



OPERATION & PARTS MANUAL

Gas Detection System

**Buckeye BFT-44
GDS GasMax II**

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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 manual is 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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NOTES

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.



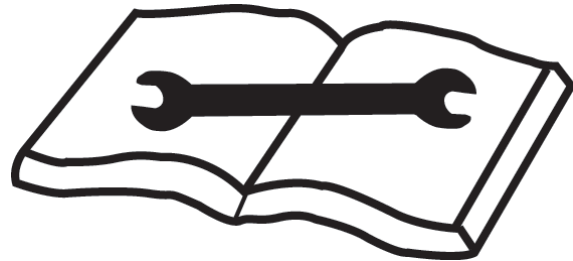
**ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!**

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.

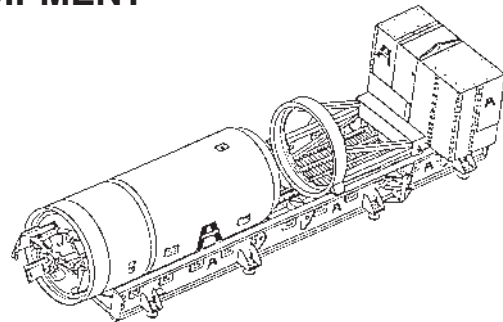
Keep personnel away from inside of yoke, on skid, or behind pump unit when jacking or moving pump unit or yoke. Failure to do so could result in serious personal injury or death.



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.

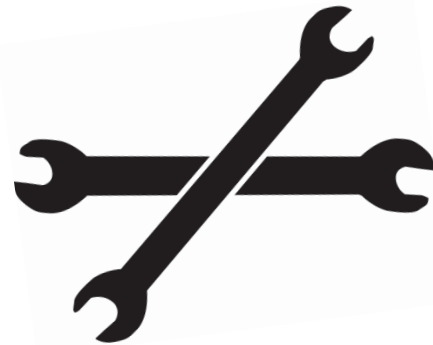
LOCKOUT power before performing any maintenance, adjustments, or removing obstructions.

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.

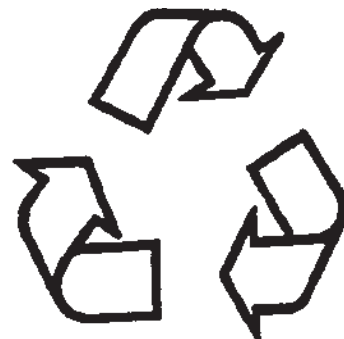
Replace worn or damaged parts. Remove grease, oil, or debris buildup.



RECYCLE WASTE

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

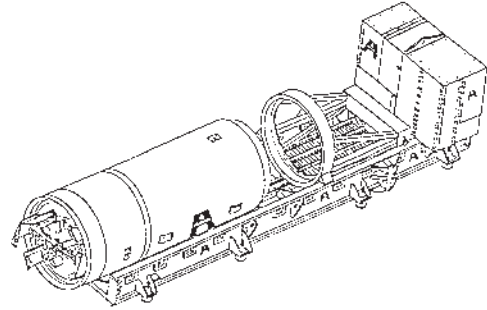
Use leakproof containers when draining fluids/oil. Do not pour waste on the ground, down a drain, or into any water source.



NO RIDERS ON EQUIPMENT

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

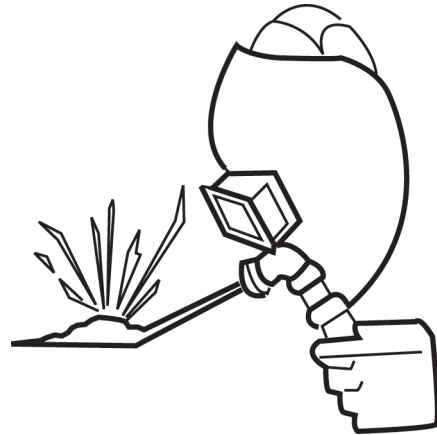
Do not allow riders on the equipment when they are moving.



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.

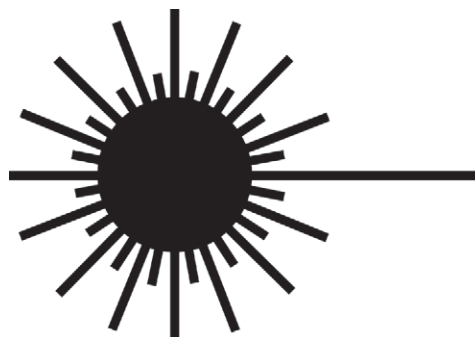


AVOID LASER LIGHT EXPOSURE

⚠ 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.

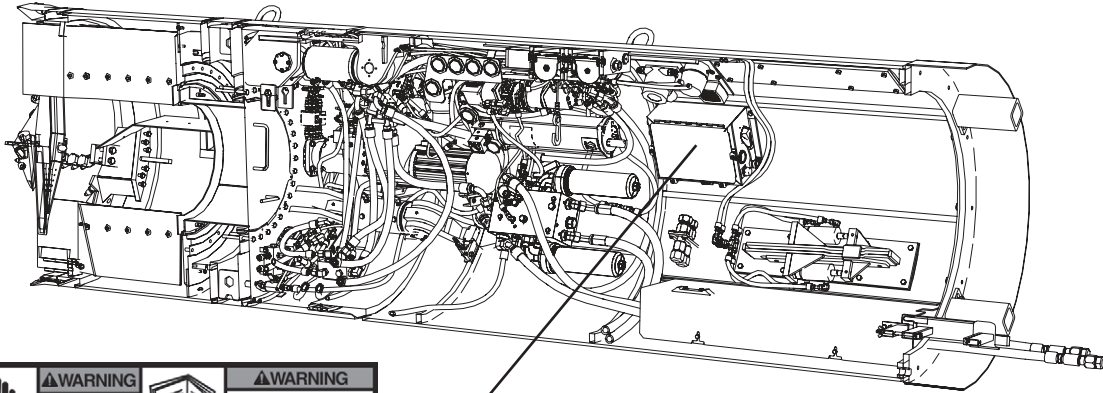




Decals

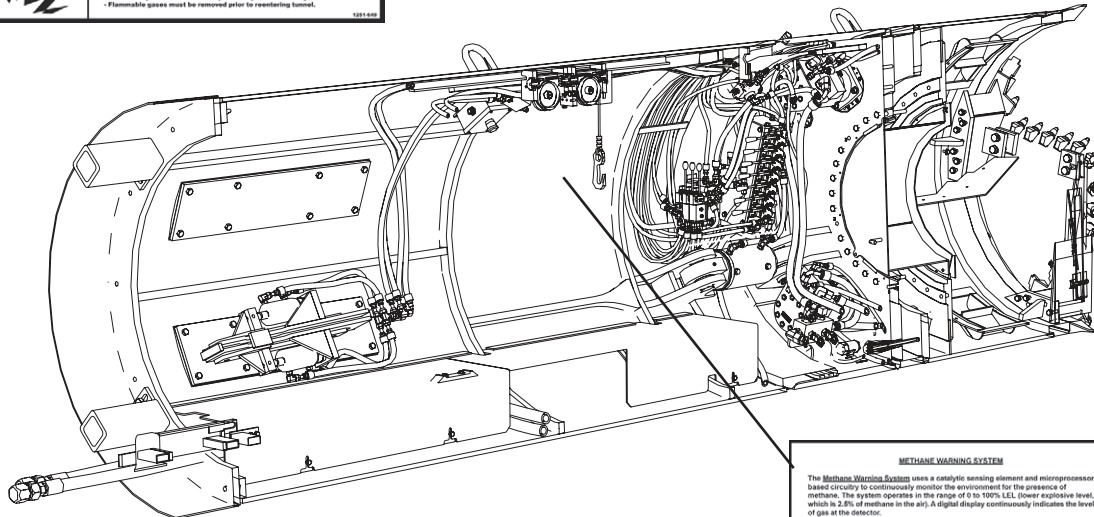
Keep all decals clean and readable. Use soft cloth, water, and a mild soap to clean the decals if they are too dirty to read. DO NOT clean decals with solvent. Solvent can damage them. Replace safety decals immediately if they are damaged, missing, or hard to read.

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.



	WARNING HIGH VOLTAGE TURN OFF POWER AT SOURCE BEFORE SERVICING.		WARNING SHARP OPERATION OR MAINTENANCE CAN CAUSE SEVERE INJURY OR DEATH. DO NOT OPERATE OR WORK ON THIS EQUIPMENT UNLESS YOU HAVE READ AND UNDERSTAND THE OPERATORS MANUAL. ALL DECALS AND SAFETY EQUIPMENT MUST BE IN PLACE PRIOR TO OPERATION.
NOTICE			
<p>This electrical system includes an integral gas detection system and up to two 24 VDC work lights.</p> <p>The gas detection system provides visual and audible alarms when the LEL (Lower Explosion Limit) exceeds the 25% level.</p>		<p>The gas detection system does not monitor oxygen levels.</p> <p>Additional copies of operation and maintenance manuals for electrical system are available from Akkerman, or can be downloaded from Akkerman's web site, at www.akkerman.com.</p>	
<p>DANGER</p> <p>Some conditions will cause accumulation of flammable gases. Accumulation of flammable gases may cause explosion or fire, with resulting serious injury or death.</p> <p>Flammable gas levels must be continuously monitored with an on-board gas detection system.</p> <p>Flammable gas levels must be checked with portable, contractor approved, gas detector prior to entering on-board gas detection system. Electrical system is not explosion proof.</p> <p>On-board gas detection system must be maintained in operational order and continuously monitored per operation and maintenance manual.</p> <p>If on-board gas detection system activates alarms, tunnel must be evacuated immediately and electrical and hydraulic systems de-energized at the source.</p> <p>Flammable gases must be removed prior to reentering tunnel.</p>			



METHANE WARNING SYSTEM

The Methane Warning System uses a catalytic sensing element and microprocessor based circuitry to continuously monitor the environment for the presence of methane. The system operates in the range of 0 to 100% LEL (Lower explosive level, which is 2.1% of methane in the air). A digital display continuously indicates the level of gas at the detector.

The system has independently adjustable Low and High alarm set points. The corresponding LOW and HIGH LEDs are illuminated and the alarm relays are energized when the gas concentration exceeds the set points. The Low alarm set point is adjusted to 25% LEL, the High alarm set point is adjusted to 80% LEL.

LOW ALARM: The Normally Open Low Alarm Relay activates the warning devices (Horn and Warning Light), when activated at the 25% LEL.

FAULT ALARM: Fault detection circuitry continuously monitors the sensing element and microprocessor based circuitry for proper operation. If a malfunction is detected, the corresponding FAULT LED is illuminated and Fault Relay activates the warning devices (Horn and Warning Light).

The Methane Warning System should be periodically calibrated. For information about the procedure and frequency of calibration and also operational information refer to the Zellweger Analytics Instructions.

The Methane Warning System **CAN NOT** be the only methane concentration monitoring and safety systems; the gas concentration **MUST** be checked by other means, for example 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 allowed to enter tunnel.

Be aware that Akkerman Tunneling Equipment is **NOT AN EXPLOSION PROOF** system. It is the contractor's responsibility to exercise all necessary precautions to ensure the safest working conditions for the personnel on the job.

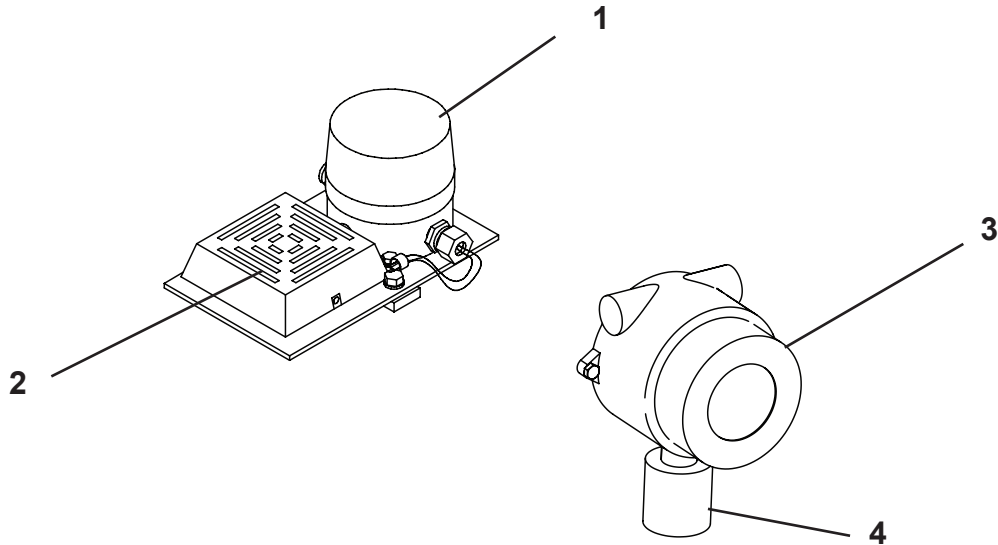
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NOTES

Terminology

GAS DETECTION SYSTEM

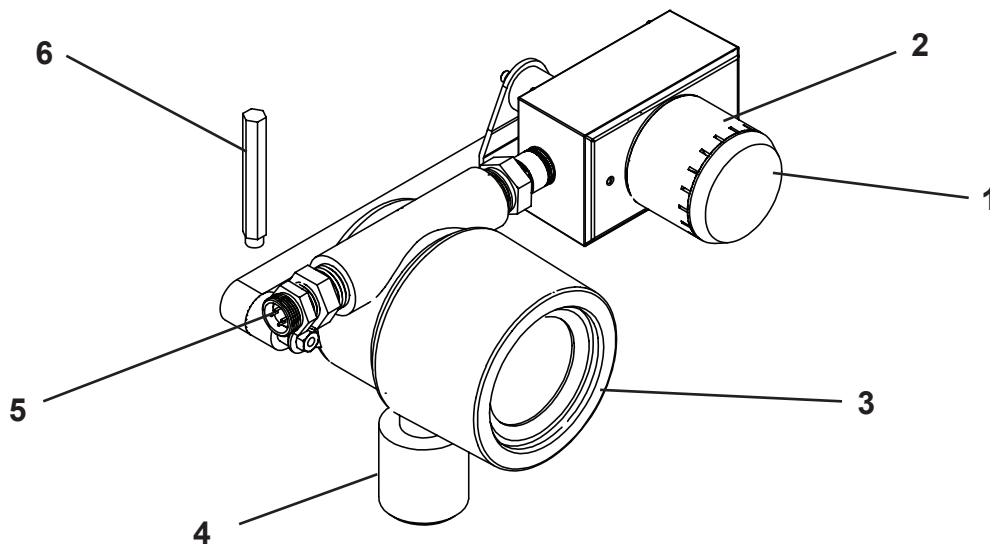
Early Units



- 1. Strobe Light
- 2. Horn

- 3. Transmitter/Relay
- 4. Sensor Element

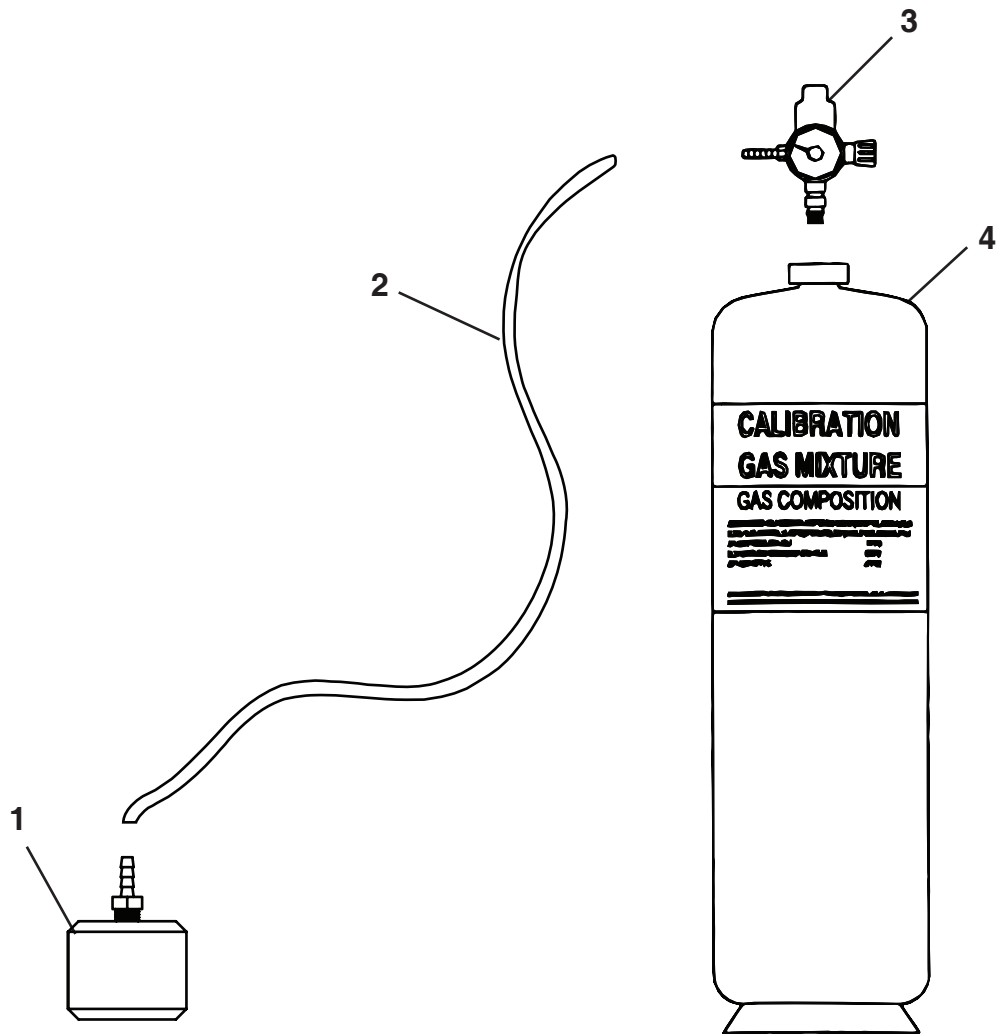
Later Units



- 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

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.

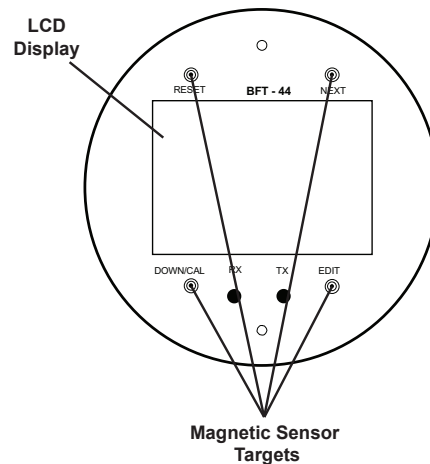
NOTICE For more information, refer to section 17 for the Buckeye manual or section 18 for the Global Detection Systems manual.

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.

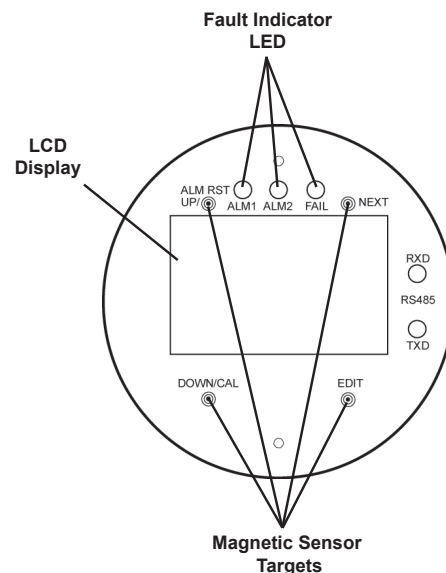
The four magnetic sensor controls are activated by a magnetic wand. Holding the magnetic wand over one of the magnetic sensor targets will activate that sensor. It may take several seconds for the magnetic sensor to activate. If the transmitter does not respond, remove the magnetic wand for several seconds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



GDS GasMax II / Buckeye With Series II TBM



Buckeye Gas Detector Transmitter Display



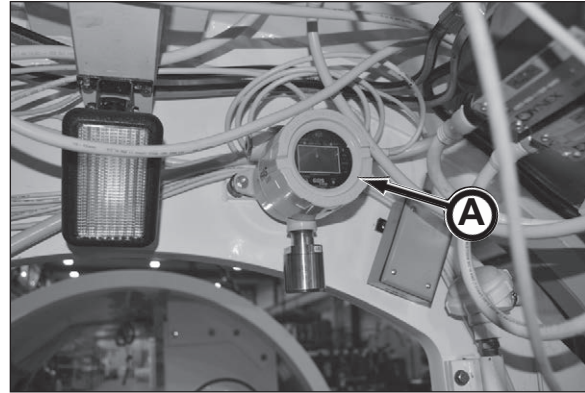
GDS GasMax II Transmitter Display

GAS DETECTOR - MTBM

⚠ DANGER The gas detection system installed in the MTBM monitors only 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.

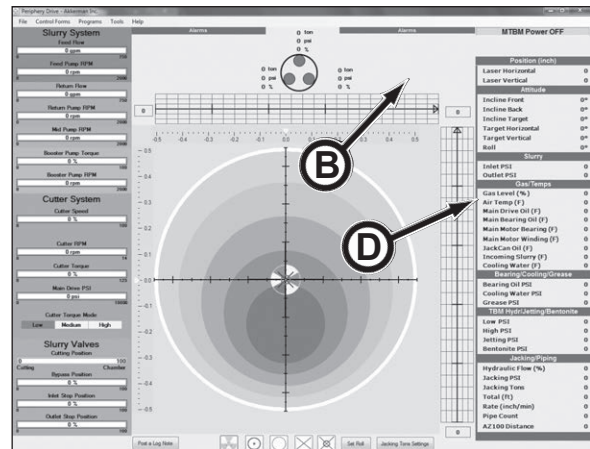
NOTICE Refer to your Microtunneling System Operator's Manual for more information on the gas detection system.

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.



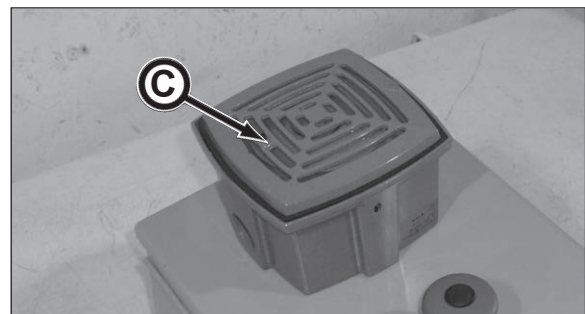
The gas detector is monitored by the control system as follows:

1. The "Gas Fault" message will appear in the 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 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 On the MTBM control screen, there is a Pit Horn test button to test the proper operation of the horn.

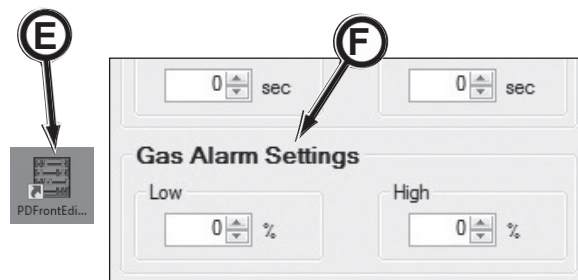
4. When the system detects a gas level reading of 25% (default setting) LEL or higher, the horn on the pit box will sound constantly.



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 PDFrontEditor icon (E) 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. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without combustible gas detectors and oxygen deficient detectors.
11. 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.
12. Do not paint the sensor assembly or the transmitter/relay.
13. 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.
- 14a. (Buckeye) If the message "Fault" scrolls across the gas detection transmitter display, the sensor or sensor element must be replaced and recalibrated immediately.
- 14b. (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.
15. Never walk or work under any part of the excavator or crane and suspended loads.
16. Lock out electrical power at the source (generator) before servicing electrical components.
17. 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.
18. Do not make any modifications to any Akkerman products. Doing so could cause structural failure and will void the warranty.
19. Check shields and guards. They must be in place and undamaged.
20. 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)

<i>% Oxygen in Air</i>	<i>Effect</i>
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 manual is located in sections 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.

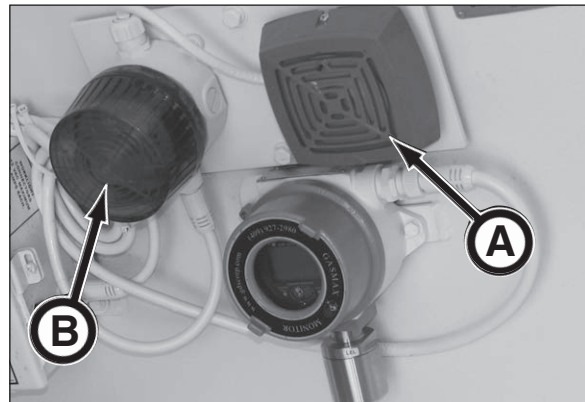
During start up, the LCD display will illuminate.

