OPERATION & PARTS MANUAL

Gas Detection System

Buckeye BDS-50 / Buckeye BFT-44
GDS GasMax II

Publication No. 050165A

Rev. No. 220428 R260428

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SERVICE • RELIABILITY • INNOVATION

Introduction

This manual contains important safety, operation, maintenance, and parts information for your Akkerman Gas Detection System. This system includes the remote relay module, non-intrusive transmitter and sensor. You must read and understand this manual, any of the system manuals (TBM, Pump Unit, Haul Unit, etc.), and the gas detection system manuals (Global Detection Systems, Buckeye Detection Systems) before you operate and maintain this equipment. The Buckeye Detection System manuals are located in section 17 and the Global Detection Systems manual is located in section 18. Keep this manual with your Tunnel Boring Machine at all times. Additional copies of this manual may be purchased from the Akkerman Aftermarket Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

The contractor is responsible for the overall safety program on the job site. Use this manual as a part of the safety program.

The use of second rate parts could affect the efficient performance of the gas detection system. ALWAYS use genuine Akkerman parts.

Understand safety signal words, DANGER, WARNING, CAUTION, SAFETY INSTRUCTIONS, and NOTICE. When you see these words in this manual or on safety decals mounted on your equipment, follow the safety message to avoid personal injury and/or property damage.

⚠DANGER Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

⚠CAUTION Indicates a potentially hazardous situation, which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices.

SAFETY INSTRUCTIONS Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

NOTICE Identifies potential property damage and important installation, operator, or maintenance information.

Akkerman Methane Gas Detection System

The methane gas detection system continually monitors methane gas levels providing a digital readout of the level, and both an audible and visual warning if the preset levels are exceeded.

If you find any errors with this manual or know of ways to improve procedures, please let us know. Mail your suggestions to: Akkerman Inc, ATTN: Technical Publications, 58256 266th Street, Brownsdale, MN 55918.

Akkerman Inc. reserves the right to improve its product without notice or obligation.

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Safety

BE ALERT FOR SAFETY INFORMATION

When you see this safety alert symbol on your equipment or in this manual, be alert to the possibility of personal injury or property damage.

Read all safety information.

Keep safety decals clean and in good condition. Replace missing or damaged safety decals.

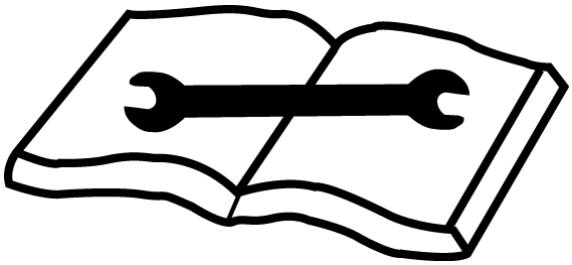
ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

READ OPERATOR'S MANUAL

⚠WARNING Unsafe operation or maintenance can cause severe injury or death.

Read and understand the Operator's Manual before operating or servicing this equipment.

Any unauthorized modifications will void the warranty.

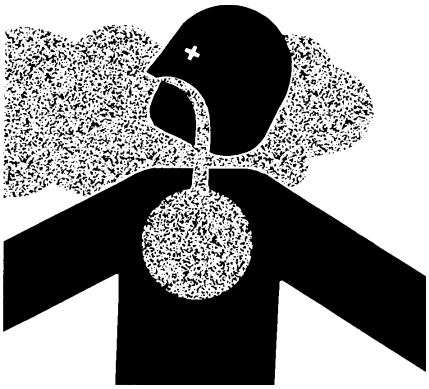


WEAR PROTECTIVE CLOTHING

Wear OSHA approved protective clothing, such as hard hat, gloves, safety goggles, earmuffs or ear plugs, face shield, and steel-toed boots, when operating and servicing this equipment.

Wear reasonably close fitting clothing and remove jewelry before working on or near this equipment. This will help prevent the danger of catching them in moving parts or controls.

TEST TUNNEL VENTILATION



⚠WARNING Keep Boring Head and tunnel well ventilated at all times.

Use an approved air analyzer to detect hazardous gases and oxygen content.

Before and during the tunnel operation, test for combustible and toxic gases and oxygen deficiency.

If the levels exceed MSHA/OSHA prescribed levels, leave tunnel immediately! Do not activate or deactivate any electrical or hydraulic devices, since any sparks could cause an explosion.

Once ALL personnel are out of tunnel, cut power from power source.

Gases must be removed before reentering tunnel.

Do not use Haul Unit to evacuate the tunnel. The electrical contacts with the unit can cause an explosion.

LOCKOUT/TAGOUT POWER BEFORE SERVICING

⚠WARNING Failure to lockout power before servicing can cause severe personal injury or death.

LOCKOUT/TAGOUT main power supply before servicing. Electrical repairs must be performed only by a certified electrician.

NO SMOKING IN TUNNEL

⚠WARNING Smoking in tunnel could cause an explosion if combustible gases are present.

Do not smoke in tunnel.

FIRE PREVENTION

⚠CAUTION Fires can cause injury or property damage.

Keep equipment clean. Remove all debris from equipment.

Have a fire extinguisher available at all times. Keep the fire extinguisher fully charged.

HYDRAULIC OIL/FLUIDS UNDER PRESSURE

⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury.

Release all pressure before performing maintenance or repairs. Never weld near pressurized fluid lines.

DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

Contact medical help immediately if any oil or fluid is injected into your skin. A serious infection or reaction can emerge without proper medical treatment.

BEWARE OF SUSPENDED LOADS

⚠WARNING Suspended loads may fall and cause severe personal injury or death.

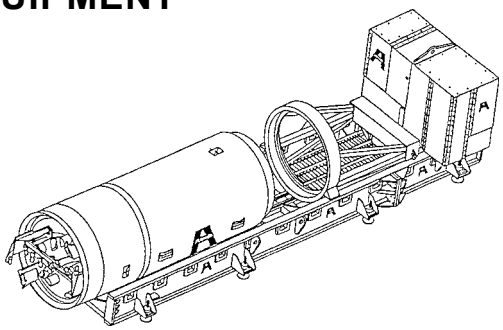
If a hydraulic hose, chain, or cable from the boom of a crane or excavator breaks, the boom and/or load can fall instantly.

Do not enter area under or around a load.

KEEP PERSONNEL AWAY FROM MOVING PARTS

⚠WARNING Crushing hazard.
Keep personnel away from inside of yoke, on skid, or behind pump unit when jacking or moving pump unit or yoke. Failure to do so could result in serious personal injury or death.

REGULARLY CLEAN AND INSPECT EQUIPMENT



Remove any grease, oil, or debris buildup to avoid potential injury or equipment damage.

Inspect equipment for damage. If damaged, repair or replace immediately.

PRACTICE SAFE MAINTENANCE

⚠WARNING Unexpected Jacking System movement may cause serious personal injury.

LOCKOUT/TAGOUT power before performing any maintenance, adjustments, or removing obstructions.

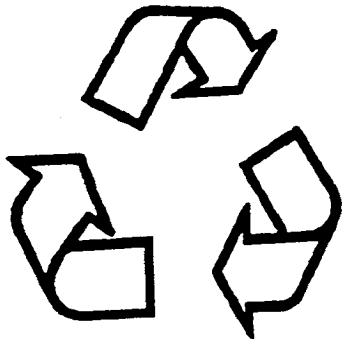
Only trained and qualified personnel should perform any maintenance or repairs.

Keep the area around the equipment clean and dry when performing maintenance.

Do not service the machine while it is in motion.

Replace worn or damaged parts. Remove grease, oil, or debris buildup.

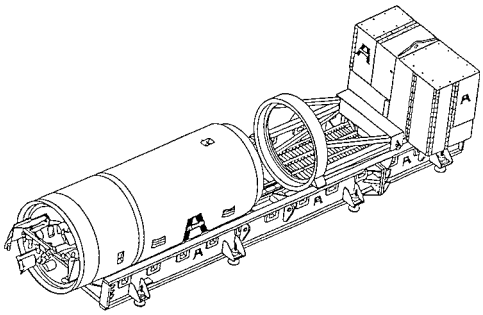
RECYCLE WASTE



Follow local, state, federal, and international regulations when recycling or disposing of waste. Waste includes fluids/oil, fuel, filters, coolant, and batteries.

Use leakproof containers when draining fluids/oil. Do not pour waste on the ground, down a drain, or into any water source.

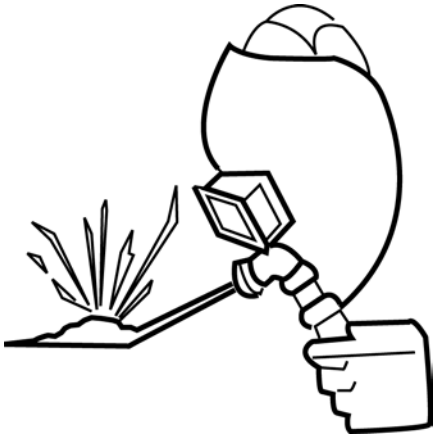
NO RIDERS ON EQUIPMENT



⚠WARNING Unexpected movement may cause riders to slip or fall resulting in serious personal injury.

Do not allow riders on the equipment when they are moving.

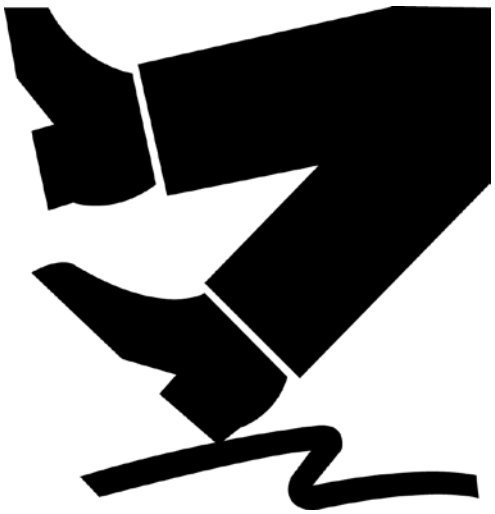
UNAUTHORIZED WELDING



⚠WARNING Unauthorized welding can cause structural failure resulting in possible injury or death.

Do not weld on any structural member. Unauthorized welding or repair will void the warranty.

SLIPPERY WHEN WET



⚠WARNING Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

Replace skid-resistant material if it is damaged or missing to prevent slips and falls.

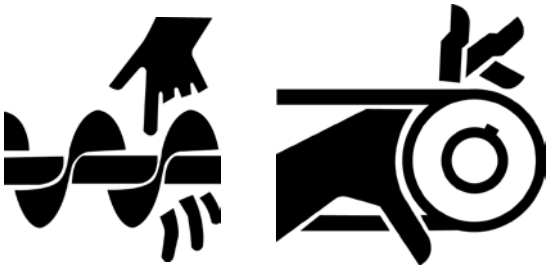
Remove any buildup of grease, oil, or debris.

KEEP JOB SITE CLEAN AND ORGANIZED

⚠WARNING Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.

KEEP AWAY FROM CONVEYORS



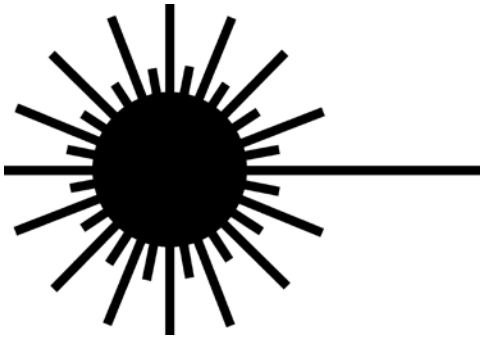
⚠DANGER Contact with rotating auger conveyor or conveyor belt idler rollers, will cause severe injury or death.

Keep hands, body, and objects clear of operating auger and conveyor.

Do not operate without covers and guards in place.

Lockout power before servicing.

AVOID LASER LIGHT EXPOSURE



⚠DANGER Staring into laser light will cause severe injury.

Do not stare into laser guidance system light beam. Avoid direct eye exposure.

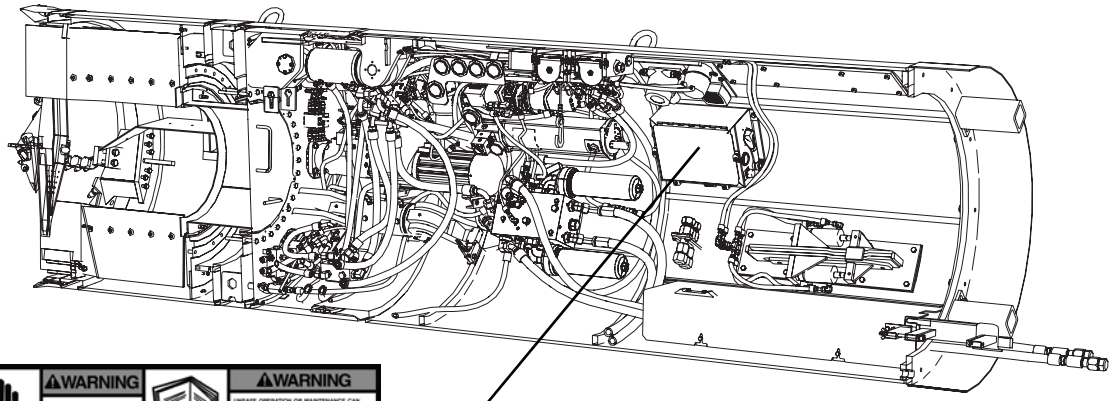
To avoid possible exposure to radiation in excess of acceptable emission limits, all repairs to laser must be performed by the original manufacturer or an authorized service technician.

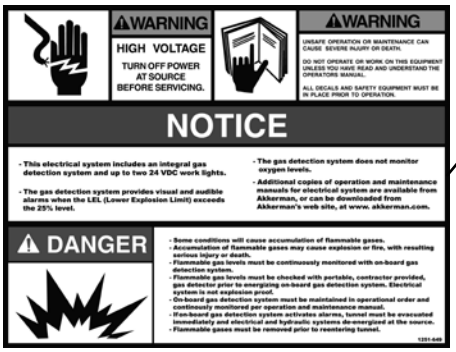
Decals

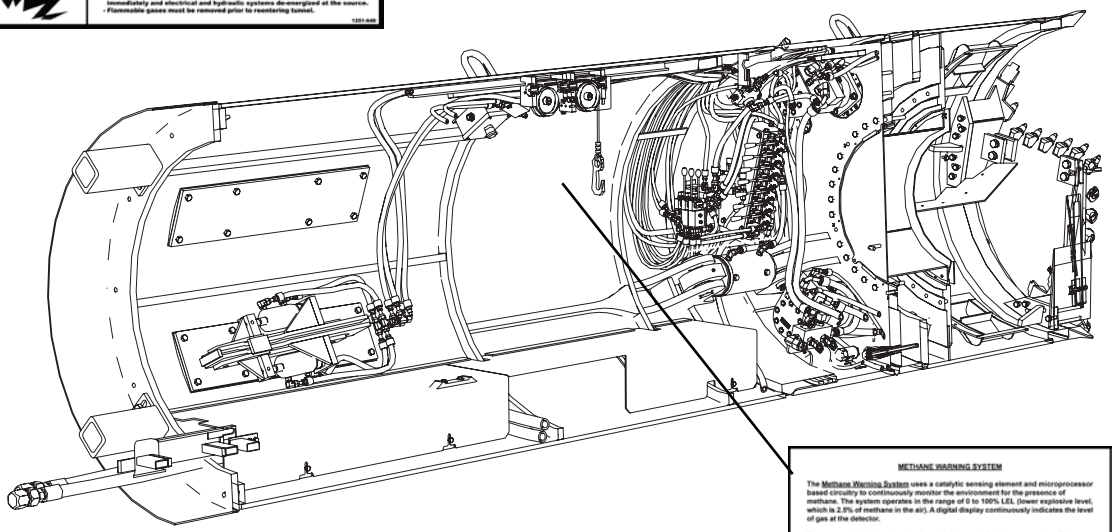
Keep all decals clean and readable. Use soft cloth, water, and a mild soap to clean the decals if they are too dirty to read. DO NOT clean decals with solvent. Solvent can damage them. Replace safety decals immediately if they are damaged, missing, or hard to read.

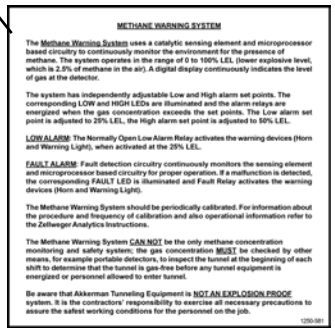
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Aftermarket Support representative for free replacement safety decals.

If a part is replaced that has a safety decal on it, apply a new safety decal to the replacement part. Before applying a new decal, be sure the surface is clean and dry.







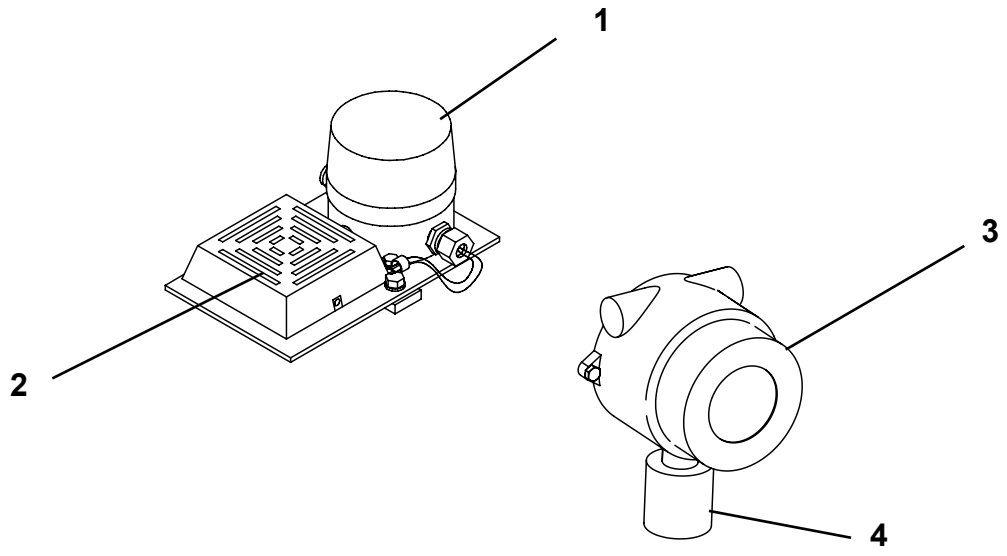


NOTES

Terminology

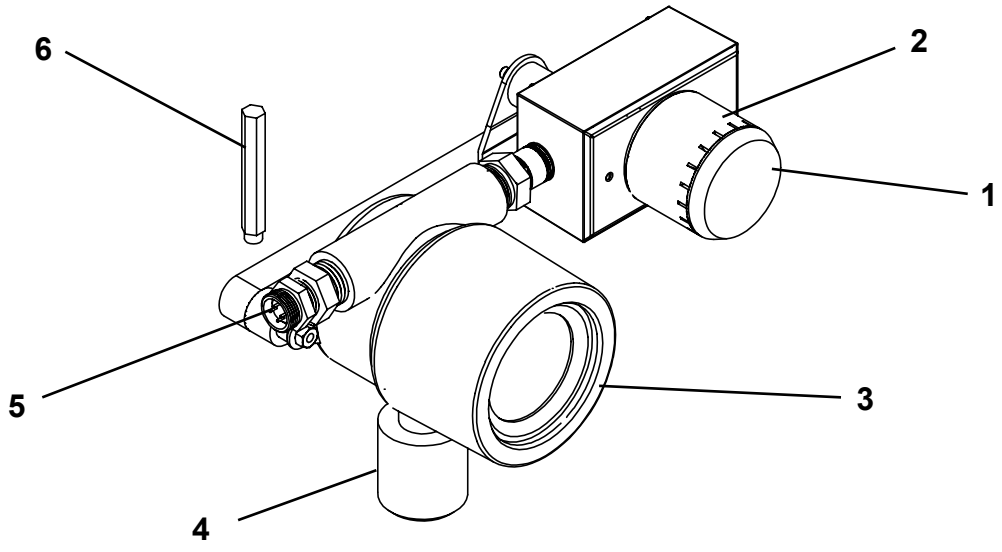
GAS DETECTION SYSTEM

Early Units



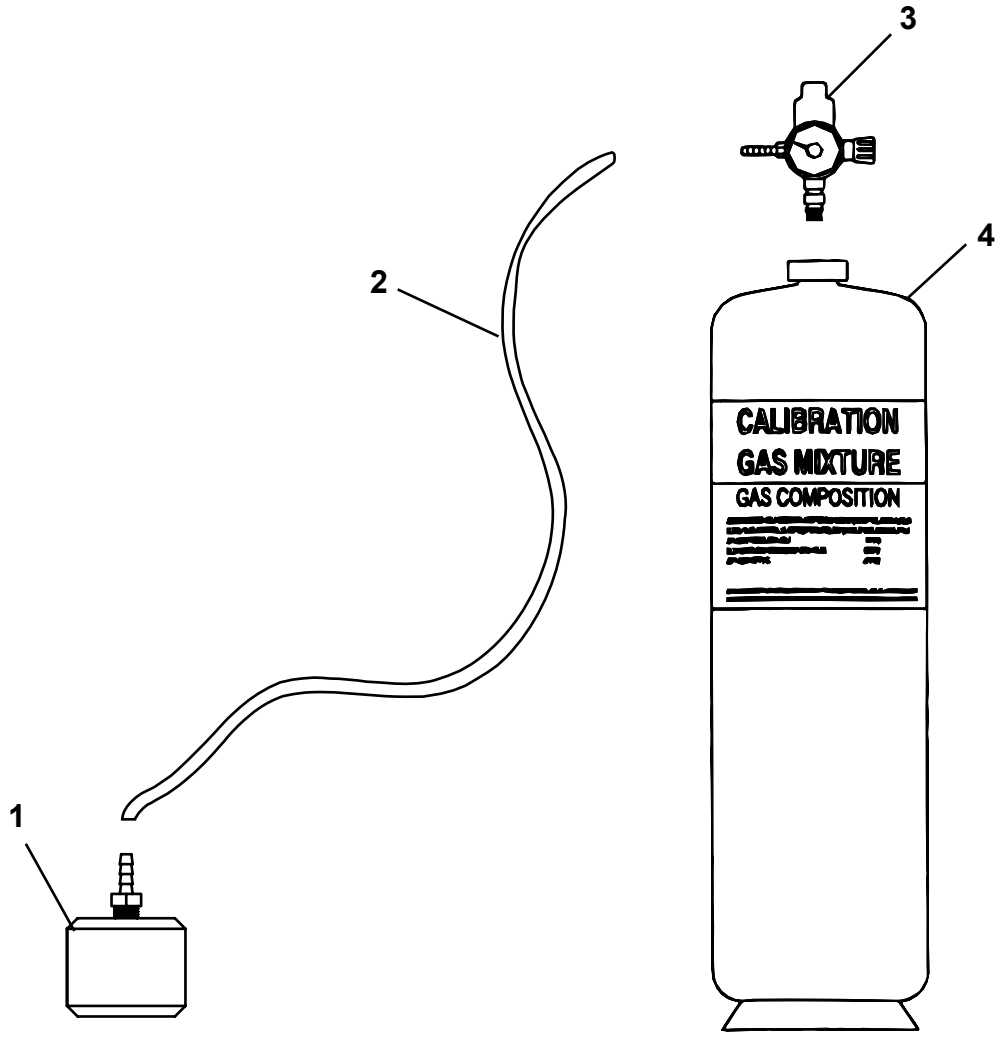
1. Strobe Light
2. Horn
3. Transmitter/Relay
4. Sensor Element

Later Units



1. Strobe Light
2. Horn
3. Transmitter/Relay
4. Sensor Element
5. Cable Connection From TBM Electrical Box
6. Magnetic Wand

GAS CHALLENGE (CALIBRATION) KIT



1. Calibration Nozzle
2. Plastic Hose
3. Regulator Valve and Gauge
4. Calibration Gas Cylinder (2)
5. Case (not shown)

Controls & Instruments

GAS DETECTION SYSTEM - TBM

⚠DANGER The gas detection system installed in the TBM monitors only methane combustible gas levels. **Monitoring of gas levels is the responsibility of the contractor.** This includes the accumulation of combustible and toxic gases, and depletion of oxygen. The contractor must keep the tunnel ventilated with fresh air.

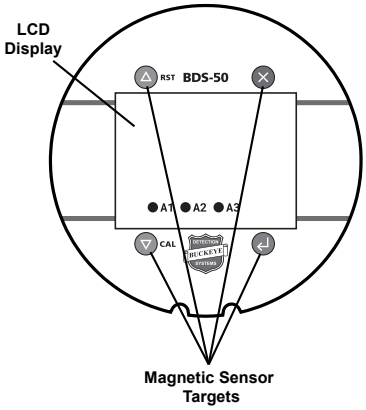
The gas detection system includes the following primary components; the gas sensor, transmitter/relay. The Akkerman system also includes the power supply connection for the system, and an audible and visual alarm system.

NOTICE For more information, refer to section 17 for the Buckeye manuals or section 18 for the Global Detection Systems manual.

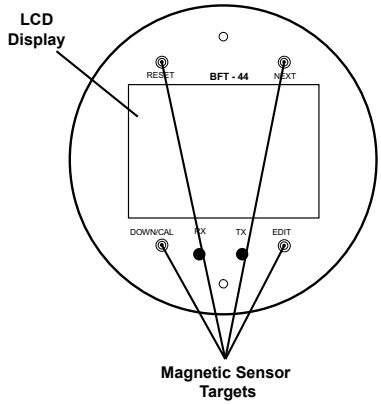
GDS GasMax II / Buckeye With Series II TBM

The transmitter LCD display shows calibrated engineering values, bar-graph data, 30 minute tread, calibration, sensor fault, and setup information. During normal operation, the current gas concentration is indicated on the display.

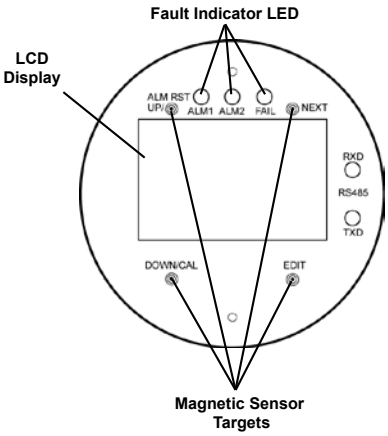
The four magnetic sensor controls are activated by a magnetic wand. Holding the magnetic wand over one of the magnetic sensor targets will activate that sensor. It may take several seconds for the magnetic sensor to activate. If the transmitter does not respond, remove the magnetic wand for several seconds and try again.



Buckeye BDS-50 Transmitter Display



Buckeye BFT-44 Transmitter Display



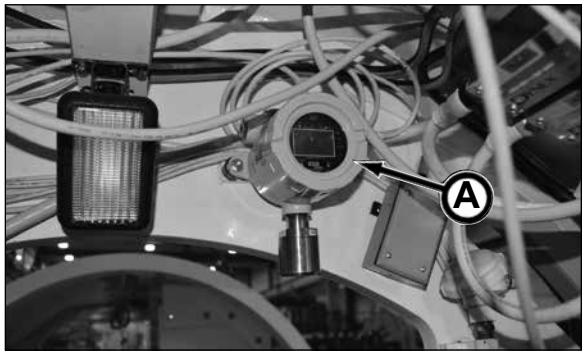
GDS GasMax II Transmitter Display

GAS DETECTOR - MTBM

⚠DANGER The gas detection system installed in the MTBM monitors only Methane combustible gas levels. **Monitoring of gas levels is the responsibility of the contractor.** This includes the accumulation of combustible and toxic gases, and depletion of oxygen. The contractor must keep the tunnel ventilated with fresh air.

NOTICE Refer to your Microtunneling System Operator's Manual for more information on the gas detection system.

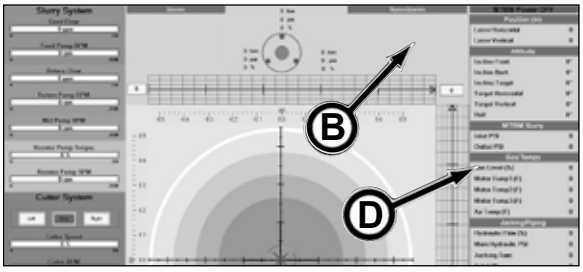
The gas detection system (A) installed in the microtunneling boring machine CANNOT be the only methane or other combustible monitoring system. The gas concentration must be checked by other portable detectors to inspect the tunnel at the beginning of each shift to determine that the tunnel is gas free before any tunnel equipment is energized or personnel are allowed to enter the tunnel. The contractor is responsible for providing air analyzers to detect hazardous gases or oxygen deficiency on the job and in the tunnel at all times.



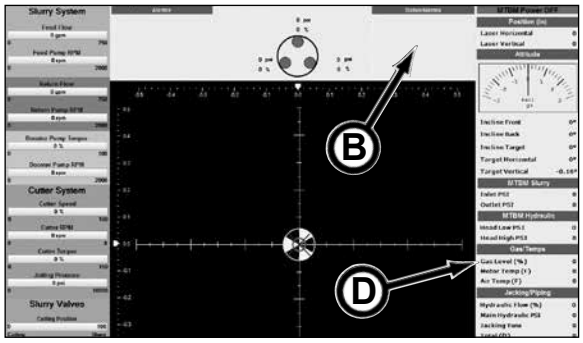
The gas detector is monitored by the control system as follows:

1. The "Gas Fault" message will appear in the status/alarms area (B) on the target screen when there is a problem with the gas detector sensor.

2. The "Gas Level High" message will appear in the status alarms area (B) on the target screen when the gas level at the gas detector reads 10% (default setting) LEL (Lower Explosive Limit) or higher.

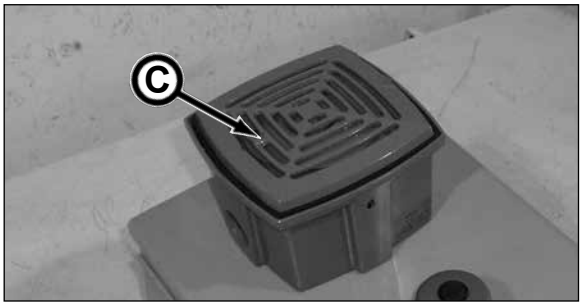


3. When the system detects a gas level reading of 10% LEL but less than 25% (default setting) LEL, the audible alarm (horn) (C) on the pit box (typically located in the launch shaft) will sound intermittently.



NOTICE Depending upon MTBM, a Pit Horn test button is either on the target screen or the MTBM control screen to test the proper operation of the horn.

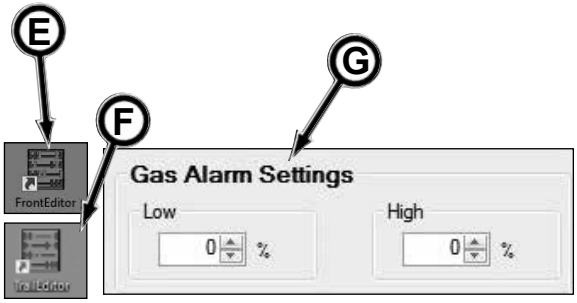
4. When the system detects a gas level reading of 25% (default setting) LEL or higher, the horn on the pit box will sound constantly.



NOTICE If the high LEL setting is reached, the cutterhead rotation and the jacking frame functions will shut down.

5. The gas level % of LEL reading (D) at the gas detector is displayed on the target screen.

NOTICE To change the LEL setting alarms, double click the FrontEditor icon (E) (early units) or Trail Section Editor (F) (later units) to load the MTBM Operational Data Editor program. Update the Gas Alarm Settings (F) by changing the low and high % fields per job requirements.



Pre-Start Inspection

⚠WARNING Do not operate this equipment until you read, study, and understand this manual, the Buckeye Gas Detector (included in section 17 of this manual), or Global Detection Systems GasMax II manual (included in section 18 of this manual), and your TBM, Pump Unit, Haul Unit, etc. manuals. A daily inspection of the equipment must be performed to prevent severe personal injury or death and equipment damage.

The contractor is fully responsible for the safety of all personnel on the job site. Check with the contractor that all site preparation requirements are in place. Be sure to comply with all MSHA and OSHA regulations, such as: an active safety program is in practice, a confined space permit (if needed) is issued, personal protective equipment is being worn; flammable, combustible, and hazardous materials are properly stored; and a lockout/tagout procedure is in place.

Use the following checklist ✓ as a guide for your daily pre-start inspection.

	1. Follow the MSHA (Mining Safety & Health Administration) and OSHA (Occupational Safety & Health Administration) regulations.
	2. Contractor is responsible for all personnel to wear proper protective equipment on the job site. Replace equipment if defective.
	3. Combustible, toxic and oxygen deficiency detectors MUST be in place and in proper working condition.
	4. Test air monitoring and ventilation detectors for proper operation.
	5. At each start up, the audible and visual alarms MUST be operating properly and the transmitter LCD display must be stabilized before tunneling.
	6. At the start of a new drive and every 40 hours of operation, use “Gas Challenge” to ensure that the gas monitor detects the proper level of the applied gas. Refer to the Perform Gas Challenge procedure in section 7, Periodic Maintenance of this manual for proper procedure.
	7. At the start of each shift, use a portable detector to make sure the tunnel is gas free before any equipment is energized or personnel are allowed to enter the tunnel.
	8. Be sure the cables from the gas detector and the horn and strobe are installed to the proper connectors on the electrical box assembly.
	9. The sensor must be installed with the sensor facing down to ensure proper operation and to prevent the buildup of moisture or contaminants, such as oil and dirt, on the filter.
	10. Work light connectors must be capped before tunneling.
	11. Remove combustible or flammable materials from equipment. Store materials properly.
	12. Inspect equipment for damage. Repair or replace as needed.
	13. Thoroughly clean equipment of mud and dirt.
	14. Be sure all covers and guards are in place before operation.
	15. Check for loose or missing hardware. Replace damaged or missing hardware.
	16. Check for worn, loose, or damaged wire connections. Repair or replace wiring connections.
	17. Tighten loose clamps or fittings.
	18. Check cables for frayed or worn insulation or wires. Replace damaged or worn cables.
	19. Keep job site clean and organized.

NOTES

Operation

OPERATING GUIDELINES

⚠WARNING Do not operate this equipment until you read, study, and understand this manual, its system manuals, and the Buckeye or Global Detection Systems manuals. Failure to do so, could result in severe personal injury or death.

1. Before operating, read and understand the Safety, Pre-Start Inspection, and Operation sections.
2. Do not operate this equipment while under the influence of alcohol, drugs, or medication.
3. Follow all Federal, State, and Local safety regulations and procedures.
4. Be sure OSHA prescribed safety protective equipment is being worn by all personnel.
5. Be sure the area is safe for operation. Keep worksite clean and orderly.
6. NEVER operate equipment if it has been engulfed with water. Contact your Akkerman Aftermarket Support representative for proper procedures on how to restore equipment for operation.
7. Have a fully charged fire extinguisher on the job site at all times.
8. Before operating, repair equipment problems.
9. Fresh air must be supplied to all underground work areas in sufficient amounts to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapor, or gases.
10. The Akkerman gas detection system **CANNOT** be the only methane or other combustible monitoring system. The gas concentration must be checked by other portable detectors to inspect the tunnel at the beginning of each shift to determine that the tunnel is gas free before any tunnel equipment is energized or personnel are allowed to enter the tunnel.
11. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without combustible gas detectors and oxygen deficient detectors.
12. When using gas detectors or other air quality analyzers, realize that there is a delay between the time the gas is encountered and when the device responds. The delay period varies with the type, age, and condition of the device. Be sure to properly maintain your equipment.
13. Do not paint the sensor assembly or the transmitter/relay.
14. Periodically test for correct operation of the system's alarm events by exposing the sensor to a targeted gas concentration above the high alarm setpoint.

15a. (Buckeye) If the message "Fault" scrolls across the gas detection transmitter display, the sensor or sensor element must be replaced and recalibrated immediately.

15b. (GDS GasMax II) If the message "Span fail - Error Code 5" scrolls across the gas detection transmitter display, the sensor or sensor element must be replaced and recalibrated immediately.

16. Never walk or work under any part of the excavator or crane and suspended loads.
17. Lock out electrical power at the source (generator) before servicing electrical components.
18. If this manual is lost, contact your Akkerman Aftermarket Support Representative for a new manual or download this manual from the Akkerman web site at www.akkerman.com.
19. Do not make any modifications to any Akkerman products. Doing so could cause structural failure and will void the warranty.
20. Check shields and guards. They must be in place and undamaged.
21. Protect the gas detector system from water and power surges. Otherwise gas detector failure will occur.

BACKGROUND INFORMATION

The release of methane and other combustible and toxic gases during boring and cutting operations without proper ventilation can be a serious hazard to workers. When the concentration of methane and other combustible gases reach a certain level, that is, above the Lower Explosive Limit (LEL) and below the Upper Explosive Limit (UEL), the gas becomes an explosive hazard. Methane is not only combustible, but high levels of methane or other contaminant gases should be a warning that the oxygen level may be too low. Gas detection must be used to assure that proper ventilation is in underground work spaces. Atmospheres with oxygen concentrations below 19.5% can have adverse physical effects (see below).

Effects of Depressed Oxygen Levels (source: MSHA)

% Oxygen in Air	*Effect*
17	Faster, deep breathing
15	Dizziness, buzzing in ears, rapid heartbeat
13	May lose consciousness with prolonged exposure
9	Fainting, unconsciousness
7	Life endangered
6	Convulsive movements, death

⚠DANGER Be aware that the harmful effects of entering an oxygen-deficient atmosphere can be so immediate that it is impossible to retreat to safety.

The Akkerman gas detection system **CANNOT** be the only methane or other combustible monitoring system. The gas concentration must be checked by other portable detectors to inspect the tunnel at the beginning of each shift to determine that the tunnel is gas free before any tunnel equipment is energized or personnel are allowed to enter the tunnel. The contractor is responsible for providing air analyzers to detect hazardous gases or oxygen deficiency on the job and in the tunnel at all times.

METHANE GAS DETECTION SYSTEM

⚠DANGER The Akkerman methane gas detection system monitors only methane gas levels. **Monitoring of gas levels is the responsibility of the contractor.** This includes accumulation of combustible and toxic gases, and depletion of oxygen. The contractor must keep the tunnel ventilated with fresh air.

The accumulation of combustible gases inside the tunnel can cause an explosion or fire, with the potential for serious injury or death of personnel. The Akkerman gas detection system continually monitors methane gas levels providing a digital readout of the level, and both an audible and visual warning if the preset levels are exceeded.

The Akkerman gas detection system includes the following primary components; the gas sensor and transmitter/relay. The Buckeye manuals are located in section 17 and the Global Detection Systems manual is located in section 18 of this manual. These manuals must be read and understood by the contractor and operators prior to operation.
The Akkerman system provides a power supply for the system, and an audible and visual alarm system.

To operate correctly, and provide the intended protection, the system must be maintained and operated per the instructions in this manual.

Although some components of the system are explosion proof, **the complete system is not explosion proof**. There is the risk of explosion or fire if the system is electrically energized when combustible gases are present. These gases can accumulate at any time that the system is not operational, such as between shifts, or an overnight shutdown. Prior to energizing the system, the tunnel must be checked for combustible gases by some other means, such as a contractor provided portable detector.

START UP

Prior to energizing the system, the tunnel must be checked for concentrations of combustible gases and oxygen deficiency. This must be done with a separate contractor supplied gas detector. Once acceptable combustible gas and oxygen levels are confirmed, the system is energized by applying power to TBM.

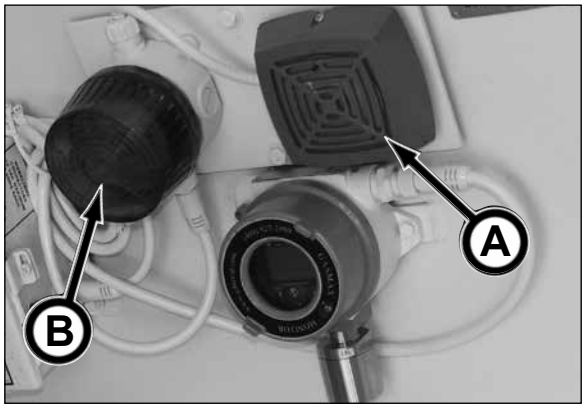
NOTICE At the start of every new drive, and every forty hours of operation, or after significant service, a “gas challenge” procedure MUST be completed on the Akkerman gas detection system. For details, refer to section 7, Periodic Maintenance, 4. Perform Gas Challenge.

During start up, the LCD display will illuminate.

If the horn (A) and strobe (B) come on immediately, typically the sensor must be replaced.

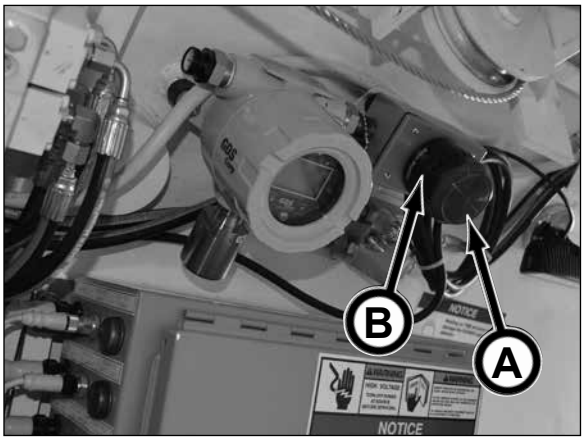
To test the operation of the horn and strobe, simply apply a gas concentration to sensor.

The horn and strobe operation can also be checked by using the magnetic wand and touch the sensor points on the LCD display per instructions in the appropriate gas detector manual (the Buckeye manuals are located in section 17 and the Global Detection Systems manual is located in section 18 of this manual).



Early Units

If horn and/or strobe do not come on or any error is shown on the LCD display, a qualified electrician MUST troubleshoot and repair the problem BEFORE allowing personnel in the tunnel and before the boring head operation.



Later Units

(continued on next page)

START UP (Continued)

(Early Units) The alarm horn volume is adjustable. The horn must be adjusted so it can be easily heard over the ambient noises of operation. Adjust the volume by using an allen wrench in the set screw on the horn face. Turn the set screw clockwise to reduce the volume. Turn the set screw counterclockwise to increase the volume.

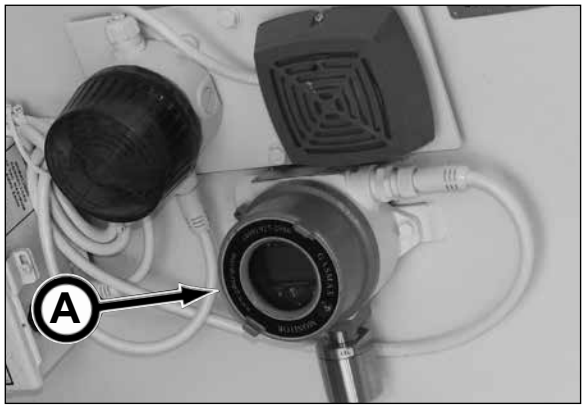
(Later Units) The alarm horn volume is preset, it is not adjustable.

The gas detection system transmitter (A) includes a LCD display. Once the system has completed its start up sequence, this display will stabilize and indicate the methane gas level.

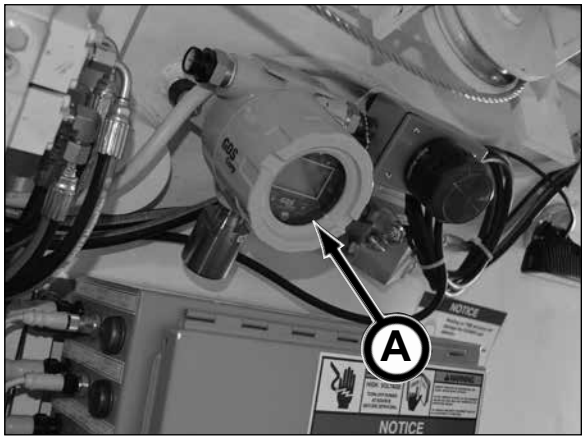
If there is no response from the alarms and the display is blank, have a certified electrician determine if power is available to the unit.

If the display has an error message, refer to the gas detector manual: Buckeye system refer to section 17 or section 18 for the Global Detection Systems GasMax II detector system in this manual.

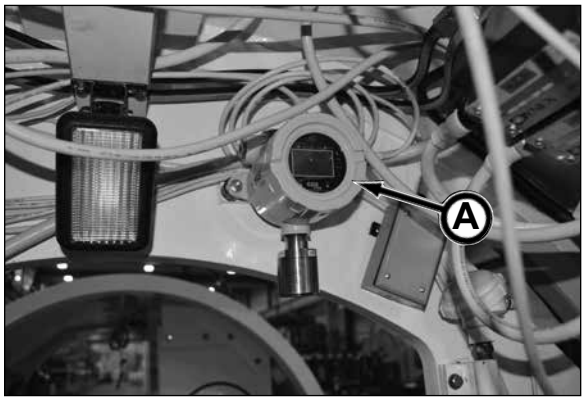
Contact the Akkerman Aftermarket Support Department for assistance.



Early Units



Later Units



MTBM

SYSTEM OPERATION

The machine operator should monitor the methane gas levels indicated in the display during operation. If levels are elevated, be prepared to evacuate the tunnel immediately.

If the fault alarm and horn activate, evacuate the tunnel immediately. Be sure tunnel is well ventilated using portable detectors before anyone is allowed to return into tunnel, and contact your electrician to check gas detection system operation. Repair or replace as necessary.

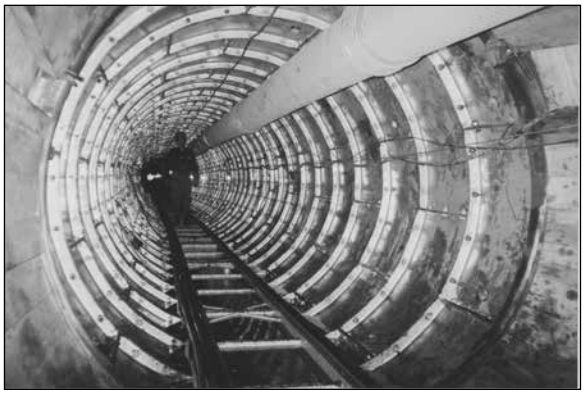
Buckeye BDS-50

GDS GasMax II

SYSTEM SHUTDOWN

⚠WARNING NEVER shut down the gas detection system while personnel are in the tunnel. Doing so could result in serious injury or death by combustible or toxic gases accumulating in the tunnel.

The gas detection system should be shut down ONLY when the job is complete for the day and ALL personnel are out of the tunnel.



NOTES

Periodic Maintenance

⚠WARNING Review the Safety section in this manual before performing maintenance. Failure to do so, could cause severe injury or death.

The requirements for maintenance are shown on the maintenance charts in this section. Intervals of maintenance are based on normal operating conditions. If operating under more difficult conditions, use a shorter time interval between maintenance.

LOCKOUT/TAGOUT POWER BEFORE SERVICING

⚠WARNING Severe personal injury or death can result from unexpected machine movement.

LOCKOUT/TAGOUT power before attempting to make repairs or adjustments to this equipment, unless otherwise indicated. Proper lockout/tagout will prevent accidents and save lives. Performing the lockout/tagout will also prevent the equipment from moving or operating unexpectedly.

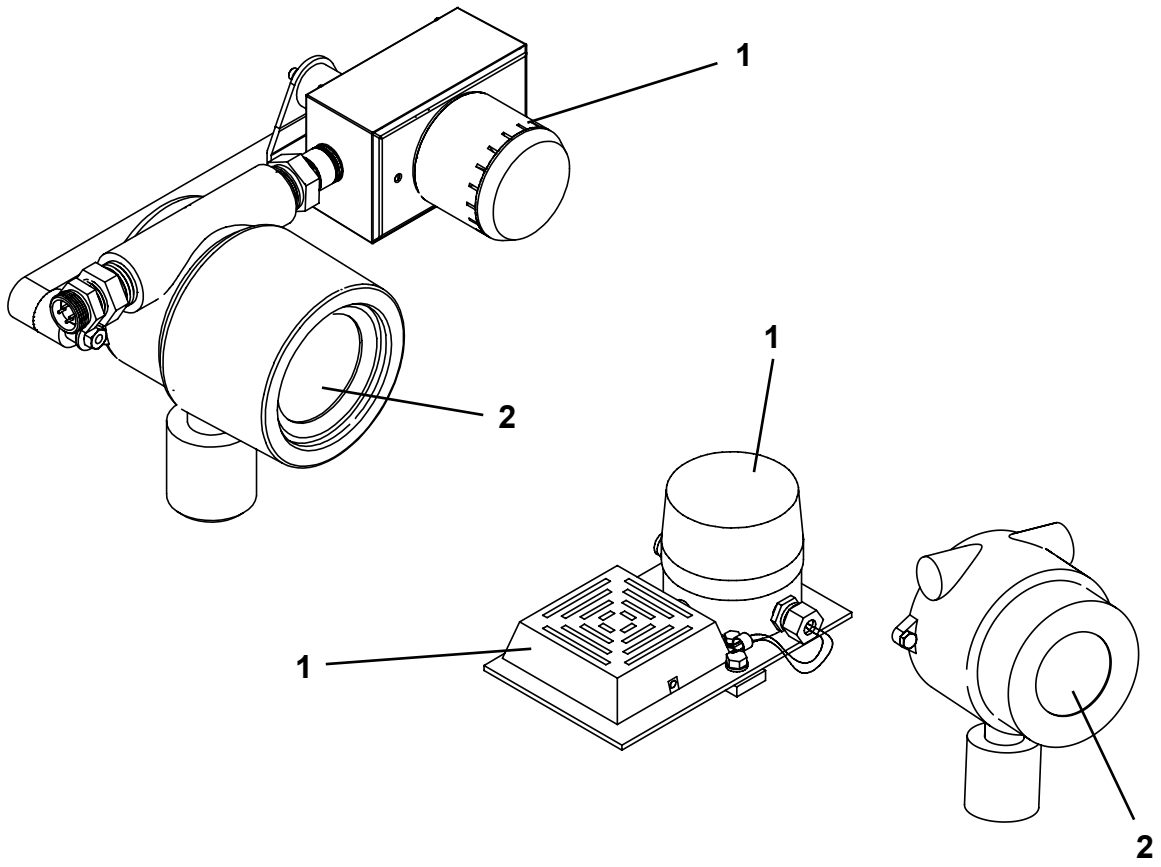
WELDING

NOTICE Welding on TBM structure will damage the gas detector.

BEFORE performing authorized welding on TBM, remove the gas detector by removing two mounting bolts and the four pin electrical connector.

MAINTENANCE CHARTS

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.

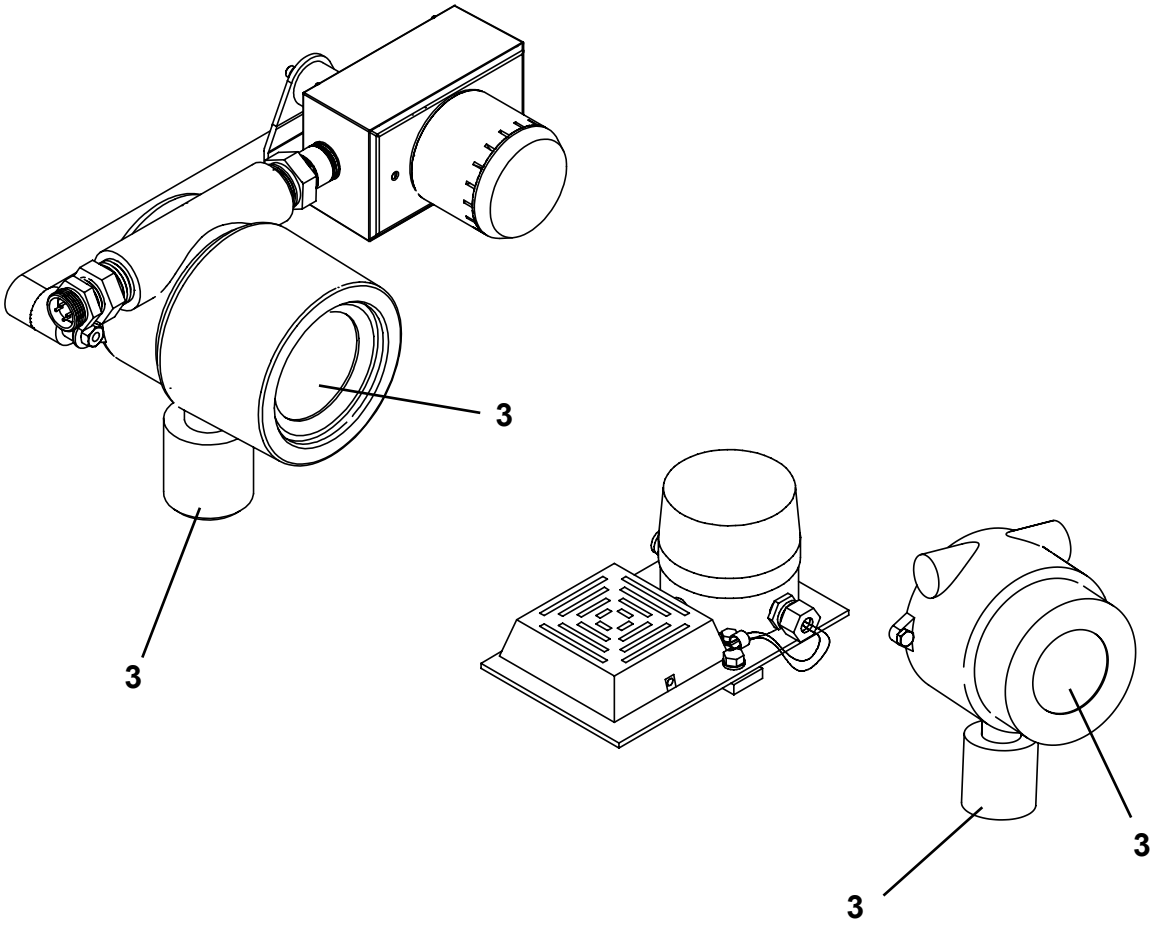


START UP

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Audible/Visual Alarms	Check	See detail in this section.	
2.	Transmitter Display	Check	Display must stabilize prior to operation.	

NOTICE For the operation and maintenance information on the transmitter/relay and sensor, refer to the Buckeye manuals in section 17 or section 18 for the Global Detection Systems GasMax II manual.

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.

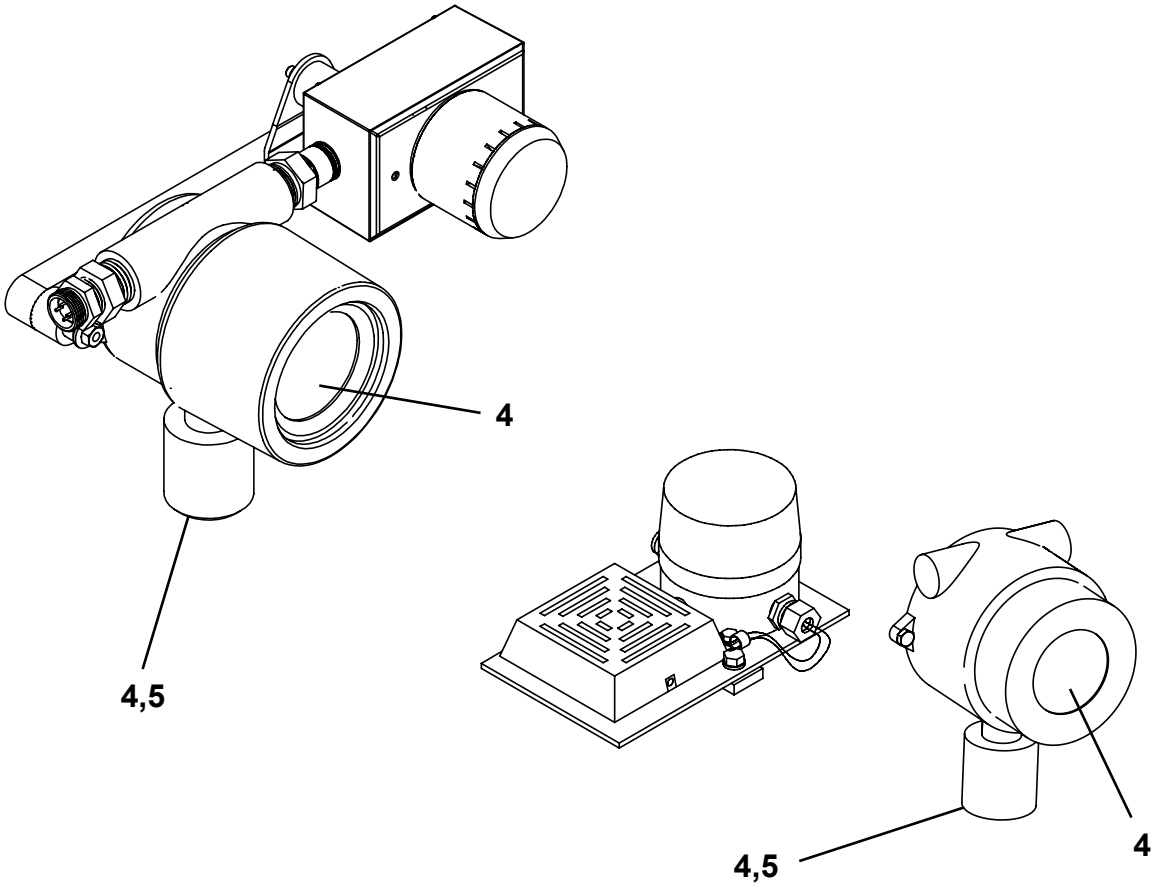


START OF NEW DRIVE AND EVERY 40 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
3.	Transmitter/Sensor	Gas Challenge	50% Full Scale Deflection of target gas.	

