DTR
Sensor Transmitter

INSTRUCTIONS

Installation and Operation of the
AMC-DTR
Sensor Transmitter

IMPORTANT:

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

Filename: Manual_amc-DTR ver 2.5.doc

The Armstrong Monitoring Corporation
215 Colonnade Road South, Ottawa, 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

TABLE OF CONTENTS

Section Title **Page**

1 GENERAL INFORMATION

1.1 WARRANTY

The AMC-DTR 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. 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).

1.2 LIABILITY

All AMC products must be installed and maintained according to instructions. Only qualified personnel 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, EXPRESSED OR IMPLIED, AND SPECIFICALLY THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF.

WARNING

CHECK TO ASSURE THE WORKING AREA IS FREE FROM HAZARDS DURING INSTALLATION OR WHEN PERFORMING MAINTENANCE, AND USE PROPER PRECAUTIONS.

1.3 PRODUCT RETURN

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

2 PRODUCT INFORMATION

2.1 Transmitter

Sensor/transmitter Unit Order Number …….	
Transmitter Part Number ……..	
Transmitter Serial Number ……	
Power Supply Requirement …….	10 to 30 VDC
Sensor Part Number ……	
Sensor Serial Number ……..	
Optional Sensor Part Number ……...	
Optional Sensor Serial Number ……	

2.2 Factory Settings

		Sensor 1	Sensor 2
Gas Type ……			
Range ……			
Zero Gas, at 4 mA signal ……			
Gas Concentration at 20 mA signal ……...			
Alarm Settings:	A1		
	A2		
	A3		
Target Gas Ratio to Methane LEL …….			
Sensor Warranty ……...			
Operating Temperature……			
Relative Humidity……...			

3 SAFETY INFORMATION

3.1 Safety Information – Read Before Installation & Applying Power

IMPORTANT
Users should have a detailed understanding of AMC-DTR installation and operating instructions. Use the AMC-DTR only as specified in this manual or detection of gases and the resulting protection provided may be impaired. Read the following **WARNINGS** prior to use.
WARNINGS

- Recalibration is necessary when replacing the sensor. Verification of calibration should be done at least once every 6 months for safety reasons, and for highly demanding applications monthly verification is recommended. More frequent inspections are encouraged to spot problems such as dirt, oil, paint, grease or other foreign materials on the sensor head.
- Do not paint the sensor assembly or the Transmitter.
- Do not use the AMC-DTR if its enclosure is damaged or cracked or has missing components.
- Make sure the cover, internal PCB's and field wiring are securely in place before operation.
- Use only a sensor assembly compatible with the AMC-DTR and approved by AMC.
- Periodically test for correct operation of the system's alarm events by exposing the monitor to a targeted gas concentration above the High Alarm setpoint.
- Do not expose the AMC-DTR to electrical shock or continuous severe mechanical shock.
- Protect the AMC-DTR from dripping liquids and high power sprays.
- Use only for applications described within this manual.

CAUTION:

FOR SAFETY REASONS THIS EQUIPMENT MUST BE INSTALLED, OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING OR SERVICING.

ATTENTION: POUR DES RAISONS DE SÉCURITÉ, CET ÉQUIPEMENT DOIT ÊTRE UTILISÉ, ENTRETENU ET RÉPARÉ UNIQUEMENT PAR UN PERSONNEL QUALIFIÉ. ÉTUDIER LE MANUE D'INSTRUCTIONS EN ENTIER AVANT D'UTILISER, D'ENTRETENIR OU DE RÉPARER L'ÉQUIPEMENT

4 INSTALLATION INSTRUCTIONS

4.1 Introduction

Important: This manual describes both the 2-Wire and the 3-Wire 4-20mA versions of the AMC-DTR. 2-Wire versions are only possible if using an electrochemical sensor and the DTR-10-0232 Display PCB IS THE ONLY PCB IN THE ENCLOSURE. If the DTR-10-0233 I/O Power Supply is installed it is a 3-Wire version.

The AMC-DTR is a single or dual channel fixed-point gas monitor designed to provide continuous monitoring of hazardous gases in the workplace. Monitored values are displayed in their engineering units as well as graphically as a bar graphs or 30-minute trends (Figure 1). Input types include Electrochemical toxic / oxygen sensors, catalytic bead combustible sensors, MOS solid-state sensors, as well as various millivolts, volt and 4-20mA inputs. Sensors supplied by the factory include an 8-wire *Smart Sensor* interface capable of configuration data uploads to the AMC-DTR. Traditional 3-wire *Simple* sensors, without the smart interface, are also supported by the AMC-DTR. Its advanced microcontroller electronics and superior graphic LCD operator interface offers enhanced diagnostics and fault analysis not possible in competing products. The AMC-DTR Transmitter provides a standard 4-20 mA output signal for connection to control systems or other alarm instrumentation. Available options include an Alarm Relay / RS-485-Modbus board or an isolated 4-20mA output. Non-volatile memory retains all configuration data during power interruptions. The magnetic, non-intrusive calibration can be easily performed by one person without opening the enclosure. A standard “real time clock & calendar” feature allows data logging of calibrations and alarm events for recall to the LCD readout or over the serial port.

A separate PC compatible USB Interface allows a *Smart* sensor to be loaded with configuration variables via a PC and upload this data to the AMC-DTR. This includes alarm set points, range, target gas, calibration constants and other variables required to match the AMC-DTR to a specific application. For traditional *Simple* sensors, without the smart interface, the USB interface allows direct AMC-DTR configuration from a PC.

Electrochemical toxic and oxygen DTR’s are capable of 2-wire 4-20mA operation (section 4.6.1) when the alarms / modbus option and LCD backlight are not required. Catalytic LEL sensors, or addition of the DTR-10-0234 Alarms / Modbus option, require the DTR-10-0233 I/O Power Supply board providing 3-wire 4-20mA operation (section 4.6.2).

Only periodic calibration checks are needed to assure dependable performance. Operator interface is very intuitive with the LCD displaying data both graphically as bar-graphs / trends and in engineering units (Figure 1). Additional features include:

- No potentiometer or jumper settings required. All setup is with menus accessed via the LCD / magnetic keypad operator interface without opening the enclosure.
- Field adjustable alarm levels may be high, low, fault, fail-safe, latching and acknowledgeable.
- New alarms cause front LED’s to flash and become steady after acknowledge.
- CAL MODE advises when to apply gas during calibrations
- One half hour trend screen shows rate of change of gas exposures
- Sensor life bar-graph updates after each SPAN calibration.
- Modular design affords efficient installation and plug in sensors allow changing target gases after installation

- New smart sensors are recognized by the AMC-DTR and prompts users to either upload new configuration data or continue with data from the previous smart sensor.
- Sensors are industry proven for fast response and long life.

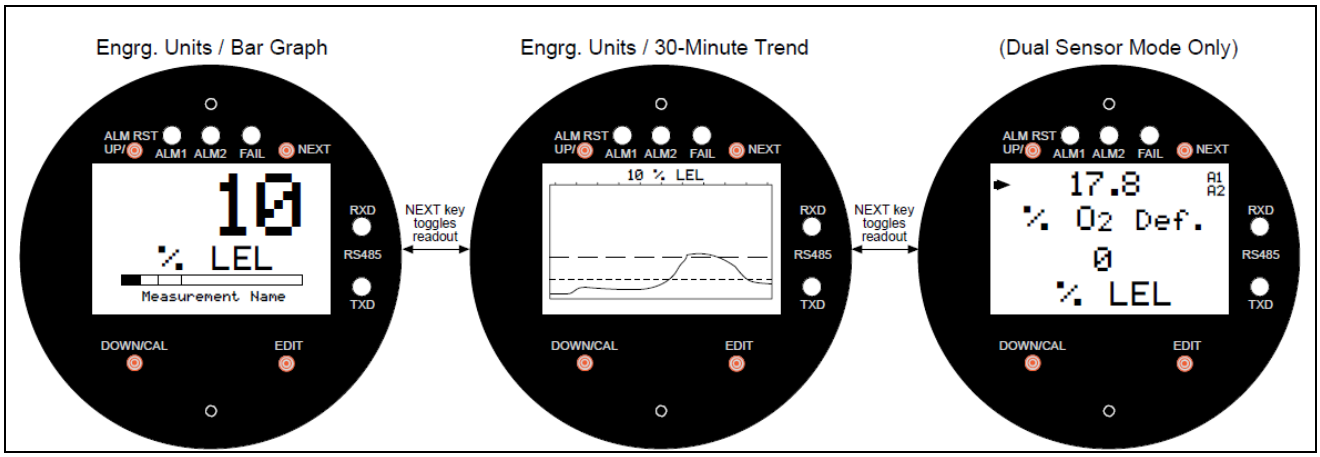

Figure 1: Data Displays

4.2 Ratings and Certifications

C US	CSA certified for Division 1 & 2 hazardous area installations for explosion proof Class 1 Groups B,C,D	Class 1 Groups A,B,C,D. (excluding Relay/Modbus variant)	Intrinsically safe (entity, excluding Relay/Modbus variant)

Designed to meet CSA C22.2 No.152 for Combustibles Monitors and ISA 92.0.01 Part 1 for Toxic Monitors.

4.3 Sensor Location

Factors such as air movement, gas density in relation to air, emission sources and environmental variables affect correct sensor location. Air movement by fans, prevailing winds and convection should be carefully evaluated to determine if a leak is more likely to raise gas levels in certain areas within the facility. Vapor density of a gas determines if it will rise or fall in air when there are no significant currents. Lighter than air gases should have the monitors mounted 12 – 18 inches (30 – 45 centimeters) above the potential gas leak and heavier than air gases should be this distance below. Even though the AMC-DTR is designed for rugged service, sensors should be protected from environmental damage from water, snow, shock, vibration and dirt.

4.4 Mounting the Enclosure

The AMC-DTR standard enclosure is a cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 2. Figure 3 shows dimensions with the dual local sensor 'Y' included.