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

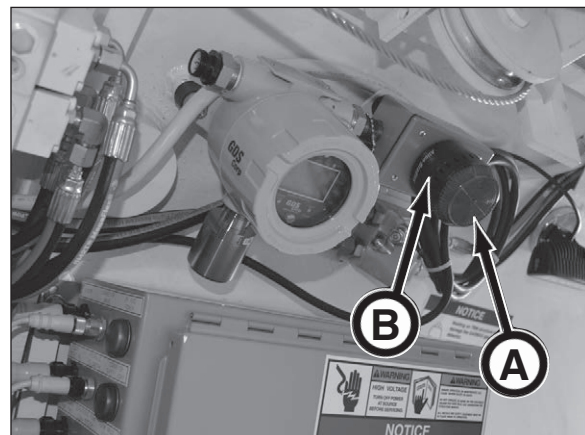
To test the operation of the horn and strobe, simply apply a gas concentration to sensor or check the horn and strobe operation by using the magnetic wand and touch the following sensor points on the LCD display:

Edit/Alarm Settings/Edit/Down Cal to Relay Config/ Edit/Edit (changes FailSafe from No to Yes to activate the horn and strobe). Press Edit again to stop horn and strobe.

If horn and strobe do not come on or any error is shown on the LCD display, the problem must be corrected prior to allowing people in the tunnel and before the boring head operation.



Early Units



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.

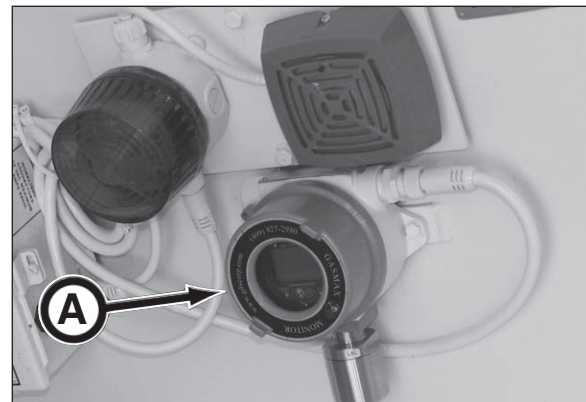


The gas detection system transmitter (A) includes a LCD display. Once the system has completed its start up sequence, this display will stabilize and indicate the methane gas level.

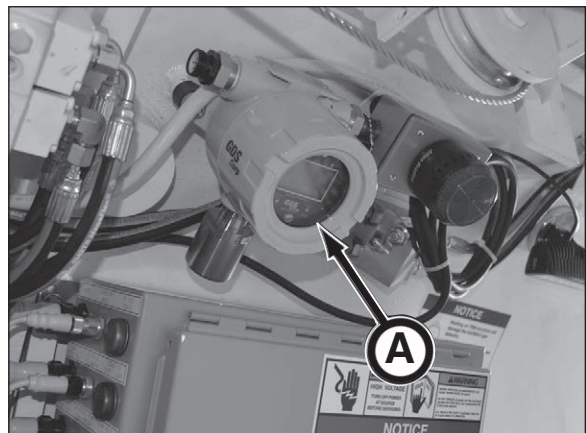
If there is no response from the alarms and the display is blank, have a certified electrician determine if power is available to the unit.

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.

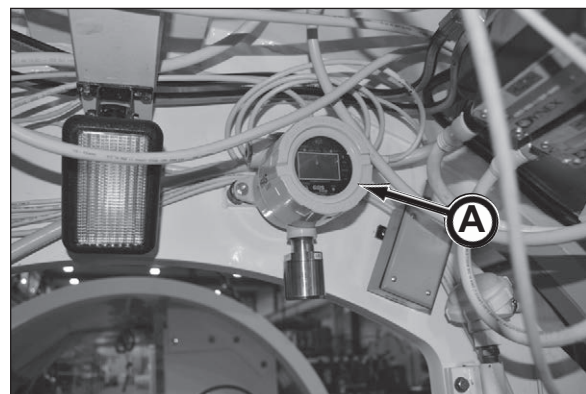
Contact the Akkerman Aftermarket Support Department for assistance.



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

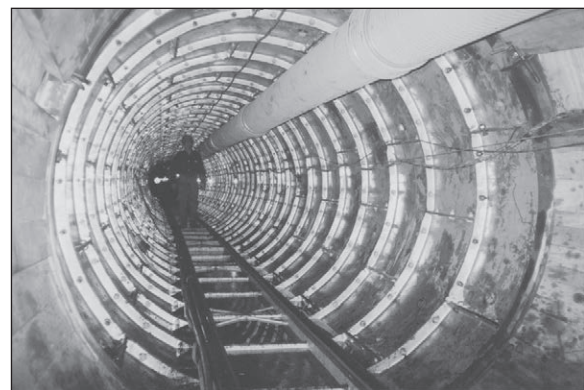


GDS GasMax II

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.

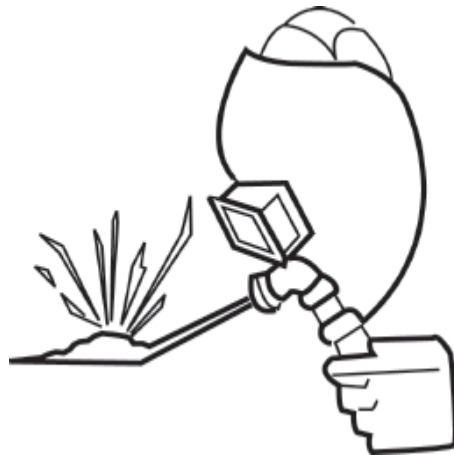
LOCKOUT/TAGOUT power before attempting to make repairs or adjustments to this equipment, unless otherwise indicated. Proper lockout/tagout will prevent accidents and save lives. Performing the lockout/tagout will also prevent the equipment from moving or operating unexpectedly.



WELDING

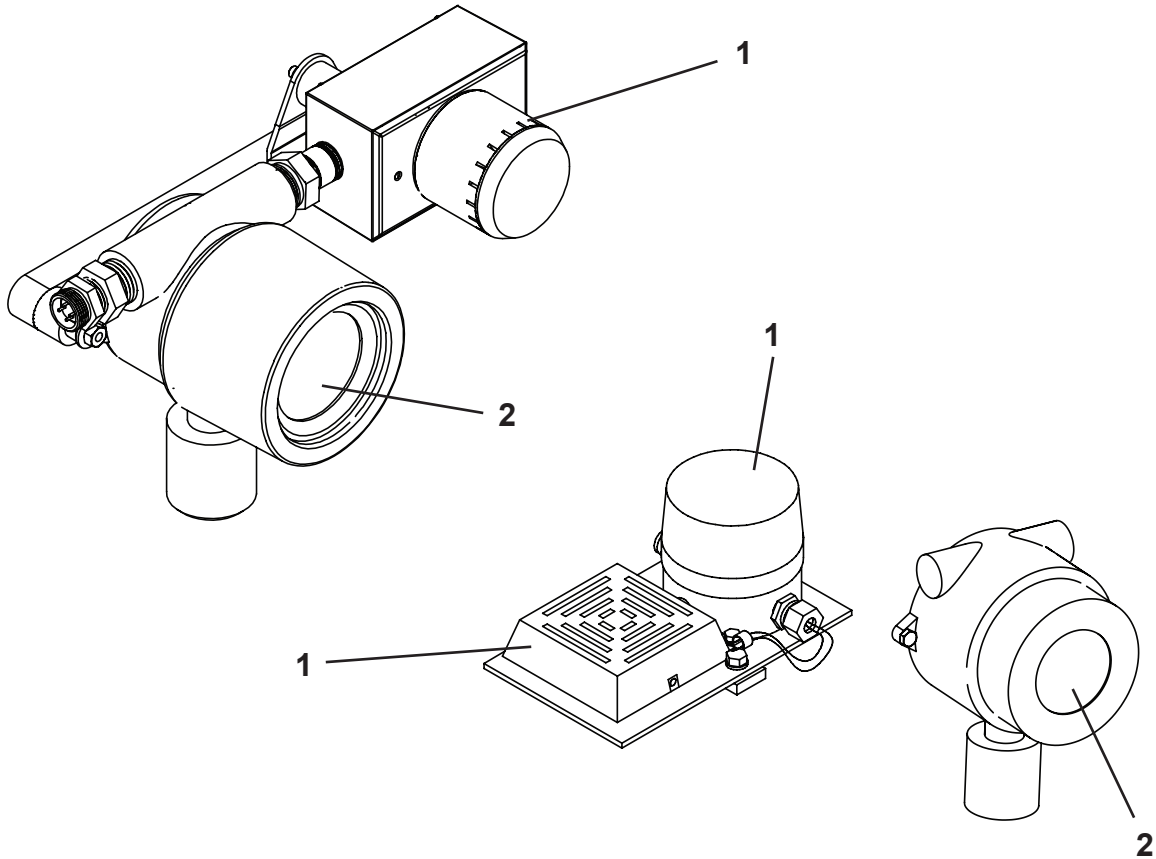
NOTICE Welding on TBM structure will damage the gas detector.

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.

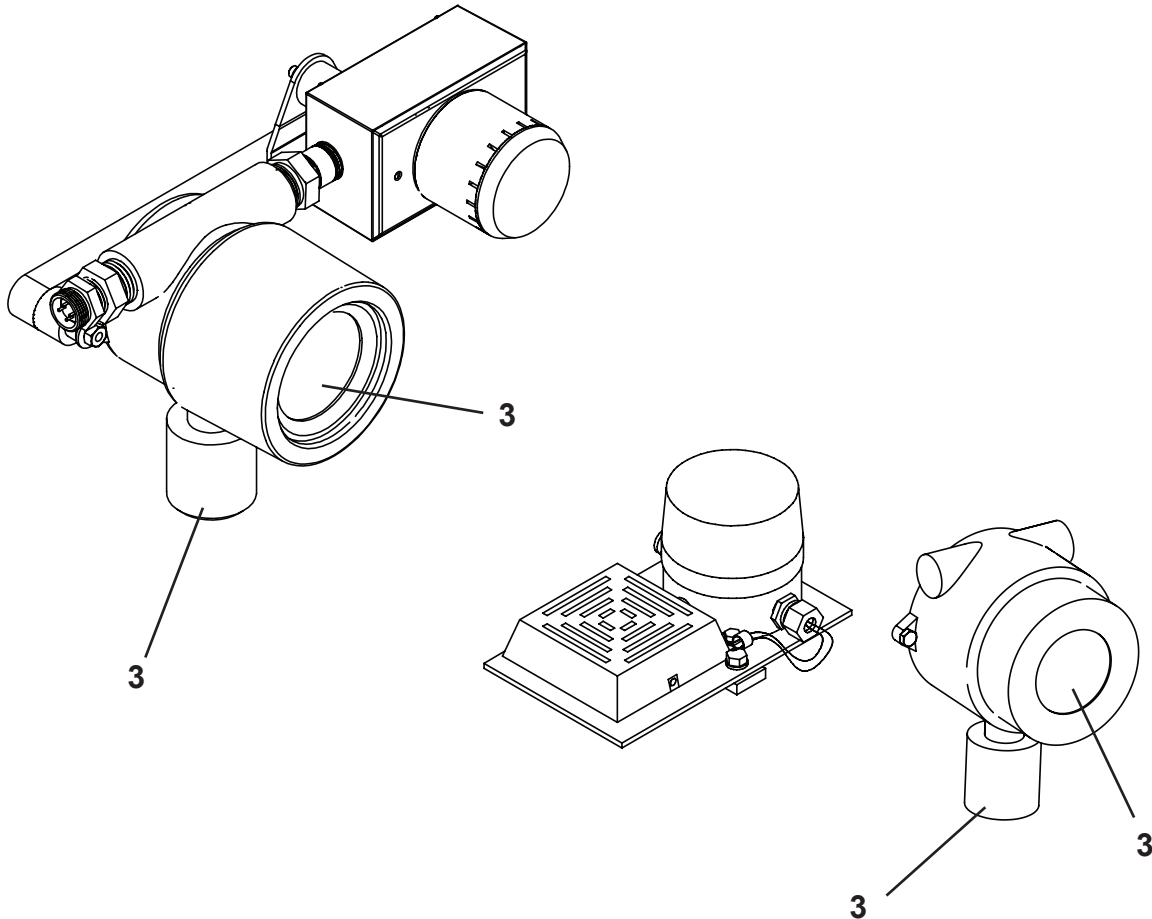


START UP

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 manual 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.

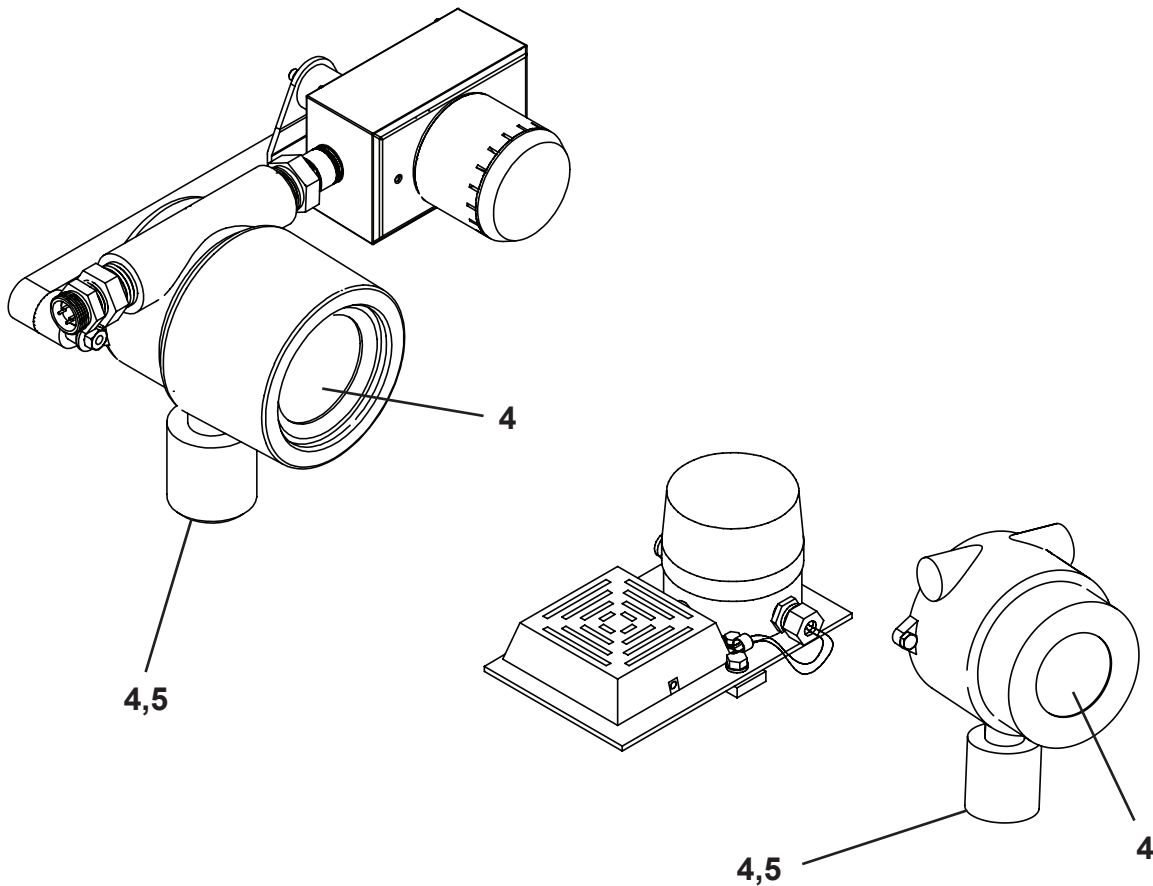


START OF NEW DRIVE AND EVERY 40 HOURS OF OPERATION

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 manual 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.

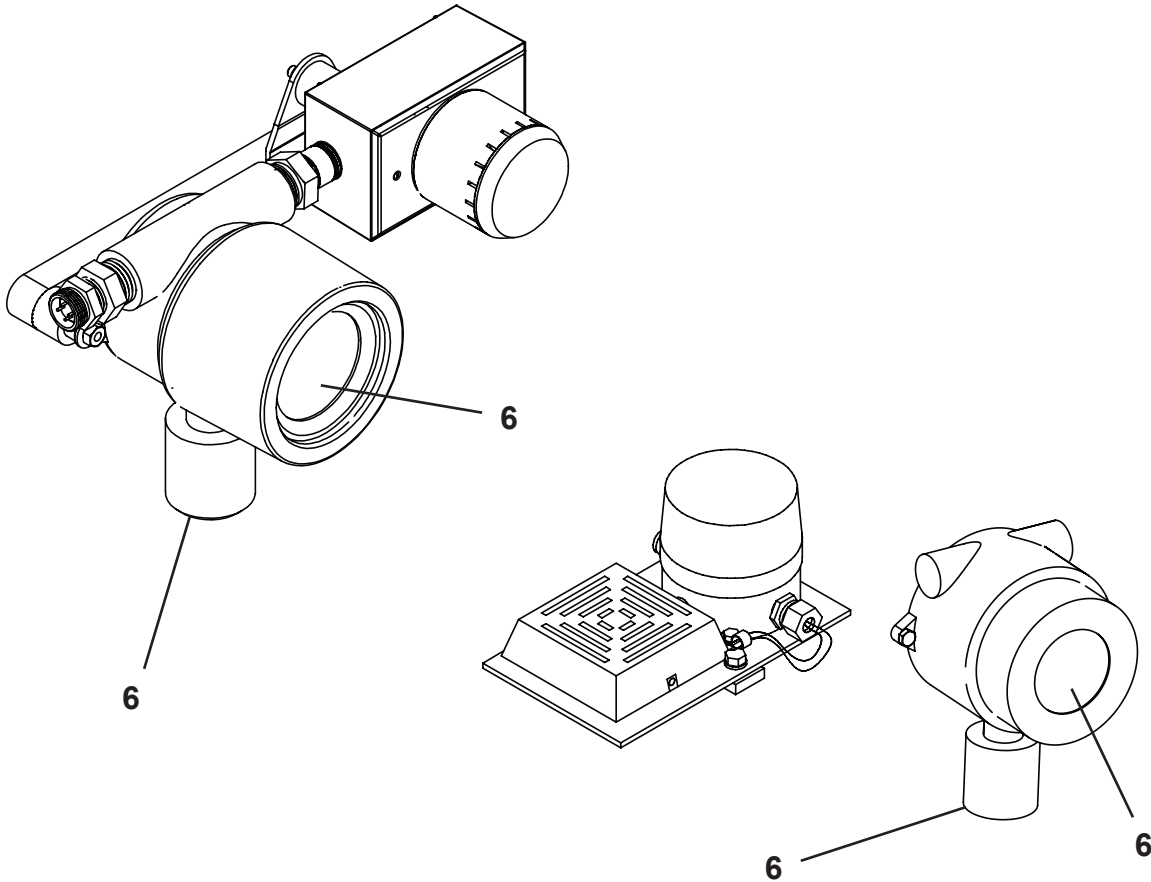


DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
4.	Transmitter/Sensor	Check	If the following appears, sensor must be replaced: <ul style="list-style-type: none"> • 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 manual 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 manual 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 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 or check the horn and strobe operation by using the magnetic wand and touch the following sensor points on the LCD display:
Edit/Alarm Settings/Edit/Down Cal to Relay Config/
Edit/Edit (changes FailSafe from No to Yes to activate the horn and strobe). Press Edit again to stop horn and strobe.

If the audible and visual alarms do not work properly, have a qualified electrician troubleshoot and repair the problem BEFORE using the TBM.



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 Buckeye User manual in section 17 of this manual or section 18 for the Global Detection Systems GasMax manual.



Buckeye 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 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 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).

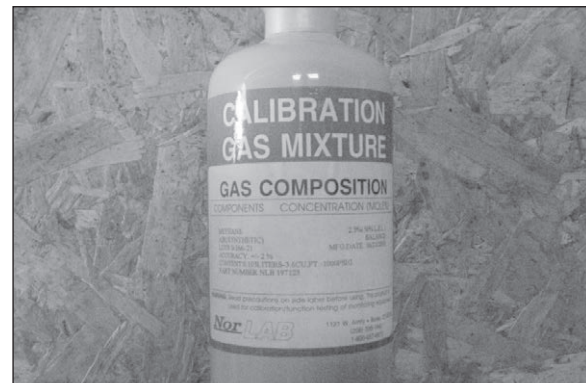
⚠ WARNING

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.

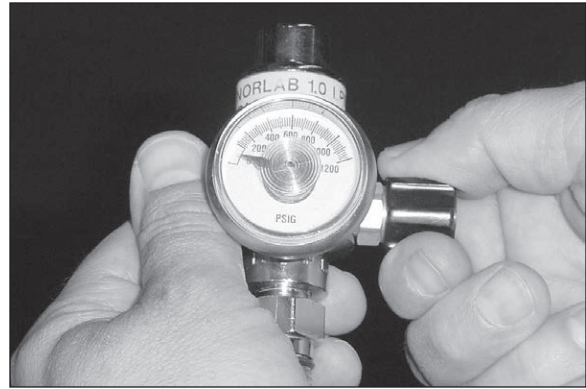
First Aid if inhaled: Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. Call physician immediately.

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)



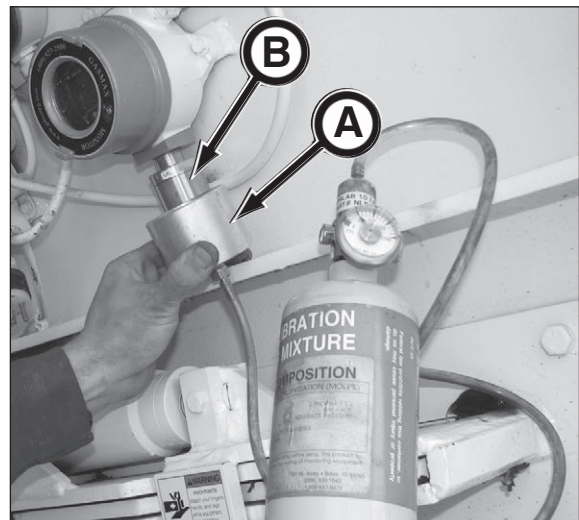
3. Close the regulator valve by turning the knob clockwise.



4. Screw the regulator valve onto the cylinder.



5. Attach one end of the plastic hose to the regulator. Attach the calibration nozzle/adaptor to the other end.
6. Attach the calibration nozzle/adaptor (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.

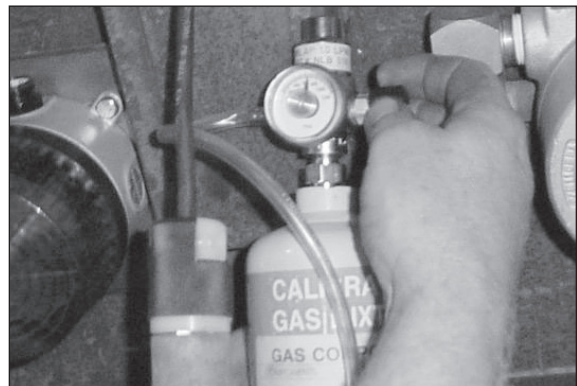
NOTICE

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



GDS GasMax II Shown

9. Close regulator valve by turning the knob clockwise.

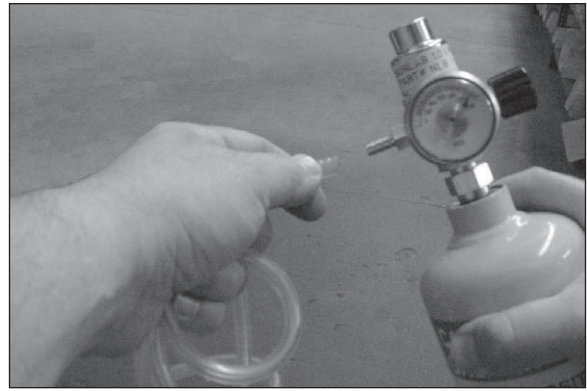


10. Remove the calibration nozzle/adaptor from the gas sensor.



(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/adaptor 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.

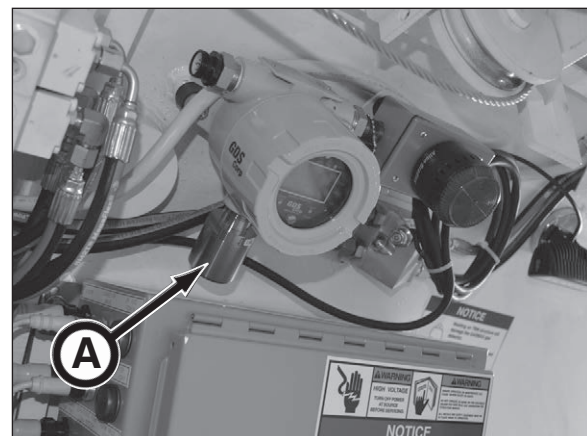
⚠ WARNING If the filter/cap is not dry, it can block gas from getting to the sensor, resulting in the environment not being properly monitored for methane gases.

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.

