DTM Series

Digital Transmitter Module

Installation and Operating Instructions for the AMC DTM Sensor Transmitter

IMPORTANT:

Please read these instructions completely and carefully before installing and operating of this equipment.

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The Armstrong Monitoring Corporation
215 Colonnade Road South, Nepean, Ontario, Canada K2E 7K3
Tel: (613) 225-9531 • Fax: (613) 225-6965 • U.S. Toll Free: (800) 465-5777
E-mail: gas@armstrongmonitoring.com • Internet: www.armstrongmonitoring.com

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1 Warranty

AMC products are warranted against defects in material and workmanship for a period of two (2) years from date of delivery. During the warranty period, we will repair or replace components that prove to be defective in the opinion of *The Armstrong Monitoring Corporation*. We are not liable for auxiliary interfaced equipment, nor 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.

1.1 Liability

All *AMC* products must be installed and maintained according to instructions. 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 labour 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, EXPRESS OR IMPLIED, AND SPECIFICALLY THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF.

1.2 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.

1.3 Product Return

All products returned for warranty service will be by prepaid freight and they will only be accepted with an R.M.A. number issued by *AMC*. All products returned to the client will be freight collect.

WARNING
USING ELECTRICALLY OPERATED EQUIPMENT NEAR GASOLINE, OR GASOLINE VAPOURS MAY RESULT IN FIRE OR EXPLOSION, CAUSING PERSONAL INJURY AND PROPERTY DAMAGE. CHECK TO ENSURE THE WORKING AREA IS FREE FROM SUCH HAZARDS DURING INSTALLATION OR WHEN PERFORMING MAINTENANCE, AND USE PROPER PRECAUTIONS.

2 Product Information

2.1 Transmitter

Sensor/ Transmitter Unit Order Number	
Transmitter Part Number	
Transmitter Serial Number	
Sensor Part Number	
Sensor Serial Number	
Power Supply Requirements	12 to 24 Vdc @ 70 mA

2.2 Factory Settings

Gas Type	
Range	
Zero Gas, at 4 mA signal	
Gas Concentration at 20 mA signal	

3 Production Description

3.1 General Description

The AMC-DTM series sensor/transmitter micro-controller based unit is designed to provide continuous, reliable surveillance of surrounding air for traces of a specific hazardous gas. There is a broad range of electrochemical gas sensors available for use with the DTM Transmitter. Parameters for each type of sensor are stored in memory allowing the operator to easily change gas types when installing different sensors. The DTM provides a non-intrusive operator interface allowing calibration and configuration. This allows the operator to calibrate and change settings while maintaining the explosion proof integrity of the transmitter. These changes are made using a touchscreen keypad that is accessible through the glass window of the enclosure using your finger. The DTM provides several different outputs for interconnectivity. There is a 4 to 20 mA, variable current signal that is proportional to the gas concentration detected, Modbus RTU/ASCCI 2 wire interface on the standard unit and an optional relay card with contacts for three alarm thresholds and fail. Each sensor/transmitter unit is factory calibrated and is ready for field installation and operation.

4 Installation

4.1 Location and Mounting

The sensor/transmitter should be mounted in a location sufficient enough for the sensor to receive its environment, and secure from potential mechanical damage. It should remain clean and free from debris. The internal area of the transmitter enclosure must be kept clean and dry. Mount the sensor/transmitter in a location such that it will not experience submersion in liquids, exposure to extreme temperatures, and electrical noise signals.

The sensor housing SHOULD NOT touch the mounting surface. In some cases, it may require the use of a spacer between the mounting surface and the transmitter housing as per Figure 4-1.

Note: Mounting arrangement of transmitter housing depends on location of transmitter, and mounting surface. Mounting hardware NOT supplied.

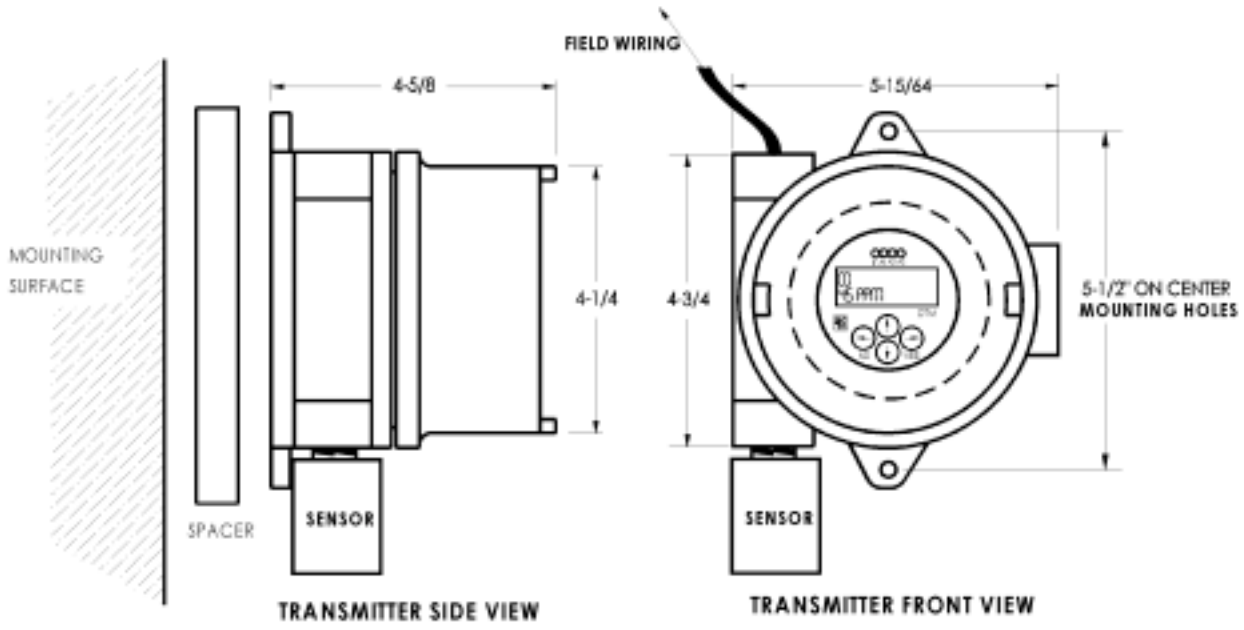

Figure 4-1: Mounting of transmitter housing

4.2 Cable Selection

Connection should be made using 3-conductor shielded cable. For best signal transmission and maximum noise rejection, run cable through steel conduit (cable shield must be grounded at the monitor or power supply). For basic cable selection (between monitor and transmitter) when using a 250 ohm load resistance, use the following chart:

Cable Selection Chart				
Wire Gauge	Cable Length			
AWG	Feet		Metres	
	@ 12 Vdc	@ 24 Vdc	@ 12 Vdc	@ 24 Vdc
22	1000	15000	305	4732
20	1500	23000	457	7010
18	2500	38000	762	11582
16	3800	57000	1158	17373

For applications not covered by the above chart, an example is shown below for selecting the right cable, using the graph in Figure 4-2 and the following formulas. Please note that some non-AMC equipment may have the load resistance built-in.

EXAMPLE: (Refer to Figure 4-2)

Known data: Obtained from measurements, ratings or specifications.

Power supply	17 VDC
Load resistance	180 Ohms
Wire gauge	20 AWG
Cable length / 1 Ohm resistance	43.6ft (13.3m) typical

Calculations on the graph: Using the power supply voltage as reference.

Maximum resistance	MR
Load resistance	LR

Formula 1: To determine remaining safe loop resistance.

Maximum resistance	518 Ohms
Load resistance	–180 Ohms
Remaining resistance	= 338 Ohms

Formula 2: To determine maximum safe cable length allowed.