NOTICE For the operation and maintenance information on the transmitter/relay and sensor, refer to the Buckeye manuals in section 17 or section 18 for the Global Detection Systems GasMax II manual.

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.

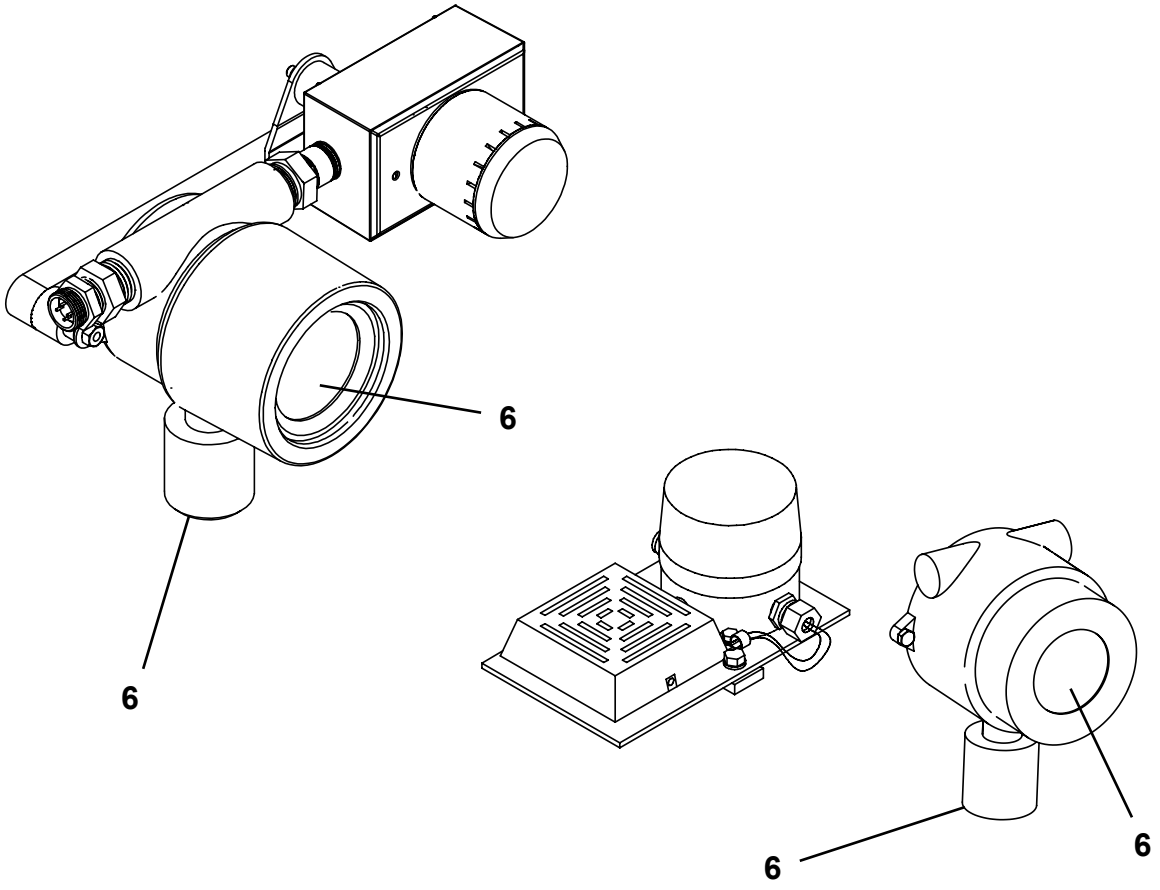


DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
4.	Transmitter/Sensor	Check	If the following appears, sensor must be replaced: • Buckeye - "Fault" • GDS - "Span Fail - Error Code 5"	
5.	Sensor Head	Inspect	Clean	

NOTICE For the operation and maintenance information on the transmitter/relay and sensor, refer to the Buckeye manuals in section 17 or section 18 for the Global Detection Systems GasMax II manual.

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



EVERY THREE MONTHS OF OPERATION OR AS REQUIRED

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
6.	Transmitter/Sensor	Check	Calibrate	

NOTICE For the operation and maintenance information on the transmitter/relay and sensor, refer to the Buckeye manuals in section 17 or section 18 for the Global Detection Systems GasMax II manual.

START UP

⚠WARNING NEVER operate tunneling equipment without proper operating gas detection systems. Severe personal injury or death can occur without proper gas detection systems in place due to accumulation of combustible and toxic gases, and depletion of oxygen.

NOTICE For the operation and maintenance information on the transmitter/relay, and sensor, refer to the appropriate Buckeye User manual in section 17 or section 18 for the Global Detection Systems GasMax manual.

1. CHECK AUDIBLE & VISUAL ALARMS

If the horn and strobe come on immediately, typically the sensor must be replaced.

To test the operation of the horn and strobe, simply apply a gas concentration to sensor.

The horn and strobe operation can also be checked by using the magnetic wand and touch the sensor points on the LCD display per instructions in the appropriate gas detector manual (the Buckeye manuals are located in section 17 and the Global Detection Systems manual is located in section 18 of this manual).

If the audible and/or visual alarms do not work properly or any error is shown on the LCD display, a qualified electrician MUST troubleshoot and repair the problem BEFORE allowing personnel in the tunnel and before the boring head operation.

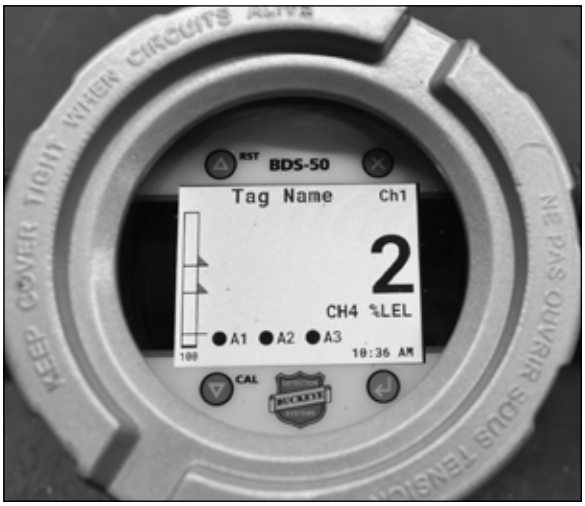
Early Units

Later Units

2. CHECK TRANSMITTER DISPLAY

When the Akkerman gas detection system is activated, the transmitter will run through a start-up sequence. The display will stabilize and show the combustible gas level.

If the transmitter display does not operate or the display does not stabilize, refer to the appropriate Buckeye User manual in section 17 of this manual or section 18 for the Global Detection Systems GasMax manual.



Buckeye BDS-50 Gas Detector Shown

START OF NEW DRIVE AND EVERY 40 HOURS OF OPERATION

NOTICE For the operation and maintenance information on the transmitter/relay, and sensor, refer to the appropriate Buckeye User manual in section 17 or section 18 for the Global Detection Systems GasMax manual.

3. PERFORM GAS CHALLENGE

A “gas challenge” is simply applying a known concentration of gas to the sensor and ensuring that the gas monitor detects the proper level of applied gas.

Gas must be presented to sensors at a level that will not over pressurize the sensor. Too strong a gas stream can lead to over reporting of concentrations. Refer to the appropriate Buckeye User manual in section 17 or section 18 for the Global Detection Systems GasMax manual. for more information.

A Gas Challenge Kit (Part No. 016423A) is available from Akkerman which provides a known concentration of gas (2.5% Methane, 50% LEL) and the equipment to apply this gas to the sensor.

⚠WARNING Do not use the calibration kit if any part is damaged or defective.

1. Before entering tunnel area, use a portable detection device to be sure that the area is safe for entry (no high levels of either toxic or combustible gas are present).

⚠WARNING Contents under pressure. Do not use or store near heat or open flame. Exposure to temperatures above 130° F (54° C) may cause contents to vent or cause bursting. Never discard container into fire or incinerator. Gas mixture containing in excess of 23.5% oxygen may vigorously accelerate combustion. Mixtures containing less than 19.5% oxygen may cause suffocation. Store and use with adequate ventilation. Use with equipment rated for cylinder pressure.

First Aid if inhaled: Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. Call physician immediately.

2. Check that the label on the pressurized cylinder contains the correct calibration gas mixture (gas composition) and LEL percentage. That is, Methane 2.5% (50% LEL).

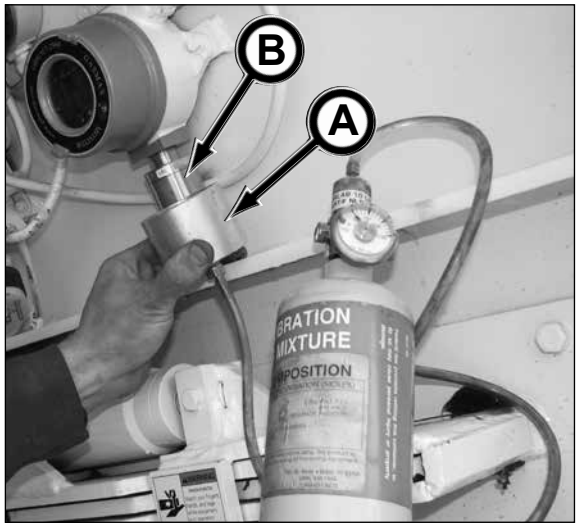
(continued on next page)

3. Close the regulator valve by turning the knob clockwise.

4. Screw the regulator valve onto the cylinder.

5. Attach one end of the plastic hose to the regulator. Attach the calibration nozzle/adapter to the other end.

6. Attach the calibration nozzle/adapter (A) to the gas sensor (B).



(continued on next page)

7. Apply a concentration of gas to the sensor by opening the regulator valve and turning the knob counterclockwise.

8. Check the transmitter display for the proper concentration of gas.

If display indicates the proper concentration of gas, the gas detection system is operating properly.

NOTICE If the system does not display the correct gas concentration, it **MUST** be calibrated per the instructions in #6 Calibrate Transmitter Sensor, As Required maintenance in this section or per the instructions in the appropriate Buckeye manual located in section 17 or the Global Detection Systems GasMax manual in section 18 of this manual.

Buckeye BDS-50 Shown

9. Close regulator valve by turning the knob clockwise.

10. Remove the calibration nozzle/adapter from the gas sensor.

(continued on next page)

11. Disconnect plastic hose from regulator and nozzle.

12. Remove regulator valve from cylinder.

13. Properly replace the cylinder, regulator valve, plastic hose, and calibration nozzle/adapter into the protective case and secure case.

DAILY OR EVERY 10 HOURS OF OPERATION

4. CHECK TRANSMITTER DISPLAY

Eventually the sensor will degrade to the point where the transmitter can no longer compensate. If this point is reached the following messages will be displayed indicating that the sensor / sensor element must be replaced immediately.

(Buckeye) The message “Fault” will be displayed on the LCD screen.

(GDS GasMax II) The message “Span Fail - Error Code 5” will be displayed on the LCD screen.

A qualified technician must replace the sensor/ sensor element.

IMPORTANT: Never install a sensor with power applied. The sensor may be permanently damaged.

Early Units

Later Units

5. INSPECT SENSOR HEAD, FILTER & COVER

Inspect sensor head cap (A), and sensor filter (B) for dirt, grease, or other foreign material.

If dirt, grease or foreign material is on the sensor head cap, simply wipe it off with a cloth, or use a mild cleaning agent (soap and water). DO NOT allow the sensor (C) to be subjected to water or the cleaning agent. Doing so will damage sensor.

If dirt is on the sensor head cap or sensor filter (silver disc), remove the sensor head cap from the sensor base (D) and use compressed air (maximum 40 - 75 psi) to remove the dirt. Then replace sensor head cap on sensor base. DO NOT use compressed air on the sensor. Sensor damage will occur.

If grease is on the sensor filter or cap:

1. Remove the sensor cap from the sensor base.

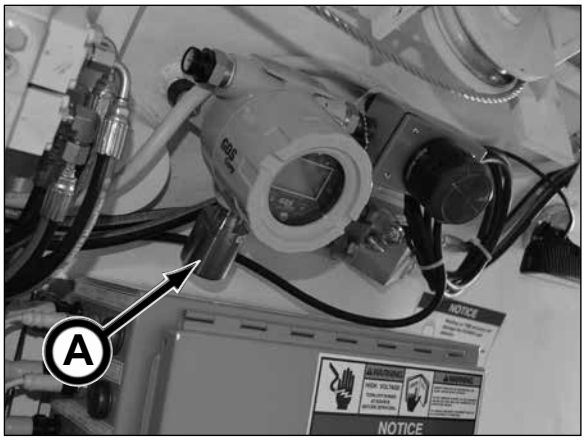
2. Clean filter and/or cap with a mild solvent to remove grease.

3. After cleaning, it is important that the filter and cap are dry before replacing on the sensor base.

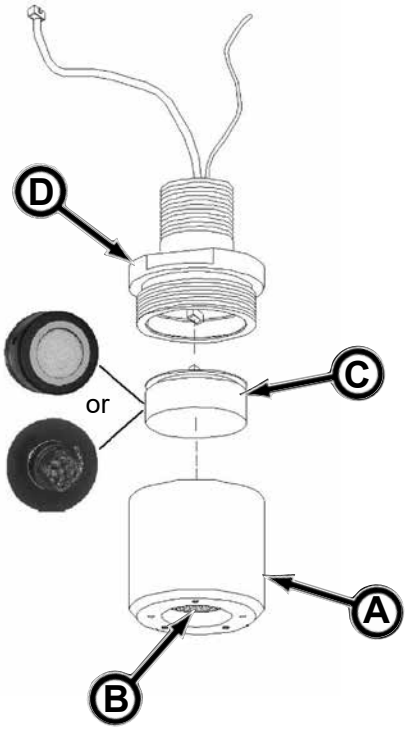
⚠WARNING If the filter/cap is not dry, it can block gas from getting to the sensor, resulting in the environment not being properly monitored for methane gases.
Or in the case of using a solvent to clean the grease out, it may cause the sensor to go into the alarm mode as it detects the solvent out-gassing from the filter.

A - Sensor Head Cap
B - Sensor Filter
C - Sensor
D - Sensor Base

Early Units



Later Units



EVERY THREE MONTHS OF OPERATION OR AS REQUIRED

NOTICE Refer to the appropriate Buckeye manual in section 17 or the GDS GasMax manual in section 18 of this manual for the operation and maintenance information on the transmitter/relay, and sensor.

6. CALIBRATE TRANSMITTER SENSOR

Calibration is the most important function for insuring correct operation of the gas detector.

The CAL MODE is designed to make calibration quick, easy and error free.

Follow these 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 20 minutes).
- Calibrate only in a clean atmosphere, which is free of background gas.

Use the following procedure to perform ZERO and SPAN calibrations.

1. Power up gas detection system.

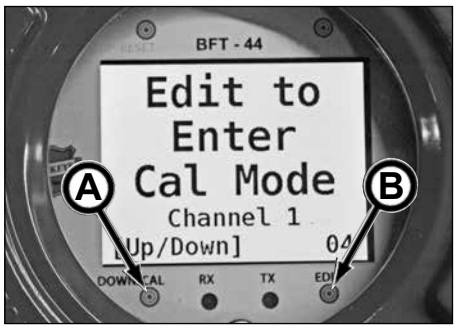
Early Units

Later Units

2. To enter the CAL (Calibration) MODE from:

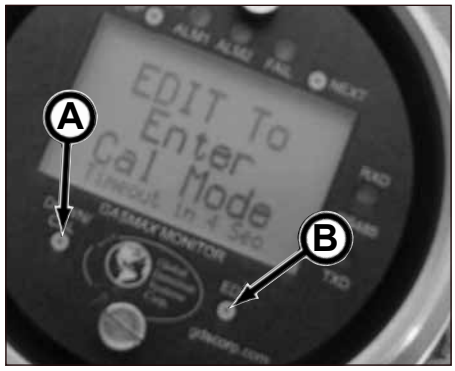
   • ***GasMax or Buckeye BFT-44:***

   press the DOWN/CAL key (A) with the magnetic wand and within 5 seconds press the EDIT key (B) to perform zero calibration.



Buckeye BFT-44

For Buckeye BDS-50, continue to next page.



GDS GasMax II

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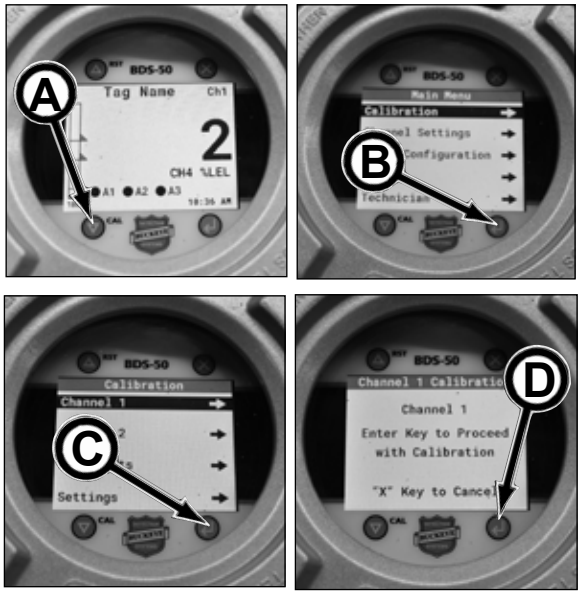
2. To enter the CAL (Calibration) MODE from: (continued)

   • BDS-50:

   press CAL key (A) with the magnetic wand. Calibration menu appears - press Enter (B), select Channel 1 - press enter (C). Channel 1 Calibration menu appears and press enter (D) to perform zero calibration.



Buckeye BDS-50

3. Using an optional process cover (Cal Cup), 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/Enter key (E) to perform a ZERO calibration.

Buckeye BFT-44

NOTICE If it is known for sure that there are no interfering gases or vapors present, ambient air may be used to set the zero point.

4. If the ZERO calibration is successful, press the following key to proceed to the SPAN check.

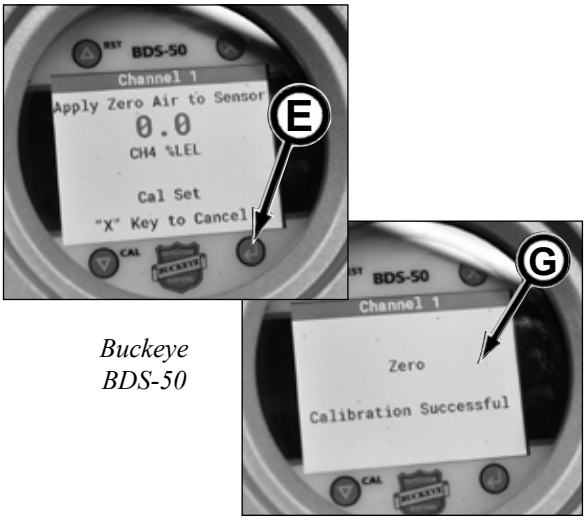
   • GasMax or Buckeye BFT-44:

   NEXT key (F) to proceed to the SPAN check.

GDS GasMax II

   • BDS-50:

   Zero Calibration Successful window (G) appears and automatically proceeds to the SPAN check screen.



Buckeye BDS-50

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5. Apply span gas to the sensor as follows:

a. Check the label on the pressurized cylinder to be sure it contains the correct calibration gas mixture (gas composition) and LEL percentage (Methane 2.5% [50% LEL]).

b. Close the regulator valve by turning the knob clockwise.

c. Screw the regulator valve onto the cylinder.

d. Attach one end of the plastic hose to the regulator.

e. Attach the calibration nozzle adapter to the other end of hose.

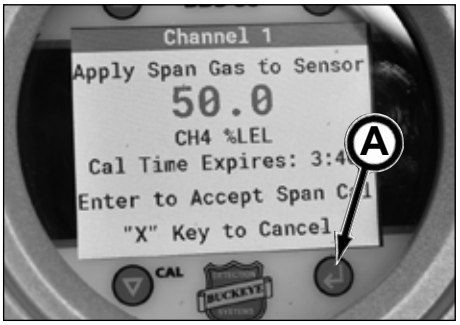
(continued on next page)

f. Attach calibration nozzle adapter to sensor.

6. Apply the calibration methane 2.5% (50% LEL) gas mixture at .5 liters/min by opening the regulator valve by turning the knob counterclockwise. After the reading is stable (approximately 1 minute) press the EDIT/Enter key (A) to perform a SPAN calibration.

GDS GasMax II

Buckeye BFT-44



Buckeye BDS-50

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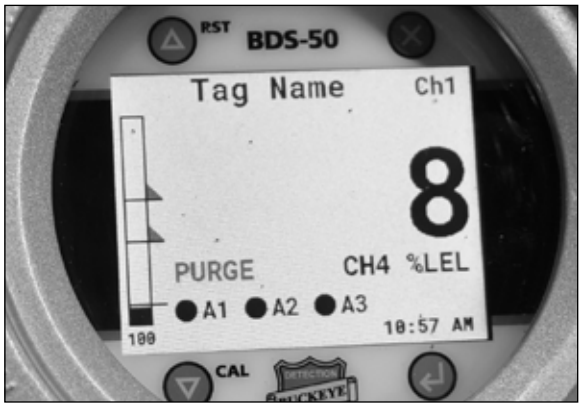
7. When the SPAN calibration is successful, the display flashes the following message and then the CAL PURGE delay starts.

   GasMax II: “REMOVE CAL GAS”
   Buckeye BFT-44: “CAL PURGE”
   Buckeye BDS-50: “PURGE”

8. Remove span calibration gas.

GDS GasMax II

Buckeye BFT-44



Buckeye BDS-50

9. The CAL MODE will be complete after the CAL PURGE delay. The main operating screen appears.

GasMax II

BFT-44

BDS-50

NOTES

Troubleshooting

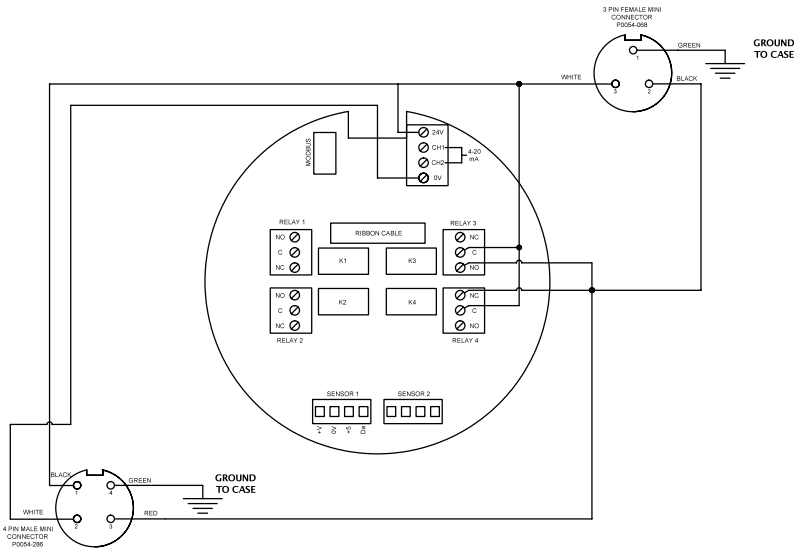
NOTICE To troubleshoot the Buckeye gas detector, refer to the appropriate Buckeye User Manual located in section 17 of this manual.

To troubleshoot the GDS GasMax II gas detector, refer to the GDS GasMax II Operation and Maintenance Manual located in section 18 of this manual.

Problem	Cause	Solution
Gas Detection System does not operate.	Power source is not activated.	Activate power source.
	Power cable is damaged.	Replace cable.
	If system still does not operate, contact your Akkerman Aftermarket Support Representative.	
Strobe does not work but horn does work.	Strobe is not properly connected to system electrical box.	Connect strobe cable to strobe connection on electrical box.
	Light bulb is burned out.	Replace light bulb.
	Cable is damaged.	Replace cable.
	If strobe still does not work, contact your Akkerman Aftermarket Support Representative.	
Horn does not work but strobe does work.	Horn is not properly connected to system electrical box.	Connect horn cable to strobe connection on electrical box.
	Volume is set too low.	Readjust horn volume by turning set screw counterclockwise.
	Cable is damaged.	Replace cable.
	If horn still does not work, contact your Akkerman Aftermarket Support Representative.	

GAS DETECTOR ASSEMBLY DIAGRAM - TBM EARLY UNITS

Buckeye Gas Detector BDS-50 Wiring Diagram



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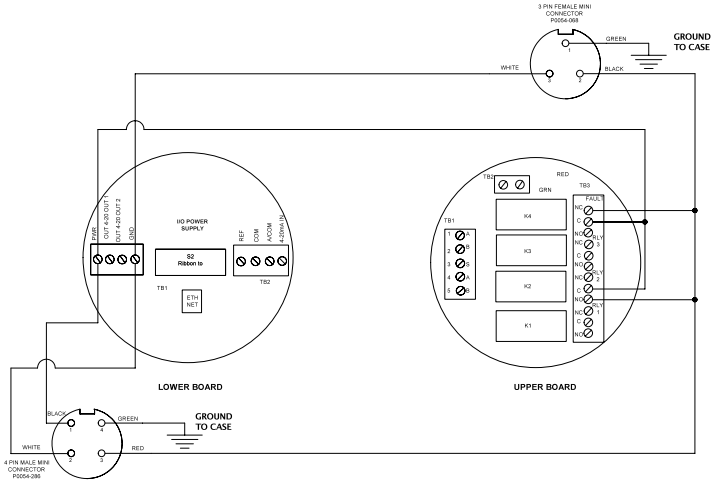
Buckeye Gas Detector BFT-44 Wiring Diagram



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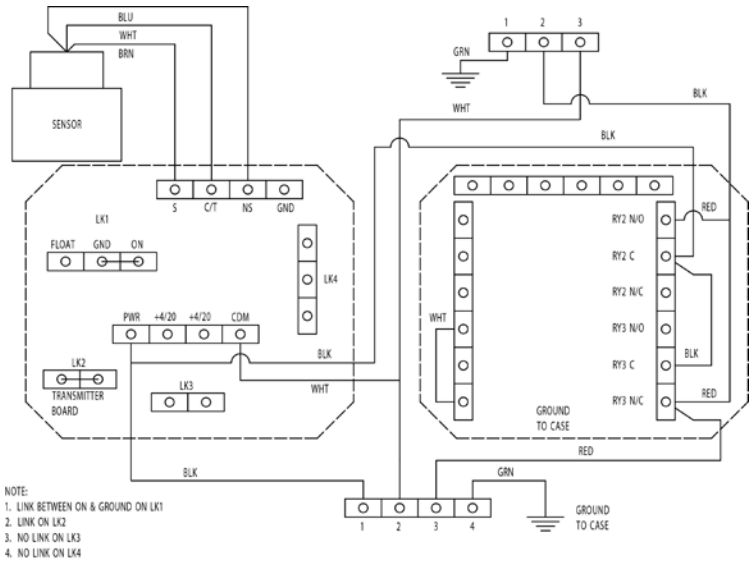
GasMax Gas Detector Wiring Diagram



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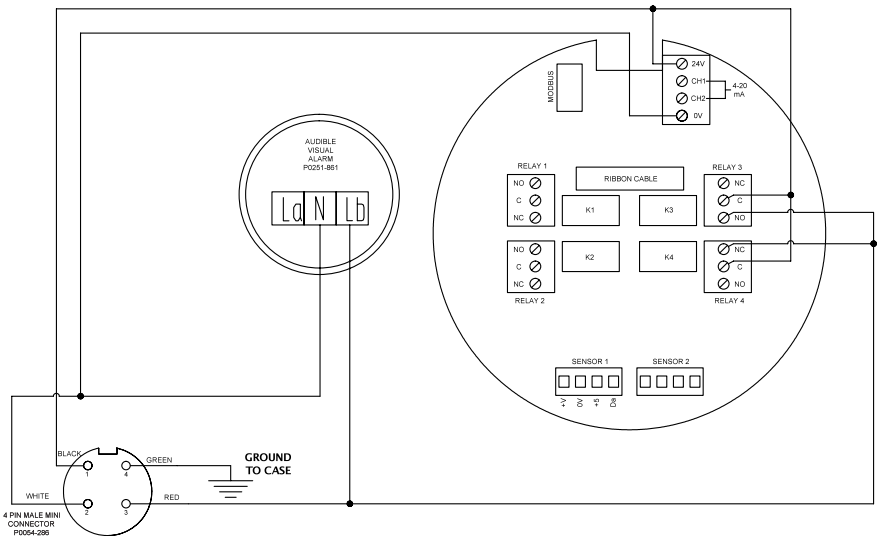
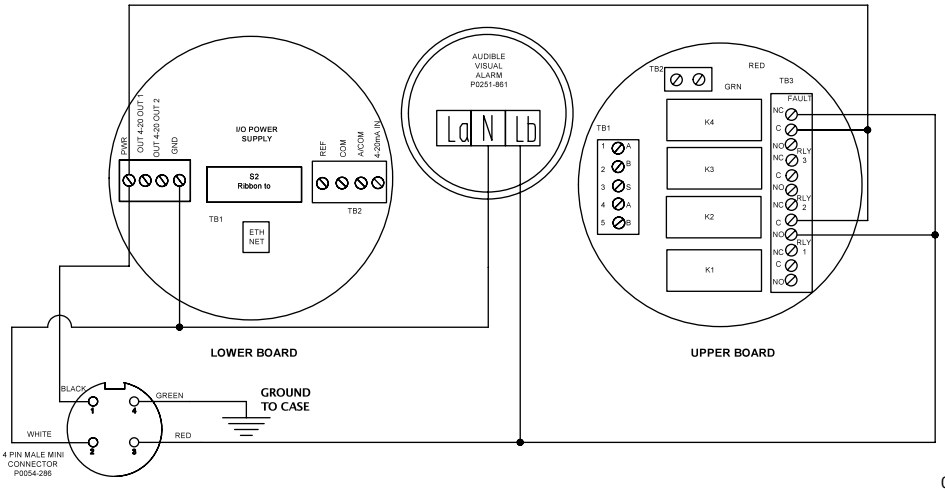
GAS DETECTOR ASSEMBLY DIAGRAM WITH ALARM - TBM LATER UNITS

Buckeye Gas Detector BDS-50 Wiring Diagram



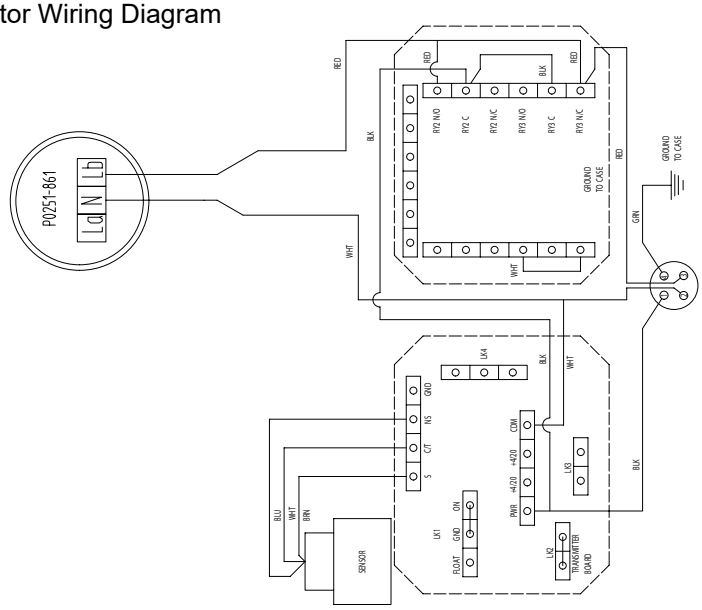
031499A_revF

Buckeye Gas Detector BFT-44 Wiring Diagram



031499A_revE

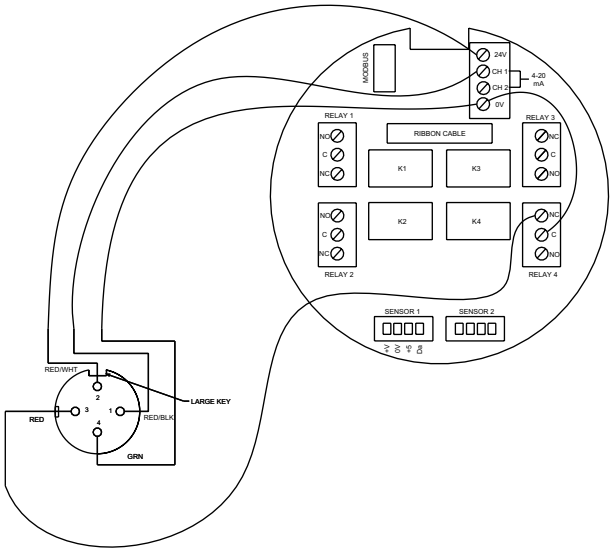
GasMax Gas Detector Wiring Diagram



031499A_revD

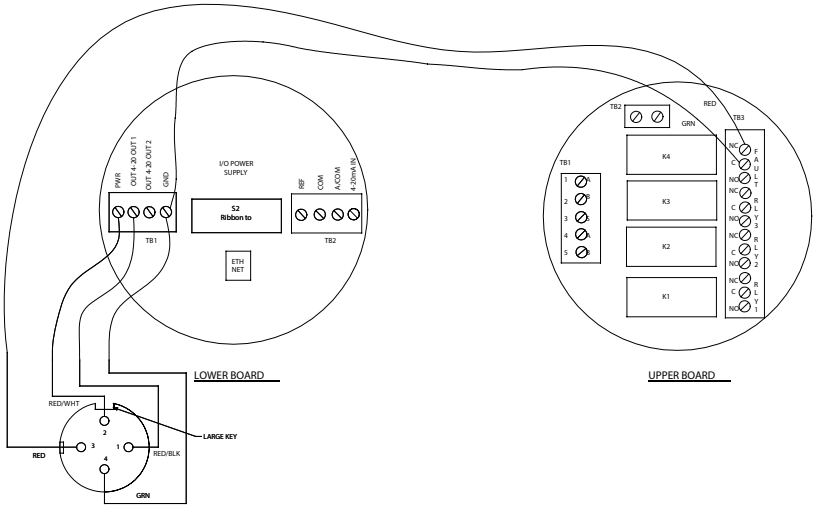
GAS DETECTOR WIRING DIAGRAM - MICROTUNNELING

Buckeye Gas Detector BDS-50 Wiring Diagram



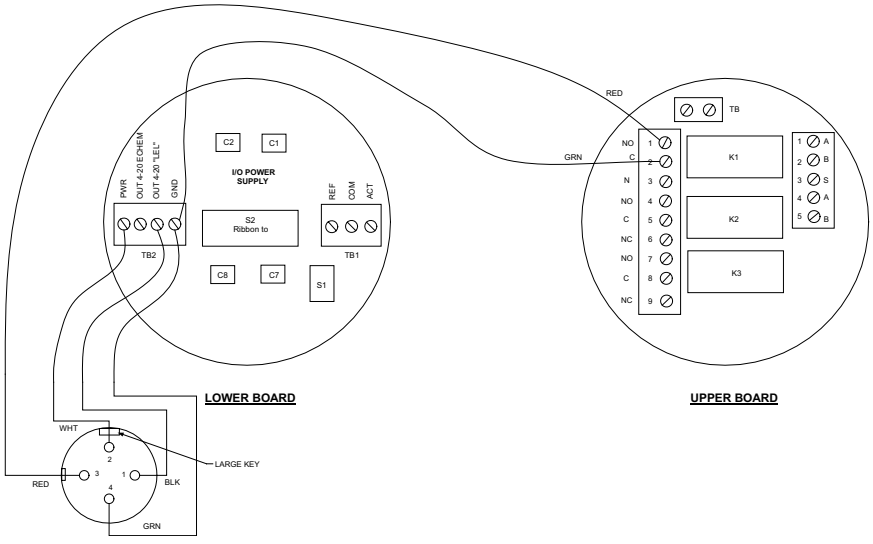
A03946A_revF

Buckeye Gas Detector BFT-44 Wiring Diagram



A03946A_revE

GasMax Gas Detector Wiring Diagram



A03946A_revD

BUCKEYE GAS DETECTOR STATUS/FAULTS

NOTICE For more information on the Buckeye gas detector, refer to the appropriate Buckeye User Manual located in section 17 of this manual.

The BFT44 and BDS-50 transmitters have a full alpha-numeric display that provides user information pertaining to the transmitter status and faults.

GASMAX II GAS DETECTOR FAULT CODES

NOTICE For more information on the GDS GasMax II gas detector, refer to the GDS GasMax II Operation and Maintenance Manual located in section 18 of this manual.

Fault Number	Description	Solution
1	Sensor Type Mismatch	Replace with proper sensor
2	Zero or Span Mismatch	Use proper test gas
3	Sensor Calibration Error	Recalibrate
4	Zero Calibration Fail	Recalibrate
5	Span Calibration Fail	Recalibrate
6	History Data File Full	Clear the event log
7 - 10	Sensor Data Memory Fail	Contact Factory

NOTES

Specifications

BUCKEYE BFT-44 GAS DETECTOR

General Specifications

Temperature Range (Operating) ..... -40°F to +140°F (-40°C to 60°C) Ambient
Temperature Drift ..... Less than .1% per degree Celsius over ambient temperature
Humidity ..... Up to 98% non-condensing
Display ..... QVGA color TFT 240 x 320 LCD pixel backlit display, 30 minute trend, bar graph and engineering units
Accuracy ..... ± 1% full scale

Electrical Specifications

Operating Voltage ..... 24 VDC nominal (10 - 30 VDC) @ 10 watts max
Cable Entries ..... 2 x 3/4" - NPT conduits
Wiring ..... 3 or 4 wire option
Electromagnetic Compatibility ..... EMI / RFI protected
Relays ..... 3 Alarm, 1 fault, contacts rated 5A @ 30 VDC (form "C")
4 - 20 mA ..... 3 wire current source output
RS-485 ..... RS-485 Modbus® compatible

Mechanical Specifications

Enclosure Material ..... Aluminum
Transmitter Dimensions ..... 5'" x 5" x 5.05"
Transmitter Weight (single) ..... 4.65 lb
Water and Dust ..... IP66 and IP67
Hazardous Area ..... CSA, Class 1 Div. 2, Groups A, B, C & D

BUCKEYE BDS-50 GAS DETECTOR

General Specifications

Temperature Range (Operating) ..... -40°F to +140°F (-40°C to 60°C) Ambient
Humidity ..... Up to 95%
Display ..... QVGA color TFT 240 x 320 LCD pixel backlit display

Electrical Specifications

Operating Voltage ..... 24 VDC nominal (10 - 30 VDC) @ 5 watts max
Cable Entries ..... 2 x 3/4" - NPT conduits
Wiring ..... 3 or 4 wire option
Electromagnetic Compatibility ..... EMI / RFI protected
Relays ..... Programmable (4) relays, contacts rate 250 VAC, 30 VDC, 5.0 A max resistive, form C
4 - 20 mA ..... Current source analog output (max loop resistance 750 phms @ 24 VDC
RS-485 ..... Modbus® RTU / RS-485

Mechanical Specifications

Enclosure Material ..... Cast Aluminum Enclosure / Stainless Steel Sensor Housing
Transmitter Dimensions (w/h/d) ..... 5.71'" x 7.76" x 5.06"
Transmitter Weight (single) ..... 5 lb (2.27 kg)
IP Rating ..... IP65 and IP66 with optional weather guard
Hazardous Area ..... CSA, Class 1 Div. 1, Groups A, B, C & D, T6

GDS GASMAX II

Power Consumption
Catalytic Combustible Sensors (requires 10-0233 I/O Power Supply and 3 wire operation):
100 mA @ nominal 24 VDC

Operating Voltage
10-30 VDC at < 3 watts with relay board. Additional power (4W peak) required for Arctic Monitor option.

Display
Backlit 64 x 128 pixel LCD with 30 minute trend, bargraph and eunits.

Inputs
EC channel: Accepts signals from GDS Corp toxic / O_2 sensors.

mA / Bridge channel: Adjustable excitation voltage for SmartIR, PID and catalytic bead. Can be converted to 4-20mA input for use with GDS-49 or other standard 4-20 mA source.

Outputs
Standard dual 3-wire 4-20mA current source. Max loop R is 750 ohms with nominal 24VDS power supply.

Optional dual 1500CMV isolated 4-20mA current source. Max loop R is 650 ohms with nominal 24VDC.

Optional three Form C Relays 5A @ 30VDC / 240VAC.

Optional RS-485 2 wire MODBUS®

Temperature Range
-40°C to +65°C operating
-55°C to +65°C operating (Arctic)

Housing
Aluminum housing with epoxy paint standard; #316 stainless steel optional.

Dimensions
Width: 5.4 “ (137 mm)
Height: 8” (203 mm)
Depth: 5” (127 mm)
Shipping weight: 6.5 lbs (3 kg)

Approvals
CSA Certified Div 1 & 2 Groups B, C, D. Suitable for XP installations.

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

Loop Resistance at nominal 24 VDC power
750 ohms maximum in 3-wire mode

Relays
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 GasMax II will be indicated as a “FAULT” condition.

Identification Numbers

Model and serial numbers are required when ordering parts or requesting service information. Record your model and serial numbers below.

TRANSMITTER (A)

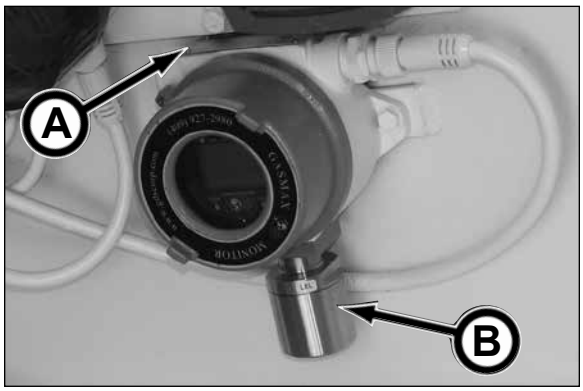
Model Number _____

Serial Number _____

SENSOR (B)

Model Number _____

Serial Number _____



NOTES

Safety Data Sheets

The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific safety data sheets (SDS) be available to employees before operating this equipment. This may include information on substances contained in this equipment such as hydraulic fluid and gear lubricant.

Akkerman Inc. will provide, at no cost, SDS which apply to its product line. Simply contact your Akkerman Aftermarket Support representative for a copy.

To ensure a prompt response to your SDS request, include your return address (including zip or postal code) and the equipment's model numbers and serial numbers with your request.

NOTES

Warranty

Akkerman warrants that all equipment manufactured by it be free from defects due to workmanship or material when normally used and serviced for a period of 90 days from the date of shipment by Akkerman. Normal wear and tear to the equipment, including, but not limited to, wear on the cutter face tooling, hydraulic filters, augers, casings, slurry line and seals is not covered by this warranty. Akkerman does not warrant that the equipment meets the requirements of any particular safety code or rule governing equipment classification. If the Customer has questions about local safety codes, rules or ordinances, authorities local to the project should be consulted.

In order to be considered as a potential warranty claim, the component in question must be returned to Akkerman (freight prepaid) for factory inspection and analysis, and determination of warranty applicability. No warranty is provided for electronics or electrical components of any kind. The validity of all warranty claims are subject to the discretion and determination of the Akkerman Aftermarket Support Department. All such determinations are final.

NOTES

Index

Parts

Contents

INTRODUCTION

This parts manual contains assembly illustrations of the methane gas detection system. The illustrations in this manual are intended to show typical construction of various parts. In some instances, the details of parts illustrated may not exactly represent their actual appearance, but will help to identify parts performing the same functions.

LOCATING PARTS

This parts manual is organized to help you locate parts information quickly. An Alphabetical Index, section 15, is provided to determine the page number of the assembly a part is used. If the part number is known, the Numerical Index, section 16, can also be utilized to find the page number of the assembly.

USE GENUINE AKKERMAN PARTS

The use of second-rate parts could affect the efficient performance of your Akkerman equipment. ALWAYS use genuine Akkerman parts.

PARTS ORDERING

To order fast, accurate, and reliable parts service, call (800) 533-0386, (507) 567-2261, or fax (507) 567-2605, and provide the following information.

1. Model Number
2. Serial Number
3. Part Number, Description, and Quantity
4. Shipping Preference

MEASUREMENTS

The unit of measure in this manual is in inches unless indicated otherwise.

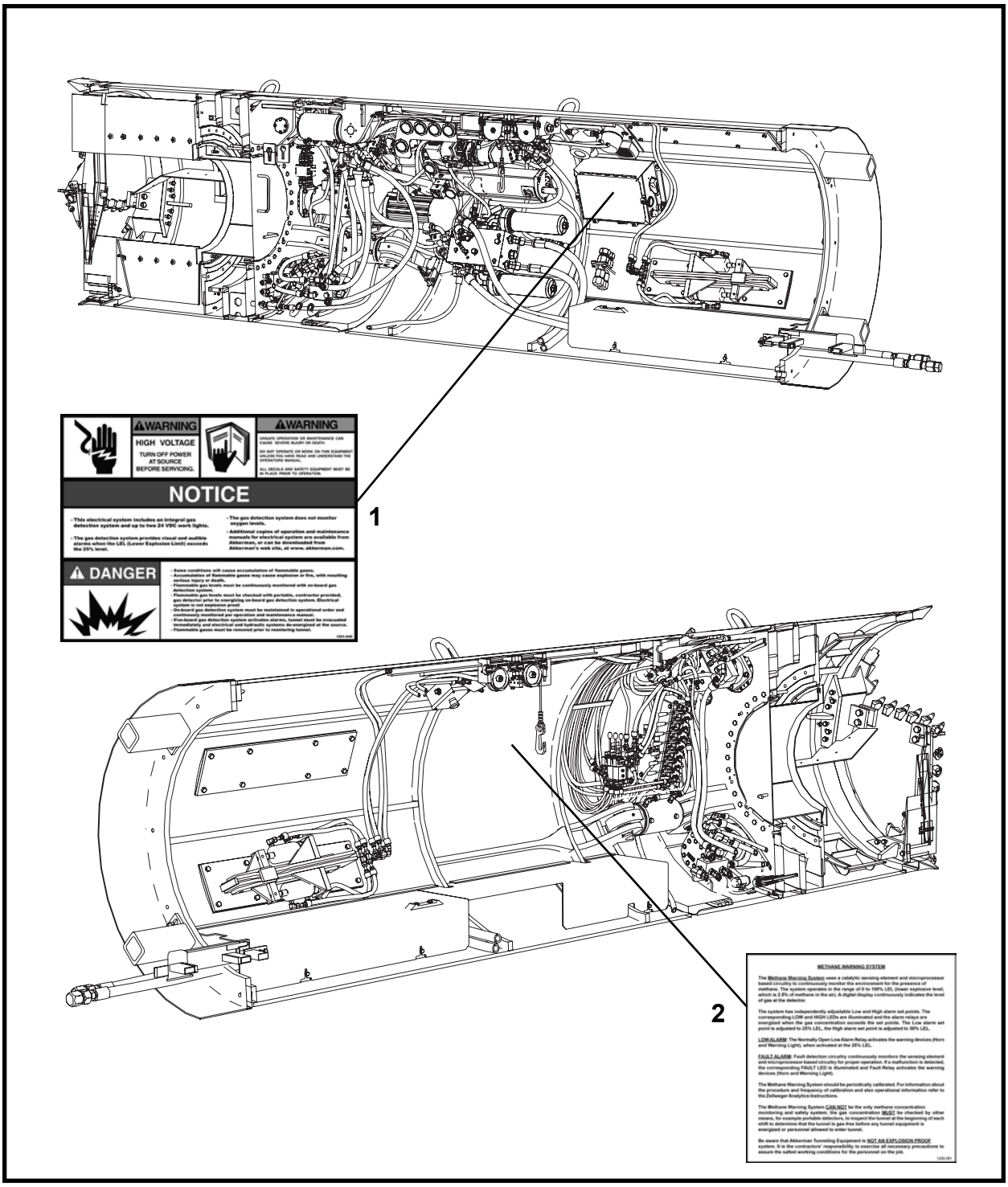
HARDWARE SPECIFICATION

All Akkerman products are assembled with SAE Grade 8 bolts, nuts, and washers. ALWAYS use matched fastener hardware when replacing or repairing the unit.

Akkerman Inc. reserves the right to improve its product without notice or obligation.

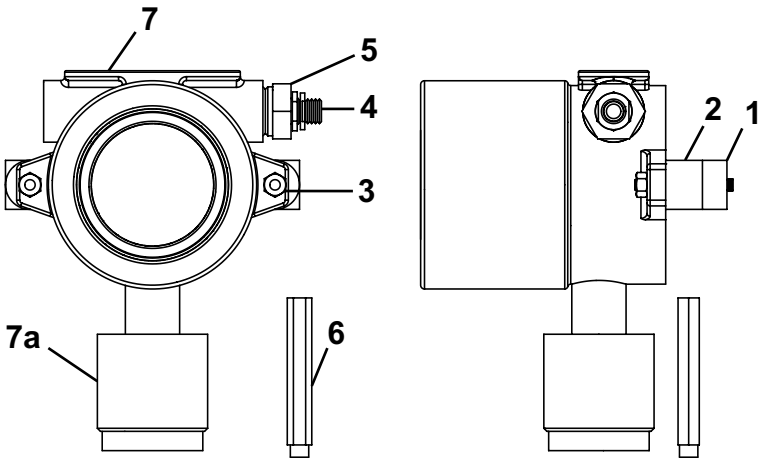
NOTICE **If components in this Parts Manual do not match your methane gas detection system, contact your Akkerman Aftermarket Support representative.**

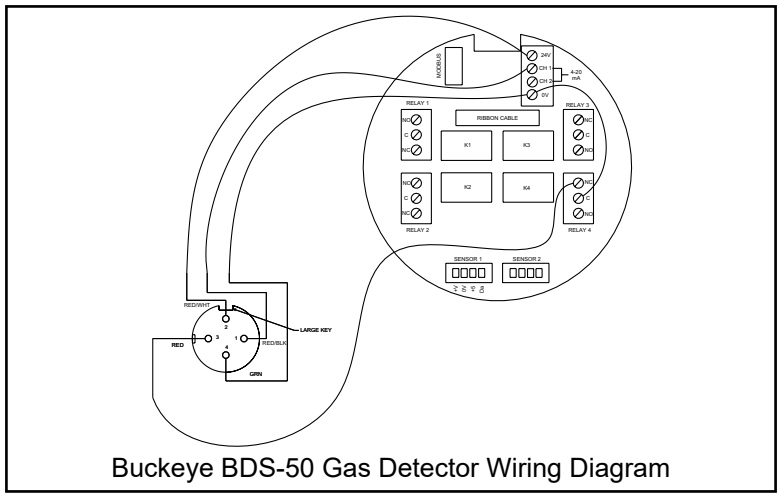
DECALS



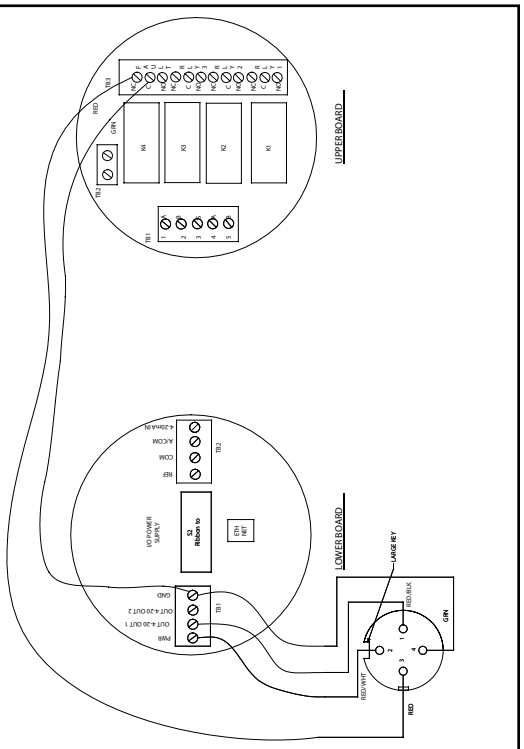
ITEM	QTY	PART NO.	DESCRIPTION
1	1	1251-649	DECAL, Danger, Warning, Notice, Gas Detector
2	1	1250-581	DECAL, Methane Warning System

NOTES

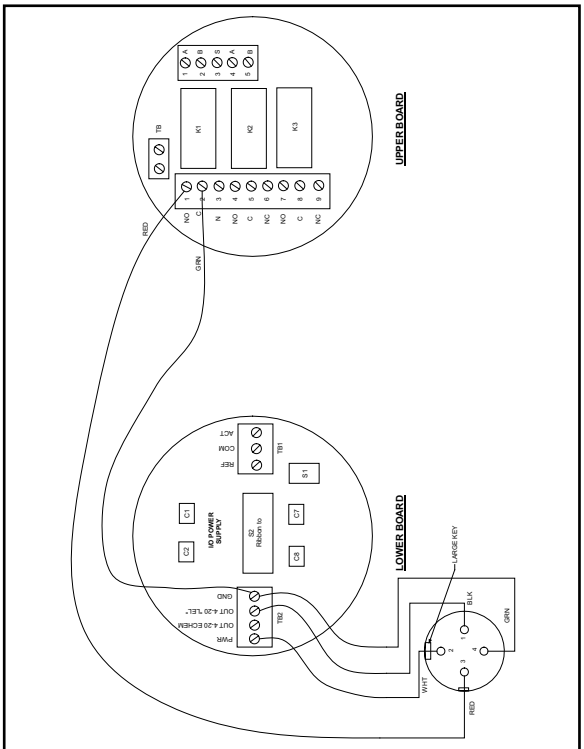




Buckeye BDS-50 Gas Detector Wiring Diagram



Buckeye BFT-44 Gas Detector Wiring Diagram



GasMax Gas Detector Wiring Diagram

GAS DETECTOR ASSEMBLY, A03946A
MICROTUNNELING SYSTEMS

ITEM	QTY	PART NO.	DESCRIPTION
0	1	A03946A	GAS MAX DETECTOR - GEN2 MTBM
1	1	016407P	MOUNT
2	2	P0070-065	MOUNT, Vibration Isolation
3	2	P0003-04-000	NUT, Hex 1/4 UNC
4	1	P0054-453	RECEPTACLE, 4C 22 GA Micro Male DK 12”
5	1	P0300-080	REDUCER, 12MP-04FPS
6	1	P0310-283B	WAND, Magnetic
7*	1	P0251-1065	DETECTOR, Gas, Methane - Buckeye BDS-50 (Includes item 7a)
7a1	1	P0251-1065A	ELEMENT, Sensor (Buckeye BDS-50)
7a2	1	P0251-1003A	ELEMENT, Sensor (Buckeye BFT-44)
7a3	1	P0251-197A	ELEMENT, Sensor (GasMax)

* The following gas detectors are no longer available:
  - Buckeye BFT-44
  - GasMax

If complete replacement is required, order latest gas detector Buckeye BDS-50, P0251-1065.

Note:

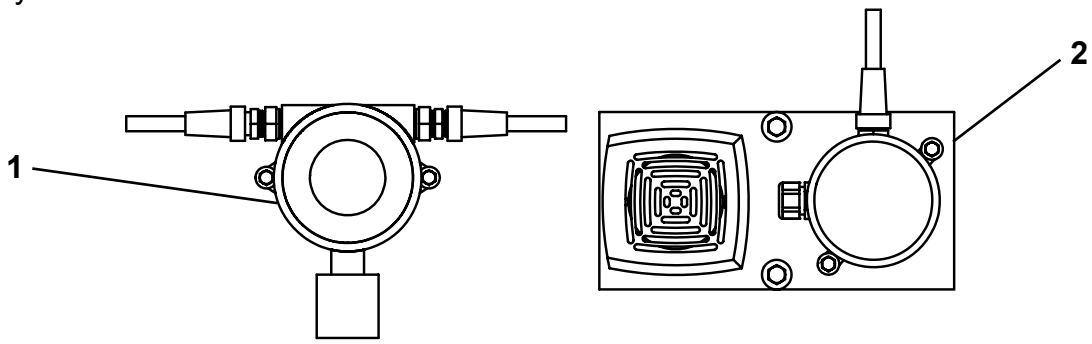
1. Contact your Akkerman Aftermarket Support representative for proper set up and calibration of this gas detector assembly.

2. If your MTBM is equipped with a dual gas detector, contact your Akkerman Aftermarket Support representative for parts information.