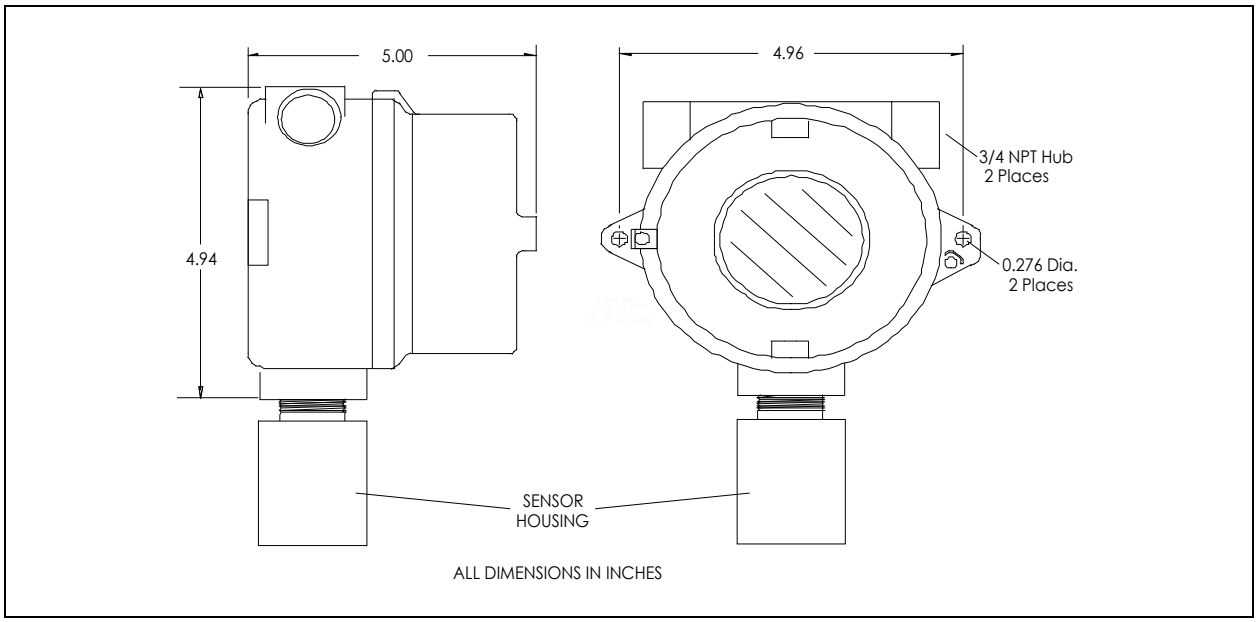

Figure 2: AMC-DTR Explosion-Proof Housing

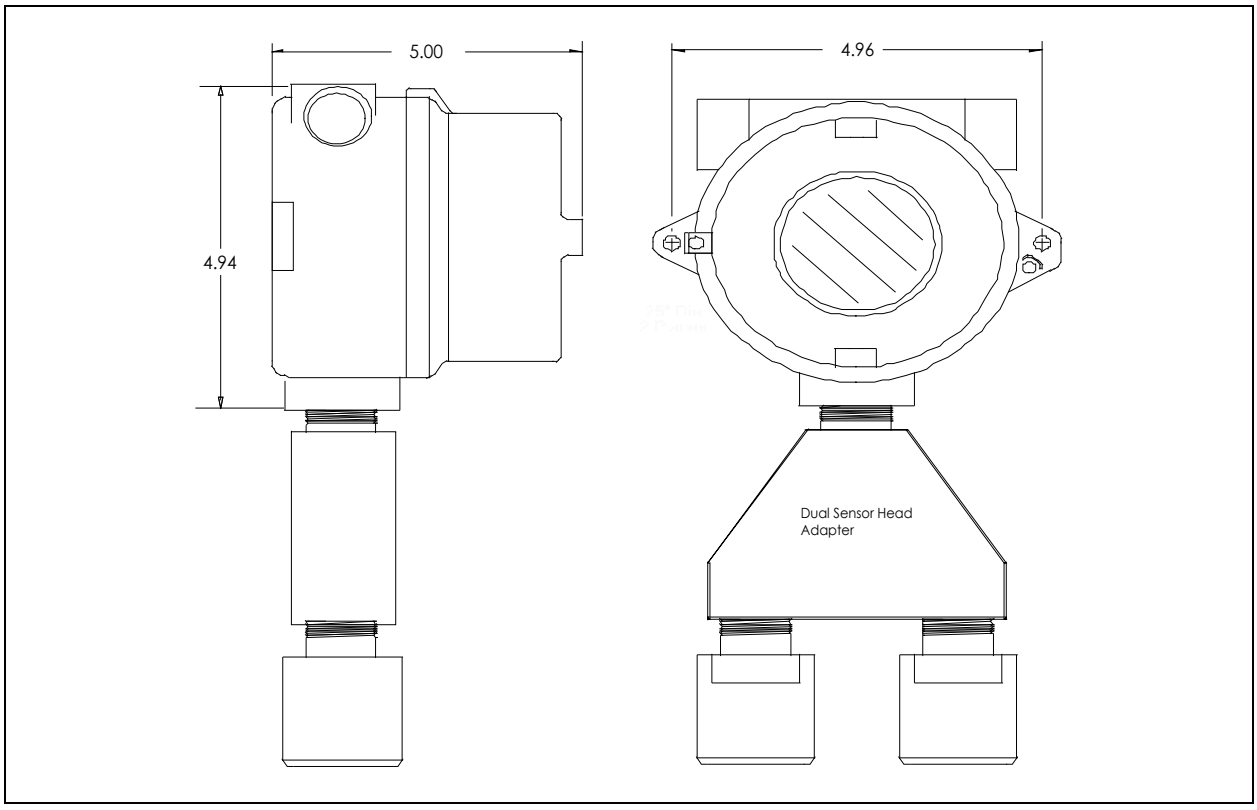

Figure 3: AMC-DTR Explosion-Proof Housing with Dual Sensor Head Adaptor

Modular design simplifies the installation of the AMC-DTR. A top Display Assembly is mounted with captive thumbscrews and is easily removed to access field-wiring terminals. An optional DTR-10-0234 Alarms/Modbus board mounts *piggyback* to the back of the Display Assembly. Wiring from toxic or oxygen sensors terminates at the DTR-10-0232 Display Assembly along with 2-wire 4-20mA signal wires. This Display Assembly is the only PC board supplied with toxic / oxygen AMC-DTRs not requiring relays, RS-485 ModBus or LCD backlight. The optional bottom DTR-10-0233 I/O Power Supply board generates voltages needed for LCD backlight, relays, RS-485 ModBus and catalytic bead LEL sensor and is required with any of these I/O functions. The enclosure is equipped with two threaded 3/4 inch NPT conduit fitting outlet and pre-drilled mounting flanges.

WARNING:

Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Insure correct cabling and sealing fitting practices are implemented. Install the AMC-DTR to a wall or bracket using the predrilled mounting flanges with I.D. 0.276 on 4.96 inch centers (Figure 2). If conduit is rigid and able to support the weight of the AMC-DTR, the mounting bolts may be omitted.

CAUTION:

The sensor should never be installed pointing upwards.

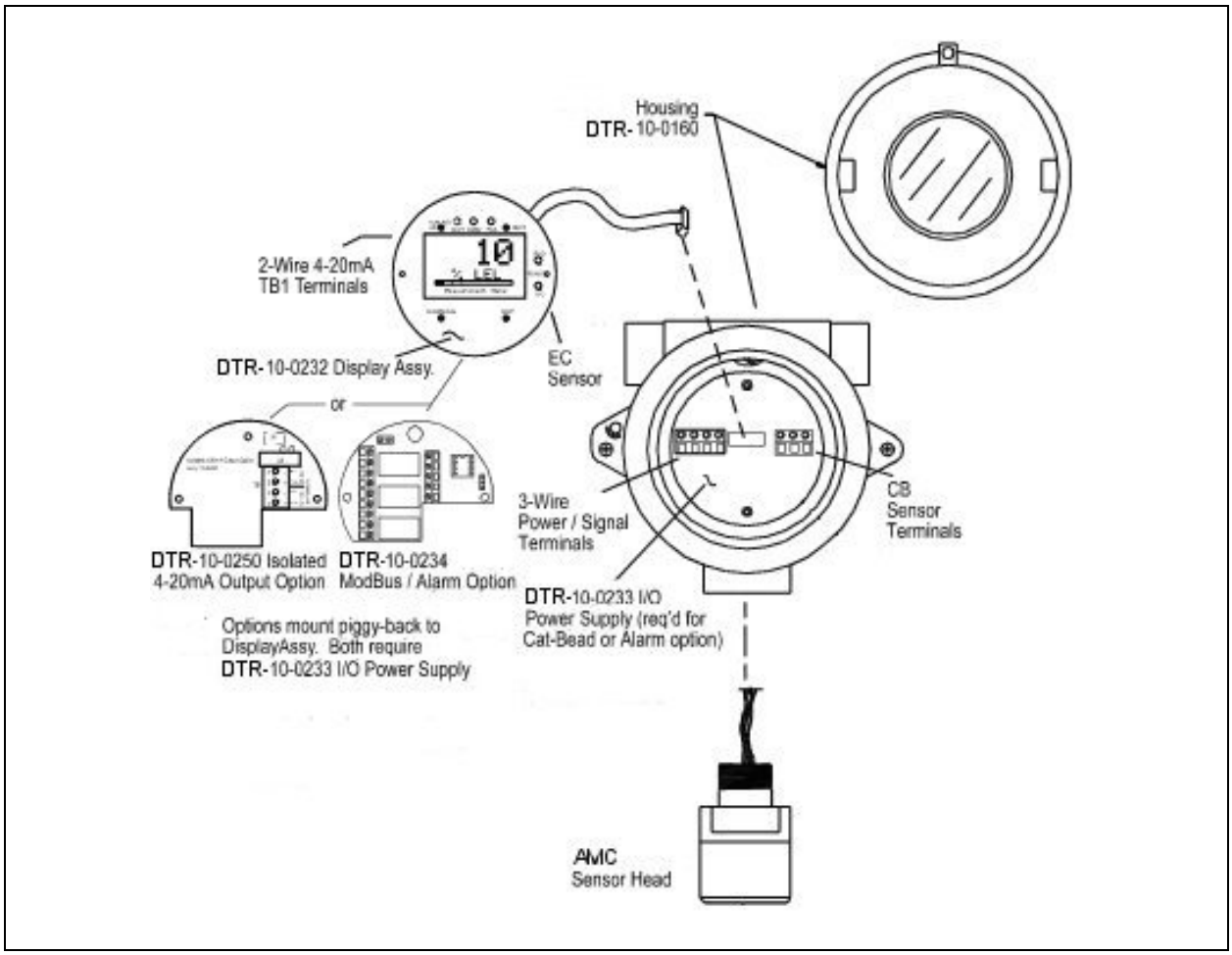

Figure 4: Outline Drawing

4.5 System Design Specifications

Supply Voltage:
10 to 30 volts
Power Consumption:

- **Catalytic Combustible Sensors (requires DTR-10-0233 I/O Power Supply and 3-wire operation): 100 mA @ nominal 24 VDC**
- Toxic/Oxygen Sensors without Relays / Modbus Option (2-wire 4-20mA operation): 25 mA @ nominal 24 VDC.
- Relays / RS-485 Modbus Option Board (requires DTR-10-0233 I/O Power Supply and 3-wire operation): 40 mA per relay (120 mA total with all 3 energized); RS-485 use adds 20mA

Memory:
Non-volatile E2 memory retains configuration values in the event of power outages.

Loop Resistance at nominal 24 VDC power:
650 ohms maximum in 2-wire mode
750 ohms maximum in 3-wire mode.

Relays (Optional):
Three configurable form C (SPDT) relays rated for 5 amp at 30 VDC or 250VAC RESISTIVE.

Relay 1 and Relay 2 level alarms are configurable for HIGH or LOW trip, for normally energized (Failsafe) or normally de-energized and for latching or non-latching.

Relay 3 is always normally energized for failsafe operation so loss of power to the AMC-DTR will be indicated as a “FAULT” condition. Relay 3 is always non-latching.

CAUTION:

Relays are rated for RESISTIVE loads. Inductive loads, such contactor coils or motors may cause contact arcing, which emits RFI into the sensor signals. Use appropriate snubbers and MOV’s across inductive loads and keep wiring away from signal wires.

4.6 Field Wiring Installation

Maximum Field Wiring Lengths

Supply 10-32VDC	Current@24VDC	Maximum wiring run with 250 Ohm Load		Max Curent with DTR-10-0234 Option @24VDC	Maximum wiring run with 250 Ohm Load	
		18AWG	20AWG		18AWG	20AWG
DTR-EC	20mA	36000ft	23000ft	190mA	4850ft	3050ft
DTR-CAT	100mA	9200ft	5797ft	270mA	3400ft	2100ft
DTR-DS	120mA	7680ft	4830ft	290mA	3100ft	2000ft
DTR-ST	400mA	2340ft	1449ft	570mA	1600ft	1000ft
DTR-10-0234 option includes three 5 AMP Alarm Relays and RS-485 Modbus						

For other field wiring setups, contact the factory for further information. Note when using modbus communication feature total wire loops should not exceed 1000ft/300M remote power supplies may be necessary for some configurations to ensure a minimum of 10VDC.

4.6.1 2-Wire 4-20mA Mode Installation

Description:
The 2-wire current sinking transmitter is the easiest and most economical to install since there are only two wires. All of the power needed comes from the current loop and wire sizes may be smaller. However, only very low power applications are eligible for such transmitters. The AMC-DTR Display assembly shown in Figure 5 consumes <2.5 mA of quiescent current. Toxic and oxygen electrochemical sensors generate their own signals and therefore require no additional current. If a 4-20mA output is all that is required for toxic / oxygen measurements (no LCD backlight, alarms or RS-485) the AMC-DTR may be used in the 2-wire mode.

CAUTION:

It is important to understand the receiver, or controller device must supply the loop power in 2-wire 4-20mA modes. Be sure the receiver to be used supports this type of operation.

Instructions:
Unscrew the cover on the AMC-DTR explosion-proof enclosure. Loosen the 2 thumbscrews holding the display assembly in place and remove it. A small sensor cable is attached with sufficient length to allow access to the back of the display assembly where 2 position TB1 is located. Route the receiver wires through the conduit entry and connect to TB1. Steering diodes in the AMC-DTR 2-wire 4-20mA output automatically correct for polarity so positive and negative are interchangeable. Reassemble the AMC-DTR. Follow the procedures and recommendations in the receiver manual to complete the installation. Be sure the AMC-DTR enclosure and conduit are properly grounded. Apply loop power by appropriately powering the receiver device (DCS, PLC, Controller, etc) and the AMC-DTR should function. Proceed to section 5.

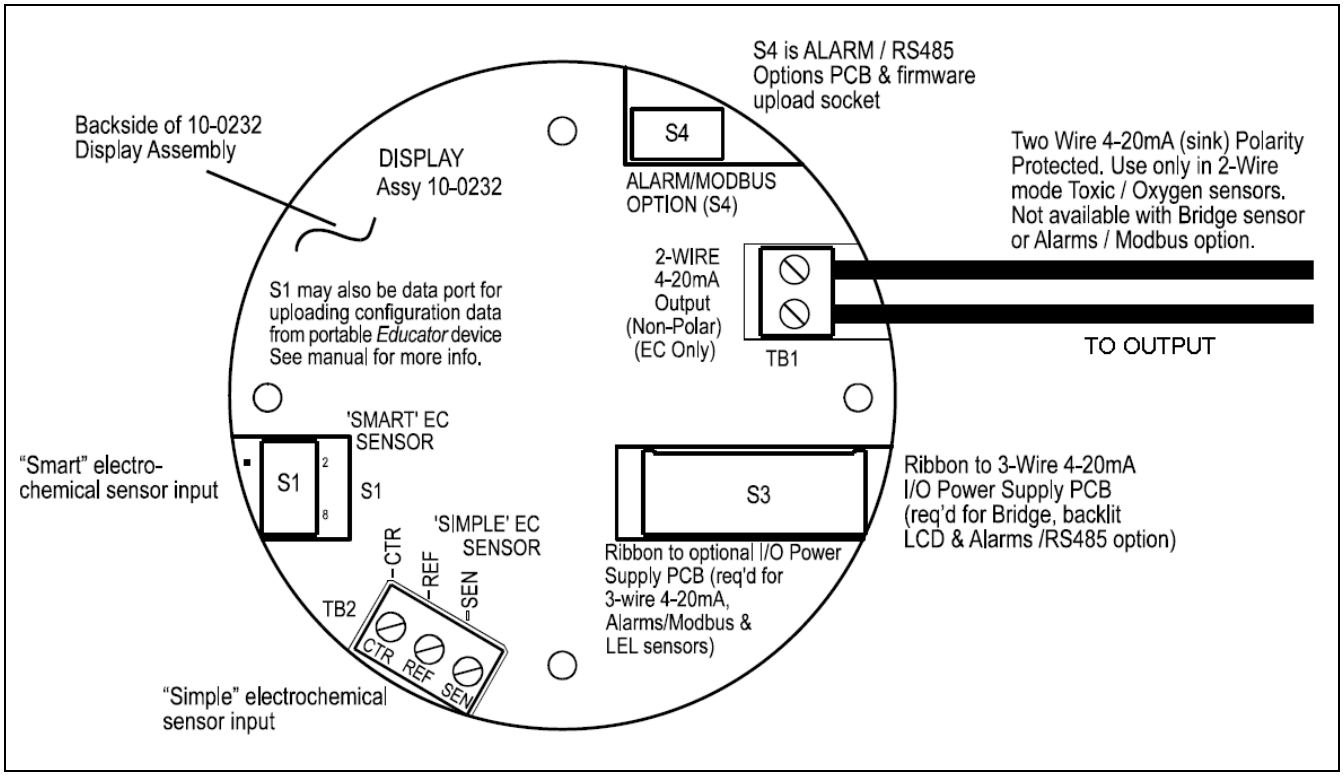

Figure 5: DTR-10-0232 Display / 2-Wire 4-20mA Assembly

4.6.2 3-Wire 4-20mA Mode Installation

Description:
3-wire sourcing transmitters require an additional dedicated 24 VDC wire. The 4-20mA loop current is then delivered, or sourced, from the transmitter output and the receiver device must not provide 24 VDC from its input terminal. When the AMC-DTR is equipped with the bottom DTR-10-0233 I/O Power Supply board shown in Figure 6, the 2-wire 4-20mA output is disabled and one of the DTR-10-0233's 3-wire outputs must be used. TB2 terminal 2 is for ECHEM toxic / oxygen 3-wire 4-20mA output signals and TB2 terminal 3 is for Catalytic bead 3-wire 4-20mA output signals. See Figure 6 below.