Remaining resistance	338 Ohms
Cable length (for 1 Ohm)	x 43.6 Feet
Maximum safe cable length	= 14736 Feet

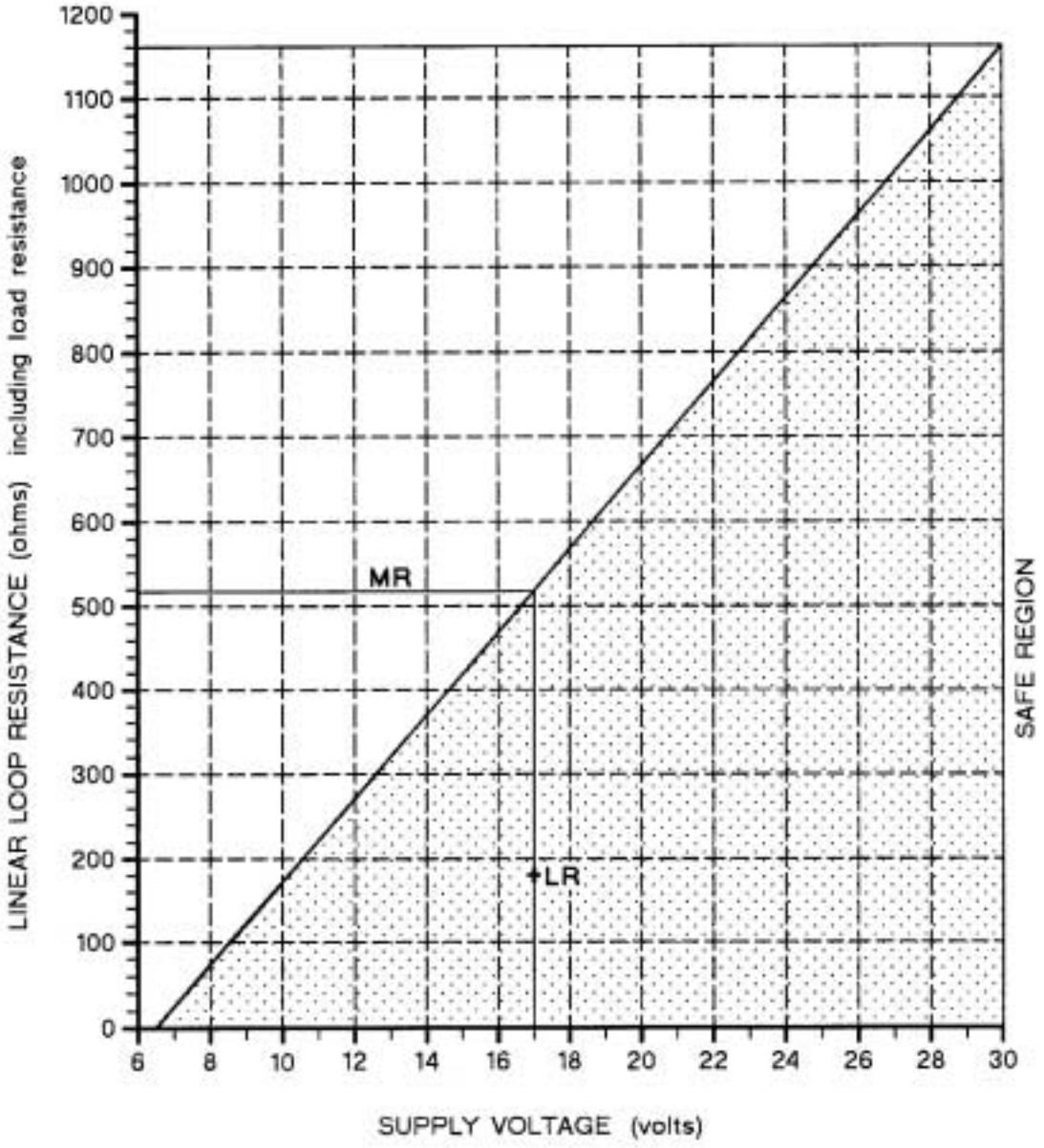

Figure 4-2: Cable Selection Graph

4.3 Electrical Interfaces

4.3.1 Input Power Supply

The AMC-DTM series sensor/transmitter requires an input power supply as follows.

Parameter	Value		Units
	Min	Max	
Input Voltage (VIN)	12	24	VDC
Power Consumption	5.0	2.5	W

Table 4-1: Input Power Supply

4.3.2 Analogue Output (4-20 mA)

For installation to a DC Power Supply only, the AMC-DTM series sensor/transmitter is field wired as illustrated in Figure 4-3. The terminal block pinout for TB-3 is given in Table 4-2 and output specifications are provided in Table 4-3.

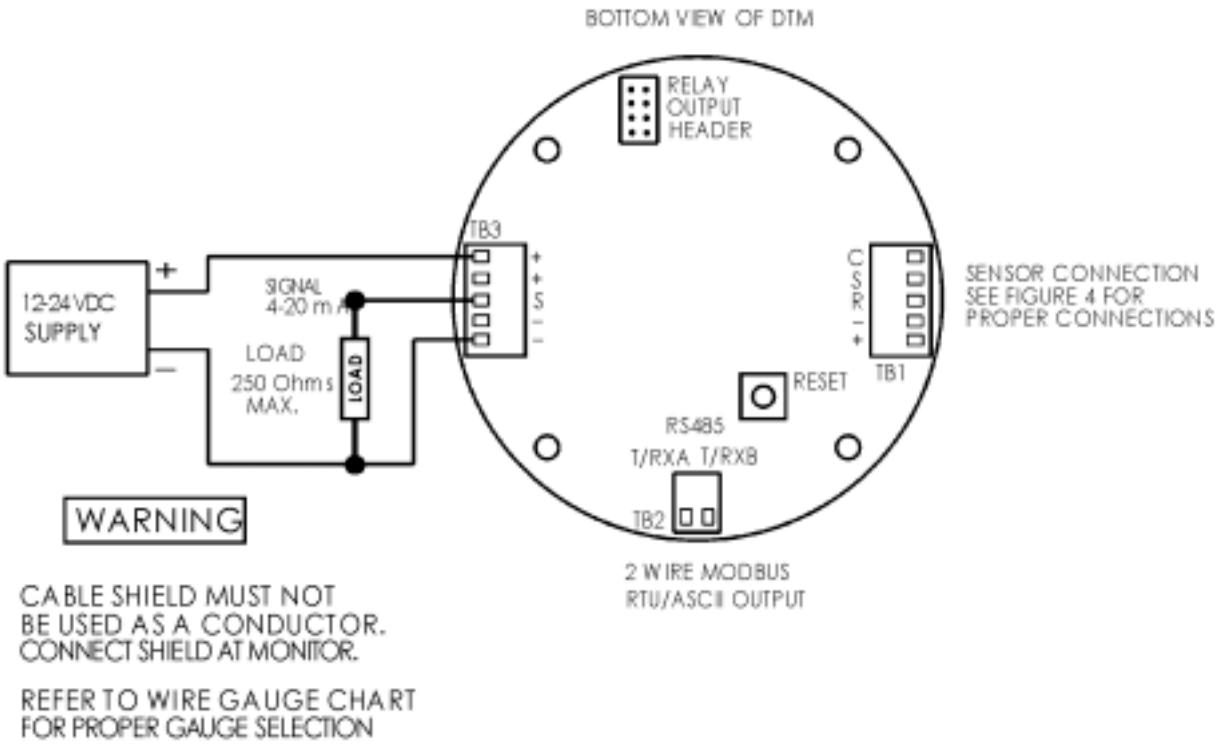

Figure 4-3: Typical Field Wiring of AMC-DTM to DC Power Supply

For installation to an AMC Monitor, the AMC-DTM series sensor/transmitter is field wired as illustrated in Figure 4-4. The terminal block pinout for TB-3 is given in Table 4-2 and output specifications are provided in Table 4-3.

