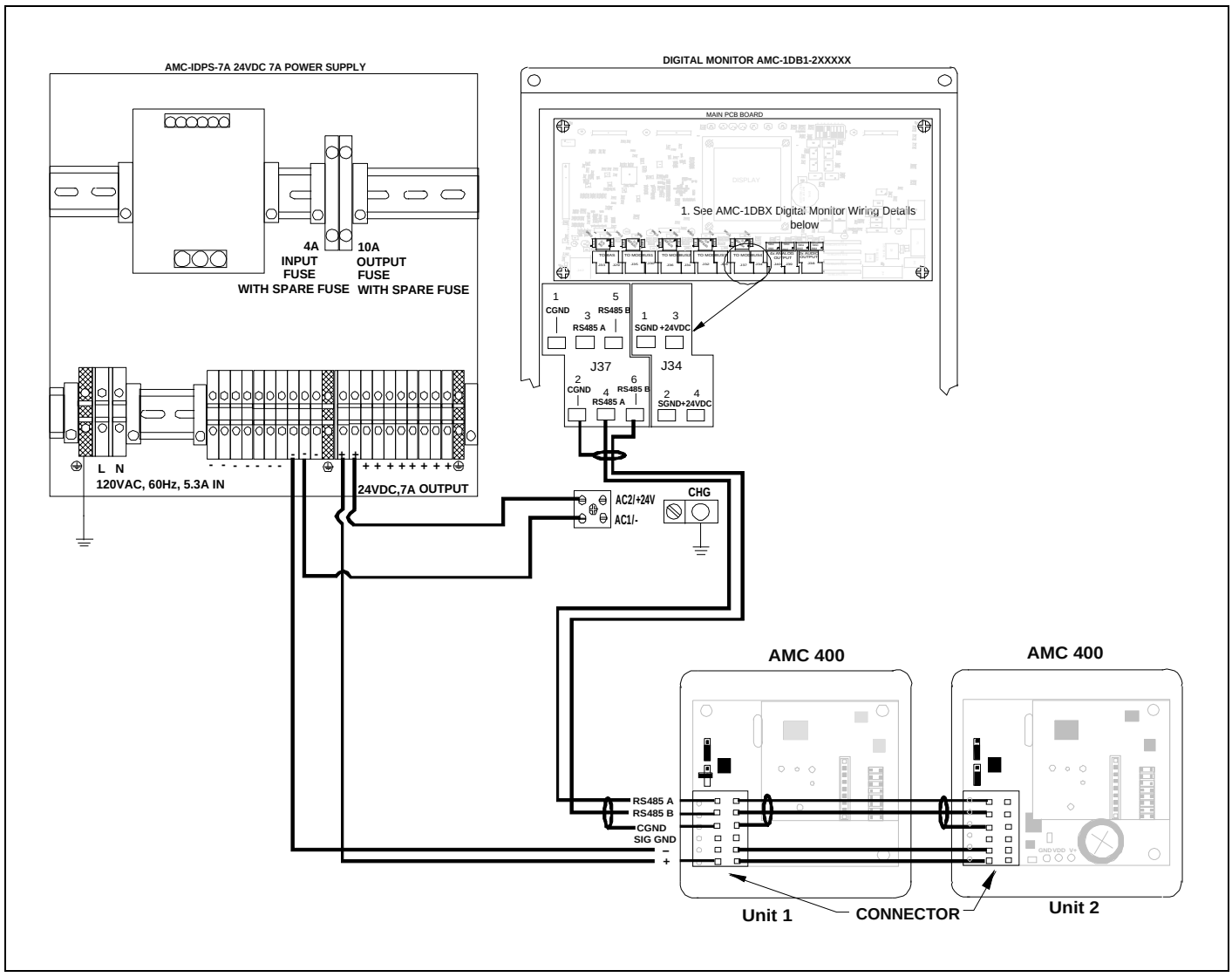


Figure 4-5 Example of connections to a 24VDC AMC-1DB1-2XXXXX configuration

Caution:

Care must be taken when installing to ensure that all Digital Transmitters are connected with the same power supply polarity across the network. Digital Transmitter + should be connected to +24VDC power terminal at monitor and Digital Transmitter - should be connected to SGND power terminal at monitor. Do not use SIG GND on AMC-400 for powering.

4.2.1.3 COMMUNICATION

The AMC-400 Digital Transmitter is to be controlled by the AMC-1DBx Digital Monitor. The AMC-1DBx can manage up to 988 devices through 4 MODBUS channels. Additional power supplies and repeaters would be needed to meet these maximum configurations. All devices are connected to the same two communication signals; RS485A and RS485B. The AMC-400 Digital Transmitter communicates through a cable connection on RS485A and RS485B as shown in the Figure 3-3 REAR LID OVERVIEW; item 8 Power and Communication Connector:

Caution:

Care must be taken when installing to ensure that all Digital Transmitters are connected with the same MODBUS polarity across the network. Digital Transmitter RS485A should be connected to RS485A terminal and Digital Transmitter RS485B should be connected to RS485B terminal. Do not use SIG GND at Digital Transmitter for powering.

The total cable length for a bus segment should not exceed 1000 M (3280 ft) without the use of repeaters. Please refer to MODBUS OVER SERIAL LINE SPECIFICATION AND IMPLEMENTATION GUIDE V1.0 27/44

MODBUS AC termination is required for the last unit of the bus. Without this termination reflections of fast driver edges can cause multiple data edges that can cause data corruption. Termination resistors also reduce electrical noise sensitivity due to the lower impedance, and bias resistors. Please refer to Figure 3-3 Rear Lid View; item #14 for details.

There is a 32 unit load (UL) transmitter limit per RS-485 bus segment determined by ANSI/TIA/EIA-485-A-1998 standard. The AMC-1DBx Digital Monitor, the AMC-1DA-RPT4 Repeater, and the AMC-1DA-RPT Repeater all have one RS-485 unit load on each or their MODBUS outputs so only 31 additional RS-485 unit loads can be driven on each MODBUS Bus Segment. Note that each device and the repeaters have a UL on each input. The devices include AMC-400 Digital Transmitter or Relay Modules. Either AMC-1DA-RPT4 or AMC-1DA-RPT Repeaters are required to expand beyond this 32 UL limit configuration limit per MODBUS. The example below shows the 32 UL limit for each Bus Segment. Note the UL on each MODBUS output and each MODBUS input. Typically the drop out voltage will become an issue before the maximum of 31 RS-485 devices are connected.