Instructions:
Unscrew the cover on the AMC-DTR explosion-proof enclosure. Loosen the 2 thumbscrews holding the display assembly in place and remove it. A small ribbon cable is attached with sufficient length to allow access to the I/O PCB mounted in the bottom of the enclosure (Figure 6). Power and signal connections are to TB2 where 24 VDC, Signal and Common wires must be connected. A blocking diode protects the AMC-DTR if polarity of the power supply is reversed but it will not operate. Reassemble the AMC-DTR. Follow the procedures and recommendations in the receiver and power supply manuals to complete the installation. Be sure the AMC-DTR enclosure and conduit are properly grounded. Apply power and the AMC-DTR should function. Proceed to section 5.

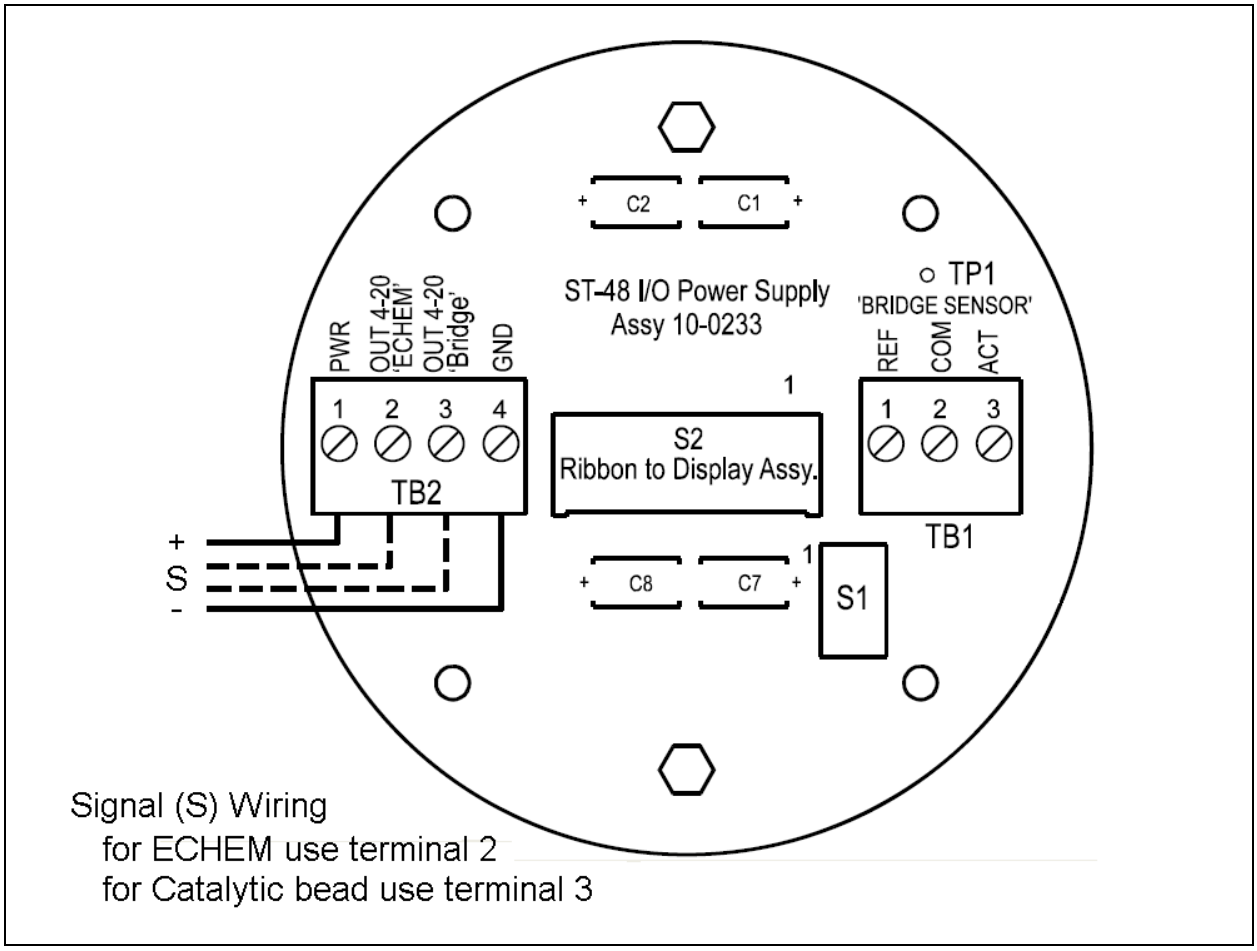

Figure 6: DTR-10-0233 I/O Power Supply / 3-Wire 4-20mA Assembly

4.7 Alarms / RS-485 Modbus DTR-10-0234 Option Installation

Description:
The optional DTR-10-0234 Alarms/RS-485 Modbus board supplies two level alarm relays, a FAULT relay and an RS-485 ModBus RTU slave port (Figure 7). This board is "piggybacked" behind the DTR-10-0232 Display Assembly (Figure 5). Addition of this option requires 3-wire mode 4-20mA operation and thereby requires the DTR-10-0233 I/O Power Supply board (Figure 6). This is since relays and RS-485 circuits require much more power than 2-wire 4-20mA loops can deliver.

CAUTION:

Alarm relays have dry contacts and power must be supplied from an external source. Contacts are rated for RESISTIVE loads! Inductive loads, such as contactor coils or motors, may cause contact arcing, which shortens life and emits RFI into the sensor signals. Use appropriate arcing snubbers and MOV's across inductive loads and keep wiring away from signal wires. External wiring to TB3 (Remote Alarm Reset) should be shielded and protected from noise spikes to prevent false Alarm Reset.

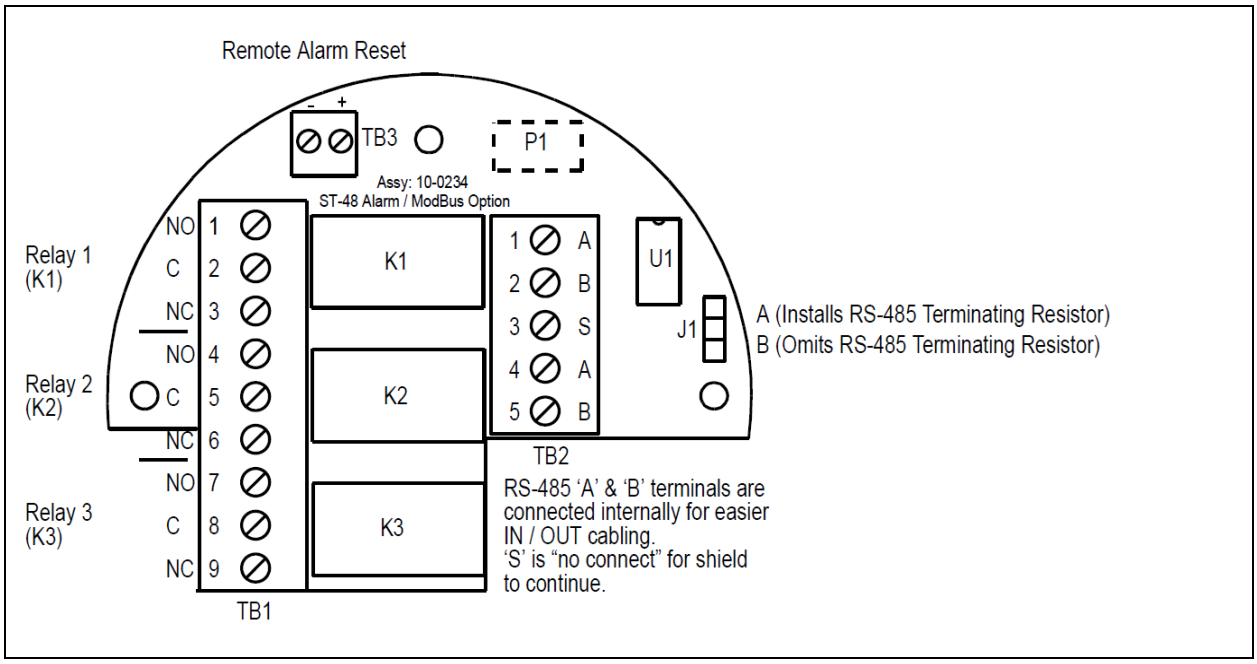

Figure 7: DTR-10-0234 Alarm Relays / Modbus Option

Instructions:
Unscrew the cover on the AMC-DTR explosion-proof enclosure. Loosen the two thumbscrews holding the display assembly in place and remove it. A small ribbon cable is attached with sufficient length to access the back of the Display assembly where the Alarms/RS-485 Modbus board option is located. It is possible to use only the relays, only RS-485, or use both. Relay terminals are labeled NO (normally open), NC (normally closed) and C (common or the pole). These designators correspond to the shelf, or de-energized, state of the relays. The FAULT relay is always failsafe, meaning it is energized when there is not a fault condition and therefore its action is reverse of the designators.

RS-485 Modbus networks should be wired as shown in Figure 8. Each AMC-DTR connected represents an RTU and must have a unique RTU address. RTU addresses are assigned in the Modbus setup menu described in section 7.10. Cabling must be a "daisy chain" as opposed to

a “star” pattern for reliable operation. The “end of line” unit should have J1 installed in the ‘A’ position for terminating resistor installation. All others should have J1 in the ‘B’ position. Front panel Rx / Tx LEDs are helpful troubleshooting tools.

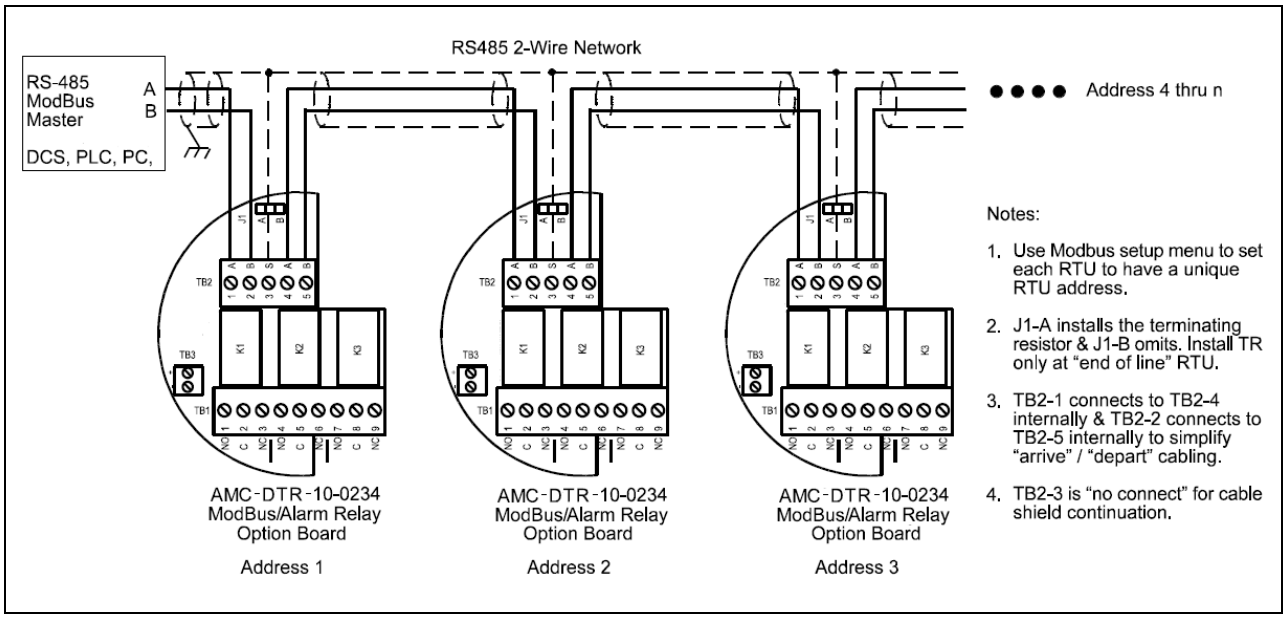

Figure 8: RS-485 Modbus Wiring

4.8 Isolated 4-20mA Output DTR-10-0250 Option

Description:
The optional DTR-10-0250 Isolated 4-20mA option (Figure 9) provides dual 4-20mA outputs that are electrically isolated from sensor inputs and the 24 VDC power source. Each 4-20mA output share the same common terminal and are not isolated from each other. This board is “piggybacked” behind the DTR-10-0232 Display Assembly (Figure 5). Addition of this option requires 4-wire mode 4-20mA operation and thereby requires the DTR-10-0233 I/O Power Supply board (Figure 6).