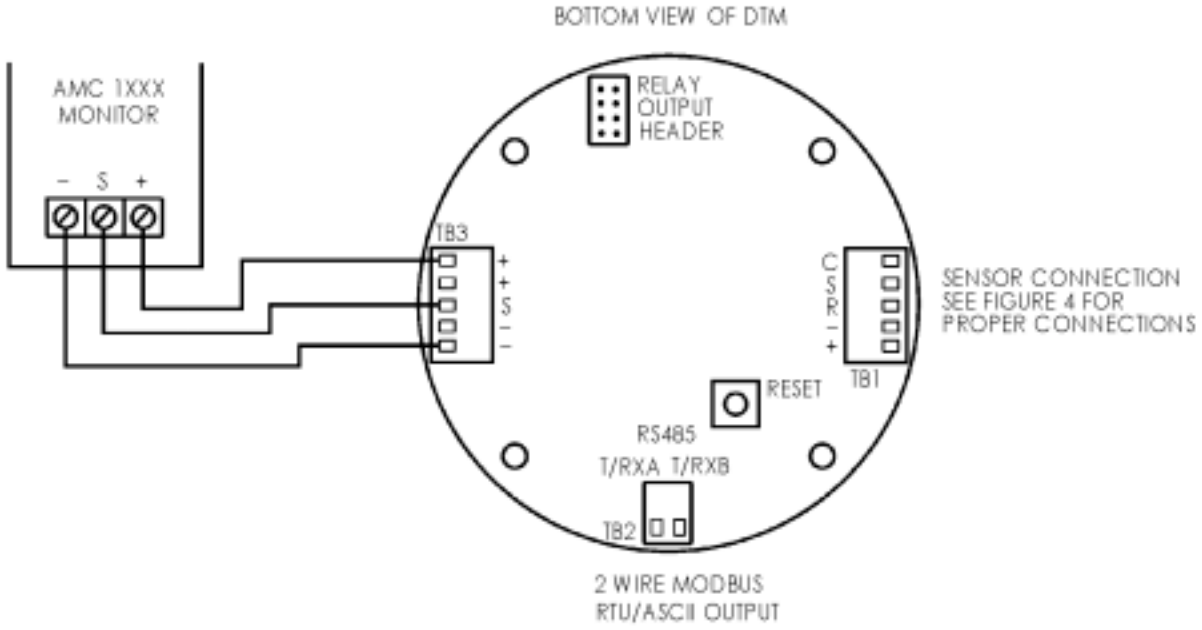

Figure 4-4: Typical Field Wiring of AMC-DTM to AMC Monitor

Terminal	Type	Description
1	PWR	Input Voltage (+)
2	PWR	Input Voltage (+)
3	ANALOG OUT	4-20mA Output Signal (S)
4	PWR	Power Supply Common (-)
5	PWR	Power Supply Common (-)

Table 4-2: TB3 Interface Pinout

Parameter	Value			Units
	Min	Typ	Max	
Load Resistance	n/a	250	275	ohms
Loop Current	0.25		21	mA
Conductor Size	See Note		16	AWG

Table 4-3: 4-20mA Output Specifications

4.3.3 MODBUS RS485 Interface

For installation in a MODBUS configuration, the AMC-DTM series sensor/transmitters are field wired as illustrated in Figure 4-5. The terminal block pinout for TB-2 is given in Table 4-4 and RS485 specifications are provided in Table 4-5 and Table 4-6.

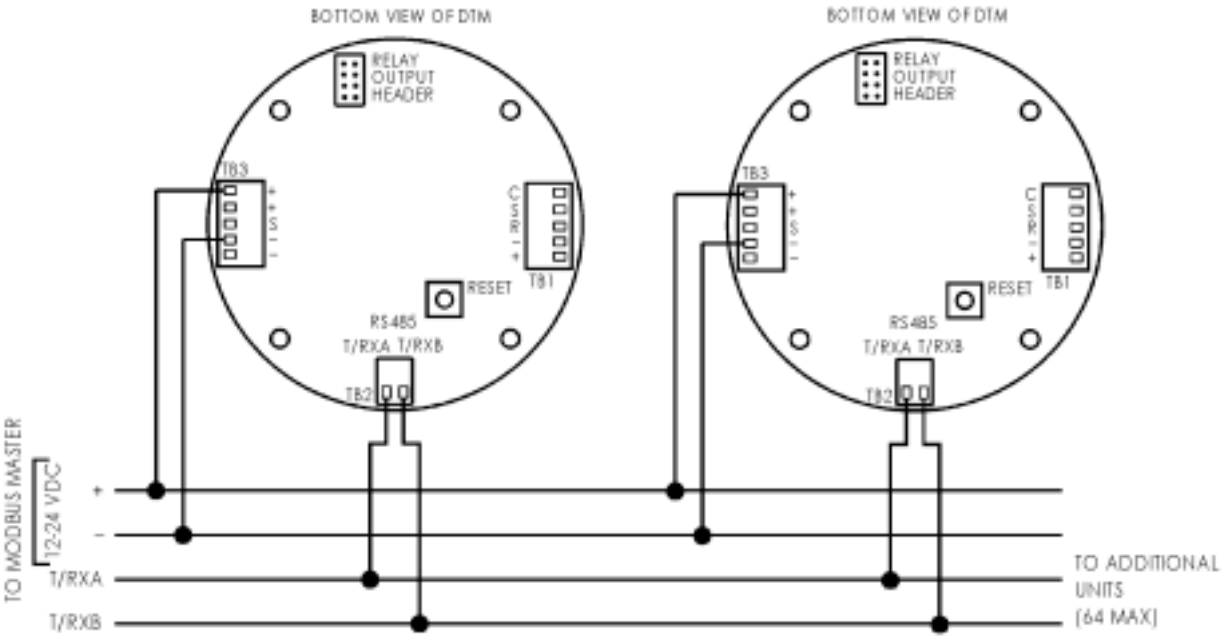

Figure 4-5: Typical Field Wiring of Multidrop MODBUS Installation

Terminal	Type	Description
1	IN/OUT	RS485 Transmit/Receive Data A (T/RXA)
2	IN/OUT	RS485 Transmit/Receive Data B (T/RXB)

Table 4-4: TB2 Interface Pinout

Parameter	Value			Units
	Min	Typ	Max	
data rate	1200	19200	57600	bps
Parity	NONE/EVEN/ODD			
Data Bits (LSB sent first)	8			Bits
Stop Bits	1			Bits
Start Bits	1			Bits
Voltage	5		24	VDC
Conductor Size	26		16	AWG

Table 4-5: RS485 Interface Specification (RTU Modbus Mode)

Parameter	Value			Units
	Min	Typ	Max	
data rate	1200	19200	57600	bps
Parity	NONE/EVEN/ODD			
Data Bits (LSB sent first)	7			Bits
Stop Bits	1			Bits
Start Bits	1			Bits
Voltage	5		24	VDC
Conductor Size	26		16	AWG

Table 4-6: RS485 Interface Specification (ASCII Modbus Mode)

5 Operation

The transmitter has a non-intrusive operation interface. The front face contains a capacitive contact that operates like normal push buttons. To operate a push button, simply place your index finger on the glass over the desired arrow.