5 OPERATION AND CALIBRATION

This section describes how the functionalities of the AMC-400 Digital Transmitter are operated and performed. Please consult the operation and initial configuration chapters below before attempting to operated the AMC-400 Digital Transmitter.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot plugging of the Smart Sensor 2 Module. Please completely disconnect power from Digital Transmitter before replacing Smart Sensor 2 Module.

5.1 OPERATION

5.1.1 TRANSMITTER JUMPER

The Digital Transmitter has two straps; Smart Sensor 2 Termination and MODBUS Termination. Please refer to Figure 3-3 Rear Lid View for details.

5.1.2 TRANSMITTER AND SMART SENSOR 2

The AMC-400 Digital Transmitter is factory calibrated for the gas listed in the Product Information (Section 2) at the beginning of this manual. The unit should not require re-calibration when first installed and powered up, but a test for correct sequence of operation is recommended after a stabilization period of five minutes. Activity on the LED(s) indicates that the board is powered on.

At power up, the display runs through the following sequence:

1. Indicates the software/hardware versions and performs a self test
2. Display sensor stabilization status
3. Displays the gas type
4. Displays the gas concentration.

Note:

The transmitter will experience a reboot and repeat the above sequence if no MODBUS traffic is detected for a period of five minutes. Additionally a failed transmitter will reboot after one to two minutes.

Additionally the AMC-400 Digital Transmitter can insert other sensor status between gas type and gas concentration. This following sensor status is available:

Sensor Status	*Definition*	*Action*
"*PUP*"	Sensor in stabilization Power Up Period	Wait up to 5 minutes for sensor to stabilize.
"*CAL*"	Sensor needs Calibration	Consult CALIBRATION and MAINTENANCE sections in this manual.
"*OFL*"	Sensor in Over Flow out of range state. Gas concentration is exceeding full span range of sensor.	Consult AMC for appropriate Smart Sensor 2 type and use. It is not recommended to operate Smart Sensor 2 outside specified operating limits. Gas concentration is this mode may be at hazardous levels. When the gas concentration falls to a point it no longer exceeds the full span range this display is cleared.
"*SEr*"	Smart Sensor 2 module requires service	Contact AMC for Smart Sensor 2 module service or replacement.

In near zero gas and after the stabilization period, the transmitter will send accurate gas concentration MODBUS packets to the monitor or controller. Although the electrochemical sensors are very selective, there are some interference gases which can cause a response from the sensor. In the case of a large response, please check background gas potential or the possibility of an interference gas being present.

Caution:

When the gas concentration exceeds the full scale range, the display will alternate between the reading value and the letters "*OFL*" for overflow. Refer to 2.1.2 SMART SENSOR 2 MODULE(S) SPECIFICATION **for Range, consult AMC for alternative Smart Sensor 2 types. It is not recommended to operate Smart Sensor 2 outside specified operating Range. Gas concentration in this mode may be at hazardous levels.**

The front panel view below shows the four areas of user interface; Pushbutton, Display, TX Status, and Sensor Status. These user interfaces are briefly described below and referenced in more detail under the initial configuration and calibration sub-sections.

Figure 5-1 Front Panel User Interface

Note:

The Pushbutton (reference point 1) is positioned behind the front panel and requires a small Tool to access it through a small hole. Use Wiha 27215 slot screwdriver.

The Pushbutton allows a user to navigate through configuration menu. The pushbutton has two states; short and long button press. Short press is less than two seconds while long press is greater than two seconds. Feedback of the pushbutton state is provided on the display. A short press will display both decimal points, while a long press will display "*SEL*". As an example the pushbutton must be pressed and held for at least 2 seconds to enter configuration. The display will indicate "*SEL*" when user has held the pushbutton long enough to enter the configuration menu.

The Display has 3 character positions with two decimal points, each character has 7 segments. The LCD can display numbers and various alphabetic characters. Some alphabetic characters are upper case while others are lower case. In normal operation the display will cycle between the gas concentration and gas type, in configuration the display is used to indicate configuration titles and items. By default the gas concentration is displayed in PPM or LEL and may or may not have a decimal point. The gas type is displayed in alphanumerical characters as an example "*co*" indicates Carbon Monoxide, "*no2*" indicates Nitrogen Dioxide, "ch4" indicates methane, "*Pro"*" indicates Propane, and "H2" indicates Hydrogen.

The TX Status is a green and red LED to indicate activity of the MODBUS link and transmitter health and state. As an example a slow blinking green TX status indicates healthy MODBUS activity detected, while a period of fast blinking red TX status can indicate a momentary MODBUS fault. Please refer to TRANSMITTER STATUS LED for further details.

The Sensor Status is a green and red LED to indicate activity of the Smart Sensor 2 link and Smart Sensor 2 health and state. As an example a slow blinking green Sensor status indicate healthy activity detected, while a period of fast blinking red Sensor status can indicate a momentary sensor bus fault. Please refer to SENSOR STATUS LED for further details.

Note:

AMC-400 Digital Transmitter LED will appear to blink slow green even though it is not being accessed by a monitor. This is the case when MODBUS address is not properly configured. Use 5.3.4 GAS TEST AND SERVICE MODES to verify proper configuration this will allow gas concentration to be observed at the monitor or controller.

5.1.3 TRANSMITTER STATUS LED

The Transmitter Status LED under normal operation should be slow blinking green indication. Slow blinking green indicates MODBUS communication detected and no transmitter faults. Numerous transmitter faults can occur under various situations and is indicated with momentary fast blinking red indication. A fast blinking green indicated no MODBUS communication present and no transmitter faults.

Note:

AMC-400 Digital Transmitter Status LED will momentarily fast blink red under a minor transmitter fault situation, such as erroneous MODBUS packet. Consult AMC for service if minor transmitter fault persists.

Below is the possible Transmitter Status LED:

Transmitter LED State	*Definition*	*Action*
Slow Blinking Red	Transmitter initializing.	Wait for initialization to complete.
Slow Blinking Green	Transmitter is healthy.	No action required.
Fast Blinking Green	Transmitter is healthy, but no MODBUS communication detected.	Check if monitor is MODBUS connected and not in setup.
Slow Blinking Green/Red	Transmitter is in configuration mode.	Complete configuration and exit.
Fast Blinking Green/Red	Transmitter is in gassing state of calibration.	Complete calibration and exit.
Fast Blinking Red	Transmitter has experienced a minor fault in the last 10 seconds of operation.	Check if transmitter and/or other system components have valid operating limits (i.e. connections, power supply, temperature, and MODBUS addressing). Consult AMC for service if status persists.
Solid or long period Red, Green or Orange	Transmitter has experienced a severe fault.	Wait one to two minutes for unit to enter normal mode. Consult AMC for service if status persists.
LED Extinguished	Transmitter is powered off.	Check transmitter wiring or power supply state. Consult AMC for service if status persists.