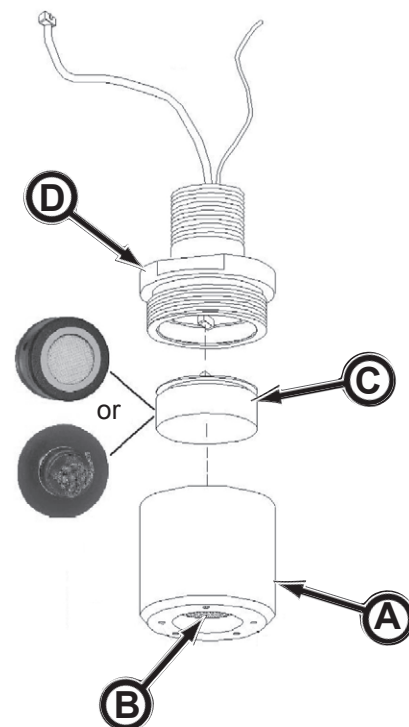
- A - Sensor Head Cap
- B - Sensor Filter
- C - Sensor
- D - Sensor Base



Early Units



Later Units



EVERY THREE MONTHS OF OPERATION OR AS REQUIRED

NOTICE

Refer to the Buckeye manual in sections 17 or the GDS GasMax manual in section 18 in 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:

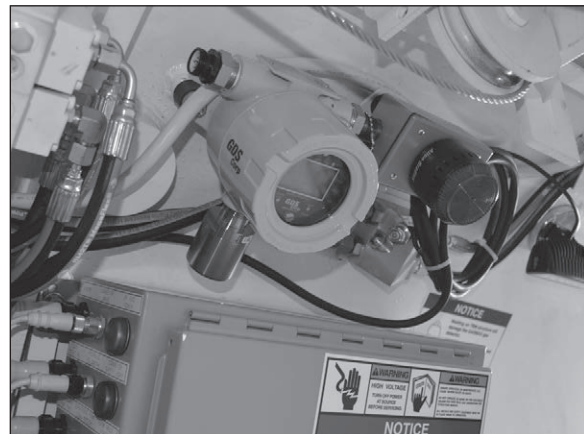
- Calibration accuracy is only as good as the calibration gas accuracy.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate only in a clean atmosphere, which is free of background gas.

Use the following procedure to perform ZERO and SPAN calibrations.

1. Power up gas detection system.

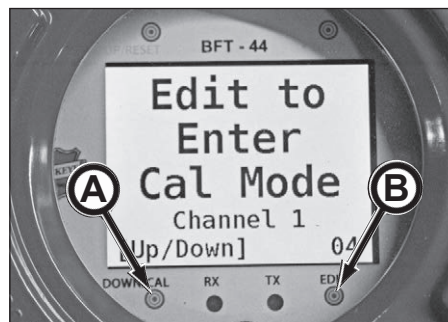


Early Units



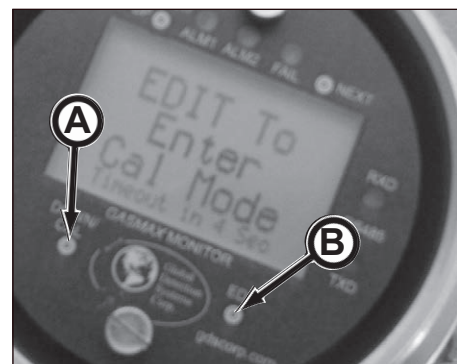
Later Units

2. To enter the CAL MODE from either data display, press the DOWN/CAL key (A) with the magnetic wand and within 5 seconds press the EDIT key (B).



Buckeye Gas Detector Display

GDS GasMax II Display

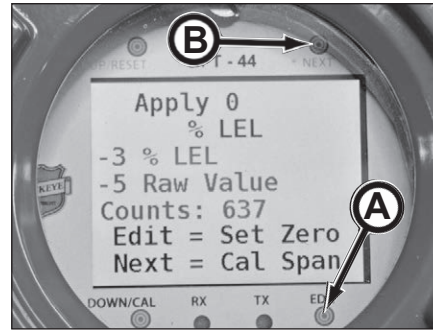


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3. Using an optional process cover (Cal Cup), apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable (approximately 1 minute), press the EDIT key (A) to perform a ZERO calibration.

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



Buckeye Gas Detector Display



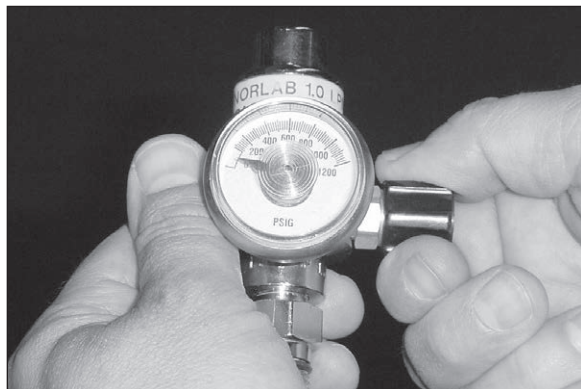
GDS GasMax II Display

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.

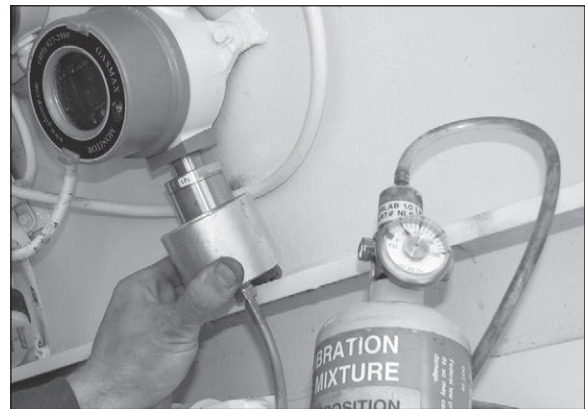


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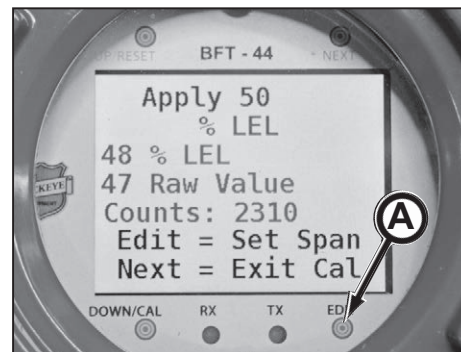
- d. Attach one end of the plastic hose to the regulator.
- e. Attach the calibration nozzle adapter to the other end of hose.



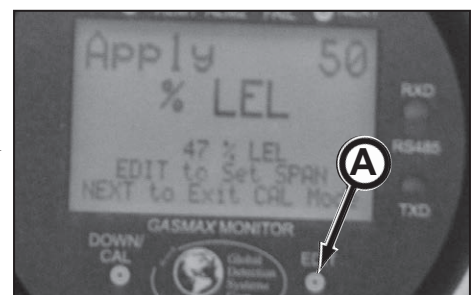
- f. Attach calibration nozzle adapter to sensor.



- 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 key to perform a SPAN calibration.



Buckeye Gas Detector Display



GDS GasMax II Display

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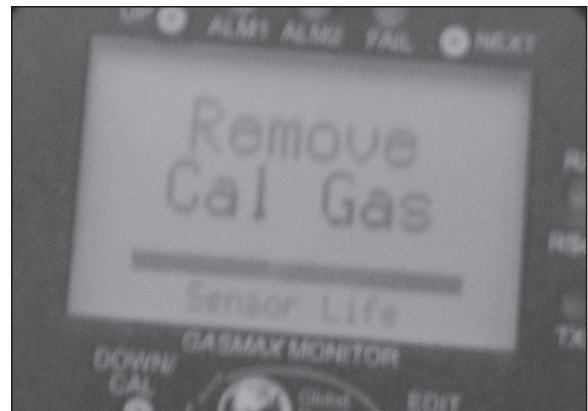
7. If the SPAN calibration is successful, the display flashes:

- Buckeye - CAL PURGE and starts the CAL PURGE delay.



Buckeye Gas Detector

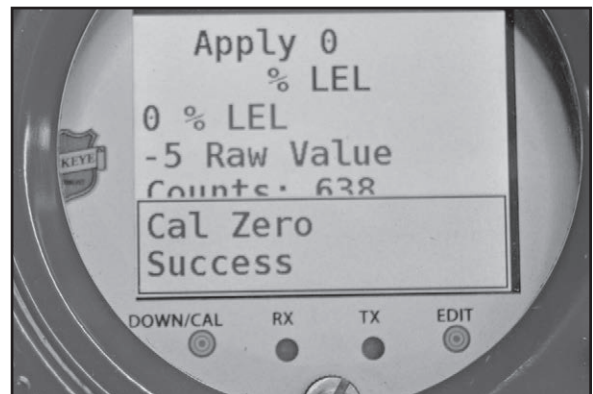
- GasMax II - REMOVE CAL GAS.



GDS GasMax II

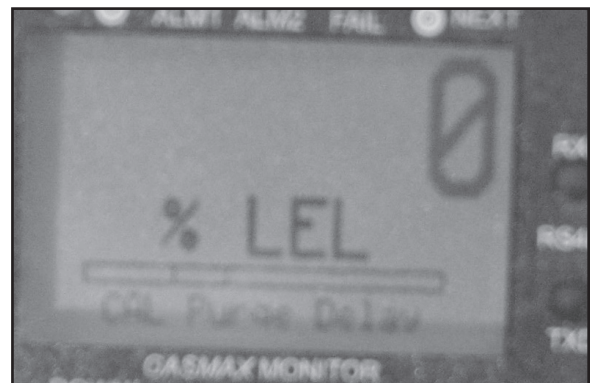
8. The CAL MODE will be complete after:

- Buckeye - the Cal Zero Success window appears.



Buckeye Gas Detector

- GasMax II - the end of the CAL PURGE delay.



GDS GasMax II

Troubleshooting

NOTICE

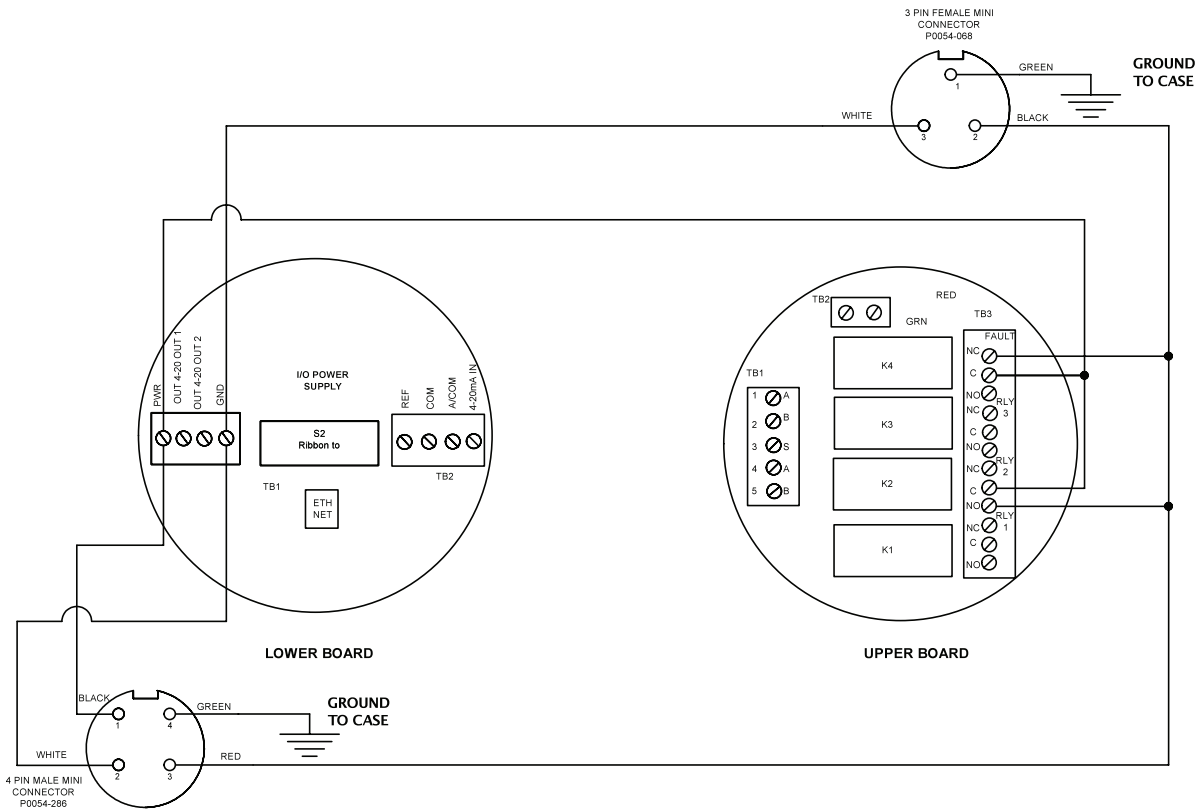
To troubleshoot the Buckeye gas detector, refer to the Buckeye User Manual located in section 17 of this manual.

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.

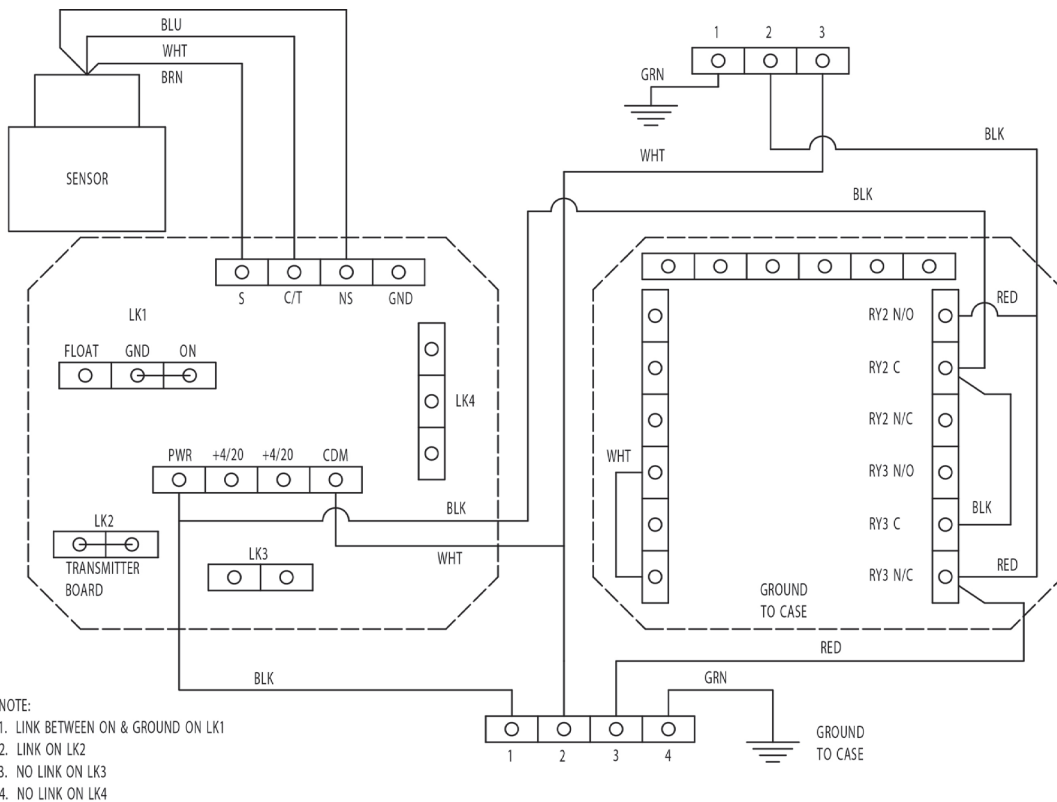
Problem	Cause	Solution
Gas Detection System does not operate.	Power source is not activated.	Activate power source.
	Power cable is damaged.	Replace cable.
	If system still does not operate, contact your Akkerman Aftermarket Support Representative.	
Strobe does not work but horn does work.	Strobe is 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 Wiring Diagram

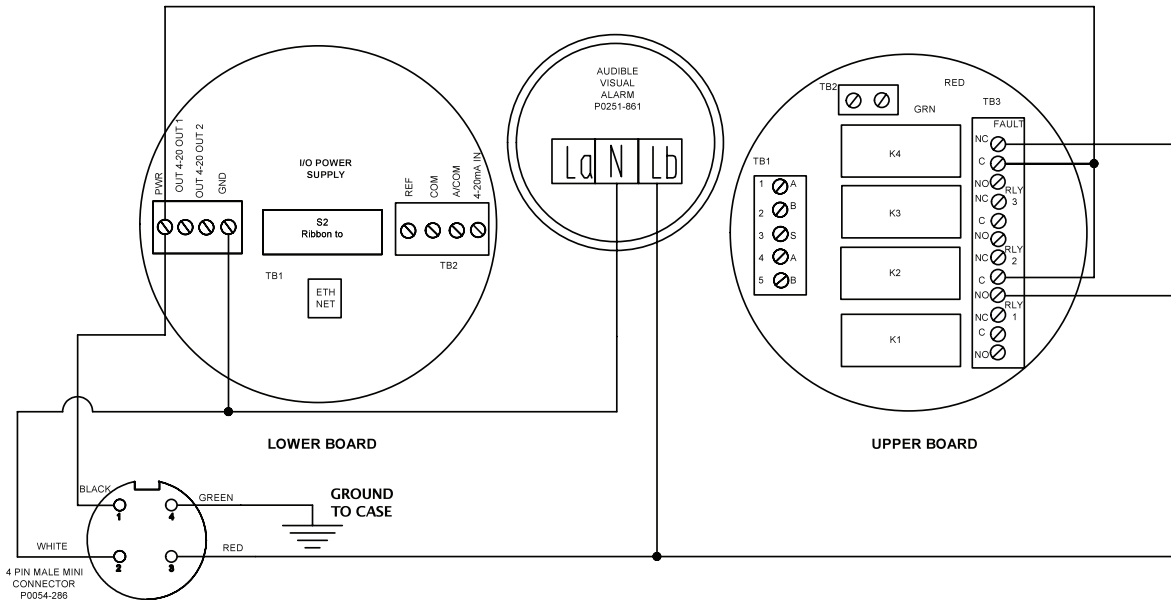


GasMax Gas Detector Wiring Diagram

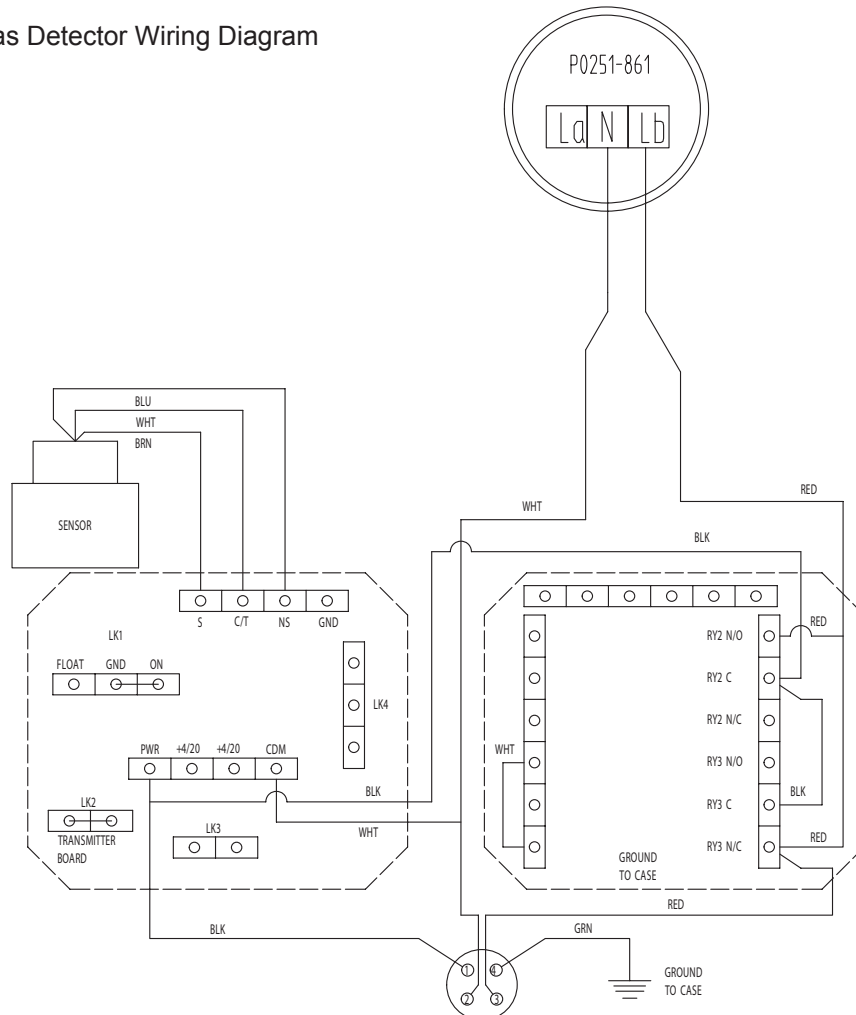


GAS DETECTOR ASSEMBLY DIAGRAM WITH ALARM - TBM LATER UNITS

Buckeye Gas Detector Wiring Diagram

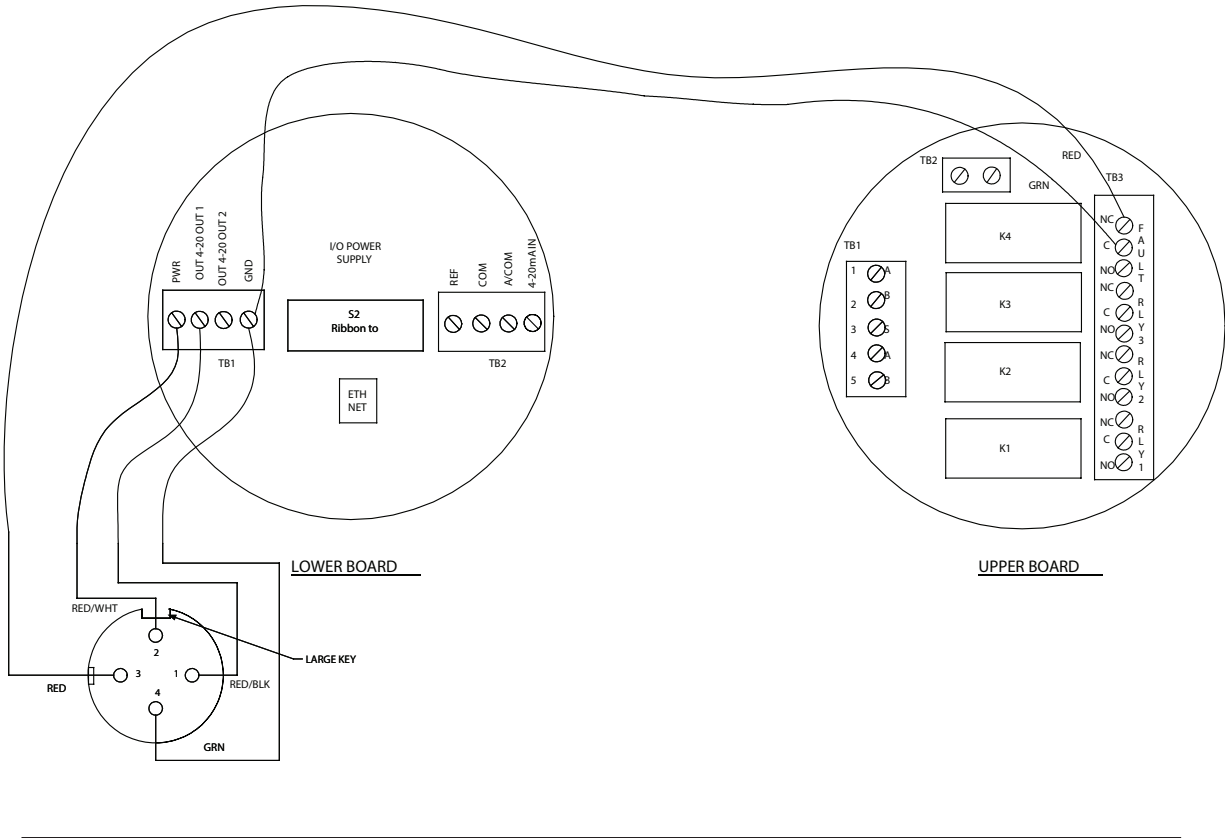


GasMax Gas Detector Wiring Diagram

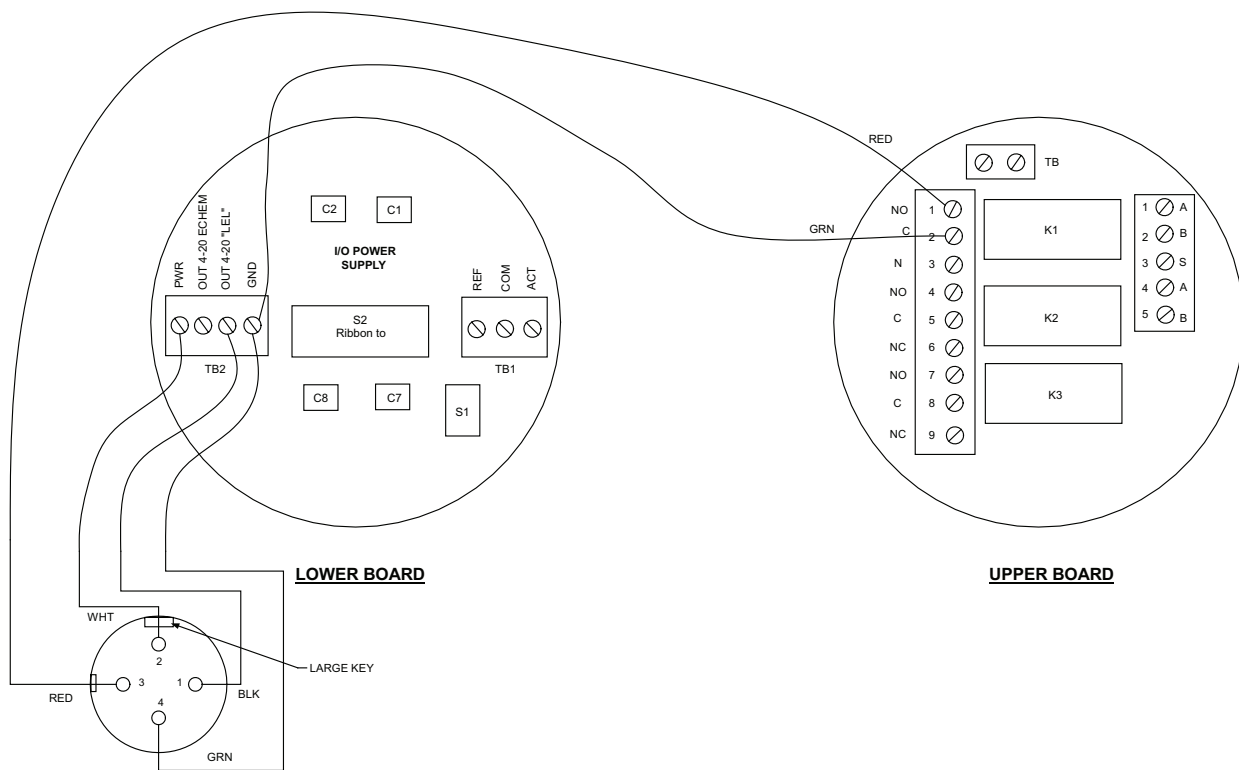


GAS DETECTOR WIRING DIAGRAM - MICROTUNNELING

Buckeye Gas Detector Wiring Diagram



GasMax Gas Detector Wiring Diagram



BUCKEYE GAS DETECTOR STATUS/FAULTS

NOTICE

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

The BFT44 transmitter has 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 BFT44 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

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 / O₂ 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)

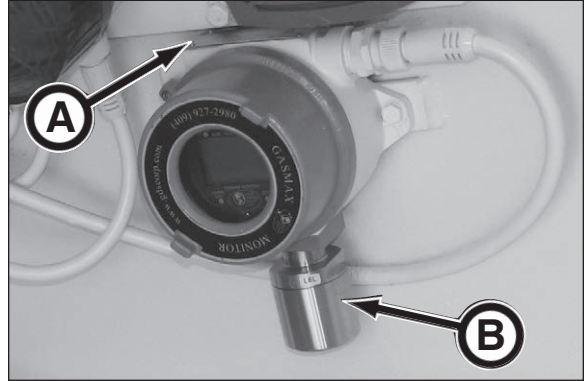
Model Number _____

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.