5.1 Operator Interface

Operator Interface, illustrated in Figure 5-1, consists of a four-button keypad, four LEDs and a LCD. The DTM provides a non-intrusive operator interface allowing calibration and configuration. This allows the operator to calibrate and change settings while maintaining the explosion proof integrity of the transmitter. LED's A1, A2 and A3 denote active alarms when illuminated in the color red. LED F denotes unit failure when illuminated in the color amber.

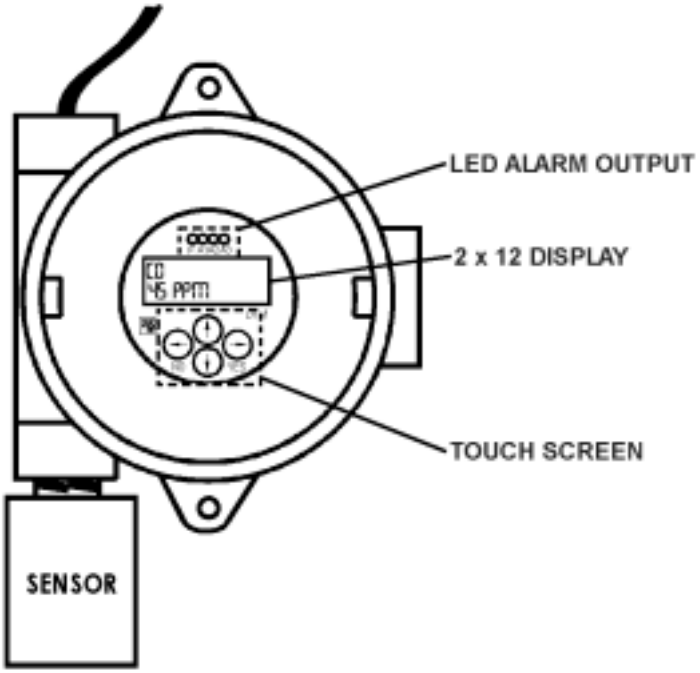

Figure 5-1: Transmitter Operator Interface

5.1.1 Touch Screen Keypad Operation

The touch screen keypad consists of four targets, as illustrated in Figure 5-2, that are activated by either touching the sensor pad itself, or touching the viewing window of the transmitter housing.

- Button "Back" cancels current operation and goes back in the menu hierarchy. It also serves as "no" choice, when offered. When entering text or numbers, it returns entry point back one character.
- Buttons "Up" and "Down" scroll submenu items. They can also scroll numeric or alphanumeric characters, depending on the context.

- Button “Forward” enters currently scrolled submenu. It also serves as “yes” choice, when offered. When entering text or numbers, it moves entry point forward one character.

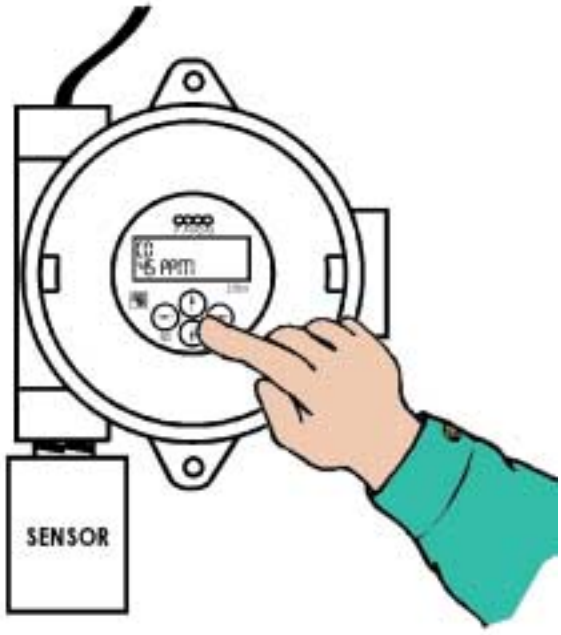

Figure 5-2: Keypad part of the Operator Interface

5.1.2 Liquid Crystal Display

Liquid Crystal Display (LCD) displays 12 characters in each of the two lines (2x12). The color of the characters is yellow on dark blue background.

During normal operation, the transmitter shows the gas label in the first LCD line and the current gas concentration in the second line expressed in the chosen Engineering Units. See Figure 5-3. Engineering Units, section 5.5.5, describes different formats of the gas concentration value applicable to Figure 5-3.

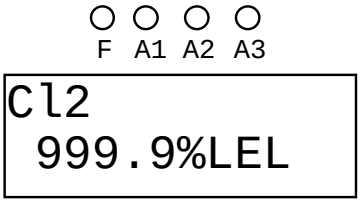

Figure 5-3: Gas Concentration Display

When an Alarm is declared, LCD displays Concentration Display and Alarm Display in 2 two-second flash periods. See Figure 5-3 and Figure 5-4.

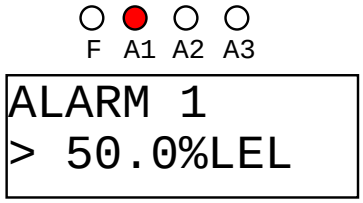

Figure 5-4: Alarm Display

The first line shows the name of the active alarm. The second line shows the condition triggering the alarm. “>” character is used for increasing alarms and the “<” for decreasing. The concentration value (50.0%LEL in the example) is the value of the alarm threshold. Alarm LED rapidly flashes when the corresponding alarm is active.

It is possible to change default alarm names (ALARM 1, ALARM 2 and ALARM 3) to an operator defined value. See Figure 5-5.

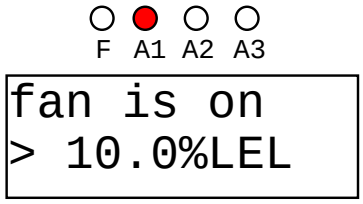

Figure 5-5: Alarm display – renamed alarm

Active alarms are displayed in flash cycles together with the Default Display. Up to four displays can be shown this way (three gas alarms and the default display). Gas alarms are mutually exclusive. They can be active in any order or combination.

During the Minimum Run Time period, hourglass symbol is displayed in the second line. See Figure 5-6. Alarm LED flashes slowly when the alarm is in this mode.

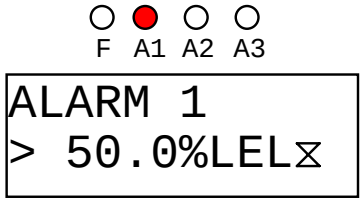

Figure 5-6: Alarm display during Minimum Run Time

When alarm is silenced, the character “s” is also displayed together with the hourglass symbol during the silence period. See Figure 5-7. Alarm LED flashes slowly when the alarm is in this mode.

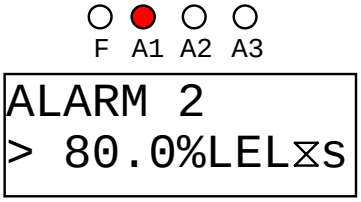

Figure 5-7: LCD - Alarm display during Silence period

When the transmitter detects a failure, Fail Alarm condition is displayed. See Figure 5-8.