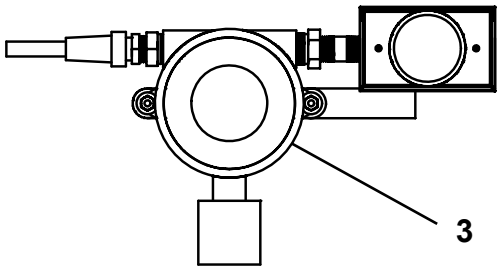
NOTES

GAS DETECTOR ASSEMBLY
TBM Series II, D Series

Early Units



Later Units

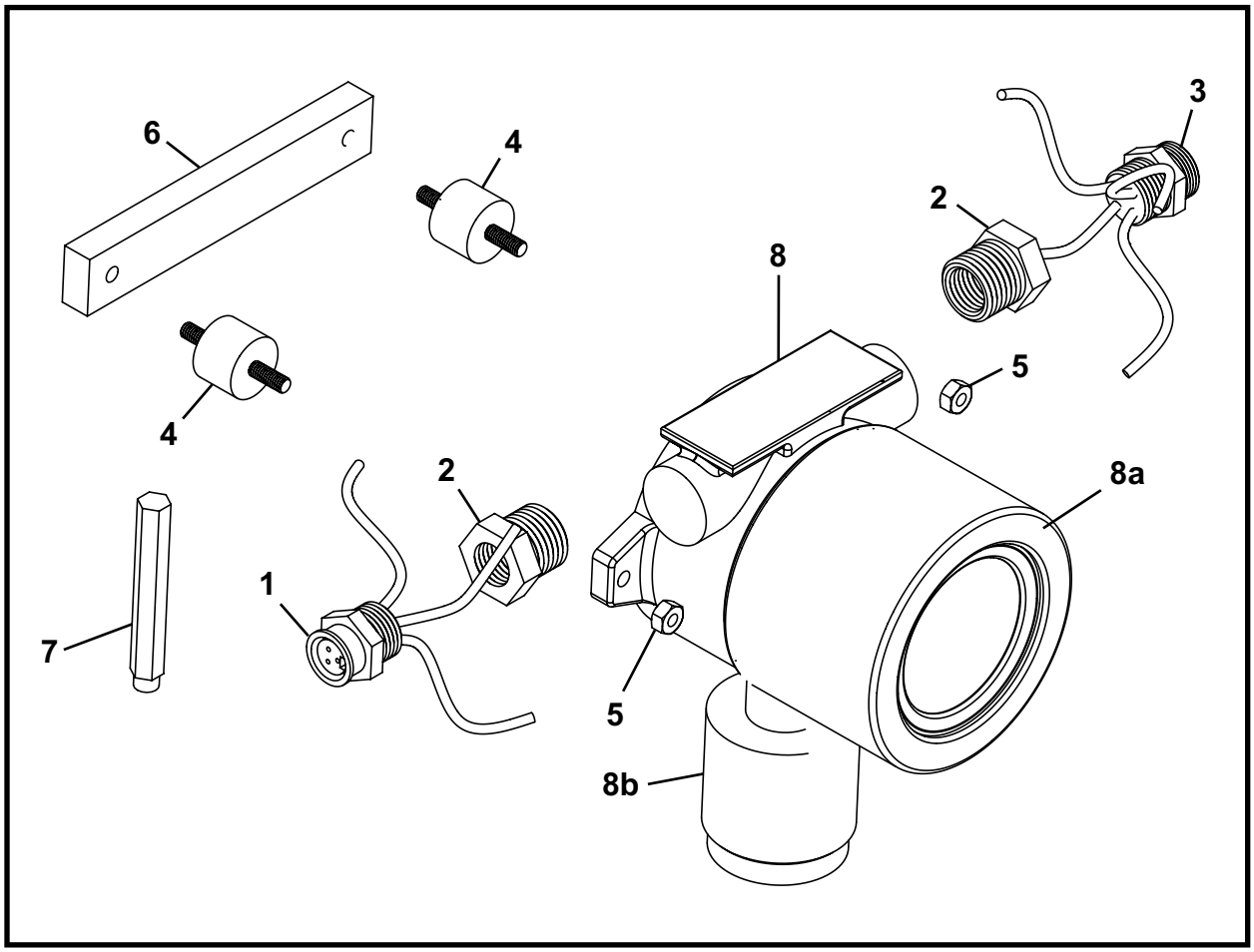


ITEM	QTY	PART NO.	DESCRIPTION
1*	1	019049A	GAS DETECTOR ASSEMBLY
2*	1	024401A	STROBE-HORN ASSEMBLY
3*	1	031499A	GAS DETECTOR ASSEMBLY

* Refer to this section for parts information.

GAS DETECTOR ASSEMBLY, 019049A

TBM Series II, D Series - Early Units



ITEM	QTY	PART NO.	DESCRIPTION
0	1	019049A	GAS DETECTOR ASSEMBLY
1	1	P0054-068	RECEPTACLE, Mini Cable
2	2	P0300-012	FITTING, 12MP-08FPS
3	1	P0054-286	RECEPTACLE, 4 Pin Male
4	2	P0070-065	MOUNT, Vibration Isolation
5	2	P0003-04-000	NUT, Hex 1/4 UNC
6*	1	016407P	BRACKET, Mounting
7	1	P0310-283B	WAND, Magnetic
8**	1	S10057A	DETECTOR, Gas (Includes item 8a-8b)
8a	1	P0251-1065	DETECTOR, Gas, Buckeye BDS-50
8b1	1	P0251-1065A	ELEMENT, Sensor (Buckeye BDS-50)
8b2	1	P0251-1003A	ELEMENT, Sensor (Buckeye BFT-44)
8b3	1	P0251-197A	ELEMENT, Sensor (GasMax)

* Not part of this assembly. Shown for reference only.

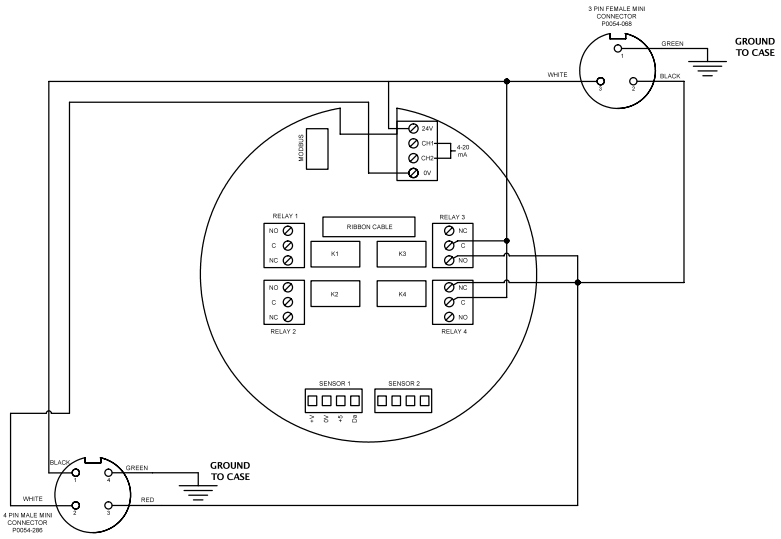
** The following gas detectors are no longer available:
- Buckeye BFT-44
- GasMax

If complete replacement is required, order latest gas detector Buckeye BDS-50, P0251-1065.

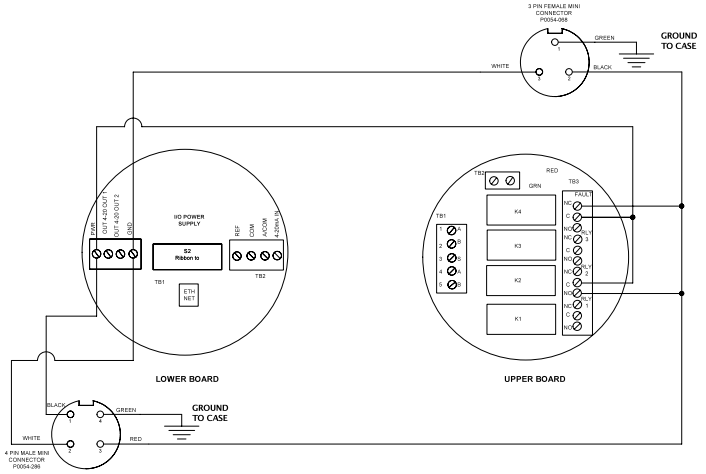
Note: Contact your Akkerman Aftermarket Support representative for proper set up and calibration of this gas detector assembly.

GAS DETECTOR ASSEMBLY WIRING DIAGRAM, 019049A
TBM Series II, D Series - Early Units

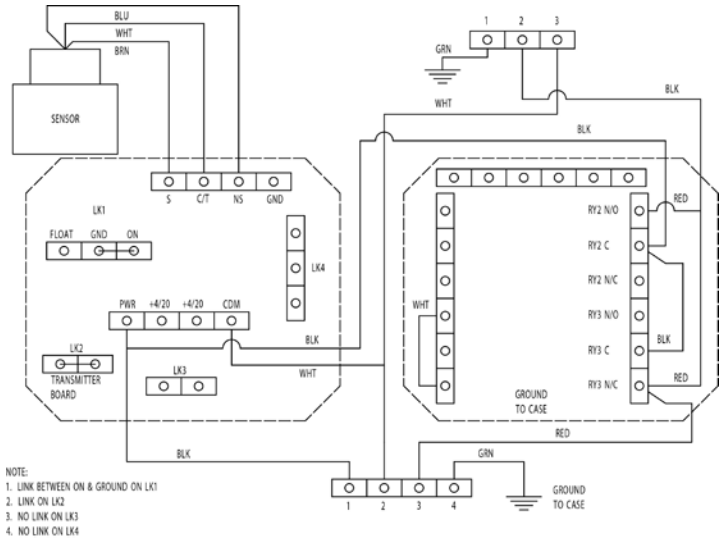
Buckeye Gas Detector BDS-50 Wiring Diagram



Buckeye Gas Detector BFT-44 Wiring Diagram

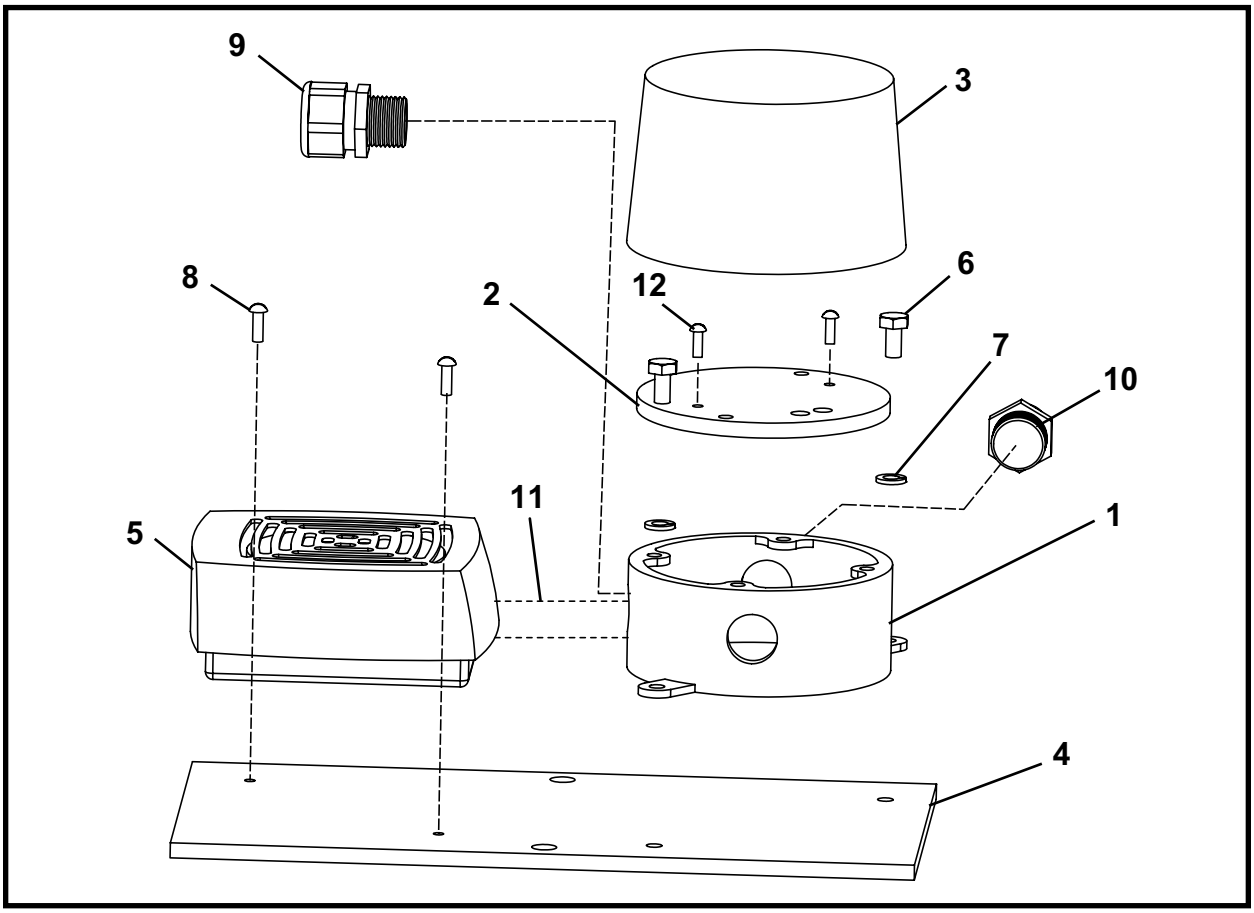


GasMax Gas Detector Wiring Diagram



STROBE - HORN ASSEMBLY, 024401A

TBM Series II, D Series - Early Units



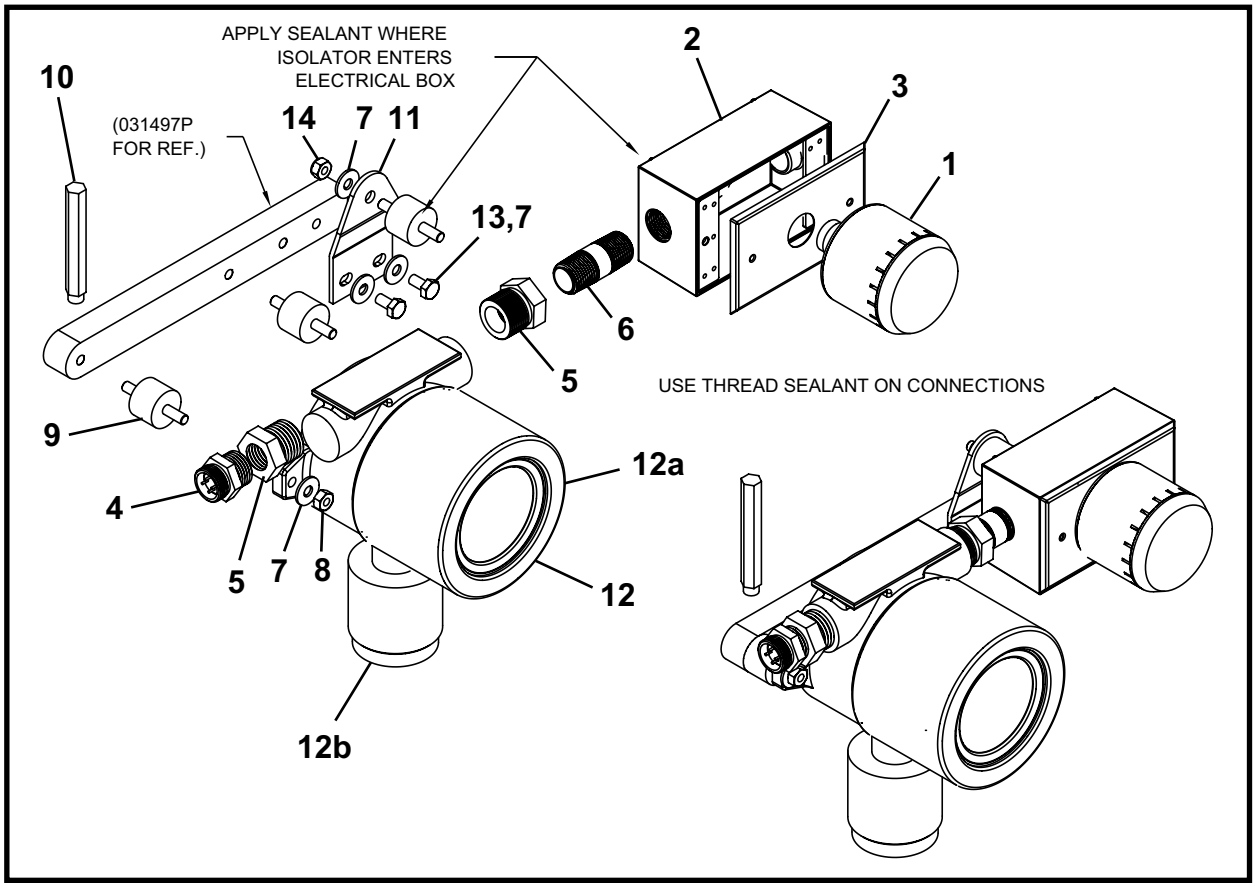
ITEM	QTY	PART NO.	DESCRIPTION
0	1	024401A	STROBE - HORN ASSEMBLY
1	1	P0310-251	HOLDER BOX
2	1	023534P00	COVER, Back
3	1	P0310-286B	STROBE LIGHT, Red 24VDC (Includes item 3a)
3a	1	P0310-286A	LENS
4	1	016405P	PLATE, Mounting
5	1	P0310-287D	HORN, Warning 24VDC
6	2	P0001-04-002	BOLT, Hex 1/4 UNC x .5
7	2	P0040-004	WASHER, Hardened Flat 1/4
8	2	P0017-08-323	SCREW, Machine 8-32 x .5
9	1	P0311-121	CONNECTOR, Strain Relief
10	1	P0054-069	RECEPTACLE, Mini
11	8 LI	P0054-018	CABLE
12	2	P0017-10-375	SCREW, Round Machine 10-24 x 3/8

LI - Linear Inch

NOTES

GAS DETECTOR WITH ALARM ASSEMBLY, 031499A

TBM Series II, D Series - Later Units



ITEM	QTY	PART NO.	DESCRIPTION
0	1	031499A	GAS DETECTOR WITH ALARM ASSEMBLY
1	1	P0251-861	SOUNDER, Panel Mount, w/LED
2	1	P0310-105	BOX
3	1	P0310-154	COVER
4	1	P0054-286	RECEPTACLE, Mini
5	2	P0300-012	FITTING, 12MP-08FPS
6	1	P0405-002	NIPPLE
7	6	P0040-004	WASHER, Hardened Flat 1/4
8	3	P0003-04-000	NUT, Hex 1/4 UNC
9	3	P0070-065	MOUNT, Vibration Isolation
10	1	P0310-283B	WAND, Magnetic
11	1	031645P	BRACKET, Beacon
12*	1	S10057A	DETECTOR, Gas (Includes items 12a-12b)
12a	1	P0251-1065	DETECTOR, Gas, Buckeye BDS-50
12b1	1	P0251-1065A	ELEMENT, Sensor (Buckeye BDS-50)
12b2	1	P0251-1003A	ELEMENT, Sensor (Buckeye BFT-44)
12b3	1	P0251-197A	ELEMENT, Sensor (GasMax)
13	2	P0001-04-002	BOLT, Hex 1/4 UNC x .5
14	1	P0013-04-000	NUT, Nylock 1/4

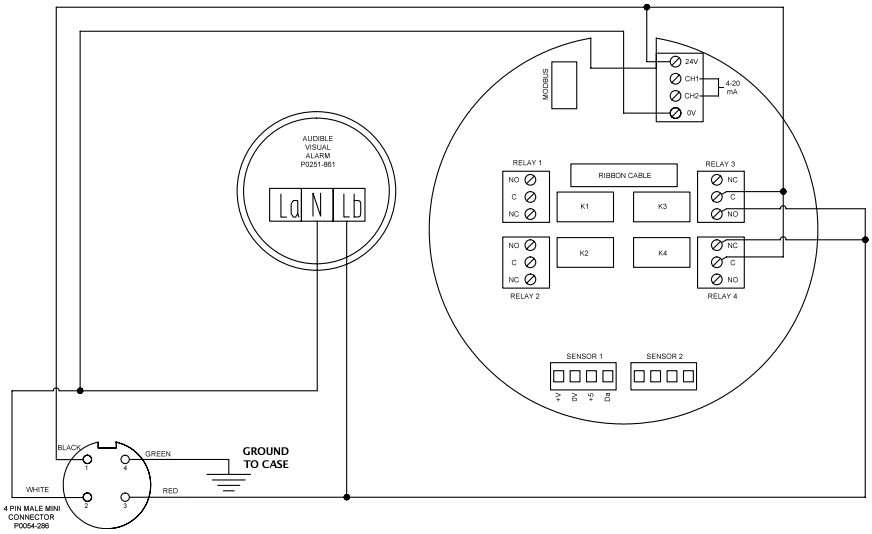
* The following gas detectors are no longer available:
  - Buckeye BFT-44
  - GasMax

  If complete replacement is required, order latest gas detector Buckeye BDS-50, P0251-1065.

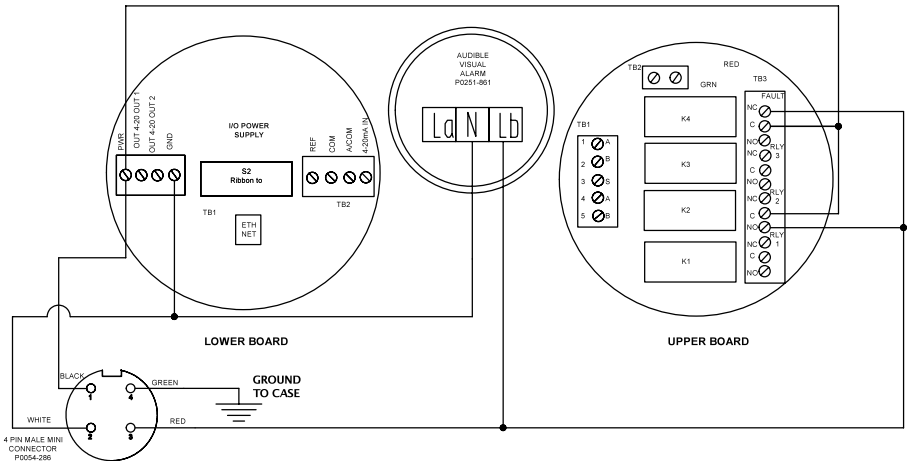
Note: Contact your Akkerman Aftermarket Support representative for proper set up and calibration of this gas detector assembly.

GAS DETECTOR WIRING DIAGRAM, 031499A
TBM Series II, D Series - Later Units

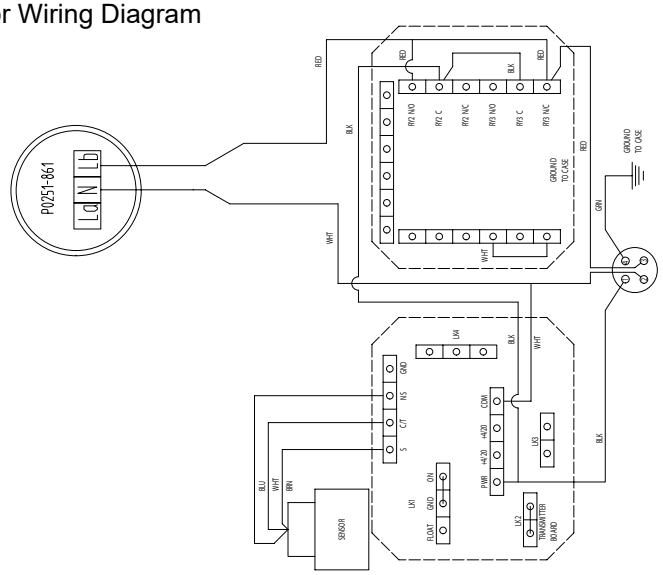
Buckeye Gas Detector BDS-50 Wiring Diagram



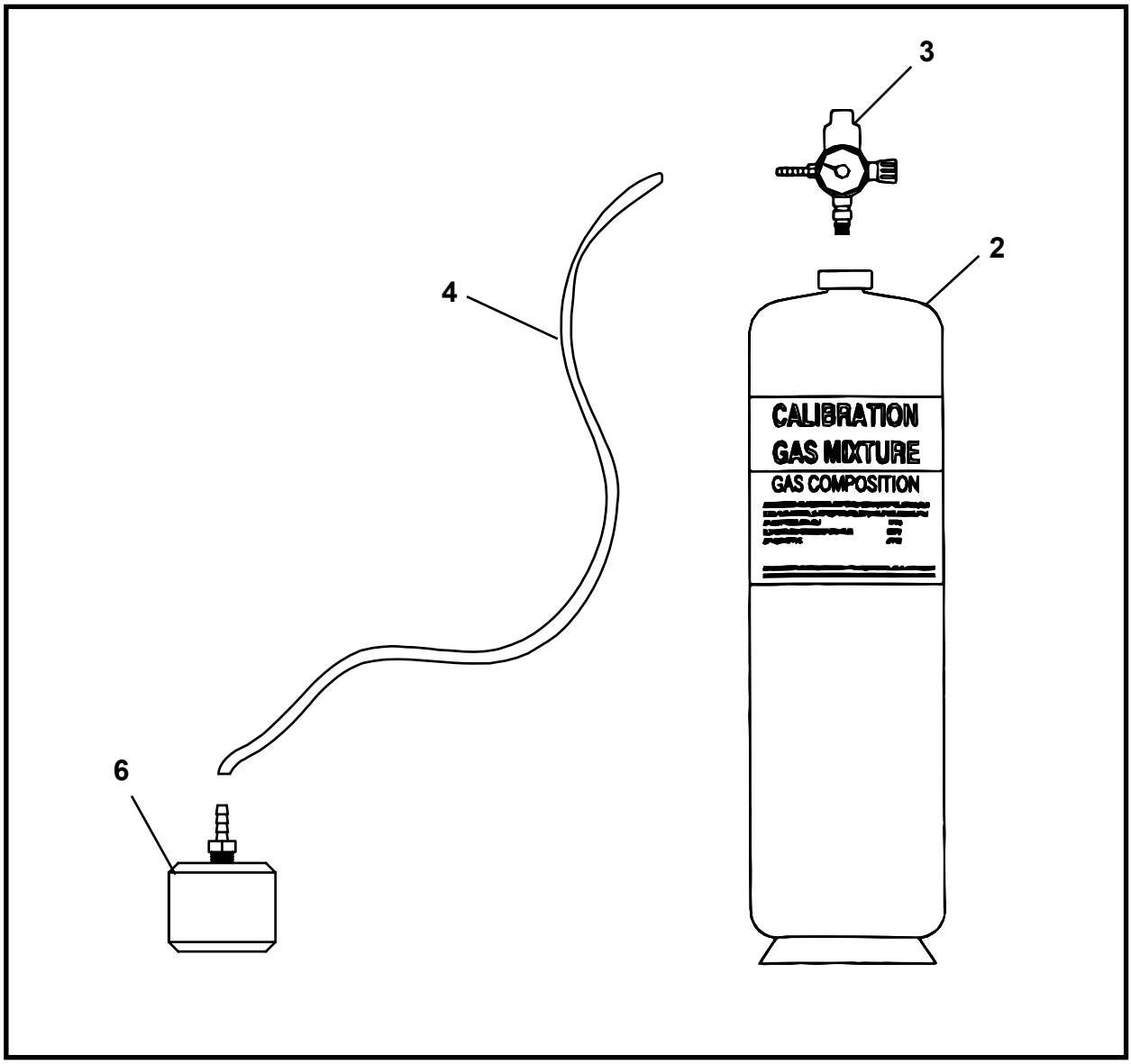
Buckeye Gas Detector BFT-44 Wiring Diagram



GasMax Gas Detector Wiring Diagram



CALIBRATION (GAS CHALLENGE) KIT, 016423A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	016423A	KIT, Calibration
1	1	P0310-266	GAS CHALLENGE KIT (Includes items 2 - 5)
2	2	-	CYLINDER, 50% LEL Methane Gas Concentration
3	1	-	REGULATOR VALVE & GAUGE
4	1	-	TUBE, Plastic
5*	1	-	PROTECTIVE CASE
6	1	016422A	NOZZLE, Calibration (Buckeye & GasMax)

* Not Shown

Alphabetical Index

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Numerical Index

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Buckeye Gas Detector Manuals

NOTES

BFT-44 User Manual
Document: UM-1001 Revision Level 8

MODEL BFT-44 DUAL CHANNEL SENSOR TRANSMITTER

Warning: Read & understand contents of this manual prior to operation. Failure to do so could result in serious injury or death.

Buckeye Detection Systems
110 Kings Road
Kings Mountain, NC 28086
1-800-438-1028
www.buckeyefire.com

NOTES

NOTES

Chapter 1 Safety Information

1.1 SAFETY INFORMATION – READ BEFORE INSTALLATION AND APPLYING POWER

The following symbols are used in this manual to alert the user of important instrument operating issues:

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.

This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

WARNINGS:

- **Shock Hazard** - Disconnect or turn off power before servicing this instrument.
- **WARNING- EXPLOSION HAZARD**- DO NOT REPLACE FUSE UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- **WARNING- EXPLOSION HAZARD**- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- Use a properly rated CERTIFIED AC power (mains) cable installed as per local or national codes
- A certified AC power (mains) disconnect or circuit breaker should be mounted near the controller and installed following applicable local and national codes. If a switch is used instead of a circuit breaker, a properly rate CERTIFIED fuse or current limiter is required to be installed as per local or national codes. Markings for positions of the switch or breaker should state (I) for on and (O) for off.
- Clean only with a damp cloth without solvents.
- Equipment not used as prescribed within this manual may impair overall safety.

1.2 CONTACTING BUCKEYE DETECTION SYSTEMS

Buckeye Detection Systems
110 Kings Road
Kings Mountain, NC 28086
1-800-438-1028
bfec@buckeyef.com

Chapter 2 General Description

2.1 INTRODUCTION

The state-of-the art BFT-44 sensor transmitter is an updated version of our proven BFT-48 transmitter. This versatile unit has a bright color display and embedded web page promoting simple intuitive user interface. The web page is accessed through the standard Ethernet connection and allows the transmission of data over existing network infrastructure to computers, tablets, smart phones and Buckeye Detection Systems BFT-64, 64 channel controller.

Features include:

- QVGA color TFT display which displays engineering units and monitored data graphically as a bar graph and 30-minute trend.
- Display changes color to indicate alarm status
- Ethernet: embedded webpage for configuration and HMI, Modbus TCP master/slave
- Webpage offers offsite viewing capabilities.
- Remote sensor abilities
- Single/Dual modes standard
- Modbus TCP, Modbus RTU, EC, bridge and 4-20mA inputs
- Magnetic switches allow "one man" sensor calibration in hazardous areas without area declassification with a simple magnetic wand.

Optional features include:

- Three programmable relays and a dedicated fault relay.
- Two individually programmable RS-485 ports for Modbus master or slave.

2.2 RATINGS AND CERTIFICATIONS

NRTL CSA APPROVALS (File # 219995)
BFT-44 with BFT10-0247 is Division 1 and 2 Group A, B, C, D Exia. Suitable for explosion proof installations

EXPLOSION PROOF HOUSING
Instrument enclosure suitable for Class 1, Division 1 and 2, Groups A, B, C and D

POLYCARBONATE ENCLOSURE
Instrument enclosure suitable for Class 1, Division 2, Groups A, B, C and D (Pending)

2.3 SYSTEM DESIGN SPECIFICATIONS

ANALOG OUTPUTS
BFT-44 Bridge models have 3-wire 4-20mA current source output with nominal 24VDC power supply

BFT10-0388 Relays / RS-485 Modbus® (Optional)
Relays are Form C 5AMP @ 30VDC and 240VAC RESISTIVE
RS-485 is 2-wire Modbus® RTU

DISPLAY
240X320 pixel LCD displays 30-minute trend, bar-graph and large engineering units, LED Backlight

ACCURACY
±1% of full scale

AMBIENT TEMPERATURE RANGE
-40 – 60 degrees C

TEMPERATURE DRIFT
Less than .1% per degree Celsius over ambient temperature range

POWER SUPPLY
10 - 30 VDC at 10 Watts max

Chapter 3 Installation Instructions

3.1 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 BFT-44 is designed for rugged service, sensors should be protected from environmental damage from water, snow, shock, vibration and dirt.

3.2 MOUNTING THE ENCLOSURE

The BFT-44 standard enclosure is a cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 3-1. Figure 3-2 shows dimensions with the dual local sensor head 'Y' adaptor (BFT0010-1200) included. Figure 3-3 shows the dimensions, without the sensor head installed, of the BFT-44's polycarbonate enclosure.

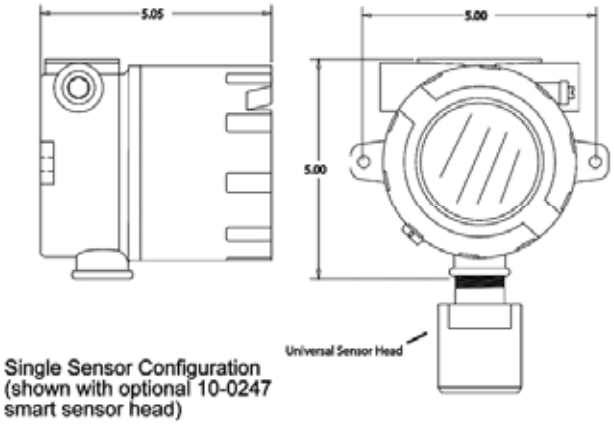


Figure 3-1 BFT-44 Explosion-Proof Housing

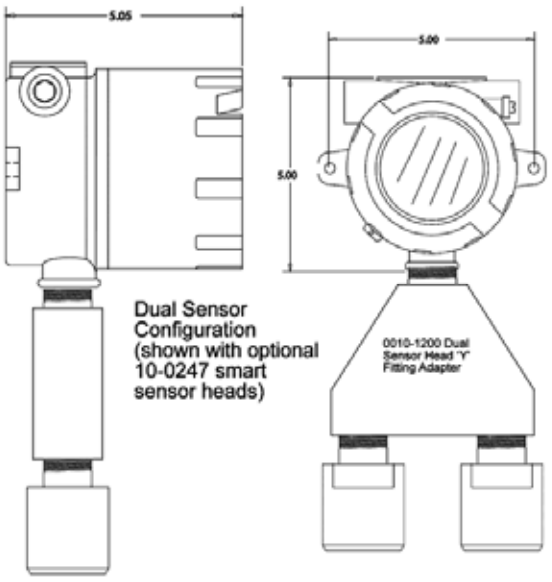


Figure 3-2 BFT-44 Explosion-Proof Housing with Dual Sensor Head Adaptor

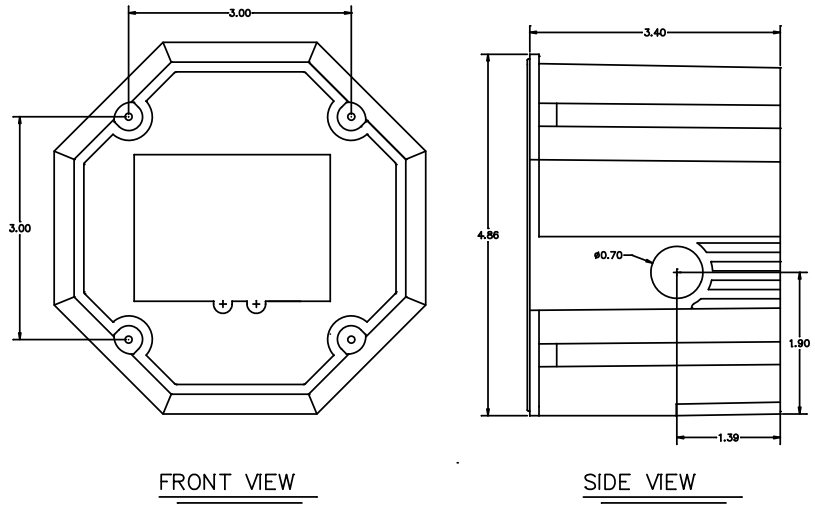


Figure 3-3 BFT-44 Poly Enclosure without Sensor Head

Modular design simplifies the installation of the BFT-44. A top Display Assembly is mounted with captive thumbscrews and is easily removed to access field-wiring terminals. An optional BFT10-0388 Alarm/RS-485 Modbus board mounts *piggyback* to the back of the Display Assembly. Wiring from simple bridge sensors terminates at the TB2 of the BFT10-0390 I/O PCB. The bottom BFT10-0390 I/O Power Supply board generates voltages needed for LCD, relays, RS-485 Modbus, Bridge and Electrochemical Smart Sensor Connections and Simple Bridge sensor.

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Ensure correct cabling and sealing fitting practices are implemented. Do not aim the sensor pointing upward. Install the BFT-44 to a wall or bracket using the predrilled mounting flanges with I.D. 0.25 on 5 inch centers (Figure 3-2). If conduit is rigid and able to support the weight of the BFT-44, the mounting bolts may be omitted.

CAUTION: The sensor head should never be installed pointing upwards.

3.3 3-WIRE 4-20 MA MODE INSTALLATION

TB2 provides inputs for Channel 1 and Channel 2. By default it is set to provide a Simple Bridge input for Channel 1 and a 4-20mA input for Channel 2. However, a slight board modification will switch Channel 1 from a Simple Bridge input to a 4-20mA input. To switch Channel 1 to a 4-20mA input SB1 and SB2 must have their left pad and center pad connection cut and the center and right pad soldered together. This will provide 24V power to the first (leftmost) terminal of TB2 and a 4-20mA input at the terminal second from the left (Figure 3-4). J4 provides a connection for EC Smart Sensors for Channel 2 inputs. J5 provides a connection for Bridge or EC

Smart Sensors for Channel 1 inputs. J3 provides an Ethernet connection for connecting the BFT-44 to a network. TB1 provides terminals for 24V power input and common. Along with 4-20mA outputs for both Channel 1 and Channel 2.

Instructions: Remove the cover on the BFT-44. Loosen the two thumbscrews holding the display assembly in place and remove it. A 14-pin ribbon cable is attached with sufficient length to allow access to the I/O PCB mounted in the bottom of the enclosure (Figure 3-3). Power and signal connection are to TB1 where 24VDC, Signal and Common wires must be connected. A blocking diode protects the BFT-44 if polarity of the power supply is reversed, but it will not operate. Reassemble the BFT-44. Follow the procedures and recommendations in the receiver and power supply manuals to complete the installation. Be sure the BFT-44 enclosure and conduit are properly grounded. Apply power, and the BFT-44 should function.

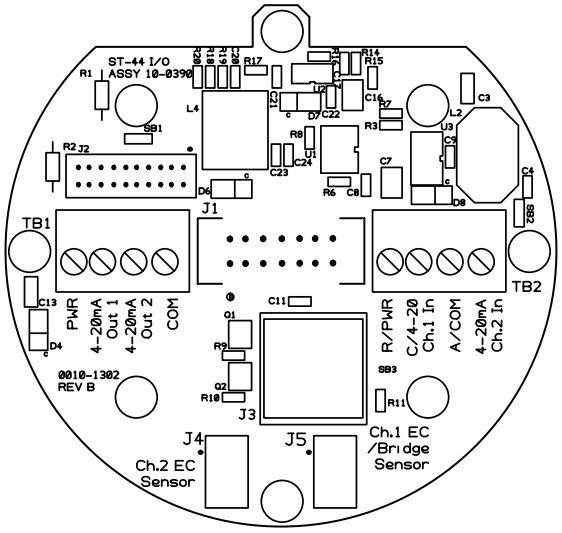


Figure 3-4 BFT10-0390 BFT-44 I/O Power Supply Board

3.4 B10-0388 RELAY / RS-485 MODBUS OPTION INSTALLATION

The optional BFT10-0388 Relay/RS-485 Modbus Option Board supplies three programmable alarm relays, a FAULT relay and two RS-485 Modbus RTU master/slave ports (Figure 3-5). This board is "piggybacked" behind the BFT10-0387 BFT-44 CPU/Display Board.

Caution: Alarm relays have dry contacts and power must be supplied from an external source. If this power source exceeds 3 amps, users should consider fusing relay wiring with 3 amp fuses. Contacts are rated for RESISTIVE loads! Inductive loads, such as contactor coils or motors, may cause contact arcing. This will shorten life and emit RFI into the sensor signals. Use appropriate arcing snubber and MOVs across inductive loads, and keep wiring away from signal wires. External wiring to TB2 should be shielded and protected from noise spikes to prevent false alarm resets or overrides.

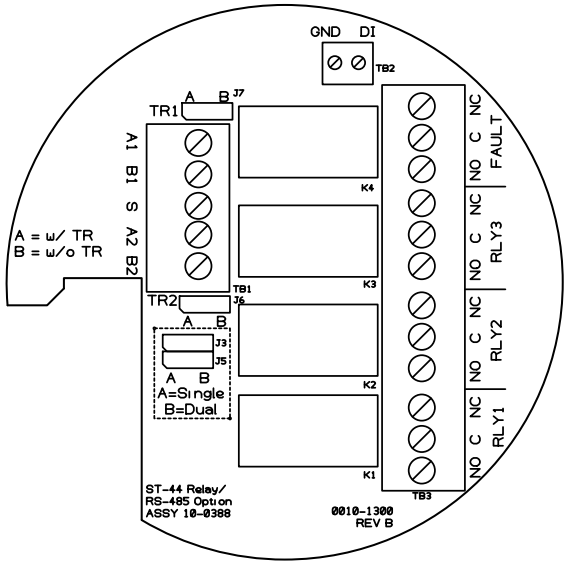


Figure 3-5 BFT10-0388 Relay/RS-485 Option Board

Remove the cover of the BFT-44 enclosure. Loosen the two thumbscrews holding the display assembly in place and remove it. A 14-pin ribbon cable is attached with sufficient length to access the back of the Display assembly where the Alarm/RS-485 Modbus board option is located. It is possible to use only the relays, only RS-485 or both. Relay terminals are labeled NO (Normally Open), NC (Normally Closed) or C (Common, or 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 3-6. Each BFT-44 represents an RTU, and must have a unique Remote ID address. Remote ID addresses are assigned in the Data From Menus discussed in Section 4.4.1.3. Cabling must be a daisy chain as opposed to a star pattern for reliable operation. The "end of line" unit should have J6 and J7 installed in the A position.

With J3 and J5 in the A position, TB1 functions as a Single communication port with A1 tied to A2 and B1 tied to B2. With J3 and J5 in the B position, TB1 functions as a Dual communication port with A1 and B1 being port 1 and A2 and B2 being port 2.

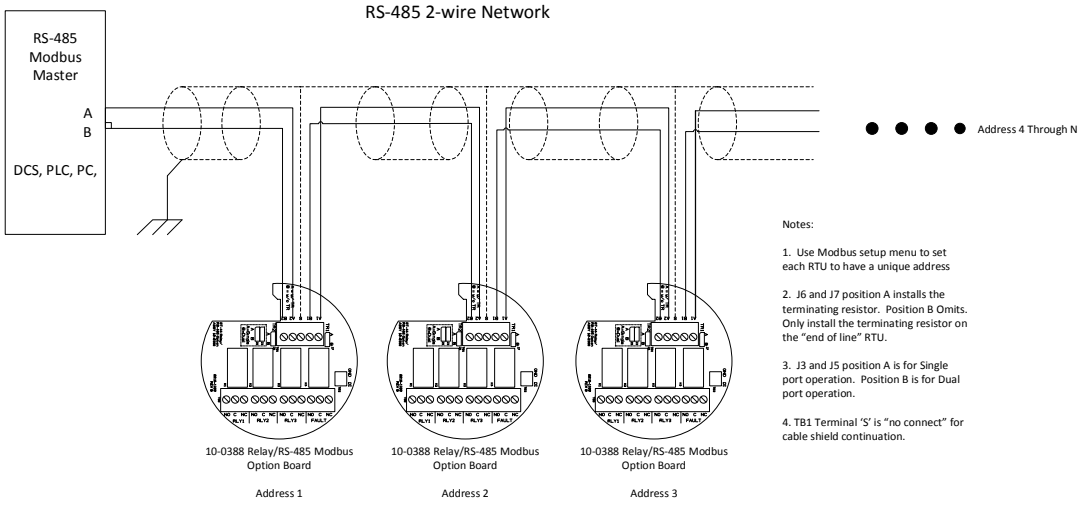


Figure 3-6 RS-485 Modbus Wiring

3.5 SENSOR INSTALLATION

Many manufacturers offer industry standard electrochemical (EC) and catalytic bead sensors for toxic/oxygen and LEL combustible gas detection. These are referred to as simple sensors in this manual. The BFT-44 design accommodates users wishing to continue use of their existing catalytic bead Simple type of sensors, however, EC Simple sensors are not supported. The BFT-44 Smart Sensor interface also uses proven EC 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 the BFT-44 factory supplied Smart Sensors allowing them to contain the entire database of BFT-44 parameters onboard the replaceable Smart Sensor assembly.

This unique Smart Sensor Interface may be used to configure Smart Sensors and/or BFT-44s from a PC rather than entering all variables via the magnetic key pad.

EC and catalytic bead smart sensors both plug into the BFT10-0247 Smart Sensor Head, which connects to the BFT-44 with its 8-conductor Smart Sensor Interface cable (Figure 3-7).

Note: BFT10-0247 Smart Sensor Heads with EC/Oxygen sensors may connect to J4 or J5 on the BFT10-0309 I/O Board. Bridge Smart sensors can only be connected to J5.

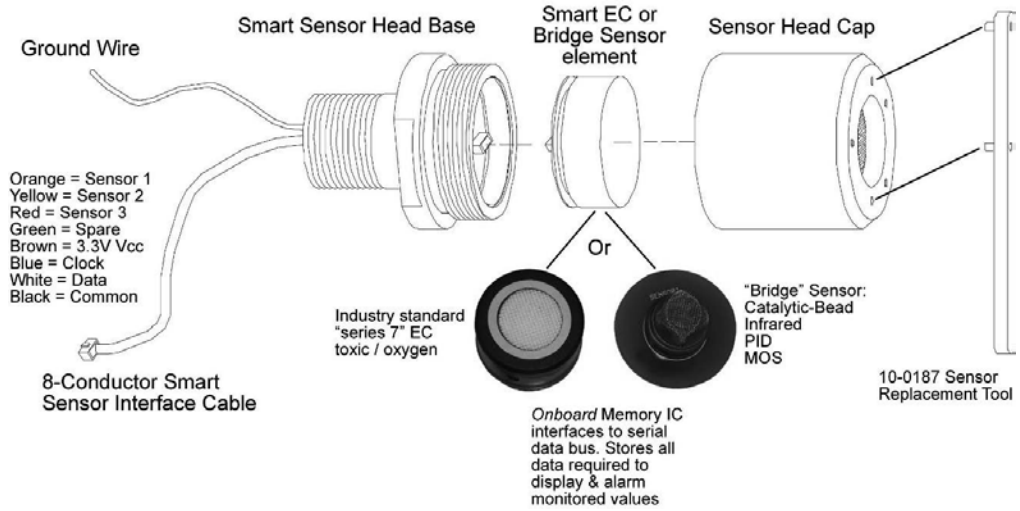


Figure 3-7 BFT10-0247 Smart Sensor Head Assembly

Chapter 4 General Operating Instructions

4.1 INTRODUCTION

Swiping a magnetic wand past the Edit key, from any of the Data Display screens, displays the Main Menu. The Up and Down keys maneuver the selection marker up and down, and Edit selects the highlighted item to enter the sub menus. All items with a submenu are indicated by a right facing arrow at the end of the line. To edit menu item values swipe the Edit key, and use the Up/Down keys to edit the value. Once the desired value is entered, swipe the Edit key again to save the value. Swipe the Next key to reverse out of a submenu.

4.2 ROUTINE SENSOR CALIBRATION

Calibration is the most important function for ensuring correct operation of the BFT-44. The CAL MODE is designed to make calibration quick, easy and error free. A successful Zero and Span calibration requires only four keystrokes. The 4-20mA output indicates Cal Mode by transmitting the InCal mA as set in Section 4.4.1.5.8 (default of 3mA). It then transmits 4mA during the subsequent Cal Purge Delay as set in Section 4.7.2.5 to prevent external alarms during calibration. Local BFT-44 alarm relays (optional BFT10-0388 BFT-44 Relay/RS-485 Board) are inhibited during Cal Mode. Cal Mode is exited automatically if no keystrokes are detected after five minutes.

Follow these BFT-44 calibration guidelines:

1. Calibration accuracy is only as good as the calibration **gas** accuracy. Buckeye Detection Systems recommends calibration gases with National Institute of Standards and Technology (NIST) traceable accuracy to increase the validity of the calibration.
2. Do not use gas cylinders beyond their expiration date.
3. Calibrate a new sensor before it is put in use.
4. Allow the sensor to stabilize before starting calibration.
5. Calibrate on a regular schedule. Buckeye Detection Systems recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.
6. Calibrate only in a clean atmosphere, free of background gas.

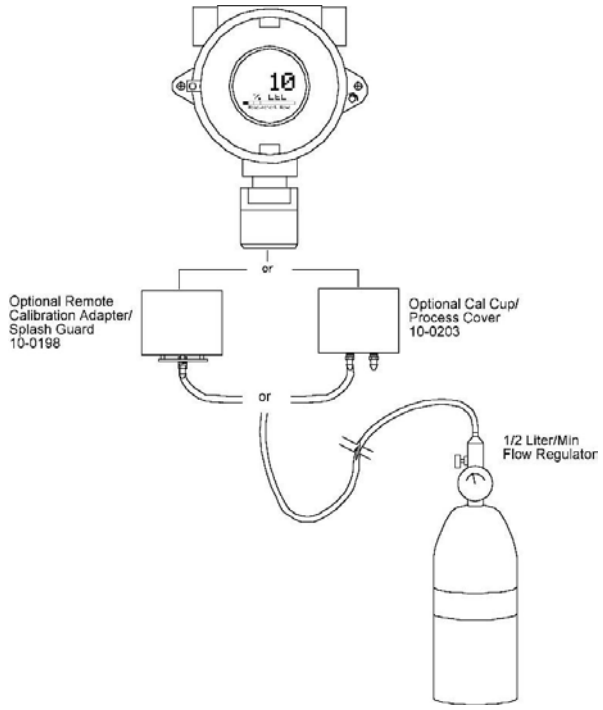


Figure 4-1 Calibration Gas Input

Use the following step-by-step procedure to perform Zero and Span calibrations (Figure 4-2 may be used for reference to the Menus.):

Note: The first three steps must be performed before the timer in the bottom right corner expires, 15 seconds, otherwise the BFT-44 will exit back to the Data Display Screen.

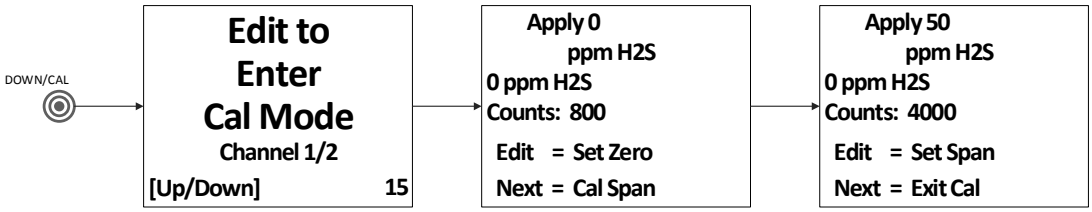


Figure 4-2 Cal Mode Flowchart and Menus

1. Enter Cal mode from any of the Data Display Screens by swiping the DOWN/CAL key.
2. Swipe the Up and/or Down key to select the Channel to be calibrated. **Note**: Only channels with Local Cal enabled, per Section 4.4.1.3, will be available for calibration.
3. Swipe the EDIT key to enter Cal Mode.

4. Apply a clean Zero Gas (Figure 4-1), using the Cal Cup, part number BFT10-0203, or be sure there is no background target gas in the monitored area. After the reading is stable (approximately one minute), swipe the EDIT key to Set the Zero Calibration. To skip the Zero calibration and go to the Span calibration swipe the NEXT key. When a message that the Zero calibration was completed successfully, proceed to the next step.
5. Apply the correct, as indicated, Span gas (Figure 4-1) at 0.5 liters/min. After the reading is stable (approximately one minute), swipe the EDIT key to Set the Span Calibration. To skip the Span Calibration swipe the NEXT key. When a message that the Span calibration was completed successfully, the ST-44 will exit back to the Data Display Screen.
6. Remove the Cal Gas. Once the Cal Purge Delay (Section 4.7.2.5) has expired, normal alarm and relay functionality will be restored.

Calibration history records are logged, and may be viewed in the Sensor Information (Section 4.4.1.3).

4.3 ALARM OUTPUTS

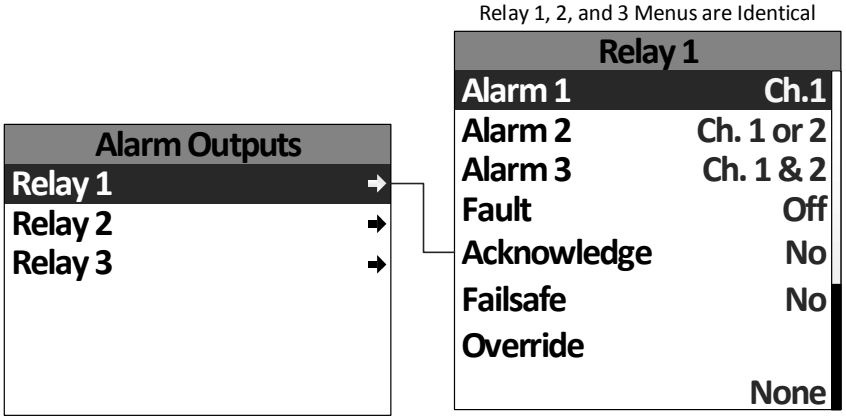


Figure 4-3 Alarm Outputs Menu Tree

The Alarm Outputs Menu is accessed via the Main Menu, and is used to configure the mapping of the three programmable relays to the alarm setpoints, and relay configuration items such as Acknowledge, Failsafe and Override.

The BFT10-0388 Relay/RS 485 Option Board has three programmable relays and a fourth relay which is dedicated to the Fault alarm.

Note: While these settings only affect relays if the BFT10-0388 BFT-44 Relay/RS 485 Option Board is installed, the menu options are always available for configuration purposes, regardless as to whether the option board is installed or not.

4.3.1 RELAY 1/2/3

Relay 1, 2, and 3 Menus are Identical

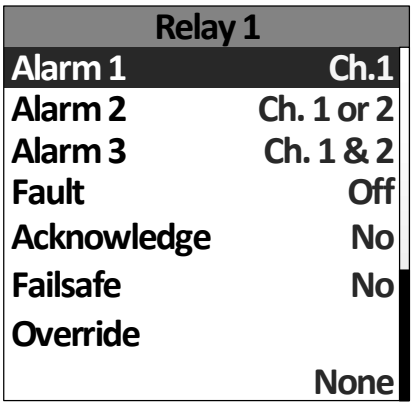


Figure 4-4 Relay Menu

From this menu, you may select one of the three programmable relays for which you would like to change the settings or mapping.

4.3.1.1 ALARM 1/2/3/FAULT

The Alarm 1, Alarm 2, Alarm 3 and Fault menu items determine the mapping of the relay to each of these alarm setpoints. The selection for each of these four items must all be met simultaneously to activate the relay. Options for each of these items are: Off, Ch.1, Ch.2, Ch.1 & 2, Ch.1 or 2.

Example: If you are in the Relay 1 menu, and have the following settings Alarm 1 set to Ch.1, Alarm 2 set to Ch.1 & 2 and Alarm 3 set to Ch.1 or 2. Relay 1 will energize in the event that the Alarm 1 setpoint for Channel 1 is reached **AND** The Alarm 2 setpoint for BOTH Channel 1 and Channel 2 are reached **AND** the setpoint for Alarm 3 is reached for either Channel 1 or Channel 2.

4.3.1.2 ACKNOWLEDGE

Set to Yes means the UP/RESET key will set the relay to the normal state even if the alarm condition still exists. This is useful for silencing an audible device driven from the relay.

4.3.1.3 FAILSAFE

Set to Yes means the relay de-energizes during alarm and energizes with no alarm. This is useful for signaling an alarm on a loss of power. The dedicated Fault alarm is always Failsafe.

4.3.1.4 OVERRIDE

Override allows the user to have an OR type of condition for energizing/de-energizing a relay. The options are:

1. None
2. Ch1 Alarm 1

3. Ch1 Alarm 2
4. Ch1 Alarm 3
5. Ch1 Fault
6. Ch2 Alarm 1
7. Ch2 Alarm 2
8. Ch2 Alarm 3
9. Ch2 Fault
10. Ch1/2 Cal Zero
11. Ch1 Cal Span
12. Ch2 Cal Span
13. 1/2 Cal Zero/Span

An Override is necessary when you want the relay to trip when either of two different setpoints are reached. For Example, if you want Relay 1 to trip when channel 1 is in Alarm 1 or Fault, you can set the **Alarm 1** setting for Ch1 and set **Override** to Ch1 Fault.

4.4 CHANNEL SETTINGS

The Channel Settings Menu is accessed via the Main Menu.

4.4.1 CHANNEL 1/2

The Channel 1 and Channel 2 Menus are accessed via the Channel Settings Menu.

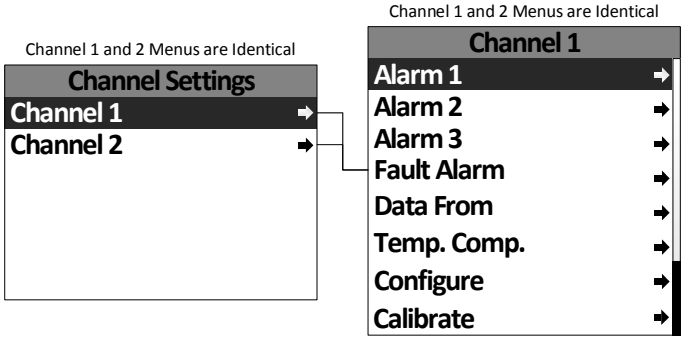


Figure 4-5 Channel 1/2 Menu Tree

4.4.1.1 ALARM 1/2/3

Alarm 1, 2 and 3 Menus may be accessed from the Channel 1 and Channel 2 Menus. Alarm 1 is always enabled and has **Setpoint**, **Latching**, **Trip On**, **On Delay**, **Off Delay** and **Dead Band** settings. Alarm 2 has the same setting options as Alarm 1, but also adds the **Color** setting. Alarm 3 is the same as Alarm 2, but may be **Enabled** or **Disabled**.