Warranty

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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 the Jacking System. 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.

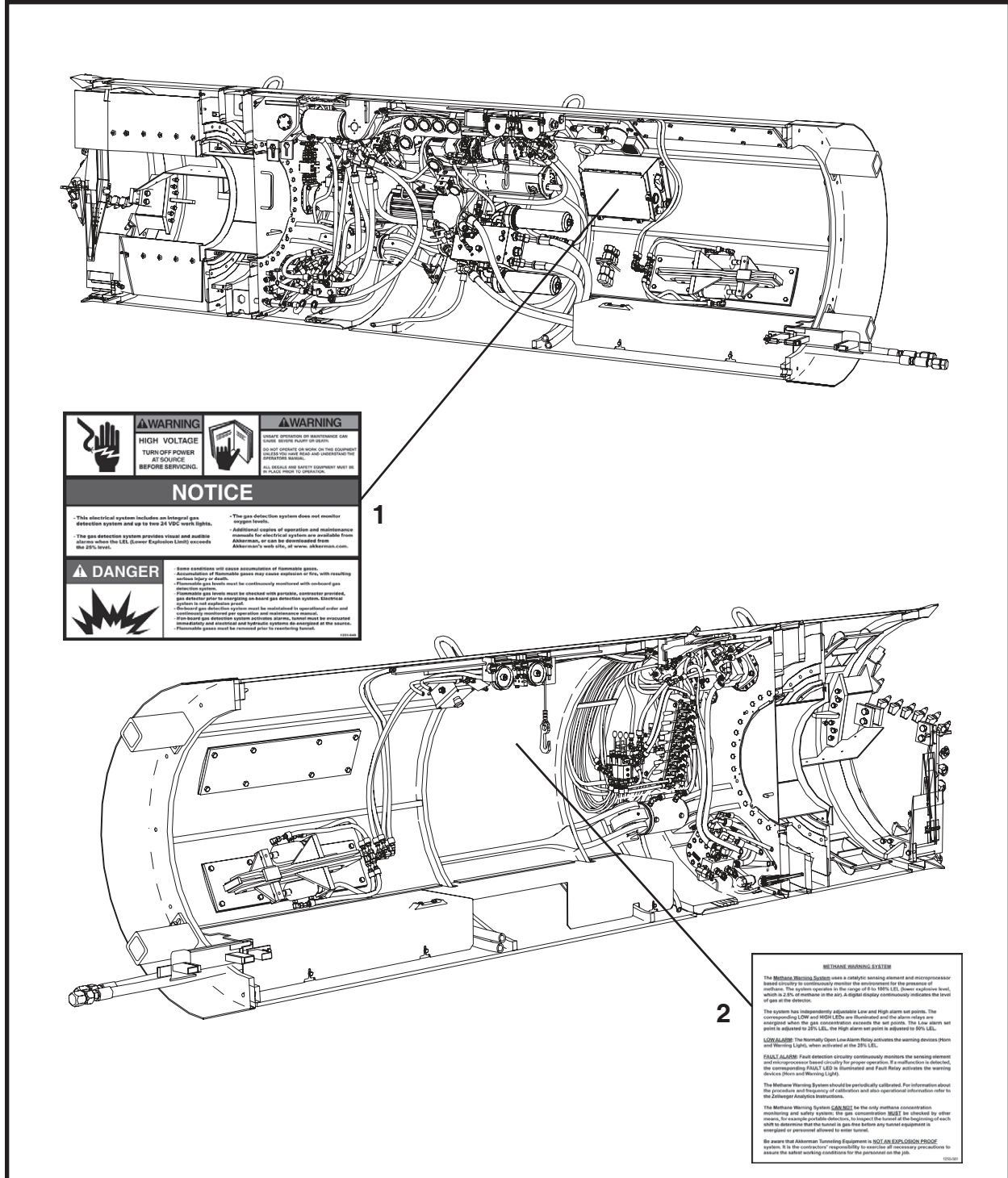
HARDWARE SPECIFICATION



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



	WARNING HIGH VOLTAGE TURN OFF POWER AT SOURCE BEFORE SERVICING.		WARNING UNSAFE OPERATION OR MAINTENANCE CAN CAUSE SERIOUS INJURY OR DEATH. DO NOT CONTACT OR WORK ON THE EQUIPMENT UNLESS YOU READ AND UNDERSTAND THE OPERATIONS MANUAL. FOR FULL AND COMPLETE SAFETY INFORMATION SEE THE USER MANUAL OR VISIT www.akkerman.com .
NOTICE			
<p>*This electrical system includes an integral gas detection system and up to five 24 VDC work lights.</p> <p>*The gas detection system provides visual and audible alarms when the LEL (Lower Explosive Limit) exceeds the 25% level.</p>		<p>*The gas detection system does not monitor oxygen levels.</p> <p>*Additional details of operation and maintenance manuals for electrical systems are available from Akkerman, or can be downloaded from Akkerman's web site, at www.akkerman.com.</p>	
▲ DANGER			
<p>Some conditions will cause accumulation of flammable gases. Accumulation of flammable gases may cause explosion or fire, with resulting serious injury or death.</p> <p>Flammable gas levels must be continuously monitored with on-board gas detection systems.</p> <p>Flammable gas levels must be checked using portable, calibrated personal gas detectors prior to entering an on-board gas detection system. Electrical systems must be de-energized and maintenance performed in order and the board gas detection system service alarm. Personnel must be equipped immediately and emergency and hydraulic systems de-energized at the alarm. Flammable gases must be removed prior to re-energizing board.</p>			

METHANE WARNING SYSTEM

The Methane Warning System uses a catalytic sensing element and microprocessor based circuitry to continuously monitor the concentration for the presence of methane. The system operates in the range of 0 to 100% LEL (Lower Explosive Limit), which is 2% of methane in the air. A digital display continuously indicates the level of gas at the detector.

The system has independently adjustable Low and High alarm set points. The corresponding LOW and HIGH LEDs are illuminated and the alarm relay are energized when the gas concentration exceeds the set points. The Low alarm set point is adjusted to 25% LEL, the High alarm set point is adjusted to 95% LEL.

LOW ALARM: The normally Open Low Alarm Relay activates the warning device (horn and Warning Light), when activated at the 25% LEL.

FAULT ALARM: Fault detection circuitry continuously monitors the sensing element and microprocessor based circuitry for proper operation. If a malfunction is detected, the corresponding FAULT LED is illuminated and Fault Relay activates the warning device (horn and Warning Light).

The Methane Warning System should be periodically calibrated. For information about the procedure and frequency of calibration and also operational information refer to the Safety and Service instructions.

The Methane Warning System **CANNOT** be the only methane concentration monitoring and safety system; the gas concentration **MUST** be checked by other means, for example portable detectors. It is important to inspect the tunnel at the beginning of each shift to determine that the number of gas detectors before any tunnel equipment is installed or personnel allowed to enter tunnel.

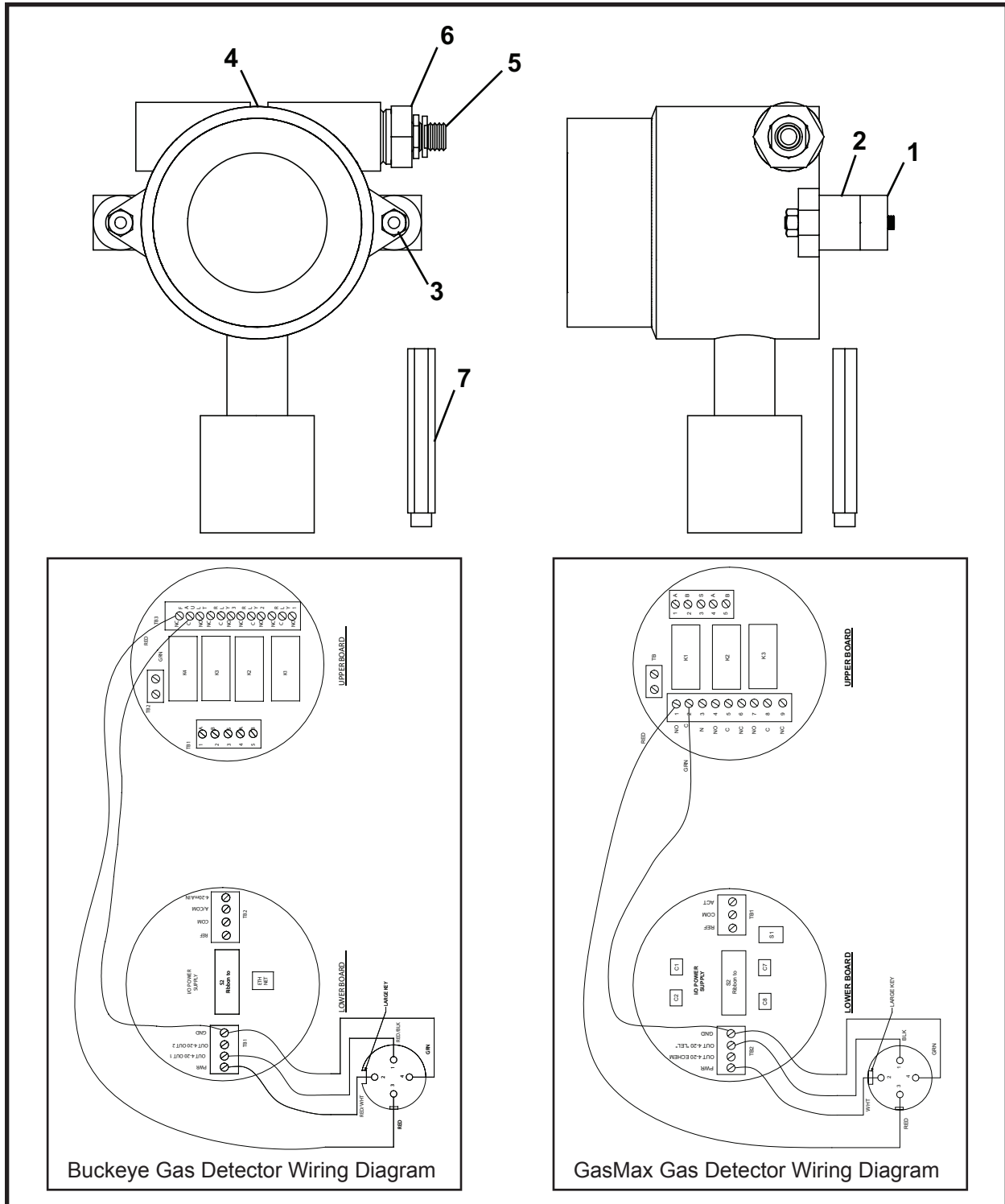
Be aware that Akkerman Tunneling Equipment is **NOT AN EXPLOSION PROOF** system. It is the contractor's responsibility to exercise all necessary precautions to ensure the safest working conditions for the personnel on the job.

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

NOTES

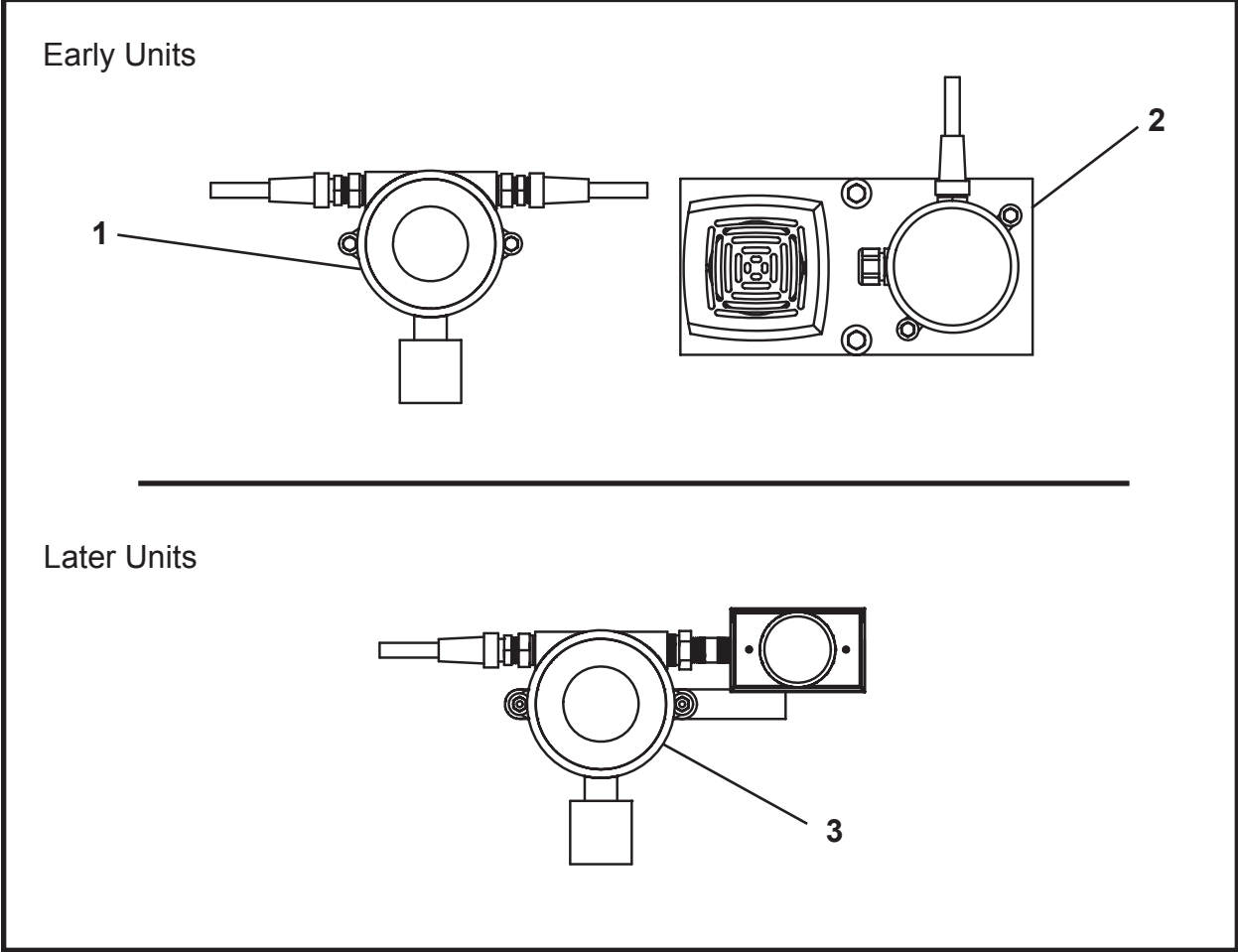
GAS DETECTOR ASSEMBLY, A03946A

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	S10041A	GAS DETECTOR, MTBM (Includes item 4a)
4a	1	P0251-197A	ELEMENT, Sensor
5	1	P0054-453	RECEPTACLE, 4C 22 GA Micro Male DK 12"
6	1	P0300-080	REDUCER, 12MP-04FPS
7	1	P0310-283B	WAND, Magnetic

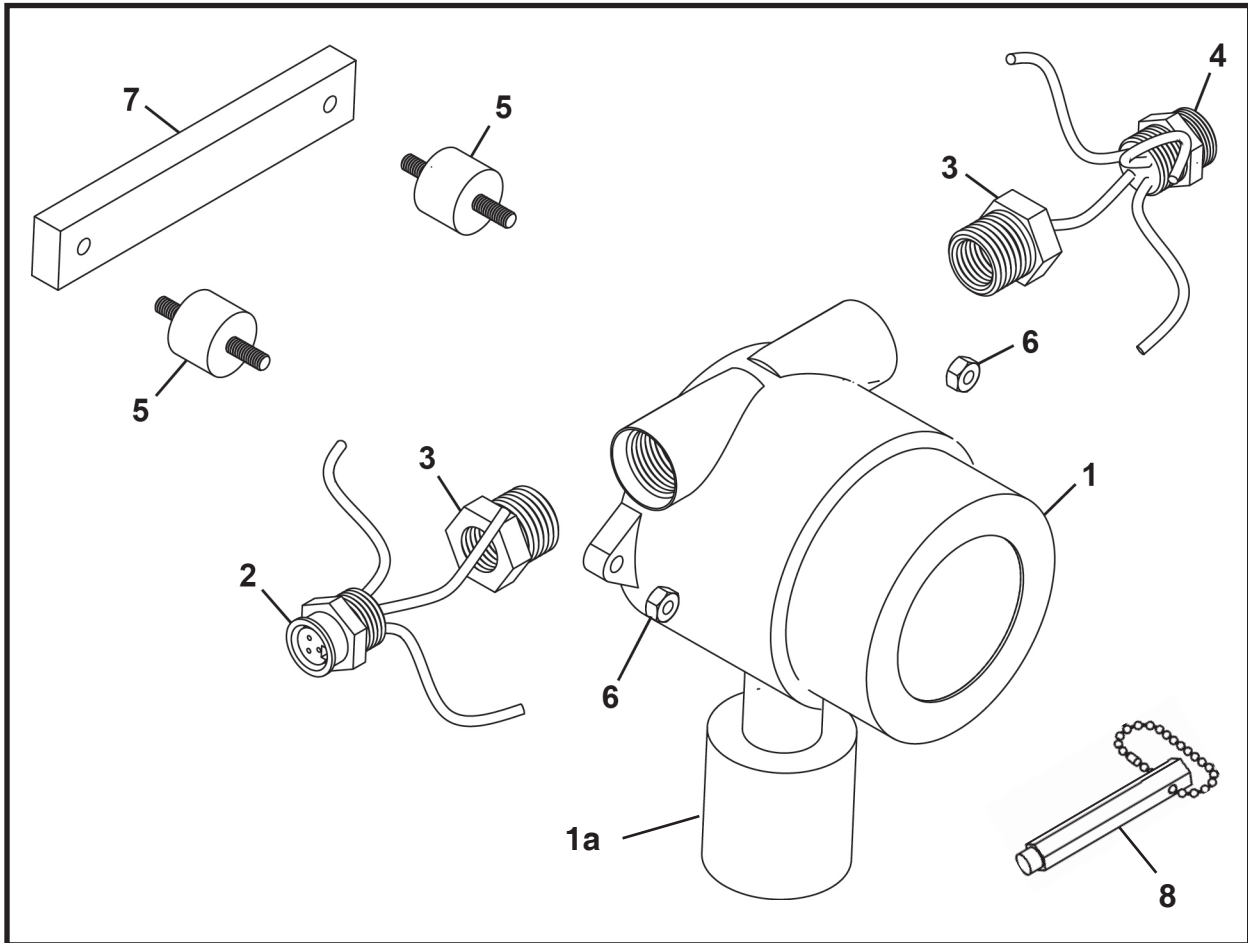
GAS DETECTOR ASSEMBLY
TBM Series II, D Series



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	S10057A	DETECTOR, Gas (Includes item 1a)
1a	1	P0251-197A	ELEMENT, Sensor
2	1	P0054-068	RECEPTACLE, Mini Cable
3	2	P0300-012	FITTING, 12MP-08FPS
4	1	P0054-286	RECEPTACLE, 4 Pin Male
5	2	P0070-065	MOUNT, Vibration Isolation
6	2	P0003-04-000	NUT, Hex 1/4 UNC
7*	1	016407P	BRACKET, Mounting
8	1	P0310-283B	WAND, Magnetic

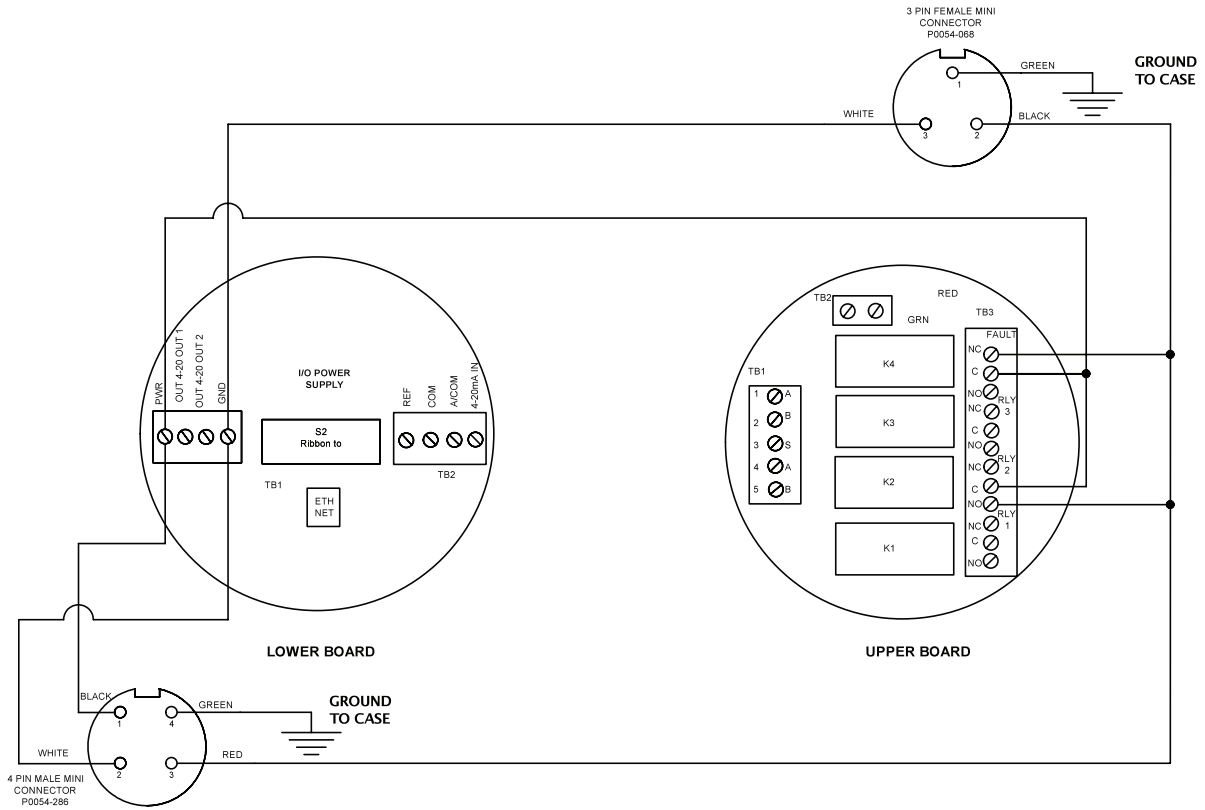
Note: Contact your Akkerman Aftermarket Support representative for proper set up and calibration of this gas detector assembly.