5.1.4 TROUBLESHOOTING MODBUS USING THE TRANSMITTER STATUS LED

The Transmitter Status LED indirectly provides a MODBUS monitor function. Using this LED in conjunction with other transmitters can help in diagnostic of MODBUS faults. Here is a list of troubleshooting guidelines of the Transmitter Status LED:

A. If all transmitters blink fast green and the monitor is in operation mode then the MODBUS wiring is likely disconnected at the monitor.
B. If one or more transmitter(s) in a chain are blinking fast green and a unit closer to the monitor is blinking slow green then a MODBUS disconnection point begins after the slow blinking green unit.
C. If a transmitter is blinking fast red and other transmitter units are blinking slow green then check that the MODBUS connections are not reversed on the flashing red unit.
D. If a transmitter blinks slow green, but the monitor indicates “na” for that unit then the transmitter unit needs its MODBUS address to be assigned.
E. If two transmitter units blink slow green, but all other transmitter units indicate fast blinking red, then the two slow blinking green transmitter units have the same MODBUS address.
F. If the monitor appears to be operating well with one or more transmitters, but transmitter unit(s) have fast blinking red from time to time, then MODBUS signal degradation is present. Check that the both MODBUS signals wires and shield are properly connected.

5.1.5 SENSOR STATUS LED

The Sensor LED Status under normal operation has a slow blinking green indication. Slow blinking green indicates good Smart Sensor 2 communication detected and no sensor faults. Numerous sensor faults can occur under various situations and is indicated with momentary fast blinking red indication.

Caution:

Sensor LED status will momentarily fast blink red under a minor sensor fault situation, such as a packet error. Consult AMC for service if minor sensor fault persists.

Below is the possible Sensor LED Status:

Sensor LED State	*Definition*	*Action*
Slow Blinking Red	Smart Sensor 2 initializing.	Wait for initialization to complete.
Slow Blinking Green	Smart Sensor 2 is healthy.	No action required.
Fast Blinking Green	Smart Sensor 2 is healthy, but no communication detected.	Check if Smart Sensor is properly connected to TX.
Slow Blinking Green/Red	Smart Sensor 2 is in configuration mode.	Complete configuration and exit.
Fast Blinking Green/Red	Smart Sensor 2 is in gassing state of calibration.	Complete calibration and exit.
Blinking Red for 10seconds every minute of Slow Blinking Green	Smart Sensor 2 module requires services either calibration or other service. DT display will complement this with "CAL" and/or "SEr" indication.	Consult calibration section in this manual or contact AMC. It is not recommended to operate Smart Sensor 2 module requiring service or when calibration is needed. Sensor operated beyond calibration schedule or requiring service may provide erroneous readings.
Fast Blinking Red	Smart Sensor 2 has experienced a minor fault in the last 10 seconds of operation.	Check if Smart Sensor has valid operating limits (i.e. power supply, temperature, and Smart Sensor addressing). Consult AMC for service if status persists.
Solid or long period Red, Green or Orange	Smart Sensor 2 has experienced a severe fault.	Wait one to two minutes for unit to enter normal mode. Consult AMC for service if status persists.
LED Extinguished	Smart Sensor 2 is powered off.	Check Smart Sensor 2 wiring or power supply state. Consult AMC for service if status persists.

Note:

The Smart Sensor 2 will experience a reboot and enter initialization state (slow blinking RED Sensor Status LED) if no transmitter requests are detected for a period of five minutes. Additionally a failed Smart Sensor 2 will reboot after one to two minutes.

5.2 INITIAL CONFIGURATION

Initial installation requires a unique MODBUS address to be configured for each MODBUS devices connected to the same MODBUS channel. The current MODBUS address may be pre-configured and labeled on the front panel in small box (see front panel view item 5). User can change the MODBUS address by entering configuration. MODBUS addresses must be in the range of 1-247. Please refer to Appendix for menu flow diagrams and guide.

Caution:

An invalid MODBUS address may cause other devices to malfunction. It is important to carefully map out MODBUS addresses.

Note:

AMC-400 Digital Transmitter will automatically exit current level of configuration after 1 minute of inactivity without change. This can be useful when user is lost or unsure of current modification.

The AMC-400 Digital Transmitter configuration is divided into 6 areas;

- MODBUS Configuration
- Smart Sensor 2 Configuration
- Digital Transmitter Configuration
- Zero Calibration
- Span Calibration
- Service Modes

1. To enter configuration press and hold the pushbutton for 2 seconds or more until the display shows "*SEL*". When the pushbutton is released the Configuration Menu title "*-CF*" will be displayed.

2. The possible items in configuration are:

   "*-CF*" Configuration Title and Exit Point
   "*A01*" MODBUS Configuration
   "*A02*" Smart Sensor 2 Configuration
   "*A03*" Digital Transmitter Configuration
   "*A04*" Zero Calibration
   "*A05*" Span Calibration
   "*A06*" Service Modes

3. At this point the user can immediately exit configuration by push and holding the pushbutton for >2 seconds and releasing. Alternatively the user can scroll through the above 6 choices by short pressing the pushbutton (<2seconds). The list is circular in nature.

Note:

Configuration titles with a negative sign are exit points. Just press and hold the pushbutton for >2seconds and release to get to the previous level. Scrolling with quick

button presses will normally cycle you to an exit point without change.

4. To enter MODBUS Configuration the user must press and hold the pushbutton for >2 seconds and release at the item A01. The MODBUS title "-FB" will be displayed.

5. To configure the MODBUS address short press to the item "F01" and press and hold for >2seconds and release to enter sub-item. At this point the current MODBUS address will be displayed; a short press returns you back to "F01" which can lead you to an exit point.

6. To modify the MODBUS address press and hold for >2seconds and release to edit the first digit of the address. The least significant digit can now be changed, scroll quickly with short presses and cycle through the number choices from the current number to 9 and then back to 0. Press and hold >2seconds and release to move to next most significant digit position. Repeat sequence for second digit and third digit. When the MODBUS address is displayed use a short press to return to "F01".

7. Use short presses to scroll to item "-FB" and push and hold the pushbutton for >2 seconds and release to return to A01. Use short presses to scroll to item A03.

8. To enter Digital Transmitter Configuration the user must push and hold for >2seconds and release at item A03. The title "-du" will be displayed. Scroll through to d01, push and hold for >2seconds and release to enable LCD blanking. LCD will blank after 1 minute of pushbutton inactivity, pressing the pushbutton restores display. Alternatively scroll to d02, push and hold for >2seconds and release to disable LCD blanking. Or scroll to d03, push and hold for >2seconds and release to enter Digital Transmitter location label. Location labeling allows a unique 3 character string to be assigned to Digital Transmitter. This procedure is similar to entering the MODBUS address, but the choices are alphanumeric.