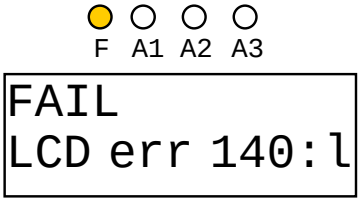

Figure 5-8: FAIL Alarm display

5.2 Device Programming Menu

The following is a graphical representation of the programming menu of the transmitter provided for assisting the operator in configuring the transmitter parameter.

```
Silence_____
      all_________
      alarm 1_____
      alarm 2_____
      alarm 3_____
log in_____
      0_________
      calibrate___
            Zero________
                  stable?
            Span________
                  0000.0ppm___
                  -----------
                  stable?
```

- options
  - alarm 1
    - threshold
      - 0000.0ppm
    - type
      - disabled
      - increasing
      - decreasing
    - On Delay
      - 00min
    - Silence
      - 00min
    - Run Time
      - set value
        - 00min
      - infinite
    - name
      - ALARM 1
  - alarm 2
  - alarm 3
  - Range
    - 0000.0ppm
  - Hysteresis
    - 0.0%Range
  - Zero Buffer
    - 0.0%Range
  - gas label
    - name
  - relays
    - alarm 1
      - norm.eng

- norm.de-eng
- alarm 2
- alarm 3
- Fail
- test
- are you sure?
- advanced
- password
  - enter old:
  - 0
  - ----------
  - enter new:
  - 0
  - ----------
  - new again:
  - 0
- Modbus
  - address
    - 001
  - type
    - ASCII
    - RTU
  - data rate
    - 1200bps
    - 2400bps
    - 4800bps
    - 9600bps
    - 19200bps
    - 38400bps
    - 57600bps
- sensor

#electrodes_
0_____
polarity____
+(positive)_
-(negative)_
ref bias____
+(positive)_
000mV_____
-(negative)_
000mV_____
fail detect_
manuf. data_
s/w version_
Eng. Units__
ppm_____
ppb_____
%LEL_____
%VOL_____
pre-configs_
---- unconfi
86AA NH3____
86AD NH3bla_
91AE CO_____
91AF CO_____
..._____
factry test_
alignment___
unit reset__
A/D readout_
uA/mV/wiper_
4-20mA_____

5.3 Features

The AMC Digital Transmitter Module (DTM) has the following features.

5.3.1 Keypad Inactivity

While operating in Menu mode, the transmitter will automatically switch back to Display mode if keypad inactivity has been detected for a period of 10 minutes.

5.3.2 Scroll Speedup

Pressing the Up or Down key for half a second starts scrolling at faster speed, 10 characters per second, until either the key is released or 1 minute has elapsed since the key was pressed.

5.3.3 Key Press Indication

When a key is pressed, a block character is flashed briefly in the upper right corner of the LCD. The only exception is when Back key is pressed when the unit is not in the menu mode displaying gas concentration or alarms.

5.3.4 Displaying Currently Configured Values

Menu mode provides information about the current configuration values. Section 5.2, Device Programming Menu, of this manual illustrates the Menu Structure. The menu operates as follows:

- When setting numerical or text values the current value is displayed (e.g. Range, alarm name…).
- When choosing a value from a list, the currently chosen value is displayed with a "->" in front of it when the list is first displayed (e.g. alarm type, currently chosen configuration…).
- The operator can view the value and back out by pressing the Back button.

5.3.5 Fail Alarm Condition

During a fail alarm condition, Relay 4 is switched (usually to the de-energized state) and the transmitter output current is set to the minimum value. For minimum value, see Table 4-3, 4-20mA Output Specifications.

The fail alarm condition is not effected by the Minimum Run Time or the Activation Delay features.

Also during a fail alarm condition, other alarms can **not** be active at the same time. *Note: the transmitter does not store a log of fail alarms.*

5.3.6 Power Up Sequence

During power up and initialization, the transmitter displays the message “warm-up”, suppresses gas alarms and leaves fail alarm conditions unaffected. The transmitter output current is also set to the minimum value. For minimum value, see Table 4-3, 4-20mA Output Specifications.

If the transmitter has an error recorded in its Flash Memory device, the error condition information is restored from Flash Memory. The following will occur, depending upon the nature of the error condition:

- a fail alarm condition and the error code will be displayed for 10 seconds prior to continuing with the normal power up and initialization, or
- a fail alarm condition and the error code will be displayed; and, the transmitter will wait for the operator to press “yes” key to proceed.

A fail alarm condition is de-asserted if no fail condition was detected. Gas Alarms remain suppressed for further 30 seconds to enable the sensor to stabilize. At the outset of this period, unit resumes normal operation and raises or clears any alarms as needed.

5.3.7 Manufacturing Data

The manufacturing data that the transmitter stores is the software version information. This information is programmed into the non-volatile memory together with the software load itself.

5.3.8 Modbus

The transmitter is a Modbus slave device that supports the following Modbus configuration options:

- Modbus device address (1-247).
- type (RTU or ASCII)
- RS485 bps rate

The supported Modbus functions and the accessible data are listed in Appendix A, Modbus Accessible Data.

5.3.9 Test

A Test Mode is provided. When entered, all four relay outputs are activated until any key is pressed. During testing the 4-20mA current loop is driven to 20mA, all four alarm Light Emitting Diodes (LEDs) are illuminated and all four alarm relays are asserted. *Note: the keypad timeout is suppressed during testing.*

5.4 Gas Alarm Options

Each of the three alarms has its individual set of Alarm Options.

5.4.1 Threshold

This option is the gas concentration at which the alarm is activated subject to Activation Delay.

5.4.2 Type

Alarm can be of three types: Increasing, Decreasing and Disabled.

5.4.3 Name

Operator can specify the name of the alarm displayed on the Liquid Crystal Display (LCD). The name may have up to 12 characters and can include any of the characters displayable by the LCD.

5.4.4 Activation Delay (On Delay)

When gas concentration crosses given alarm threshold, alarm is not activated until the concentration remains above the threshold for Activation Delay period of time. The Activation Delay Timer is adjustable from 0 to 99 minutes in increments of 1 minute.

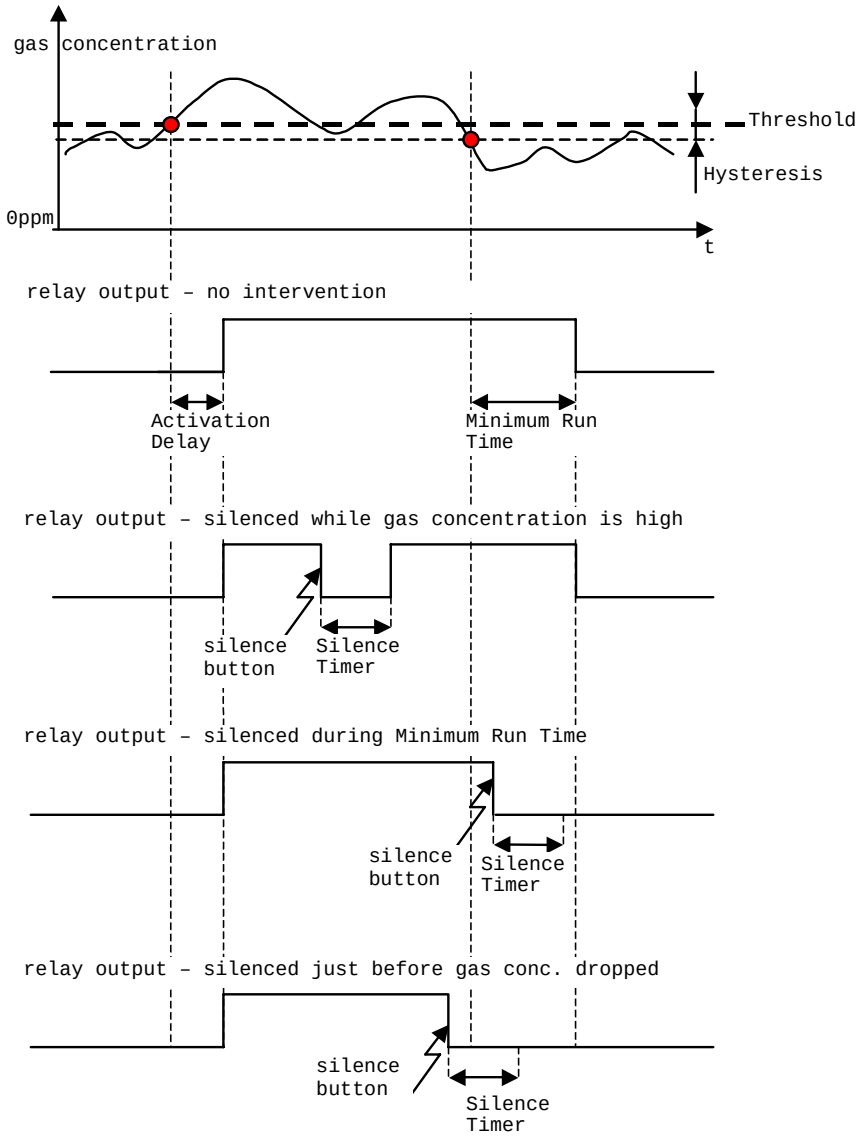

Figure 5-9: Alarm activation, silencing and deactivation

5.4.5 Silence Timer

This feature is used to silence an alarm and to temporarily deactivate its relay output. Alarm LED and LCD displays are still shown.