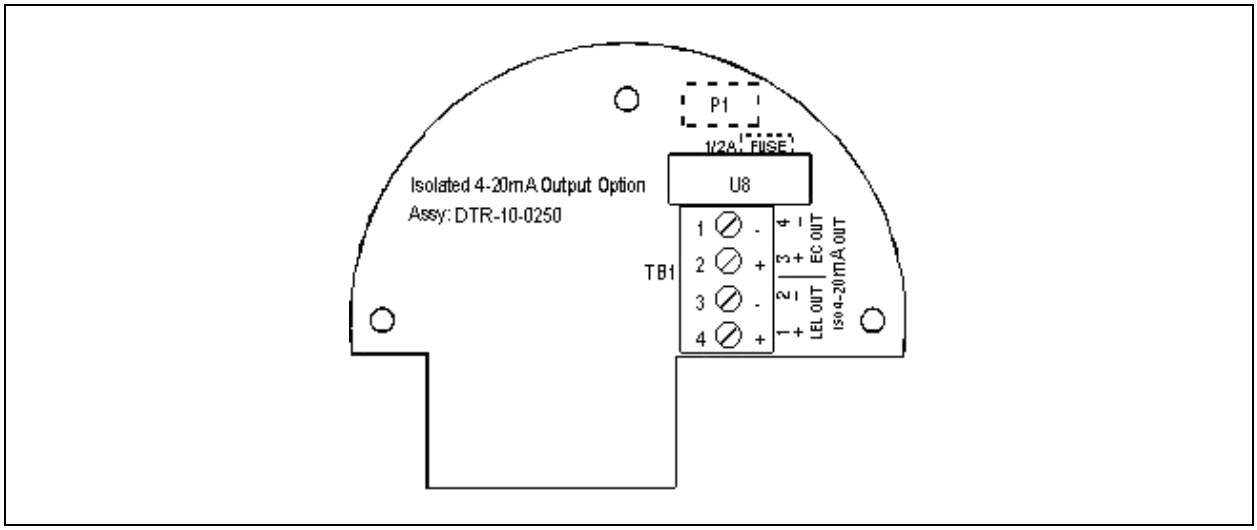

Figure 9: DTR-10-0250 Isolated 4-20mA Output Option

4.9 Sensor Installation (with Smart/Simple Sensor Definition)

3-wire electrochemical and catalytic bead sensors for toxic / oxygen and LEL combustible gas detection are offer as an industry standard. These are referred to as ***Simple*** sensors. The AMC-DTR design accommodates users wishing to continue use of their existing simple sensors by accepting electrochemical types into TB2 of the DTR-10-0232 Display Assembly or catalytic bead types into TB1 of the DTR-10-0233 I/O Power Supply (mounted to the bottom of the enclosure). The AMC-DTR *Smart Sensor* interface also uses proven electrochemical technology for toxic / oxygen and catalytic bead for LEL combustibles BUT has taken this technology a step further. A tiny memory IC is incorporated into AMC-DTR factory supplied Smart sensors allowing them to contain the entire database of AMC-DTR parameters onboard the replaceable Smart Sensor assembly. This unique ***Smart Sensor Interface*** may be used to configure smart sensors and / or AMC-DTR's from a PC rather than entering all variables via the magnetic keypad.

Electrochemical and catalytic bead smart sensors both plug into the ***Smart Sensor Housing*** that connects to AMC-DTR electronics with its 8-conductor Smart Sensor Interface cable.

CAUTION:

Smart sensor housing with electrochemical toxic / oxygen sensors must connect to S1 located on the back of the DTR-10-0232 Display Assembly (See Figure 11). Smart sensor housing with catalytic bead combustible sensors must connect to S1 located on the optional DTR-10-0233 I/O Power Supply PCB assembly (See Figure 12).

The AMC-DTR design accommodates a range of sensor technologies, accepting electrochemical types into TB2 of the DTR-10-0232 Display Assembly, solid state, IR or catalytic bead types into TB1 of the DTR-10-0233 I/O Power Supply (mounted to the bottom of the enclosure). The following sections show each.

When the Smart sensor is used, only the Sensor Module needs to be replaced when the sensor needs replacement. To replace the Sensor Module, turn the power off, unscrew the sensor housing cover from the sensor housing base (See Figure 10) and remove the sensor module. Install the new sensor module and turn the power on. The AMC-DTR will power up and configure with the new sensor module.

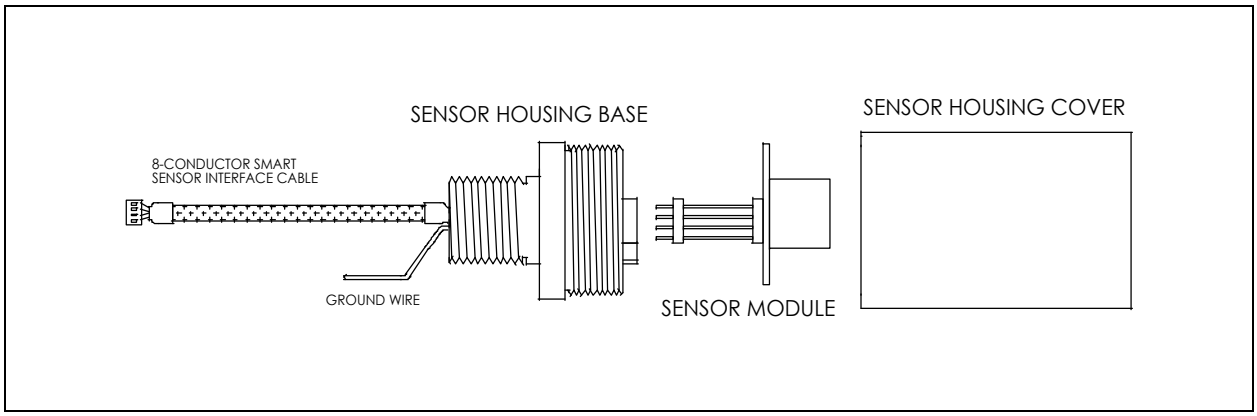

Figure 10: Smart Sensor Housing Assembly

4.9.1 Electrochemical Sensor Wiring to the DTR-10-0232 Display

Connect the simple electrochemical sensor to TB2 on the DTR-10-0232 Display board. Note the colour of the wires for proper installation. Or connect the smart electrochemical sensor to S1 the DTR-10-0232 Display board as shown in Figure 11.

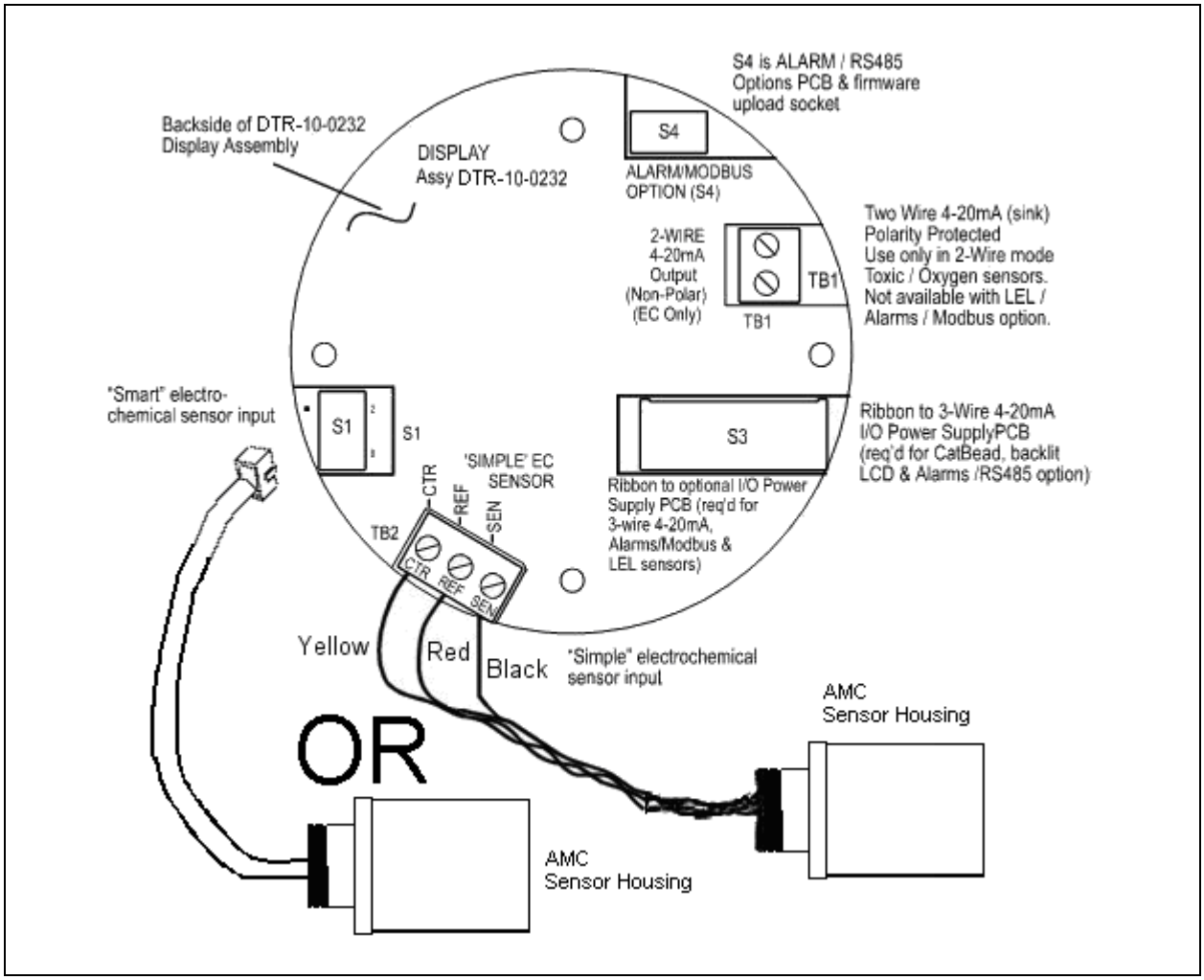

Figure 11: Electrochemical Sensor Wiring to the DTR-10-0232 Display

4.9.2 Catalytic Bead Sensor Wiring to the DTR-10-0233 I/O Power Supply

Connect the simple catalytic bead sensor to TB1 on the DTR-10-0233 I/O Power Supply board. Note the colour of the wires for proper installation. Or connect the smart catalytic bead sensor to S1 the DTR-10-0233 I/O Power Supply board as shown in Figure 12.

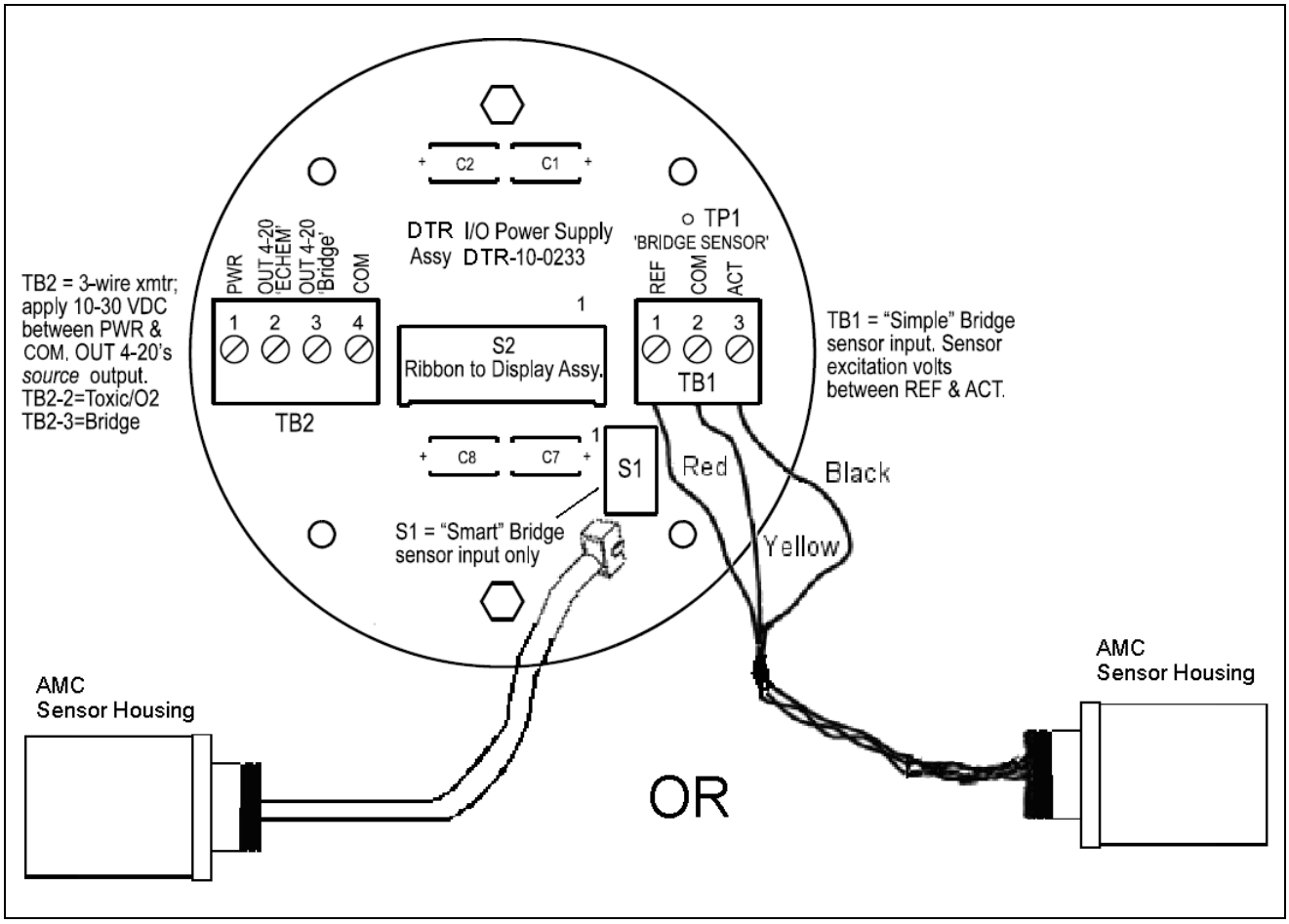

Figure 12: Catalytic Bead Sensor Wiring to the DTR-10-0233 I/O Power Supply

4.9.3 Remote 2 and 3 wire 4-20mA transmitter wiring to the DTR-10-0233 I/O Power Supply Board(3 wire Shown)

For DTR-10-0233 power supply boards that have been modified to accept a 4-20mA input, use the following wiring diagram for connection information. For AMC 2 wire transmitters connect Transmitters connect (-) to (in+) and transmitter (+) to (PWR) on DTR-10-0233 Power Supply.