Note:

Currently location label is not required by a monitor or controller and can be used as needed to store and retain user information.

9. Items A04 to A06 can be skipped for initial configuration.

5.3 CALIBRATION

This calibration procedure is applicable for all versions of the AMC-400 Digital Transmitter.

Every AMC-400 Digital Transmitter is factory calibrated, so each unit is to be ready for operation after installation and a 5 minute stabilization time.

The AMC-400 Digital Transmitter and Smart Sensor 2 are equipped with Calibration and Service indicators. When Calibration or sensor service has occurred the display will interleave "CAL" and/or "SEr" respectively during normal gas concentration updates.

Subsequent calibration is required as a part of regular maintenance, but it is not required when replacing the Smart Sensor 2 module with a factory pre-calibrated Smart Sensor 2 module. See the Maintenance section of this manual for the recommended calibration schedule.

Note:

When the gas sensor needs calibration or service the display will alternate between the reading value and the letters "CAL" and/or "SEr".

Warning:

When performing calibration the results are not saved in Smart Sensor 2 until successful Span procedure has been completed. Powering off unit after Zero procedure and before completing a successful Span procedure will result in calibration information being lost. Also failed Span procedure due to user abort or procedure limit checking leaves the unit with unstable calibration information. It is important to complete a successful SPAN procedure for unit to function properly.

Caution:

- Only qualified personnel should perform the actual calibration.
- Users new to gas calibration are advised to consult with Armstrong Monitoring

The Armstrong Monitoring Corporation offers the following calibration plans:

1. Factory pre-calibrated exchange replacement smart sensor 2 modules.
2. On site installation by Armstrong Monitoring.
3. On site calibration by Armstrong Monitoring.
4. Training by Armstrong Monitoring for end users.

For additional details please refer to CONTACT INFORMATION**.**

5.3.1 REQUIRED EQUIPMENT; EXCHANGE PROGRAM

For qualified personnel, the following is a recommended list of equipment required:

- 5/16 nut driver and Phillips and Robertson screw driver set
- TOOL SCREWDRVR SLOT ESD 1.5MM, Wiha 27215.

To replace Smart Sensor 2 Module with a pre-calibrated unit, first completely remove power from Digital Transmitter by unplugging Power and Communication Connector as shown in. Use a nut driver to remove nut that is holding Smart Sensor 2 Module to Digital Transmitter. Carefully remove and replace Smart Sensor 2 Module attached to SS2 Female Connector. Replace nut holding Smart Sensor 2 to Digital Transmitter with nut driver.

Warning:

It is possible to improperly insert SS2 Male Pins into SS2 Female connector. Ensure pins are lined up properly with these connectors before inserting.

5.3.2 REQUIRED EQUIPMENT; ON-SITE CALIBRATION

For qualified personnel, the following is a recommended list of calibration equipment required.

- TOOL SCREWDRVR SLOT ESD 1.5MM, Wiha 27215
- Calibration kit and Cal Gas, please refer to Section 2.1.2.

5.3.3 CALIBRATION PROCEDURE

The AMC-400 Digital Transmitter is equipped with a calibration feature allowing for one-man calibration at the transmitter location. In most cases it is only Zero and Span adjustments that are made in field calibrations. All Calibration procedures will automatically exit to normal operation without change if left inactive for several minutes. Please refer to Appendix for menu flow diagrams and guide**.**

Note:

During calibration new gas concentration is not updated to monitor and last gas concentration value will be reported.

Refer to Figure 5-1 Front Panel User Interface to perform the following calibration procedure:

1) The zero calibration can perform a calibration with any background air where the monitored gas is greater than 0 PPM (as example 5ppm CO gas could be used instead of 0ppm). Specifics are described in 3rd step of this process. Perform gassing with a calibration adapter that is firmly inserted into front panel of AMC-400 Digital Transmitter; please refer to 2.1.2 SMART SENSOR 2 MODULE(S) SPECIFICATION for gas flow rate and Calibration kit.

2) Enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "A04" item with short presses. To begin zero calibration enter the "A04" item with a push and hold >2seconds and release. The zero calibration title "-0C" will be displayed.

3) At this point short press pushbutton to display the Zero Gas Concentration. If the zero gas concentration is to be modified then push and hold for >2seconds and release. The gas concentration can be modified one digit at a time similar to MODBUS address modification in INITIAL CONFIGURATION. Once all digits have been modified another short press will advance procedure to the gassing phase. The AMC-400 Digital transmitter may ignore modifications if the gas concentration entered is not acceptable.

4) At the beginning of zero calibration the AMC-400 Digital Transmitter will display "GaS" "0n". Begin gassing at this point to perform a T99 type calibration. The qualified personnel can begin gassing after this point to perform a T90 type calibration by advancing the procedure to measurement phase with a press of the pushbutton.

5) During zero gassing measurement the display will indicate either "Inc" or "dEc" depending of signal level from sensor increasing or decreasing respectively. Also the LCD will display the sensor voltage when the gas concentration is not changing. The measurement phase contains a minimum and maximum gassing period and will automatically complete after gas measurement is stable. Proceed to calibration complete by pressing the pushbutton.

6) During zero calibration complete the AMC-400 Digital Transmitter will display "GaS" "0FF". At this point the qualified personnel must accept or reject this calibration by a push and hold >2seconds or short press respectively. If the accept is given the AMC-400 Digital Transmitter will check the limits of the result and accept or reject it by displaying "Acc" or "bAd" respectively. If result has been rejected the LCD will indicate "bAd".

7) The zero calibration title "-0C" will be re-displayed for retry or exit. Push and hold and release to exit. Scroll through to the "A05" item with short presses. To begin span calibration enter the "A05" item with a push and hold >2seconds and release. The span calibration title "-SC" will be displayed.

8) At this point short press pushbutton to display the Span Gas Concentration. If the span gas concentration is to be modified then push and hold for >2seconds and release. The gas concentration can be modified one digit at a time similar to MODBUS address modification in INITIAL CONFIGURATION. Once all digits have been modified another short press will advance procedure to the gassing phase. AMC-400 Digital transmitter may ignore modification if the gas concentration entered is not acceptable.

9) At the beginning of span calibration the AMC-400 Digital Transmitter will display "*GaS*" "*On*". Begin gassing at this point to perform a T99 type calibration. The qualified personnel can begin gassing after this point to perform a T90 type calibration by advancing the procedure to measurement phase with a press of the pushbutton.