The Silence Timer is adjustable from 0 to 99 minutes in steps of 1 minute. A timer value of 0 disables this feature, except when Minimum Run Time is infinite. An alarm can not be silenced in advance – an attempt to silence an alarm just before it becomes active is ignored. Silencing alarm again while the alarm is already silenced resets the Silence Timer to the default value of 0 minutes, effectively disabling the timer.

5.4.6 Minimum Run Time (Run Time)

After gas concentration decreases or increases to below or above the Threshold (subject to hysteresis), alarm is kept turned on for an additional period of time, the Minimum Run Time. Minimum Run Timer can be adjusted from 0 to 99 minutes in steps of 1 minute or set to infinite. When set to infinite value, alarm can be cleared only by Silencing it (thereby requiring human intervention). *Note: when the Minimum Run Timer is set to infinite, it is possible to silence the alarm even if Silence Timer is set to 0.*

5.5 Transmitter Options

These options apply to the whole unit as well as all three gas alarms.

5.5.1 Gas label

Gas labels may have a maximum of 12 characters. The label is displayed on the first line of the Gas Concentration Display. The operator can change the default label.

Note: It is considered good practice to include the gas type in the label name for example, "Cl2-west wall".

After the software has been loaded for the first time, the gas label reads "align me" indicating that electrical alignment of the unit should be performed.

After the alignment has been completed, the label "align me" is changed to "configure me".
If the unit is configured to one of the stored configurations ("log in", "options", "advanced", "pre-configs") the label is replaced with the gas label and the name of the sensor chosen.

5.5.2 Hysteresis

The Hysteresis option is used to prevent multiple alarms that are produced by the oscillation of the sensor signal around the threshold value. The Hysteresis value is the same for all three gas alarms.

Increasing alarm triggers when gas concentration stays greater than the threshold value for period of time equal to Activation Delay. Increasing alarm is deactivated when concentration falls below the threshold minus the hysteresis value for period of time equal to Minimum Run Time.

Decreasing alarm triggers when gas concentration stays lower than the threshold value for period of time equal to Activation Delay. It is deactivated when concentration stays above the threshold plus the hysteresis value for period of time equal to Minimum Run Time.

The default Hysteresis parameter is 2% of Range.

5.5.3 Zero Buffer

Gas concentrations smaller than this value are interpreted as 0 to reduce false readings due to noise and zero-level sensor drift. Note that the result of this is a "jump" in the concentration. For example, if Zero Buffer is 2ppm, LCD display will "jump" from 0ppm to 2.1ppm when concentration increases from 2ppm to 2.1ppm.

It is possible to measure and display negative values for an un-calibrated unit.

The default Zero Buffer parameter is 2% of Range.

5.5.4 Range

Range is the gas concentration used as a reference point to set the saturation point for the 4-20mA output current loop. When measured gas is of equal or higher concentration than Range output current is driven to 20mA. It is usually set close to the highest gas concentration the sensor can measure (saturation point).

The transmitter is capable of showing concentration values greater than the Range up to maximum of 21mA (5% overshoot), assuming that the sensor can measure these concentrations.

5.5.5 Engineering Units

***Advisory**: Changing Engineering Units is an intrusive action. Usually, the unit configuration (sensor parameters) would have to be adjusted. Also, the unit would have to be re-calibrated when engineering units are changed.*

The transmitter supports the following Engineering Units:

- ppm,
- ppb,
- %LEL, and
- %VOL.

Gas concentration values have different format for different Engineering Units:
(Note that the following does not apply to values displayed in the operator menu).
" d" denotes decimal digit:

ppm:

dddd.dppm if Range <= 30ppm.
dddddppm if Range > 30ppm.
Max value 4999.ppb:
ddddppb
Value always rounded to 10ppb.
Max value 4999.

%LEL:
ddd%LEL
Max value 499.

%VOL:
ddd.d%VOL if Range <= 30%VOL.
ddd%VOL if Range > 30%VOL.
Max value 100.0

If measured concentration is greater than the Maximum value displayable it is capped to the Maximum value. Leading zeros are not shown.

5.5.6 Pre-config (Predefined Configuration)

***Advisory**: Changing pre-config configuration is a destructive action. It restores factory configuration values and overwrites all corresponding previously used configuration values.*

The transmitter comes pre-programmed with factory values for a number of different configurations.

5.5.7 Sensor Configuration

Sensor configuration stipulates following parameters:

5.5.7.1 Number of Electrodes

The number of sensor electrodes value must be set for 2 or 3.

Note that the transmitter supports only 2 and 3 terminal electrochemical sensors that have both positive and negative going current signals. Two additional electrode connections are supported for future development purposes.

5.5.7.2 Polarity

The sensor can act as either current source or current sink.

5.5.7.3 Ref Bias

The reference electrode bias voltage is from –499 mV to +499 mV.

5.5.7.4 No Sensor Fail Detection

The transmitter can detect sensor presence. If 1 minute average positive current supplied by the sensor is greater than 3nA or if 1 minute average negative current is smaller than –3nA, the transmitter assumes that the sensor is present. If this is the case, the transmitter declares “no sensor” failed state.

This feature can be enabled or disabled using the menu.

5.5.8 Password

The transmitter contains two passwords: an operator configurable and a factory password. They are of fixed length of 5 characters. The initial operator password is “12345”. This password can be changed. Factory password cannot be changed. Contact AMC for the factory password.

5.5.9 Relays Option

The Relays functionality of the transmitter is fixed as follows:

- Relay 1 – alarm 1
- Relay 2 – alarm 2
- Relay 3 – alarm 3
- Relay 4 – fail alarm

All four relays can be configured as normally energized or normally de-energized. It is recommended that the Fail Alarm is normally energized and that the Gas Alarms are normally de-energized to ensure the proper operation during power failure (Fail asserted, Gas Alarms de-asserted).

6 Calibration Procedure

6.1 General

Before the unit can be calibrated, the correct sensor must be set in the sensor pre-config menu. These are found in the menu “log in”, “options”, “advanced”, “pre-config”. Gas sensor is calibrated using two gas concentrations: Zero concentration and an adjustable concentration value (Span). Calibration is deemed completed when both Zero and Span points have been calibrated. Figure 6-1 illustrates the basic equipment step-up to calibrate the AMC DTM sensor/transmitter.