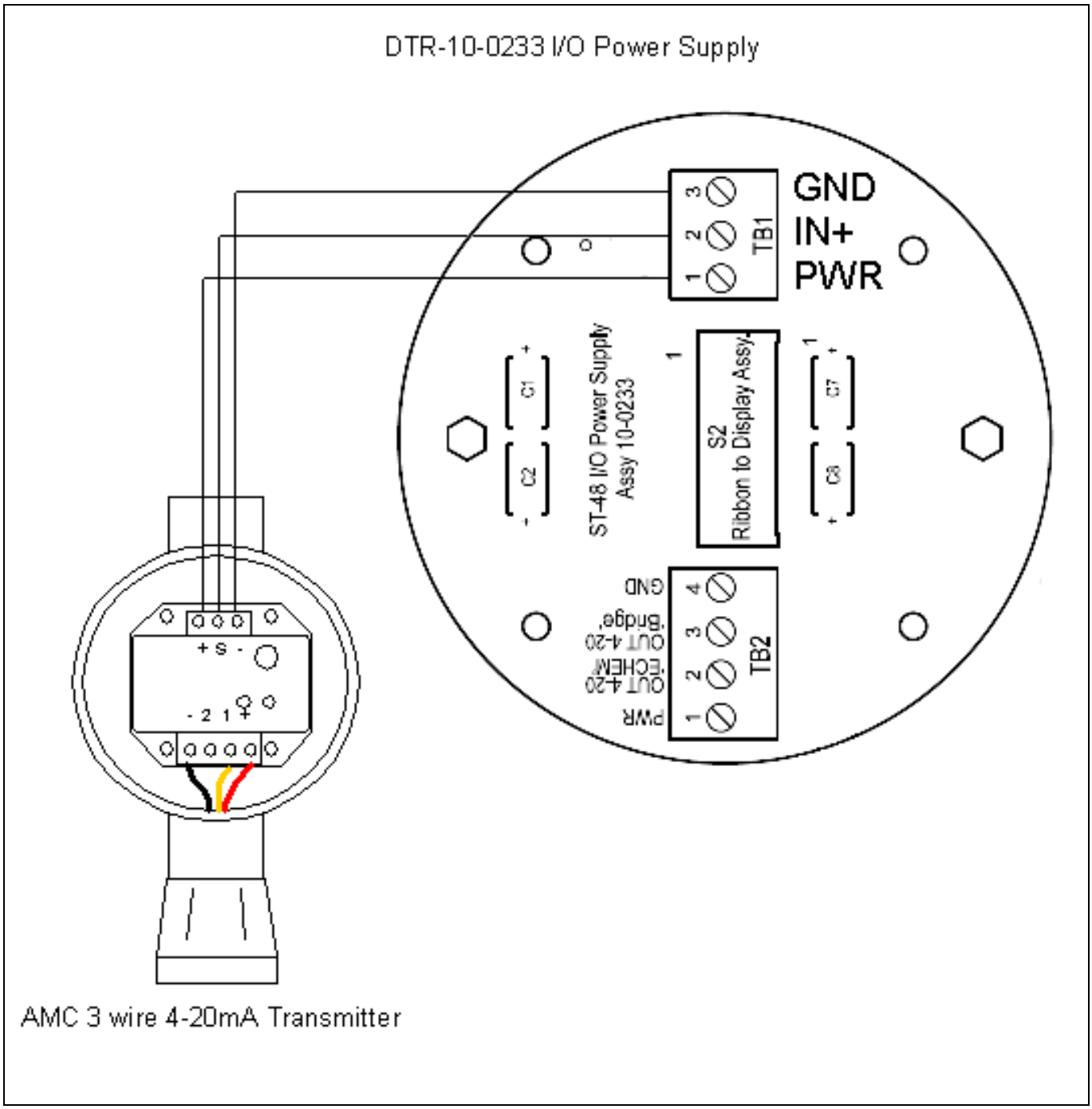

Figure 13: 3 Wire 4-20mA transmitter wiring to the DTR-10-0233 I/O Power Supply

4.10 "Sensor Type" and AMC-DTR Signal Conditioning

Catalytic bead and electrochemical sensors obviously have different signal conditioning requirements. In addition, same sensor types have different response coefficients, signal strength and gain and offset requirements. The block / wiring diagram in Figure 14 illustrates how AMC-DTR's are able to accept many sensor types without the need of manual potentiometers or jumpers. Smart Sensors carry this setup information with each sensor.

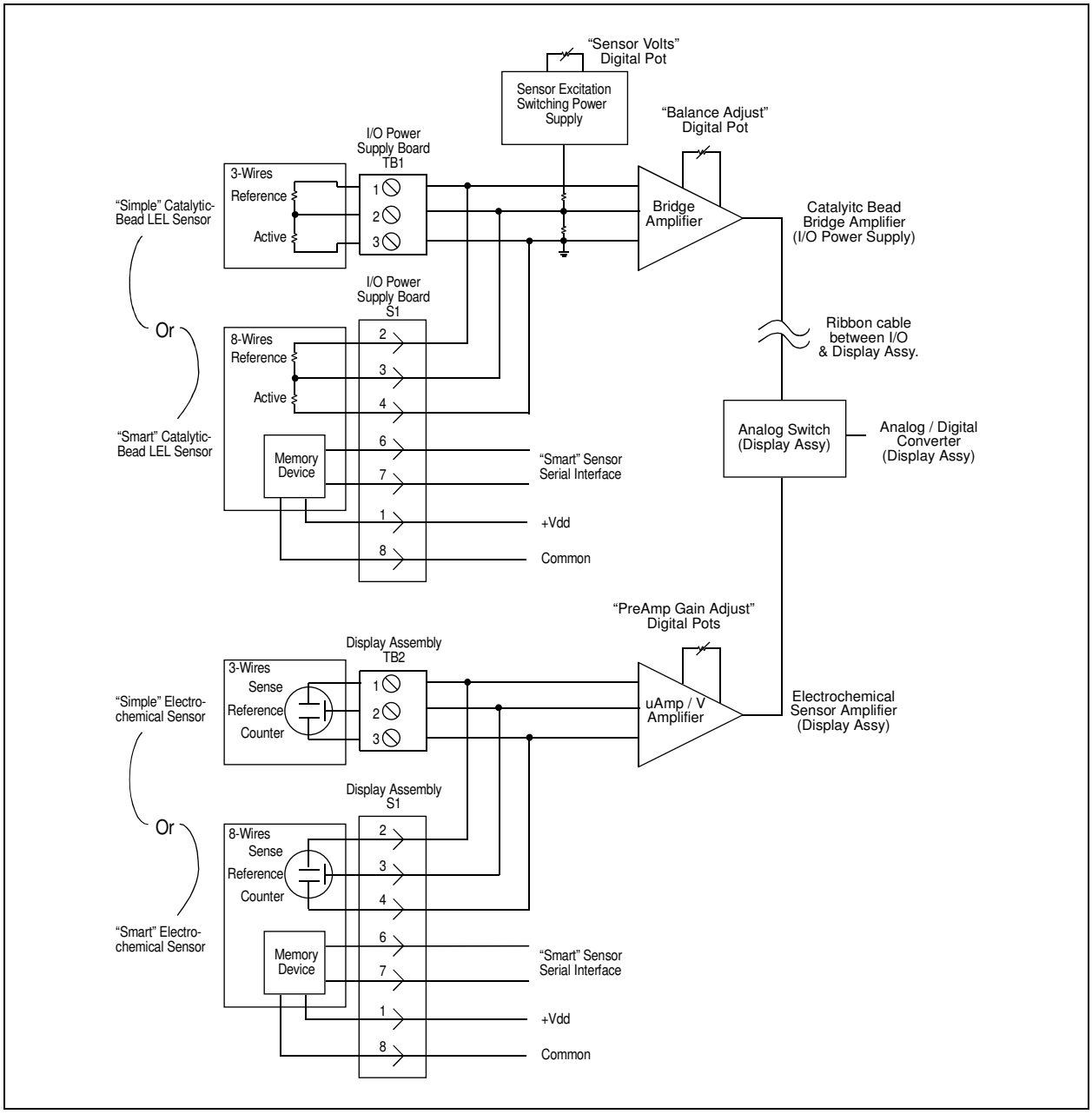

Figure 14: AMC-DTR Block / Wiring Diagram

5 INITIAL START-UP

5.1 "Transmitter Configuration" Menu

Figure 15 shows the AMC-DTR XMITTER CONFIG menu used to activate channels, precisely calibrate 4-20mA outputs and set time / date. Its menus are set at the factory and typically not needed by the user. To access from any data display, press and hold the NEXT key for 5-seconds until the screen appears requesting a special key sequence (4-UP keystrokes).

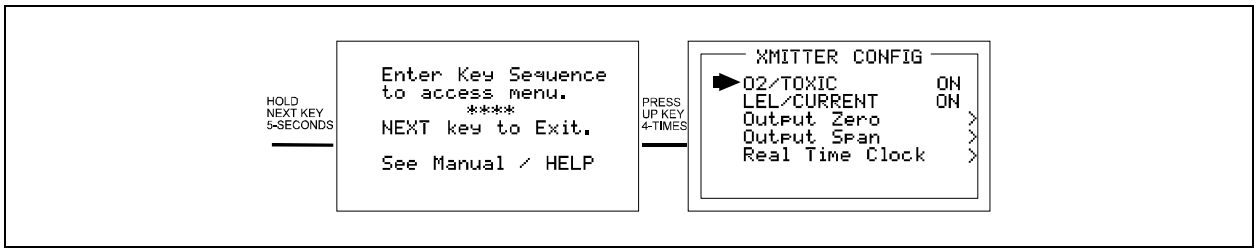

Figure 15: Transmitter Configuration Menu

5.1.1 Single / Dual Gas Monitor Configuration

AMC-DTR-EC's are 2-wire 4-20mA devices and support only one electrochemical sensor. Addition of the DTR-10-0233 Power Supply board automatically adds the catalytic bead sensor input and dual 4-20mA outputs. If both the O2/TOXIC and LEL/Current menu items are ON, the AMC-DTR will function as a dual gas monitor with both sensor inputs and 4-20mA outputs active. Either input may be turned off for single gas EC or LEL monitors.

5.2 Initial Catalytic Bead LEL Monitor Start-Up

AMC-DTR LEL Monitors are factory equipped with a local Simple or Smart Catalytic Bead LEL sensor, which rarely require adjustments, other than routine calibrations, to provide accurate LEL readings. However, after installation the checks in the following sub-sections should be performed to insure proper operation. In addition, alarm levels, Measurement Name ASCII fields and other variables may require attention by users in order to best serve their application.

5.2.1 Initial Catalytic Bead LEL Monitor "Sensor Volts" Check

CAUTION:

Sensor Volts in excess of the rated values may destroy catalytic bead sensors. AMC-DTR sensors are rated for 2 volts.

The voltage displayed on the LCD is monitored across TB1-REF and TB1-ACT on the AMC-DTR Power Supply board (Figure 6) and may be confirmed with a voltmeter. This TB-1 value is correct for locally mounted sensors only. Sensors mounted more than a few feet away from the AMC-DTR may receive a lower voltage due to the inherent voltage drop across sensor wiring. Remote mounted sensors must have their sensor voltage (across ACTIVE and REFERENCE beads) measured AT THE SENSOR end of the cable. The AMC-DTR setting will require a

higher value in order to achieve the correct voltage at the sensor. Correct sensor voltage should be confirmed after start-up for locally and remotely mounted catalytic bead sensors.

5.2.2 Initial Catalytic Bead LEL Monitor "Balance" Check

Catalytic bead sensors connect to a bridge circuit that may require a balance adjustment after installation especially when the sensor is remote mounted from the AMC-DTR. Correct BALANCE setting should be confirmed after start-up for locally and remotely mounted catalytic bead sensors.

5.2.3 Initial Catalytic Bead LEL Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 6.1, a coarse SPAN gas reading verification should be performed after installation. After correct Sensor Volts and BALANCE have been verified, apply an upscale gas value such as 50% LEL to the sensor. The indicated value should read between 35 and 65% LEL with 50% LEL gas applied. Larger errors may indicate incorrect sensor wiring or defective sensor. Remember that this is only a coarse check and precision calibrations are performed in *Routine Sensor Calibrations* described in the following section 6.1.

5.3 Initial Toxic / Oxygen Monitor Start-Up

AMC-DTR Toxic / Oxygen Monitors, are factory equipped with a local Simple or Smart electrochemical sensor, rarely require adjustments (other than routine calibrations) to provide accurate readings. However, after installation the following checks should be performed to insure proper operation. In addition, alarm levels, Measurement Name ASCII fields and other variables may require attention by users in order to best serve their application.

5.3.1 Initial Toxic / Oxygen Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 6.1, a coarse SPAN gas reading verification should be performed after installation. Apply an upscale gas value of at least 25% of full scale to the sensor. For example, if 0-100ppm H2S is the measurement range, apply at least 25ppm but not more than 100ppm. The indicated value should read within 15% of full scale. Remember that this is only a coarse check and precision calibrations are performed in *Routine Sensor Calibrations* described in the following section 6.1.

6 OPERATING INSTRUCTIONS

6.1 Routine Sensor Calibrations

Calibration is the most important function for insuring correct operation of the AMC-DTR. The CAL MODE (flow chart shown in Figure 17) is designed to make calibration quick, easy and error free. A successful ZERO and SPAN calibration requires only four keystrokes. The 4-20mA output transmits 3mA during CAL MODE and 4mA during the subsequent CAL PURGE delay to prevent external alarms during calibration. Local AMC-DTR alarm relays (if equipped) are inhibited during CAL MODE. CAL MODE automatically exits if no keystrokes are detected after 5 minutes.

Follow these AMC-DTR calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate on a regular schedule. (AMC recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.)
- Calibrate only in a clean atmosphere, which is free of background gas.