10) During span gassing measurement the display will indicate either "*Inc*" or "*dEc*" depending of signal level from sensor increasing or decreasing respectively. Also the LCD will display the sensor voltage when the gas concentration is not changing. The measurement phase contains a minimum and maximum gassing period and will automatically complete after gas measurement is stable. The qualified personnel can proceed to calibration complete by pressing the pushbutton.

11) During span calibration complete the AMC-400 Digital Transmitter will display "*GaS*" "*OFF*". At this point the qualified personnel must accept or reject this calibration by a push and hold >2seconds or short press respectively. If the accept is given the AMC-400 Digital Transmitter will check the limits of the result and accept or reject it by displaying "*Acc*" or "*bAd*" respectively. If result has been rejected the LCD will indicate "*bAd*".

12) At this point the span calibration title "*-SC*" will be re-displayed for retry or exit. Push and hold >2seconds and release to exit. Scroll through to the "-CF" exit point with short presses. Push and hold >2seconds and release to exit configuration back into normal operation.

5.3.4 GAS TEST AND SERVICE MODES

The AMC-400 Digital Transmitter should be bump tested after calibration to ensure proper sequence of operation. Gas testing under normal operation provides verification of full path operation from sensor, to monitor, to interlock. Gas testing under normal mode requires the re-application of span gas concentration as performed in gassing phase of calibration. Please refer to Appendix for menu flow diagrams and guide.

Note:

When the gas testing with low concentration gasses the AMC-400 digital transmitter may display gas concentration of 0. Consult 2.1.2 SMART SENSOR 2 MODULE(S) SPECIFICATION **for Zero buffer gas concentration value.**

The AMC-400 Digital Transmitter is equipped with two service modes:

1) Service Mode 1: Gas testing without reporting gas concentration to monitor. This mode allows sensor sensitivity to be tested locally without alarming the rest of the building or building automation system. The gas concentration reported to monitor during this mode will be the last known level.
2) Service Mode 2: Forces gas concentration to monitor without actual gas testing. This mode allows the monitor alarms or building automation system to be tested without using gas.

Note:

All service mode procedures will automatically exit to normal operation without change if left inactive for 10 minutes.

Service Mode 1:

A. To enter Service Mode 1; enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "ADR" item with short presses. To begin service mode choice enter the "ADR" item with a push and hold >2seconds and release. The service mode title "-SE" will be displayed.

B. Short press pushbutton to scroll to the "SE1" choice. Push and hold >2seconds and release to enter service mode. The Service Modes will enter a routine; displaying the gas type and concentration. With Service Mode 1 the qualified personnel can begin gassing without changing the gas concentration to monitor. The monitor will continue to receive last known gas concentration. To exit service modes wait for gas concentration to return to background levels, then push and hold >2seconds and release.

C. Short press pushbutton to scroll through items to return to "-SE" exit point. Push and hold >2seconds and release to return to "ADR" item. Again short press pushbutton to scroll through items to return to "-CF" exit point. Push and hold >2seconds and release to return to normal operation.

Service Mode 2:

A. To enter Service Mode 2; enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "ADR" item with short presses. To begin service mode choice enter the "ADR" item with a push and hold >2seconds and release. The service mode title "-SE" will be displayed.

B. Short press pushbutton to scroll to the "SE2" choice. Push and hold >2seconds and release to enter service mode. In Service Mode 2 the qualified personnel must enter a gas concentration to be forced to the monitor. Once entered the Service Modes will continuously transmit gas concentration and type to the monitor. This entry is similar to MODBUS address modification in INITIAL CONFIGURATION. To exit service modes push and hold >2seconds and release.

C. Short press pushbutton to scroll through items to return to "-SE" exit point. Push and hold >2seconds and release to return to "ADR" item. Again short press pushbutton to scroll through items to return to "-CF" exit point. Push and hold >2seconds and release to return to normal operation.

5.4 SPECIAL CONFIGURATION FOR SERVICE

Above and beyond calibration the AMC-400 Digital Transmitter may indicate it requires service by displaying "SEr" along with the sensor LED periodically flashing red. Consult AMC for service. Once correct sensor operation has been confirmed; qualified personnel can inhibit the "SEr" display and associated sensor red LED indicator until the next calibration schedule.

To inhibit this SEr operation enter Digital Transmitter Configuration; from normal operation the user must push and hold the pushbutton for >2seconds (“SEL”) to enter “-CF”. Scroll through to “A03” with short pushbutton presses, push and hold for >2seconds (“SEL”) and release to enter. The title “-du” will be displayed. Scroll through to “d07”, push and hold for >2seconds (“SEL”) and release to inhibit this SEr display action. In operation mode the Digital Transmitter display will no longer show “SEr” until the next calibration schedule at which time both “CAL” and “SEr” will be displayed along with the gas type and gas concentration. The Digital Transmitter will operate with this configuration indefinitely.

The Digital Transmitter can be returned to original SEr display configuration by entering “A03” and scrolling through to “d08”, push and hold for >2seconds (“SEL”) and release to enable normal SEr display action during operation mode when sensor is requiring service.

6 MAINTENANCE

Maintenance is a very important activity that should be done at the proper time intervals, which are discussed below.

6.1 GENERAL

The AMC-400 Digital Transmitter should be brushed or wiped as required, depending on the rate of accumulation of any dust or dirt.

To avoid sensor damage, the unit MUST NOT be submerged in any liquids. Hosing or splashing of the unit with any liquids must also be avoided.

Ensure the green indicators (LEDS) are slowly blinking to indicate a healthy state.

6.2 SCHEDULED CALIBRATION

Scheduled calibration is critical in maintaining proper function of the AMC-400 Digital Transmitter. It is recommended that the AMC-400 Digital Transmitter be calibrated a minimum of twice a year or more often for demanding work place applications. As mentioned, Armstrong Monitoring Corporation offers a number of different maintenance plans to suit your requirements. Please see CONTACT INFORMATION section.

6.3 SMART SENSOR 2 MODULE REPLACEMENT

The Smart Sensor 2 Module tracks time and displays SEr when service is required. When the Smart Sensor 2 Module can no longer be calibrated replacement is required; see section 2.1.2 for replacement sensor P/N.

Please note that the sensor itself is not replaceable. The Smart Sensor 2 and sensor are replaced as one assembly or module; please refer to 5.3.1 REQUIRED EQUIPMENT; EXCHANGE PROGRAM for instructions.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot plugging of the Smart Sensor 2 Module.