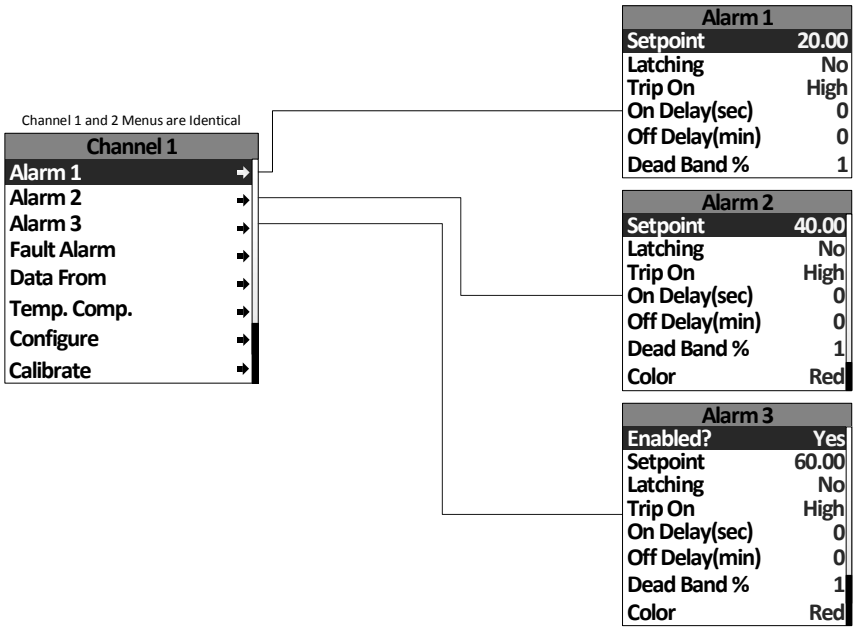


Figure 4-6 Alarm 1/2/3 Menu Tree

4.4.1.1.1 SETPOINT

Setpoint enters the engineering unit value where the alarm will trip. It may be negative and trip when monitored values fall out of range in this direction.

4.4.1.1.2 LATCHING

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

4.4.1.1.3 TRIP ON

Set **Trip On** to HIGH to have the alarm trip when the value goes above the setpoint. Set to LOW to trip when the value falls below the setpoint.

4.4.1.1.4 ON DELAY(SEC)

On Delay allows entering a maximum 10 second delay before this alarm becomes active. This is useful for preventing spurious alarms by brief spikes beyond the alarm setpoint.

4.4.1.1.5 OFF DELAY(MIN)

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.

4.4.1.1.6 DEADBAND %

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%. **Note**: Deadband affects **all** outputs as well as the local reading.

4.4.1.1.7 COLOR

Selecting **Color** changes the color associated with the particular alarm. Options are Red, Blue and Orange. **Note**: Alarm 1 is always set to Yellow.

4.4.1.2 FAULT ALARM

The **Fault Alarm** is always enabled, and is accessed via the Channel 1 and Channel 2 menus.

4.4.1.2.1 SETPOINT

Fault Alarm has a default setting of negative 10 with Low Trip set for YES. This makes it function as a FAULT alarm and trip when the monitored value falls to less than negative 10. It is important to adjust this value when the transmitter's span value is set for another value other than 100. For example, a typical span setting for monitoring oxygen level is 25 therefore the fault level value should be adjusted to -2.5 which is equal to negative 10% of full scale.

4.4.1.3 DATA FROM

4.4.1.3.1 EC SENSOR

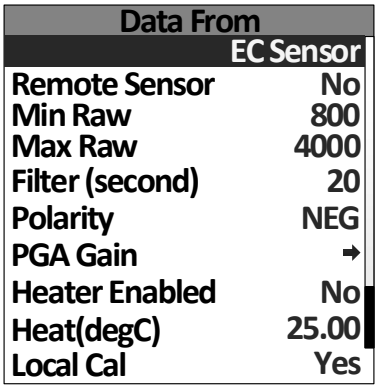


Figure 4-7 Data from EC Sensor Menu

4.4.1.3.1.1 Remote Sensor

Enable **Remote Sensor** when using the optional Remote Sensor Board BFT10-2080, see Section 5.4.

When enabled, two additional menu items appear for Remote ID and Interface. Remote ID matches the Remote ID of the Remote Sensor Board and is set between 1 and 247. Interface indicates which of the two COM ports are being used for that channel.

Note: In order to use the BFT10-2080 Remote Sensor Board, the BFT-44 must have a BFT10-0388 Relay/ RS-485 Option board installed.

4.4.1.3.1.2 Min Raw

Min Raw defines the minimum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 0 at 800 then Min Raw should be set to 800.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero.

4.4.1.3.1.3 Max Raw

Max Raw defines the maximum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 100% at 4000 then Max Raw should be set to 4000.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for 100%. Forcing the input device to read 100% should provide the A/D counts value needed to make this channel's display also read 100%.

4.4.1.3.1.4 Filter (second)

The **Filter** setting sets the number of seconds over which samples are averaged. This may be set from 0 to 60 seconds. If a channel has a noisy input the time may be increased to filter out some of the noise by averaging it over a longer period of time. This causes the reading to react slower to a change in input.

4.4.1.3.1.5 Polarity

Polarity sets the polarity of the sensor POS for positive and NEG for negative.

4.4.1.3.1.6 PGA Gain

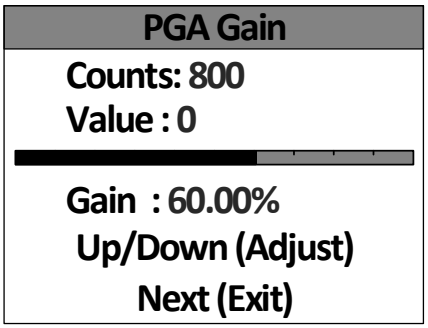


Figure 4-8 PGA Gain Menu

Depending upon the input type, BFT-44 inputs range from a few micro amps to hundreds of micro amps. **PGA Gain** is the adjustment that matches the input signal range to the BFT-44 input signal conditioning circuits. Altering the PGA Gain setting automatically resets previous calibration Offset and Gain values to Unit.

If it is determined the PGA Gain value is incorrect, apply the desired up-scale input and use the UP/DOWN keys to obtain the correct Value. Counts are the binary A/D value.

Caution: For standard installations, this is a factory adjustment. Do not use the PGA Gain menu for calibrating sensors. It should only be adjusted if a new measurement gas or input range is required.

4.4.1.3.1.7 Heater Enabled

Heater Enabled enables the locally mounted heater/ temperature controller circuit on the EC Sensor Amplifier Series 7 board BFT10-0415 and the Series 4 board BFT10-0381. **Note**: This feature should only be used in low temperature environments.

4.4.1.3.1.8 Heat (degC)

The **Heat** setting indicates the minimum temperature at which the temperature controller circuit will energize the heater if enabled. It may be set from -25 to 25C. **Note**: The Heater function should only be enabled in low temperature environments.

4.4.1.3.1.9 Local cal

Local Cal allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration Settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.3.1.10 View Sensor Info

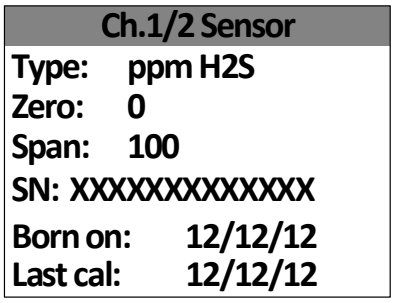


Figure 4-9 Sensor Information Screen

Sensor Info includes the sensor's Type, Zero and Span values, Serial Number, Born on Date and the Date when the last Calibration was performed.

4.4.1.3.2 BRIDGE SENSOR

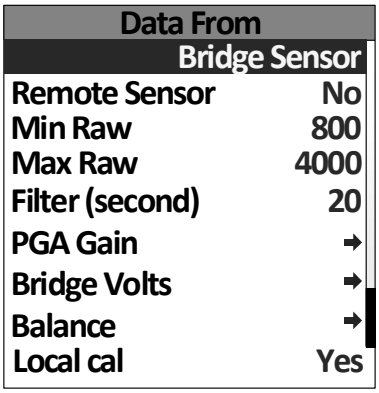


Figure 4-10 Data from Bridge Sensor Menu

4.4.1.3.2.1 Remote Sensor

Enable **Remote Sensor** when using the optional Remote Sensor Board BFT10-2080, see Section 5.4.

When enabled, two additional menu items appear for Remote ID and Interface. Remote ID matches the Remote ID of the Remote Sensor Board and is set between 1 and 247. Interface indicates which of the two COM ports are being used for that channel.

Note: In order to use the BFT10-2080 Remote Sensor Board, the BFT-44 must have a BFT10-0388 Relay/ RS-485 Option board installed.

4.4.1.3.2.2 Min Raw

Min Raw defines the minimum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 0 at 800 then Min Raw should be set to 800.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero.

4.4.1.3.2.3 Max Raw

Max Raw defines the maximum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 100% at 4000 then Max Raw should be set to 4000.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for 100%. Forcing the input device to read 100% should provide the A/D counts value needed to make this channel's display also read 100%.

4.4.1.3.2.4 Filter (second)

The **Filter** setting sets the number of seconds over which samples are averaged. This may be set from 0 to 60 seconds. If a channel has a noisy input the time may be increased to filter out some of the noise by averaging it over a longer period of time. This causes the reading to react slower to a change in input.

4.4.1.3.2.5 PGA Gain

Depending upon the input type, BFT-44 inputs range from a few micro amps to hundreds of micro amps. **PGA Gain** is the adjustment that matches the input signal range to the BFT-44 input signal conditioning circuits. Altering the PGA Gain setting automatically resets previous calibration Offset and Gain values to Unit.

If it is determined the PGA Gain value is incorrect, apply the desired up-scale input and use the UP/DOWN keys to obtain the correct Value. Counts are the binary A/D value.

Caution: For standard installations, this is a factory adjustment. Do not use the PGA Gain menu for calibrating sensors. It should only be adjusted if a new measurement gas or input range is required.

4.4.1.3.2.6 Bridge Volts

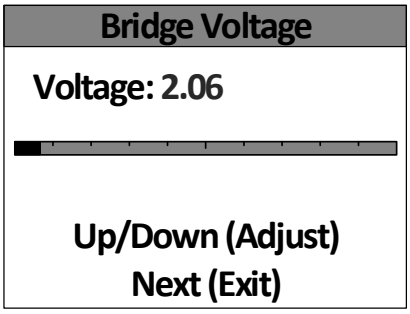


Figure 4-11 Bridge Voltage Adjust Menu

The **Bridge Voltage** is factory configured, and only requires field adjustment if the catalytic bead sensor is mounted remotely from the BFT-44 or if a new sensor is installed. BFT-44 bridge sensors may be from 2 to 6 volts excitation voltage at the sensor. This means, if the sensor is mounted a long distance away, the voltage at the BFT-44 may have to be higher in order to compensate for losses in the field wiring. Be careful not to exceed correct sensor voltage at the sensor's A and R terminals.

4.4.1.3.2.7 Balance

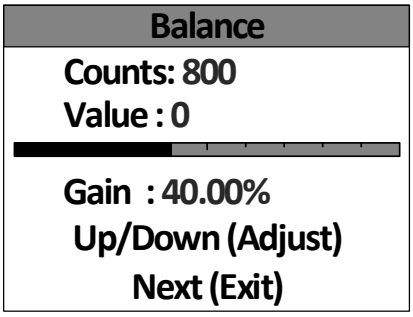


Figure 4-12 Bridge Balance Adjust Menu

The **Bridge Balance** is factory configured, and only requires field adjustment if the catalytic bead sensor is mounted remotely from the BFT-44 or if a new sensor is installed. Balance allows adjusting the balance of the catalytic bead sensor, and must only be performed with ZERO gas on the sensor. Balance is similar to a very coarse ZERO calibration, and does not need to be precise, since subsequent calibrations will correct for small errors. ZERO gas applied to the sensor should provide a reading of -3 to +3 on the Value in the Balance Menu.

4.4.1.3.2.8 Local Cal

Local Cal allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration Settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.3.2.9 View Sensor Info

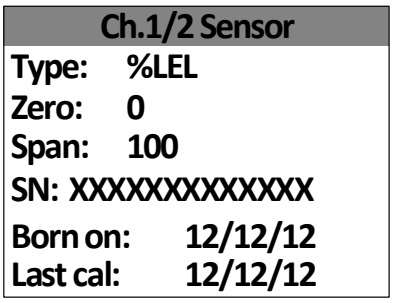


Figure 4-13 Sensor Information Screen

Sensor Info includes the sensor's Type, Zero and Span values, Serial Number, Born on Date and the Date when the last Calibration was performed.

4.4.1.3.3 AI 4-20MA

Data From	
	AI 4-20mA
Min Raw	800
Max Raw	4000
Filter (second)	5
Local Cal	Yes
Marker Menu	➔

Figure 4-14 Data from Analog Input 4-20mA Menu

4.4.1.3.3.1 Min Raw

Min Raw defines the minimum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 0 at 800 then Min Raw should be set to 800.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero.

4.4.1.3.3.2 Max Raw

Max Raw defines the maximum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 100% at 4000 then Max Raw should be set to 4000.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for 100%. Forcing the input device to read 100% should provide the A/D counts value needed to make this channel's display also read 100%.

4.4.1.3.3.3 Filter (second)

The **Filter** setting sets the number of seconds over which samples are averaged. This may be set from 0 to 60 seconds. If a channel has a noisy input the time may be increased to filter out some of the noise by averaging it over a longer period of time. This causes the reading to react slower to a change in input.

4.4.1.3.3.4 Local Cal

When enabled, this allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.3.3.5 Marker Menu

Marker Menu	
Marker Enabled	No
Marker %	-15.63
Mark as	IN CAL
Sensor Life	NO

Figure 4-15 Marker Menu

Some monitors indicate special modes of operation such as Calibration or Maintenance by transmitting a special <4mA "Marker" value. The BFT-44 offers a 4-20mA **Marker Menu** for detecting inputs between -20% and 0% that represent such events. Once detected, the BFT-44 transmits a constant mA output equal to the Marker value.

Caution: Since FAULT alarms are also tripped in the < 4mA region it is important to understand that the Marker events override the FAULT alarm.

Selecting Yes in the *Marker Enabled* field activates the Marker. *Marker %* allows entering a value from -20% to 0% with up to three decimal points. *Mark as* allows entry of the up to six digit ASCII message the readout will display when the marker is detected.

4.4.1.3.4 MODBUS 16BIT

Data From	
	Modbus 16bit
Min Raw	800
Max Raw	4000
Remote ID	1
Alias	31001
Interface	COM1
Local cal	Yes

Figure 4-16 Data from Modbus 16-bit Menu

For additional information on Modbus slave configuration refer to Chapter 5.

4.4.1.3.4.1 Min Raw

Min Raw defines the minimum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 0 at 800 then Min Raw should be set to 800.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used

to test the input device for what A/D counts are provided for zero. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero.

4.4.1.3.4.2 Max Raw

Max Raw defines the maximum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 100% at 4000 then Max Raw should be set to 4000.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for 100%. Forcing the input device to read 100% should provide the A/D counts value needed to make this channel's display also read 100%.

4.4.1.3.4.3 Remote ID

Each device on a Modbus network must have a unique Remote ID. When Data From is set to Modbus, **Remote ID** is where the slave's unique ID number is entered. Remote ID numbers up to 247 are valid.

4.4.1.3.4.4 Alias

The **Alias** register numbers define the location of the variable representing the input value of the Modbus data received through the Communications ports. This number must be obtained from the manufacturer of the Modbus RTU device.

4.4.1.3.4.5 Interface

The **Interface** assigns what communication port the Modbus slave is connected to and the channel will get its data from. The communication port that is assigned here must be configured as a Modbus Master.

4.4.1.3.4.6 Local Cal

Local Cal allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration Settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.3.5 MODBUS 16 SIGNED

Data From	
Modbus 16 Signed	
Min Raw	800
Max Raw	4000
Remote ID	1
Alias	31001
Interface	COM1
Local cal	Yes

Figure 4-17 Data from Modbus 16-bit Signed Menu

For additional information on Modbus slave configuration refer to Chapter 5.

4.4.1.3.5.1 Min Raw

Min Raw defines the minimum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 0 at 800 then Min Raw should be set to 800.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero.

4.4.1.3.5.2 Max Raw

Max Raw defines the maximum range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is 100% at 4000 then Max Raw should be set to 4000.

If the input device's resolution is unknown, the live counts variable on the Analog inputs menu displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for 100%. Forcing the input device to read 100% should provide the A/D counts value needed to make this channel's display also read 100%.

4.4.1.3.5.3 Remote ID

Each device on a Modbus network must have a unique Remote ID. When Data From is set to Modbus, **Remote ID** is where the slave's unique ID number is entered. Remote ID numbers up to 247 are valid.

4.4.1.3.5.4 Alias

The **Alias** register numbers define the location of the variable representing the input value of the Modbus data received through the Communications ports. This number must be obtained from the manufacturer of the Modbus RTU device.

4.4.1.3.5.5 Interface

The **Interface** assigns what communication port the Modbus slave is connected to and the channel will get its data from. The communication port that is assigned here must be configured as a Modbus Master.

4.4.1.3.5.6 Local Cal

Local Cal allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration Settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.3.6 MODBUS 32BIT

Data From	Modbus 32bit
Remote ID	1
Alias	31001
Interface	COM1
Byte Order	BADC
Local cal	Yes

Figure 4-18 Data from Modbus 32-bit Menu

For additional information on Modbus slave configuration refer to Chapter 5.

4.4.1.3.6.1 Remote ID

Each device on a Modbus network must have a unique Remote ID. When Data From is set to Modbus, **Remote ID** is where the slave's unique ID number is entered. Remote ID numbers up to 247 are valid.

4.4.1.3.6.2 Alias

The **Alias** register numbers define the location of the variable representing the input value of the Modbus data received through the Communications ports. This number must be obtained from the manufacturer of the Modbus RTU device.

4.4.1.3.6.3 Interface

The **Interface** assigns what communication port the Modbus slave is connected to and the channel will get its data from. The communication port that is assigned here must be configured as a Modbus Master.

4.4.1.3.6.4 Byte Order

Byte Order determines WORD and BYTE alignment of data at the remote Modbus transmitter when sending its 4 byte IEEE Floating Point values. With the selection bar on this entry, swipe the Edit key to toggle between the four possible modes. The default setting is BADC.

4.4.1.3.6.5 Local Cal

Local Cal allows the sensor to be calibrated locally from the BFT-44. To configure the Calibration Settings refer to Section 4.4.1.6. For information on how to perform sensor calibration refer to Section 4.2.

4.4.1.4 TEMP. COMP.

Temp. Comp.		
Temp	Gain	Offset
-40	1.00	+0.00
-30	1.00	+0.00
-20	1.00	+0.00
-10	1.00	+0.00
0	1.00	+0.00
10	1.00	+0.00
20	1.00	+0.00
30	1.00	+0.00
40	1.00	+0.00
50	1.00	+0.00
60	1.00	+0.00

Figure 4-19 Temperature Compensation Menu

Temperature Compensation allows the user to adjust the gain and offset that is applied to sensors to compensate for temperature drift. Factory supplied sensors are preprogrammed with these values which are automatically uploaded to the BFT-44 from the smart sensor. The default values are 1.000 for gain and 0.000 for offset. With these default values entered, there is no extra gain or offset applied to the sensor. This menu is not accessible unless a smart sensor, which is equipped with the temperature sensor, is installed. From this menu, you can adjust the gain and offset applied to the sensor at 10C increments from -40 to 60C. The gain is applied to the span value, and the offset is adjusted to make the sensor read zero at different temperatures.

4.4.1.5 CONFIGURE

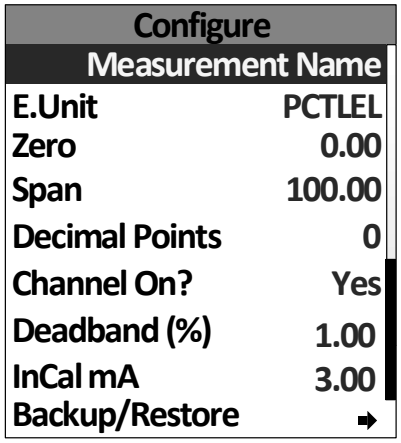


Figure 4-20 Channel Configuration Menu

4.4.1.5.1 MEASUREMENT NAME

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 number or other familiar terminology.

4.4.1.5.2 E.UNIT

Engineering Units (EUNIT) may have up to a 10 character ASCII field. Many common gases have preconfigured EUNITs based upon the sensor type, and each may be edited in this menu.

4.4.1.5.3 ZERO

Zero defines the reading to be displayed when 4mA (0%) is the BFT-44 output.

4.4.1.5.4 SPAN

Span defines the reading to be displayed when 20mA (100%) is the BFT-44 output. The highest reading allowed is 9999 and include a polarity sign and a decimal point.

4.4.1.5.5 DECIMAL POINTS

Decimal Points sets the resolution of the displayed reading and may be set to zero, one or two decimal points.

4.4.1.5.6 CHANNEL ON?

Channel ON determines whether or not the channel is active and being used.

4.4.1.5.7 DEADBAND (%)

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%. **Note**: Deadband affects **all** outputs as well as the local reading.

4.4.1.5.8 INCAL MA

InCal mA determines the output when the channel is in Calibration mode. It may be set from 0 to 20mA. This signal may be used by the controller to determine that the unit is in calibration.

4.4.1.5.9 BACKUP/RESTORE

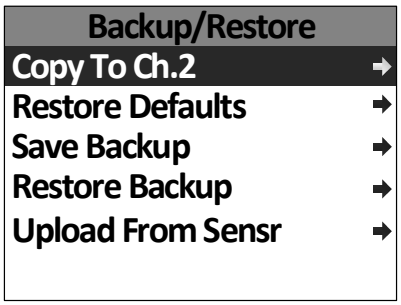


Figure 4-21 Configuration Backup/Restore Menu

The **Backup/Restore Menu** allows you to perform many operations dealing with the configuration of the BFT-44. Selecting *Copy To Ch.1/Ch.2* will copy the current channel's configuration to the other channel. *Restore Defaults* sets all configuration data back to factory defaults. *Save Backup* saves a copy of the configuration to non-volatile memory for restoration at a later time. *Restore Backup* will restore the configuration to the last saved Backup. *Upload From Sensr* will upload the sensor configuration data to the BFT-44.

4.4.1.6 CALIBRATE

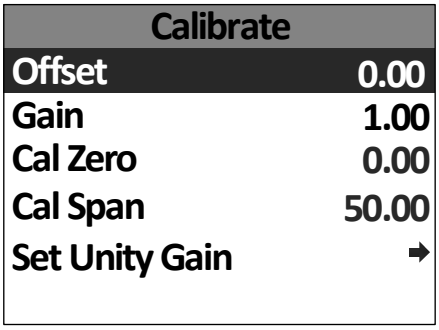


Figure 4-22 Channel Calibration Menu

The **Calibrate Menu** shows the settings for calibration. It will display any Offset or Gain currently applied, and allows you to enter the values for the zero and span gases that will be used during calibration. You may also reset the gain back to unity by selecting *Set Unity Gain*.

4.5 COMM SETTINGS

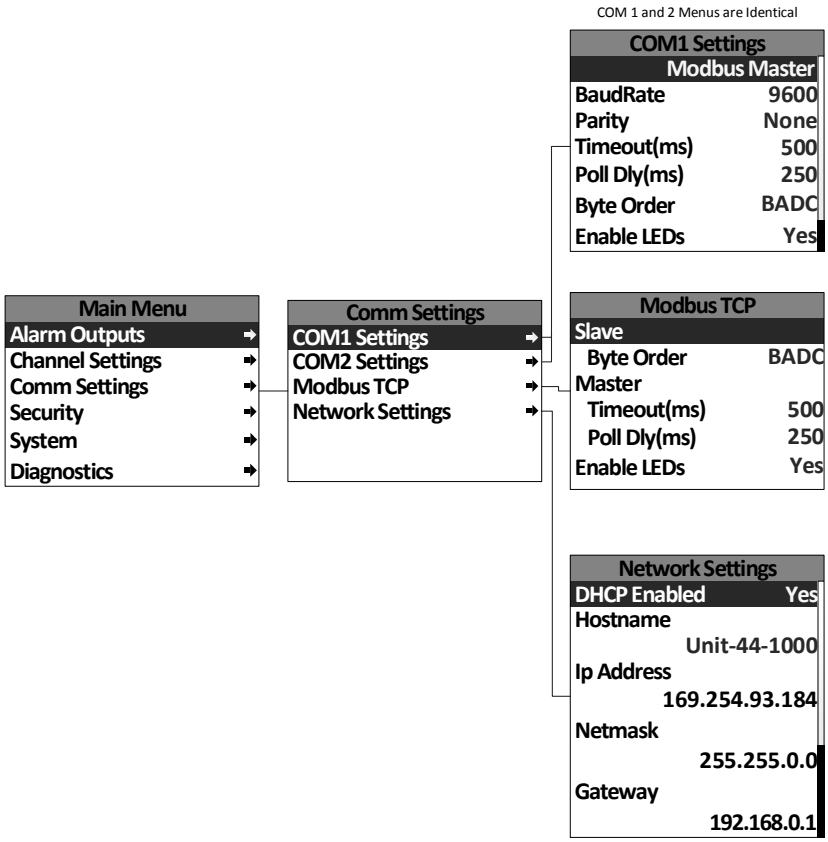


Figure 4-23 Comm Settings Menu Tree

Comm Settings Menu is accessed through the Main Menu. This menu is used to configure the two possible communication ports on the optional BFT10-0388 Relay/RS-485 Modbus Option Board.

4.5.1 COM1/COM2 SETTINGS

COM 1 and 2 Menus are Identical

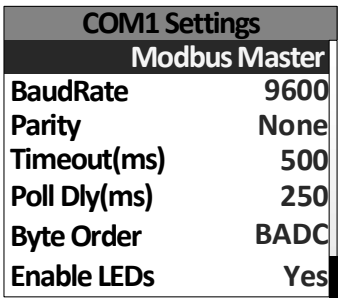


Figure 4-24 COM1 and COM2 Settings Menu

The function parameter allows the communication ports to be set to **Modbus Master**, **Modbus Slave** or **Disabled**.

Modbus Master Mode allows the communication port to poll any device using the Modbus RTU protocol.

Modbus Slave Mode allows the communication port to be polled by any Modbus Master device using the Modbus RTU protocol.

Select **Disabled** to turn the port off if not needed.

4.5.1.1 BAUDRATE

Baudrate allows users to set the data rate of the communication port. The options include 9600, 19200, 38400, 57600 and 115200.

4.5.1.2 PARITY

A **Parity** bit is a bit that is added to ensure that the number of bits with the value "1" in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting within code. The default is **None**.

4.5.1.3 TIMEOUT (MS)

The **Timeout** menu item affects the BFT-44's *Master* Modbus ports. **Timeout** is the length of time, in milliseconds, the controller waits before a Modbus request fails. Three consecutive failed requests must occur before a communication error is indicated. This item is useful for optimizing throughput to the BFT-44 from other slave RTUs.

4.5.1.4 POLL DLY (MS)

Poll Dly is the time in milliseconds the unit will delay between Modbus master requests.

4.5.1.5 BYTE ORDER

Byte Order determines WORD and BYTE alignment of data at the remote Modbus transmitter when sending its 4 byte IEEE Floating Point values. Selecting this value cycles through four options ABCD, CDAB, BADC (default) and DCBA.

4.5.1.6 ENABLE LEDS

Enable LEDs enables the RX and TX LEDs to flash green on valid transmit and receive transmissions. For ports configured as master, the RX LED will flash red if there is a Comm Error or if an exception is received. Slave ports will cause the RX LED to flash red under the same conditions, but can also cause the TX LED to flash red if an invalid function code is received or if the wrong register is given.

Caution: When using the LEDs to assist with troubleshooting it is important to note that LEDs may be enabled via Comm Port settings and Modbus TCP settings. So it is important to disable the LEDs for the ports which are not being tested.

4.5.1.6 SLAVE ID

Slave ID is set to uniquely identify a BFT-44 in Modbus Slave mode. May be set to any value 1-247.

4.5.2 MODBUS TCP

Modbus TCP	
Slave	
Byte Order	BADC
Master	
Timeout(ms)	500
Poll Dly(ms)	250
Enable LEDs	Yes

Figure 4-25 Modbus TCP Menu

4.5.2.1 SLAVE BYTE ORDER

If Modbus Slave is selected, **Slave Byte Order** determines WORD and BYTE alignment of data at the remote Modbus transmitter when sending its 4 byte IEEE Floating Point values. With the select bar on this entry, swiping the EDIT key toggles between the 4 possible modes. Min/Max Raw values are not used in this mode. Default is set to BADC.

4.5.2.2 MASTER TIMEOUT (MS)

Master Timeout is the time in milliseconds before the unit gives up on a Modbus request and moves on to the next channel. After three consecutive timeouts, the channel enters the COM Error state.

4.5.2.3 MASTER POLL DLY (MS)

Master Poll Dly is the time in milliseconds the unit will delay between Modbus Master requests.

4.5.2.4 ENABLE LEDS

Enable LEDs enables the RX and TX LEDs to flash green on valid transmit and receive transmissions. For ports configured as master, the RX LED will flash red if there is a Comm Error or if an exception is received. Slave ports will cause the RX LED to flash red under the same conditions, but can also cause the TX LED to flash red if an invalid function code is received or if the wrong register is given.

Caution: When using the LEDs to assist with troubleshooting it is important to note that LEDs may be enabled via Comm Port settings and Modbus TCP settings. So it is important to disable the LEDs for the ports which are not being tested.

4.5.3 NETWORK SETTINGS

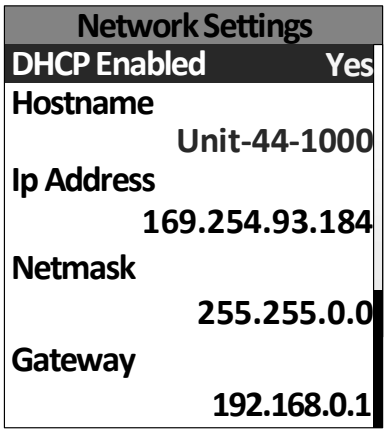


Figure 4-26 Network Settings Menu

See Section 6.2 for integrating a BFT-44 into a network.

4.5.3.1 DHCP ENABLED

DHCP Enabled allows the IP address to be set automatically by an external DHCP server. When this parameter is enabled, the unit can be accessed by its hostname or IP address. However, the IP address will be dependent on the DHCP server, and could potentially change.

4.5.3.2 HOSTNAME

Hostname identifies the BFT-44 on a network as an alternative to the IP address.

4.5.3.3 IP ADDRESS

IP Address identifies the BFT-44 on a network. This is automatically set when DHCP is enabled.

4.5.3.4 NETMASK

Specify if your network requires. **Netmask** specifies the subnet addressing scheme. This is automatically set when DHCP is enabled.

4.5.3.5 GATEWAY

Gateway is the IP address of the device that may connect this subnet to other networks. This is automatically set when DHCP is enabled.

4.6 SECURITY

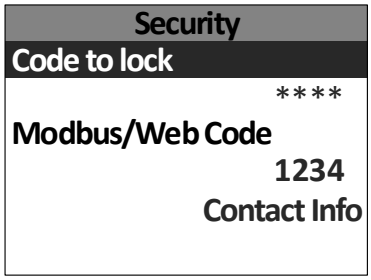


Figure 4-27 Security Menu

The **Security Menu** offers the ability to lock the BFT-44 using a four digit Code. Once enabled, the only actions that may be taken are to view the menus, view the data displays and perform calibrations. No fields may be edited without entering the Code to unlock in the Security Menu.

To enable the Security Mode, enter a four digit Code. **Note**: This is a one-time use code, which will be used to unlock the unit at a later time. Re-enter the Code to confirm and the BFT-44 will lock.

To disable the Security Mode, enter the four digit Code entered previously in the Security Menu.

The Modbus/Web Code is used on the embedded webpage to provide security by preventing inadvertent manipulation of the configuration from the webpage (See Section 6.1).

The Contact Info field is a 16 character ASCII field available for displaying a phone number or name of personnel who know the Code. Lost codes may be recovered by entering the locked security menu and entering the code 8621.

4.7 SYSTEM

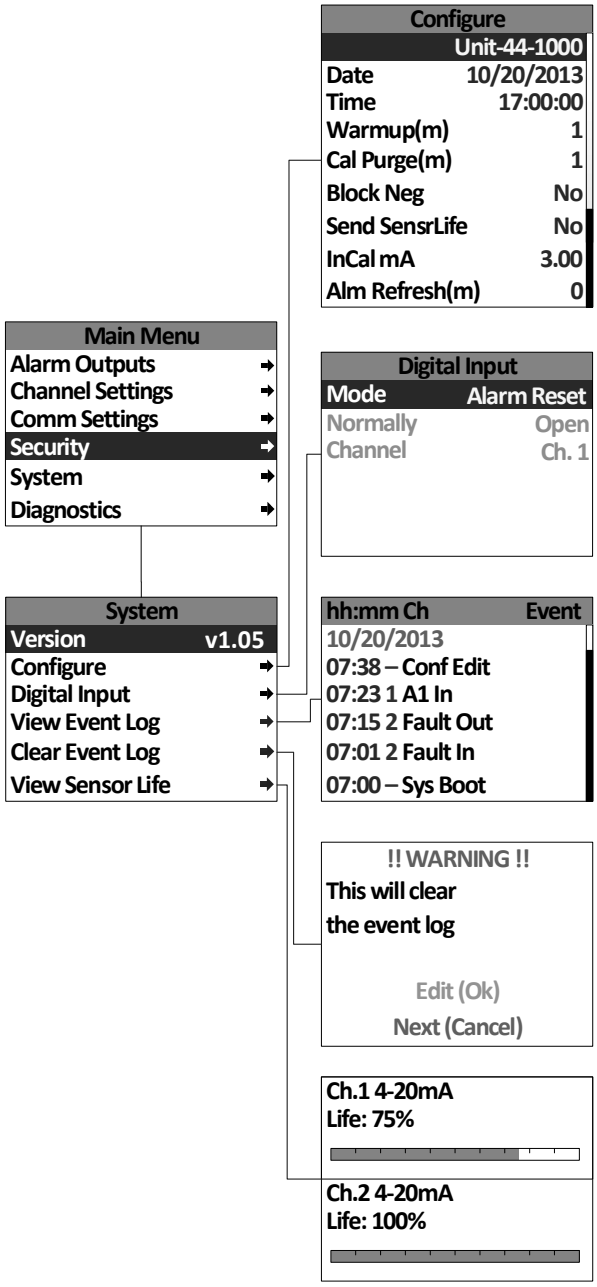


Figure 4-28 System Menu Tree

The **System Menu** is accessed through the Main Menu. System Menu items are items which effect the entire BFT-44, and are not specific to either channel. Submenus are accessed by highlighting the desired item and swiping the Edit key.

4.7.1 VERSION

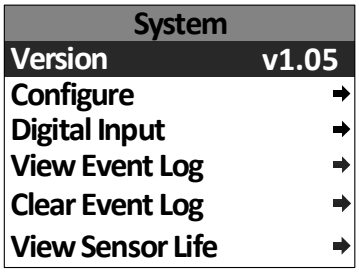


Figure 4-29 System Menu

The **Version** line in the System Menu displays the version of firmware that is programmed in the BFT-44.

4.7.2 CONFIGURE

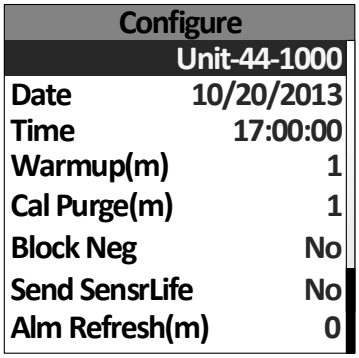


Figure 4-30 Configure System Menu

Configure Menu items are edited by highlighting the desired item and swiping Edit. Swipe UP and DOWN keys to change the value highlighted by the cursor and NEXT to move the cursor. Swipe EDIT again to save the value.

4.7.2.1 UNIT NAME

Unit Name is used to assign the transmitter a name for use in the backup configuration file name. The unit name is limited to 16 characters.

4.7.2.2 DATE

Date is used for Data and Event Logging. This is a factory setting, but may need to be adjusted for the end user's location.

4.7.2.3 TIME

Time (24 hour clock) is used for Data and Event Logging. This is a factory setting, but may need to be adjusted for the end user's location.

4.7.2.4 WARMUP (M)

Warmup is available to prevent unwanted alarm trips during sensor warmup. This time can be adjusted up to five minutes for sensors that take a long time to warm up.

4.7.2.5 CAL PURGE (M)

Cal Purge is available to prevent unwanted alarm trips during calibration purge time. This time can be adjusted up to five minutes for sensors that take a long time to drift back down after calibration.

4.7.2.6 BLOCK NEG

Block Neg prevents negative channel values from being displayed. It applies to both channels.

4.7.2.7 SEND SENSRLIFE

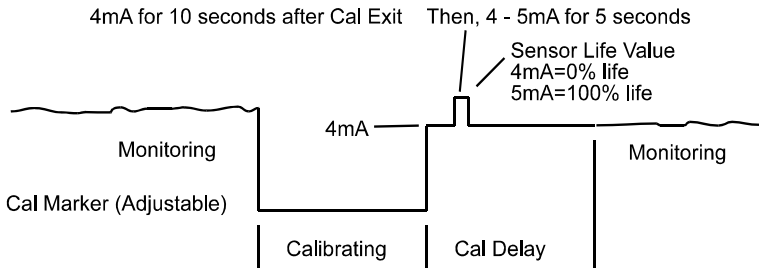


Figure 4-31 Send SensrLife Timing Diagram

Set for Yes, **Send SensrLife** causes the BFT-44 to transmit a sensor life value after successful calibrations during the Cal Purge Delay. Normal operation is the BFT-44 transmits 4mA during the Cal Purge Delay, but with Send SensrLife set to Yes it will transmit 4mA for the first 10 seconds then for 5 seconds it will transmits a value between 4mA and 5mA, with 4mA equal to 0% sensor life and 5mA equal to 100% sensor life. The output then returns to 4mA for the remainder of the Cal Purge Delay. For example, if after a calibration sensor life is 75%, the BFT-44 transmits 4.75mA during the 5 second interval.

Note: Send SensrLife should always be set for No unless the 4-20 mA receiver is capable of interpreting the sensor life signal. The Buckeye Detection Systems BFC-16 and BFC-64 are both capable of this function.

4.7.2.8 ALM REFRESH (M)

Alarm Refresh allows reactivation of Acknowledged alarms after the time period expires. This feature is used primarily to restart audible alarm devices after having been silenced by an acknowledge function (via serial port or swiping the Up/Reset button). An entry of 0 minutes effectively disables the Alarm Refresh function. A maximum of 60 minutes is allowed.

4.7.3 DIGITAL INPUT

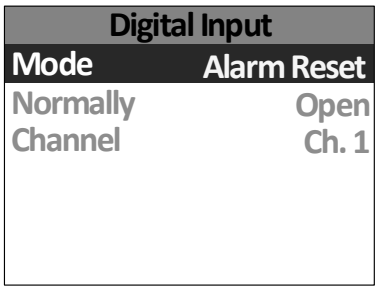


Figure 4-32 Digital Input System Menu

If a digital input is installed on the BFT10-0388 Relay/RS-485 Option Board, the Digital Input Menu can be set to one of three available configuration options:

1. *Alarm Reset* – when selected any active alarms, acknowledge enabled, will be acknowledged and reset when an input is received.
2. *A3 Override* – when selected, Alarm 3 will be activated on the selected channels when a signal is received. The *Normally* menu option refers to the type of connection to the digital input. If the input is normally a short it should be set to Normally Closed, otherwise it should be set to open (This is useful in a similar manner to the Failsafe mode mentioned in Section 4.3.1.3.)
3. *Flt Override* – when selected, the Fault Alarm will be activated on the selected channels when a signal is received. The *Normally* menu option refers to the type of connection to the digital input. If the input is normally a short it should be set to Normally Closed, otherwise it should be set to open (This is useful in a similar manner to the Failsafe mode mentioned in Section 4.3.1.3.)

4.7.4 VIEW EVENT LOG

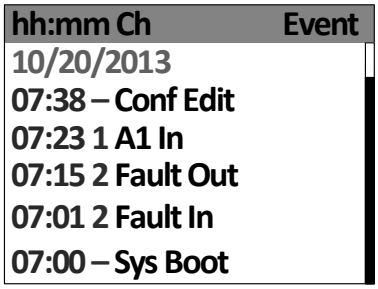


Figure 4-33 View Event Log System Menu

View Event Log displays the Event Log for the unit, which displays the last 100 events. Swipe up and down to scroll through the log. Entries have a date and time stamp followed by the channel number (or dash for system entries) and the type of event logged.

Logged events include:

1. Alarms/Fault In and Out
2. Alarm and Remote Alarm Resets

3. Alarm Refresh
4. Event Log Cleared
5. Configuration Changed
6. Calibration in and out
7. System and Cold Boots
8. Communication and Configuration Errors
9. Corrupt Sensor
10. Sensor Error
11. Configuration Edits

4.7.5 CLEAR EVENT LOG

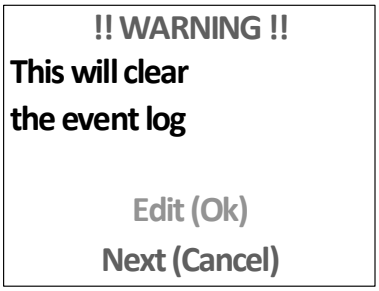


Figure 4-34 Clear Event Log System Menu

Clear Event Log clears the event log, swipe the Edit key to confirm.

4.7.6 VIEW SENSOR LIFE

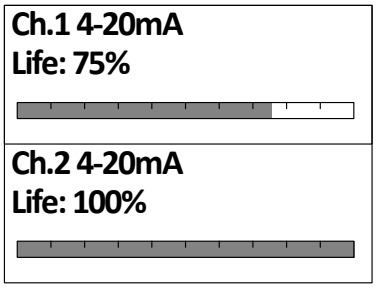


Figure 4-35 View Sensor Life System Menu

View Sensor Life provides an indication of the Sensor Life remaining. This percentage is calculated by comparing the amount of gain needed to be applied at the most recent calibration when compared to the amount of gain needed to be applied at the initial calibration.

4.8 DIAGNOSTICS

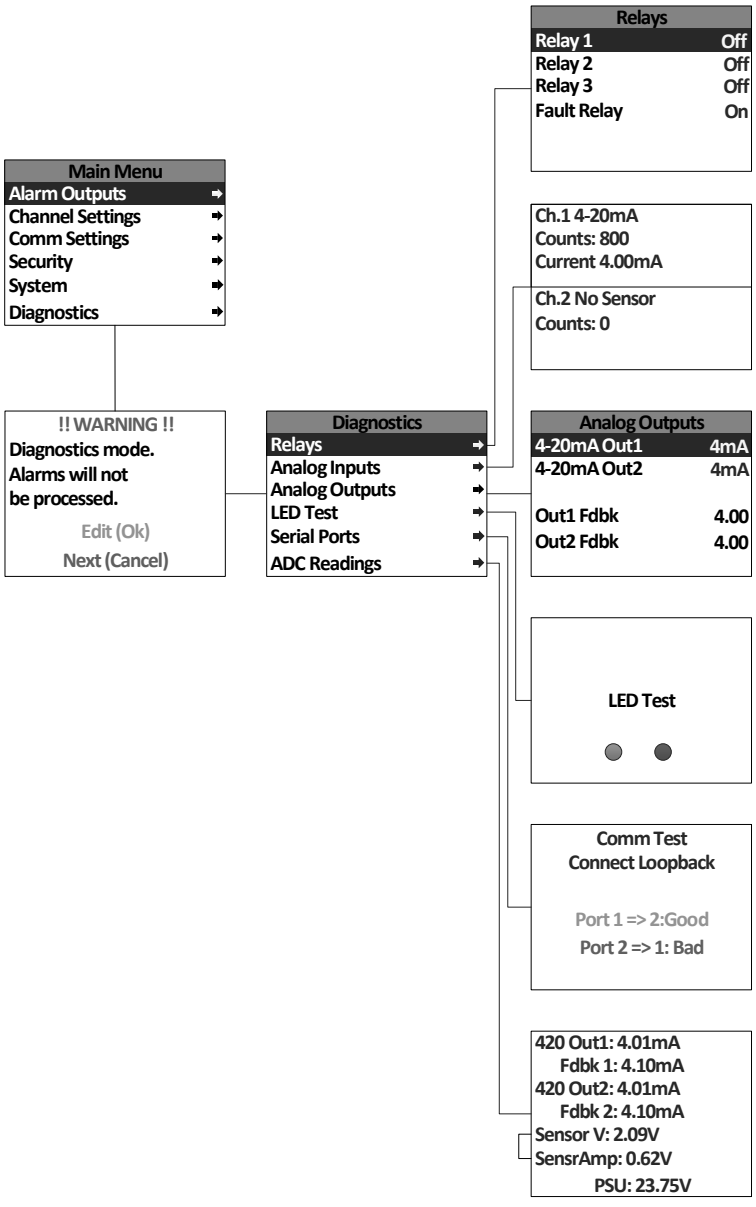


Figure 4-36 Diagnostics Menu Tree

A System Diagnostic Mode shown in Figure 4-36 may be entered during normal operation from the Main Menu. The entry menu offers useful routines for testing front panel LEDs, relays, serial ports, ADC readings and analog I/O. It is exited manually by swiping the Next key with a magnet, and automatically if no keys are swiped for five minutes.

Caution: It is very important to understand that **CHANNEL DATA IS NOT PROCESSED DURING THE SYSTEM DIAGNOSTICS MODE**. It is possible to miss important input values while utilizing this mode, and appropriate safeguards should be in place. However, the System Diagnostics Mode can prove invaluable when testing I/O since relays and analog outputs may be stimulated without driving inputs to precise levels.

4.8.1 RELAYS

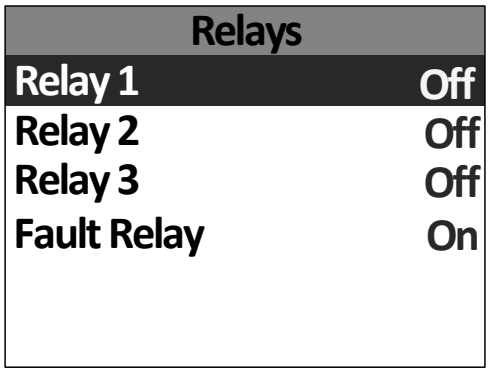


Figure 4-37 Relay Diagnostics Menu

The **Relays Menu** allows manual actuation of the Relays (optional BFT10-0388 BFT-44 Relay/RS-485 Option Board) while in the System Diagnostics Mode. Highlight the relay to be actuated and swipe Edit. Confirm relay actuation, and swipe Edit again to de-energize the relay.

4.8.2 ANALOG INPUTS

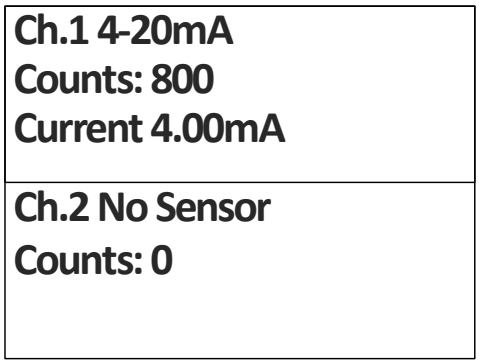


Figure 4-38 Analog Inputs Diagnostics Menu

The **Analog Inputs Menu** displays both channel's raw counts and input data.

4.8.3 ANALOG OUTPUTS

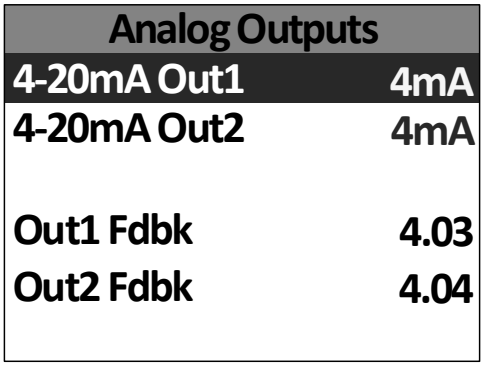


Figure 4-39 Analog Outputs Diagnostics Menu

Analog Outputs manually stimulates the 4-20mA outputs by selecting the channel and swiping EDIT. Each swipe increments the output by 4mA from 0-20mA. The Out1 Fdbk and Out2 Fdbk can be useful in determining if there are issues with the output. A circuit is installed on each of the two outputs which measures the actual current flow out of the output terminals. If this number reads zero when an output is stimulated, it could indicate that there is a cut wire or some other failure in connection with the wiring to the controller.

4.8.4 LED TEST

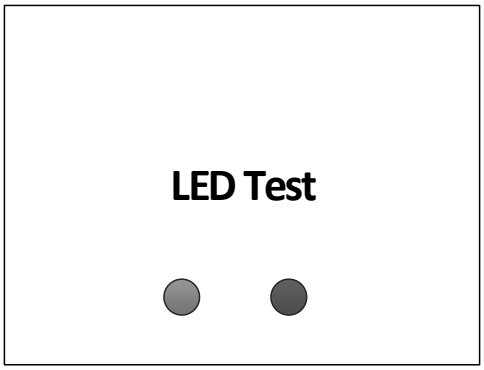


Figure 4-40 LED Test Diagnostics Menu

LED Test causes the two LEDs on the front panel to blink alternating red and green.

4.8.5 SERIAL PORTS

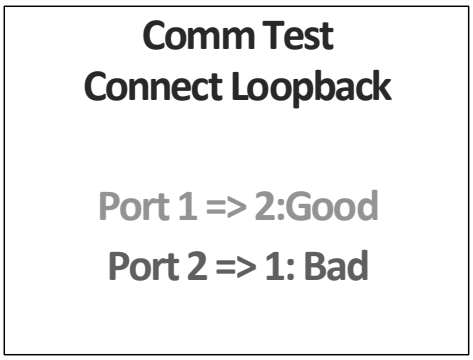


Figure 4-41 Serial Ports Diagnostics Menu

Serial Ports is used to test the two communication ports on the optional BFT10-0388 Relay/RS-485 Modbus Option Board. To test the Serial Ports connect A1 to A2 and B1 to B2, and set jumpers J3 and J5 to dual port mode, position B. The screen will then display a Good or Bad status report as shown in Figure 4-41.

4.8.6 ADC READINGS

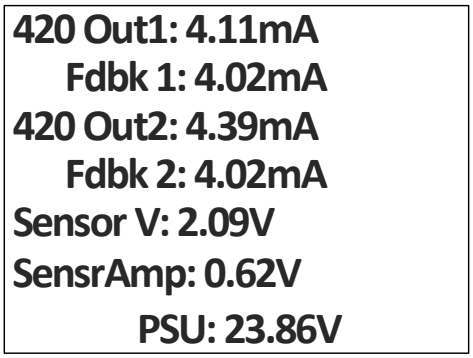


Figure 4-42 ADC Readings Diagnostics Menu

The **ADC Readings** displays Channel 1/2 4-20mA output and feedback current, sensor voltage for bridge inputs and sensor amplifier and power supply voltage as shown in Figure 4-42. These values may be useful to technicians when trying to determine whether or not a sensor is working properly.

The Fdbk1 and Fdbk2 can be useful in determining if there are issues with the output. A circuit is installed on each of the two outputs which measures the actual current flow out of the output terminals. If this number reads zero when an output is stimulated, it could indicate that there is a cut wire or some other failure in connection with the wiring to the controller.

BUCKEYE DETECTION SYSTEMS

BDS-50
Gas Detection Transmitter

User Manual

DETECTION BUCKEYE SYSTEMS

www.buckeyedetects.com

DETECTION
BUCKEYE
SYSTEMS

TABLE OF CONTENTS

TABLE OF CONTENTS *(Continued)*

1.0 SAFETY

1.1 Safety Information

The following symbols are used in this manual to alert the user of important instrument operating issues

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.

This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

1.2 Warnings:

- SHOCKHAZARD - DISCONNECT OR TURN OFF POWER BEFORE SERVICING THIS INSTRUMENT.

- RISQUE DE CHOC - DÉBRANCHEZ OU COUPEZ L'ALIMENTATION AVANT L'ENTRETIEN CET INSTRUMENT.

- WARNING: KEEP EXPOSION PROOF COVER TIGHT WHILE CIRCUITS ARE ALIVE

- ATTENTION: LE COUVERCLE ANTIDÉFLAGRANT DOIT ÊTRE HERMÉTIQUEMENT FERMÉ LORSQUE LES CIRCUITS SONT SOUS TENSION.

- EXPLOSION HAZARD- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

- RISQUE D'EXPLOSION: NE PAS DÉBRANCHER L'ÉQUIPEMENT SAUF SI L'ALIMENTATION A ÉTÉ COUPÉE OU SI LA ZONE EST CONNUE COMME NON DANGEREUSE

- For safety reasons this equipment must be operated and serviced by qualified personnel only. Do not operate equipment until after the instruction manual is read and understood for proper installation and operation

- Pour des raisons de sécurité, cet équipement doit être utilisé et entretenu uniquement par du personnel qualifié. Ne pas utiliser l'équipement avant d'avoir lu et compris le manuel d'instructions pour une installation et un fonctionnement appropriés.

- Equipment not used as prescribed within this manual may impair overall safety of the product.

- Une utilisation de l'équipement non conforme aux prescriptions de ce manuel peut nuire à la sécurité gnérale du produit.

- Power down transmitter in hazardous locations before removing or installing a sensor or any activity requiring removal of the enclosure cover.

- Mettez l'émetteur hors tension dans des endroits dangereux avant de retirer ou d'installer un capteur ou toute activité nécessitant le retrait du couvercle du boîtier.

1.3 Recommended Reference Material

- IEC 60079-29-2: Explosive atmospheres- Selection, installation, use and maintenance of detectors for flammable gases and oxygen
- IEC 60079-20-1: Explosive Atmospheres Material Characteristics for Gas and Vapor Classification

1.4 Cleaning

Use a clean damp cloth to clean the BDS-50. Do not use harsh chemicals or solvents to clean the BDS-50.

2.0 GENERAL PRODUCT DESCRIPTION

2.1 Introduction

The BDS-50 is a state-of-the art gas detection transmitter approved for Class I, Division 1, Groups A, B, C, and D, T6 locations, (Canada & U.S.) for Toxic and Combustible gases. The BDS-50 is a universal transmitter that can be a single or dual channel gas monitor and accepts all Buckeye Detection Systems sensor types and ranges. The BDS-50 provides the user with an easy-to-read color display and user-friendly interface with a menu structure that is intuitive and feature rich. The BDS-50 is equipped with 4-20 mA and Modbus communication interface. The BDS-50 comes standard with four fully programmable relays.

2.2 Ratings Certifications

CSA Approvals (File # 2681264): BDS-50 with the 01-0001001 Sensor Housing is approved for Class I, Division 1, Groups A, B, C, and D T6 (Canada & U.S.)

Supply: Rated 10-30 VDC, 1 Amp max. input provided by a Class 2 / SELV source.

Ambient Temperature: Range -40C to +60C.

Relay Contacts: Rated 250 VAC, 30 VDC, 5.0 A max. Resistive, Form "C"

Warranty: See Standard Limited Warranty Section 14.0

2.3 System Design Specifications

Display: 2.4" Diagonal 240 x 320 Pixels LCD Color Display, LED Backlight

Analog Out: 3-wire 4-20mA current sourcing output at nominal 24V DC power supply

Power Supply: 10 – 30VDC @ 5 Watts

2.4 Buckeye Contact Information

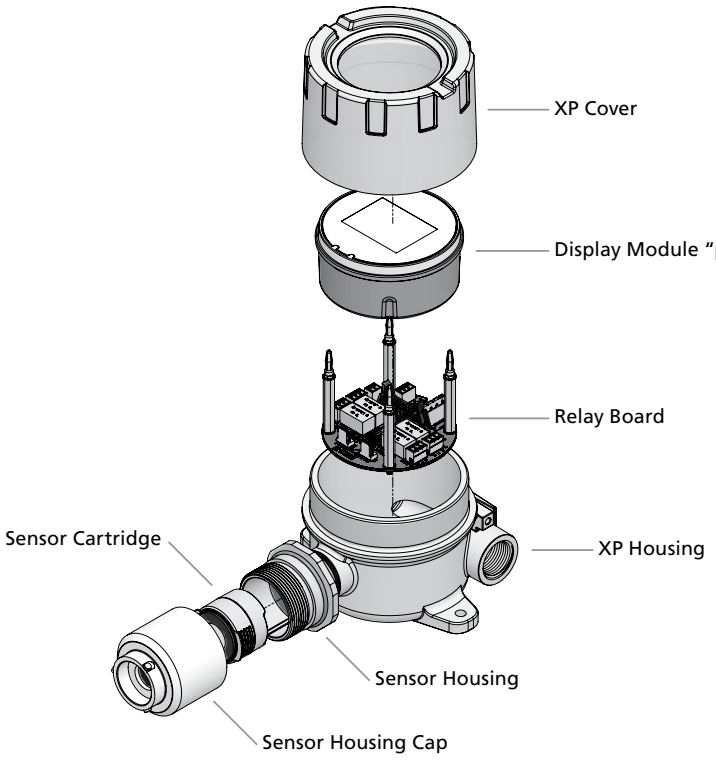
Address: Buckeye Fire Equipment, 110 Kings Road, Kings Mountain NC 28086
Main: 704.739.7415 **Direct:** 704.710.0322
Website: www.buckeyedetects.com

3.0 SYSTEM COMPONENTS

3.1 Overview

The BDS-50 gas detection transmitter assembly consists of the XP cast aluminum enclosure, display module "puck", relay board, sensor housing, sensor cartridge and sensor housing accessories.