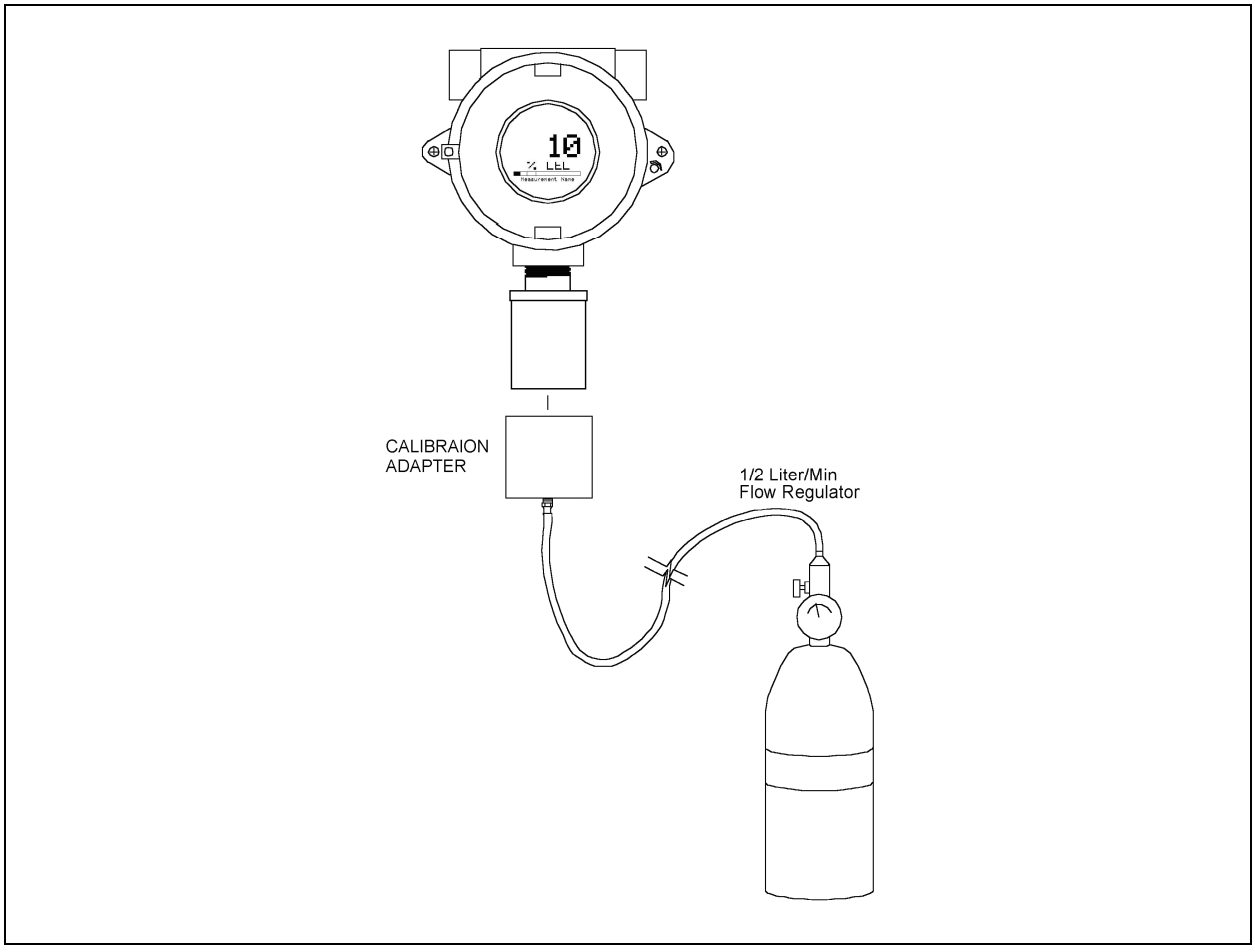

Figure 16: Calibration Gas Input

Use the following step-by-step procedure to perform ZERO and SPAN calibrations.

1. To enter the CAL MODE from either data displays, press the DOWN / CAL key and within 5 seconds press the EDIT key.
2. Using the appropriate calibration adapter, apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a ZERO calibration.
3. If the ZERO calibration is successful, press the NEXT key to proceed to the SPAN check.
4. Apply the **correct** SPAN gas at .5 liters/min. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a SPAN calibration.

WARNING:

The SPAN gas used must match the value specified since this is what the AMC-DTR will indicate after a successful SPAN calibration. The *Cal Span Value* may be edited if it becomes necessary to apply a different gas concentration (see *Cal Span Value* in section 7.3).

5. If the SPAN calibration is successful, the display flashes “REMOVE CAL GAS” and starts the CAL PURGE delay.
6. CAL MODE will be complete after the end of the CAL PURGE delay.

The flow chart in Figure 17 illustrates the above procedure. UP, CAL, NEXT & EDIT labels indicate keystrokes using the magnetic wand. The CAL MODE information screen (top of the chart) is available for advanced users to see Offset / Gain calibration constants and live analog to digital converter (A/D) counts. Span Gas calibration values may also be edited from this screen. Holding the UP key, for 5 seconds during CAL MODE, displays this screen.

Calibration history records are logged and may be viewed in the *Sensor Information* menu (see section 7.5).

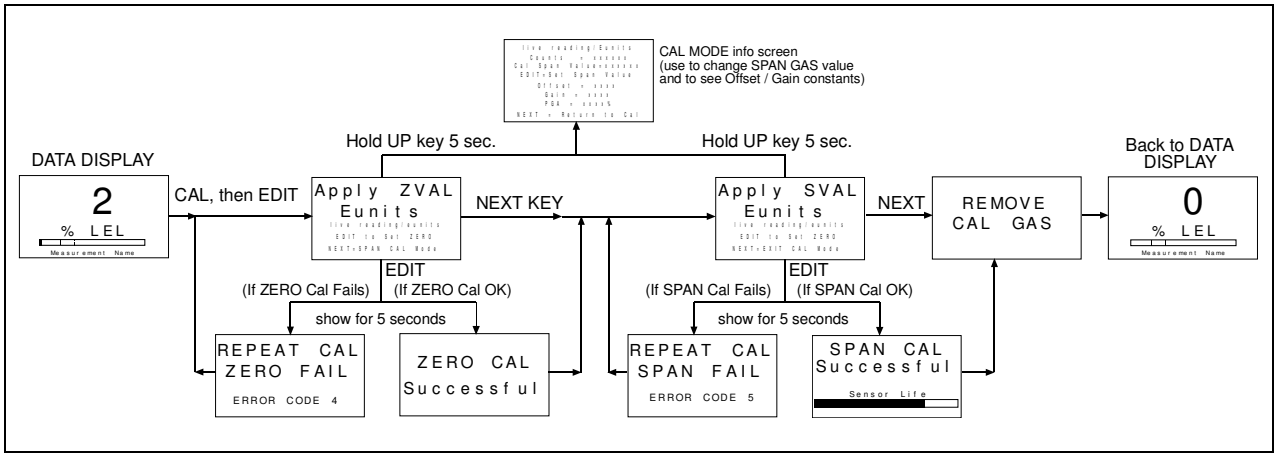

Figure 17: Cal-Mode Flow Chart and Menus

6.2 Alarm Operation

AMC-DTR's have front panel LED indicators for Alarm 1, Alarm 2 and Alarm 3. An optional DTR-10-0234 Relay/Modbus board adds K1, K2 & K3 relays for these alarms.

CAUTION:

AMC-DTR Alarm LED indicators function even without the presence of the DTR-10-0234 Relay option. With 2-Wire 4-20mA operation, to conserve power, alarm LED's only flash during alarm events. With 3-Wire 4-20mA operation, alarm LED's flash when new, and become steady after an operator ACKNOWLEDGE - pressing the UP/RESET key.

6.2.1 ALARM 3 – Understanding Fault / Level Operation

The "A3" alarm is typically dedicated to FAULT conditions indicating sensor failures or "out of measurement range" conditions. However, some applications require a third level alarm. The A3 menu is identical to A1 & A2 and may be set to trip at an upscale level value. A3 WILL ALSO TRIP WITH MISSING OR FAILED SENSORS REGARDLESS OF THE LEVEL VALUE!

CAUTION:

Missing or failed sensors always trip Alarm 3 and relay K3 (if equipped). This is true even with A3 configured as a level alarm and it must be accepted that A3 level alarm events might be caused by the monitored level, or, by a missing or failed sensor.

7 SETUP MENU CONFIGURATION

7.1 Menus Database Configuration

All AMC-DTR configuration variables are stored in its menu database. Many menu items will contain default values from the factory and require changes to better match a user's particular application. AMC-DTR menus may be configured from the magnetic keypad in 5-10 minutes per transmitter. For installations consisting of numerous points, an interface device is offered to allow Smart sensors or AMC-DTR's can be configured from a PC's USB port. This is useful when AMC-DTR's are not yet installed or if a portable computer may be carried to each unit.

The AMC-DTR's configuration menus are shown in Figure 18.

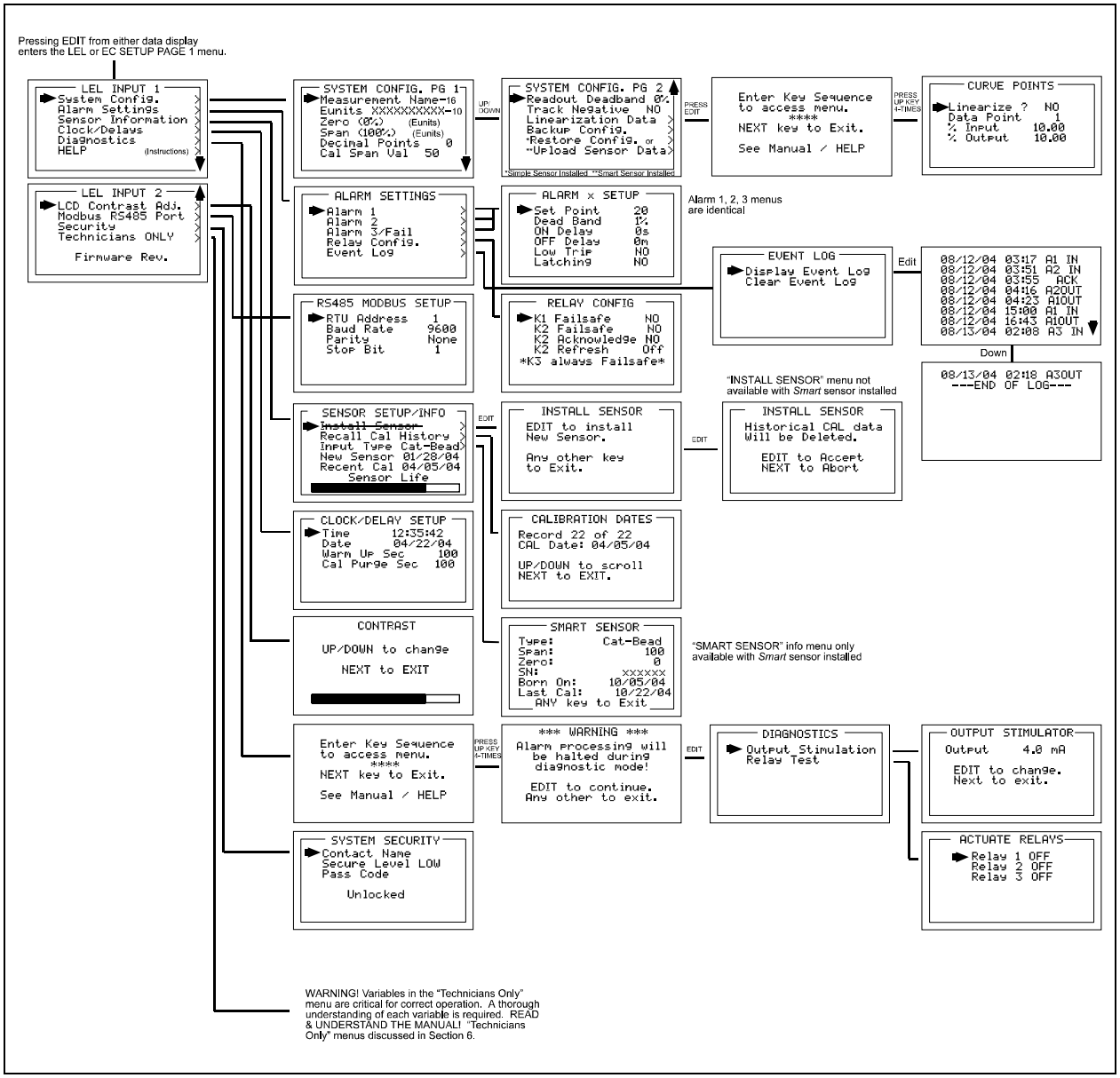

Figure 18: Configuration Menu Tree

7.2 Configuration Using the Magnetic Wand

Passing the magnetic wand past the EDIT key, from either data display, displays SETUP PAGE 1 as shown in Figure 19. The UP / DOWN keys maneuver the pointer while EDIT enters sub-levels of menu items. All SETUP menu items have at least one page of sub-menus. Items with sub-menus are indicated by the > symbol (right hand pointing arrow) at the end of each line. Edit menu items by pointing to them, press the EDIT key to display the cursor, press UP / DOWN to change that character, press NEXT to move the cursor, then press EDIT again to load the new item and remove the cursor. Press NEXT to reverse out of the sub-menu. To view **SETUP PAGE 2**, press the DOWN key with the pointer aimed at the bottom item on PAGE 1.

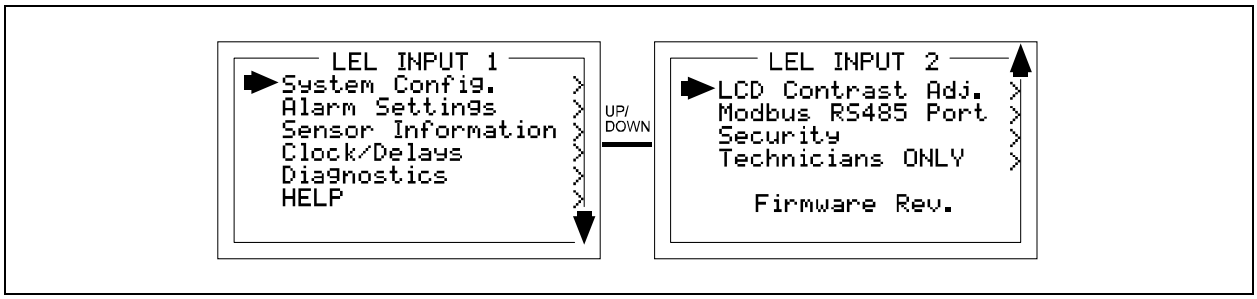

Figure 19: Setup Menu Entry

7.3 System Configuration Menus

The **System Config**. group consists of two pages of menus as shown in Figure 20. Each item's description follows in this section.