* Not part of this assembly.

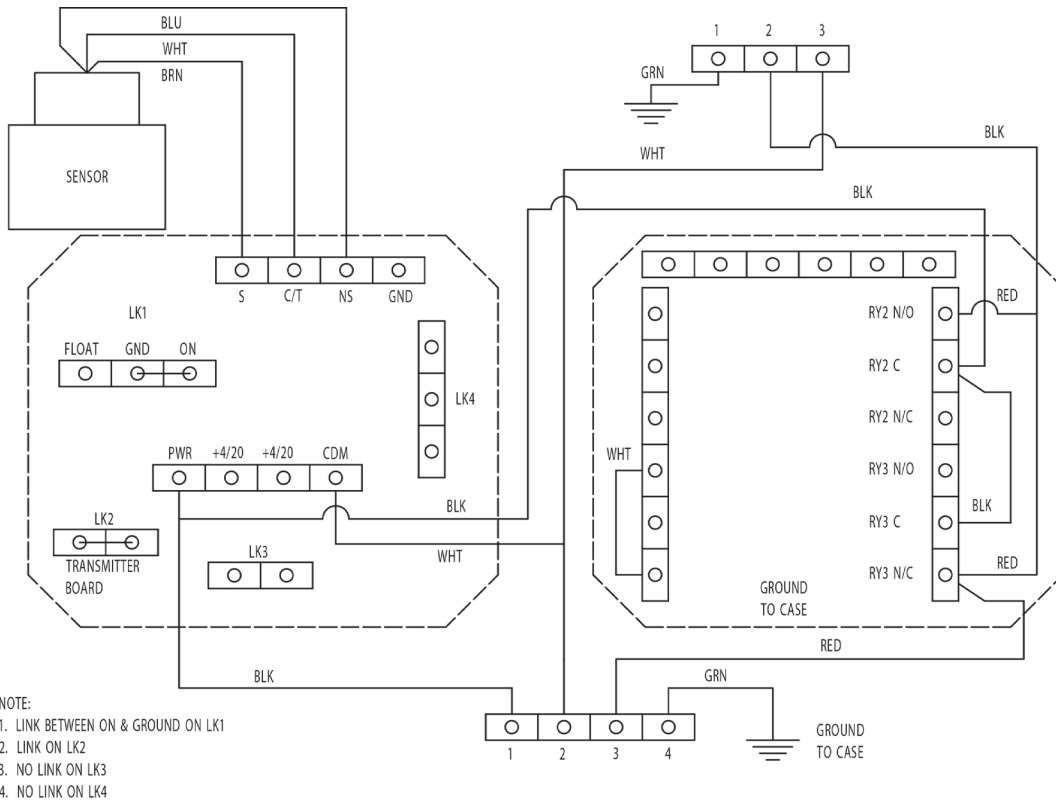
GAS DETECTOR ASSEMBLY WIRING DIAGRAM, 019049A

TBM Series II, D Series - Early Units

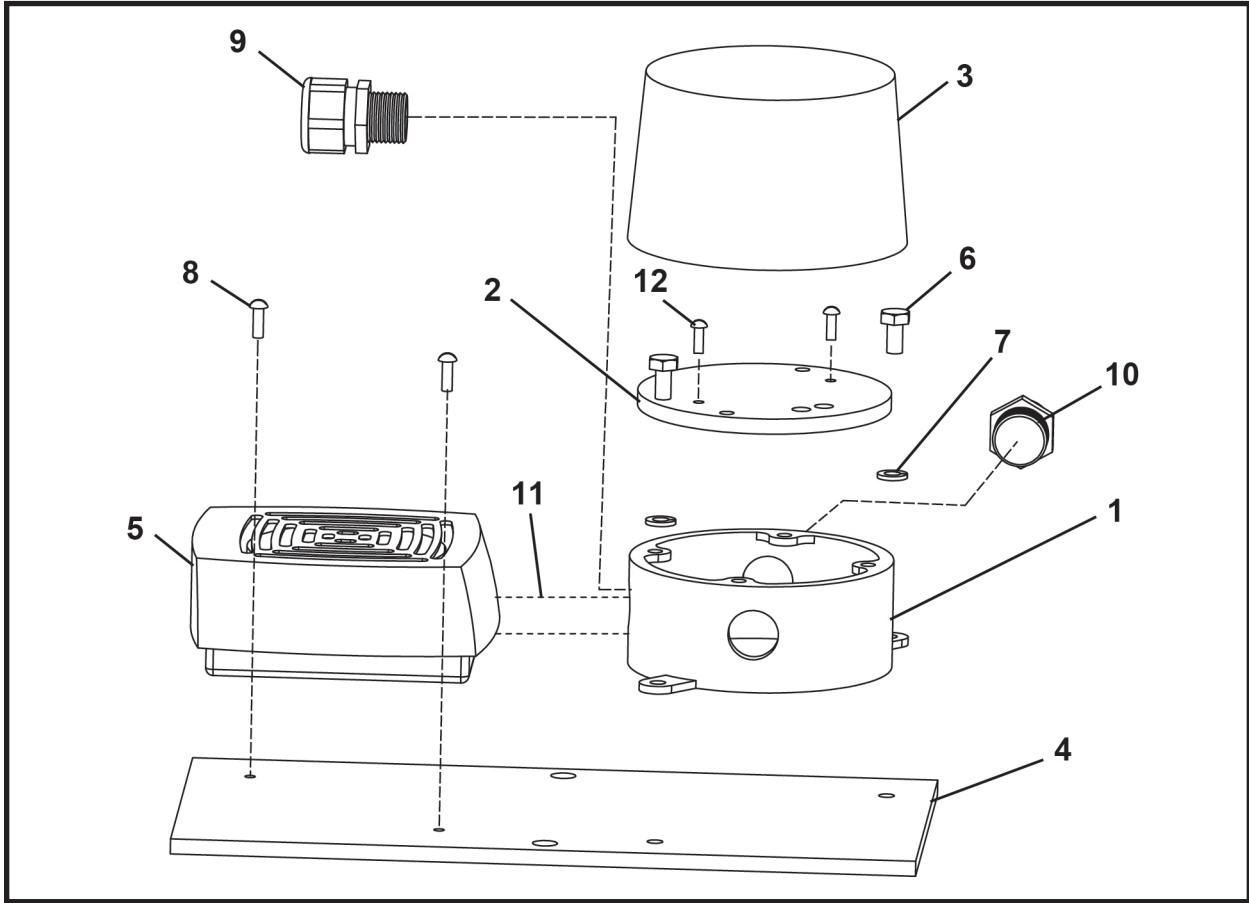
Buckeye Gas Detector Wiring Diagram



GasMax Gas Detector Wiring Diagram



STROBE - HORN ASSEMBLY, 024401A
TBM Series II, D Series - Early Units

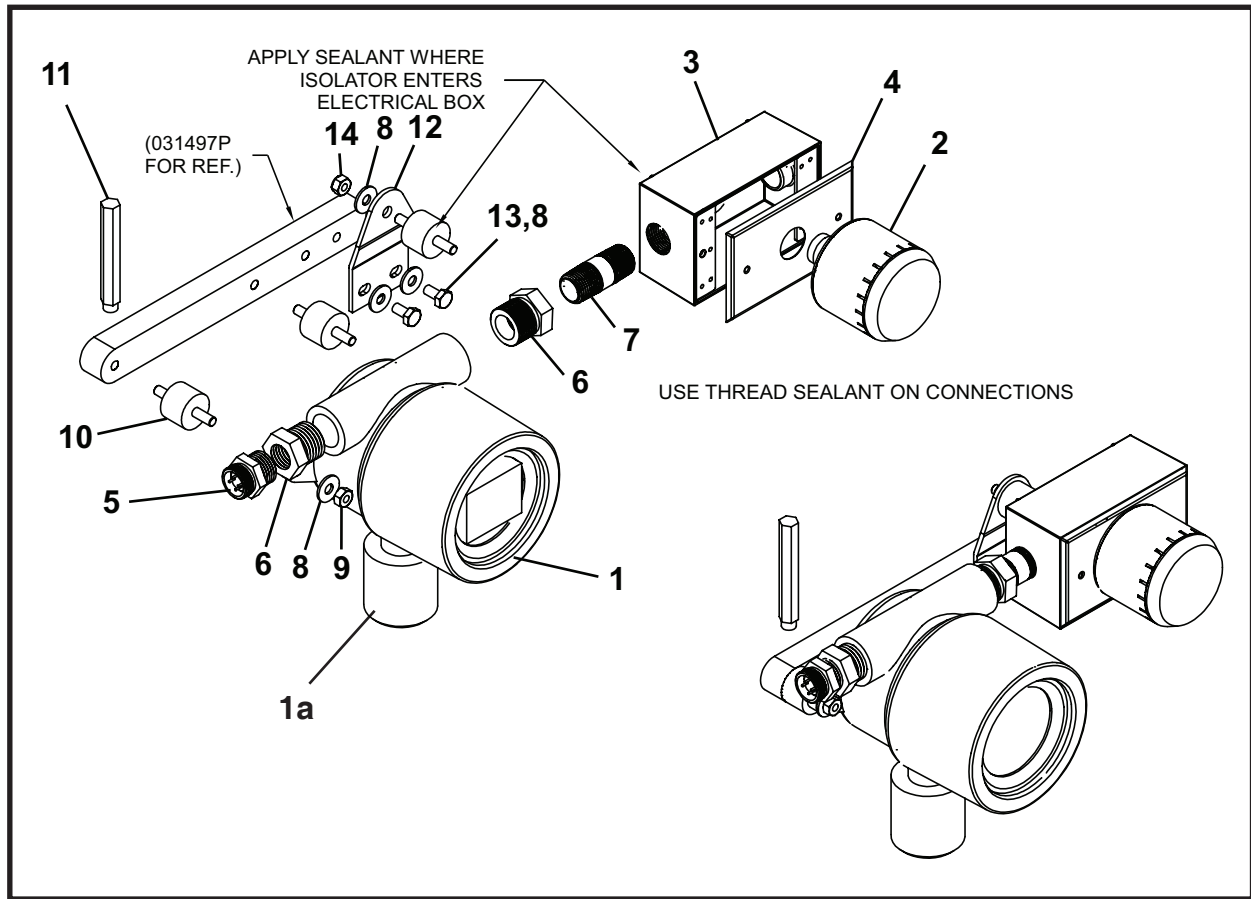


ITEM	QTY	PART NO.	DESCRIPTION
0	1	024401A	STROBE - HORN ASSEMBLY
1	1	P0310-251	HOLDER BOX
2	1	023534P00	COVER, Back
3	1	P0310-286B	STROBE LIGHT, Red 24VDC (Includes item 3a)
3a	1	P0310-286A	LENS
4	1	016405P	PLATE, Mounting
5	1	P0310-287D	HORN, Warning 24VDC
6	2	P0001-04-002	BOLT, Hex 1/4 UNC x .5
7	2	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



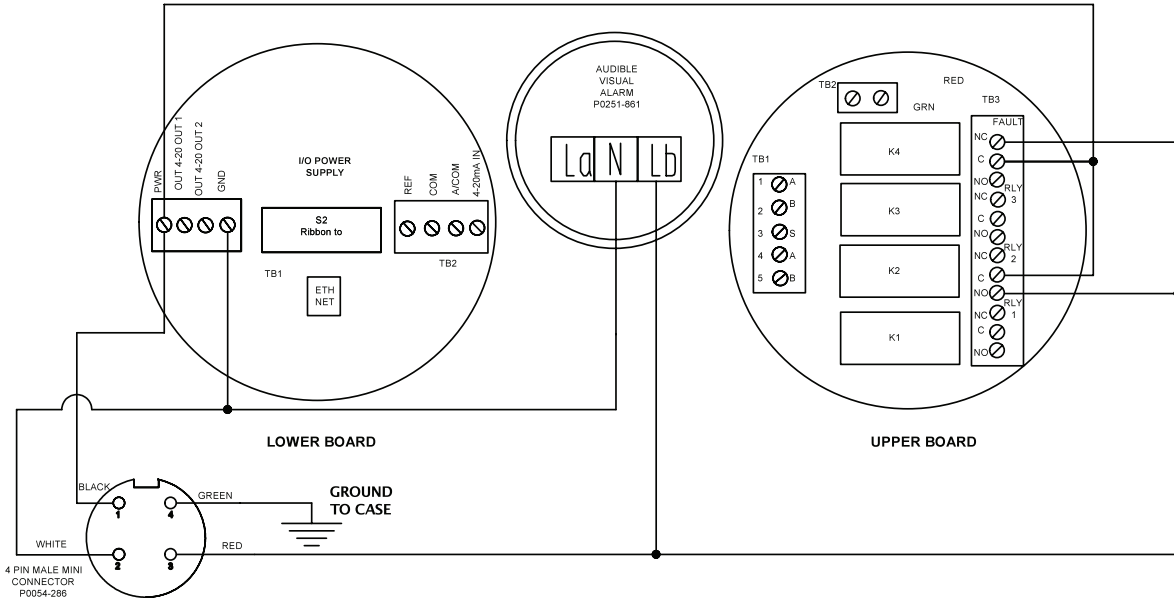
ITEM	QTY	PART NO.	DESCRIPTION
0	1	031499A	GAS DETECTOR WITH ALARM ASSEMBLY
1	1	S10057A	DETECTOR, Gas (Includes item 1a)
1a	1	P0251-197A	ELEMENT, Sensor
2	1	P0251-861	SOUNDER, Panel Mount, w/LED
3	1	P0310-105	BOX
4	1	P0310-154	COVER
5	1	P0054-286	RECEPTACLE, Mini
6	2	P0300-012	FITTING, 12MP-08FPS
7	1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

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

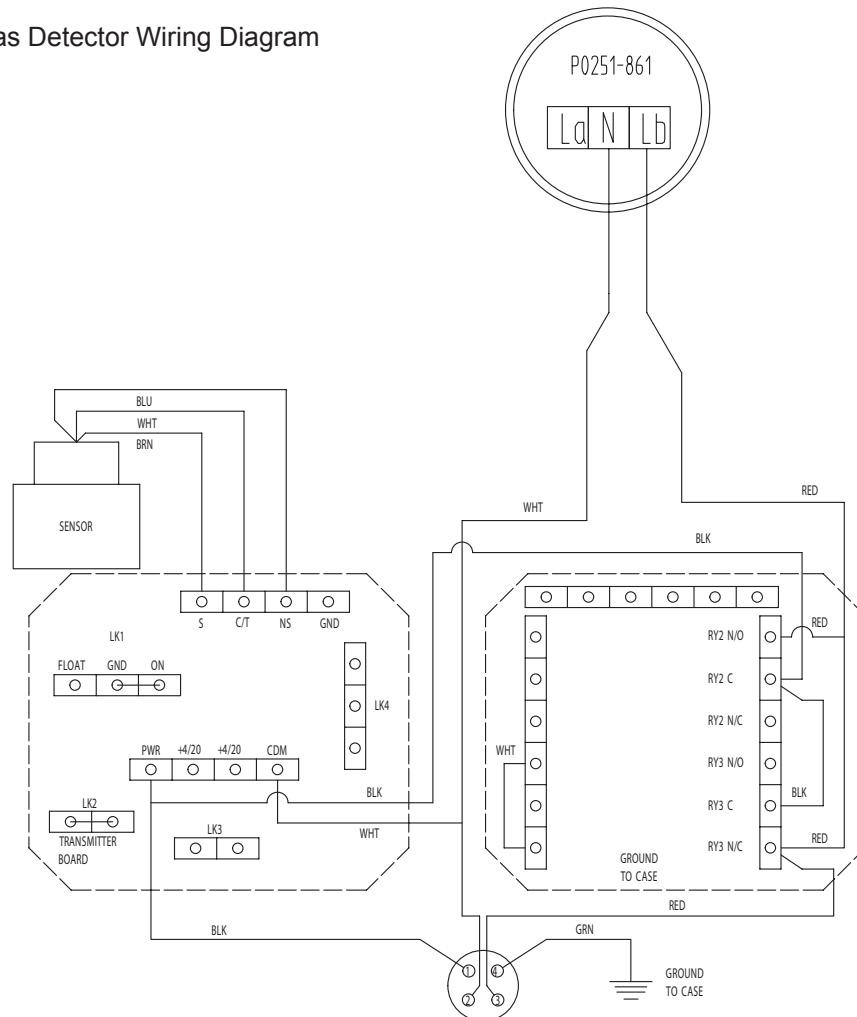
GAS DETECTOR WIRING DIAGRAM, 031499A

TBM Series II, D Series - Later Units

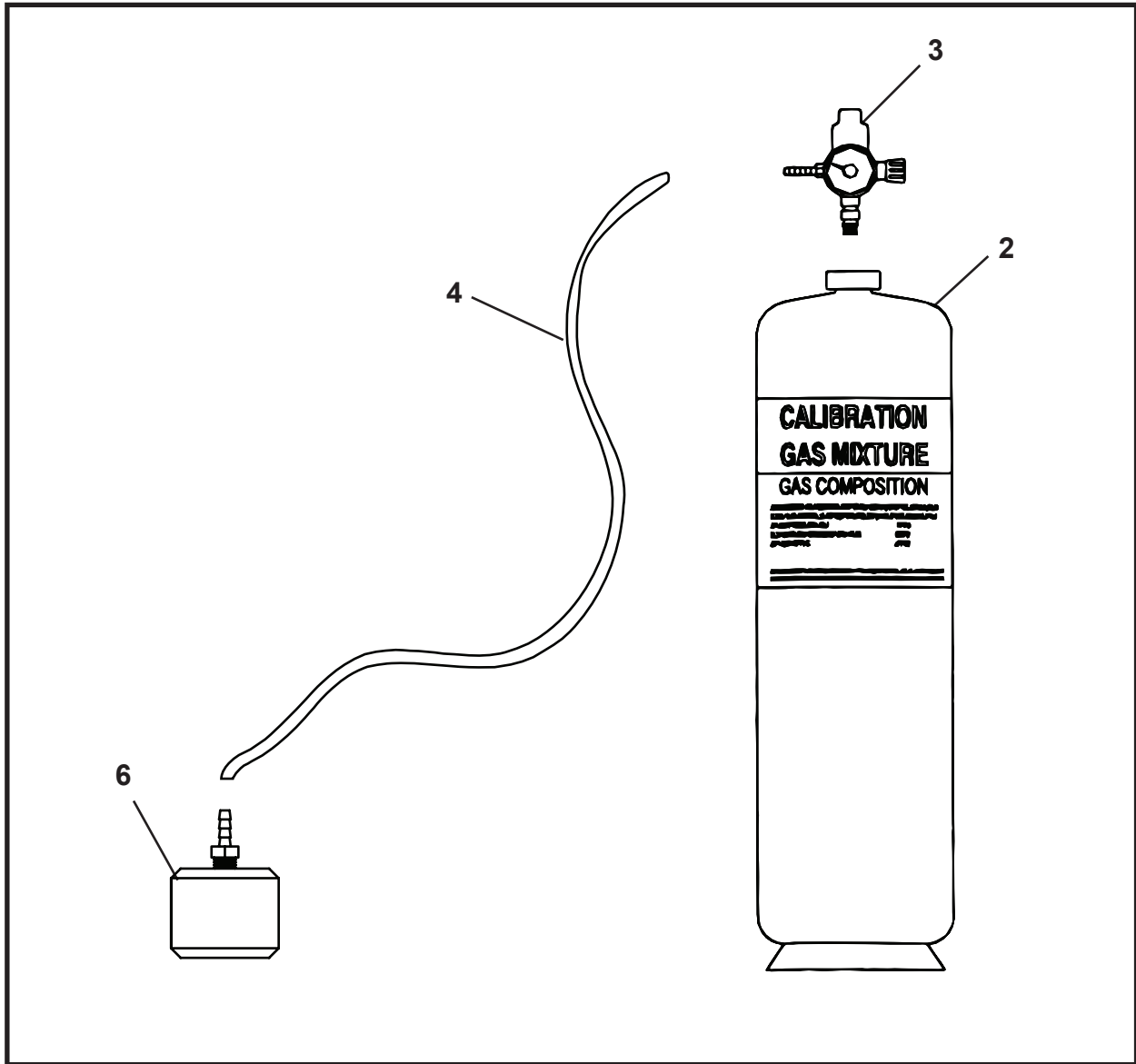
Buckeye Gas Detector Wiring Diagram



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

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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

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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.

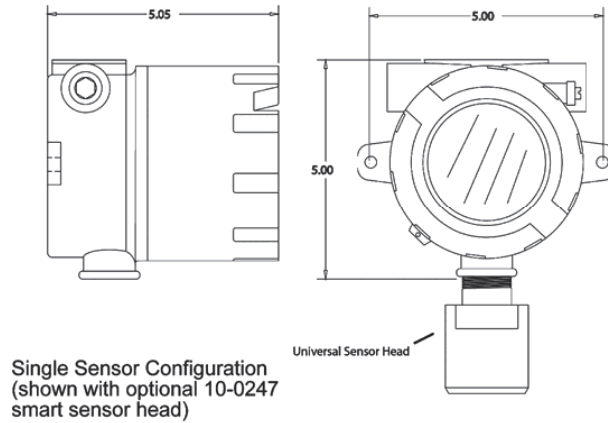


Figure 3-1 BFT-44 Explosion-Proof Housing

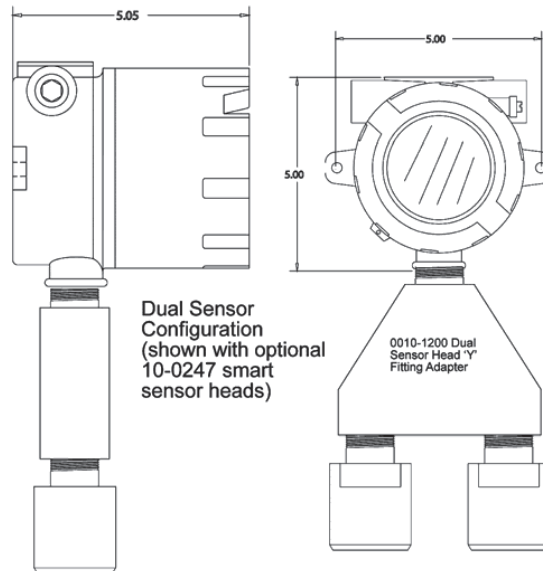


Figure 3-2 BFT-44 Explosion-Proof Housing with Dual Sensor Head Adaptor

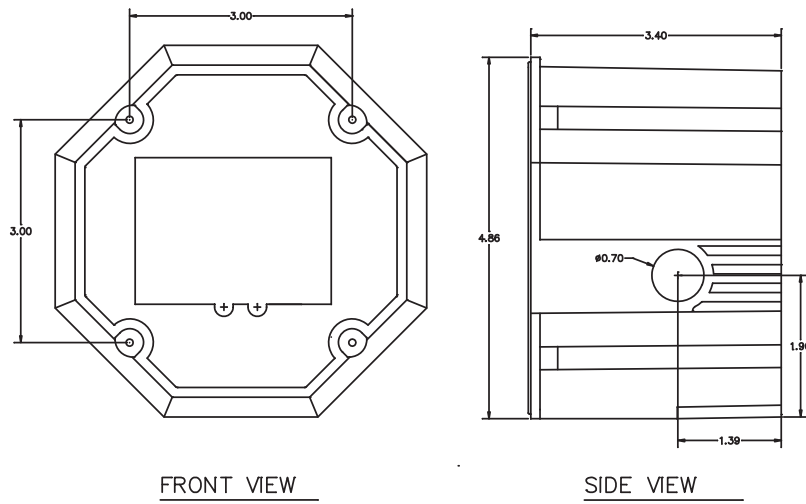


Figure 3-3 BFT-44 Poly Enclosure without Sensor Head

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



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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.

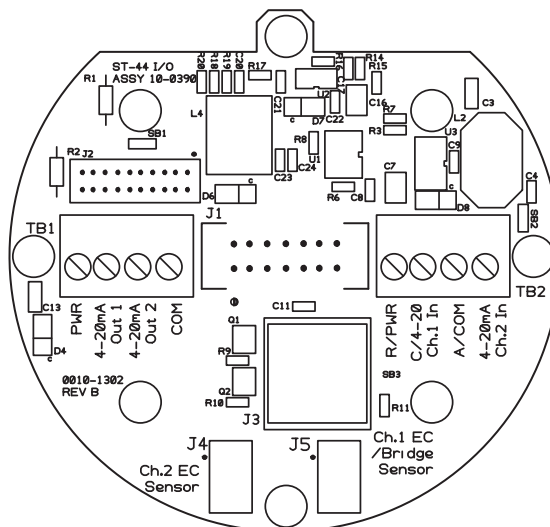


Figure 3-4 BFT10-0390 BFT-44 I/O Power Supply Board

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.