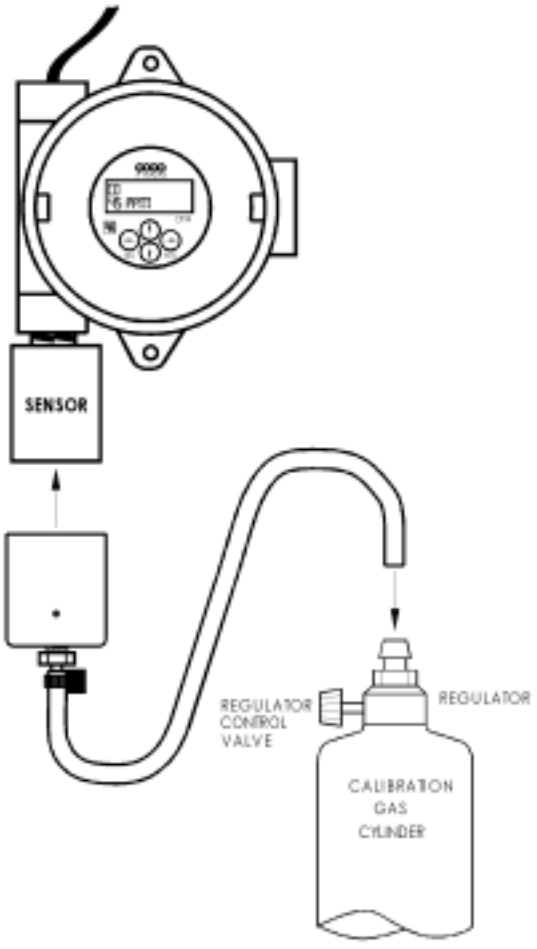

Figure 6-1 Basic equipment step-up for calibration.

6.2 Calibration Procedure

When operator enters “calibrate” menu, “calibrate the unit?” question is presented. If the operator confirms that their intention is to calibrate the unit, the unit drives 4-20mA output to 2mA and de-asserts all gas alarms. This state is retained for 2 minutes after the calibration is over to allow gas sensor to recover from the high gas concentration applied during calibration. Calibration is deemed over after the operator leaves the “calibrate” menu, either by successfully completing calibration or by canceling calibration.

6.2.1 Zero Adjustment

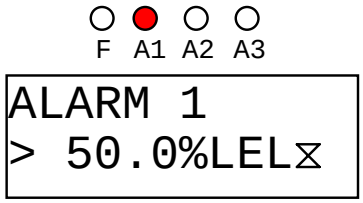

Figure 6-2: Alarm 1 Menu

Operator chooses “calibrate”, “Zero” in the menu. Operator then applies Zero gas concentration to the sensor. Sensor displays the current concentration of the gas in the upper line and a moving block character in the lower line. Zero Buffer functionality is inhibited during calibration to enable operator to see the exact measured gas concentration. The block character moves from left to right if the concentration is rising and from right to left if it is falling. The unit measures average concentration over an averaging period of about 10 seconds. When the average concentration difference between the two successive 10 second periods is less than 1% of the average concentration, the block character slows down. The unit then tries to detect that the concentration has stabilized. It does so by waiting for two rising slopes and two falling slopes of the average 10 second concentration. Since this is a random process, it usually takes longer than 40 seconds. When this is detected, the block character is replaced with a question “ok. proceed?”.

Operator does not have to wait for the “ok. proceed?” question to calibrate. Operator can at any moment during the calibration press “yes” button to accept the currently measured concentration as the calibrating point.

If this process takes longer than 5 minutes, the unit displays the question “unstable. cancel?”. If “yes” is pressed, the calibration is cancelled. If “no” is pressed, the calibration continues unaffected.

6.2.2 Span Adjustment

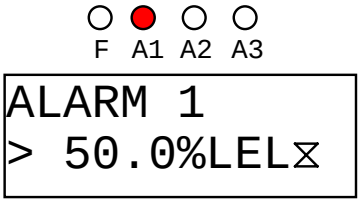

Figure 6-2: Alarm 1 Menu

Operator then chooses “Span” in the “calibrate” menu. Operator is then required to enter the concentration of the gas used for calibration. Operator then applies the gas used for calibration. After this is done, operator continues in the same fashion as with Zero concentration. After the button “yes” is pressed again, calibration is completed.

Note: The current gas concentration displayed during the calibration procedure may be different from expected by a small percentage of the Range because the instrument is not yet calibrated. (e.g. when calibration concentration of 100ppm is applied, instrument can display e.g. 102ppm.).

The calibration concentration (Span) is permitted to be greater than the Range concentration as long as the concentration can be properly measured with the given parameters (e.g. Range concentration is 100ppm but the gas used for calibration is 106ppm).

*Note: The transmitter electronics itself is **not** calibrated. It is assumed that the transmitter outputs 20mA at Range and 4mA at Zero without actually measuring these values. It is the responsibility of the monitoring unit to calibrate the current loop.*

To guard against the possibility of an incorrect or incomplete calibration, the newly calibrated points are compared with the previous calibration points. If new Span point is off by more than 20% of the value of the previous point, a warning is displayed requiring the operator to confirm if the values are correct or not. If the new Zero value is different from the old one by more than 3% of Range, similar warning is displayed.

Operator is allowed to calibrate only one point. Unit detects this condition and asks the operator to confirm this intention.

Helpful messages such as: “set Span”, “apply Span”, “apply Zero”, “calibration completed”, “calibration cancelled” are displayed during the calibration to guide the operator.

6.2.3 Using Gas Depletion As A Measure Of Another Gas’s Concentration

In some applications depletion of one gas (usually oxygen) is used to detect the presence of another gas. In these cases, concentration of the target gas is displayed on the LCD although it is oxygen that is being measured. The transmitter is configured to work in such a mode by simply calibrating it. At calibration completion, if the transmitter recognizes that the Span point is lower than the Zero point, a warning message is displayed. The operator is required to confirm the values. If the operator confirms the values, the transmitter applies an inverse function to all the measured values making it appear as though the target gas is being measured.

7 Preventive Maintenance

7.1 Maintenance

The sensor/transmitter unit should be brushed or wiped clean once a year or more, depending on the accumulation, of any dust or dirt that has settle on the transmitter.

7.2 Sensor Replacement and Wiring

Sensor life is typically 2 to 5 years. The sensor should be replaced under the following conditions:

1. When the sensor element fails and becomes an open circuit, the transmitter outputs a fixed 1 mA signal.

2. When the sensor no longer responds to the presence of gas or produces an unstable zero signal.

When the sensor needs replacing, reorder the Sensor Part Number listed in section 2.1, Transmitter. See Figure 7-1 for sensor replacement and wiring procedure.

***Advisory**: Allow 24 hours for the new sensor element to stabilize (burn-in) before recalibration, then follow instructions in the transmitter calibration in section 6 of this manual.*

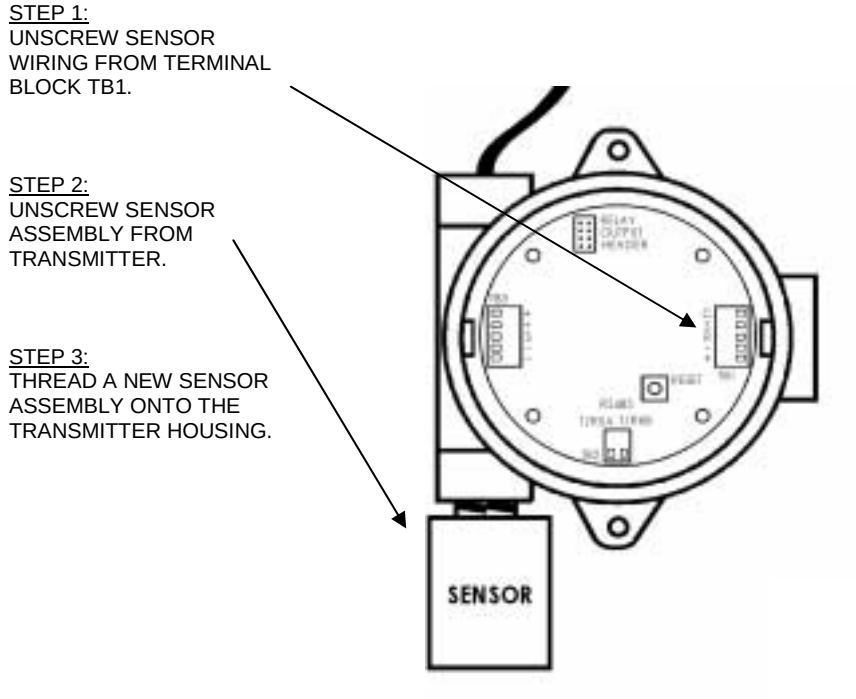

Figure 7-1 Sensor Replacement and Wiring

7.2.1 Sensor Interface

The AMC-DTM series transmitter accepts either a 3-wire or 2-wire electrochemical sensor. Figure 7-2 illustrates connections at terminal block TB-1 for both sensor types. The terminal block pinout for TB-1 is given in Table 7-1.