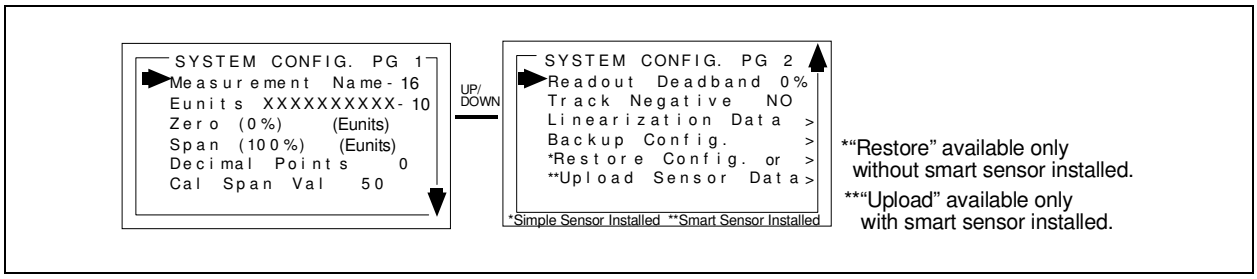

Figure 20: System Config. Menus

Measurement Name may be edited to contain virtually any 16-character ASCII field. It is typically used to describe the monitored point by user tag # or other familiar terminology.

Eunits (engineering units) may have up to a 10 character ASCII field. Many common gases have pre-configured Eunits based upon the sensor type and each may be edited in this menu as described in *Configuration Using the Magnetic Wand* section 7.2.

Zero (0%) defines the reading to be displayed when 4mA (0%) is the AMC-DTR output.

Span (100%) defines the reading to be displayed when 20mA (100%) is the AMC-DTR output. The highest reading allowed is 9999 includes negative polarity sign and one decimal point. Polarity is only indicated for negative readings.

Decimal Points sets the resolution of the LCD readings and may be for 0, 1 or 2. Example: ZERO readings for 0, 1 & 2 DP's respectively are 0, 0.0 & 0.00.

Cal Span Value sets what upscale value must be applied when performing Span calibrations.

Readout Deadband allows forcing low values to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating readouts above zero. The highest amount of deadband allowed is 5%. The 4-20mA output is not affected by this menu item.

Track Negative*,* set to NO, causes negative values to read the ***Zero (0%)*** value in data displays. The CAL MODE readout displays negative values regardless of this setting and negative values below the Fault setpoint will still cause the Fault alarm to trip. The 4-20mA output always locks at 4mA when the reading is negative.

Linearization Data allows nonlinear signals to be linearized by entering the correct curve into the AMC-DTR (Figure 21). If Linearize is set for NO, the CURVE POINTS menu data is not used and no linearization is applied. When YES, the CURVE POINT entries are used and a straight-line approximation is calculated between each of the 9 entries. 0% input always provides 0% output and 100% input always provides 100% output. To prevent accidental data entry, a special keystroke sequence of 4 consecutive UP keys are required to enter this menu.

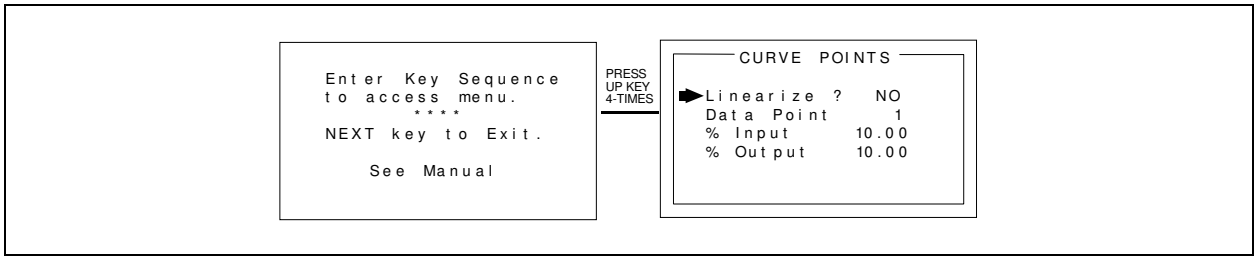

Figure 21: Linearization Menu

Backup Config. allows users to store the entire current AMC-DTR menu database into non-volatile memory for restoration later if incorrect values are accidentally entered or uploaded.

Restore Config. restores the AMC-DTR menu database to the values from the most recent Backup Config. The special keystroke sequence of 4 consecutive UP keys is also required to perform backup and restore operations.

Upload Sensor Data. allows manually uploading the entire smart sensor database to the AMC-DTR from the smart sensor.

7.4 Alarm Settings

The **Alarm Settings** page has the **Alarm 1, 2, 3 Setups, Relays** and **Event Log** submenus shown in Figure 22. Alarm 1, Alarm 2 and Alarm 3/Fail menus are identical and therefore described only once in this section.

IMPORTANT: Alarm functions and their associated LED's are active without the DTR-10-0234 Relay / ModBus option installed.

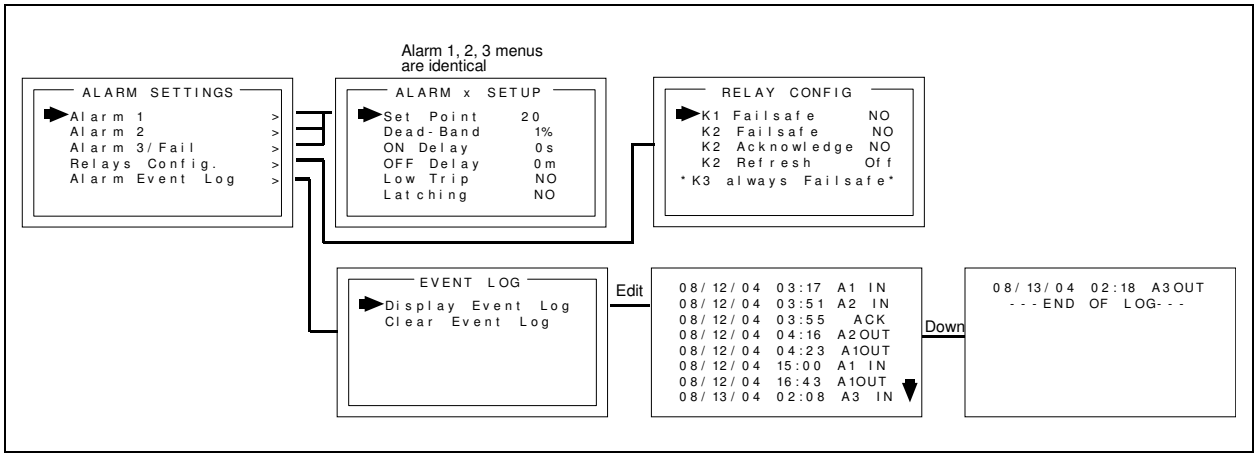

Figure 22: Alarm Settings Menus

Set Point enters the engineering unit value where the alarm trips. It may be negative and trip when monitored values fall out of range in this direction. A3 has a default negative 5% of range Set Point with Low Trip set for YES. This makes it function as a FAULT alarm and trip when the monitored value is more than 5% "out of range".

Dead-Band has a minimum value of 1% and a maximum value of 10%. It is useful for preventing alarm cycling when the monitored value is hovering around the set point. EXAMPLE: With a range of 0-100 ppm, if Dead-Band equals 5% and the set point is 20 ppm, after tripping at 20 ppm the value must drop below 15 ppm to reset.

ON Delay allows entering a maximum 10 second delay before this alarm becomes active. This is useful for preventing nuisance alarms caused by brief spikes beyond the set point.

OFF Delay allows entering a maximum 120 minute delay before clearing an alarm after the alarm condition is gone. This is useful for continuing an alarm function, such as operation of an exhaust fan, for a period of time after the alarm condition clears.

Low Trip set to YES causes the alarm to trip as the value falls below the set point.

Latching set to YES causes the alarm to remain active even after the condition is gone and only reset when the UP / RESET key is pressed from a data display.

7.4.1 Relay Configuration (if equipped)

Relay Config has the submenu shown in Figure 23. The optional relay PCB must be installed to access this menu or a "HARDWARE NOT PRESENT" message appears.

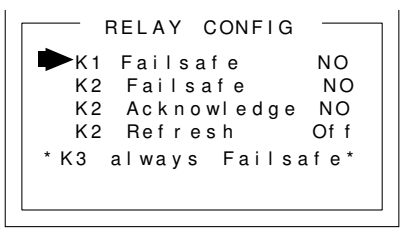

Figure 23: Relay Config. Menu

K1 / **K2 Failsafe** set for YES means the relay de-energizes during alarm and energizes with no alarm. This is useful for also signaling alarm when AMC-DTR power is lost. K3 is a FAULT alarm and is always failsafe.

K2 Acknowledge set for YES means the UP / RESET key (RESET key during either data display) will set K2 to the normal state EVEN when an Alarm 2 condition exists. This is useful for silencing an audible device, driven from K2, during the alarm condition.

K2 Refresh set for ON causes an acknowledged Alarm 2 condition to reactivate K2 if it continues beyond the designated Refresh interval. This feature insures against "forgotten" alarms after an Acknowledge.

7.5 Sensor Information

Sensor Information has the **SENSOR SETUP/INFO** menus shown in Figure 24.

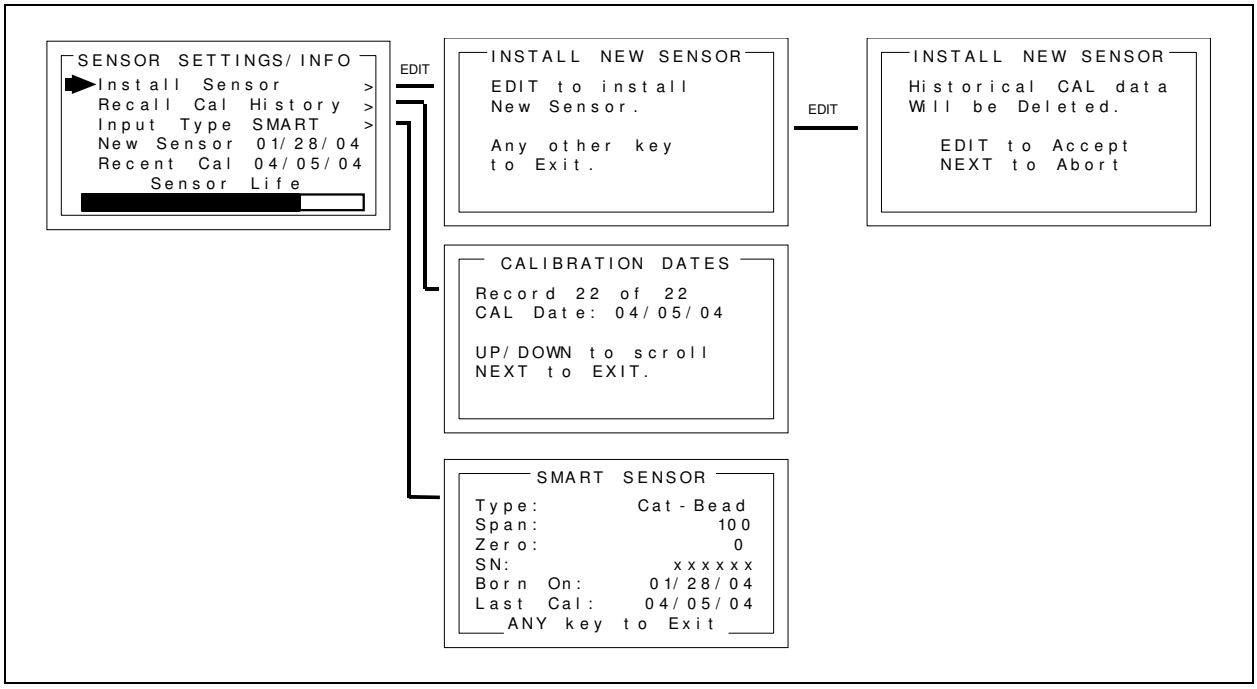

Figure 24: Sensor Information Menus

Install New Sensor should always be performed when a new simple sensor is installed. This deletes historical CAL data and sets sensor life to 100% after initial calibration of the new simple sensor. The AMC-DTR *Smart* sensor interface will automatically detect new smart sensors and this menu is therefore not available with a smart sensor connected.

Recall Cal History recalls each successful calibration. These dates may be reviewed by scrolling with the UP / DOWN keys.

Input Type indicates what kind of input or sensor the AMC-DTR is configured to accept and is typically pre-configured at the factory. There are five Input Type possibilities consisting of Cat-Bead, EC negative, EC positive and 4-20mA and Smart. Smart sensors upload sensor type and other data to the AMC-DTR and may be viewed on the SMART SENSOR information screen.

New Sensor displays the date when a new sensor was last installed.

Recent Cal displays the most recent calibration date.

7.6 CLOCK/DELAY Setup

Since the AMC-DTR is equipped with a Real Time Clock & Calendar **Time** and **Date** must be set to correctly match its location. They are set at the factory in a 24 hour format but may require adjustment to match the location's time & date after shipment. Follow the procedure in *Configuration Using the Magnetic Wand* in section 7.2.

Warm Up and **Cal Purge** time delays are also available to prevent unwanted alarm trips. Figure 25 shows the menu for these items.

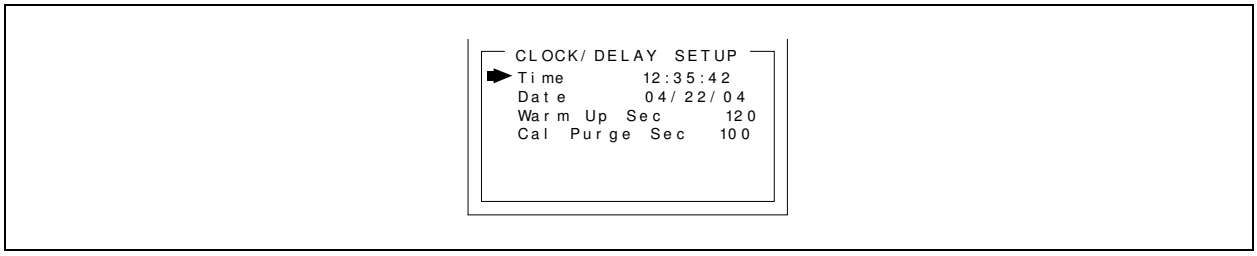

Figure 25: Clock & Calendar / Delay Timer Menu

7.7 LCD Contrast Adj

LCD Contrast Adj. may be set for optimum viewing using the menu shown in Figure 26.