6.4 VERIFICATION OF OPERATION

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

7 APPENDIX: DIGITAL TRANSMITTER CONFIGURATION MENU FLOW

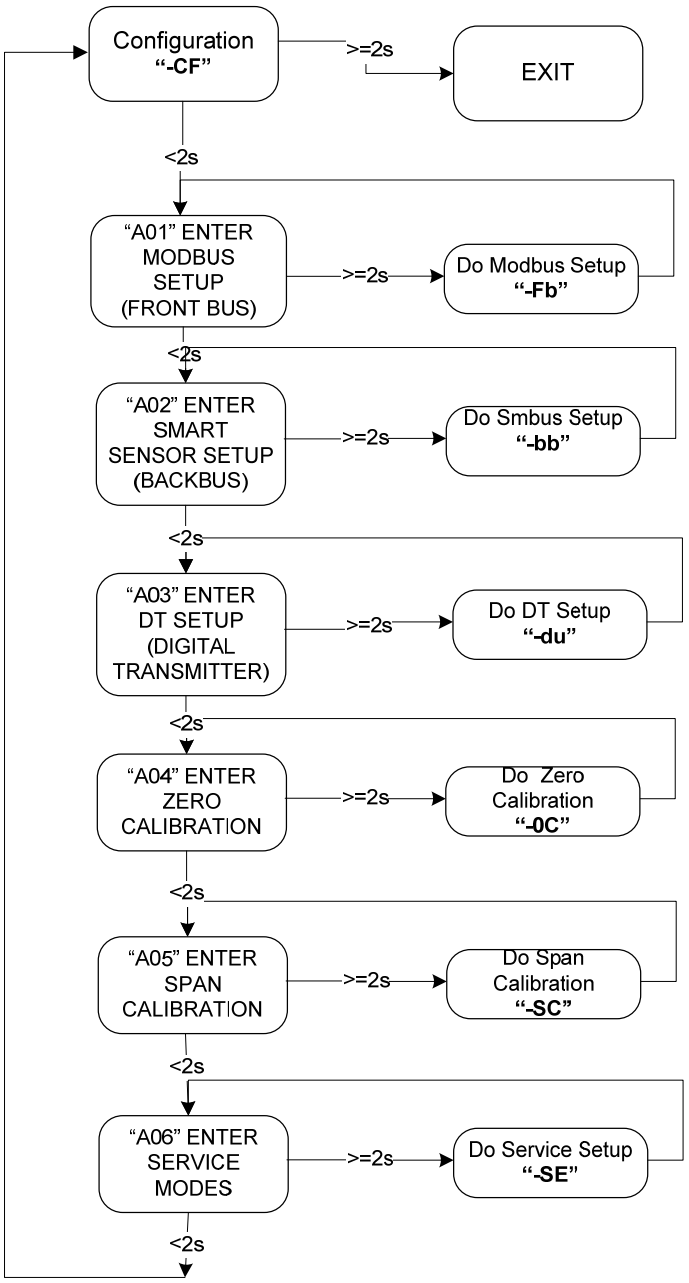
Digital Transmitter Configuration

PUSHBUTTON ACTIONS

<2 SECOND – INCREMENT OR NEXT CHOICE
>=2 SECOND – ENTER OR SELECT

DEFAULT ACTION

1 minute in any state defaults Exit Menu.



Note : Front Bus is the Modbus communication between the Monitor and the AMC-400. Back Bus is the ModBus communication between the AMC400 Smart Sensor 2 card and the AMC-400 Digital Transmitter card.

8 APPENDIX: DIGITAL TRANSMITTER CALIBRATION MENU FLOW

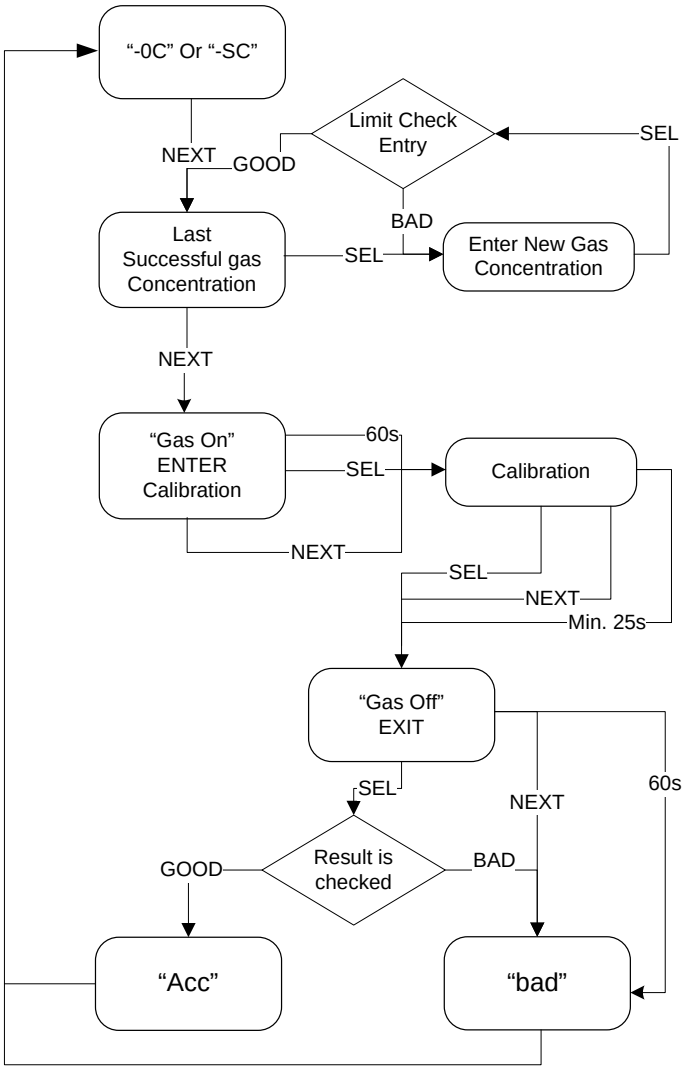
Digital Transmitter Zero or Span Calibration Menu

PUSHBUTTON ACTIONS

<2 SECOND = NEXT
>=2 SECOND = SEL (SELECT)

DEFAULT ACTION

1 minute in any state defaults Exit Menu.



9 APPENDIX: USER SUPPORTED MENU GUIDE

Below is the configuration menu that describes the USER supported portion of the Digital Transmitter.

< is Pushbutton input; PB is pressed, SEL is selected.