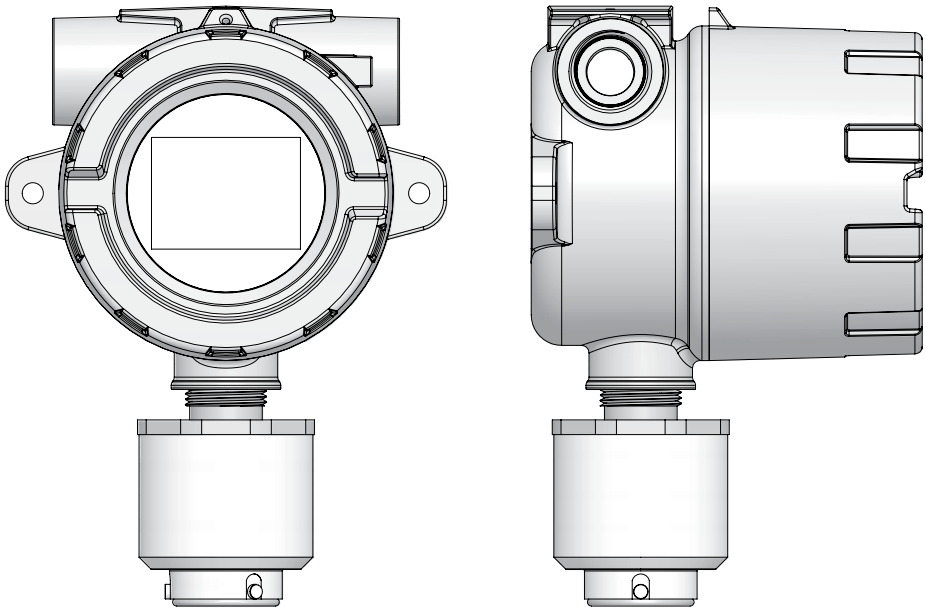
Fig 3.1a



3.2 XP Enclosure

The BDS-50 gas detection transmitter housing is an explosion proof aluminum cast enclosure with a viewing window. The enclosure has a mounting flange with two mounting holes with clearance for a ¼ inch bolt. The BDS-50 has two ¾ inch NPT ports for wiring entry into the enclosure.

Fig 3.2a



3.3 Sensor Housing

The sensor housing provides an XP approved enclosure for the sensor cartridge and electronics. The sensor housing is approved for hazardous locations Class I, Division 1, Groups A, B, C, and D T6 locations, (Canada & U.S.) for Toxic and Combustible gases. The sensor housing provides a unique keyed design for easy sensor insertion.

Fig 3.3a

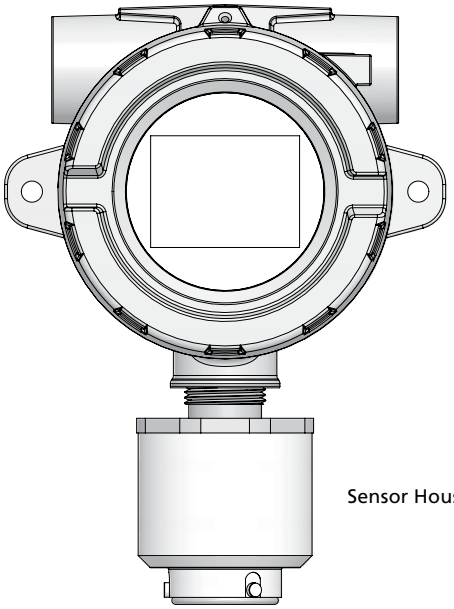
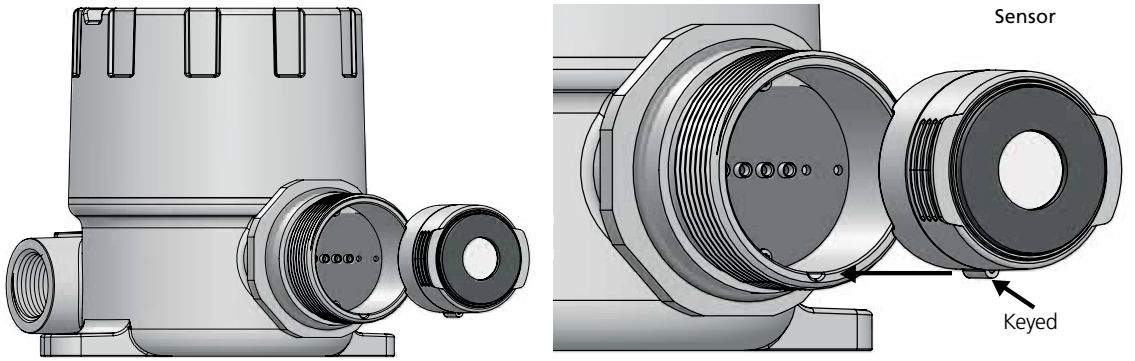


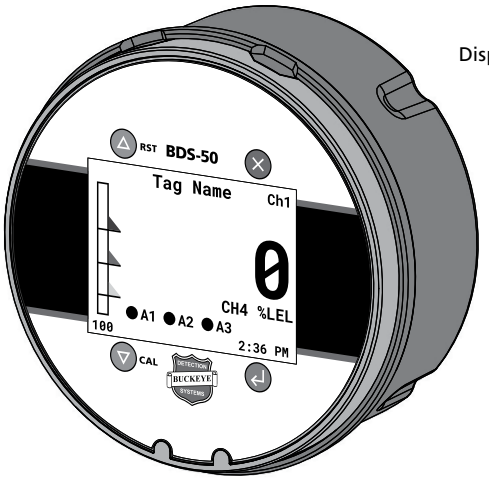
Fig 3.3b



3.4 Display Module

The BDS-50 display module "puck" has a bright color display that provides all information in an alpha-numerical format that is easy to view and understand.

Fig 3.4a



Display Module "Puck"
P/N 50-3001

3.4.1 Display Module Non-Intrusive User Interaction

Fig 3.4.1a

Magnetic Wand
P/N 50-1001

The BDS-50 implements a non-intrusive method to allow the user to interact with the transmitter. Non-intrusive allows interaction with the transmitter without exposing the electrical components to the hazardous area. The transmitter has four hall-effect switches that detect a presence of a magnetic field. The hall-effect switch mimics a push-button switch but as a non-intrusive format. Buckeye Detection Systems provides a magnetic wand that is included with the transmitter and is required for transmitter user interaction.

The BDS-50 has four hall-effect switches that represent a specific user interaction / function. The BDS-50 display module overlay / label has four graphics that represent each hall-effect switch. The graphic area will be referenced as a "button" going forward.

RST The "Up / RST" button, Allows the user to scroll "Up" through screen menu items, configuration selections and alpha-numeric entries. This button also allows the user to acknowledge alarms.

CAL The "Down / Cal" button, Allows the user to scroll "Down" through screen menu items, configuration selections and alpha-numeric entries This button also allows the user to short-cut to the calibration function.

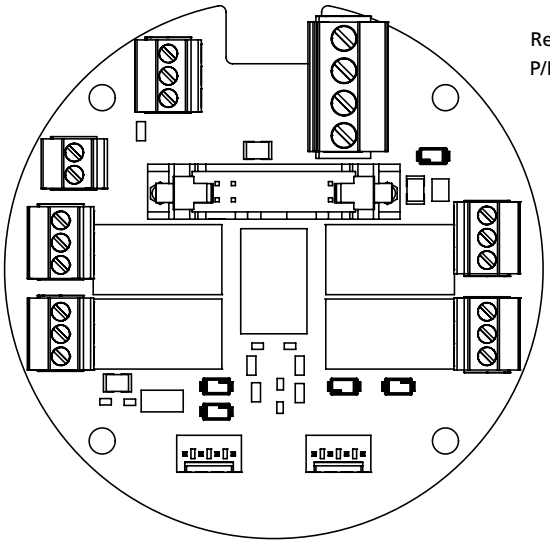
The "X" button, This button has multiple functions and will be discussed when applicable. However the "X" button allows the user to escape out of a menu selection, cancel a function or configuration, move between configuration selections, etc.

The "Enter" button, This button allows the user to enter into the transmitter configuration menu screens as well as accept a configuration selection or execute a function.

3.5 Relay Board

The BDS-50 Relay board provides all of the field wiring terminations for power, channel 1 and channel 2 analog 4-20 mA signals, relays, Modbus and alarm acknowledgement or discrete digital input. All wiring terminations have connectors that can be removed from the connector receptacle to assist with wiring.

Fig 3.5a



Relay Board
P/N 50-3002

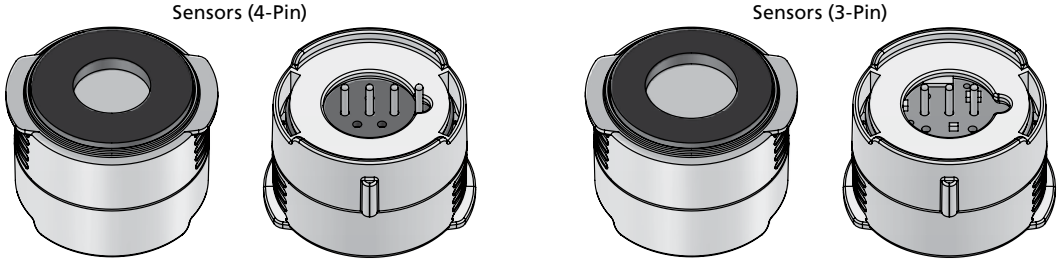
3.6 Sensor Cartridge

The BDS-50 has an unique sensor cartridge that is designed to allow all toxic and combustible sensors to be in one universal sensor cartridge. Once the sensor is installed into the sensor housing the sensor data is uploaded into the BDS-50 transmitter and is operational for any sensor installed without additional transmitter configuration.

Fig 3.6a

Combustible and CO2
Sensors (4-Pin)

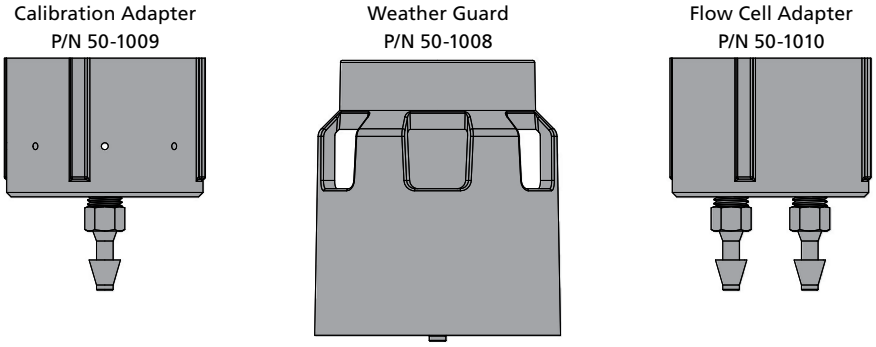
Toxic and O2
Sensors (3-Pin)



3.7 Sensor Housing Accessories

The BDS-50 sensor housing implements a quarter turn connection design to allow for easy attachment of the BDS-50 accessories such as the calibration adapter, weather guard and flow cell.

Fig 3.7



3.7.1 Calibration Adapter

The calibration adapter allows the BDS-50 sensor housing / sensor to be connected to a Buckeye Detection Systems calibration kit.

3.7.2 Weather Guard Adapter

The weather guard adapter is recommended for applications in wash down areas, splash prone areas, outdoor weather elements, etc. The weather guard adapter has a ¼" tube barb that can be used as a bump test assembly for remote or elevated installations.

3.7.3 Flow Cell

The flow cell adapter allows the BDS-50 gas detector to be integrated into a sample draw system that allows the gas sample to flow in and out of the sensor housing.

4.0 INSTALLATION INSTRUCTIONS

4.1 Location

Consideration must be given to the following factors when choosing a location for mounting the BDS-50 transmitter.

Orientation – The BDS-50 should be mounted so that the transmitter sensor is pointed downward, failure to do so will restrict the sensor performance, allow for dust and contaminants and moisture to collect in the sensor housing preventing proper sensor diffusion detection.

Accessibility – When determining the BDS-50 mounting location, consider calibration procedures, future maintenance requirements and ease of location access.

Gas Density – For gases with densities greater than air, the BDS-50 should be installed approximately 18" from floor level. In these applications care should be taken to protect the sensors from physical damage. For gases with densities less than air, the Instrument should be installed at a high level or close to the potential leak source. For gases with densities equal to air, mount as close to potential leak source as practical. Ultimately transmitter placement is the responsibility of the end-user applicable to the application and safety concerns.

Air Flow – Factors such as air movement, gas density in relation to air, emission sources, gas interferences and environmental variables should be considered when determining the correct transmitter location. Air movement by fans, prevailing winds, exhaust duct, strong air-flow through a room, and convection should be carefully evaluated.

Gas Release Temperature – Evaluate the behavior of the gas when it is cooled or heated when released. Gases may rise or fall when first released but change as their temperature and properties change.

Avoid Pressure and Excessive Air Velocity – BDS-50 sensors are designed to detect gas concentrations under normal atmospheric conditions. Higher air velocities will result in inaccurate measurement.

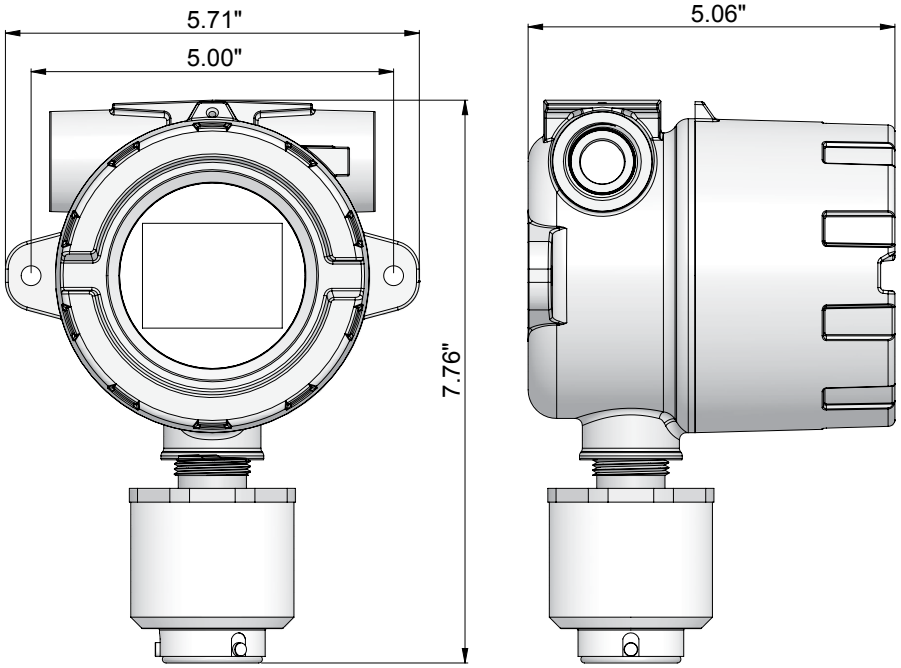
Ambient Temperature – Ensure that the device is located within an area that complies with the specified operating temperature range.

Environmental Damage – Effort should be made to protect the BDS-50 sensors from environmental damage caused by water, ice, shock, vibration, dirt, etc.

4.2 Mounting

The BDS-50 enclosure has a mounting flange with two mounting holes with a clearance for a ¼ inch bolt. The BDS-50 can be mounted on a flat surface or be pole mounted with the applicable hardware. The mounting infrastructure should be strong enough to maintain mounting and wiring / conduit integrity.

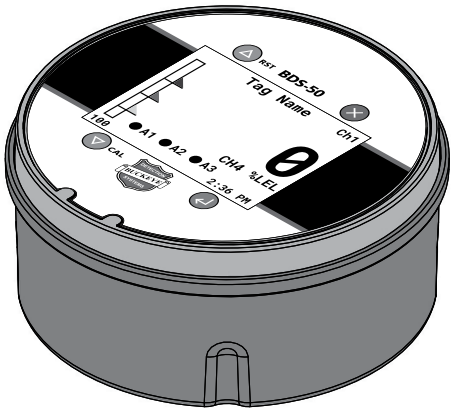
Fig 4.2a



4.3 Wiring

The BDS-50 relay board provides connectors for all field wiring terminations. Removing the display module "puck" allows access to the relay board connectors / terminations. To remove the display module firmly grip the display module grip ring and pull forward being careful as the display module is connected to the relay board via a ribbon cable.

Fig 4.3a



Display Module Grip Ring

All field wiring terminations have removable connectors to allow easy wiring and wire routing management.

The BDS-50 has two types of removable terminals. A spring clamp terminal and a screw clamp terminal. The type of terminal shipped is determined by the BDS-50 transmitter part number.

The screw clamp terminal can be wired in place or removed from the terminal receptacle. The spring clamp terminal can remain in the terminal receptable and provides an alternative wiring implementation.

To wire the spring clamp terminal. Strip the wire insulation 10 mm (approx. 3/8"), with a small blade screwdriver press down the orange tab for the applicable termination point. Insert the wire fully into the terminal wire entry and release the orange tab. Test the connection with a slight pull-tug of the wire to ensure the mechanical connection of the termination.

Spring Clamp Terminal

2 and 3 position 24-16 Ga. range

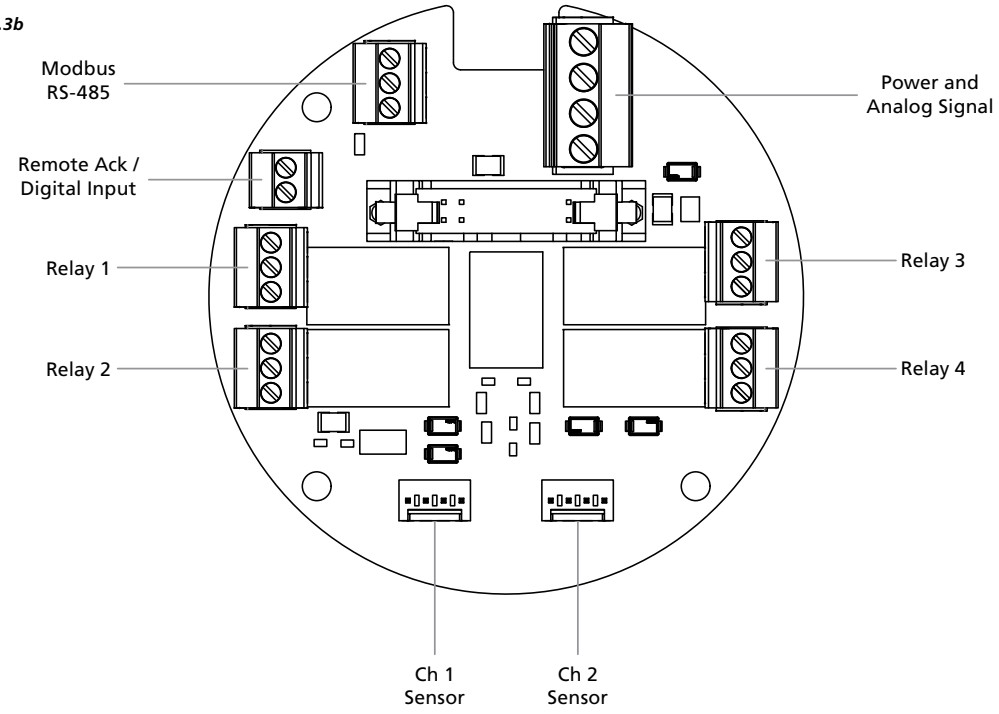
4 position 24-16 Ga. range

Screw Clamp Terminal

2 and 3 position 28-16 Ga. range

4 position 24-12 Ga. range

Fig 4.3b



4.3.1 Determining Wiring Parameters

Wire / Cable Recommendation – The BDS-50 is a sourcing transmitter that utilizes an analog 4-20 mA signal to communicate the transmitter concentration value to controllers, receivers, PLC, etc. The cable should be a 3 conductor (for single channel) or 4 conductor (for dual channel) shielded, (braided or foil wrapped) with a drain wire.

When the BDS-50 analog 4-20 mA signal is utilized the analog loop voltage drop is the determining factor for wire gauge and maximum length between the power supply / receiver input and the transmitter. The recommended wire gauge is 16 gauge and in most cases is sufficient for long distances within the 10-30 VDC range. The maximum distance between the transmitter and its power supply / controller is determined by the maximum allowable interconnecting loop-voltage drop. At the minimum 10 VDC supply power the max loop load is 300 ohms and at 30 VDC the max loop load is 1300 ohms, At a nominal 24 VDC the max loop load is 1000 ohms

For example: A BDS-50 powered by a nominal 24 VDC power supply is approximately 1000 feet from the power supply and PLC input. The "loop" consist of the PLC input resistor and the wiring. If the PLC input resistor is 250 ohms then the remaining loop resistance is 750 ohms. Since there is a loop wire and a +24 wire the wire resistance is doubled. 16 gauge wire would have an approximately resistance of 4 ohms per 1000 feet (times two = 8 ohms).

Conclusion: With the BDS-50 powered by a nominal 24 VDC at a 1000 feet distance from the power supply / PLC the "loop" resistance total is the PLC input resistance of 250 ohms plus the total wire (16 gauge) resistance of 8 ohms. The total "loop" resistance of 258 ohms is well below the allowed 1000 ohms available at a nominal 24 VDC supply.

4.3.2 Max Analog 4-20 mA Loop Resistance

The BDS-50 has the following nominal and max analog 4-20 mA loop resistance for the following common supply voltages.

Fig 4.3.2a

Supply Voltage	Rmax Nominal	Rmax
10 VDC	135	150
12 VDC	220	245
15 VDC	355	395
20 VDC	585	652
24 VDC	750	850
30 VDC	1030	1144

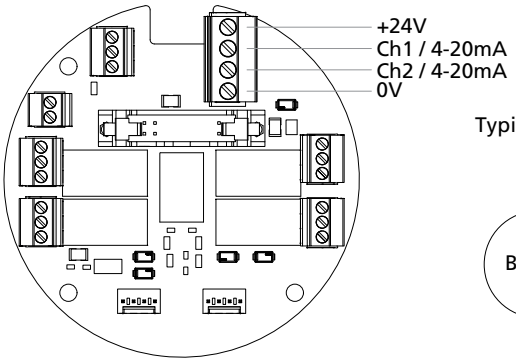
4.4 Wiring the BDS-50

4.4.1 Power and Analog Wiring

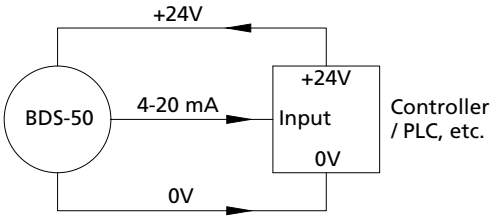
The BDS-50 power wiring and signal wiring are terminated on the relay board as shown in Fig 4.4.1a. The terminal block is equipped with a removable plug for ease of wiring and is marked "Power" on the relay board.

Fig 4.4.1a

Power and Analog Signal Terminations



Typical Analog Wiring (3 wire, Sourcing)

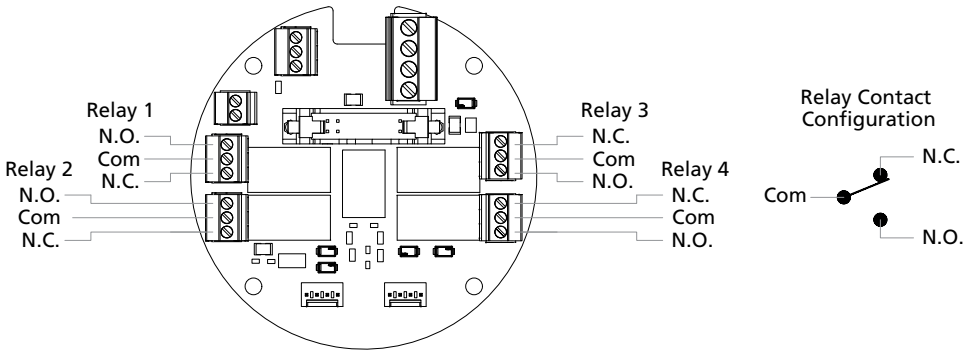


Note: The BDS-50 power terminations are reverse polarity protected to avoid power mis-wiring.

4.4.2 Relay Wiring

The BDS-50 is standard with four programmable relays and are wired on the relay board as shown in Fig 4.4.2a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Relay 1, Relay 2, Relay 3, and Relay 4. Each relay terminal is marked as N.O. (Normally Open), C, (Common) and N.C (Normally closed). These designators correspond to the quiescent (de-energized) state of the relay. When the relay is energized, the terminals reverse states. (see figure 4.4.2a below)

Fig 4.4.2a

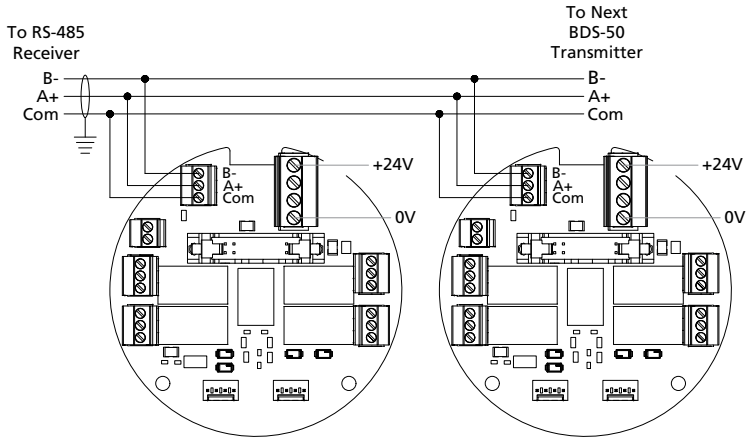


Relay Contacts are rated 250 VAC, 30 VDC, 5.0 A max. Resistive, Form "C".

4.4.3 Modbus Wiring

The BDS-50 is standard with RS-485 Modbus Communications and is wired on the relay board as shown in Fig 4.4.3a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Modbus. The terminal is marked B-, A+ and Com. A termination resistor is not required on the last transmitter.

Fig 4.4.3a



4.4.4 Alarm Acknowledge and Digital Input

The BDS-50 is standard with an alarm acknowledge / reset and digital Input and is wired on the relay board as shown in Fig 4.4.4a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Alarm Ack, the terminal is marked Ack and Gnd. The termination allows for a remote switch to be implemented to remotely acknowledge an alarm or be used as a digital input to activate relays. Remote switch distance is max 75 feet at min 18 gauge.
(see figure 4.4.4a on the next page.)

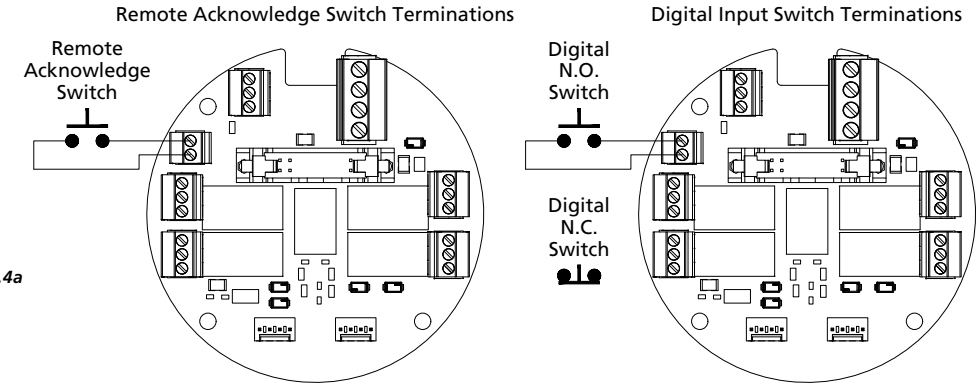


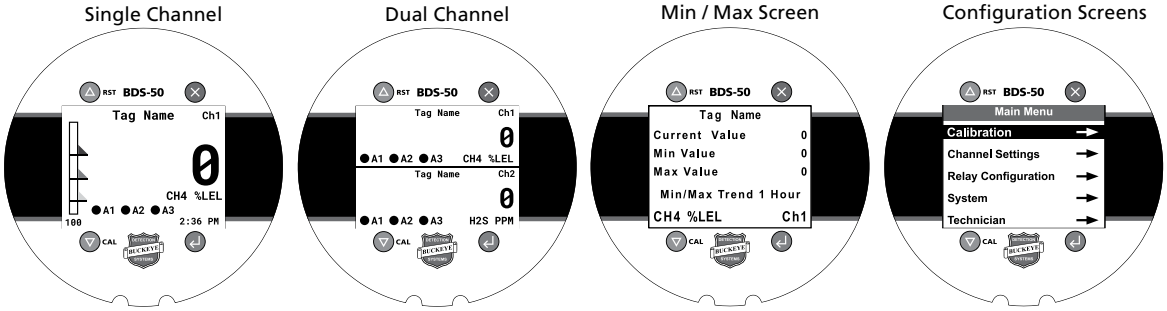
Fig 4.4.4a

5.0 BDS-50 DISPLAY SCREENS

The BDS-50 large color display provides the user with an enhanced transmitter interaction and configuration.

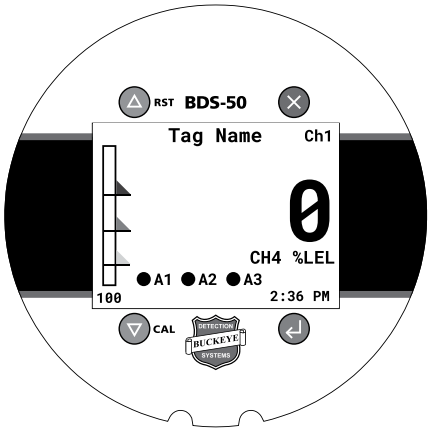
The BDS-50 has several main display screens that the user can select. In a single channel mode, tapping the "X" will cause the display to change from the enabled single channel screen to the same channel Min/Max screen. In a dual channel mode with both channels enabled, tapping the "X" will cause the display to change from the dual channel screen to the channel one min/max screen then the channel two min/max screen then the channel one main screen and then the channel 2 main screen.

Fig 5.0a



5.1 Single Channel Screen

Fig 5.1a

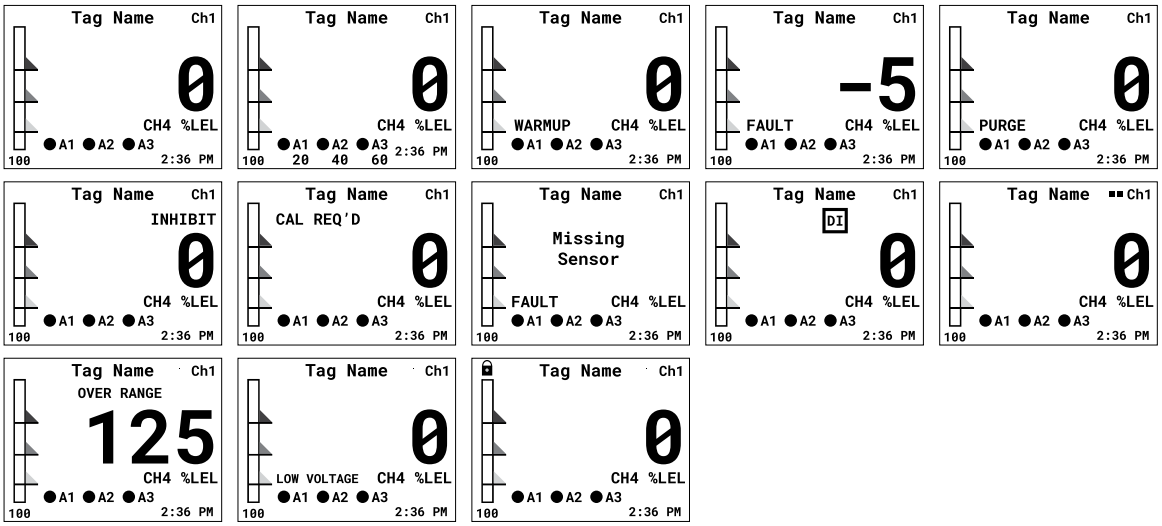


Single Channel

- Tag Name
- Channel No.
- Gas Concentration Value
- Engineering Units
- Bar Graph with Alarm Indicators
- Full Scale Value Indicator
- Alarm LED's with Alarm Setpoint
- Clock
- Warmup, Fault, Purge, Inhibit, Cal Req'd, Missing Sensor, and DI (Digital Input)

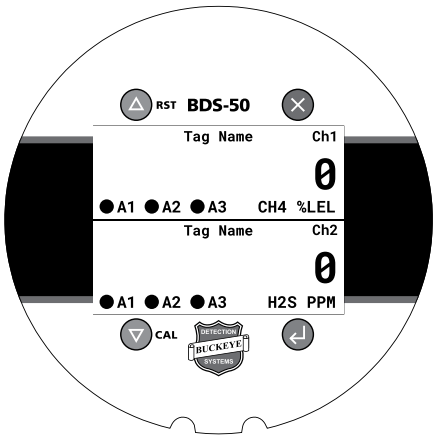
Single Channel Display Screens

Fig 5.1b



5.2 Dual Channel Screen

Fig 5.2a

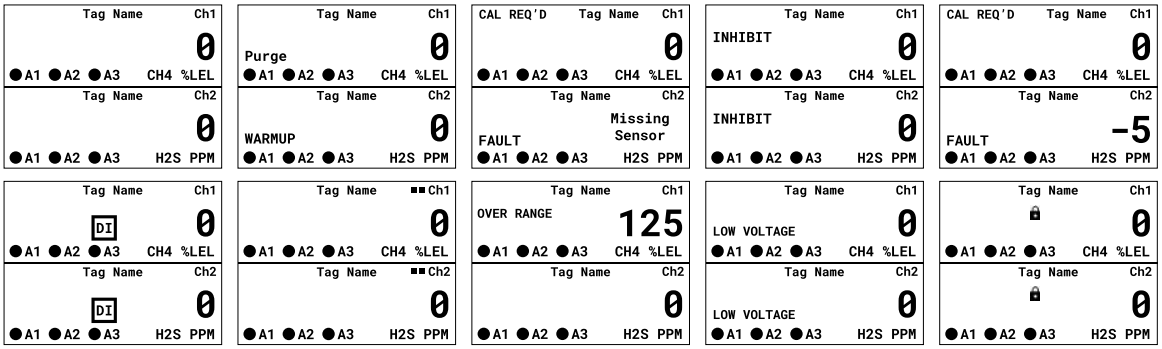


Dual Channel

- Dual Tag Name
- Dual Channel No.
- Dual Gas Concentration Value
- Dual Engineering Units
- Alarm LED's
- Warmup, Fault, Purge, Inhibit, Cal Req'd, Missing Sensor and DI (Digital Input)

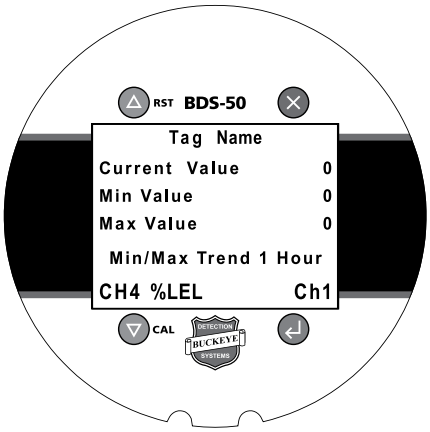
Dual Channel Display Screens

Fig 5.2b



5.3 Min/Max Screen

Fig 5.3a



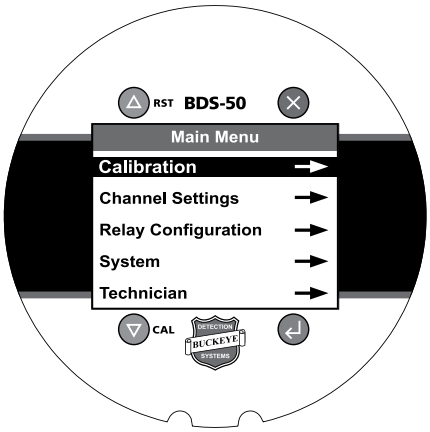
Min/Max Channel

- Tag Name
- Current Value
- Minimum Value
- Maximum Value
- Engineering units
- Channel No.

The BDS-50 gas detector tracks the gas concentration value for a duration of one hour and displays the minimum and maximum value on the Min/Max screen. The min/max displayed value is a continuous result of the past values for the past one hour from when the Min/Max screen is displayed. The min/max past one hour results can be reset at any given time by holding the magnet on the Up/RST button for two seconds. The reset feature is useful to track changes in a short period of time.

5.4 Configuration Screens

Fig 5.4a



Configuration Screen

- Calibration
- Channel Settings
- Relay Configuration
- System
- Technician

6.0 OPERATING THE BDS-50

Initially powering on the BDS-50 will display the Buckeye logo for about 5 seconds. The BDS-50 will perform a system check and display any sensor detected followed by a sensor data screen for each active channel then go to the single channel or dual channel main screen. If a sensor is missing in an active channel upon power-up then the display will show "missing sensor" once the main screen is displayed.

After the initial system check and the main screen is displayed the active channels will go into a warmup mode allowing the sensors to stabilize and inhibit all alarms and outputs. Once the warmup mode expires (default one minute) the BDS-50 will be operational "live" and display all transmitter current status conditions.

Note: Anytime a sensor is installed and initialized the BDS-50 will go into warmup mode and inhibit all alarms and outputs.

6.1 BDS-50 Main Menu Overview

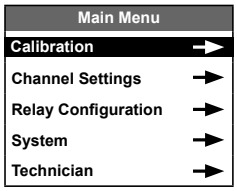
This section covers the various configuration parameters for the BDS-50. All configuration variables are selected via the menu screens and those variables are stored in the non-volatile memory. Many menu items contain default values from the factory and may require changes to better match the user application. Refer to section 7.0 for instruction and details for user interaction and navigating through the BDS-50 menus and configurations.

Quick Note: BDS-50 Magnetic Wand Interaction

- Tapping the wand on the "enter" button opens menu items, places the variable into edit mode and enters and saves new variables.
- Tapping the up or down arrow buttons moves the cursor "highlight" thru the active menu or variable choices.
- Tapping the "X" button can toggle the main screen through the single, dual, min/max screens, escape to the previous screen, move the cursor through variable selections, etc.
- The BDS-50 screens have a wand activation indicator in each corner to confirm to the user that the corresponding button was activated by a magnetic wand. This function assist the user when interacting with the BDS-50 with a magnetic wand.

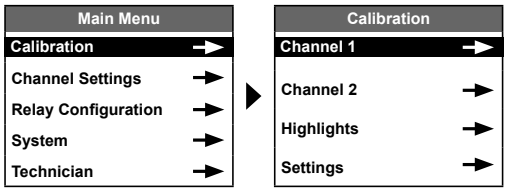
6.1.1 Main Menu

When the main operating screen is displayed, tapping the magnetic wand on the "Enter" button will access the BDS-50 Main menu. The main menu comprises of five categories with associated supporting screens.



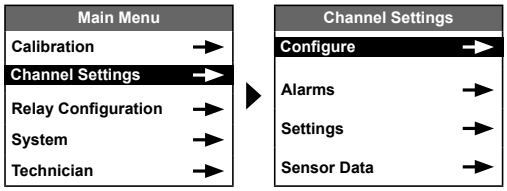
6.1.2 Calibration Menu

The Calibration menu allows the user to calibrate sensors, view calibration highlights and change the calibration time interval requirement.



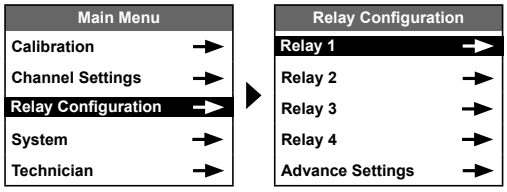
6.1.3 Channel Settings Menu

The Channel Settings menu allows the user to edit the channel configurations, information, alarms, settings and view sensor data.



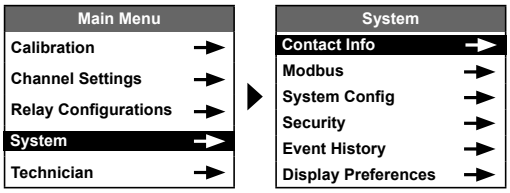
6.1.4 Relays Configuration Menu

The Relay Configuration menu allows the user to define the relay settings and assignments



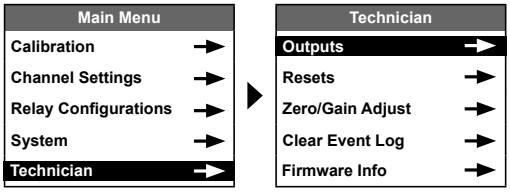
6.1.5 System Menu

The System Menu provides information and system parameter configurations for numerous functions of the BDS-50.



6.1.6 Technician Menu

The Technician Menu provides transmitter functions to test, simulate, clear event logs, etc.



6.2 Transmitter / Sensor Interaction

The BDS-50 gas detector is truly a universal transmitter that can be used with any Buckeye Detection Systems sensor type and sensor range. BDS-50 gas detectors are typically shipped with a sensor installed and the transmitter is ready for installation. However, BDS-50 gas detectors can be shipped without sensors or a sensor can be installed after installation or as a replacement.

When a sensor is inserted into a BDS-50 it runs a sensor profile check and the BDS-50 screen will prompt the user accordingly.

6.2.1 New Sensor / Same Type and Range

When a new sensor is inserted that is of the same type and range as the previous channel sensor data, the user will be prompted that a new sensor is detected and is of the same sensor type and range and the new sensor does not match the current channel data. The user will be prompted to upload the new sensor profile.

Note: If a sensor is removed and then re-inserted the BDS-50 will display sensor detected then the sensor data screen and then the user should choose not to upload sensor data. if the sensor data was altered, calibrated, etc prior to re-insertion then the new data should be uploaded.

6.2.2 Different Sensor Type

When a sensor is inserted that is a different type as the previous channel sensor data, the user will be prompted a new sensor is detected and the sensor type is different than the current channel data. The user has a choice to proceed and upload the sensor data or decline.

Decline: To decline the upload, highlight "No" by using the up/down arrow buttons and tap "Enter". The display will prompt the user to Remove the Sensor and tap the "Enter" button after removal. This will allow the BDS-50 to resume the channel and sensor data as previous and the display will state "Missing Sensor" and "Fault". Note: tapping the "X" button will change the display to the previous screen.

Accept: To accept the upload, highlight "Yes" by using the up/down arrow buttons and tap "Enter". The BDS-50 will upload from the sensor all applicable sensor data and apply to the transmitter configurations. The BDS-50 will automatically go into a warmup mode.

Note: When a new sensor type is uploaded, the sensor type and range default alarm setpoints over-write previous setpoints.

6.2.3 Calibration

The BDS-50 gas detection monitor is recognized as a safety device when operated and maintained correctly. Verifying proper operation of the device in the form of zero calibration and span calibration is essential to ensure the device performs as intended. The frequency at which zero calibration and span calibration occur is best determined based on local regulatory standards, company policies, and industry best practices. Buckeye Detection Systems is not responsible for setting calibration interval policies or practices.

6.3 Calibration At a Glance

Zero Calibration is performed to establish baseline readings of atmospheres that are known to be free of toxic or combustible gases.

Span Calibration is performed to ensure the device detects target gases within specified operating parameters. Span Calibration is the adjustment of the gas detector sensor response to match a known concentration of gas. Sensors can lose sensitivity through normal degradation, humidity, temperature, exposure to high gas concentrations, age etc and should be calibrated periodically to ensure proper span adjustments are aligned with the sensor performance. Accurate calibration can be achieved only if specific concentrations of the correct gases are used.

Note: Although all BDS-50 sensors are calibrated at the factory. It is important to calibrate a sensor when its installed and powered to accommodate for atmospheric factors, (temperature, humidity, etc).

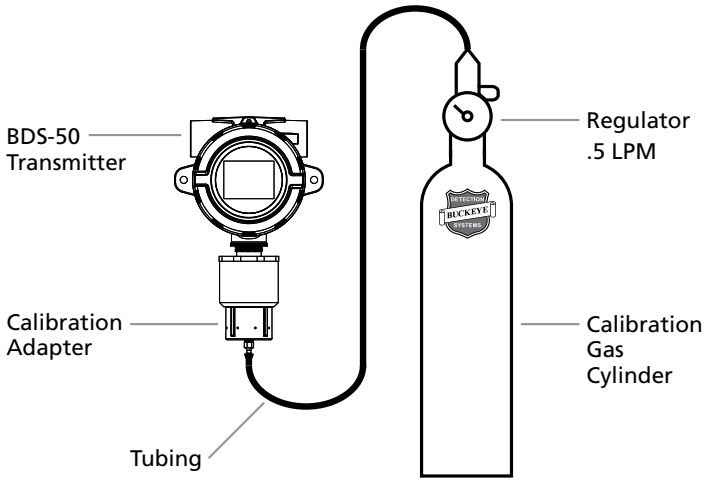
- Use the following guidelines for calibrating your BDS 50:
- Use calibration gases with National Institute of Standards and Technology (NISTS) trace ability.
- Only uses gases that have not exceeded their expiration date.
- Use proper Tygon or Teflon tubing that is applicable for the calibration gas
- Use a .5 LPM regulator for proper calibration gas flow
- Always calibrate a new sensor before it is commissioned for use.
- Create and maintain a regular calibration schedule as a part of preventive maintenance program.
- Ensure the calibration is performed in an environment free of background gases.

Note: Buckeye Detection Systems recommends, a calibration kit be ordered with the BDS-50 gas detector. All the components are included for a successful calibration, span calibration gas, zero calibration gas, regulator, calibration adapter and tubing are in the kit.

6.4 Typical Calibration Setup

The Buckeye Detections calibration kit would be assembled as shown below

Fig 6.4a



Note: Buckeye Detection Systems recommends using the appropriate tubing for a specific calibration gas. Tygon tubing is recommended for combustible gases and non-reactive gases. Teflon tubing is recommended for reactive "sticky" gases such as Ammonia, Chlorine, etc.

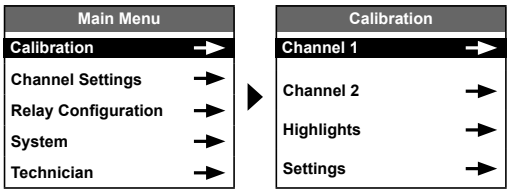
6.5 Calibration Procedure

The BDS-50 is designed so that calibration is an easy process. The following section provides step by step instructions to successfully calibrate a BDS-50 gas detection transmitter.

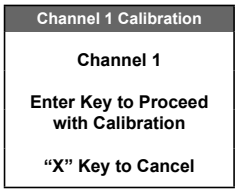
It's important that when a sensor is to be calibrated that the sensor has had ample time to stabilize with in its environment. Sensor types have various recommended burn-in times (powered) that are suggested prior to a calibration. Section 13.0 highlights recommended burn-in times for Buckeye Detection Systems sensors.

Once the sensor is ready for calibration and the user has the calibration kit assembled according to Fig 6.4a with the Zero Air calibration gas cylinder attached. The BDS-50 can then be placed into the calibration mode.

The BDS-50 can be placed into calibration mode by two different methods. Holding the magnetic wand on the Cal button (down arrow) for three seconds or by going into the main menu by tapping the enter button and navigating to the calibration procedure per the below sequence



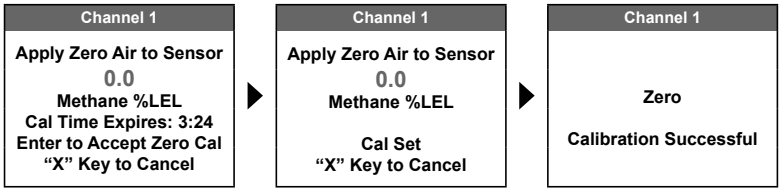
Once in the calibration procedure for the selected channel / sensor the following screen will be displayed for the applicable channel. Tap the enter button to proceed with the calibration or if required tap the "X" button to cancel the calibration and the BDS-50 will go back to the main operating screen.



6.5.1 Zero Calibration

Establishing a good "zeroing" is of the utmost importance for a successful calibration. It is recommended to use zero air to flush any background gases or impurities from the sensor to avoid zero offsets. Once in the Zero calibration screen as shown below, apply the zero air by turning on the .5 LPM regulator attached to the zero air calibration gas cylinder.

With the zero air flowing, the "live" reading in red will provide a real time zeroing response. It's a good practice to let the zero air flow long enough to allow the reading to reach "0" or stabilize close to "0" to establish a good zero baseline. When "0" is reached and or stabilized close to "0" tap the enter button to accept the zero calibration value and the screen will display "Cal Set" confirming the zero calibration was set. The BDS-50 will then display "Zero Calibration Successful"



The zero calibration screen has a five minute timer that provides the user an indication of how much time the Zero Air has been flowing as well as how much time is left before the zero calibration mode expires. If the user does not tap the enter button to set the zero calibration before the timer expires the BDS-50 will display "Calibration Time Exceeded". When the calibrated time exceeded screen is displayed the user has the option to tap the enter button to proceed back to the main operating screen or after a few seconds the BDS-50 will automatically go back to the main operating screen.

Note: An approximate time for the zero air to flow across the sensor would be 30 – 90 seconds or when the "live" reading has reached "0" or a reading close to "0" and has stabilized.

Note: An unsuccessful zero calibration can result if the "live" reading is too high of a percentage of the full scale. If this occurs the calibration procedure will not allow the user to proceed to the span calibration. Evaluate the calibration setup and resolve any issues that could prevent a successful zero calibration and enter the calibration procedure again.

Note: When zeroing an O2 (oxygen) sensor, Nitrogen gas must be used to provide a complete absence provide a complete absence of O2 to properly zero an O2 sensor.

Note: When a background gas is suspected, applying zero air to a sensor can be a good tool to see if the current value goes to zero or is reduced significantly.

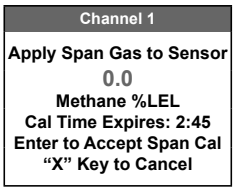
Note: The calibration of a sensor / gas detector remains within the sensor memory.

6.5.2 Span Calibration

Calibration span gas that matches the "target" gas should be used whenever possible. It's important that the span gas concentration value matches the "Span Value" located in the channel configuration menu as this is the value the BDS-50 gas detector will span to. Default span values are uploaded from the sensor to the BDS-50 gas detector for all sensors. if a different span value other than the default is to be used then Buckeye Detection Systems recommends to use a span gas concentration that is within 25 – 75 % of the sensor range or approximate of the alarm setpoints to be used.

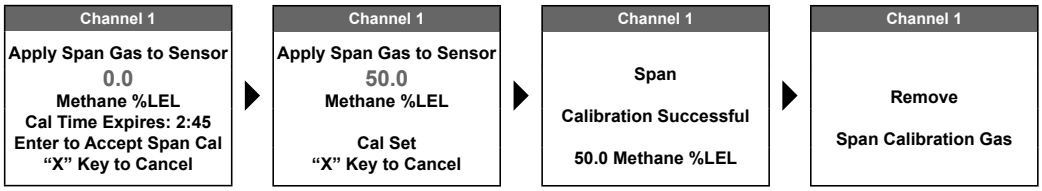
Note: For some applications a surrogate gas with a K-factor may be applied to simulate the target gas when the target gas is not readily available as a calibration gas standard. Surrogate calibration gases and K-factors will be discussed in a separate section.

A successful span calibration after a completed zero calibration aligns the BDS-50 to have an accurate response to a given gas concentration within the sensor type and range of the target gas. The BDS-50 span calibration can only be performed after a successful zero calibration. Once the zero calibration success screen is displayed the BDS-50 will automatically move to the span calibration screen as shown below.

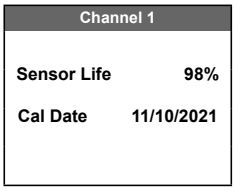


With the span calibration screen as shown above. Apply the span calibration gas by turning on the .5 LPM regulator attached to the span gas calibration gas cylinder. With the span gas flowing, the "live" reading in red will provide a real time span gas response. It's a good practice to let the span gas flow long enough to allow the sensor to reach its fullest response as well as to reach a stabilized value.

When the span gas is first applied the "live" reading will rapidly climb to a value and then the value will increase slowly until it stabilizes. When the sensor has reached its maximum response and is stabilized tap the enter button to accept the span calibration and the screen will display "Cal Set" confirming the span calibration was set to the configured Span Value. The BDS-50 will then display "Span Calibration Successful" and to remove the span calibration gas.



Following the span calibration successful screen and remove the span calibration gas screen the BDS-50 will display a "Sensor Life" screen (See next page) indicating an approximate life percentage that the sensor has remaining based on previous calibrations and gain applied during calibrations. Although the sensor life value is an approximation, it's a good indicator of sensor life to support maintenance schedules and sensor replacement.



Once the Span Value was "Set" the BDS-50 will go into a purge mode that allows the outputs to be inhibited while the sensor recovers to zero to avoid false alarms, etc. During the purge mode the main screen will display "Purge" for the default time period of 60 seconds. The purge time period is adjustable in the system config menu.

Like the zero calibration screen the span calibration screen has a five minute timer that provides the user an indication of how much time the span gas has been flowing as well as how much time is left before the Span Calibration mode expires. If the user does not tap the enter button to set the Span Calibration before the timer expires the BDS-50 will display "Calibration Time Exceeded". When the calibrated time exceeded screen is displayed the user has the option to tap the enter button to proceed back to the main operating screen or after a few seconds the BDS-50 will automatically go back to the main operating screen.

Note: Both zero and span calibrations algorithms have parameters that must be met to provide a successful zero or span calibration. In the event that a zero or span calibration fails the BDS-50 will provide a calibration failed / out of range screen and the user can choose the "X" key to cancel or after five minutes the BDS-50 will return back to the main operating screen.

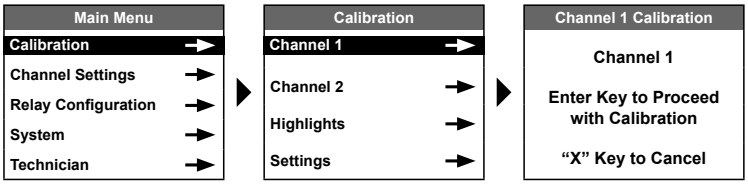
Note: During a calibration procedure, the BDS-50 is not detecting hazardous gases. Thus, gas monitoring and alarms are inhibited. During this time the 4-20 mA signal will be inhibited to the default of 4mA for all toxics and combustibles and a default of 17.38 mA for O2 (oxygen). The inhibit mA level is adjustable under the channel settings screen and will be discussed in another section.

7.0 NAVIGATING & UNDERSTANDING MENUS BDS-50 FUNCTIONS & CONFIGURATIONS

Quick Note: BDS-50 Magnetic Wand Interaction

- Tapping the wand on the "enter" button opens menu items, places the variable into edit mode and enters and saves new variables.
- Tapping the up or down arrow buttons moves the cursor "highlight" thru the active menu or variable choices.
- Tapping the "X" button can toggle the main screen through the single, dual, min/max screens, escape to the previous screen, move the cursor through variable selections, etc.
- The BDS-50 screens have a wand activation indicator in each corner to confirm to the user that the corresponding button was activated by a magnetic wand. This function assist the user when interacting with the BDS-50 with a magnetic wand.

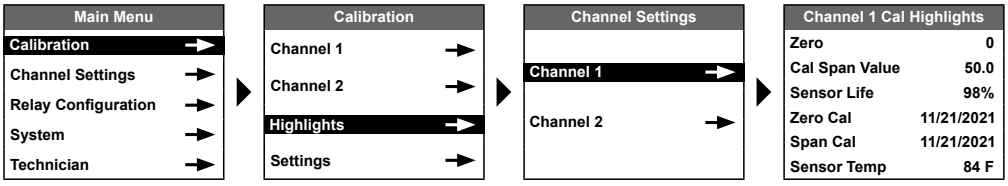
7.1 Calibration



7.1.1 Channel 1 / Channel 2

As highlighted in the calibration section, the calibration procedure is accessed via the calibration menu and the user is given the option to calibrate channel 1 or channel 2

7.1.2 Highlights



The calibration highlights screen provides a static overview of the calibration data and parameters for that particular channel.

Zero

This is the value that the sensor / gas detector will be zeroed to during a calibration procedure.

Cal Span Value

This is the value that the sensor / gas detector will be spanned to during a calibration procedure. This value can be changed.

Sensor Life

The sensor life value is an inverse representation of the sensors gain that is applied during a calibration procedure. The more gain required during a span calibration the less the sensor life is available. This function is a good tool to gauge the degradation of the sensor and assist with sensor replacement.

Last Zero Cal

The BDS-50 tracks the last date the sensor was zeroed during a calibration procedure

Last Span Cal

The BDS-50 tracks the last date the sensor was spanned during a calibration procedure

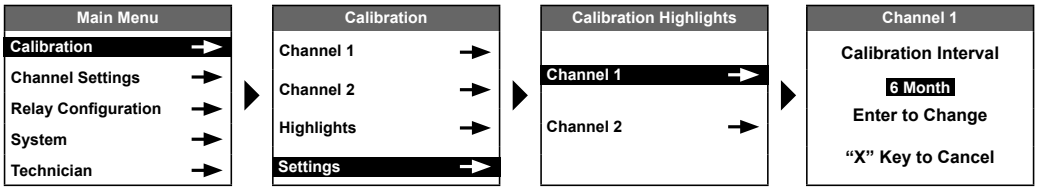
Sensor Temp

The BDS-50 sensors provide continuous temperature readings to facilitate gas response temperature compensation.

7.1.3 Settings

Calibration Interval

This function allows the user to setup a calibration interval that will monitor the last time the sensor / gas detector was calibrated and then display a "Cal REQ'D" on the main operating screen when the calibration interval has expired.