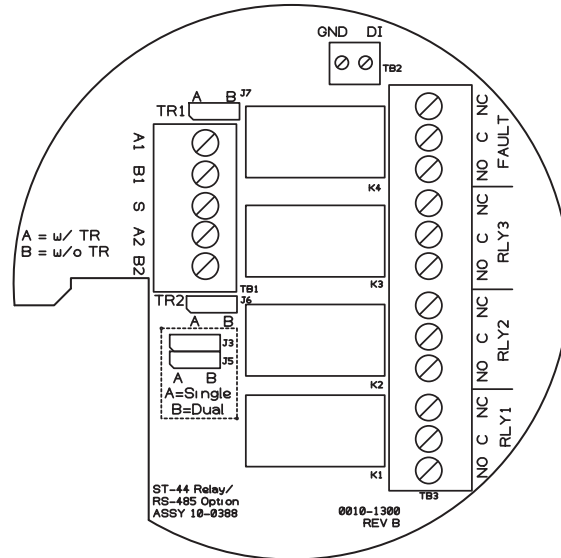


Figure 3-5 BFT10-0388 Relay/RS-485 Option Board

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.

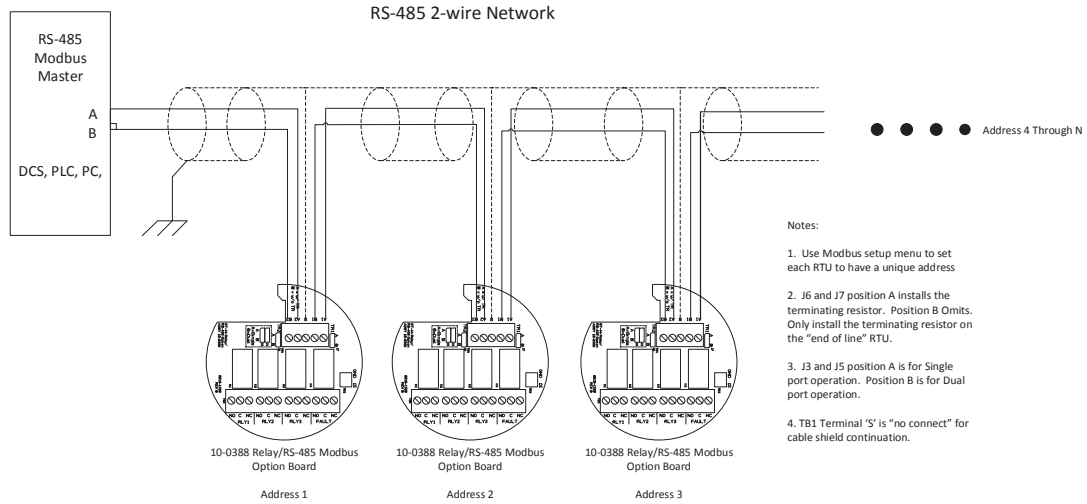


Figure 3-6 RS-485 Modbus Wiring

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.

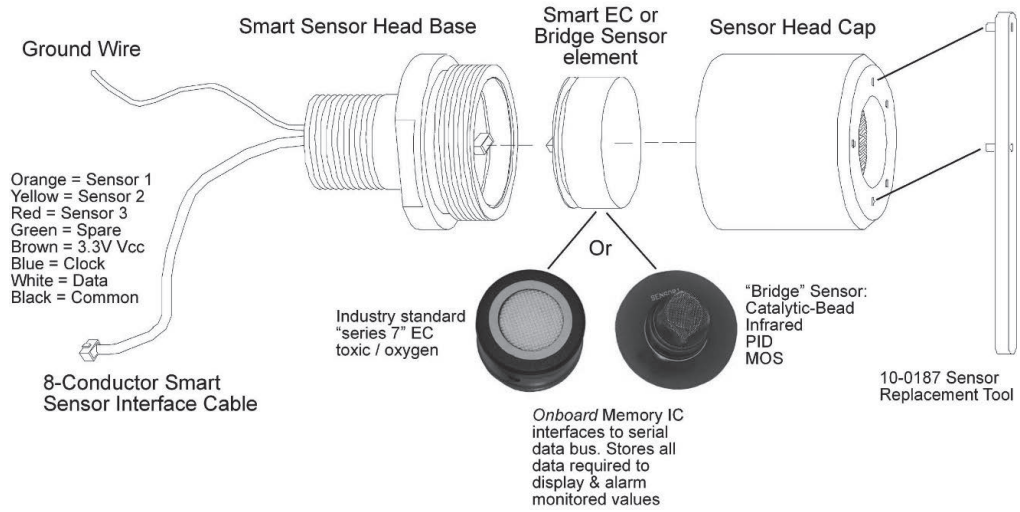


Figure 3-7 BFT10-0247 Smart Sensor Head Assembly



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.

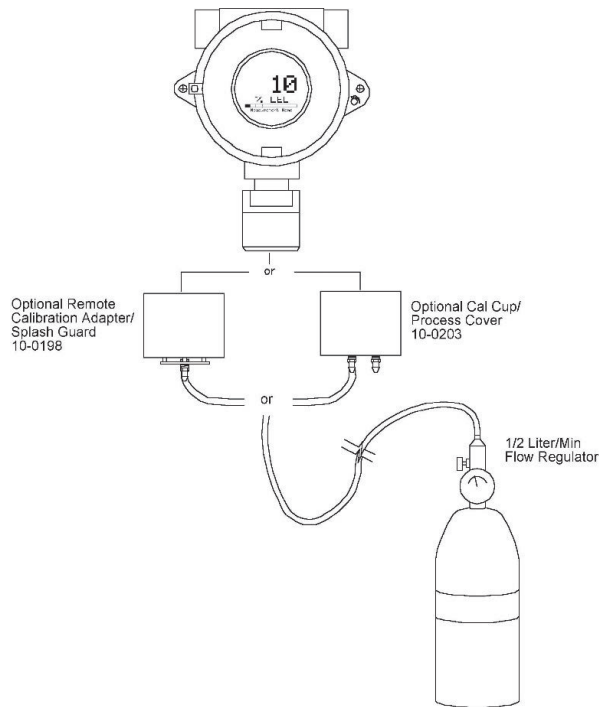


Figure 4-1 Calibration Gas Input

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.

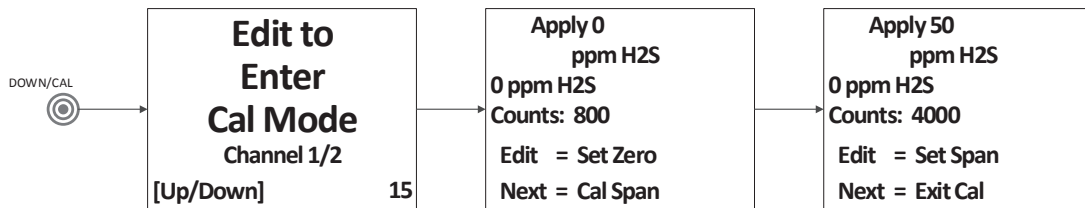


Figure 4-2 Cal Mode Flowchart and Menus

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

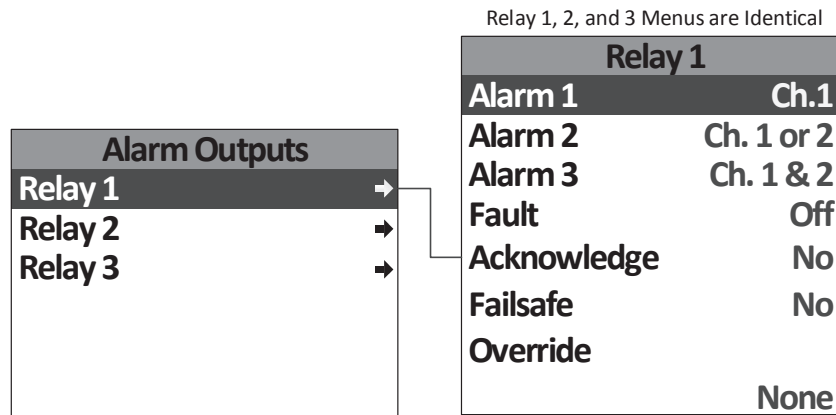


Figure 4-3 Alarm Outputs Menu Tree

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

Relay 1	
Alarm 1	Ch.1
Alarm 2	Ch. 1 or 2
Alarm 3	Ch. 1 & 2
Fault	Off
Acknowledge	No
Failsafe	No
Override	None

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.

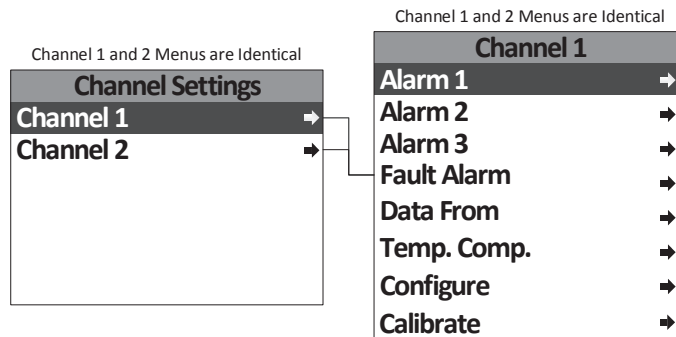


Figure 4-5 Channel 1/2 Menu Tree

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**.

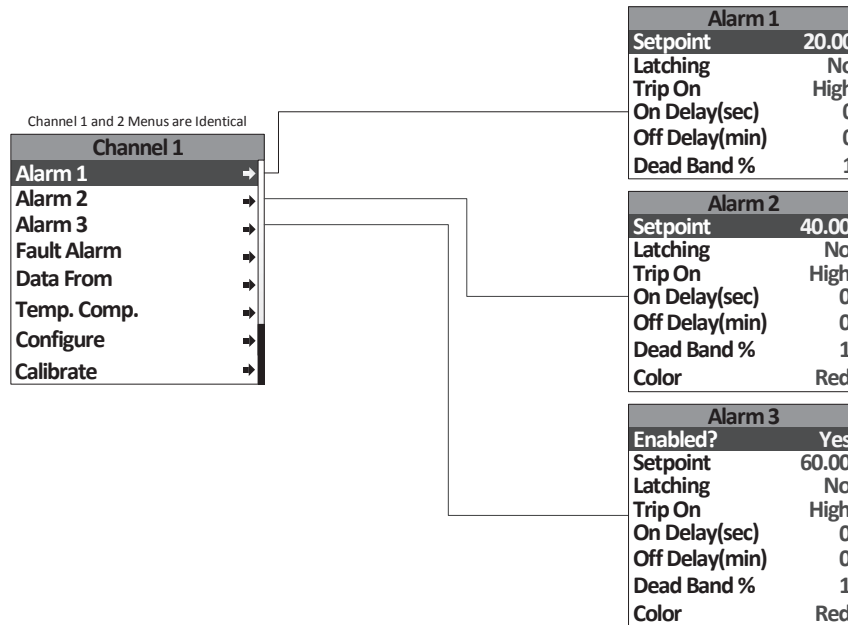


Figure 4-6 Alarm 1/2/3 Menu Tree

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

Data From	
EC Sensor	
Remote Sensor	No
Min Raw	800
Max Raw	4000
Filter (second)	20
Polarity	NEG
PGA Gain	→
Heater Enabled	No
Heat(degC)	25.00
Local Cal	Yes

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

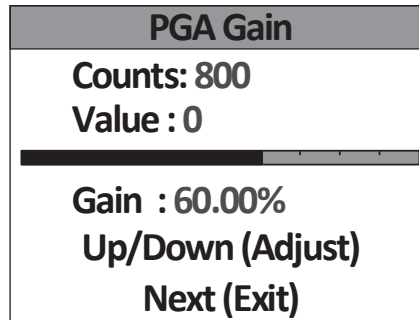


Figure 4-8 PGA Gain Menu

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*

Ch.1/2 Sensor	
Type:	ppm H2S
Zero:	0
Span:	100
SN:	XXXXXXXXXXXXXX
Born on:	12/12/12
Last cal:	12/12/12

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

Data From	
Bridge Sensor	
Remote Sensor	No
Min Raw	800
Max Raw	4000
Filter (second)	20
PGA Gain	→
Bridge Volts	→
Balance	→
Local cal	Yes

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*

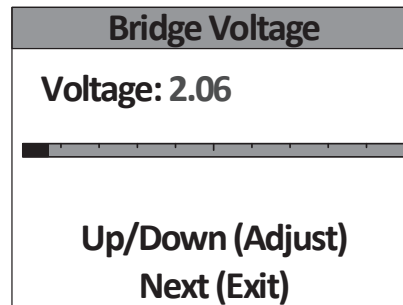


Figure 4-11 Bridge Voltage Adjust Menu

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*

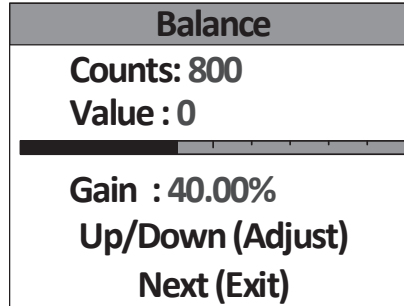


Figure 4-12 Bridge Balance Adjust Menu

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*

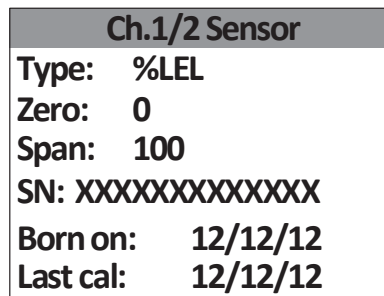


Figure 4-13 Sensor Information Screen

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

Configure	
Measurement Name	
E.Unit	PCTLEL
Zero	0.00
Span	100.00
Decimal Points	0
Channel On?	Yes
Deadband (%)	1.00
InCal mA	3.00
Backup/Restore	➔

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

Backup/Restore	
Copy To Ch.2	→
Restore Defaults	→
Save Backup	→
Restore Backup	→
Upload From Sensr	→

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

Calibrate	
Offset	0.00
Gain	1.00
Cal Zero	0.00
Cal Span	50.00
Set Unity Gain	→

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

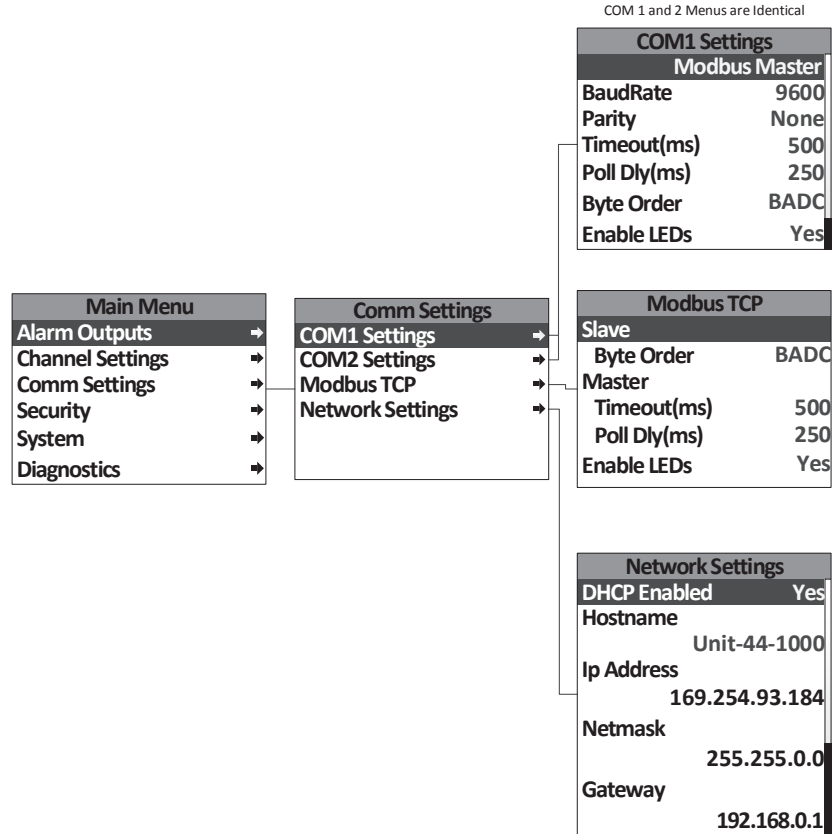


Figure 4-23 Comm Settings Menu Tree

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

COM1 Settings	
Modbus Master	
BaudRate	9600
Parity	None
Timeout(ms)	500
Poll Dly(ms)	250
Byte Order	BADC
Enable LEDs	Yes

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

Network Settings	
DHCP Enabled	Yes
Hostname	Unit-44-1000
Ip Address	169.254.93.184
Netmask	255.255.0.0
Gateway	192.168.0.1

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

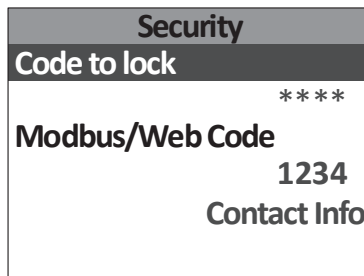


Figure 4-27 Security Menu

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

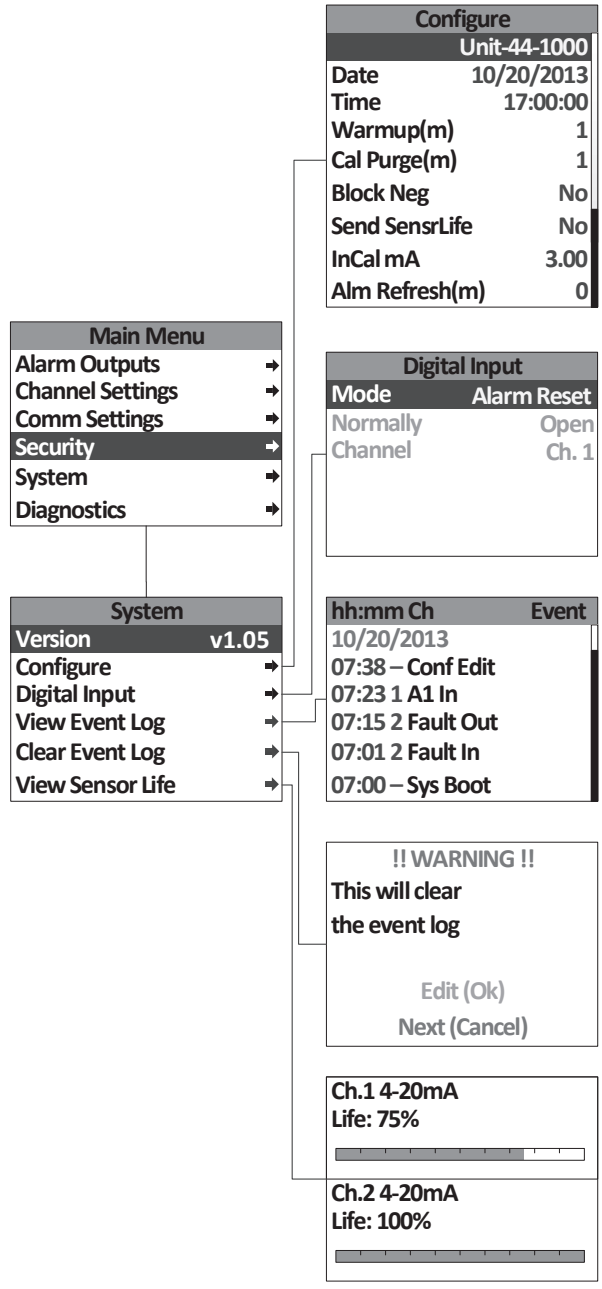


Figure 4-28 System Menu Tree

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

System	
Version	v1.05
Configure	→
Digital Input	→
View Event Log	→
Clear Event Log	→
View Sensor Life	→

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

Configure	
Unit-44-1000	
Date	10/20/2013
Time	17:00:00
Warmup(m)	1
Cal Purge(m)	1
Block Neg	No
Send SensrLife	No
Alm Refresh(m)	0

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 SENSLIFE

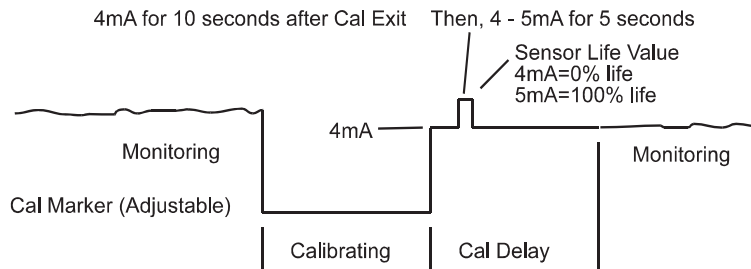


Figure 4-31 Send SensrLife Timing Diagram

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

Digital Input	
Mode	Alarm Reset
Normally Channel	Open Ch. 1

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

hh:mm Ch	Event
10/20/2013	
07:38	– Conf Edit
07:23 1	A1 In
07:15 2	Fault Out
07:01 2	Fault In
07:00	– Sys Boot

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

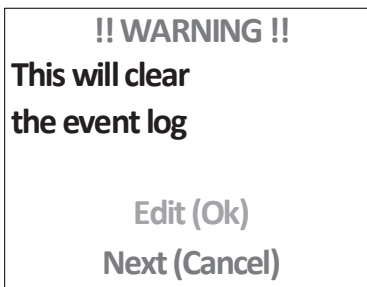


Figure 4-34 Clear Event Log System Menu

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

4.7.6 VIEW SENSOR LIFE

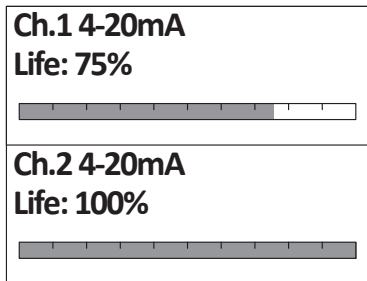


Figure 4-35 View Sensor Life System Menu

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

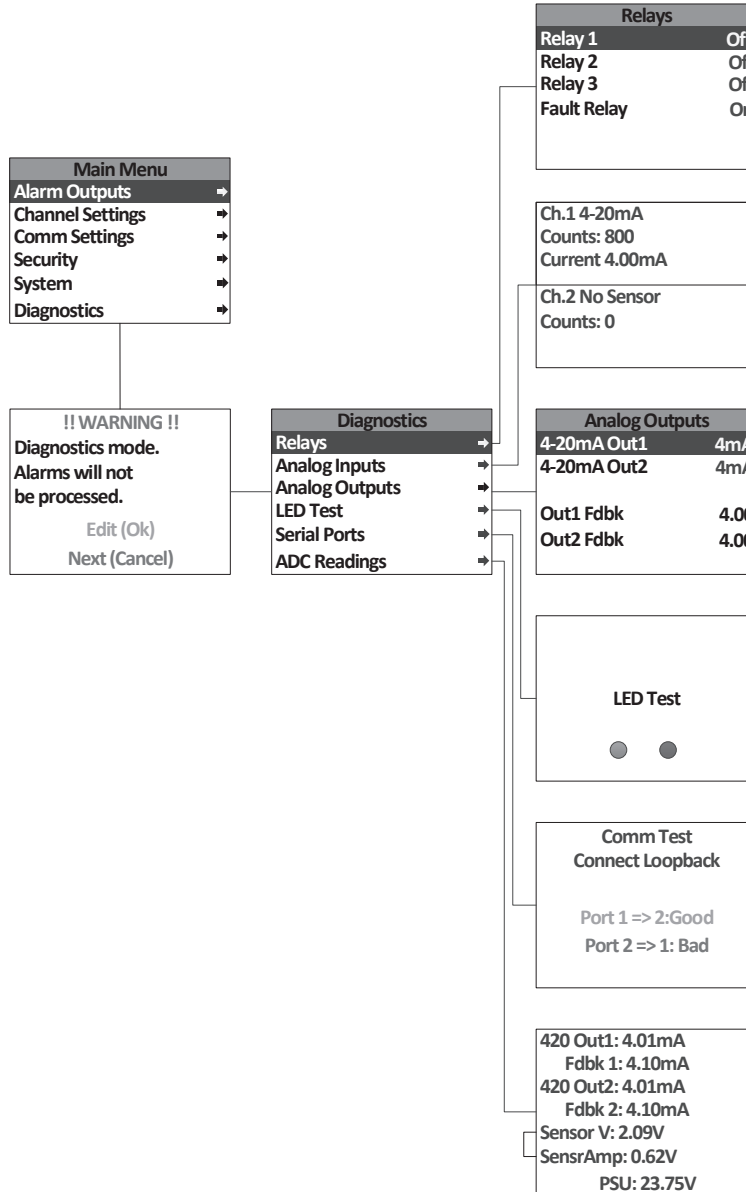


Figure 4-36 Diagnostics Menu Tree

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

Relays	
Relay 1	Off
Relay 2	Off
Relay 3	Off
Fault Relay	On

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

<p>Ch.1 4-20mA Counts: 800 Current 4.00mA</p>
<p>Ch.2 No Sensor Counts: 0</p>

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

Analog Outputs	
4-20mA Out1	4mA
4-20mA Out2	4mA
Out1 Fdbk	4.03
Out2 Fdbk	4.04

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

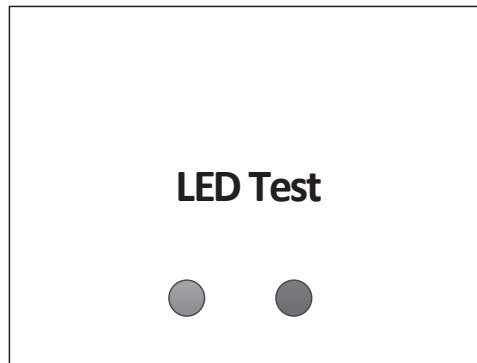


Figure 4-40 LED Test Diagnostics Menu

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



4.8.5 SERIAL PORTS

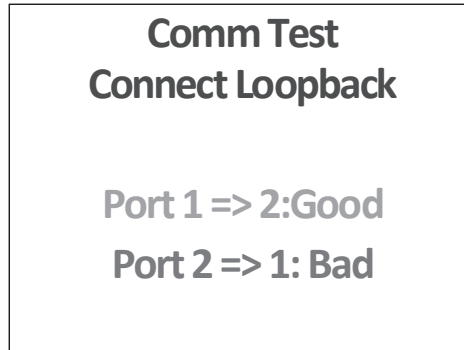


Figure 4-41 Serial Ports Diagnostics Menu

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

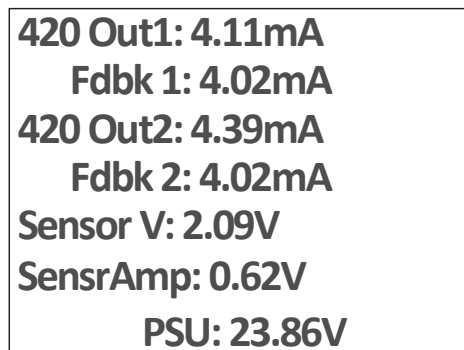


Figure 4-42 ADC Readings Diagnostics Menu

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.