> is LCD output; ___ is a Static Display, while ___ is Blinking Display

User Interface Action	Description	*Comment*
>411	Digital Series	*2seconds*
>S1A	Software Version Revision Display (Version 1 Rev A)	*2seconds*
>0.08	Software Dot Revision Display	*2seconds*
>H1C	Hardware Version Revision Display (Version 1 Rev C)	*2seconds*
>___	Hardware Dot Revision Display (___)	*2seconds*
>Ini	Unit Initialization	*2seconds*
>888	Unit Self-Test	*1seconds*
>Na	Sensor Not Available yet Waiting for communication from SS2 module.	*7seconds*
>*co or no2* >PUP >0.00	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	*Running Display*
<*SEL* >*Co or n02* >PUP >0.00	Exit Scrolling Gas Concentration Display	*Select Configuration Menus*
< *PB* >-CF	Configuration Title	*Scroll to Choices*
<*SEL* >A01	Front Bus Setup Choice	*Select Front Bus Configuration*
< *PB* >-Fb	Front Bus Title	*Scroll to Choices*
<*SEL* >F01	MODBUS Address Choice	*Select MODBUS Address Configuration*

<SEL >063	Default or Last MODBUS Address	Select to edit 1st position address
<SEL > 3		Select 2nd position
<PB > 6		Change 2nd position
<PB > 073		Change 2nd position
<PB > 083		Change 2nd position
<PB > 093		Change 2nd position
<PB > 003		Change 2nd position
<SEL >003		Select 3rd position
<SEL >0		Select finish display
<PB >003		Enter MODBUS Address
<PB >F01	MODBUS Address Setup Choice	Scroll to Choice
<SEL >-Fb	Front Bus Title	Exit Front Bus Menu
<PB >A01		Scroll to next Choice
<SEL >A02	Back Bus Setup Choice	Select Back Bus Configuration
< PB >-bb	Back Bus Title	Scroll to Choices
<SEL >b01	SMBUS Address Choice	Select SMBUS Address Configuration
<SEL >001	Default or Last SMBUS Address	Select to edit 1st position address
<SEL > 1		Select 2nd position
<SEL > 0		Select 3rd position
<SEL >0		Select finish display
<PB >001		Enter SMBUS Address
<PB >b01	SMBUS Address Choice	Scroll to Next Choice
<SEL >-bb	Back Bus Title	Exit Back Bus Menu
<PB >A02	Back Bus Setup Choice	Scroll to next Choice
<SEL >A03	DT Setup Choice	Select DT Configuration
< PB >-du	DT Title	Scroll to Choices
<PB >d01	LCD Off Mode Choice	Scroll to next Choice

<PB >d02	LCD On Mode Choice	Scroll to next Choice
<SEL >d03	Location Label Choice	Select Location Label Configuration
< SEL >LO1	Default or Last Label	Select to Change Label
<PB > 1		Modify 1st position
<PB >LO2		Modify 1st position
<SEL >LO2		Select 2nd position
<SEL > O		Select 3rd position
<SEL >L		Select to finish display
<SEL >LO2	New Location Label	Scroll Label Change
<PB >d03	Location Label Choice	Scroll to Next Choice
<PB >d07	Inhibit SEr Choice	Scroll to Next Choice
<PB >d08	Enable normal SEr Choice	Scroll to Next Choice
<SEL >-du	DT Title	Exit Digital Transmitter Menu
<PB >A03	DT Setup Choice	Scroll to next Choice
<SEL >A04	ZERO Calibration Choice	Select ZERO Calibration
<PB >-OC	ZERO Calibration Title	Scroll to Enter Gas Concentration
<SEL >00.0	Default or Last Gas Concentration	Select to edit 1st position Gas
<SEL > .0		Select 2nd position
<PB > 0.		Change 2nd position
<SEL >01.0		Select 3rd position
<SEL >0 .		Select finish display
<PB >01.0		Enter Gasing
>GAS>ON	Gas On Instruction	Maximum 60seconds PB or SEL to continue
>Inc	Increasing Concentration	PB or SEL to end
>dEc	Decreasing Concentration	PB or SEL to end
>1.80	Stable Concentration (signal voltage)	Monitors for 10 consecutive stable samples.

		Minimum 25 seconds. *PB or SEL to end*
>GAS >OFF	Gas Off Instruction	*SEL to Accept* *PB or idle (Maximum 60) seconds to discard (bad)*
>Acc or bad	Confirmation	*1second*
<SEL >-OCA	ZERO Calibration Title	*Exit to Zero Gas Menu*
<PB >A04	ZERO Calibration Choice	*Scroll to next Choice*
<SEL >A05	SPAN Calibration Choice	*Select SPAN Calibration*
<PB >-SC	SPAN Calibration Title	*Scroll to Enter Gas Concentration*
<SEL >100	Default or Last Gas Concentration	*Select to edit 1st position Gas*
<SEL > 0		*Select 2nd position*
<PB > 0		*Change 2nd position*
<PB > 110		*Change 2nd position*
<PB > 120		*Change 2nd position*
<PB > 130		*Change 2nd position*
<PB > 140		*Change 2nd position*
<PB > 150		*Change 2nd position*
<SEL >150		*Select 3rd position*
<PB > 1		*Change 3rd position*
<PB > 250		*Change 3rd position*
<PB > 350		*Change 3rd position*
<PB > 450		*Change 3rd position*
<PB > 550		*Change 3rd position*
<PB > 650		*Change 3rd position*
<PB > 750		*Change 3rd position*
<PB > 850		*Change 3rd position*
<PB > 950		*Change 3rd position*
<PB > 050		*Change 3rd position*

<SEL >050		Select finish display
<PB >050		Enter Gasing
>GAS>ON	Gas On Instruction	Maximum 60seconds PB or SEL to continue
>_uP	Increasing Concentration	PB or SEL to end
>dn_	Decreasing Concentration	PB or SEL to end
>2.00	Stable Concentration (signal voltage)	Monitors for 10 consecutive stable samples. Minimum 25seconds. PB or SEL to end
>GAS >OFF	Gas Off Instruction	SEL to Accept PB or idle (Maximum 60) seconds to discard (bad)
>Acc or bad	Confirmation	1second
<SEL >-SC	SPAN Calibration Title	Exit to Span Gas Menu
<PB >A05	SPAN Calibration Choice	Scroll to next Choice
<SEL >A06	SERVICE Setup Choice	Select SERVICE Option
< PB >-SE	SERVICE Title	Scroll to Choices
<SEL >SE1	Service Mode1 Choice	Select Service Mode2 Setup
>co or no2 >000	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	Running Display. Unit can be bump tested without gas concentration reflected to monitor.
<PB or <SEL> or 10minutes	Exit Service Mode1	Exit Service Mode
<PB >SE1	Service Mode1 Choice	Scroll to next Choice
<SEL >SE2	Service Mode2 Choice	Select Service Mode2 Setup
<SEL >100	Default or Last Forced Gas Concentration	Select to edit 1st position address
<SEL > 0		Select 2nd position
<SEL > 0		Select 3rd position

<SEL >1		Select finish display
>co or no2 >100	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	Running Display. Unit will force gas concentration to monitor without gassing.
<PB or <SEL> or 10minutes	Exit Service Mode2	Exit Service Mode
<PB >SE2	Service Mode2 Choice	Scroll to next Choice
<SEL >-CF	Configuration Title	Exit to Configuration Menu
>co or no2 >PUP >0.00	Scrolling Gas Concentration Display	Running Display

10 APPENDIX: MODBUS REGISTER MAP

A developer of a monitor can use the below MODBUS register map to query gas type and gas concentration from an AMC-400 series digital transmitter. A minimalistic monitor need only poll a couple of MODBUS registers to achieve the gas concentration.