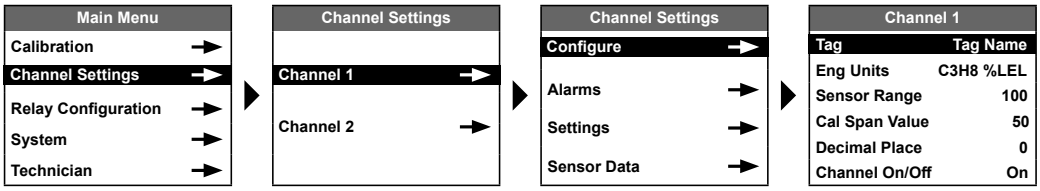


To edit, navigate through the calibration menu as shown above which will open the channel calibration interval screen. The user can view the current interval value and then scroll through calibration interval time period options by tapping the enter button and tap the up/down buttons. Once the new calibration interval has been selected the user can tap the enter button to save the selection or to exit tap the "X" button to cancel.

Note: If a calibration interval option is selected and the user taps the "X" button to cancel then the previous calibration interval will remain as the selected calibration interval time period. Default = "None" , Options = None, 1 week, 2 weeks, 1 month, 3 months, 6 months, 9 months, 12 months.

7.2 Channel Settings

7.2.1 Configure



Tag Name

The Tag Name is a user configurable field that can be used to identify the BDS-50 gas detector with a unique name, number, location, etc. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The tag name will appear on both a single or dual screen. Default = "Tag Name"

Eng Units

The Eng Units is a configurable field that can be used to identify the BDS-50 gas detector target gas with a unique engineering unit name. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The tag name will appear on both a single or dual screen. Default = The default engineering unit is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Sensor Range

The sensor range is a view only value that is uploaded from the sensor upon installation when a new type of sensor is installed and upload selected.

Cal Span Value

The Cal Span Value is the value that the BDS-50 will use to span to during a span calibration procedure. The cal span value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected. The cal span value can be edited by the user if a different calibration gas concentration is to be used for span calibration or if a surrogate gas with a K-factor is to be used. (K-factor will be discussed in a later section) Default = The cal span value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected

Decimal Place

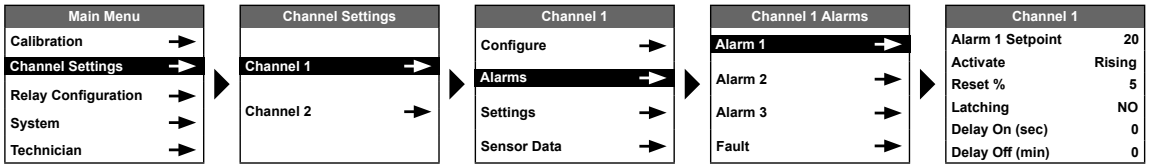
The decimal place value is a user configurable field and allows the user to define a lower or higher resolution of the displayed concentration value. The number of available decimal places to the right are defined by the full range of the sensor. Default = The Decimal Place value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Channel On/Off

The Channel On/Off function allows the gas detector selected channel to be enabled or dis-enabled. Note: The BDS-50 must have at least one channel on at all times. If a user attempts to turn both channels off the BDS-50 will display an error and will prevent the channel from being dis-enabled.

7.2.2 Alarms (A1, A2, A3)

The BDS-50 channel alarming structure is designed to provide many programming features to allow the user to define parameters for various alarms. The BDS-50 provides three alarm levels as well as a fault level per each channel. Alarm 1, Alarm 2 and Alarm 3 all have the same configuration screen, thus only "Alarm 1" configuration screen will be discussed.



Note: The main display as well as some configurations abbreviate Alarm 1 as "A1", Alarm 2 as "A2" and Alarm 3 as "A3"

Alarm Setpoint

The alarm setpoint is a value that sets the threshold for an alarm to activate. The user can edit the setpoint within the sensor full range. Default = The alarm setpoint value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected. User defined setpoints are maintained in the gas detector unless a new sensor type or range is installed and uploaded.

Activate

Alarms can be defined to activate upon a rising or falling value. Most target gases and applications are triggered by a rising value that exceeds the alarm setpoint. However with an O2 (oxygen) sensor its typical for the alarms to be activated upon a falling value that exceeds the alarm setpoint. In some cases an application may require an alarm to be of a falling value and another to be a rising value thus each alarm can be independently configured to be rising or falling. Example: An O2 application where alarm 1 and alarm 2 are configured to be a falling to alarm for O2 deficiency and A3 would be configured for rising to alarm for O2 enrichment. Default = The rising or falling parameter is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Reset %

The reset percentage is a value that defines the percentage of the full scale range that the alarm value needs to exceed before deactivating an activated alarm. Example: If a reset percentage value was five for a 0-100 full range sensor and an A1 setpoint was at 20, then the once the alarm activated at 20 the value would need to fall below 15 before the alarm deactivated (5% of 100 = 5). Default = 5.

Latching

The latching function allows the user to set the alarm to be latched or unlatched after an activated alarm is deactivated. Unlatched allows the alarm to reset automatically once the channel concentration value exceeds the Reset % value. Latched allows the alarm to remain in the alarm state even though the channel concentration value has exceeded the Reset % value. To reset a latched alarm, tap the Up or RST (reset) button to acknowledge (reset) the latched alarm. Note: To acknowledge the latched alarm the channel concentration value must exceed the reset % value. Default = No.

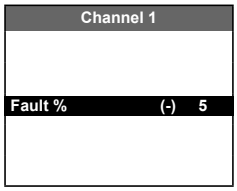
Delay On

The delay on value (maximum 10 seconds) delays the activation of an alarm when the channel concentration value exceeds the alarm setpoint. This function can reduce nuisance or false alarms within an application. Default = 0

Delay Off

The delay off value (maximum 120 minutes) delays the de-activation of an alarm when the channel concentration value exceeds the alarm reset % value. This function can hold an alarm active for a period of time after the alarm would typically reset. Default = 0

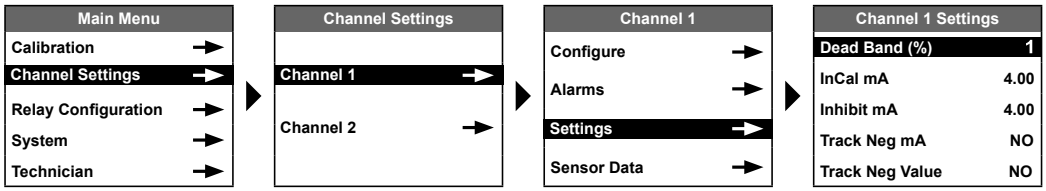
Alarms (Fault)



Fault

The negative drift fault alarm value is a percentage (maximum 10%) of the sensor full scale range. The value is the negative drift tolerance that the concentration value can fall below zero before the fault alarm is activated. Default = 10%

7.2.3 Settings



Deadband %

The deadband percentage value allows low concentration readings to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating concentration values above zero. The maximum amount of deadband allowed is 5%. Default = 1% Note: deadband affects the 4-20mA output signal and Modbus value register.

InCal mA

The InCal mA value allows the user to adjust the analog 4-20 mA output signal to lock in at a set value when the BDS-50 is in the calibration and purge mode. Default = 4.00 mA for all toxic and combustible sensors and 17.38 mA for O2 sensors.

Inhibit mA

The Inhibit mA value allows the user to adjust the analog 4-20 mA output signal to lock in at a set value when the BDS-50 is placed into the inhibit mode. The inhibit function allows the user to place the gas detector outputs and relays in a non-responsive mode. This function is useful when bump testing the BDS-50, sensor replacement or general maintenance. Default = 4.00 mA for all toxic and combustible sensors and 17.38 mA for O2 sensors.

To place the BDS-50 transmitter into an inhibit mode, hold the magnetic wand on the "Up" button for three (3) seconds. The Inhibit icon will appear on the display and will remain in inhibit for up to five (5) minutes. To manually exit the Inhibit mode hold the magnetic wand over the "Up" button for two (2) seconds.

Track Negative mA

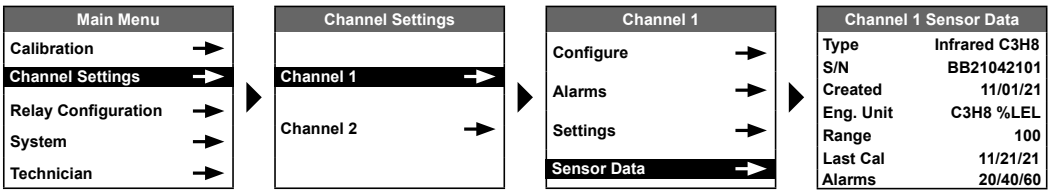
The track negative mA function allows the user to prevent the analog 4-20 mA output signal to follow the concentration value when it falls below zero. Default = No

Track Negative Value

The track negative value function allows the user to prevent the displayed readout value to follow the concentration value when it falls below zero. Default = No

7.2.4 Channel Sensor Data

The sensor data screen is a read only (non-edit) screen that provides an overview of default sensor parameters and user edited parameters.



Type

This is the type of sensor used (electrochemical "echem", Infrared "IR", pellister "cat-bead", etc) and the target gas.

S/N

Each sensor cartridge has its own unique serial number that is programmed into the sensor when the sensor cartridge is assembled and configured. The serial number represents various information pertaining to the sensor programmed parameters.

- The sensor SN shall possess the following structure. TTYYMMDDXX
- TT = two-digit alpha defining the sensor gas.
- YY = two digit numeric defining the year
- MM = two digit numeric defining the month
- DD = two digit numeric defining the day of the month
- XX = two digit numeric with range 01- 99 defining the sensor production sequence

Created

When the sensor cartridge is assembled and programmed the sensor "created" date will be date-stamped accordingly.

Eng. Unit

The engineering unit is a unit of measure that defines the target gas. The engineering unit is uploaded from the sensor as a default per the sensor type but can be edited by the user per their preference or application specifics. Ex: LEL%, PPM, PPB, % , etc.

Range

The range value is the full scale range of the sensor. This value is uploaded from the sensor and is not an edited parameter.

Last Cal

The last cal date is a date-stamp which represents the last successful zero and span calibration.

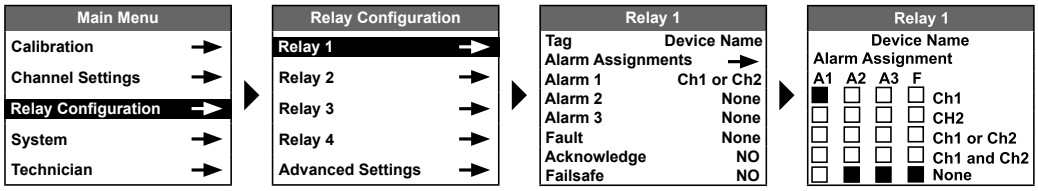
Alarms

The alarm values are the current alarm setpoints for A1, A2 and A3 alarm levels. Alarm setpoint values are uploaded from a sensor when a new sensor "type" is installed. The alarm setpoints can be edited will be displayed as the current alarm setpoints and will remain with the sensor cartridge.

7.3 Relay Configuration

The BDS-50 is standard with four relays that have an extensive programmable function that allows the user to assign channel 1 and / or channel 2 alarms with various relays and combinations. The relay configuration menu has a unique programming user interaction that provides easy and straight forward programming for the relay assignments and configurations. The relay configuration menu has four separate relay menus for Relay 1, 2, 3 and 4 that are identical in function, therefor only Relay 1 menu will be reviewed. Note: Relay 4 menu has the "failsafe" default as "YES"

The BDS-50 gas detector has an Advanced Settings menu that configures the Alarm Ack switch input termination to be used as a remote Alarm Acknowledgement switch input or as a Digital input switch to activate assigned relays.



7.3.1 Relays

The relay 1,2,3 and 4 menu is a multi-purpose screen that incorporates Device Name editing, relay assignment supporting menus, relay assignment overview, and relay configuration.

Tag

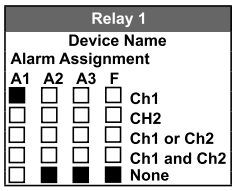
The BDS-50 implemented a function so that the user can assign a device name (ex. strobe, fan, horn, fire panel, etc) to each relay to assist with relay identification and programming. The device name is a user configurable field that can be used to identify the device that the relay is activating. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The device name will appear on the relay assignment screen and the relay test screen. Default = "Device Name"

Alarm Assignments

The BDS-50 gas detector relays can be assigned to various channel alarms as well as and/or combinations. The Device Name appears at the top of the screen to provide a relay to device identification and purpose. The assignment screen consist of boxes that when are selected have a solid box appearance and when not selected a box outline appearance.

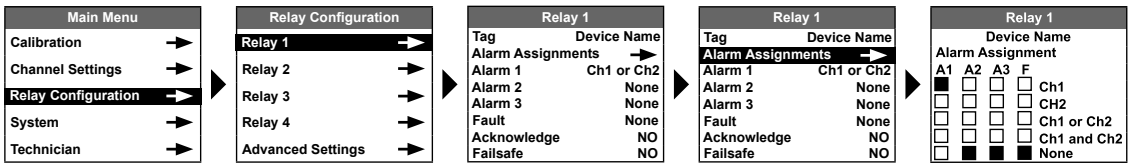
The relay assignment matrix is easily programmed by selected the alarm level and the channel or channel combination for the relay to activate. Each column under the alarms A1, A2, A3 and F (fault) can be selected per the channel or channel combination and/or condition or None.

Example, If the relay 1 was to activate only when channel 1 went into an alarm 1 (A1) condition then the following programming would be as follows



Relay Assignment Programming

To program the relay for a specific alarm level and channel or channel combination. Enter the Alarm Assignment screen by using the Up/Down buttons to highlight the Relay Assignments menu and tap the Enter button.



When the alarm assignments programming screen is displayed a selection box will flash like a cursor in the A1 column, to select a new box within that column move the cursor with the Up/Down buttons to the desired box and tap the "X" button to accept the selection and the flashing box will become a solid black box as well as the cursor will move to the next column. The cursor can be moved to the desired column by tapping the "X" button and using the Up/Down buttons to make a relay assignment selection. If the relays assignments are complete tap the enter button to save selections and to exit the relay assignment screen.

Alarms and Fault Relay Assignment Overview

The BDS-50 provides a nice overview of what conditions the relay will activate. This feature allows the user to easily see what alarms and channel or channel combinations are assigned to the relay without entering the relay assignment programming screen and interpretating the alarming matrix. This feature also provides a confirmation of the programming results to the user. As shown below the relay assignments are displayed.

Relay 1	
Tag	Device Name
Alarm Assignments	→
Alarm 1	Ch1 or Ch2
Alarm 2	None
Alarm 3	None
Fault	None
Acknowledge	NO
Failsafe	NO

Default relay assignments are as follows:

Relay 1	**Relay 2**	**Relay 3**	**Relay 4**
A1 = Ch1 or Ch2	A1 = None	A1 = None	A1 = None
A2 = None	A2 = Ch1 or Ch2	A2 = None	A2 = None
A3 = None	A3 = None	A3 = Ch1 or Ch2	A3 = None
F = None	F = None	F = None	F = Ch1 or Ch2
Acknowledge = No	Acknowledge = No	Acknowledge = No	Acknowledge = No
Failsafe = No	Failsafe = No	Failsafe = No	Failsafe = Yes

Acknowledge

The BDS-50 gas detector alarms can be acknowledged by tapping the Up / RST button or via the remote input switch as well as a Modbus write to command. By selecting "YES" , an active alarm can be acknowledged and will change the state of an assigned relay. This feature is useful to silence a horn while an alarm is still active. When an alarm is acknowledged the associated display LED will change from blinking to a solid indication. Note: see advanced settings in this section for the acknowledge timeout setting. Default = "NO"

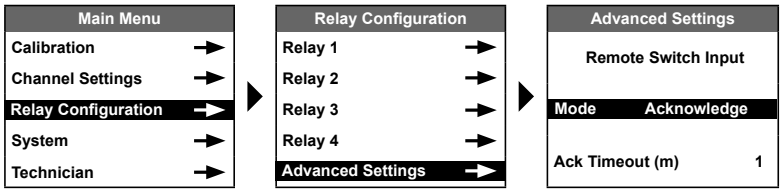
Failsafe

The failsafe function allows the relay to be set as non-failsafe or failsafe configuration during normal operating (no alarms) condition. Selecting "NO" represents a non-failsafe setting that configures the relay to be de-energized (shelf state) during normal operating conditions. Selecting "YES" allows the relay to be energized during normal operating conditions and is de-energized during an alarm or when power is lost. Default = "NO" (exception of relay 4 = YES)

7.3.2 Advanced Settings

The BDS-50 gas detector relay board has a remote input switch termination connector CN6 that can be wired to a switch to be configured as a remote acknowledge input or a digital input. The switch can be remotely mounted and wired to the connector with a wire length maximum of 75 feet.

The Remote Input Switch Mode can be selected as an Acknowledge input, N.O Digital input or a N.C. Digital input. Default = "Acknowledge"



Remote Input Switch Mode / Acknowledge

The BDS-50 remote input switch mode can be selected to be a remote acknowledge. By selecting "Acknowledge" an active alarm can be acknowledged via the remote switch and will change the state of an assigned relay. This feature is useful to silence a horn while an alarm is still active. When an alarm is acknowledged the associated display LED will change from blinking to a solid indication. The remote acknowledge switch will reset a latched alarm if the alarm is set to latched.

Ack Timeout

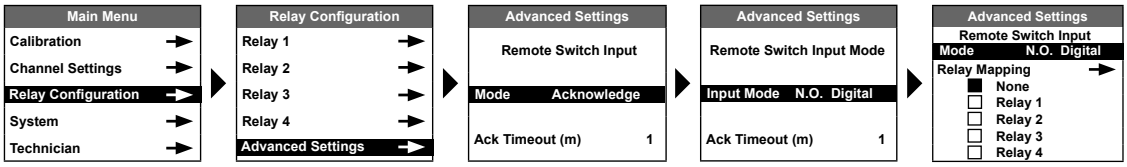
The ack timeout provides a time interval to re-activate the relay assigned to the current alarm. When a relay is acknowledged the BDS-50 acknowledgement timer will begin. Once the selected ack timeout interval is expired the current relay in an alarmed state will return to the alarmed condition. The user configurable ack timeout intervals are 1,5,10, 30 and 60 minutes. Default = "1"

Remote Input Switch Mode / Digital Input

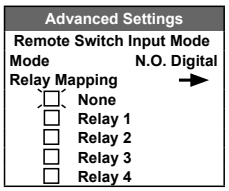
The BDS-50 gas detector relay board has a remote input switch termination connector CN6 that can be wired to a switch to be configured as a remote digital switch input that can be assigned to one of the four relays for remote relay activation. The switch can be remotely mounted and wired to the relay board connector with a wire length maximum of 75 feet.

The digital input can be selected as a N.O. (normally open) Digital switch or a N.C. (normally closed) Digital switch. A N.O. (normally open) switch when closed will activate the Digital N.O. input and the assigned relay. A N.C. (normally closed) switch when opened will activate the Digital N.C. input and the assigned relay.

To configure the remote input switch to be a digital input, highlight the Mode as shown below and tap the enter button to edit the field. Use the up/Down buttons to toggle through the input switch mode choices and tap enter to accept the normally open (N.O.) or normally closed (N.C.) digital switch input mode.

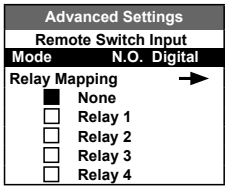


When selecting the remote input switch to be a digital input, a relay mapping screen is displayed as shown above. The relay assignment for the digital input will be identified by a solid box. To assign a relay or relays to the digital input switch, highlight "Relay Mapping" and tap the enter button to place the screen into edit mode.



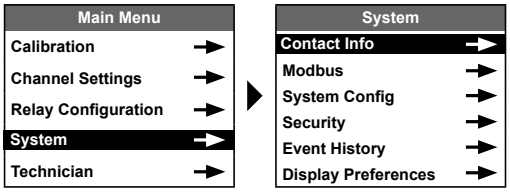
The box next to "None" will flash like a cursor. To assign a relay use the Up/Down buttons to move the flashing cursor box to the desired relay and tap the enter button to select that relay. To select and deselect the box use the enter button once selected the box becomes solid. Continue using the UP/Down buttons to move the flashing cursor box to assign additional relays or when the relay assignments are complete tap the "X" button to accept and exit edit mode. Default = "None". Note: More than one relay can be assigned to the digital input switch.

To change the remote switch input mode from a Digital input to the Acknowledge input, highlight the Input Mode N.O. or N.C. Digital as shown below and tap the enter button to place the screen into edit mode and then use the Up/Down buttons to select "Acknowledge" and then tap the enter button.



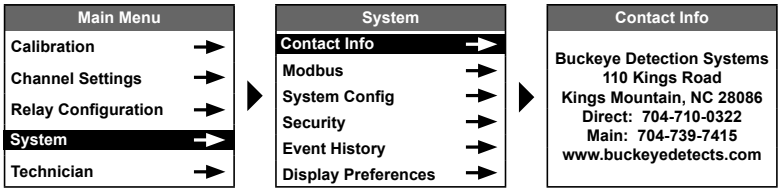
7.4 System

The system menu handles settings and configurations that support the transmitter operations, Modbus parameters, security, event history and display preferences.



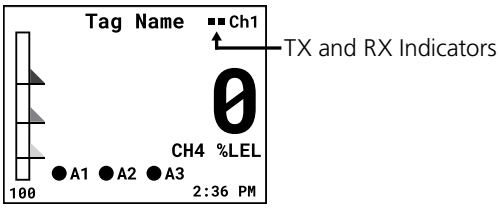
7.4.1 Contact Info

The contact info page provides company contact info, address, phone number, website, etc.

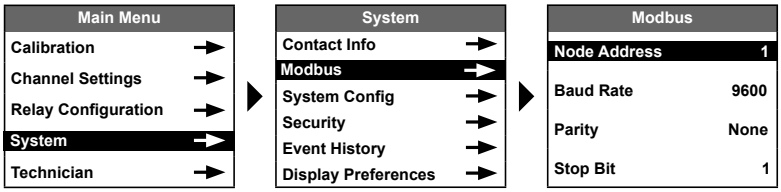


7.4.2 Modbus

The BDS-50 main display screen for the single and dual channel mode has TX and RX indicators next to the Ch1 or Ch2 that indicate the modbus communications. The TX and RX indicators are only visible when the TX or RX line is active.



Modbus parameters for the RS-485 Modbus port are handled in the Modbus menu, Node Address, Baud rate, Parity and Stop Bit. See section 4.4.3 for wiring protocol.



Node Address

Specifies the Modbus ID of the BDS-50 gas detector. Up to thirty-two (32) BDS-50 gas detector transmitters can be on a Modbus serial communication. Default = "1"

Baud Rate

Specifies the rate of bits transferred via the RS-485 digital communications protocol. The BDS-50 has multiple baud rate presets that can be selected. 9600, 19200, 38400, 57600 and 115200. Default = "9600"

Parity

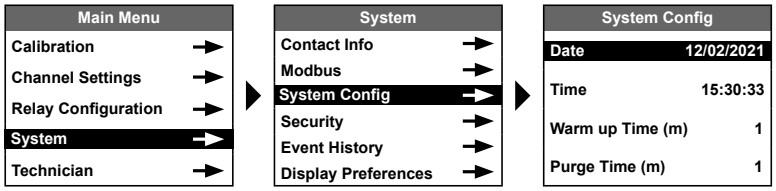
A parity bit is a bit that is added to ensure that the number of bits with the value "1" in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting within code. Default = "None"

Stop Bit

Serial communications stop bits, specifies 1 or 2 stop bit. Default = "1"

7.4.3 System Configuration

The system configuration screen provides access to the BDS-50 Date, Time, and time durations for the Warmup and Purge mode.



Date

The BDS-50 date is created at the factory upon the manufacturing initialization period, however the date can be edited via the edit procedure.

Time

The BDS-50 time is created at the factory upon the manufacturing initialization period, however the time can be edited via the edit procedure. The BDS-50 hour configuration parameter is based on a 24 hour setting. Note: The clock on the main display is a 12 hour am/pm.

Warm Up Time

Upon power up or a new sensor install the BDS-50 gas detector will initialize a warmup period to allow the sensor to stabilize or to prevent unwanted alarms. During the warmup mode the BDS-50 output signals and relays will be in an inhibit mode. The warm up time duration can be edited from 0 – 9 minutes. Default = "1 minute").

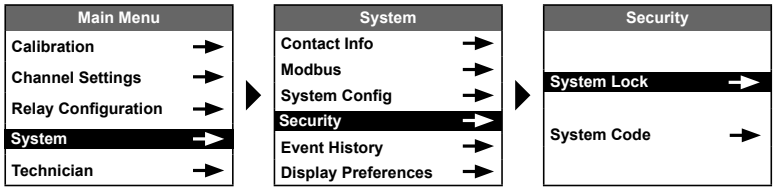
Purge Time

After a calibration procedure the purge time allows the BDS-50 gas detector to recover to a zero reading or (20.9 for O2). During the purge mode the BDS-50 output signals and relays will be in an inhibit mode. The Purge time duration can be edited from 0 – 9 minutes. Default = "1 minute").

7.4.4 Security

The security screen allows the BDS-50 to enable or disable the system lock function. The security lock function prevents unauthorized transmitter access or parameters to be changed. Once the security lock is enabled the user will be alerted that the security lock is enabled and the parameter or task cannot be edited. The security screen has two main functions, the "System Code" and the "System Lock". Default = "Disabled".

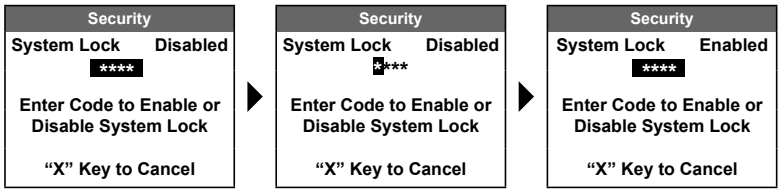
Note: A new BDS-50 will require a user unique four digit system code to be created prior to enabling the system lock. See the system code section below to create a user unique four digit system code.



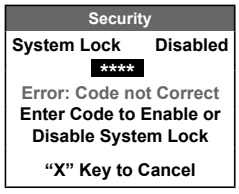
System Lock

The system lock option enables or disables the system lock function. Each time the four digit system code is entered the system lock option will toggle from the disabled to enabled or visa versa depending on what function is currently selected. Each time the system lock function enabled or disabled selection is changed the BDS-50 requires the system lock code to be entered.

To enable or disable the System Lock function, highlight the system lock and tap the enter button. Then tap the enter button again to allow access to enter the system lock code. Using the Up/Down buttons and the "X" button to move to the next digit, Enter the four digit system lock code and tap enter to toggle from Disabled or Enabled, etc as shown on the following page.



Note: If the entered system lock code is incorrect the Security screen will display "Error: Code not Correct"

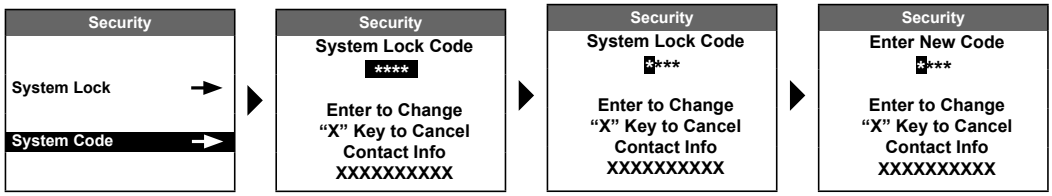


The System Code

The system code provides the user the ability to select a unique four digit number from 0001 – 9999 to create a password to enable or disable the system lock.

To change the system code unique four digit number, highlight the system code option as shown below and tap the enter button, In order to enter a new unique four digit code the BDS-50 will require the previous four digit code to be entered to allow access to change to the new four digit user system lock code.

If the BDS-50 is a new transmitter the factory four digit code is "0000", With the four asterisks field highlighted tap the edit button and Using the Up/Down buttons and the "X" button to move to the next digit select a number, enter the "0000" or the previous code, then tap the edit button and if the code entered matches the existing system lock code then the display will display "Enter New Code" as shown below.

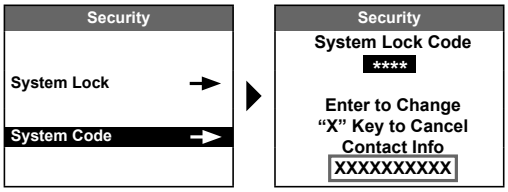


Using the Up/Down buttons and the "X" button to move to the next digit, Enter the new user unique four digit system lock code and tap enter to save. The screen will display "New Code Accepted". Tap the "X" button to exit and return to the Security screen.

Contact Info

The system code screen allows the user to edit the contact Info field to create a contact person, dept, phone number, etc in order to retrieve the unique system lock code.

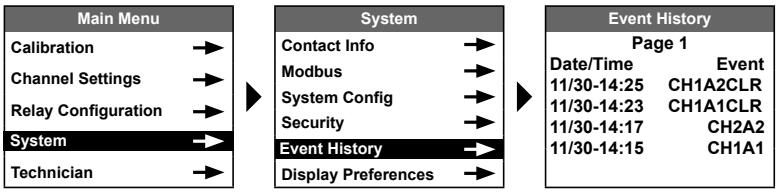
With the system lock screen displayed use the Up/Down arrow to highlight the contact field as shown on the next page and tap enter to edit. Using the "X" button to move to the next character and the Up/Down buttons to select the desired character, enter the contact information, etc then tap the enter button to accept the contact information. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available.



Note: If the transmitter is locked out and all efforts have been made to unlock or to retrieve the system lock code call the factory for assistance.

7.4.5 Event History

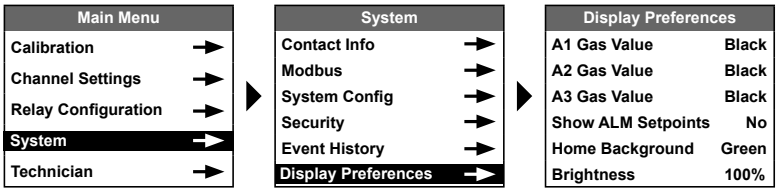
The event history screen highlights BDS-50 events with a time and date stamp. The event history screen will store up to 100 events and will populate the list in a first in / first out sequence. As events are posted the BDS-50 will create pages (max 20 pages) for the user to scroll through to view. Use the up/down arrows to scroll through the available pages.



Events per condition are listed in section 9.0

7.4.6 Display Preferences

The display preferences provides the BDS-50 main display screen to be configured to have various aesthetics, display information and alarm display preferences to customize the main screen per the user preferences.



A1, A2 and A3 Value Display Preference

The BDS-50 main operating display can be configured to highlight the concentration value in an alarm state to be red and flashing verses black and steady on.

A1 Alarm. During an A1 alarm event, the concentration value can be selected to be displayed as black steady on or can be displayed red (no-flash) while the concentration value is an alarm state. Default = "Black".

A2 Alarm. During an A2 alarm event, the concentration value can be selected to be displayed as black steady on or can be displayed red with a 1 Hz flash rate while the concentration value is an alarm state. Default = "Black"

A3 Gas Value, During an A3 alarm event, the concentration value can be selected to be displayed as black steady on or red with a 2 Hz flash rate while the concentration value is an alarm state. Default = "Black"

Show ALM Setpoints

The BDS-50 main operating display has alarm indicating icons A1, A2 and A3 that have the option to post the current alarm setpoints next to each alarm symbol. Default = "No".

Home Background

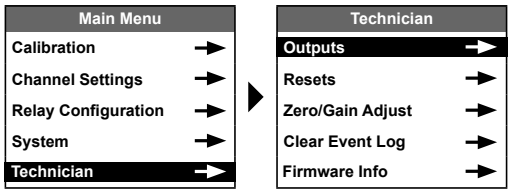
The BDS-50 main operating screen can be configured to have a green back-lit background or a white back-lit background. Default = "Green"

Display Preferences

The BDS-50 display brightness can be adjusted to four preset levels. This feature is useful for applications that require a brighter or dimmer display. The four preset levels are 25%, 50%, 75% and 100%. Default = "50%"

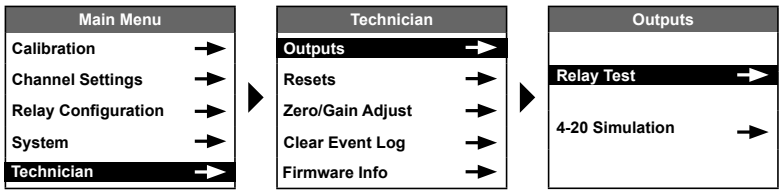
7.5 Technician Menu

The technician menu provides various technician level functions for testing outputs as well as system resets. Understanding the functions and their purpose is important when executing the technician menu.



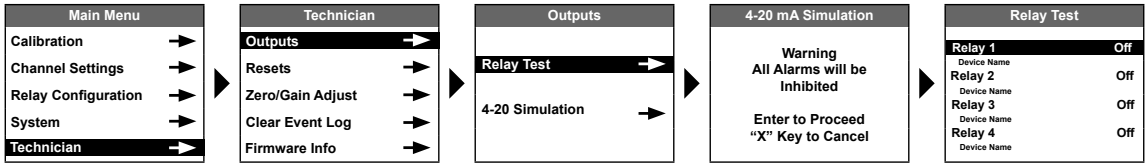
7.5.1 Outputs

The outputs screen consist of the relay test and 4-20 simulation function to assist with troubleshooting and system integration testing.



7.5.1.1 Relay Test

The relay test screen allows the user to activate or deactivate the onboard relays. This feature is convenient when testing relay interaction with connected components during system installation, system testing, etc.



Prior to entering the Relay Test screen, the user is prompted that all alarms will be inhibited when the relay test screen is displayed. When entering the relay test screen all relays will be shown in their energized or de-energized state depending on their current condition or their configured state.

To test the relay, highlight the relay to be tested and tap the enter button. The on / off variable field will be highlighted, use the up/down buttons to choose the relay state to be tested and tap the enter button to execute the relay test.

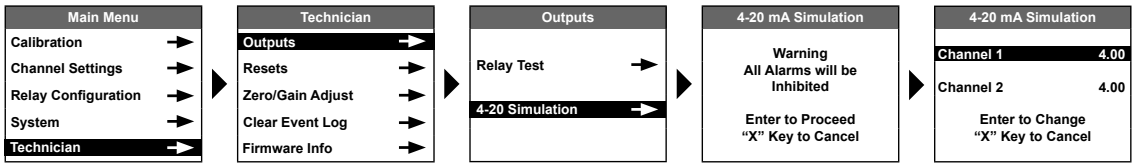
The relays are identified by their relay number as well as a device name that can be changed to a unique name such as strobe, horn, etc. in the Relay Configuration screen.

To exit the relay test screen, tap the "X" button and the relays will return to their current state or their configured state prior to opening the relay test screen.

Note: Once the relay test screen is displayed "activated" it will expire after five minutes regardless of interaction or if relays are in test mode.

7.5.1.2 4-20 Simulation

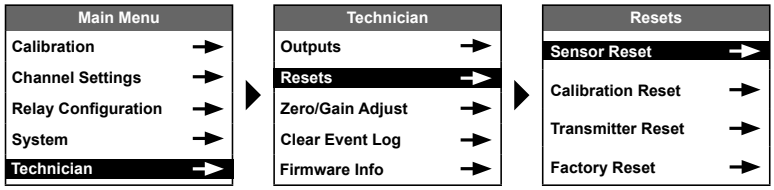
The BDS-50 gas detector has the capability to simulate an analog 4-20 mA signal for either the channel 1 or channel 2 output. This function is a great tool to test connected receivers, PLC's, controllers, etc, and their associated alarming executions. When the 4-20 mA simulation screen is displayed the analog 4-20 mA signal for both channels will be at 4 mA and can be incremented up or down by 1mA. If a channel is an "oxygen" O2 channel then then the simulation output will start at 17mA, with the intent that the simulation function outputs start at a safe or inhibit level preventing unwanted alarms or events.



To simulate a channels 4-20 mA output, enter the 4-20 mA simulation screen and highlight the channel to be simulated and tap the enter button. The mA value will be highlighted, use the up/down buttons to select a mA value and tap the enter button to simulate the selected value. To choose another mA value repeat the process. Upon exiting the 4-20 mA Simulation screen the mA values will return to their default values.

7.5.2 Resets

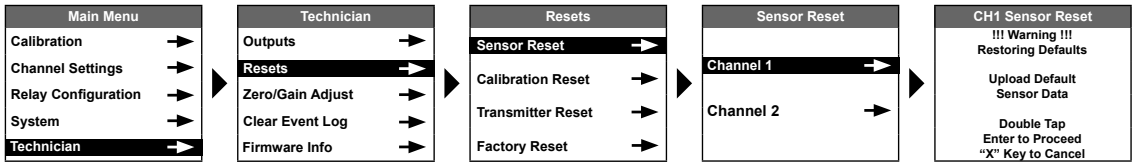
The resets screen consist of the sensor reset, calibration reset, transmitter reset and the factory reset. The reset functions assist with resetting various aspects of the sensor or transmitter back to factory defaults.



7.5.2.1 Sensor Reset

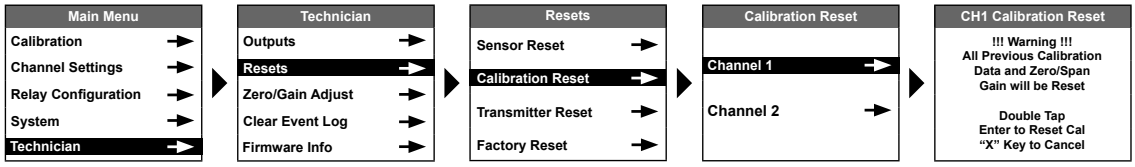
The sensor maintains a backup memory of the factory defaults that can be uploaded to the BDS-50 transmitter and overwrite user defined configurations. A sensor reset would include, alarm setpoints and types, number of decimals to be displayed and span calibration gas concentration, etc.

To reset the sensor (restore factory defaults), double tap the enter button such like a mouse double click. This technique prevents from unwanted sensor resets while navigating menus with the magnet.



7.5.2.2 Calibration Reset

The calibration reset should be reserved as a last effort to resolve a bad calibration or to set the sensor unity gain back to one. Performing a calibration reset will erase all previous calibration data which supports the sensor life percentage as well as reset the zero and span gains applied.



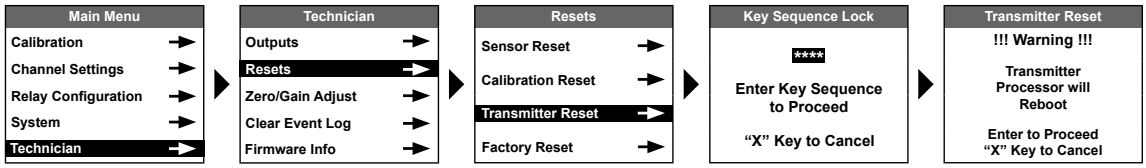
The calibration reset is an important function that should be used if only required. To reset the calibration, double tap the enter button such like a mouse double click. This technique prevents from unwanted calibration resets.

7.5.2.3 Transmitter Reset

The BDS-50 transmitter reset function provides a soft-reboot of the main processor. This function can be useful if for some unforeseen reason the display is non-responsive or the sensor is not recognized. The transmitter reset function should only be used if all other trouble shooting efforts have not been successful.

Important: The transmitter reset will reboot / restart the BDS-50 much like a power cycling. All previous transmitter and user configured parameters will remain intact.

To access the transmitter reset screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.

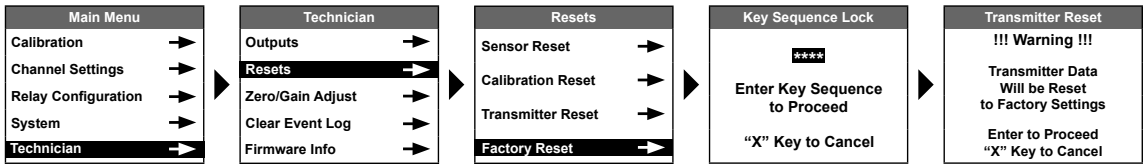


7.5.2.4 Factory Reset

The BDS-50 has a unique feature to allow the transmitter to be reset to factory defaults. This reset function should only be used if all other trouble shooting efforts have not been successful.

Important: The transmitter reset will reset the transmitter memory to the default state (same as a new transmitter). All user configured parameters will be reset to factory defaults. (Note: The event log will not be reset and will log a transmitter reset event)

To access the transmitter reset screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.



7.5.3 Zero/Gain Adjust

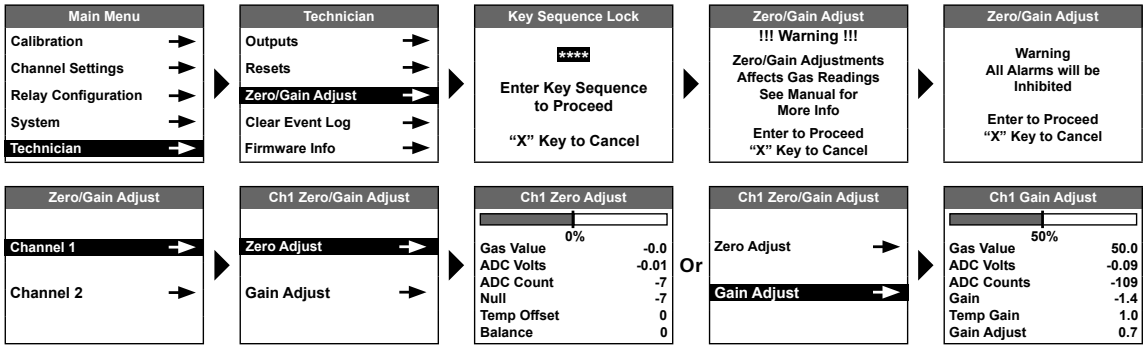
The zero/gain adjust screen consist of a zero adjust and a gain adjust function that provides a technician level capability to adjust sensor balance, zero and gain parameters.

It is recommended to perform a sensor calibration reset per section 7.5.2.2 prior to any zero/gain adjustments. A calibration reset will erase all previous calibration data and reset the zero and span gains applied

To access the transmitter zero/gain adjust screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.

Note: It is recommended that the zero/gain adjust screen only be used as a last resort for calibration situations that require additional sensor output tuning. The zero/gain adjust screen should be used by a qualified technician that has a good understanding of gas detection instrumentation and has read the BDS-50 manual.

Note: The zero calibration is the key to a successful span calibration, therefor the zero adjust function should always be the first step to resolve a unique situation when using the zero/gain adjust function.



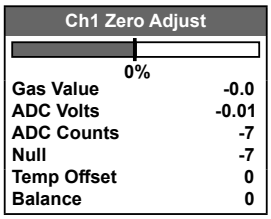
7.5.3.1 Zero Adjust

The zero adjust screen can be used to dial in the zero as a last resort when the zero calibration can not be successfully completed via the calibration procedure or has a zero gas reading outside of the 25% of the sensor range.

With zero gas applied to the sensor and the gas value reading has stabilized. Tap the up or down buttons so that the gas value is close to zero. The bar graph showing the current gas value will be in the range of -25% to +25% of the sensor range. The bar graph fill color will be green if the current gas value is within 5% of zero. Otherwise, the fill color will be red.

Once the zero gas value is within the 5% range or the desired gas value is obtained, tap the enter button to accept the new zero adjustment settings before exiting the zero adjust screen.

Note: The BDS-50 transmitter outputs and alarms will be inhibited during the zero/gain adjust function.\



- Gas value – live reading of gas value.
- ADC volts – conversion of sensor ADC reading to voltage
- ADC counts – ADC counts sent from sensor board
- Null – null value set during zero cal
- Temp Offset – temperature offset which is a function of the temperature
- Balance – value adjusted by the user in this screen

7.5.3.2 Gain Adjust

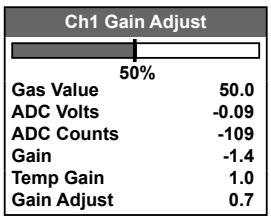
The gain adjust screen can be used to dial in the span as a last resort when the span calibration can not be successfully completed via the calibration procedure or has a span gas reading outside of the –25 to +25% of the sensor range.

With the applicable span gas applied to the sensor and the gas value reading has stabilized. Tap the up or down buttons so that the gas value is close to the cal span value. The bar graph showing the current gas value will be in the range of -25% to 25% of the sensor range. The bar graph fill color will be green if the current gas value is within 5% of the cal span value. Otherwise, the fill color will be red.

Once the gain gas value is within the 5% range or the desired gas value is obtained tap the enter button to accept the new span adjustment settings before exiting the gain adjust screen.

Note: Adjusting the gain will affect the sensor response and should be a last resort to resolve a failed calibration that was outside of the 25% range of the cal span value. If the gain requirement is too high it may result in the sensor being to sensitive and should be replaced.

Note: The BDS-50 transmitter outputs and alarms will be inhibited during the zero/gain adjust function.

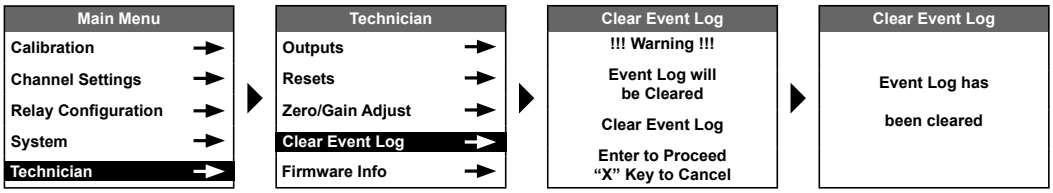


- Gas value – live reading of gas value.
- ADC volts – conversion of sensor ADC reading to voltage
- ADC counts – ADC counts sent from sensor board
- Gain – gain value set during span cal
- Temp Gain – temperature gain which is a function of the temperature
- Gain Adjust – value adjusted by the user in this screen

7.5.4 Clear Event Log

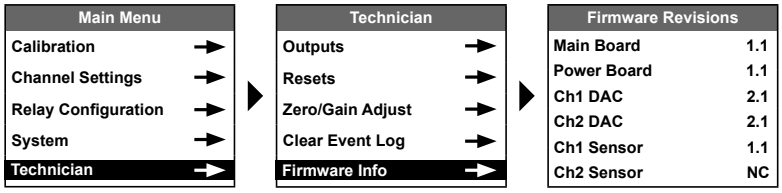
The BDS-50 transmitter stores various events as mentioned in section 7.4.5. The memory can hold 100 events and will continue to post new events and delete old events as required (FIFO). In the event that the user wants to clear the entire event history log then the "clear event log" function can be performed.

To clear the event log, enter the clear event log screen and tap the enter button to clear the event log. A new screen will appear confirming the event log was cleared and will automatically change the screen back to the main operating screen. (See next page)



7.5.5 Firmware Info

The firmware revision screen provides insight of the firmware revision for multiple processors. This level of information provides a better platform to identify upgrades, enhancements, etc.

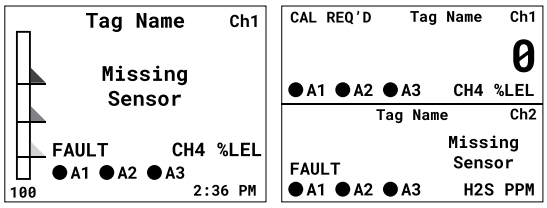


Note: if a channel is not "on" or a sensor is not installed then the corresponding channel DAC or channel sensor will have a "NC" as a firmware revision.

7.6 Faults, Over Range, and Low Voltage Indication

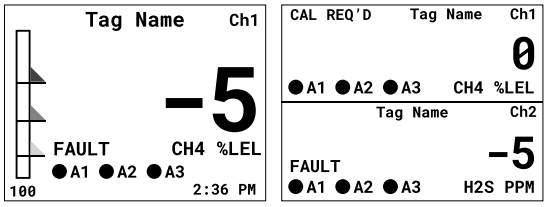
7.6.1 Missing Sensor Fault

If a channel is active and a sensor is not inserted into the sensor housing then the main display will indicate MISSING SENSOR and FAULT. The missing sensor fault event will cause the 4-20 analog signal to output a 1mA for the applicable channel.



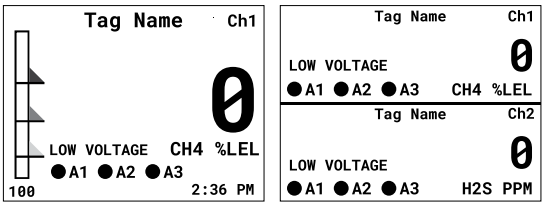
7.6.2 Negative Drift Fault

The negative drift fault alarm is a percentage (maximum-10%) of the sensor full scale range. The value is the negative drift tolerance that the concentration value can fall below zero before the fault alarm is activated. Upon a fault alarm the main display will indicate a FAULT condition and the 4-20 analog signal output will be 1mA for the applicable channel.



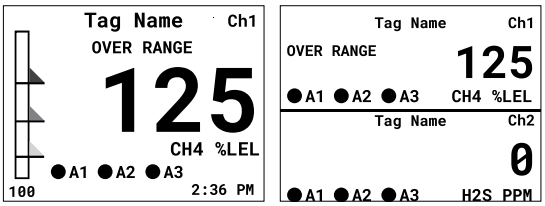
7.6.3 Low Voltage

The BDS-50 monitor has a supply voltage range of 10-30 VDC. When the BDS-50 is powered, it will monitor the supply voltage and if the supply voltage is below 10 VDC the main display will indicate LOW VOLTAGE. If the supply voltage is below 9 VDC the LOW VOLTAGE indication will continue, and the 4-20 analog signal output will be 1mA.



7.6.4 Over-Range

The BDS-50 monitor value will have a maximum displayed value of 125% of the full scale for that applicable channel. In the event of an over-range condition the BDS-50 will indicate OVER RANGE on the main display and the analog 4-20mA signal will be a maximum of 22mA.

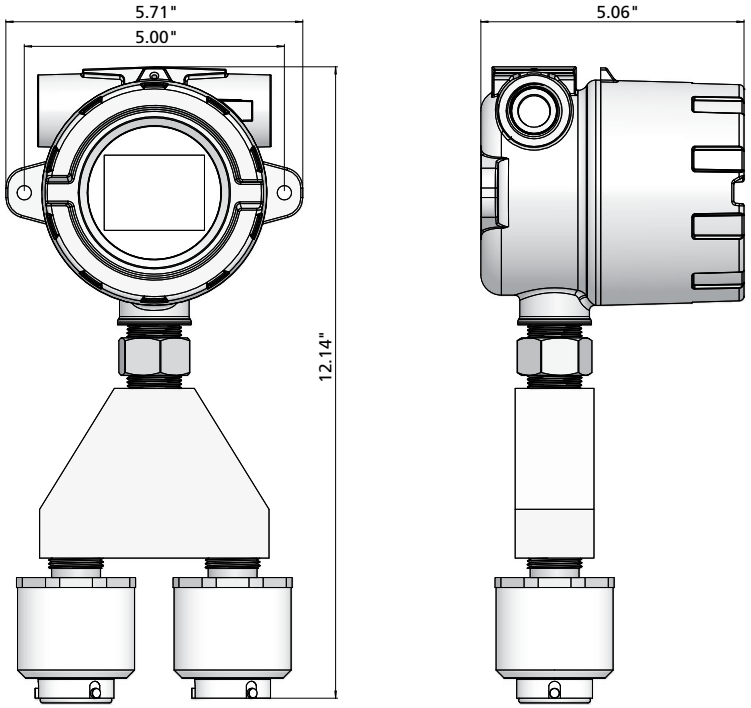


8.0 BDS-50 DUAL CHANNEL

The BDS-50 can be a single or dual channel transmitter. The BDS-50 can accept any combination of combustible or toxic sensors and can be installed into any channel.

8.1 BDS-50 Dual Channel Dimensions

Fig 8.1a



BDS-50 System Events

9.0 EVENT HISTORY

As discussed in section 7.4.5, the following events will be posted in the event history screen and have the corresponding applicable abbreviation.