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.

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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.

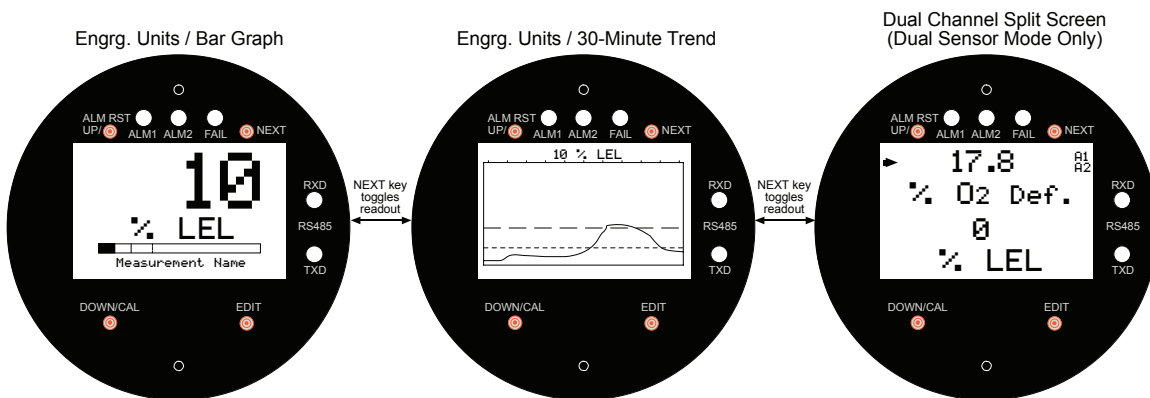


Figure 2-1: Data Displays

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.

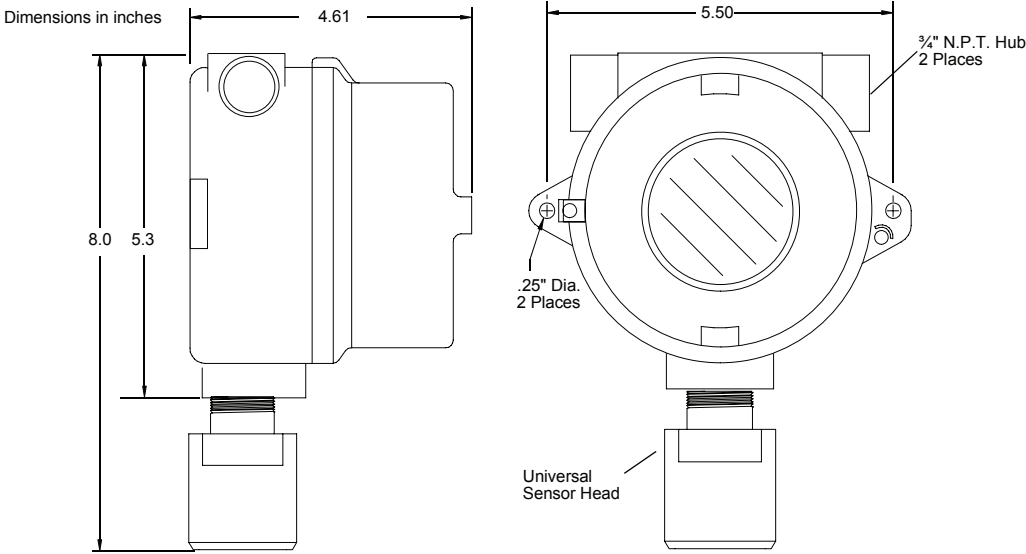


Figure 2-2: GASMAX Explosion-Proof Housing

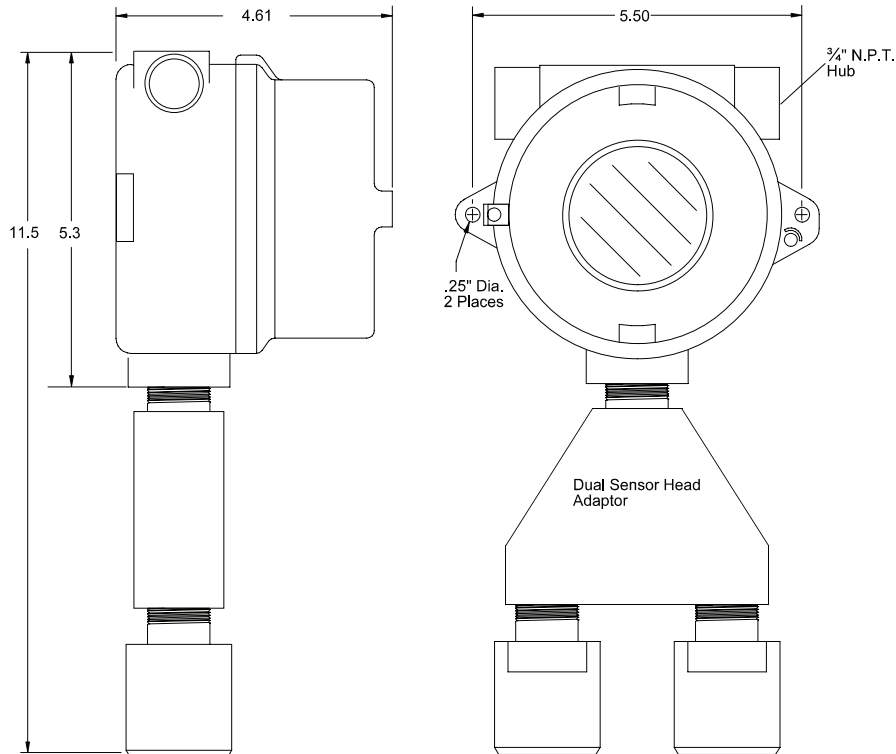


Figure 2-2a: GASMAX Explosion-Proof Housing with Dual Sensor Head Adaptor

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.

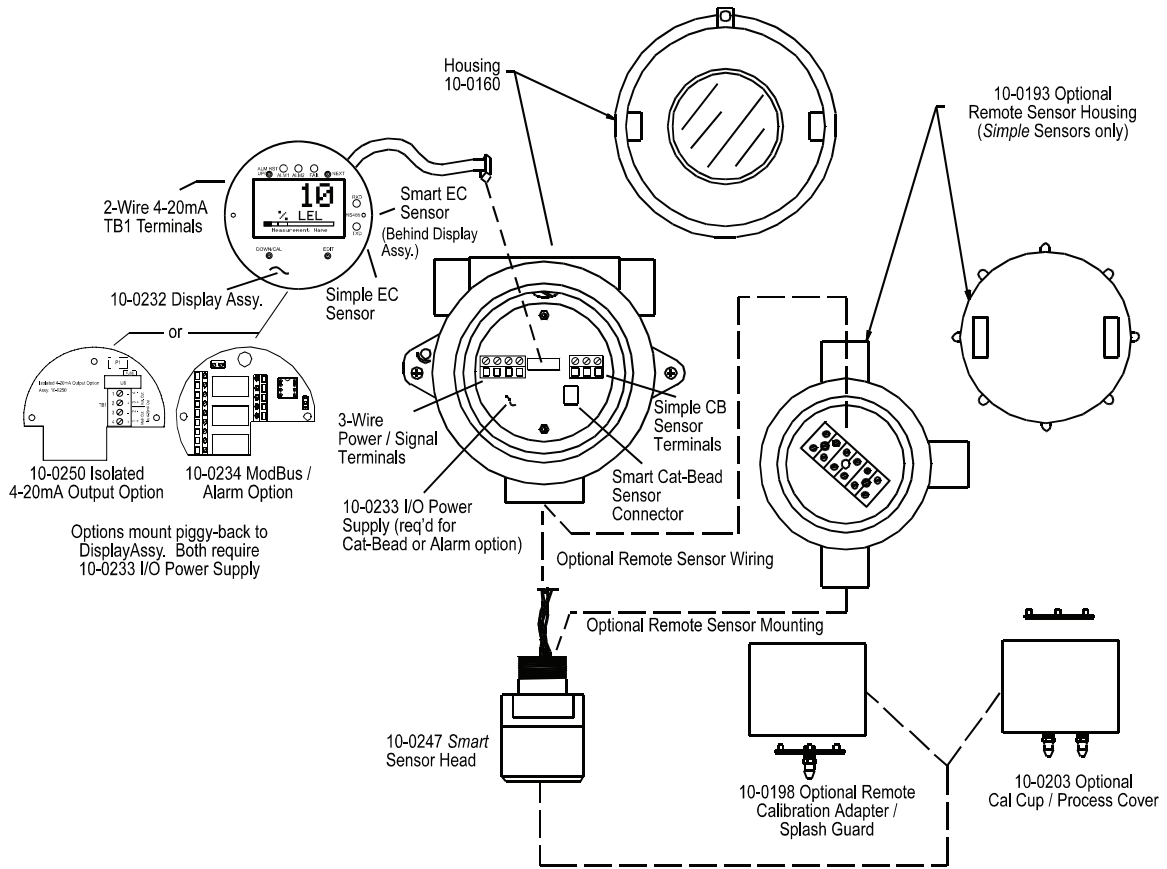


Figure 2-3: Outline Drawing

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 as 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.

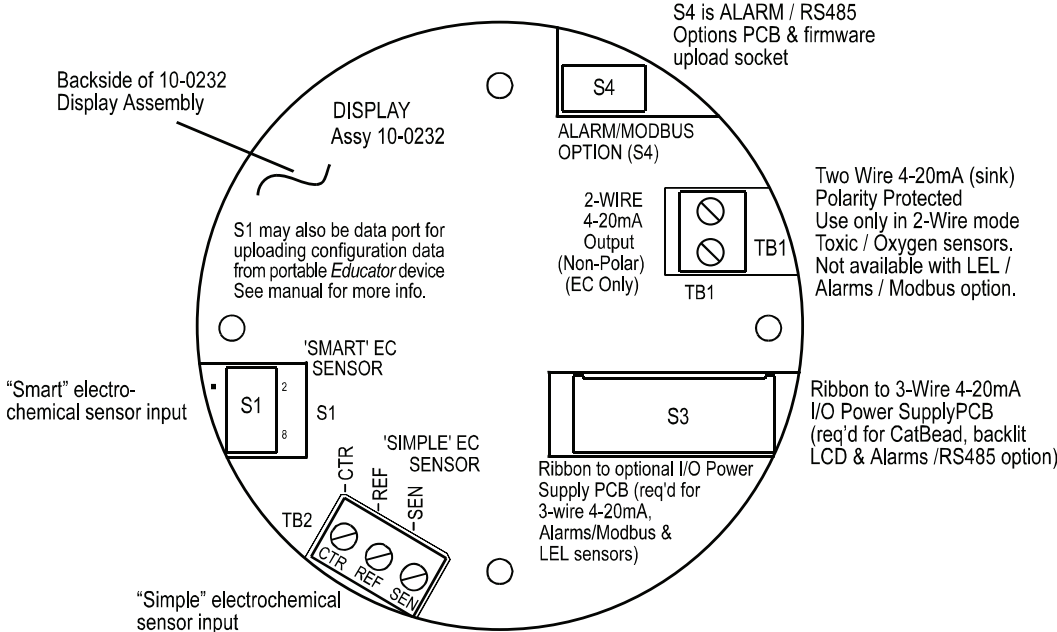


Figure 2-4: 10-0232 Display / 2-Wire 4-20mA Assembly

2.8 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.

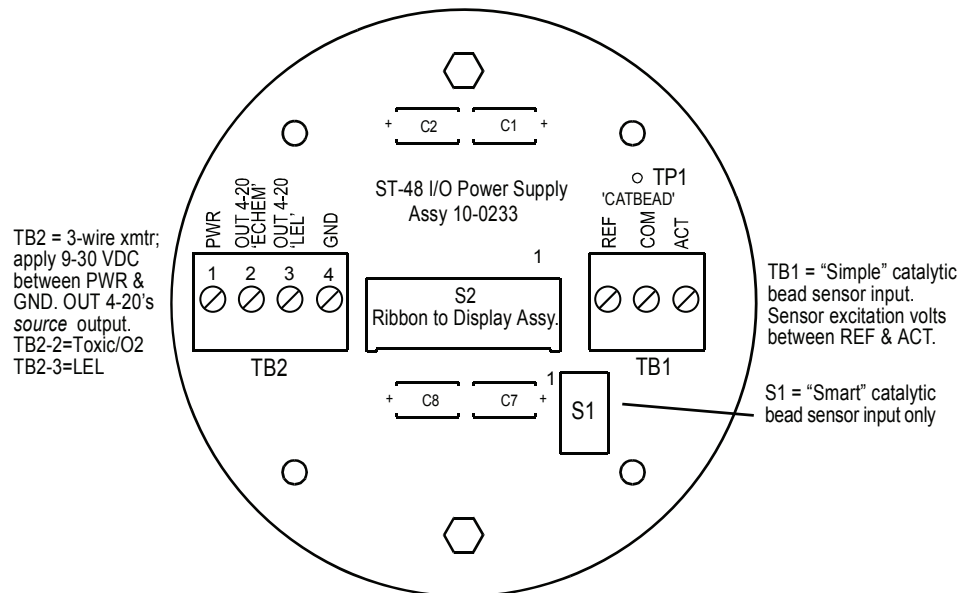


Figure 2-5: 10-0233 I/O Power Supply / 3-Wire 4-20mA Assembly

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.

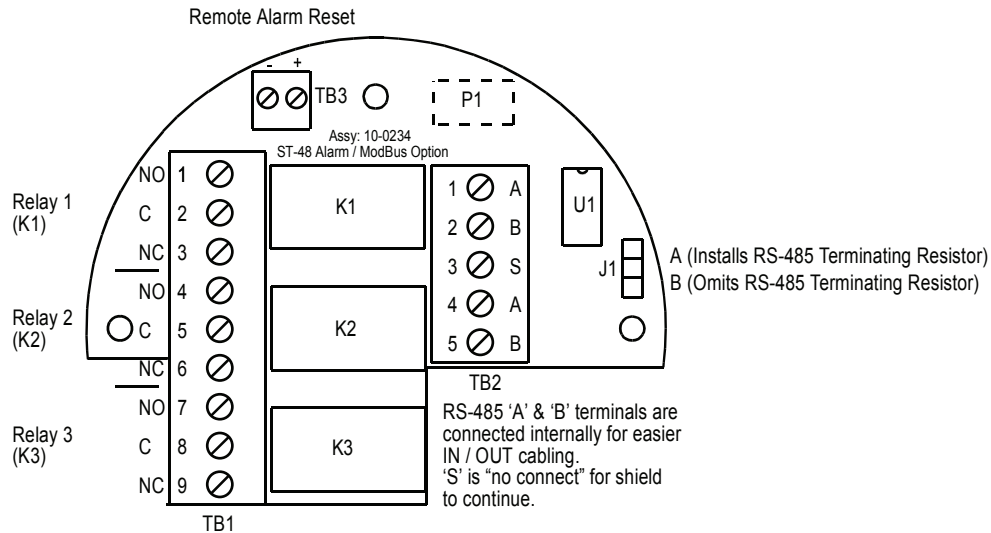


Figure 2-6: 10-0234 Alarm Relays / Modbus Option

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.

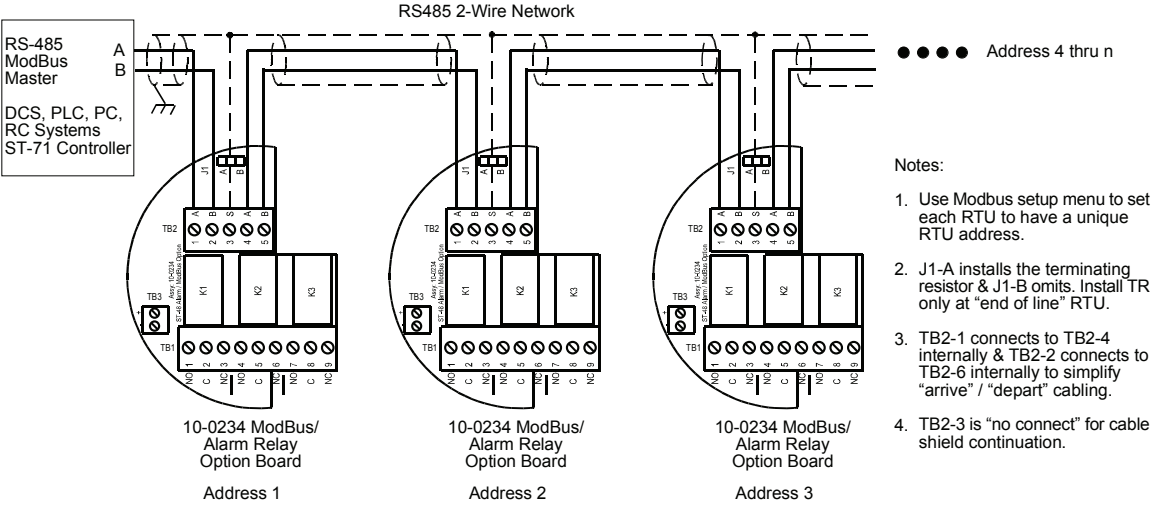


Figure 2-7: RS-485 Modbus Wiring

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).

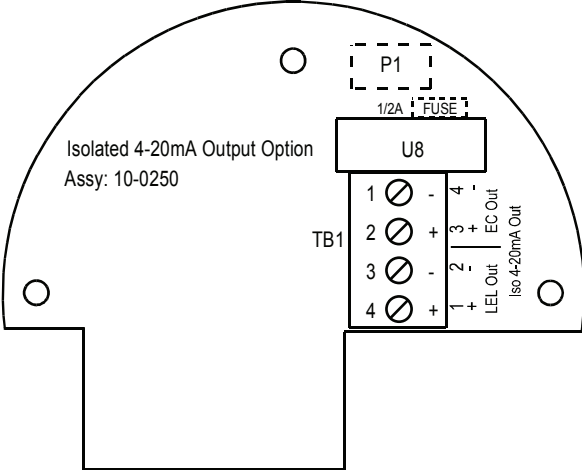


Figure 2-8: 10-0250 Isolated 4-20mA Output Option

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).

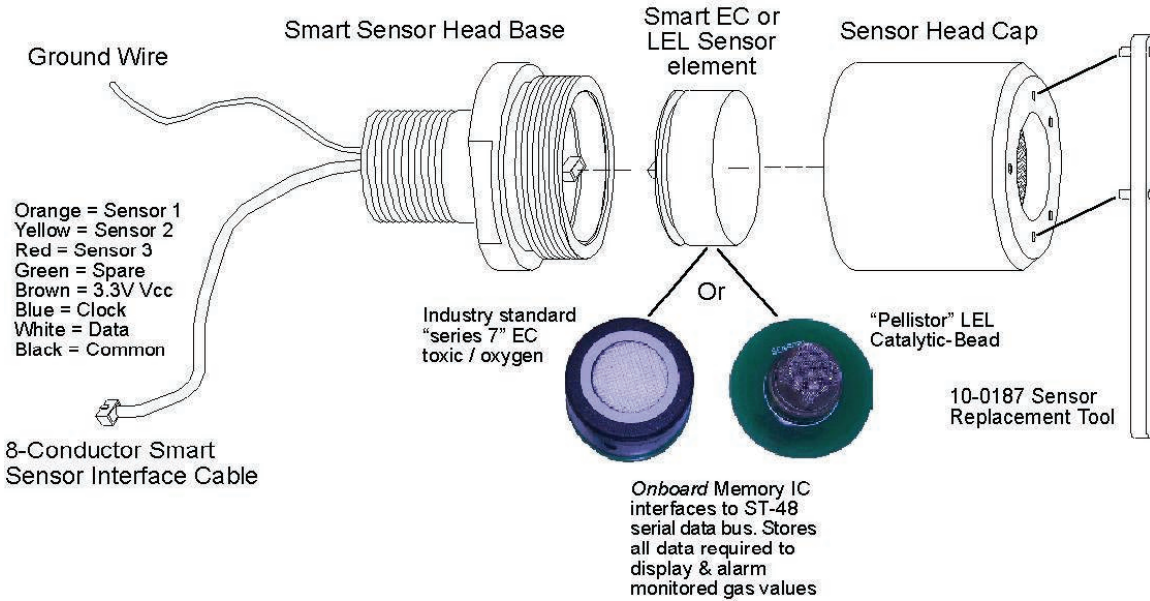


Figure 2-9: 10-0247 Smart Sensor Head Assembly

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).

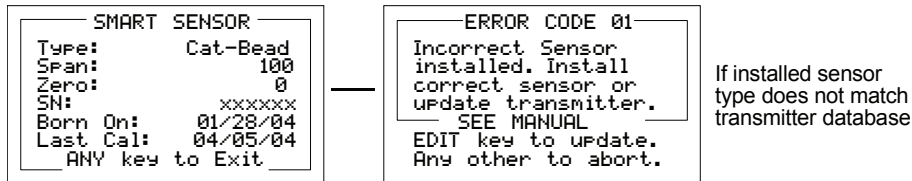


Figure 2-10: Smart Sensor Info / ERROR Screens

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.