- Setup polling MODBUS address with MODBUS protocol at 9600Baud, Even Parity on EIA/TIA-485 link. Please see section 3.3 FRONT LID OVERVIEW for MODBUS address. The MODBUS address can be configured from the transmitter with the user interface. Please see section 5.2 INITIAL CONFIGURATION for details.

- Only Read Holding Register(s) MODBUS function(s) can be used to read these register(s). Up to a maximum number of 12 registers can be read at a time.

- Poll Transmitter Status (Register 2)
  - A hex value not equal to 00xx indicate not available or not ready.
  - A value of 0x008F indicates transmitter is okay at 9600baud with no analog output available.

- Read Gas Number/Device Address (Register 3)
  - A hex Gas Number of 00xx or 01xx or 02xx or 03xx or 09xx represents CO, NO_2, CH4, Pro(C3H8) or H2 respectively.

- Read Sensor Unit 32 bit Registers r28-r29 currently in PPM or LEL.
  - Swap 16bit values to create 32bit IEEE754 float value in PPM or LEL.

Notes:

*1 Read. These registers can be read or written, write operation is not currently supported and will produce unpredictable results.

*2 Not Supported. The transmitter will provide default or unspecified value.

*3 Float. These registers are a IEEE754 decimal 32 format floating point representation when low and high 16bit registers are swapped (I.e. IEEE 754 Sensor Unit float = r29[31:16] and r28[15:0]). Holding Registers (MODBUS function=03) is supported.

The registers below are based at address 0 and the maximum consecutive registers

<table>
<tr><th>Data Register</th><th>MODBUS Register Index</th><th>Monitor Access</th></tr>
<tr><td>Serial Number; a 16bit number between 1-65535 exclusive to a specific AMC-400 model.</td><td>0</td><td>*1 Read</td></tr>
<tr><td>Hardware Rev / Software Rev; a 16bit number made up of four bit fields:
5 bit hardware version [15:11] (1-32 versions)
3 bit hardware revision [10:8] (A-H revisions)
5 bit software version [7:3] (1-32 versions)
3 bit software revision [2:0] (A-H revisions).
These fields are displayed on the LCD during power up.</td><td>1</td><td>*1 Read</td></tr>
<tr><td>Transmitter Status / Mode; a 16bit number made up of two 8 bit fields representing transmitter status and modes.
Instrument Status Bits[15:8]:
<table>
<tr><td>Transmitter Okay</td><td>=0x00</td></tr>
<tr><td>Transmitter Error</td><td>=0xFF</td></tr>
</table>
Instrument Mode Bits[7:0]: (Default 0x8F)
<table>
<tr><td>Reserved for Self Test=1
(always being self-tested)</td><td>Bit7</td></tr>
<tr><td>Reserved for Remote Calibration Type=0
(Remote Calibration not supported)</td><td>Bit6</td></tr>
<tr><td>Reserved for Output Enable=0
(Output not available)</td><td>Bit5</td></tr>
<tr><td>Reserved for Output Type=0
(Output not applicable)</td><td>Bit4</td></tr>
<tr><td>Reserved for Baud Rate=1
(Fixed at 9600)</td><td>Bit3</td></tr>
<tr><td>Reserved bit=1</td><td>Bit2</td></tr>
<tr><td>Reserved bit=1</td><td>Bit1</td></tr>
<tr><td>Reserved bit=1</td><td>Bit0</td></tr>
</table></td><td>2</td><td>*1 Read</td></tr>
</table>

<table>
<tr><td>Gas Number / Device Address; a 16bit number made up of two 8 bit fields of Smart Sensor 2 gas number and Transmitter MODBUS address. Gas number is updated from Smart Sensor 2 upon registration.
Gas Number [15:8]:<table><tr><td>CO</td><td>=0</td></tr><tr><td>NO2</td><td>=1</td></tr><tr><td>CH4</td><td>=2</td></tr><tr><td>Pro(C3H8)</td><td>=3</td></tr><tr><td>H2</td><td>=9</td></tr></table>MODBUS Address [7:0]: 1-247</td><td>3</td><td>*1 Read</td></tr>
<tr><td>Slope; a reserved 32bit float number representing the slope of the Smart Sensor 2 gas updated from Smart Sensor 2 at registration. Slope is reserved for a monitor based calibration procedure. *2 Not Supported.</td><td>4-5</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Offset; a reserved 32bit float number representing the offset of the Smart Sensor 2 gas updated from Smart Sensor 2 at registration. Offset is reserved for a monitor based calibration procedure. *2 Not Supported.</td><td>6-7</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Calibration Data1; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.</td><td>8-9</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Calibration Data2; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.</td><td>10-11</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Calibration Data3; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.</td><td>12-13</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Calibration Data4; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.</td><td>14-15</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Output Trim Slope; a reserved 32bit float number for calibrating output slope. *2 Not Supported.</td><td>16-17</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Output Trim Offset; a reserved 32bit float number for calibrating output offset. *2 Not Supported.</td><td>18-19</td><td>*1 Read
*3 Float</td></tr>
</table>

High Alarm; a reserved 32bit float number for Transmitter high alarm set point. *2 Not Supported.	20-21	*1 Read *3 Float
Low Alarm; a reserved 32bit float number Transmitter low alarm set point. *2 Not Supported.	22-23	*1 Read *3 Float
Output Span; a reserved 32bit float number for Transmitter output span. *2 Not Supported.	24-25	*1 Read *3 Float
Output Value; a reserved 32bit float number for Transmitter output value. *2 Not Supported.	26-27	*1 Read *3 Float
Sensor Unit; a 32bit float number for Smart Sensor 2 Gas Concentration. Currently in PPM or LEL.	28-29	*1 Read *3 Float
Sensor Output; a 32bit float number for zero based Smart Sensor 2 sensor signal voltage. *Not Supported.	30-31	*1 Read *3 Float