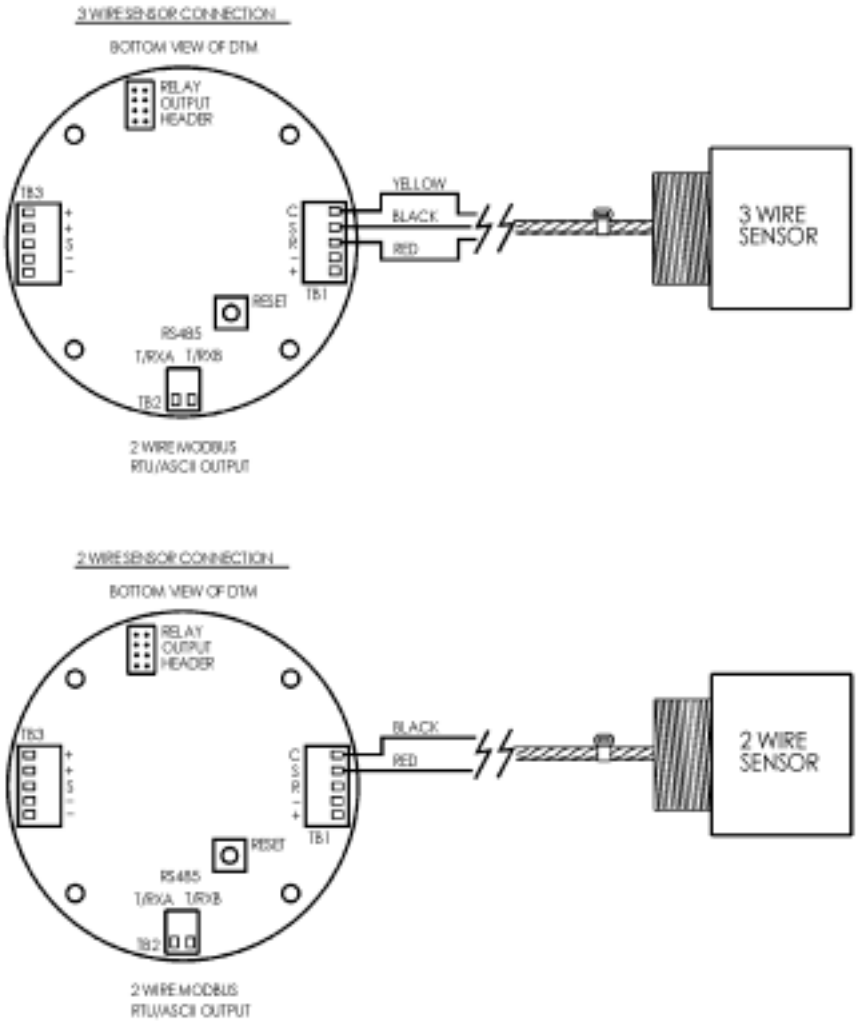

Figure 7-2: Typical Wiring of AMC-DTM to 3-Wire and 2-Wire Sensors

Terminal	Type	Description
1	ANALOG	AUX+ Input (+)
2	ANALOG	AUX- Input (-)
3	ANALOG	Sensor REFERENCE electrode (R)
4	ANALOG	Sensor SENSE electrode (S)
5	ANALOG	Sensor COUNTER electrode (C)

Table 7-1: TB1 Interface Pinout

Appendix A - Modbus Accessible Data

The Modbus functions that are supported are:

1 – Read coil
3 – Read Holding Registers
6 – Write Single Register
16 – Write Multiple Registers

Modbus Accessible features

Data	Modbus Register # or Coil #	Modbus function	Read/Write Access
Alarm 1 status (LSB bit 0,1&2: 0-off, 1-on, 2-Activation Delay timer active, 3-Silence timer active, 4-Run Timer active)	1	3	R
Alarm 2 status (LSB bit 0,1&2: 0-off, 1-on, 2-Activation Delay timer active, 3-Silence timer active, 4-Run Timer active)	2	3	R
Alarm 3 status (LSB bit 0,1&2: 0-off, 1-on, 2-Activation Delay timer active, 3-Silence timer active, 4-Run Timer active)	3	3	R
Fail Alarm status (LSB bit 0-off, 1-on)	4	3	R
Alarm 1 type (LSB bits 0&1: 0-disabled, 1-increasing, 2-decreasing)	5	3/16/6	RW
Alarm 2 type (LSB bits 0&1: 0-disabled, 1-increasing, 2-decreasing)	6	3/16/6	RW
Alarm 3 type (LSB bits 0&1: 0-disabled, 1-increasing, 2-decreasing)	7	3/16/6	RW
Alarm 1 threshold *	8	3/16/6	RW
Alarm 2 threshold *	9	3/16/6	RW
Alarm 3 threshold *	10	3/16/6	RW
Alarm 1 silence timer value (0-99 minutes)	11	3/16/6	RW
Alarm 2 silence timer value (0-99 minutes)	12	3/16/6	RW
Alarm 3 silence timer value (0-99 minutes)	13	3/16/6	RW
Engineering units (ppm:0, ppb:1, %LEL:2, %VOL:3)	14	3	R
Current gas concentration * **	15	3	R
Range *	16	3/16/6	RW
Zero Buffer (in % * 10 (9.9% written as 99)	17	3/16/6	RW
Test (when LSB bit is 1 test is running. When it is 0, test is not running)	18	3/16/6	W
Reserved	19	3	R
Gas label (Each register contains 2 characters. Register 20 contains MSByte, register 15 LSByte)	20-25	3	R
Alarm 1 status Coil (0-alarm is off or alarm is in Activation Delay state. 1-alarm is on, Silence timer is active or Run Timer is active)	Coil 1	1	R

Data	Modbus Register # or Coil #	Modbus function	Read/Write Access
Alarm 2 status Coil (0-alarm is off or alarm is in Activation Delay state. 1-alarm is on, Silence timer is active or Run Timer is active)	Coil 2	1	R
Alarm 3 status Coil (0-alarm is off or alarm is in Activation Delay state. 1-alarm is on, Silence timer is active or Run Timer is active)	Coil 3	1	R
Fail Alarm status Coil (0-off, 1-on)	Coil 4	1	R

* Includes decimal points. E.g. if concentration of 1ppm is recorded as 10, concentration of 1.2 is recorded as 12.

** Although the unit can display current concentrations of –5000.0 to 5000.0 this number is limited to –3276.8 to 3276.7. Concentrations smaller than –3276.8 are set to –3276.8 and concentrations greater than 3276.7 are set to 3276.7.