9.1 Channel 1 Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Alarm 1	CH1ALM1	Alarm 1 activated
Alarm 2	CH1ALM2	Alarm 2 activated
Alarm 3	CH1ALM3	Alarm 3 activated
Alarm 1 Clear	CH1ALM1CLR	Alarm 1 cleared
Alarm 2 Clear	CH1ALM2CLR	Alarm 2 cleared
Alarm 3 Clear	CH1ALM3CLR	Alarm 3 cleared
Fault	CH1FAULT	Fault activated
Fault Clear	CH1FAULTCLR	Fault cleared
Cal Start	CH1CALSTART	Calibration started
Cal Exit	CH1CALEXIT	Calibration exited
Zero Cal	CH1ZEROCAL	Zero calibration successful
Span Cal	CH1SPANCAL	Span calibration successful
Cal Purge Timeout	CH1PURGETO	Calibration purge timed out
Cal Required	CH1CALREQD	Calibration is required flag activated
Cal Timeout	CHAN1CALTO	Calibration timer expired
Channel On	CH1ON	Channel is activated
Channel Off	CH1OFF	Channel is de-activated
Sensor Detected	CH1SENDET	Triggered when sensor first detected.
Sensor Missing	CH1SENMSSNG	Triggered when sensor is not detected
New Sensor Data	CH1NEWDATA	New / different sensor installed
Cal Reset	CH1CALRESET	Calibration reset
Sensor Reset	CH1SENRESET	Sensor reset
Min Max Reset	CH1HISTRST	Min / Max values reset
4-20 Connected	CH1420CONN	4-20 mA loop connected
4-20 Disconnected	CH1420DISN	4-20 mA loop disconnected
4-20 Error	CH1420ERR	4-20 mA internal error due to loop, etc
4-20 Error Cleared	CH1420ERRCLR	4-20 mA internal error cleared

9.2 Channel 2 Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Alarm 1	CH2ALM1	Alarm 1 activated
Alarm 2	CH2ALM2	Alarm 2 activated
Alarm 3	CH2ALM3	Alarm 3 activated
Alarm 1 Clear	CH2ALM1CLR	Alarm 1 cleared
Alarm 2 Clear	CH2ALM2CLR	Alarm 2 cleared
Alarm 3 Clear	CH2ALM3CLR	Alarm 3 cleared
Fault	CH2FAULT	Fault activated
Fault Clear	CH2FAULTCLR	Fault cleared
Cal Start	CH2CALSTART	Calibration started
Cal Exit	CH2CALEXIT	Calibration exited
Zero Cal	CH2ZEROCAL	Zero calibration successful
Span Cal	CH2SPANCAL	Span calibration successful
Cal Purge Timeout	CH2PURGETO	Calibration purge timed out
Cal Required	CH2CALREQD	Calibration is required flag activated
Cal Timeout	CHAN2CALTO	Calibration timer expired
Channel On	CH2ON	Channel is activated
Channel Off	CH2OFF	Channel is de-activated
Sensor Detected	CH2SENDET	Triggered when sensor first detected.
Sensor Missing	CH2SENMSSNG	Triggered when sensor is not detected
New Sensor Data	CH2NEWDATA	New / different sensor installed
Cal Reset	CH2CALRESET	Calibration reset
Sensor Reset	CH2SENRESET	Sensor reset
Min Max Reset	CH2HISTRST	Min / Max values reset
4-20 Connected	CH2420CONN	4-20 mA loop connected
4-20 Disconnected	CH2420DISN	4-20 mA loop disconnected
4-20 Error	CH2420ERR	4-20 mA internal error due to loop, etc
4-20 Error Cleared	CH2420ERRCLR	4-20 mA internal error cleared

BDS-50 System Events *continued*

9.3 BDS-50 System Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Powerup	POWERUP	BDS-50 Transmitter
Relay 1	RLY1COILON	Relay 1 is energized
Relay 1	RLY1COILOFF	Relay 1 is de-energized
Relay 2	RLY2COILON	Relay 2 is energized
Relay 2	RLY2COILOFF	Relay 2 is de-energized
Relay 3	RLY3COILON	Relay 3 is energized
Relay 3	RLY3COILOFF	Relay 3 is de-energized
Relay 4	RLY4COILON	Relay 4 is energized
Relay 4	RLY4COILOFF	Relay 4 is de-energized
Alarm Ack	SYSACK	Alarm acknowledge was activated
Alarm Ack Clear by Modbus	SYSACKMBCLR	Alarm acknowledge was cleared via Modbus
Alarm Ack Timeout	SYSACKTO	Alarm acknowledge was cleared via timeout
Digital Input Change	DIGINPCHG	Digital input state was changed / activated
Password Entered	PSWDENT	Password entered was successful
Password Changed	PSWDCHNG	Password changed was successful
Event Log Cleared	EVENTLOGCLR	Event log was cleared
Relay Test Start	RLYTSTSTART	Relay test screen was activated
Relay Test End	RLYTSTEND	Relay test screen was exited
4-20 Simulation Start	420SIMSTART	4-20 mA simulation screen activated
4-20 Simulation End	420SIMEND	4-20 mA simulation screen exited
Inhibit Mode Start	INHBTSTART	Inhibit mode activated
Inhibit Mode End	INHBTEND	Inhibit mode de-activated
Date Change	DATECHG	System date was changed
Time Change	TIMECHG	System time was changed
Transmitter Reset	XMTRRESET	Transmitter reset was successful

10.0 MODBUS REGISTERS

All Modbus variables are accessible via Function 4 (read-only)

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 1 Gas Value	0	30001	2	Float	
Channel 1, 4-20 mA Value	2	30003	1	Integer	Integer value representative of 4-20 value. For example, 4000 = 4 mA; 20000 = 20 mA
Channel 1 Status Flags Ordering of bits from least significant to greatest are: Sensor 1 Enable Flag Sensor 1 Detected Flag Sensor 1 Warm Up Flag Sensor 1 Alarm 1 Flag Sensor 1 Alarm 2 Flag Sensor 1 Alarm 3 Flag Sensor 1 Fault Flag Sensor 1 Alarm 1 Latched Flag Sensor 1 Alarm 2 Latched Flag Sensor 1 Alarm 3 Latched Flag Sensor 1 Cal Required Flag Sensor 1 Cal in Progress Flag Sensor 1 Cal Purge Flag CH1 Sensor Reset Flag CH1 Cal Reset Flag Remaining bits are meaningless	3	30004	1	Packed Bits	Sensor 1 Cal in Progress Flag = Set when entering calibration, reset when out of calibration Sensor 1 Cal Purge Flag = Set when entering calibration, reset when purge is complete CH1 Sensor Reset Flag = Set for 10 seconds after Sensor Reset CH1 Cal Reset Flag = Set for 10 seconds after Cal Reset
CH1 Alarm 1 Flag	4	30005	1	Integer	
CH1 Alarm 2 Flag	5	30006	1	Integer	
CH1 Alarm 3 Flag	6	30007	1	Integer	
CH1 Fault Flag	7	30008	1	Integer	
CH1 Cal Required Flag	8	30009	1	Integer	
Channel 2 Gas Value	9	30010	2	Float	
Channel 2, 4-20 mA Value	11	30012	1	Integer	Integer value representative of 4-20 value. For example, 4000 = 4 mA; 20000 = 20 mA

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 2 Status Flags Ordering of bits from least significant to greatest are: Sensor 2 Enable Flag Sensor 2 Detected Flag Sensor 2 Warm Up Flag Sensor 2 Alarm 1 Flag Sensor 2 Alarm 2 Flag Sensor 2 Alarm 3 Flag Sensor 2 Fault Flag Sensor 2 Alarm 1 Latched Flag Sensor 2 Alarm 2 Latched Flag Sensor 2 Alarm 3 Latched Flag Sensor 2 Cal Required Flag Sensor 2 Cal in Progress Flag Sensor 2 Cal Purge Flag CH2 Sensor Reset Flag CH2 Cal Reset Flag Remaining bits are meaningless	12	30013	1	Packed Bits	Sensor 2 Cal in Progress Flag = Set when entering calibration, reset when out of calibration Sensor 2 Cal Purge Flag = Set when entering calibration, reset when purge is complete CH2 Sensor Reset Flag = Set for 10 seconds after Sensor Reset CH2 Cal Reset Flag = Set for 10 seconds after Cal Reset
CH2 Alarm 1 Flag	13	30014	1	Integer	
CH2 Alarm 2 Flag	14	30015	1	Integer	
CH2 Alarm 3 Flag	15	30016	1	Integer	
CH2 Fault Flag	16	30017	1	Integer	
CH2 Cal Required Flag	17	30018	1	Integer	
Global Status Flags Ordering of bits from least significant to greatest are: Relay 1 Triggered Flag Relay 2 Triggered Flag Relay 3 Triggered Flag Relay 4 Triggered Flag Acknowledge Flag Inhibit Mode Flag Technician Relay Test Control Flag Technician 4-20 Control Flag Event Log Clear Flag Zero Gain Adjust Flag Low Voltage Flag Remaining bits in register are meaningless	18	30019	1	Packed Bits	Technician Relay Test Control Flag = Set when technician relay test menu is entered Technician 4-20 Control Flag = Set when technician 4-20 mA simulation menu is entered Event Log Clear Flag = Set for 10 seconds after Event Log Clear event Technician Zero/Gain Adjust Control Flag = Set when technician zero/gain adjust menu screen is entered "LOW VOLTAGE" on the screen and 4-20 goes to 1 mA
Relay 1 Coil Energized Flag	19	30020	1	Integer	
Relay 2 Coil Energized Flag	20	30021	1	Integer	
Relay 3 Coil Energized Flag	21	30022	1	Integer	
Relay 4 Coil Energized Flag	22	30023	1	Integer	
Remote Switch Input Mode	23	30024	1	Integer	0 = Acknowledge mode. 1 = N.O. Digital, 2 = N.C. Digital
Remote Switch State	24	30025	1	Integer	0 = When input is not activated and 1 = when activated. Activation occurs when Ack input is shorted via push button or other means
Relay 1 Tag Name	25	30026	6	ASCII String	12 Characters (2 per register)
Relay 1 Acknowledgeable Enable	31	30032	1	Integer	
Relay 1 Failsafe Enable	32	30033	1	Integer	
Relay 2 Tag Name	33	30034	6	ASCII String	12 Characters (2 per register)
Relay 2 Acknowledgeable Enable	39	30040	1	Integer	
Relay 2 Failsafe Enable	40	30041	1	Integer	
Relay 3 Tag Name	41	30042	6	ASCII String	12 Characters (2 per register)
Relay 3 Acknowledgeable Enable	47	30048	1	Integer	
Relay 3 Failsafe Enable	48	30049	1	Integer	
Relay 4 Tag Name	49	30050	6	ASCII String	12 Characters (2 per register)
Relay 4 Acknowledgeable Enable	55	30056	1	Integer	
Relay 4 Failsafe Enable	56	30057	1	Integer	
Current Time Month	57	30058	1	Integer	
Current Time Day	58	30059	1	Integer	
Current Time Year	59	30060	1	Integer	
Current Time Hour	60	30061	1	Integer	
Current Time Minute	61	30062	1	Integer	
Current Time Second	62	30063	1	Integer	
Channel 1 Tag Name	63	30064	6	ASCII String	12 Characters (2 per register)
Channel 1 Engr Units	69	30070	6	ASCII String	12 Characters (2 per register)
Channel 1 Range	75	30076	2	Float	
Channel 1 Cal Span Value	77	30078	2	Float	
Channel 1 Decimal Places	79	30080	1	Integer	

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 1 Enable	80	30081	1	Integer	
Channel 1 Alarm 1 Setpoint	81	30082	2	Float	
Channel 1 Alarm 2 Setpoint	83	30084	2	Float	
Channel 1 Alarm 3 Setpoint	85	30086	2	Float	
Channel 1 Alarm 1 Type	87	30088	1	Integer	0 = falling, 1 = rising
Channel 1 Alarm 2 Type	88	30089	1	Integer	0 = falling, 1 = rising
Channel 1 Alarm 3 Type	89	30090	1	Integer	0 = falling, 1 = rising
Channel 1 Purge Flag	90	30091	1	Integer	Sensor 1 Cal Purge Flag = Set when entering calibration, reset when out of calibration and purge is complete
Channel 1 Warmup Flag	91	30092	1	Integer	
Channel 1 Cal in Progress Flag	92	30093	1	Integer	
Channel 1 Alarm 1 Reset %	93	30094	2	Float	
Channel 1 Alarm 2 Reset %	95	30096	2	Float	
Channel 1 Alarm 3 Reset %	97	30098	2	Float	
Channel 1 Alarm 1 Latching Enable	99	30100	1	Integer	
Channel 1 Alarm 2 Latching Enable	100	30101	1	Integer	
Channel 1 Alarm 3 Latching Enable	101	30102	1	Integer	
Channel 1 Alarm 1 On Delay (sec)	102	30103	2	Float	
Channel 1 Alarm 2 On Delay (sec)	104	30105	2	Float	
Channel 1 Alarm 3 On Delay (sec)	106	30107	2	Float	
Channel 1 Alarm 1 Off Delay (min)	108	30109	2	Float	
Channel 1 Alarm 2 Off Delay (min)	110	30111	2	Float	
Channel 1 Alarm 3 Off Delay (min)	112	30113	2	Float	
Channel 1 Fault Percentage	114	30115	2	Float	
Channel 1 Deadband	116	30117	2	Float	
Channel 1 InCal mA	118	30119	2	Float	
Channel 1 Inhibit mA	120	30121	2	Float	
Channel 1 Track Neg mA Enable	122	30123	1	Integer	
Channel 1 Track Neg Value Enable	123	30124	1	Integer	
Channel 1 Sensor Type	124	30125	6	ASCII String	12 Characters (2 per register)
Channel 1 Serial Number	130	30131	5	ASCII String	10 Characters (2 per register)
Channel 1 Born Month	135	30136	1	Integer	
Channel 1 Born Day	136	30137	1	Integer	
Channel 1 Born Year	137	30138	1	Integer	
Channel 1 Zero Cal Month	138	30139	1	Integer	
Channel 1 Zero Cal Day	139	30140	1	Integer	
Channel 1 Zero Cal Year	140	30141	1	Integer	
Channel 1 Span Cal Month	141	30142	1	Integer	
Channel 1 Span Cal Day	142	30143	1	Integer	
Channel 1 Span Cal Year	143	30144	1	Integer	
Channel 1 Cal Interval [days]	144	30145	1	Integer	
Channel 2 Tag Name	145	30146	6	ASCII String	12 Characters (2 per register)
Channel 2 Engr Units	151	30152	6	ASCII String	12 Characters (2 per register)
Channel 2 Range	157	30158	2	Float	
Channel 2 Cal Span Value	159	30160	2	Float	
Channel 2 Decimal Places	161	30162	1	Integer	
Channel 2 Enable	162	30163	1	Integer	
Channel 2 Alarm 1 Setpoint	163	30164	2	Float	
Channel 2 Alarm 2 Setpoint	165	30166	2	Float	
Channel 2 Alarm 3 Setpoint	167	30168	2	Float	
Channel 2 Alarm 1 Type	169	30170	1	Integer	0 = falling, 1 = rising
Channel 2 Alarm 2 Type	170	30171	1	Integer	0 = falling, 1 = rising
Channel 2 Alarm 3 Type	171	30172	1	Integer	0 = falling, 1 = rising
Channel 2 Purge Flag	172	30173	1	Integer	Sensor 2 Cal Purge Flag = Set when entering calibration, reset when out of calibration and purge is complete
Channel 2 Warmup Flag	173	30174	1	Integer	
Channel 2 Cal in Progress Flag	174	30175	1	Integer	
Channel 2 Alarm 1 Reset %	175	30176	2	Float	
Channel 2 Alarm 2 Reset %	177	30178	2	Float	
Channel 2 Alarm 3 Reset %	179	30180	2	Float	
Channel 2 Alarm 1 Latching Enable	181	30182	1	Integer	
Channel 2 Alarm 2 Latching Enable	182	30183	1	Integer	
Channel 2 Alarm 3 Latching Enable	183	30184	1	Integer	
Channel 2 Alarm 1 On Delay (sec)	184	30185	2	Float	
Channel 2 Alarm 2 On Delay (sec)	186	30187	2	Float	
Channel 2 Alarm 3 On Delay (sec)	188	30189	2	Float	
Channel 2 Alarm 1 Off Delay (min)	190	30191	2	Float	
Channel 2 Alarm 2 Off Delay (min)	192	30193	2	Float	
Channel 2 Alarm 3 Off Delay (min)	194	30195	2	Float	
Channel 2 Fault Percentage	196	30197	2	Float	
Channel 2 Deadband	198	30199	2	Float	
Channel 2 InCal mA	200	30201	2	Float	
Channel 2 Inhibit mA	202	30203	2	Float	
Channel 2 Track Neg mA Enable	204	30205	1	Integer	

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 2 Track Neg Value Enable	205	30206	1	Integer	
Channel 2 Sensor Type	206	30207	6	ASCII String	12 Characters (2 per register)
Channel 2 Serial Number	212	30213	5	ASCII String	10 Characters (2 per register)
Channel 2 Born Month	217	30218	1	Integer	
Channel 2 Born Day	218	30219	1	Integer	
Channel 2 Born Year	219	30220	1	Integer	
Channel 2 Zero Cal Month	220	30221	1	Integer	
Channel 2 Zero Cal Day	221	30222	1	Integer	
Channel 2 Zero Cal Year	222	30223	1	Integer	
Channel 2 Span Cal Month	223	30224	1	Integer	
Channel 2 Span Cal Day	224	30225	1	Integer	
Channel 2 Span Cal Year	225	30226	1	Integer	
Channel 2 Cal Interval [days]	226	30227	1	Integer	
Global Inhibit Mode Flag	227	30228	1	Integer	
Modbus Address	228	30229	1	Integer	
Modbus Baud Rate	229	30230	1	Integer	
Modbus Parity	230	30231	1	Integer	0 = None, 1 = Even, 2 = Odd
Modbus Stop Bits	231	30232	1	Integer	
Sensor 1 Health	232	30233	2	Float	
Sensor 2 Health	234	30235	2	Float	
Sensor 1 Temp	236	30237	2	Float	Fahrenheit
Sensor 2 Temp	238	30239	2	Float	Fahrenheit
Warmup Time	240	30241	1	Integer	minutes
Cal Purge Time	241	30242	1	Integer	minutes
System Secure Flag	242	30243	1	Integer	0 = Unlocked, 1 = Locked
CH1 Sensor Reset Flag	243	30244	1	Integer	Set for 10 seconds after reset
CH2 Sensor Reset Flag	244	30245	1	Integer	Set for 10 seconds after reset
CH1 Cal Reset Flag	245	30246	1	Integer	Set for 10 seconds after reset
CH2 Cal Reset Flag	246	30247	1	Integer	Set for 10 seconds after reset
Event Log Clear Flag	247	30248	1	Integer	Set for 10 seconds after clearing log
CH1 Sensor Detected Flag	248	30249	1	Integer	
CH2 Sensor Detected Flag	249	30250	1	Integer	
Acknowledge Timeout [min]	250	30251	1	Integer	

10.1 Modbus Read / Write to Remote Acknowledge

The BDS-50 can be acknowledged remotely when in alarm via Modbus by writing a value of 1 (or 16 bit value other than 0) to Modbus address 40001 using Function 6 Modbus command.

Acknowledge mode can be cleared via Modbus by writing a 0 to this register. The current state of the acknowledge flag (0 when system not in acknowledge, 1 when system in acknowledge) can be read via Function 3 Modbus command.

11.0 CAT-BEAD (PELLISTOR) K-FACTOR CALIBRATIONS

11.1 Working with Cat-Bead Sensors and K-Factors

Foremost : It is always recommended to calibrate a Cat-Bead (Pellistor) combustible sensor with a calibration gas that is specific to the "target" gas.

However, a surrogate calibration gas along with K-factors can be used to calibrate a cat-bead sensor when acquiring or having the specific calibration gas is not available.

K-factors combined with a surrogate calibration gas can be used to simulate a response to a combustible target gas in terms of a readily available calibration gas such as methane. It should be understood that such conversion k-factors are calculated estimates only. They are intended to serve as a guide to show approximate typical responses of a monitor to the particular gas needed for calibration.

The BDS-50 gas monitor cat-bead sensor is supported with gas sensitivity response values for numerous combustible gases relative to methane calibration gas. Therefore all sensitivity methane surrogate K-factors are a multiplier that are applied to the surrogate calibration gas (methane) being used to offset the difference between how a cat-bead sensor would respond to a target gas verses a surrogate calibration gas such as methane.

When applying a k-factor to a surrogate gas, the objective is to have the gas monitor display a value that is the simulated reading of the combustible target gas being monitored. The displayed value is the sum of the response sensitivity to the calibration gas used and the applied k-factor, thus a span cal value is required to be configured.

The span cal value is the span number that the cat-bead sensor will be calibrated to when a known calibration concentration gas is applied during a calibration. Typically when using a specific calibration gas that represents the target gas, the span cal value is the actual concentration percentage of that gas.

However when a surrogate calibration gas and a k-factor is used to simulate the target gas the span cal value needs to reflect that sum (surrogate gas concentration percentage times the k-factor = cal span value).

Note: The results obtained when using the K-factors are approximate and must not be construed as representing highly accurate LEL percentages. They are usually considered to be adequate for general detection of combustible gases, but are not adequate for accurate gas analysis.

11.2 Surrogate Gas and K-factor Considerations

The relative sensitivity response chart below provides target gases that have known response sensitivity data to support k-factor calculations. In general, when using a surrogate calibration gas with a k-factor, the sum or cal span value should be 25 to 75 % of full scale.

For example. If we were using 50 % methane as a surrogate gas to simulate for the target gas N-Heptane with a k-factor of 2.08 the cal span value would be 104% which is not in the 25 – 75 % range and would be over-range. Therefore we would use a 25% concentration calibration methane gas times the k-factor of 2.08 to set the cal span value to 52%.

To set the cal span value in the BDS-50 gas detector, please refer to the channel settings / configure / cal span value menu to set the cal span value.

Cal Span Value = The methane calibration gas "concentration percentage" multiplied by the target gas k-factor from the Relative Sensitivity Response chart

Conclusion: Cat-bead sensors should always be calibrated with a specific calibration gas for the target gas. However when needed a surrogate calibration gas combined with a k-factor can simulate a target gas response. By choosing the right methane surrogate gas concentration and the corresponding k-factor as well as setting the cal span value in the BDS-50. The cat-bead / gas monitor will be calibrated so that the gas detector monitor will provide a reading of the target gas percentage.

To calibrate, set the "Cal Span Value" as previously detailed and then follow the calibration procedure discussed in section 6.5.

11.3 Relative Sensitivity Response Chart

The relative sensitivity responses are based on methane 100% LEL

GAS	FORMULA	K-FACTOR	100 % LEL/ V (USA)	RELATIVE RESPONSE LEL %
Methane	CH4	1	5	100
Acetic acid	CH3COOH	14.29	5.4	7
Acetone	(CH3)2CO	3.85	2.6	26
Cyclo-hexane	C6H12	1.82	1.3	55
Cyclo-pentane	C5H10	1.69	1.5	59
Ethanol	C2H5OH	2.63	3.3	38
Ethyl acetate	C2H5COOCH3	3.23	2.2	31
Butyl acetate	C4H9COOCH3	5.56	1.4	18
Ethylene	C2H4	1.43	2.7	70
Hydrogen	H2	1.05	4	95
Iso-butane	C4H10	1.82	1.8	55
Iso-octane	C8H18	2.50	N/A	40
Iso-propanol	CH3CH(OH)CH3	3.03	2.2	33
Methanol	CH3OH	1.49	6.7	67
n-Butane	C4H10	2.22	1.8	45
n-Heptane	C7H16	2.08	1.05	48
n-Hexane	C6H14	2.04	1.2	49
n-Pentane	C5H12	1.79	1.4	56
Propane	C3H8	1.82	2.1	55
Styrene	C6H5CH=CH2	6.67	1.1	15
Toluene	C6H5CH3	5.00	1.2	20
Ammonia	NH3	1.43	15	70
Propylene	CH3-CH=CH2	1.67	2.4	60
Carbon Monoxide	CO	2.50	12.5	40
Methyl t-butyl ether	CH3OC(CH3)	1.69	N/A	59
Xylene	C6H4(CH3)2	5.00	1.1	20
n-Octane	CH3(CH2)6CH3	2.38	0.95	42
Iso-butanol	CH3CH(CH3)CH2OH	4.00	1.7	25
Iso-pentane	CH3CH(CH3)C2H5	2.17	N/A	46
n-propanol	C3H7OH	3.85	2.2	26

12.0 INFRARED SENSOR CALIBRATION ETHANOL OR BUTANE

It is always better to calibrate a sensor with the target gas, however when the target gas is not available a surrogate gas can be used with appropriate calibration factors applied.

Obtaining Ethanol in a calibration gas cylinder is not a readily available calibration gas, therefor propane calibration gas is used as a surrogate gas as it is readily available and the IR response curve data is based on propane response curves.

K-factors combined with a surrogate calibration gas can be used to simulate a response to a combustible target gas in terms of a readily available calibration gas such as propane. It should be understood that such conversion factors are calculated estimates only and are intended to serve as a guide to show approximate typical responses of a monitor to the particular surrogate gas for calibration.

The propane IR sensor response has a nice correlation between propane and ethanol. Although the Ethanol response is lower than propane, its close enough to calibrate using 50% LEL propane as a surrogate gas and use a calibration factor / multiplier "k-factor" to perform a successful calibration for an Ethanol target.

In order for a gas detector transmitter in an Ethanol application to respond to the correct % LEL concentration the gas detector needs to be calibrated using 50% LEL propane calibration gas and a cal span value of 45.5%. To set the cal span value in the BDS-50 gas detector, please refer to the channel settings / configure / cal span value menu to set the cal span value.

Once the BDS-50 with an IR propane sensor is calibrated to a 45.5% span, the BDS-50 gas monitor will be calibrated to respond accordingly for an ethanol target gas. With the calibration in place as previously mentioned the BDS-50 should display 50% LEL when 50% LEL ethanol is present in a vapor form. Again, It should be understood that such conversion factors are calculated estimates only and are intended to serve as a guide to show approximate typical responses of a monitor to the particular surrogate gas for calibration.

To calibrate, set the "Cal Span Value" to 45.5 and then follow the calibration procedure discussed in section 6.5.

Butane: The BDS-50 Propane IR sensor can be used to detect Butane, It is recommended to use 50% Butane to calibrate the BDS-50 Propane IR sensor for a Butane application.

13.0 SENSOR WARMUP TIME RECOMMENDATIONS

13.1 Toxic (Echem) Sensors

The majority of the BDS-50 gas detector toxic sensors generally require two hours to stabilize when they are new or have been offline for a considerable amount of time. Toxic sensors that are the exception of this recommended warmup time would be NO and HCL which require approximately 12 hours.

13.2 Cat-Bead (Pellistor) Sensors

The BDS-50 cat-bead sensor when powered-up for the first time following storage or a long period of inactivity can sometimes take a several hours to completely stabilize to their final zero offset point. Although the cat-bead sensor can stabilize after a couple of minutes its highly recommended to allow the sensor to "settle-in" for a couple of hours to burn off any impurities, stabilize, etc prior to a calibration.

13.3 IR (Infrared) Sensors

The BDS-50 IR sensor should have the opportunity to reach an equilibrium with the ambient air. Warmup time varies depending upon the ambient temperature. Although IR sensors have the least amount of warmup requirements its recommended for the IR sensor to have approximately 20 minutes to acclimate to ambient conditions.

13.4 Sensor Temperature and Humidity RH

The following list supports the BDS-50 sensor temperature and humidity RH ranges for the standard sensors and range. Please consult factory for any other sensor types and ranges.

Sensor	Sensor Type	BDS-50 Sandard Range	Temperature Range in Celsius	Humidity RH
Combustible	Cat-Bead	0-100 %	-20 +70	0-95%
Combustible	IR	0-100 %	-20 +50	0-95%
Carbon Dioxide	IR	0-2 %	-20 +50	0-95%
Ammonia	Echem	0-100 PPM	-40 +50	15-90 %
Carbon Monoxide	Echem	0-100 PPM	-20 +50	15-90 %
Chlorine	Echem	0-10 PPM	-20 +50	15-90 %
Chlorine Dioxide	Echem	0-10 PPM	-20 +50	15-90 %
Hydrogen	Echem	0-1000 PPM	-20 +50	15-90 %
Hydrogen Chloride	Echem	0-20 PPM	-20 +50	15-90 %
Hydrogen Cyanide	Echem	0-25 PPM	-20 +50	15-90 %
Hydrogen Fluoride	Echem	0-10 PPM	-20 +50	15-90 %
Hydrogen Sulfide	Echem	0-100 PPM	-40 +50	15-90 %
Nitrogen Dioxide	Echem	0-20 PPM	-20 +50	15-90 %
Nitric Oxide	Echem	0-50 PPM	-20 +50	15-90 %
Oxygen	Echem	0-25 %	-30 +55	0-90 %
Ozone	Echem	0-10 PPM	-40 +50	15-90 %
Phosphine	Echem	0-5 PPM	-20 +50	15-90 %
Sulfur Dioxide	Echem	0-10 PPM	-20 +50	15-90 %

14.0 BUCKEYE DETECTION SYSTEMS STANDARD LIMITED WARRANTY

Buckeye Detection Systems, Inc. warrants products manufactured and sold by Buckeye Detection Systems to be free from defects in materials and workmanship for the period listed in the tables on the following pages. This warranty is expressly limited to the original owner who purchases the equipment directly from Buckeye Detection Systems or from an authorized Buckeye Detection Systems Distributor.

To maintain this limited warranty, the product must be operated, calibrated, and maintained in accordance with the Operation and Maintenance Manual supplied with the product. Abuse, mechanical damage, alteration, or repairs not made in accordance with the Operation and Maintenance Manual void Buckeye Detection Systems Standard Limited Warranty.

The obligation of Buckeye Detection System under this limited warranty is limited to the repair or replacement of components deemed by the Buckeye Detection Systems Technical Support Center to have been defective under the scope of this Standard Limited Warranty. To receive consideration for warranty repair or replacement, the product must be returned to a Buckeye Detection Systems Authorized Service Partner or to Buckeye Detection in Kings Mountain, North Carolina, USA, with transportation and shipping charges prepaid. If the product is being returned to Buckeye Detection Systems it is necessary to obtain a return authorization number (RMA) from Buckeye Detection Systems prior to shipment.

This limited warranty is expressly in lieu of any and all representation, express or implied, including but not limited to the warranty of fitness for a particular purpose. Buckeye Detection Systems will not be liable for loss or damage of any kind connected to the use of this product or failure of its products to function or operate properly.

Warranty for Echem Sensors - 1 year
Warranty for Cat-Bead Sensors - 1 year
Warranty for IR Sensors - 2 years
Warranty for BDS-50 Transmitter - 2 years

Buckeye Detection Systems
Direct: 704-710-0322
Main: 704-739-7415
www.buckeyedetects.com

Made in the USA | 110 Kings Road, Kings Mountain, North Carolina 28086
Manual BDS-50_Rev_1.0

Operation & Maintenance Manual

GASMAX
Product Family

GASMAX / EC
Toxic / Oxygen Loop-Powered Monitor with Smart Sensor Interface

GASMAX II
Toxic / Oxygen / LEL / VOC Monitor
Single or Dual Gas Detection with Smart Sensor Interface

Important: Read and understand contents of this instruction manual prior to use. Improper use of equipment could result in instrument malfunction or serious injury.

Global Detection Systems Corp.
2513 Hwy 646
Santa Fe, Texas 77510
(409) 927-2980
(409) 927-4180 (FAX)
www.gdscorp.com
tech@gdscorp.com

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SECTION 1 – SAFETY INFORMATION

1.1 Safety Information – Read Before Installation & Applying Power

IMPORTANT

Users should have a detailed understanding of GASMAX operating and maintenance instructions. Use the GASMAX 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

- Calibrate with known target gas at start-up and check on a regular schedule, at least every 90 days. 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 GASMAX 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 GASMAX and approved by Global Detection Systems Corp. (See the section ____ for Replacement Parts.) *Not Available this printing*
- 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 GASMAX to electrical shock or continuous severe mechanical shock.
- Protect the GASMAX from dripping liquids and high power sprays.
- Use only for applications described within this manual.

CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE 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.

1.2 Contacting GDS Corp.

To contact GDS Corp., call, fax, email or write:
Telephone: 409-927-2980, FAX: 409-927-4180, Email: info@GDScorp.com,
Address: 2513 Hwy 646, Santa Fe, TX 77510, or visit us on the World Wide Web: www.GDScorp.com

SECTION 2 – INSTALLATION INSTRUCTIONS

2.1 Introduction

Important: This manual describes both the 2-Wire 4-20mA GASMAX/EC and 3-Wire 4-20mA GASMAX II models. GASMAX/EC models are supplied when the 10-0232 Display IS THE ONLY PCB IN THE ENCLOSURE. If the 10-0233 I/O Power Supply is installed it is a GASMAX II.

The GASMAX is a single or dual channel fixed-point 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 2.1). 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 GASMAX. Traditional 3-wire *Simple* sensors, without the smart interface, are also supported by

the GASMAX. Its advanced microcontroller electronics and superior graphic LCD operator interface offers enhanced diagnostics and fault analysis not possible in competing products. The GASMAX 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 GASMAX. This includes alarm set points, range, target gas, calibration constants and other variables required to match the GASMAX to a specific application. For traditional *Simple* sensors, without the smart interface, the USB interface allows direct GASMAX configuration from a PC or a six channel GASMAX *Educator* device.

Toxic and oxygen monitors are capable of 2-wire 4-20mA operation (section 2.7) when the alarms / Modbus option and LCD backlight are not required. Catalytic LEL sensors, or addition of the 10-0234 Alarms / Modbus option, require the 10-0233 I/O Power Supply board providing 3-wire 4-20mA operation (section 2.8).

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 2-1). 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 GASMAX 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.

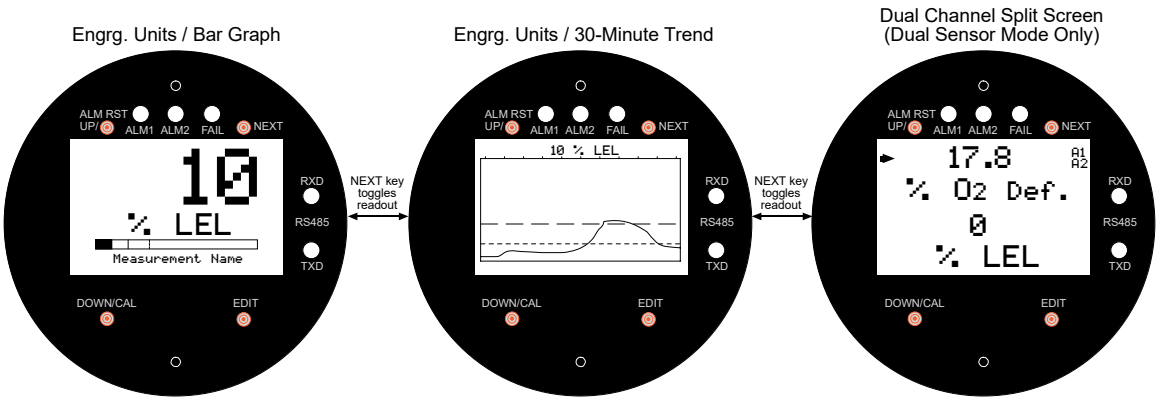


Figure 2-1: Data Displays

2.2 Ratings and Certifications

CSA certified for Division 1 & 2 hazardous area installations for explosion proof Class 1 Groups B,C,D, and intrinsically safe (GM/EC 2-wire loops only) Class 1 Groups A,B,C,D. Also see

sections 2.7, 2.7a & 2.8. Designed to meet CSA C22.2 No.152 for Combustibles Monitors and ISA 92.0.01 Part 1 for Toxic Monitors.

2.3 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 GASMAX is designed for rugged service, sensors should be protected from environmental damage from water, snow, shock, vibration and dirt.

2.4 Mounting the Enclosure

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

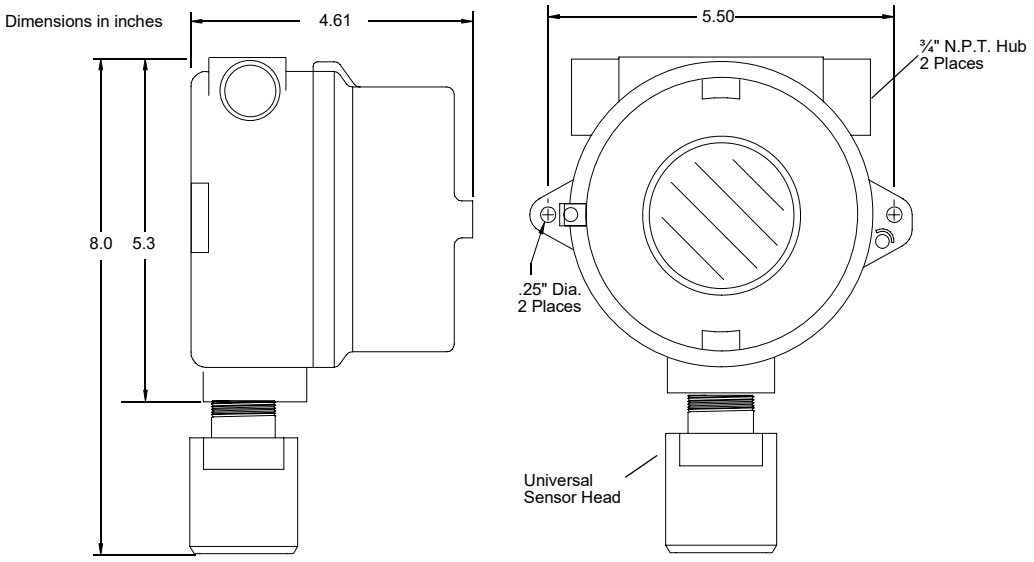


Figure 2-2: GASMAX Explosion-Proof Housing

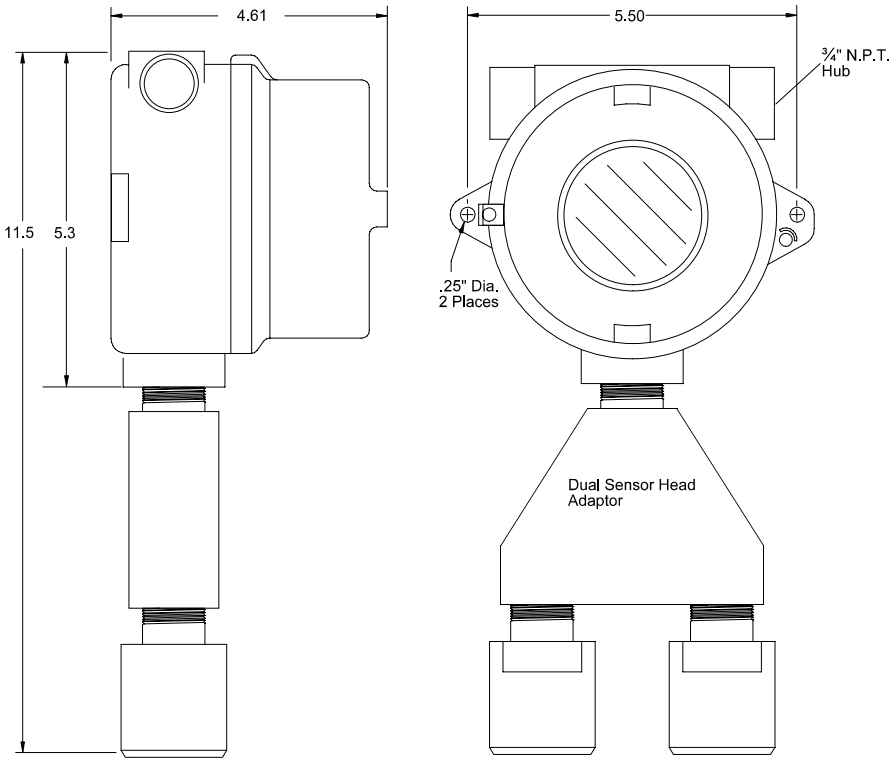


Figure 2-2a: GASMAX Explosion-Proof Housing with Dual Sensor Head Adaptor

Modular design simplifies the installation of the GASMAX (Figure 2-3). A top Display Assembly is mounted with captive thumbscrews and is easily removed to access field-wiring terminals. An optional 10-0234 Alarms/Modbus board mounts *piggyback* to the back of the Display Assembly. Wiring from toxic or oxygen sensors terminates at the 10-0232 Display Assembly along with 2-wire 4-20mA signal wires. This Display Assembly is the only PC board supplied with toxic / oxygen GASMAXs not requiring relays, RS-485 ModBus or LCD backlight. The optional bottom 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. Do not aim the sensor pointing upward. Install the GASMAX to a wall or bracket using the predrilled mounting flanges with I.D. 0.25 on 5.5 inch centers (Figure 2-2). If conduit is rigid and able to support the weight of the GASMAX, the mounting bolts may be omitted.

CAUTION: The sensor should never be installed pointing upwards.

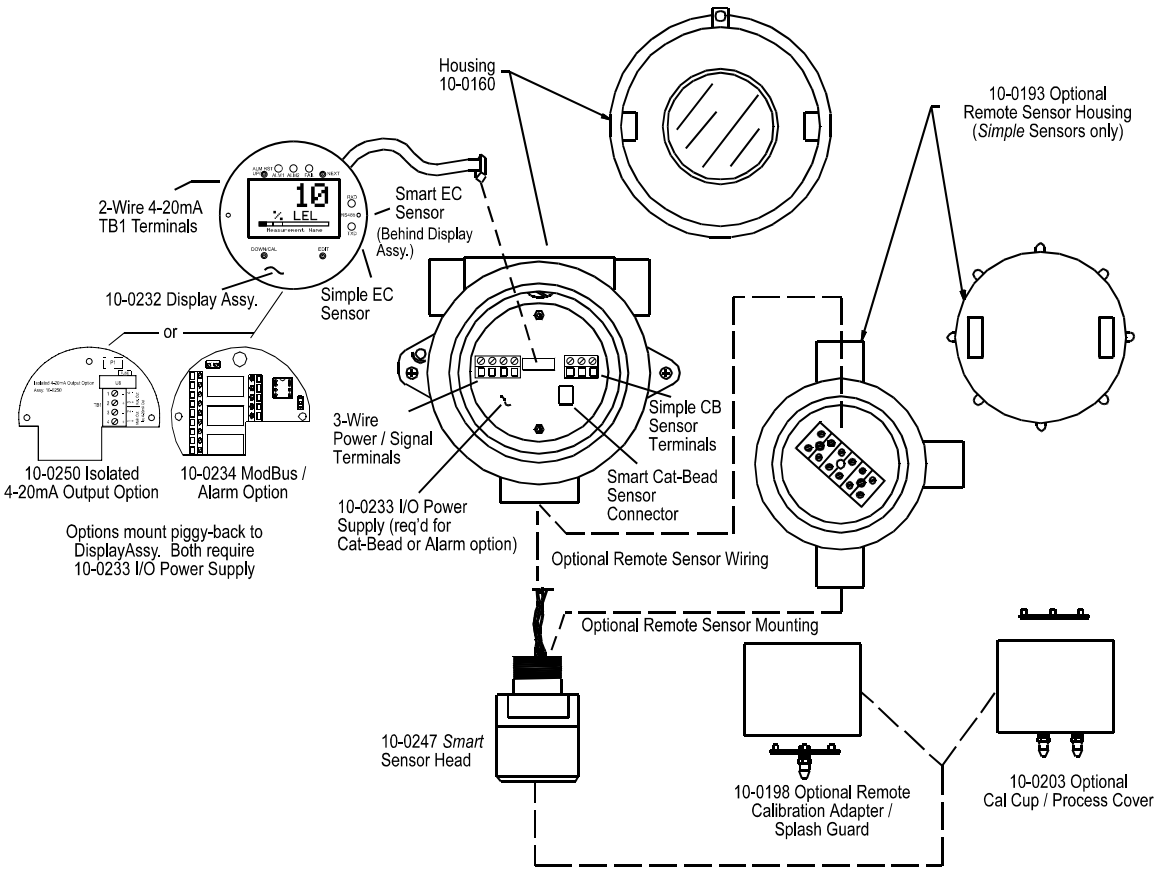


Figure 2-3: Outline Drawing

2.5 System Design Specifications

Supply Voltage:
10 to 30 volts

Power Consumption:

- Catalytic Combustible Sensors (requires 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 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 240 ~VAC **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 GASMAX II will be indicated as a “FAULT” condition.

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.

Sensor Separation Kit:
Transmission distances (see tables below)
Not included in this printing

2.6 Field Wiring Installation

4-20mA Transmission Range Info:
The distance 4-20 mA signals can travel is dependent upon several factors including the cable gauge, DC power supply voltage level and impedance of the input of the receiving device. Assuming a nominal 24 VDC power supply, maximum total loop resistance is 650 ohms in the 2-wire mode. The tables below show resistance per 1000 feet for several AWG wire gauges. Remember to double these values since the output is a loop.

Not included in this printing
Note: GDS Corp. C1 and C2 Controllers have input resistance of 100 ohms.

2.7 2-Wire 4-20mA Intrinsically Safe & Explosion Proof Installations

GASMAX/EC's equipped with 10-0247 sensor heads are NRTL (Nationally Recognized Testing Lab) certified as suitable for both intrinsically safe and explosion proof installations. GASMAX/EC's equipped with 10-0247IS sensor heads (XP flame arrestor is not installed to allow monitoring of highly reactive gases such as chlorine) are NRTL certified as suitable for intrinsically safe installations. All GASMAX/EC's are NRTL certified for explosion proof installations as long as the sensor head is CSA certified as explosion proof. Follow instructions on Installation Drawing # 11-0100 in section 2.7a for correct intrinsically safe installations.

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 GASMAX/EC Display assembly shown in Figure 2-4 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 GASMAX/EC 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 GASMAX/EC 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 GASMAX/EC 2-wire 4-20mA output automatically correct for polarity so positive and negative are interchangeable. Reassemble the GASMAX/EC. Follow the procedures and recommendations in the receiver manual to complete the installation. Be sure the GASMAX/EC enclosure and conduit are properly grounded. Apply loop power by appropriately powering the receiver device (DCS, PLC, Controller, etc) and the GASMAX/EC should function. Proceed to section-3.

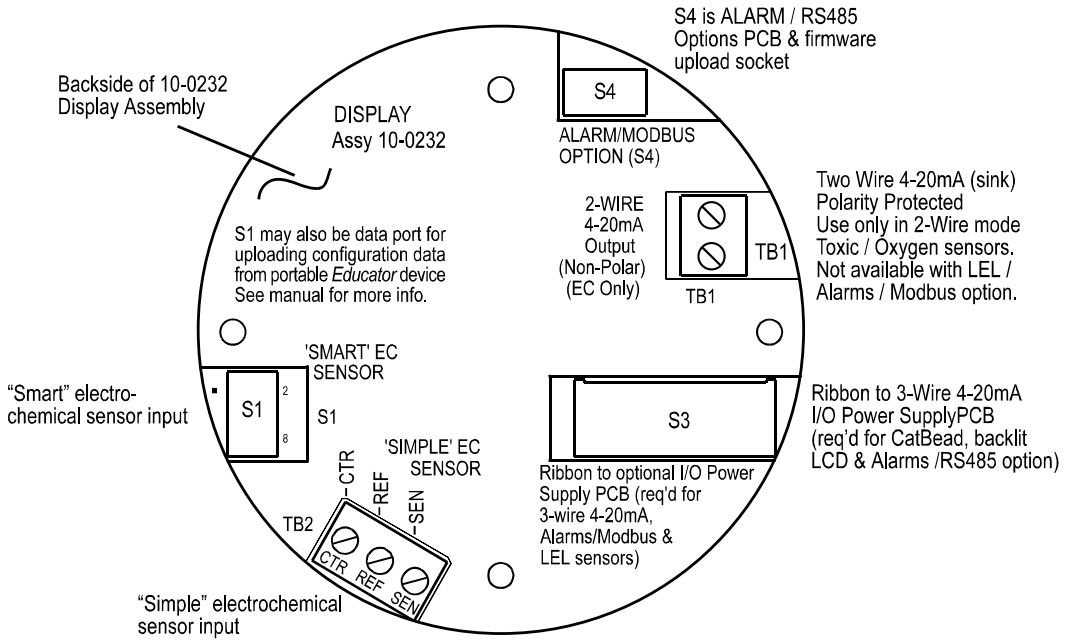
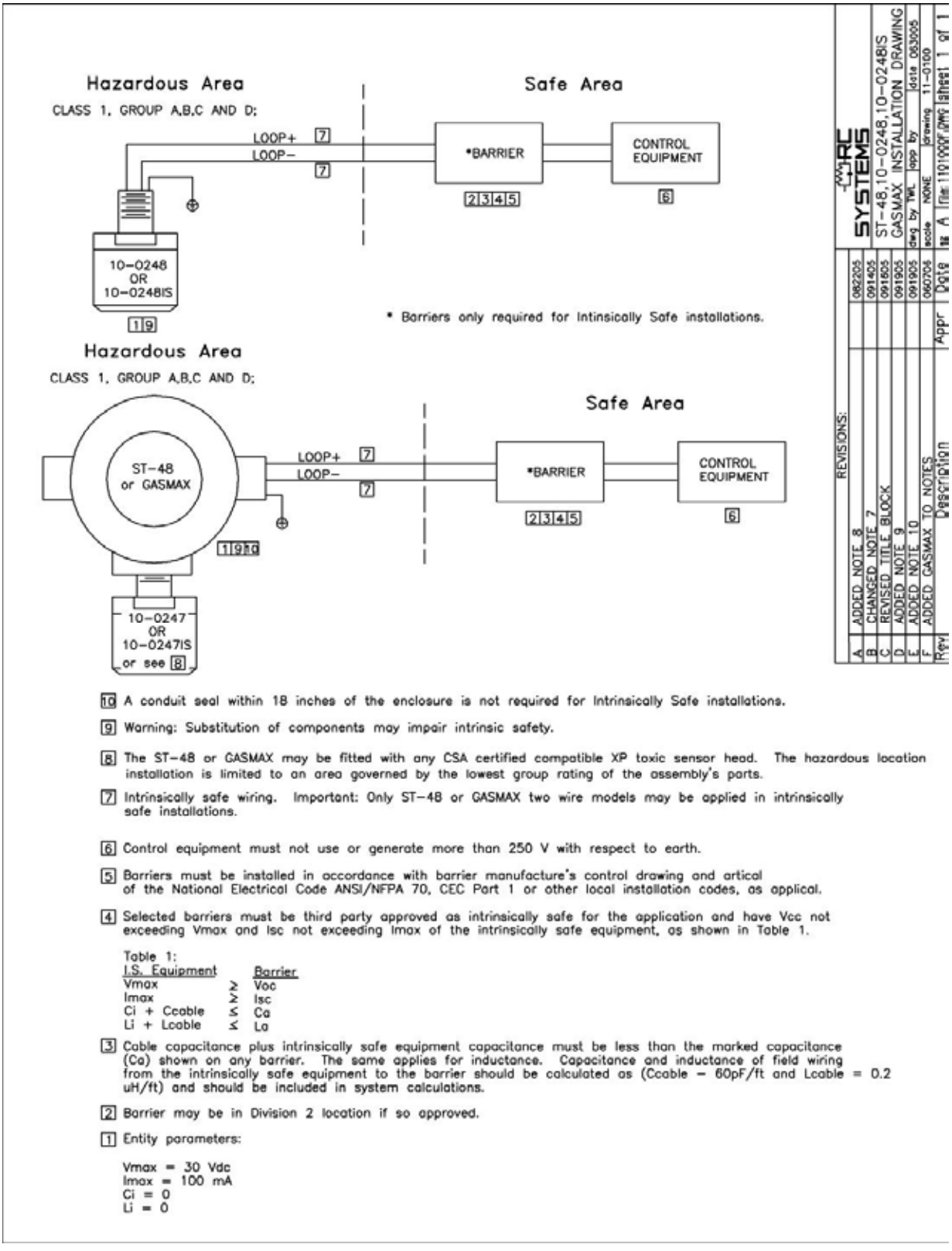


Figure 2-4: 10-0232 Display / 2-Wire 4-20mA Assembly

2.7a Installation Drawing # 11-0100



10 A conduit seal within 18 inches of the enclosure is not required for Intrinsically Safe installations.

9 Warning: Substitution of components may impair intrinsic safety.

8 The ST−48 or GASMAX may be fitted with any CSA certified compatible XP toxic sensor head. The hazardous location installation is limited to an area governed by the lowest group rating of the assembly's parts.

7 Intrinsically safe wiring. Important: Only ST−48 or GASMAX two wire models may be applied in intrinsically safe installations.

6 Control equipment must not use or generate more than 250 V with respect to earth.

5 Barriers must be installed in accordance with barrier manufacture's control drawing and artical of the National Electrical Code ANSI/NFPA 70, CEC Part 1 or other local installation codes, as applical.

4 Selected barriers must be third party approved as intrinsically safe for the application and have Vcc not exceeding Vmax and Isc not exceeding Imax of the intrinsically safe equipment, as shown in Table 1.

Table 1:

I.S. Equipment		Barrier
Vmax	≥	Voc
Imax	≥	Isc
Ci + Ccable	≤	Ca
Li + Lcable	≤	La

3 Cable capacitance plus intrinsically safe equipment capacitance must be less than the marked capacitance (Ca) shown on any barrier. The same applies for inductance. Capacitance and inductance of field wiring from the intrinsically safe equipment to the barrier should be calculated as (Ccable = 60pF/ft and Lcable = 0.2 uH/ft) and should be included in system calculations.

2 Barrier may be in Division 2 location if so approved.

1 Entity parameters:

Vmax = 30 Vdc
Imax = 100 mA
Ci = 0
Li = 0

2.8 3-Wire 4-20mA Explosion Proof Installation

CAUTION: GASMAX II's are equipped with the 10-0233 I/O Power Supply board and only operate as 3 or 4-wire 4-20mA transmitters and are not compatible with 2-wire intrinsically safe installations (see sections 2.7 and 2.7a). Such units should not be combined with 10-0247IS Sensor Heads without flame arrestors unless the area is classified as non-hazardous.

GASMAX II's equipped with the 10-0233 I/O Power Supply and 10-0234 Alarms / Modbus option are NRTL certified as suitable for Div 1 & 2 Groups B,C,D explosion proof installations with the 10-0247 or with any sensor head with an equivalent CSA certification.

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 GASMAX is equipped with the bottom 10-0233 I/O Power Supply board shown in Figure 2-5, the 2-wire 4-20mA output is disabled and one of the 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 LEL 3-wire 4-20mA output signals.

Instructions:
Unscrew the cover on the GASMAX II 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 2-5). Power and signal connections are to TB2 where 24 VDC, Signal and Common wires must be connected. A blocking diode protects the GASMAX if polarity of the power supply is reversed but it will not operate. Reassemble the GASMAX. Follow the procedures and recommendations in the receiver and power supply manuals to complete the installation. Be sure the GASMAX enclosure and conduit are properly grounded. Apply power and the GASMAX II should function. Proceed to section-3.

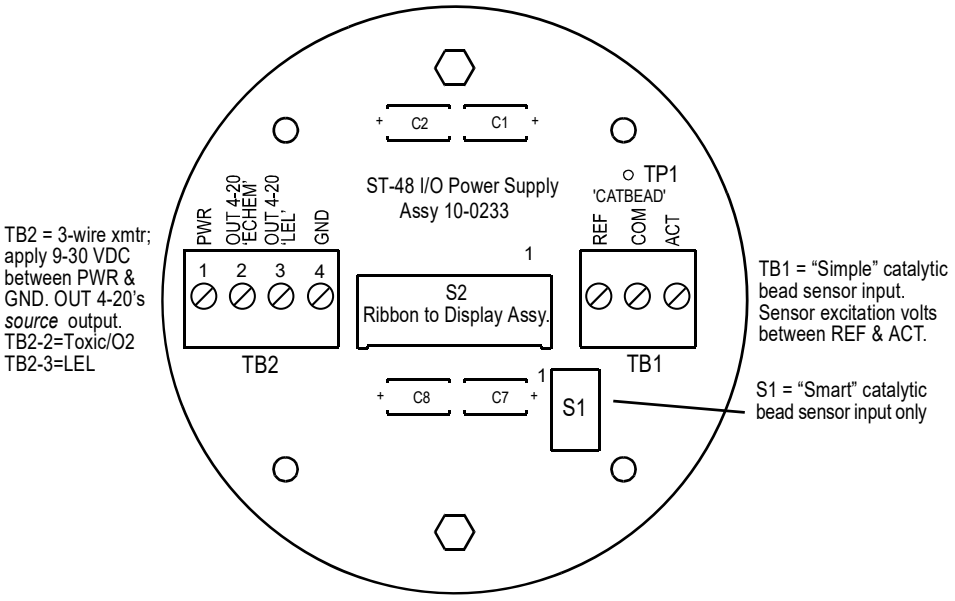


Figure 2-5: 10-0233 I/O Power Supply / 3-Wire 4-20mA Assembly

2.9 Alarms / RS-485 Modbus 10-0234 Option Installation

Description:
The optional 10-0234 Alarms/RS-485 Modbus board supplies two level alarm relays, a FAULT relay and an RS-485 Modbus RTU slave port (Figure 2-6). This board is "piggybacked" behind the 10-0232 Display Assembly (Figure 2-3). Addition of this option requires 3-wire mode 4-20mA

operation and thereby requires the 10-0233 I/O Power Supply board (Figure 2-5). 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.

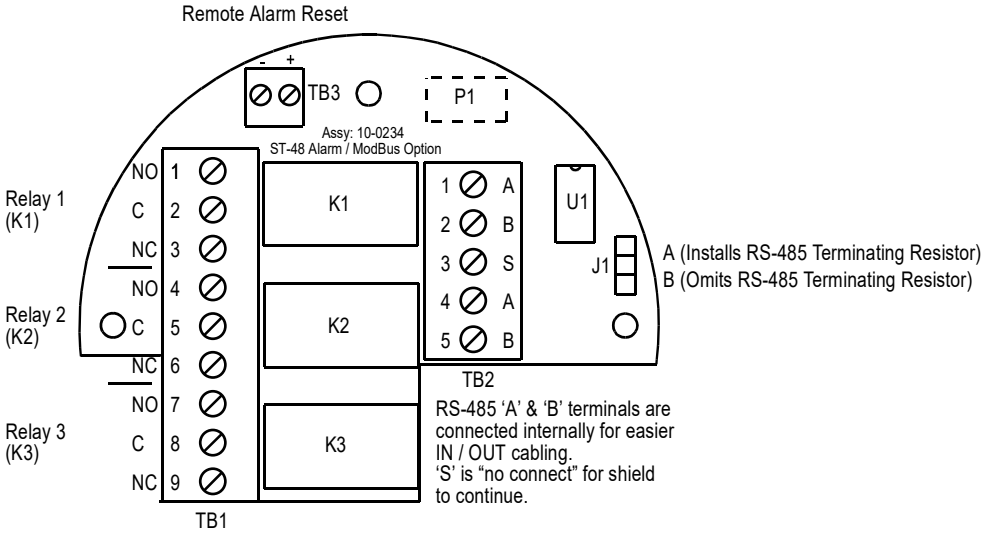


Figure 2-6: 10-0234 Alarm Relays / Modbus Option

Instructions:

Unscrew the cover on the GASMAX 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 2-7. Each GASMAX connected represents an RTU and must have a unique RTU address. RTU addresses are assigned in the Modbus setup menu described in section 4.10. 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.

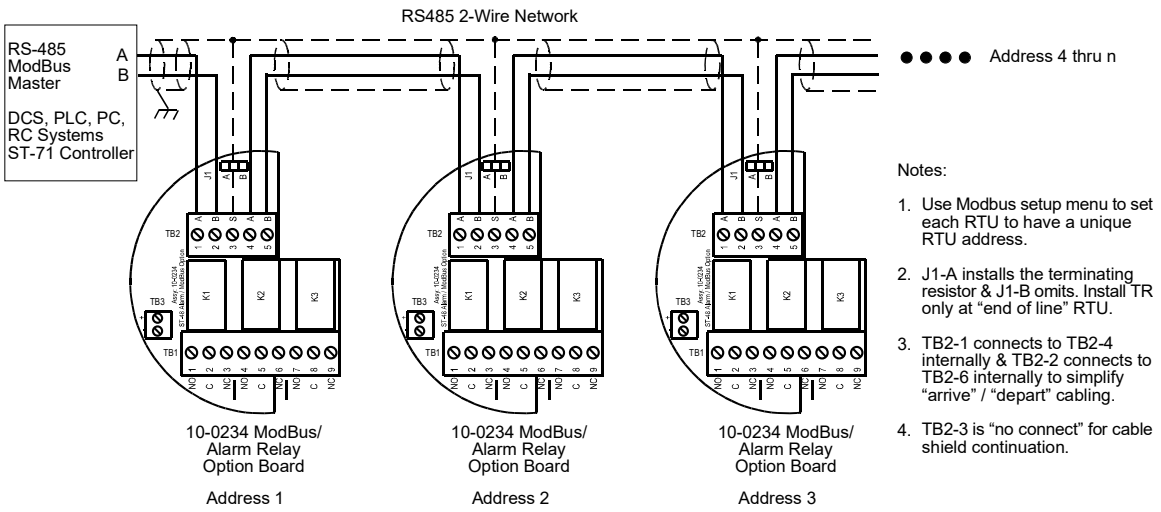


Figure 2-7: RS-485 Modbus Wiring

2.10 Isolated 4-20mA Output 10-0250 Option

Description:
The optional 10-0250 Isolated 4-20mA option (Figure 2-8) 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 10-0232 Display Assembly (Figure 2-3). Addition of this option requires 4-wire mode 4-20mA operation and thereby requires the I/O Power Supply board (Figure 2-5).

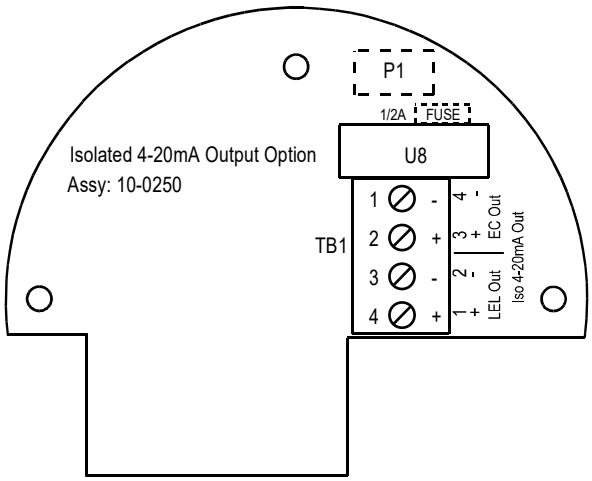


Figure 2-8: 10-0250 Isolated 4-20mA Output Option

2.11 Sensor Installation (with Smart / Simple Sensor Definition)

Many manufacturers offer industry standard electrochemical and catalytic bead sensors for toxic / oxygen and LEL combustible gas detection. These are referred to as ***Simple*** sensors in this manual. The GASMAX design accommodates users wishing to continue use of their existing simple sensors by accepting electrochemical types into TB2 of the 10-0232 Display Assembly or catalytic bead types into TB1 of the 10-0233 I/O Power Supply (mounted to the bottom of the enclosure). The GASMAX *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 GASMAX factory supplied Smart sensors allowing

them to contain the entire database of GASMAX parameters onboard the replaceable Smart Sensor assembly (Figure 2-9). This unique ***Smart Sensor Interface*** may be used to configure smart sensors and / or GASMAX's from a PC rather than entering all variables via the magnetic keypad.