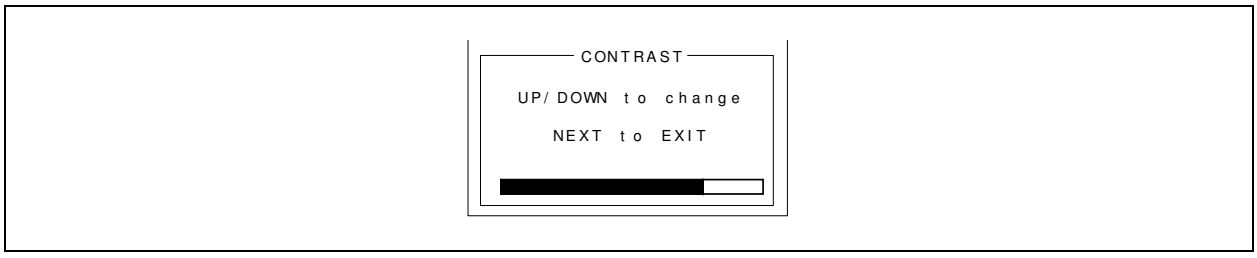

Figure 26: LCD Contrast Adjust Menu

7.8 HELP Screen

The **HELP** screen contains several pages of information describing how to operate the AMC-DTR. This is the bottom menu on page 1 of the **SETUP** screen.

7.9 Diagnostics

IMPORTANT: Gas monitoring and alarm processing are not performed while using the Diagnostics menus. **Access requires a special key sequence of four consecutive UP keystrokes**.

There are two **Diagnostics** menus useful for driving outputs without exposing the sensor to the target gas. The **OUTPUT SIMULATION** menu allows setting the 4-20mA output to virtually any desired value. This is useful for checking responses of devices receiving the AMC-DTR's 4-20mA output. The **ACTIVATE RELAYS** menu allows tripping of alarm relays (if equipped) without tripping alarm set-points with the target gas. This is useful for testing alarms events such as lights and audible devices.

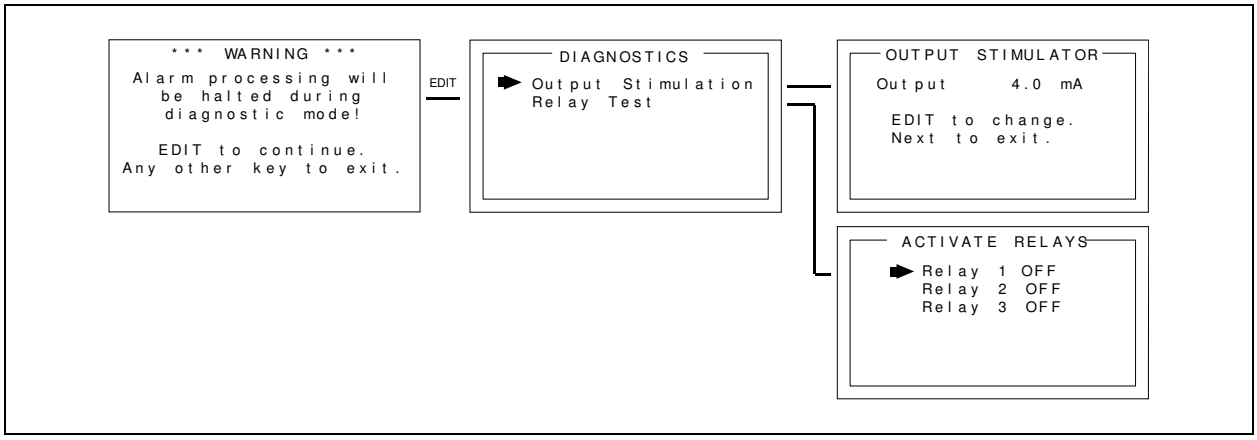

Figure 27: Diagnostics Menus

7.10 RS-485 / MODBUS Setup

The **RS-485 MODBUS SETUP** menu allows setting the RTU address (if RS-485 equipped) for each AMC-DTR on the RS-485 network. Each AMC-DTR must have a different RTU address when communicating on the same 2-wire cable. Baud rate, Parity and Stop Bit are fixed at industry standard values of 9600, none, and 1 respectively.

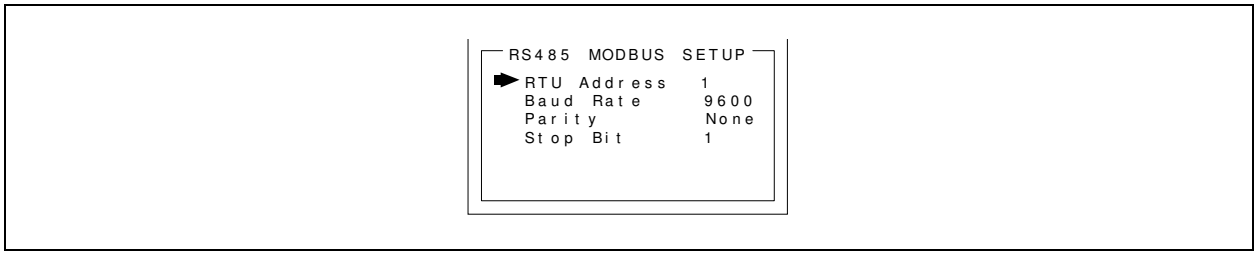

Figure 28: ModBus RS-485 Setup Menu

7.10.1 MODBUS Register and Function Code Summary

The following table identifies ST-48 Modbus register locations and function codes.

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Read Only Discretes:			
Chan 1 Alarm 1	2001	2	NA
Chan 1 Alarm 2	2002	2	NA
Chan 1 Fault	2003	2	NA
Chan 2 Alarm 1	2004	2	NA
Chan 2 Alarm 2	2005	2	NA
Chan 2 Fault	2006	2	NA

K1	2007	2	NA
K2	2008	2	NA
K3	2009	2	NA

Read/Write Coils:

Alarm Ack/Reset	12001	1	5

Note: After writing a TRUE to this register, it resets back to FALSE automatically.

Read Only Registers:

A2D Raw Chan 1	31001	4	NA
A2D Raw Chan 2	31002	4	NA

10 bit value representing the A2D value of 0 to 1023 after calibration constants are applied.

D2A Raw Chan 1	31003	4	NA
D2A Raw Chan 2	31004	4	NA

10 bit value representing the D2A value of 0 to 1023 for -25 to 105 %FS (197=0% & 1003=100%).

Chan 1 Status	31005	4	NA
Chan 2 Status	31006	4	NA

(16 bit status words; bit assignment for each channel)

ALARM1_BELOW	BIT0
ALARM2_BELOW	BIT1
ALARM3_BELOW	BIT2
ALARM1_LATCH	BIT3
ALARM2_LATCH	BIT4
ALARM3_LATCH	BIT5
ALARM3_ACTIVE	BIT6
CHANNEL_DISABLED	BIT7
CHANNEL_CAL	BIT8
CHANNEL_LINEARIZE	BIT9
FAULT_RELAY_LATCH	BIT10
DISPLAY_NEGATIVE	BIT11

Alarm Status Word	31007	4	NA

(16 bit status word; bit assignment for system status)

CH1_ALM1	BIT0
CH1_ALM2	BIT1
CH1_FAULT	BIT2
CH2_ALAM1	BIT4
CH2_ALM2	BIT5
CH2_FAULT	BIT6
K1_STASUS	BIT8
K2_STATUS	BIT9
K3_STATUS	BIT10

Transmitter Status Word	31008	4	NA

(16 bit status word; bit assignment for system status)

CHAN_1_ACTIVE	BIT0
CHAN_2_ACTIVE	BIT1
SECURE_LEVEL	BIT2
K1_FAILSAFE	BIT12
K2_FAILSAFE	BIT13
K2_ACK	BIT14
LOCK	BIT15

Memory Floating Point:

Note: Returned as 15bit plus sign 2s complement with +/- 5% over/underrange applied. Consider over/underrange when scaling values to be displayed at the workstation. The following equation may be used to determine a value for display.

$$\text{Display Value} = \frac{\text{MODBUS Value [(Span Value -Zero Value) 1.1]}}{32767} + \{\text{Zero Value - [(Span Value - Zero Value) .05]}\}$$

FP Value Chan 1	33001	4	NA
FP Value Chan 2	33002	4	NA

Memory ASCII Strings:

User Info Chan 1	40401-40408	3	NA
User Info Chan 2	40409-40416	3	NA

16 ASCII characters (2 per register) assigned to the unit identifier read as bytes.

Chan 1 ASCII Reading	40417-40419	3	NA
Chan 2 ASCII Reading	40420-40422	3	NA

6 ASCII characters (2 per register) reflecting the display readout.

EUNITS Chan 1	40423-40427	3	NA
EUNITS Chan 2	40428-40432	3	NA

10 ASCII characters (2 per register) assigned to the engineering units read as bytes.

Byte Variables:

PreAmp/Gain Ch1	40433	3	NA
PreAmp/Gain Ch2	40434	3	NA

2 bytes representing Pre Amp (HiByte) and PGA (LoByte) settings.

Firmware Version:

Version	40435-40436	3	NA

4 ASCII characters (2 per register) reflecting the firmware version.

Memory Reals:

Note: Real value represents float value without the decimal point such as 123.4 is returned as 1234. Decimal devisor is returned as 1, 10, 100, or 1000 for decimal position of 1, 2, 3, or 4, where 123.4 would return the value 10.

Chan 1 Cal Zero Real	41001	4	NA
Chan 1 Cal Zero Devisor	41002	4	NA
Chan 1 Cal Span Real	41003	4	NA
Chan 1 Cal Span Devisor	41004	4	NA
Chan 1 Zero Real	41005	4	NA
Chan 1 Zero Devisor	41006	4	NA
Chan 1 Span Real	41007	4	NA
Chan 1 Span Devisor	41008	4	NA
Chan 1 Fault Real	41009	4	NA
Chan 1 Fault Devisor	41010	4	NA
Chan 1 Alarm 1 Real	41011	4	NA
Chan 1 Alarm 1 Devisor	41012	4	NA
Chan 1 Alarm 2 Real	41013	4	NA
Chan 1 Alarm 2 Devisor	41014	4	NA
Chan 1 Alarm 3 Real	41015	4	NA
Chan 1 Alarm 3 Devisor	41016	4	NA
Chan 1 Manual Gain Real	41017	4	NA
Chan 1 Manual Gain Devisor	41018	4	NA

Chan 1 Manual Offset Real	41019	4	NA
Chan 1 Manual Offset Devisor	41020	4	NA
Chan 2 Cal Zero Real	41021	4	NA
Chan 2 Cal Zero Devisor	41022	4	NA
Chan 2 Cal Span Real	41023	4	NA
Chan 2 Cal Span Devisor	41024	4	NA
Chan 2 Zero Real	41025	4	NA
Chan 2 Zero Devisor	41026	4	NA
Chan 2 Span Real	41027	4	NA
Chan 2 Span Devisor	41028	4	NA
Chan 2 Fault Real	41029	4	NA
Chan 2 Fault Devisor	41030	4	NA
Chan 2 Alarm 1 Real	41031	4	NA
Chan 2 Alarm 1 Devisor	41032	4	NA
Chan 2 Alarm 2 Real	41033	4	NA
Chan 2 Alarm 2 Devisor	41034	4	NA
Chan 2 Alarm 3 Real	41035	4	NA
Chan 2 Alarm 3 Devisor	41036	4	NA
Chan 2 Manual Gain Real	41037	4	NA
Chan 2 Manual Gain Devisor	41038	4	NA
Chan 2 Manual Offset Real	41039	4	NA
Chan 2 Manual Offset Devisor	41040	4	NA

Binary Cal Data:

Chan 1 A2D MIN	41041	4	NA
Chan 1 A2D MAX	41042	4	NA
Chan 1 D2A MIN	41043	4	NA
Chan 1 D2A MAX	41044	4	NA
Chan 2 A2D MIN	41045	4	NA
Chan 2 A2D MAX	41046	4	NA
Chan 2 D2A MIN	41047	4	NA
Chan 2 D2A MAX	41048	4	NA

Min and Max calibration points for the A/D and D/A converters.

7.11 System Security

The **SYSTEM SECURITY** menu offers two levels of protection. A **LOW** level allows CAL MODE sensor calibrations but requires the 4-digit **Pass Code** prior to altering menus. **HIGH** level locks the entire menu database and the CAL Mode until the correct **Pass Code** is entered. **LOW** and **HIGH** security levels always allow viewing of configuration menus but they may not be changed. **Contact Name** is a 12 character ASCII field available for displaying a phone # or name of personal who know the **Pass Code**. Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

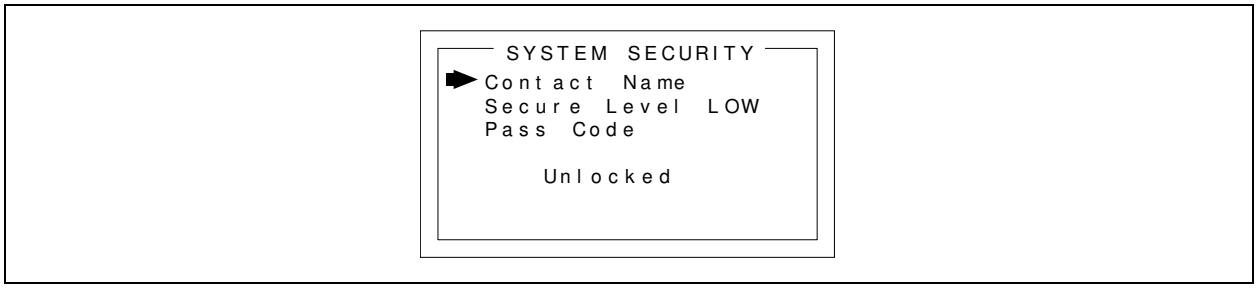

Figure 29: System Security Menu