Electrochemical and catalytic bead smart sensors both plug into the 10-0247 ***Smart Sensor Head*** that connects to GASMAX electronics with its 8-conductor Smart Sensor Interface cable (Figure 2-9).
CAUTION: 10-0247 Smart sensor heads with electrochemical toxic / oxygen sensors must connect to S1 located on the back of the 10-0232 Display Assembly (Figure 2-4). 10-0247 Smart sensor heads with catalytic bead combustible sensors must connect to S1 located on the optional I/O PCB assembly (Figure 2-5).

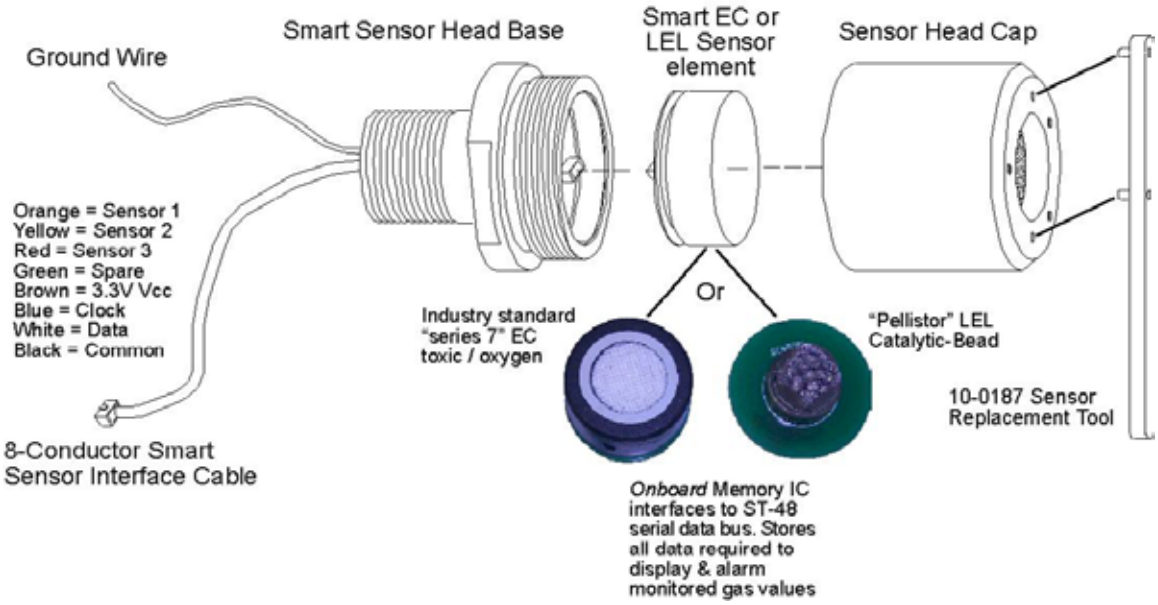


Figure 2-9: 10-0247 Smart Sensor Head Assembly

Smart Sensors are automatically recognized by the GASMAX. The Smart Sensor identification screen in Figure 2-10 is shown after power-up, upon installation of a new smart sensor or by viewing INPUT type in the SENSOR SETTINGS / INFO menu (section 5-5).

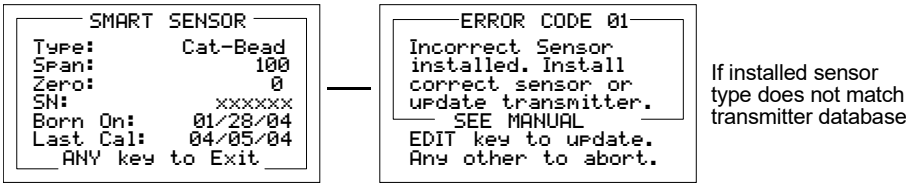


Figure 2-10: Smart Sensor Info / ERROR Screens

2.11 "Sensor Type" and GASMAX 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 2-11 illustrates how GASMAX'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.

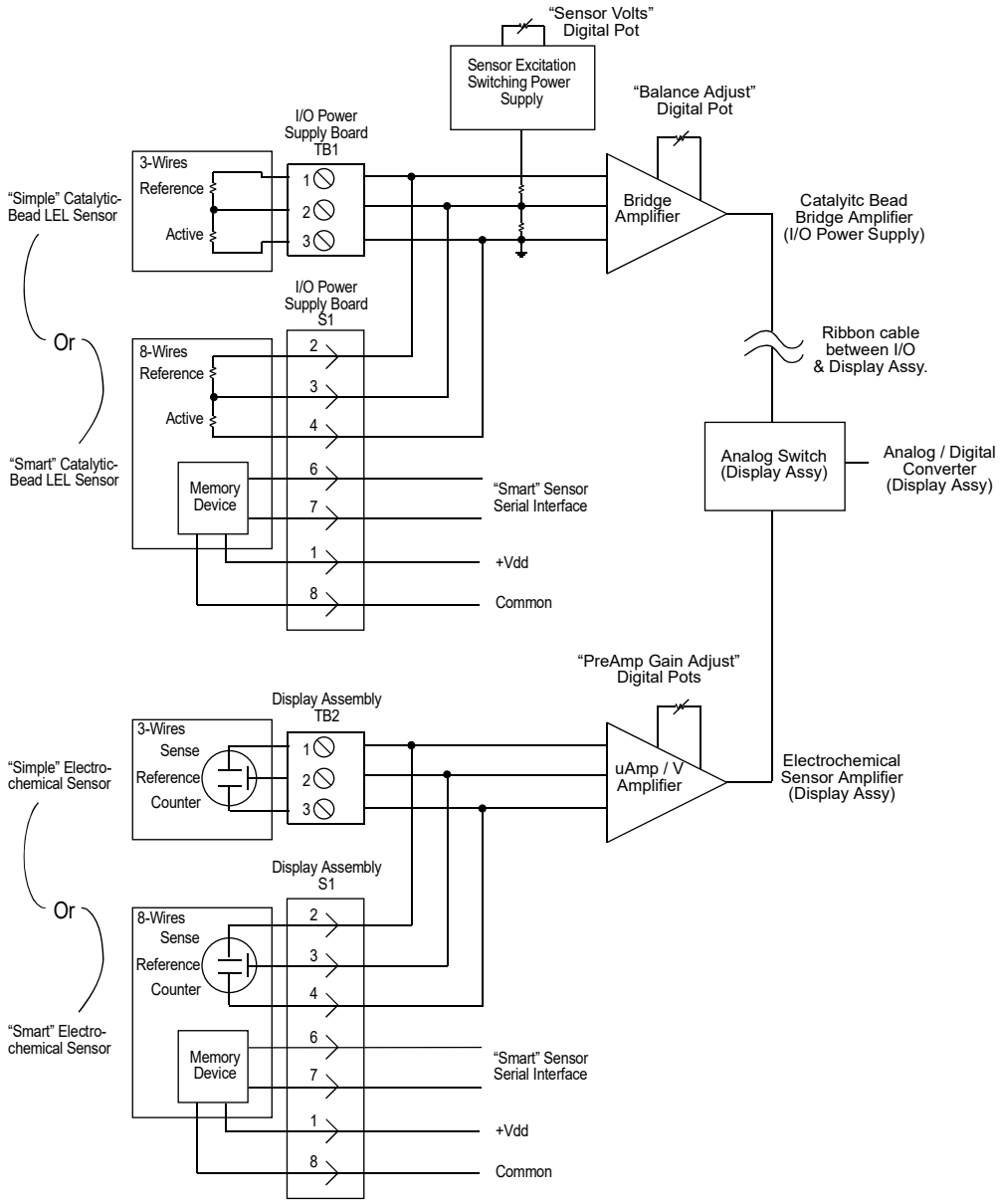


Figure 2-11: GASMAX Block / Wiring Diagram

SECTION 3 – INITIAL START-UP

3.1 "Transmitter Configuration" Menu

Figure 3-1shows the GASMAX 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).

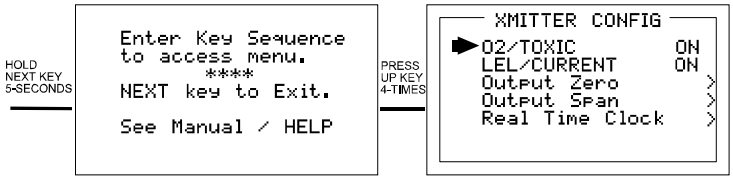


Figure 3-1: Transmitter Configuration Menu

3.1.1 Single / Dual Gas Monitor Configuration

GASMAXEC's are 2-wire 4-20mA devices and support only one electrochemical sensor. Addition of the 10-0233 Power Supply board (GASMAXLEL) 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 GASMAX 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.

3.1.2 Output Zero / Output Span Trims (Factory Preset, Technicians only!):

The **Output Zero Trim / Output Span Trim** entries are digital to analog (D2A) values that determine the GASMAX's final 4-20mA output. Their purpose is to provide precise GASMAX 4mA and 20mA outputs. To trim these values, attach a precision milliamp meter to the GASMAX 4-20mA output being used. Enter the correct OUTPUT ZERO TRIM menu shown in Figure 3-2. Use the UP/DOWN keys to trim the milliamp value to 4.00mA. Next, enter the correct OUTPUT SPAN TRIM menu and use the UP/DOWN keys to trim the milliamp value to 20.00mA. Press the NEXT key to exit this menu. The GASMAX stores these new D2A values and uses them as the 0 & 100% of full-scale endpoints.

WARNING: Target gas monitoring and alarm processing are halted during these adjustments.

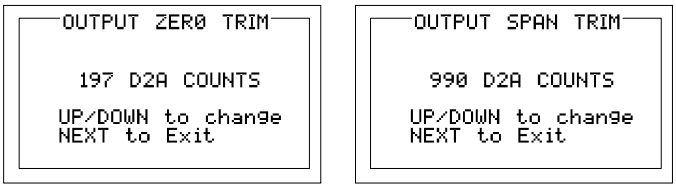


Figure 3-2: Output ZERO / SPAN Trim Menus

3.2 Initial Catalytic Bead LEL Monitor Start-Up

GASMAX LEL Monitors that are factory equipped with a local Simple or Smart Catalytic Bead LEL sensor rarely require adjustments, other than routine calibrations, to provide accurate LEL 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 configuration by users in order to best serve their application.

3.2.1 Initial Catalytic Bead LEL Monitor "Sensor Volts" Check

CAUTION: Sensor Volts in excess of the rated values may destroy catalytic bead sensors. GASMAX sensors are rated for 2 volts.

Section 6.2 describes reading and setting "sensor volts" using the GASMAX LCD. The voltage displayed on the LCD is monitored across TB1-REF and TB1-ACT on the GASMAX Power Supply board (Figure 2.4) 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 GASMAX 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 GASMAX 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.

3.2.2 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 GASMAX. Section 6.2 describes using the LCD to read and adjust BALANCE settings. Correct BALANCE setting should be confirmed after start-up for locally and remotely mounted catalytic bead sensors.

3.2.3 Initial Catalytic Bead LEL Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 4.1, 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 4.1. Section 6.4 describes PREAMP GAIN adjustments that may be required if full-scale ranges are changed.

3.3 Initial Toxic / Oxygen Monitor Start-Up

GASMAX Toxic / Oxygen Monitors, 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.

3.3.1 Initial Toxic / Oxygen Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 4.1, 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 4.1. Section 6.4 describes PREAMP GAIN adjustments that may be required if full-scale ranges are changed.

SECTION 4 – OPERATING INSTRUCTIONS

4.1 Routine Sensor Calibrations

Calibration is the most important function for insuring correct operation of the GASMAX. The CAL MODE (flow chart shown in Figure 4-2) 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 GASMAX alarm relays (if equipped) are inhibited during CAL MODE. CAL MODE automatically exits if no keystrokes are detected after 5 minutes.

Follow these GASMAX calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy. GDS Corp. recommends calibration gases with NIST (National Institute of Standards and Technology) traceable accuracy to increase the validity of the calibration.
- 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. (GDS Corp. 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.

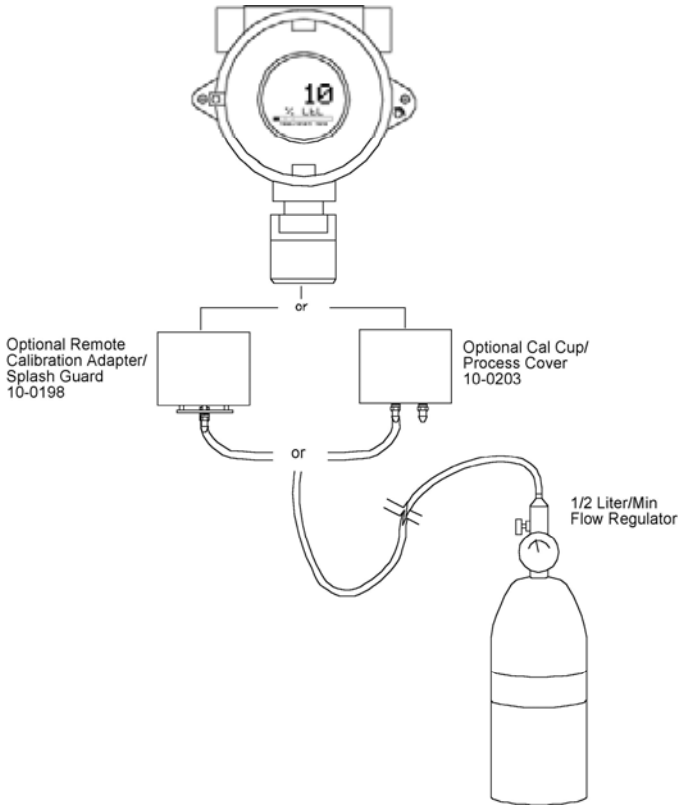


Figure 4-1: Calibration Gas Input

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

1. To enter the CAL MODE from either data display, press the DOWN / CAL key and within 5 seconds press the EDIT key.
2. Using the Cal-Cup, 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 GASMAX 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 3.4).
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 4-2 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 5-5).

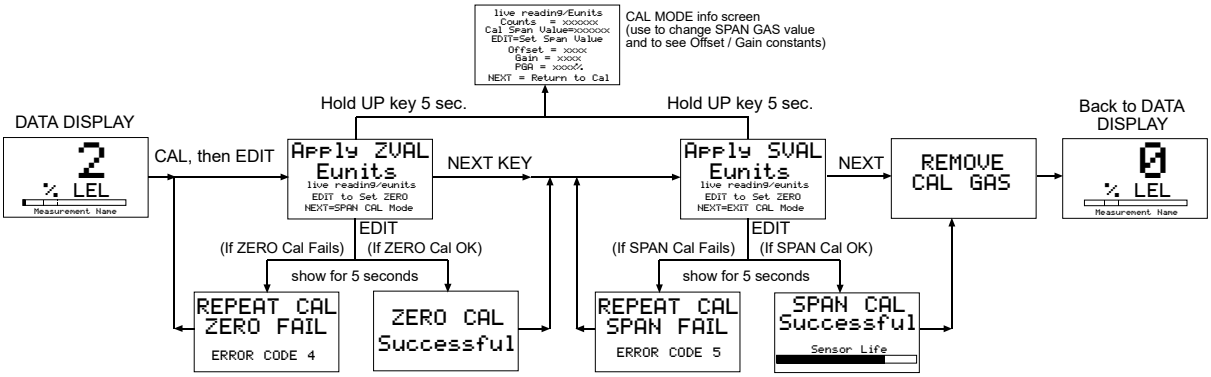


Figure 4-2: Cal-Mode Flow Chart and Menus

4.2 ALARM OPERATION

GASMAX's have front panel LED indicators for Alarm 1, Alarm 2 and Alarm 3. An optional 10-0234 Relay/Modbus board adds K1, K2 & K3 relays for these alarms.
CAUTION: GASMAX Alarm LED indicators function even without the presence of the 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.

4.2.1 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.

SECTION 5 – SETUP MENU CONFIGURATION

5.1 Menus Database Configuration

All GASMAX 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. GASMAX 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, GASMAX's or GASMAX *Educators* to be configured from a PC's USB port. This is useful when GASMAX's are not yet installed or if a portable computer may be carried to each unit. The *Educator* allows configuring up to six GASMAX's at the PC and transporting their configuration data to each location. This is useful when numerous installed units must be configured.

The GASMAX's configuration menus are shown in Figure 5-1.

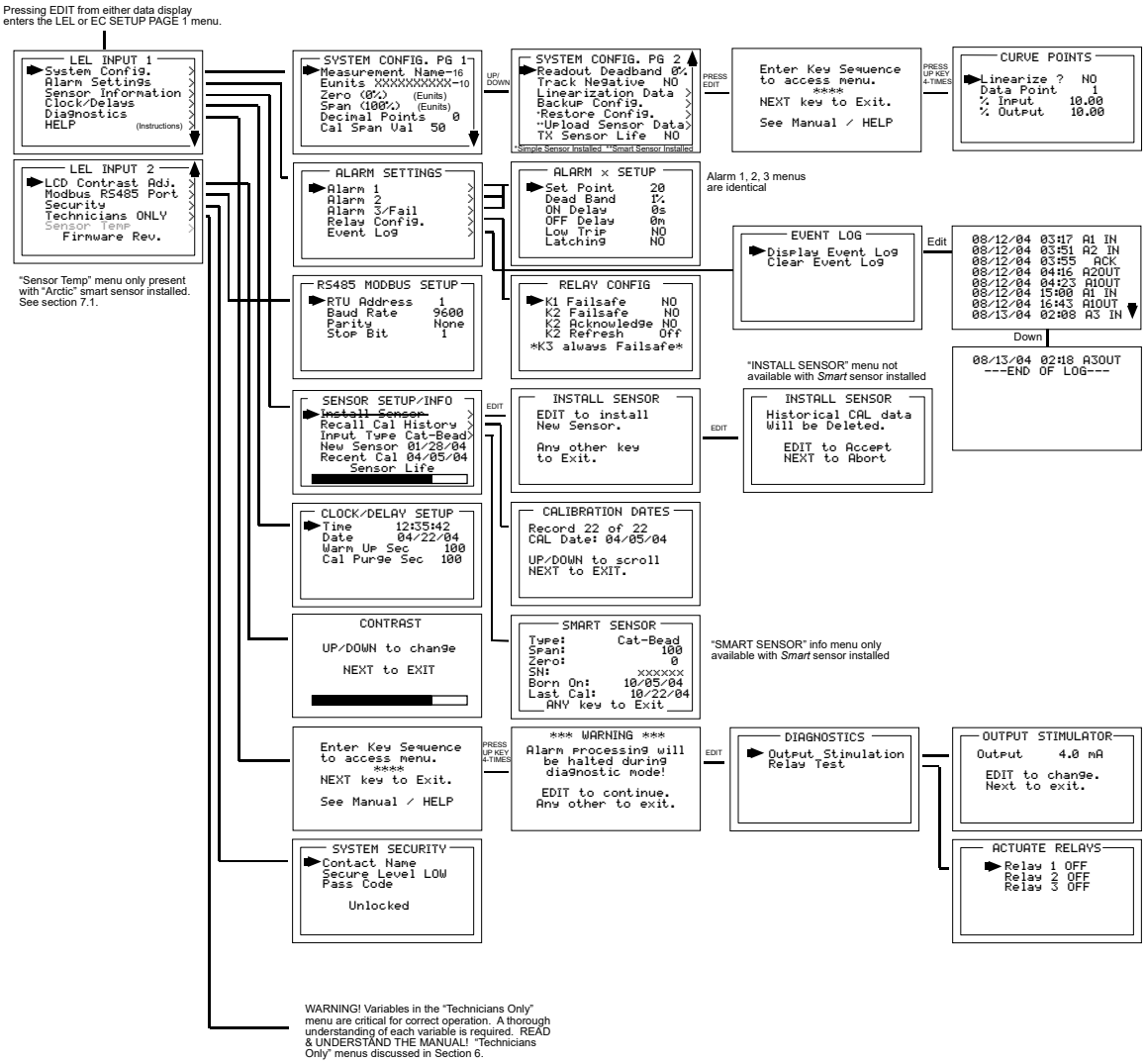
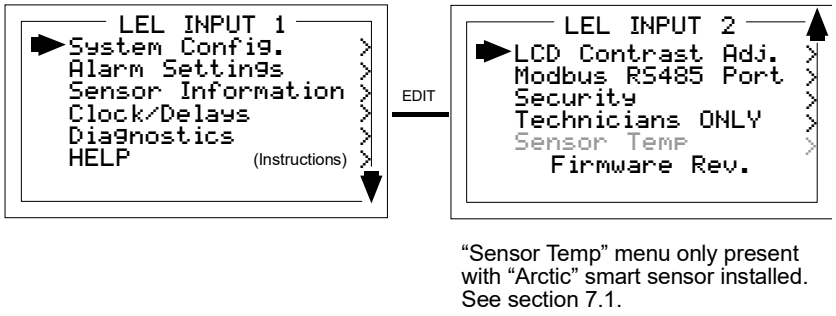


Figure 5-1: Configuration Menu Tree

5.2 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 5-2. 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.

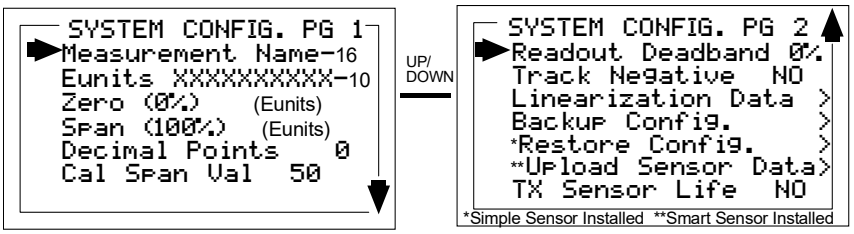


"Sensor Temp" menu only present with "Arctic" smart sensor installed. See section 7.1.

Figure 5-2: Setup Menu Entry

5.3 System Configuration Menus:

The **System Config**. group consists of two pages of menus as shown in Figure 5-3. Each item's description follows in this section.



*"Restore" available only without smart sensor installed.

**"Upload" available only with smart sensor installed.

Figure 5-3: 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 5-2.

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

Span (100%) defines the reading to be displayed when 20mA (100%) is the GASMAX 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 GASMAX (Figure 5-4). 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.

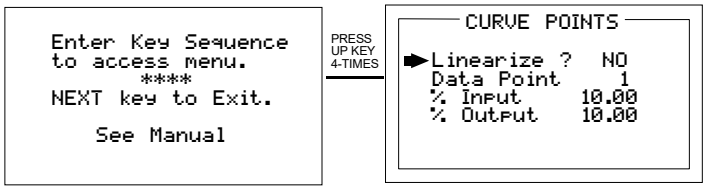


Figure 5-4: Linearization Menu

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

Restore Config. restores the GASMAX menu database to the values from the most recent Backup Config. This menu item is only available if a smart sensor is not installed. 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 GASMAX from the smart sensor.

TX Sensor Life set for YES, causes the GASMAX 4-20mA output to transmit a sensor life value after successful calibrations during the CAL PURGE delay (see section 4.1). Normal operation is the GASMAX transmits 4mA during the CAL PURGE delay. But with ***TX Sensor Life*** = **YES** it transmits 4mA for the first 10-seconds, then for 5-seconds transmits a value between 4mA and 5mA, with 4mA equal to 0% sensor life and 5mA equal to 100% sensor life (see Figure 5-5). The output then returns to 4mA for the remainder of the CAL PURGE delay. For example, if after a calibration sensor life is 75%, the GASMAX transmits 4.75mA during the 5-second interval.
Note: ***TX Sensor Life*** should always be set for NO unless the 4-20mA receiver is capable of interpreting the sensor life signal. The GDS Corp. C1 Controller is capable of this function.

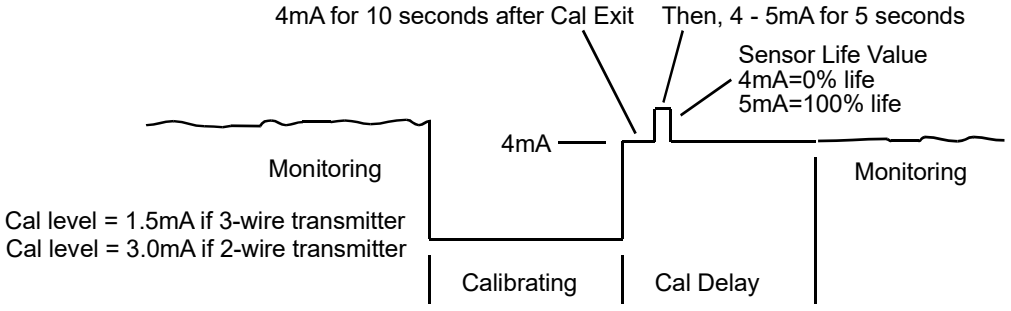


Figure 5-5: Transmit Sensor Life Timing Diagram

5.4 Alarm Settings:

The **Alarm Settings** page has the **Alarm 1, 2, 3 Setups, Relays** and **Event Log** submenus shown in Figure 5-6. 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 10-0234 Relay / Modbus option installed.

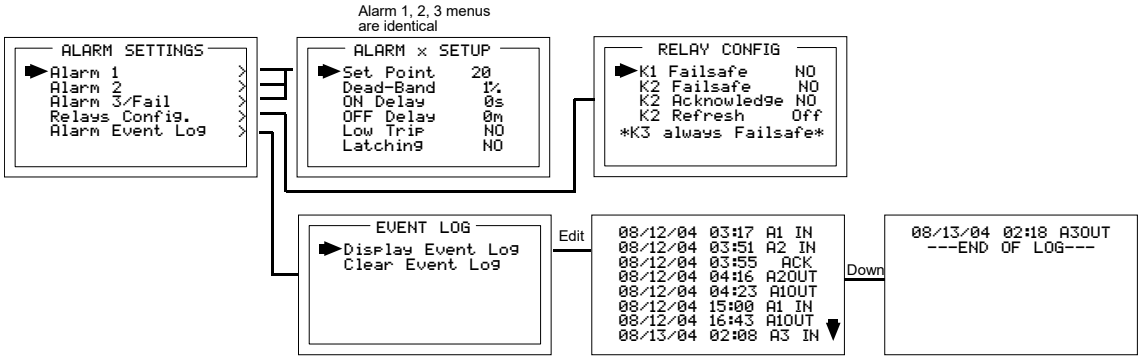


Figure 5-6: Alarm Settings Menus

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.

5.4.1 Relay Configuration (if equipped):

Relay Config has the submenu shown in Figure 5-7. The optional relay PCB must be installed to access this menu or a "HARDWARE NOT PRESENT" message appears.

Figure 5-7: 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 GASMAX 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.

5.5 Sensor Information:

Sensor Information has the **SENSOR SETUP/INFO** menus shown in Figure 5-8

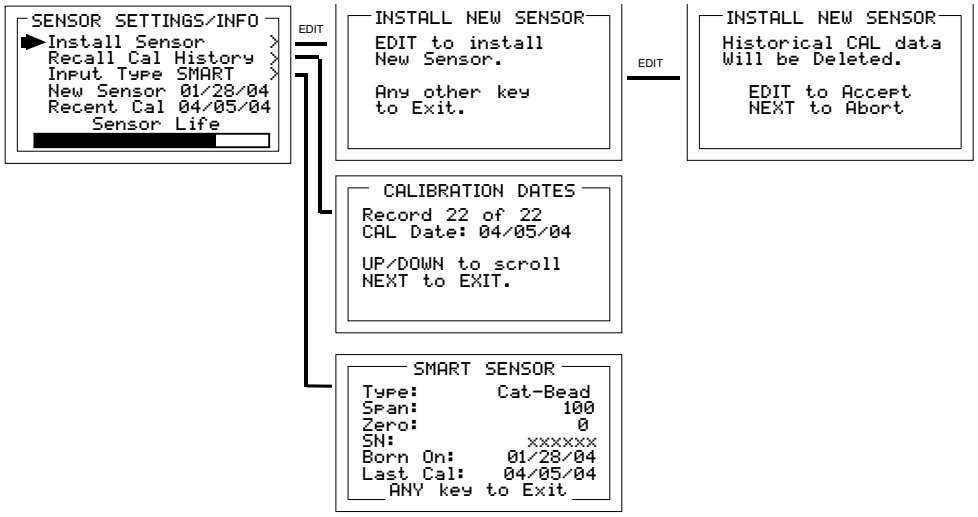


Figure 5-8: Sensor Information Menus

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 GASMAX *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 GASMAX 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, 4-20mA and Smart. Smart sensors upload sensor type and other data to the GASMAX 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.

5.6 CLOCK/DELAY SETUP:

Since the GASMAX 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 3.3.

Warm Up and **Cal Purge** time delays are also available to prevent unwanted alarm trips. Figure 5-9 shows the menu for these items.

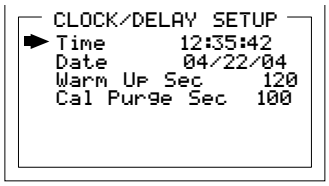


Figure 5-9: Clock & Calendar / Delay Timer Menu

5.7 LCD Contrast Adj:

LCD Contrast Adj. may be set for optimum viewing using the menu shown in Figure 5-10.

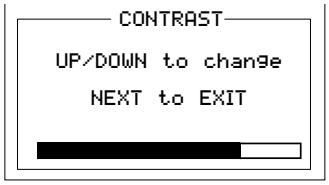


Figure 5-10: LCD Contrast Adjust Menu

5.8 HELP Screen:

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

5.9 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 GASMAX'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.

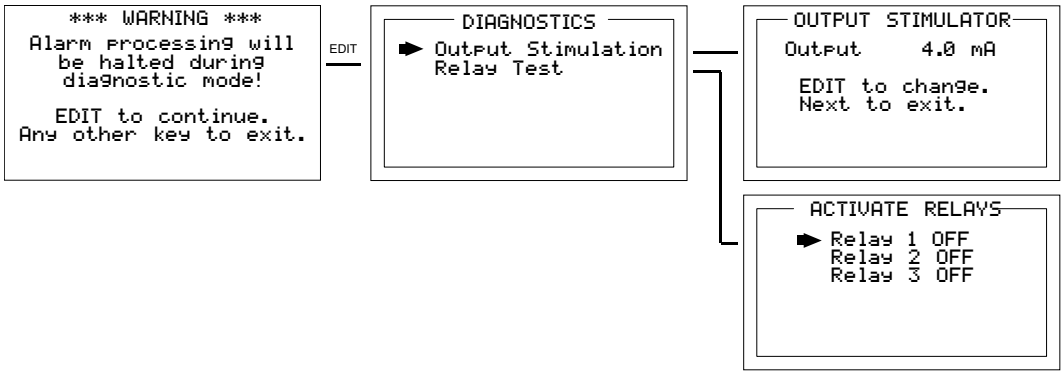


Figure 5-11: Diagnostics Menus

5.10 RS-485 / MODBUS SETUP:

The **RS-485 MODBUS SETUP** menu allows setting the RTU address (if RS-485 equipped) for each GASMAX on the RS-485 network. Each GASMAX 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,1.

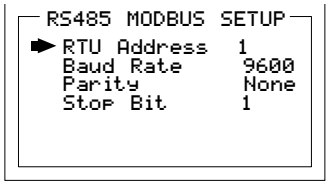


Figure 5-12: Modbus RS-485 Setup Menu

5.10.1 MODBUS REGISTER AND FUNCTION CODE SUMMARY

The following table identifies GASMAX Modbus register locations and function codes. "Chan 1" designations represent the EC channel while "Chan 2" represent the LEL / 4-20mA Input channel.

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
Chan 1 Cal Mode	2010	2	NA
Chan 2 Cal Mode	2011	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:			
D2A Raw Chan 1	31001	4	NA
D2A Raw Chan 2	31002	4	NA

Calibrated 10 bit value representing the D2A value of 0 to 1023 for -25 to 105 %FS (200=0% & 1000=100%).

IMPORTANT: READ REGISTERS 31001 / 31002 TO CREATE READINGS THAT MATCH GASMAX DISPLAY VALUES! THESE SHOULD ALSO BE READ BY C1 MODBUS MASTERS.

A2D Raw Chan 1	31003	4	NA
A2D Raw Chan 2	31004	4	NA

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

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
TRANSMIT SENSOR LIFE ENABLED	BIT12

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_STATUS	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
MARKER Tx LED	BIT3
K1_FAILSAFE	BIT12
K2_FAILSAFE	BIT13
K2_ACK	BIT14
LOCK	BIT15

Chan 1 Sensor Life	31009	4	NA
Chan 2 Sensor Life	31010	4	NA

(16 bit signed integer ranging from –1 to 100 where -1 indicates Cal Required)

Chan 1 Sensor Temperature	31011	4	NA
Chan 2 Sensor Temperature	31012	4	NA

(16 bit integer ranging from 1 to 4095 scaled for –55 to +125 degrees C)

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.

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

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.

5.11 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.

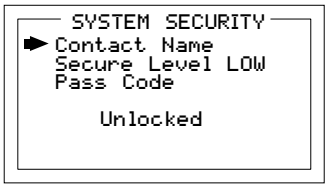


Figure 5-13: System Security Menu

SECTION 6 – TECHNICIANS ONLY MENUS

6.1 Introduction:

WARNING! Users of these menus must have a detailed understanding of their functions. While editing, monitoring of target gases, processing of alarms, 4-20mA output values and Modbus RS-485 communications should not be relied upon! Back-up the current configuration prior to altering any Technical menus in case Restore is required later (see section 5-3).

The **TECHNICIAN ONLY** menu group contains items that are **factory configured** depending upon the type sensor and input connected to the GASMAX. They should not be tampered with after installation. If configured incorrectly, some items will prevent monitoring of target gases. **The Set Sensor Voltage** menu for setting the catalytic bead sensor excitation voltage could destroy the sensor. **Access requires a special key sequence of four consecutive UP keystrokes** to prevent accidental modification of critical items.

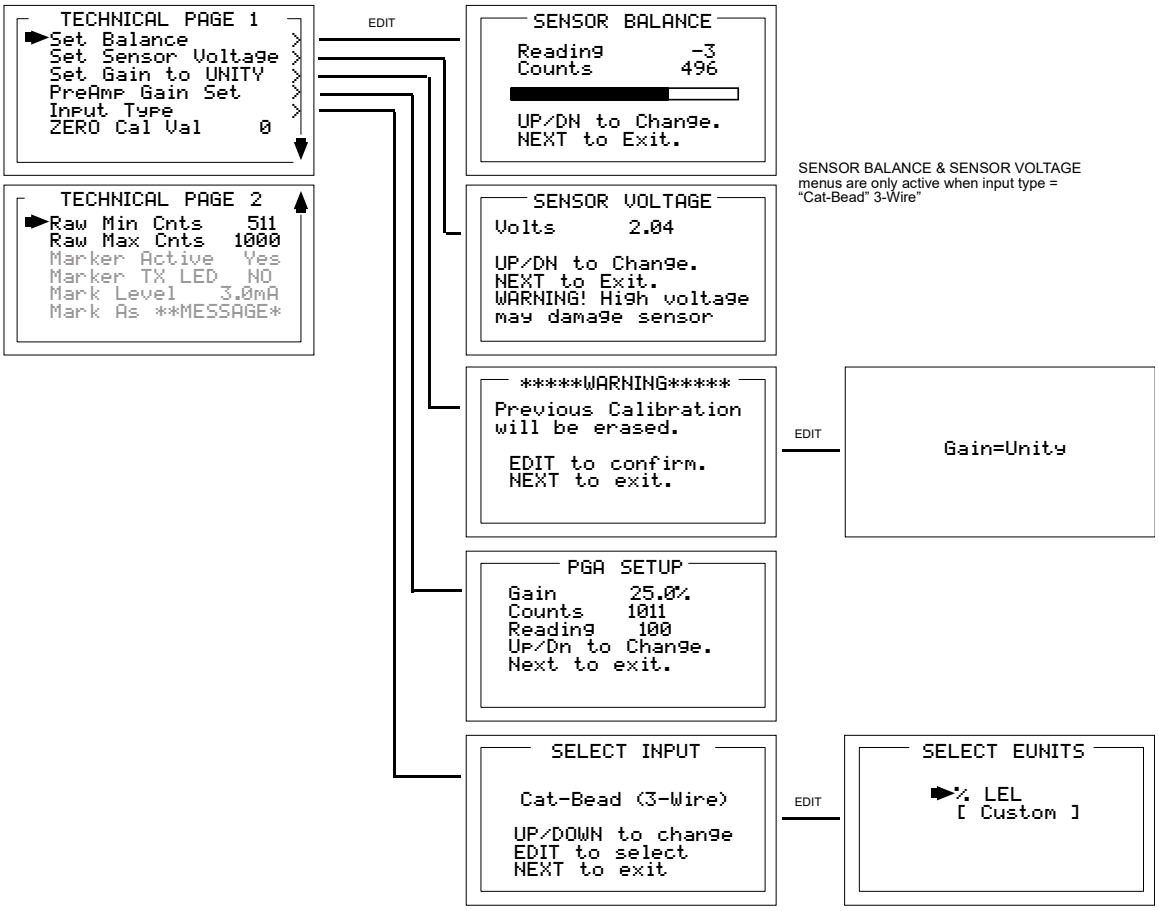


Figure 6-1: Technicians Menu Tree

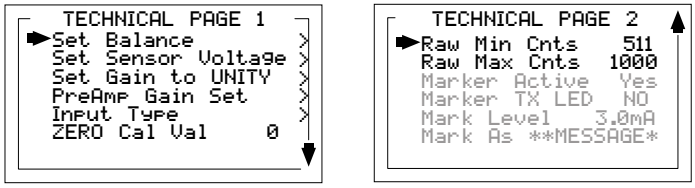


Figure 6-2: Technicians Menu Entry

6.2 Set Balance / Set Sensor Voltage (Technicians only!):

Set Balance and **Set Sensor Voltage** are used when **Input Type** is for *Catalytic Bead LEL* sensors. They are **factory configured** and only require field adjustment if the catalytic bead sensor is mounted remote from the GASMAX or if a new sensor is installed. Other input type entries draw a line through these menus and they are inactive. GASMAX catalytic bead sensors require 2.0 volts excitation voltage ***at the sensor***. This means if the sensor is mounted a long distance away the voltage at the GASMAX may have to be higher than two volts to compensate for losses in field wiring. Be careful not to exceed 2.0 volts at the sensor's A and R terminals.

Set Balance allows balancing of the catalytic bead sensor and must only be performed with ZERO gas on the sensor (Figure XXXX). Balance is similar to a very coarse ZERO calibration and does not need to be precise since subsequent calibrations will correct for small errors. ZERO gas applied to the sensor should provide a Reading of –3 to +3 on the SENSOR BALANCE menu.

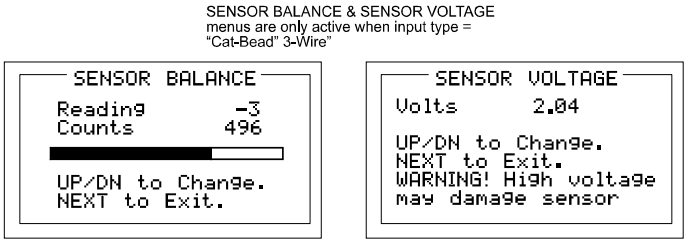


Figure 6-3: Catalytic Bead BALANCE & SENSOR VOLTS Adjust Menus

6.3 Set Gain to Unity (Technicians only!):

Set Gain to UNITY allows resetting previous calibration OFFSET to zero and GAIN to one. This is the definition of UNITY. A calibration should be performed after setting UNITY.

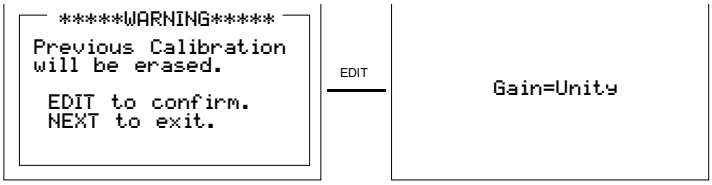


Figure 6-4: Set UNITY GAIN Menu

6.4 PreAmp Gain Adjust (Technicians only!):

Depending upon **Input Type**, GASMAX inputs range from a few micro amps to hundreds of micro amps. **PreAmp Gain Set** is the adjustment that matches the input signal range to the GASMAX input signal conditioning circuits. Altering the PreAmp Gain setting automatically resets previous calibration OFFSET & GAIN values to UNITY as described in section 6.3.

If it is determined the PreAmp Gain value is incorrect, apply the desired up-scale input and use the UP / DOWN keys to obtain the correct ***Reading*** value. ***Counts*** are the 10-bit binary A/D value with an active range value of 0 - 1023.
CAUTION: For standard installations, this is a factory adjustment. Do not use the **PreAmp Gain Set** menu for calibrating sensors. It should only be adjusted if a new measurement gas or input range is required.

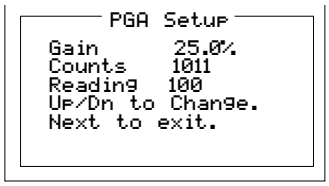


Figure 6-5: PreAmp Gain Adjust (PGA) Menu

6.5 Simple Sensor Input Type (Technicians only!):

Smart sensors automatically configure **Input Type.** *Simple* inputs must be configured manually using the **Input Type** menu. **Input Type** configures GASMAX hardware to accept catalytic-bead sensors, positive coefficient electrochemical sensors, negative coefficient electrochemical sensors or 4-20 mA inputs. Catalytic-bead and 4-20mA inputs require 3-wire operation and the 10-0233 I/O Power Supply. **Note:** Additional factory installed solder-bridge modifications are required for 4-20mA inputs – see Addendum 2. Positive / Negative coefficient electrochemical sensors have several gas types available within each group (see table below). Biased EC sensors require factory installed solder bridge SB1 on the Display Assy PCB - see Addendum 3.

After selecting **Input Type**, a **SELECT EUNITS** screen indicates the default engineering units for this sensor. These EUNITS may be accepted by pressing the EDIT key, or changed by moving the pointer to [Custom] and editing as described in *Configuration Using the Magnetic Wand* in section 5-2.

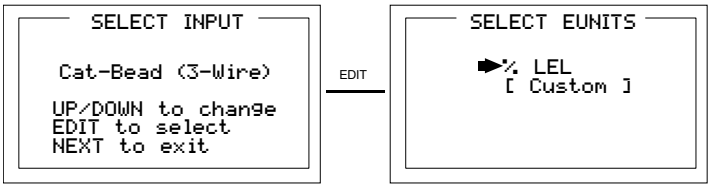


Figure 6-6: Input Type Selection Menu

Coefficient	Electrochemical Sensor Type	Default EUNITS
Negative	Hydrogen Sulfide	ppm H2S
Negative	Oxygen	% Oxygen
Negative	Carbon Monoxide	ppm CO
Negative, Bias	Ammonia	ppm NH3
Negative, Bias	Nitric Oxide	ppm NO
Negative	Ethylene Oxide	ppm Eth O2
Negative	Hydrogen Chloride	ppm HCL
Negative	Hydrazine	ppm N2H4
Negative	Arsine	ppm Arsine
Negative	Sulfur Dioxide	ppm SO2
Negative	Hydrogen	ppm H2
Negative	Hydrogen Cyanide	ppm HCN
Negative	Phosgene	ppm COCl2
Negative	Phosphine	ppm PH3
Negative	Hydrogen Fluoride	ppm HF
Positive	Nitrogen Dioxide	ppm NO2
Positive	Ozone	ppm Ozone
Positive	Chlorine	ppm Cl2

6.6 Zero Cal Value (Technicians only!):

The **Zero Cal Value** menu entry allows the zero calibration value to be set for something other than a zero reading. For example, a GASMAX 4-20mA input may represent a BTU Analyzer range of 500 – 1000 BTU's. In this case, 0% of full scale equals 500 BTU's and may be the desired zero calibration point. Other upscale values may also be used for the zero calibration point by setting this menu item to the desired engineering unit value. Do not exceed 25% of full scale.

6.7 Raw Min / Max Counts (Technicians only!):

The **Raw Min / Max Counts** menus determine the range of 10-bit analog to digital (A/D) converter counts that define 0 & 100% of full scale. Raw Min A/D counts create 0% readings and Raw Max A/D counts create 100% readings. These menus are very useful in application with non-standard input ranges. For example, if instead of a standard 4-20mA input 8-18mA must be accepted by the GASMAX. Set RAW MIN COUNTS to match the 8mA input counts value and RAW MAX COUNTS to match the 18mA input counts value. The corresponding **Zero 0%** and

Span 100% readings are entered in the Configuration Menu describe in section 5.3. Live A/D count values may be viewed from the CAL MODE Information screen described section 4.1.

6.8 4-20mA Input Marker / Message (Technicians only!):

See section 7.3.1 for description of the 4-20mA Input Marker / Message menus. This feature is only available with GASMAX II 4-20mA input models.

SECTION 7 – SPECIAL ORDER CONFIGURATIONS

7.1 ARCTIC Option

GASMAX II 3-wire models may be ordered with a special *ARCTIC* configuration to include a 175 ohm 4-watt heater / temperature controller circuit mounted to the back of the 10-0233 Power Supply PCB (Figure 2-5). In addition, when equipped with a locally mounted 10-0247 Smart Sensor Head (Figure 2-9) ARCTIC Smart sensors are available with a 1-watt heater / temperature controller for warming the sensor compartment. This is important since many electrochemical sensors have a low temperature rating of only -20C. If incoming 10-30VDC power is at least 24VDC, the ARCTIC option extends GASMAX II operation down to -55C.

Important! ARCTIC GASMAX II consumes more power when it is cold! When temperature inside the GASMAX II enclosure is below -25C the 175 ohm 10-0233 PCB heater is connected across the incoming DC power terminals. When an ARCTIC Smart Sensor is installed, its 1-watt heater is connected across the GASMAX II's internal 5VDC power supply when Sensor Temp is below the Setpoint (see section 7.1.1). These additional loads must be considered when sizing the installation's DC power supply.

7.1.1 ARCTIC Smart Sensor Temperature Setpoint Option

Both the O2/TOXIC and LEL/Current channels (see section 3.1.1) are capable of accepting ARCTIC Smart Sensors with 1-watt heater / temperature controller circuits. ARCTIC sensor temperature controllers have a unique address that is automatically detected by the GASMAX II. This activates the **Sensor Temp** menu on page 2 of the channel's main menu as shown below in Figure 7-1. Selecting **Sensor Temp** and pressing EDIT opens a window displaying the sensor's current temperature and the 1-watt heater's **Setpoint**. When the **Sensor Temp** value is below the **Setpoint** value the heater is on. This feature is helpful in applications where the sensor temperature must be higher than the ambient temperature to function properly.

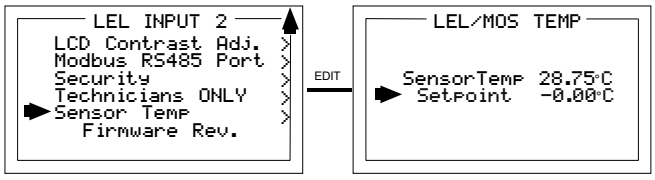


Figure 7-1: ARCTIC Sensor Temperature Menu

7.2 Special Order; 18VAC Primary Power Supply Option

A special revision of the GASMAX II I/O Power Supply is available for applications requiring 18VAC as primary power instead of the standard 10-30VDC (Order I/O Power Supply part # 10-0233-18VAC). 18VAC is applied to a bridge rectifier and filter capacitor to generate unregulated 24VDC.

The 10-0233-18VAC revision is also configured to accept 4-20mA inputs from 2 or 3-Wire 4-20mA Transmitters into terminals normally reserved for Catalytic Bead LEL Sensors. References to Catalytic Bead LEL sensors within the main body of this manual DO NOT APPLY TO THIS

REVISION. The 10-0232 Display Assembly is the standard revision and Smart or Simple electrochemical Toxic / Oxygen sensors may still be connected as described in this manual.

Figure 7-2 shows physical and electrical wiring diagrams.

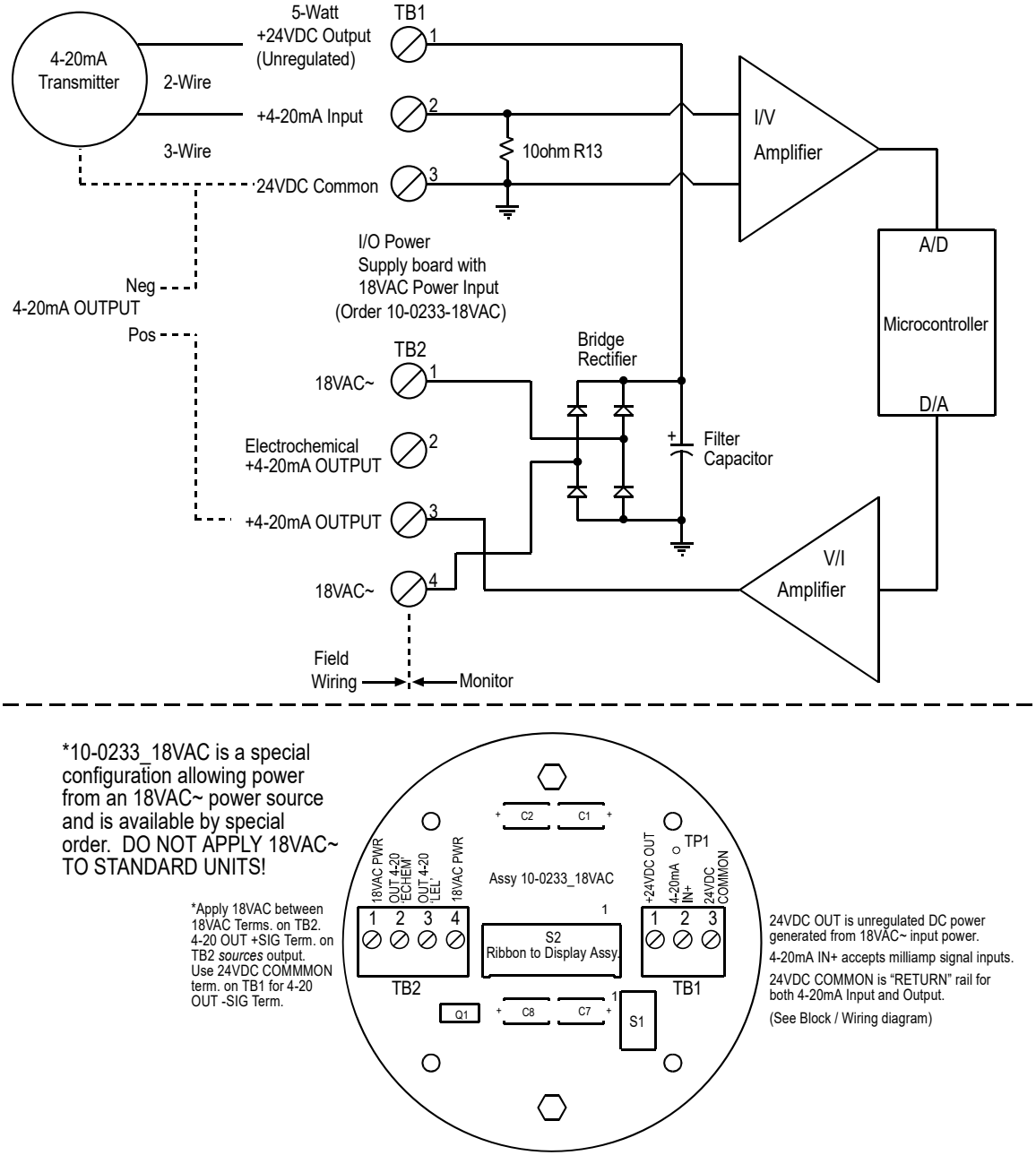


Figure 7-2: 10-00233-18VAC Block / Wiring Diagram

7.3 Special Order; 4-20mA Input to Catbead Channel

A special model GASMAX II is available for applications requiring a 4-20mA input (includes I/O Power Supply part # 10-0233-4-20mA). Solder bridges are factory installed to rewire TB1 to continue 24VDC power on to a 4-20mA transmitter as shown in Figure 7-3 below.

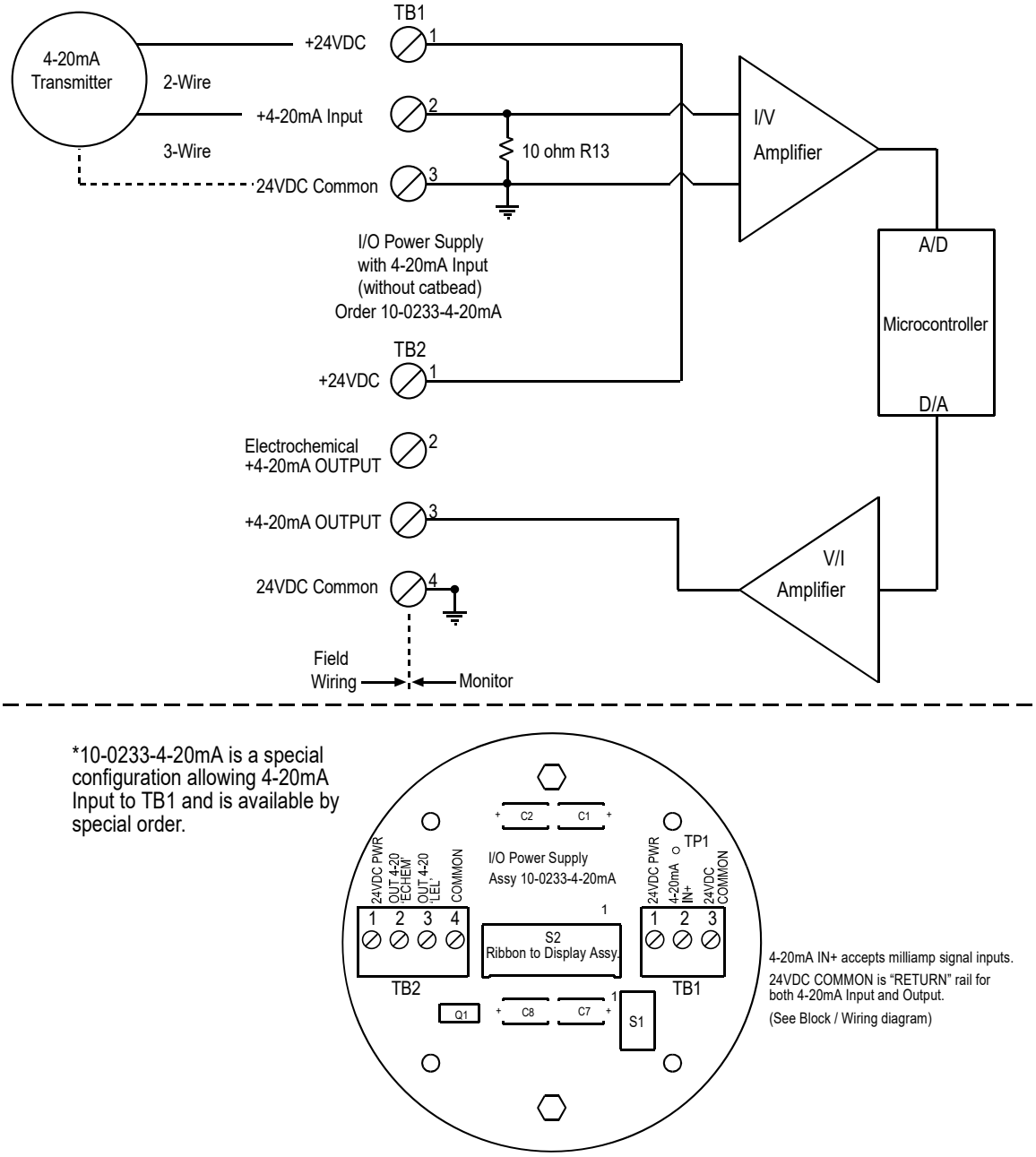


Figure 7-3: 10-00233-4-20mA Block / Wiring Diagram

7.3.1 4-20mA Input Marker / Message (Technicians only!):

Important: GASMAX II Input Marker menus are available only with special 4-20mA input configurations described in sections 7.2 and 7.3 of this manual and when the Input Type menu setting is *4-20mA (3-Wire)* (see section 6.5). Since FAULT alarms are also tripped in the <4mA region it is important to understand that the Marker events override the FAULT alarm (see section 5.4).

Some monitors indicate special modes of operation such as *Calibration* or *Maintenance* by transmitting a special <4mA **"Marker"** value. The GASMAX II offers 4-20mA input "Marker" menus, shown in Figure 7-4, for detecting inputs between 0 and 3.75mA that represent such events. Once detected, the GASMAX II transmits a constant mA output equal to the **Marker** value.

Entering **YES** in the **Marker Active** menu also activates **Marker TX LED**, **Mark Level**, and **Mark As** menus. **Mark Level** allows entering the <3.75mA value (±.2mA) to detect. **Mark As** allows entry of the up to 10 digit ASCII message the LCD readout will display when the **Marker** is detected. **Marker TX LED** menu = YES, causes the front panel TXD LED (see Figure 2-1) to also illuminate when the **Marker** is detected. **Important: Optional 10-0234 RS-485 modbus port will not function if "Marker TX LED" menu must = YES.**

Figure 7-4: 4-20mA Input "MARKER" Menus

A **Marker** application example is as follows: Many gas detection monitors transmit 1.5mA during their calibration mode. Configuring GASMAX II marker menus as shown in Figure 7-4 will provide the LCD readout in Figure 7-5 when 1.5mA is the 4-20mA input. In this example, the GASMAX II 4-20mA output will also transmit a 1.5mA marker signal.

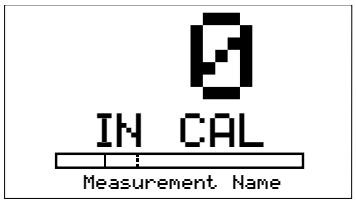


Figure 7-5: 4-20mA Input Type "MARKER" Message