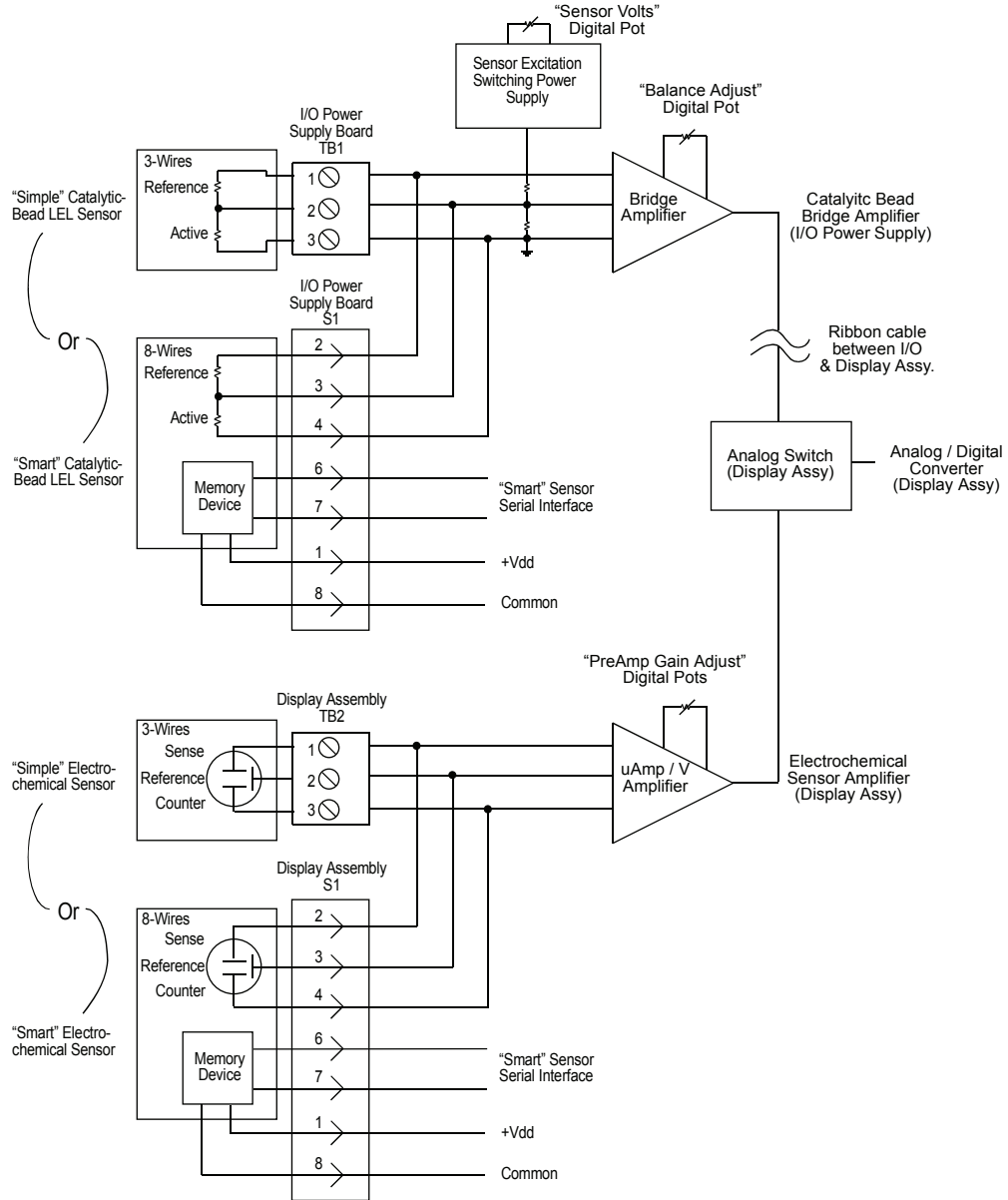


Figure 2-11: GASMAX Block / Wiring Diagram

SECTION 3 – INITIAL START-UP

3.1 “Transmitter Configuration” Menu

Figure 3-1 shows 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).

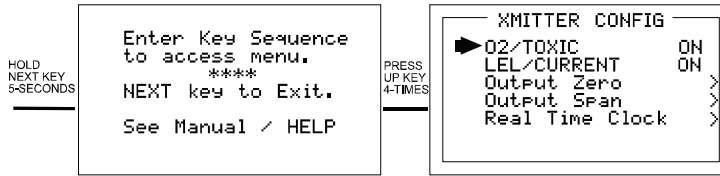


Figure 3-1: Transmitter Configuration Menu

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.

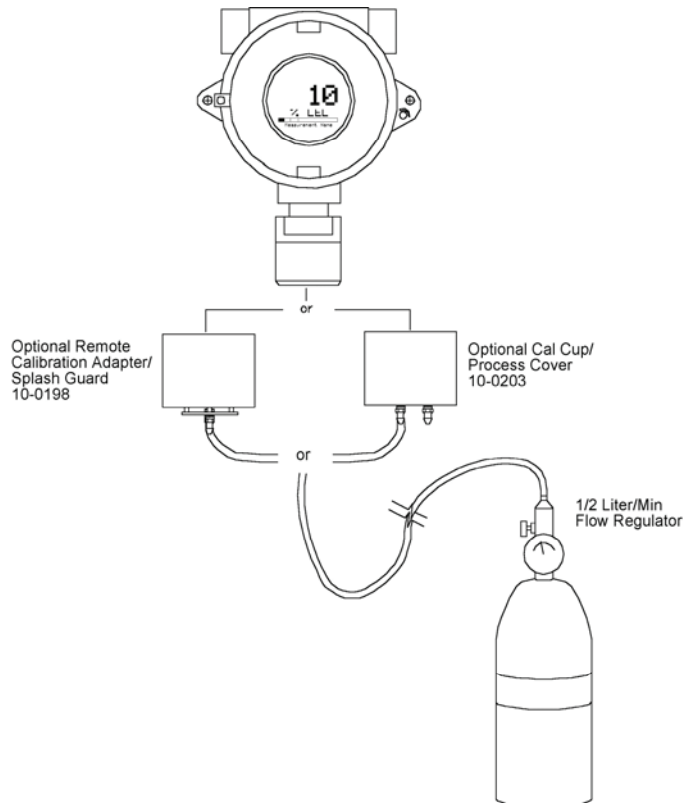


Figure 4-1: Calibration Gas Input

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).

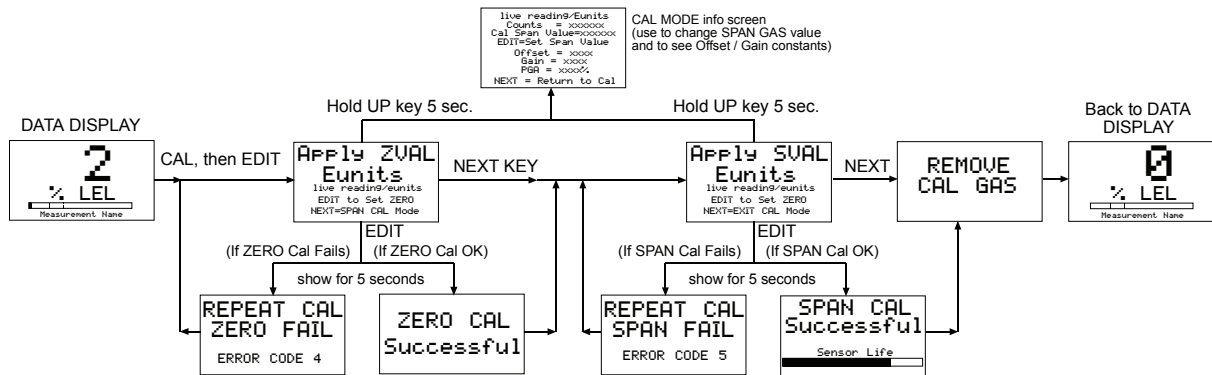


Figure 4-2: Cal-Mode Flow Chart and Menus

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!

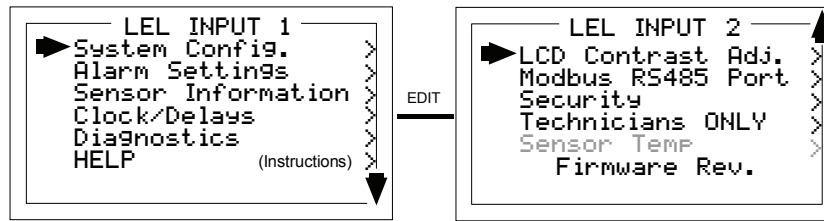
CAUTION: Missing or failed sensors always trip Alarm 3 and relay K3 (if equipped). This is true even with A3 configured as a level alarm and it must be accepted that A3 level alarm events might be caused by the monitored level, or, by a missing or failed sensor.

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.



“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.

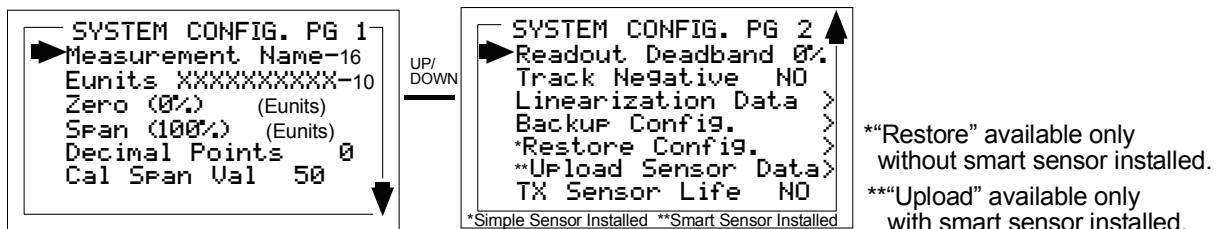


Figure 5-3: System Config. Menus

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.

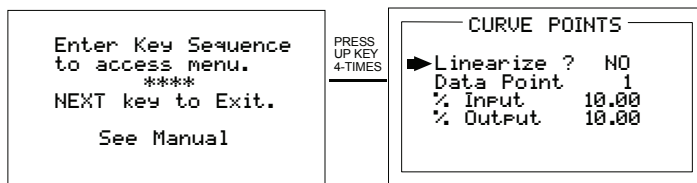


Figure 5-4: Linearization Menu

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.

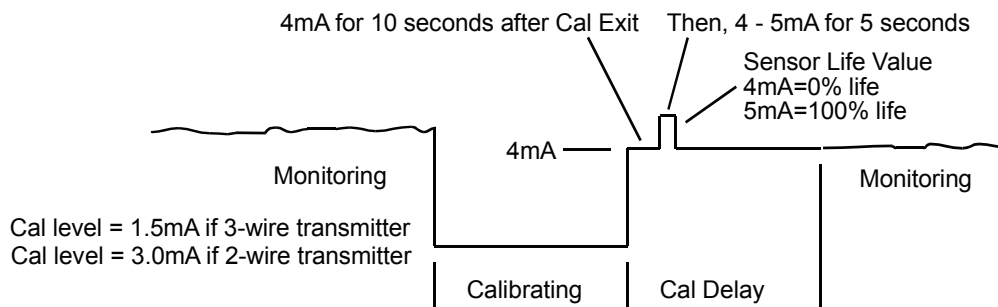


Figure 5-5: Transmit Sensor Life Timing Diagram

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.

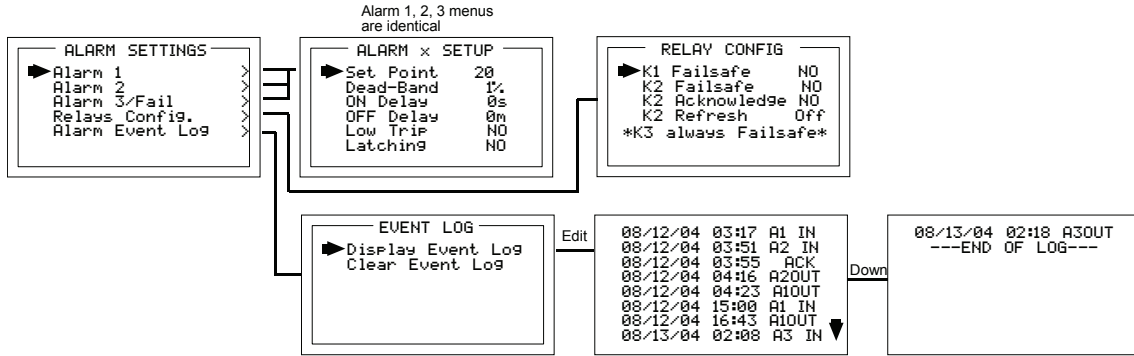


Figure 5-6: Alarm Settings Menus

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.

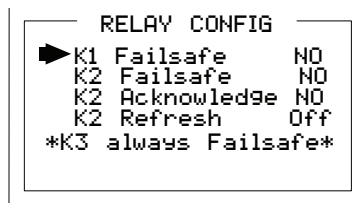


Figure 5-7: Relay Config. Menu

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

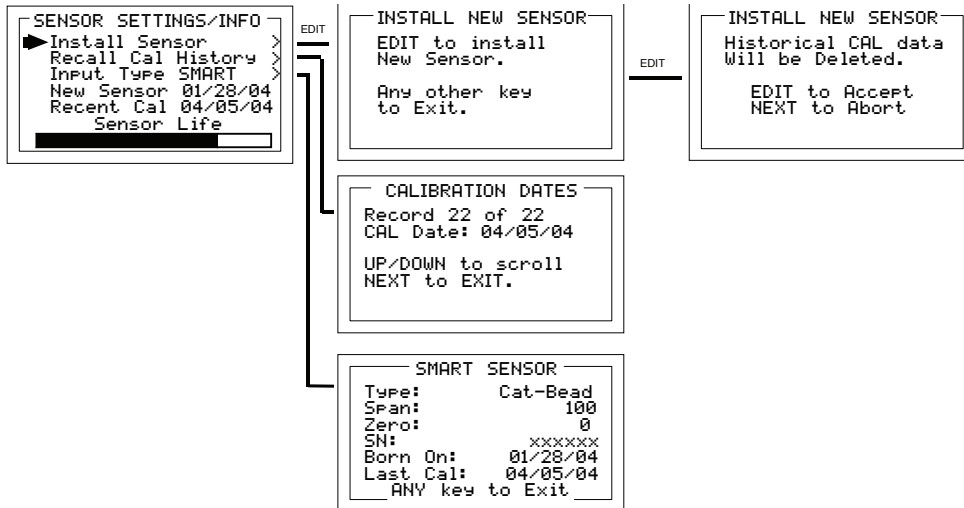


Figure 5-8: Sensor Information Menus

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.

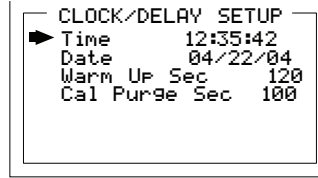


Figure 5-9: Clock & Calendar / Delay Timer Menu

5.7 LCD Contrast Adj:

LCD Contrast Adj. may be set for optimum viewing using the menu shown in Figure 5-10.

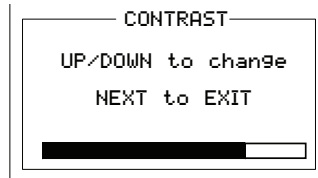


Figure 5-10: LCD Contrast Adjust Menu

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.

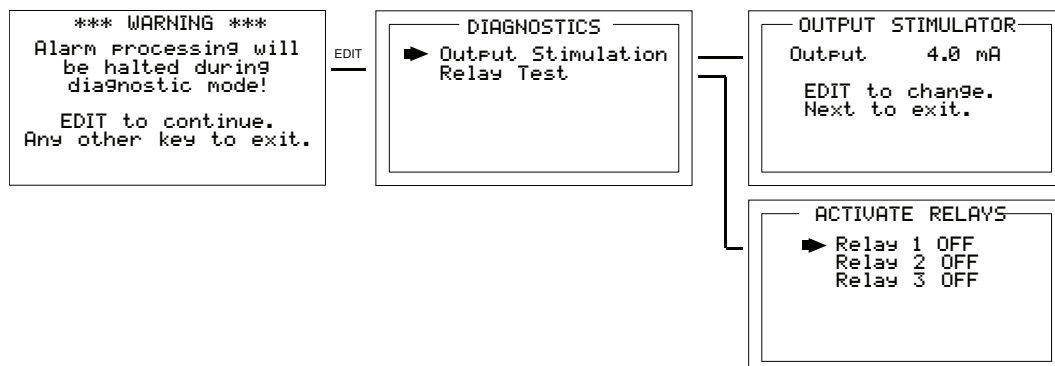


Figure 5-11: Diagnostics Menus

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.

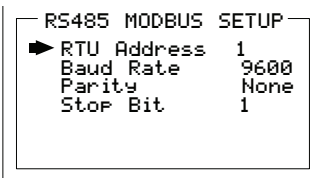


Figure 5-12: Modbus RS-485 Setup Menu

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.

$$Display\ Value = \frac{MODBUS\ Value \cdot (Span\ Value - Zero\ Value) \cdot 1.1}{32767} + \{Zero\ Value - [(Span\ Value - Zero\ Value) \cdot 0.05]\}$$

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.

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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 divisor 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.

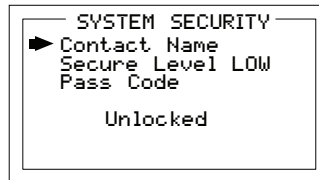


Figure 5-13: System Security Menu

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.

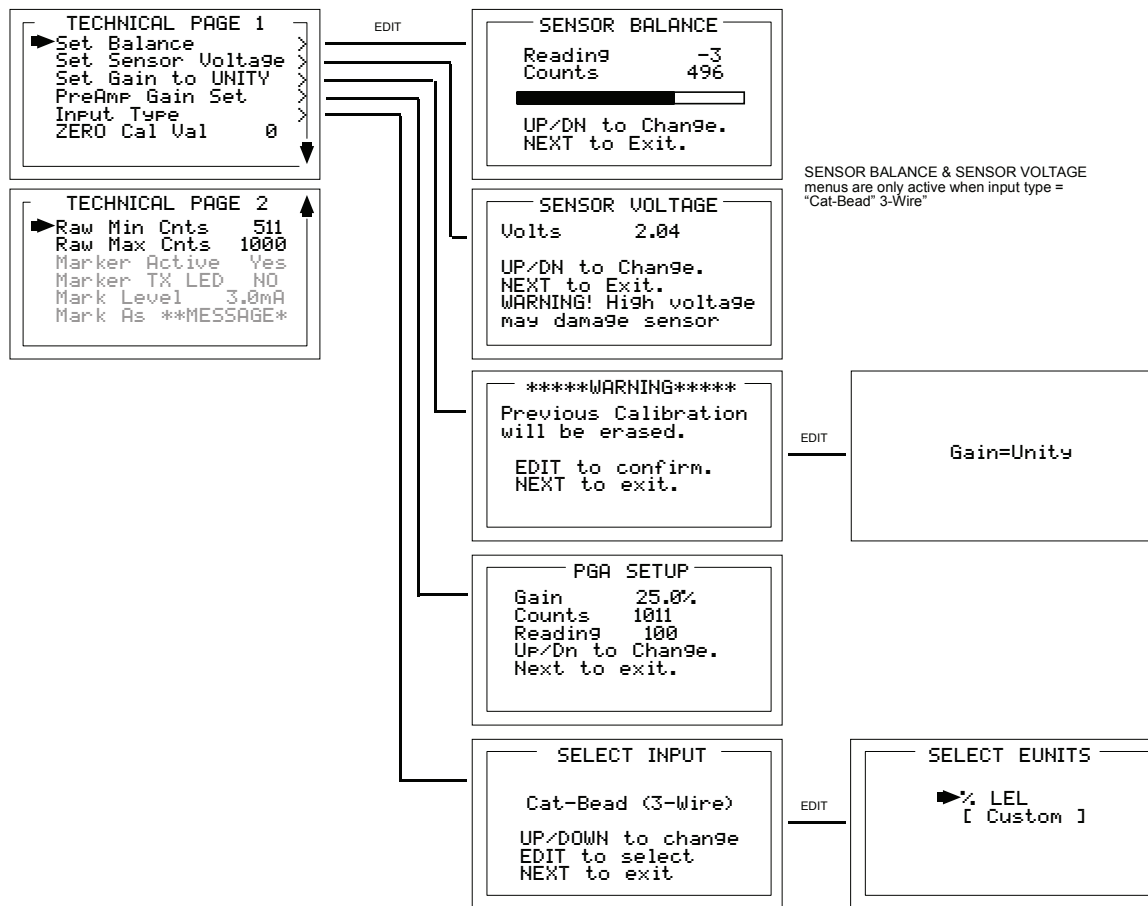


Figure 6-1: Technicians Menu Tree

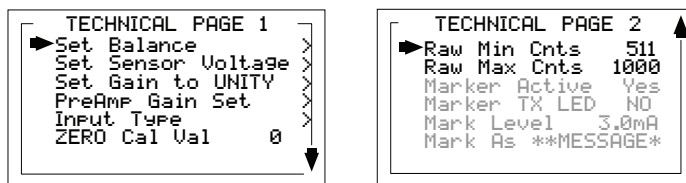


Figure 6-2: Technicians Menu Entry

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.

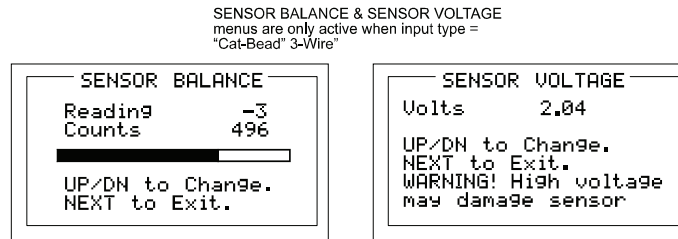


Figure 6-3: Catalytic Bead BALANCE & SENSOR VOLTS Adjust Menus

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.

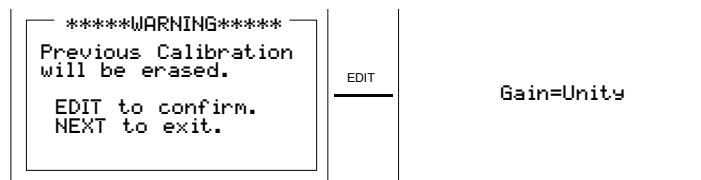


Figure 6-4: Set UNITY GAIN Menu

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.

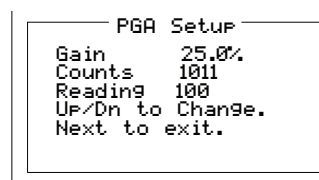


Figure 6-5: PreAmp Gain Adjust (PGA) Menu

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.

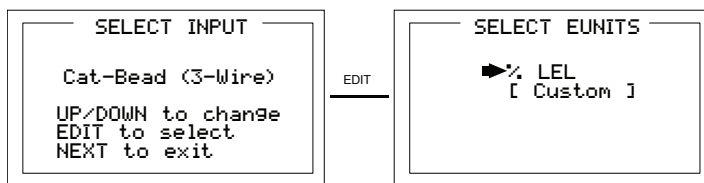


Figure 6-6: Input Type Selection Menu

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.

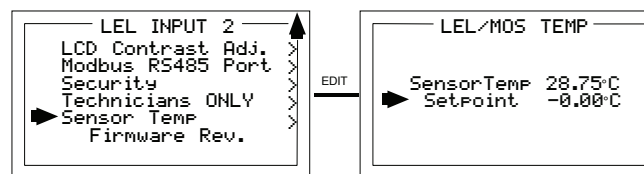


Figure 7-1: ARCTIC Sensor Temperature Menu

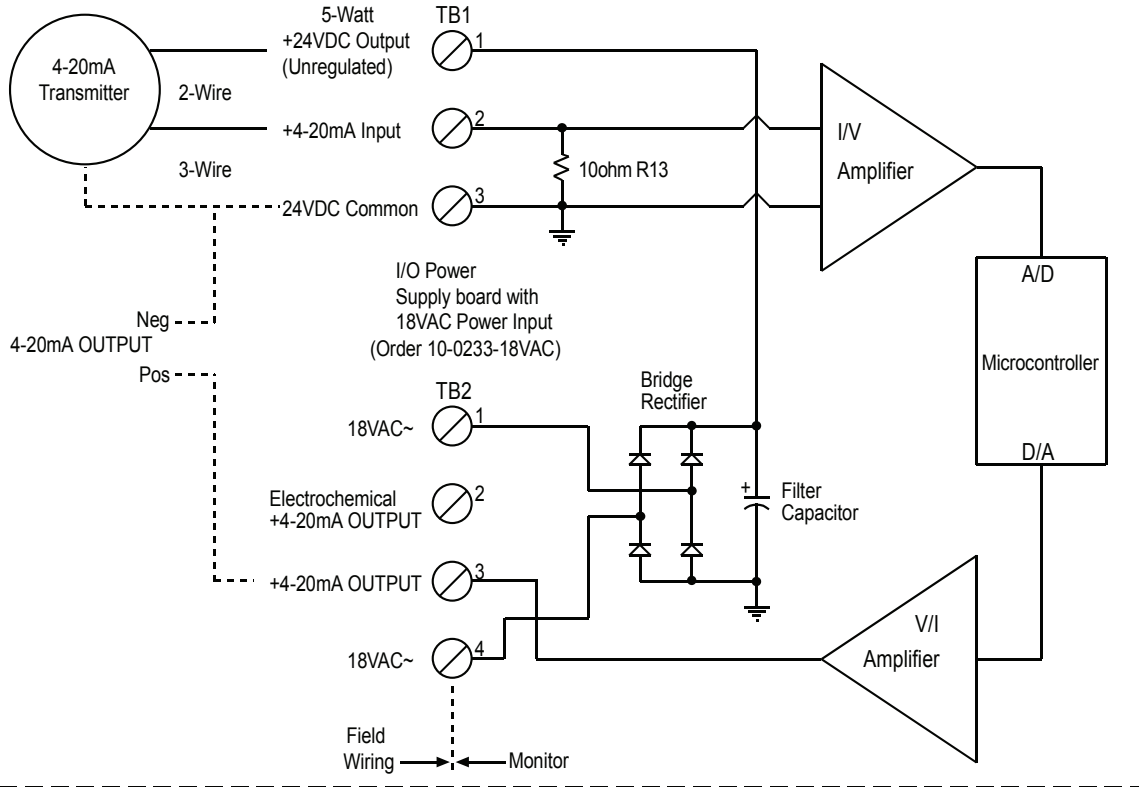
7.2 Special Order; 18VAC Primary Power Supply Option

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

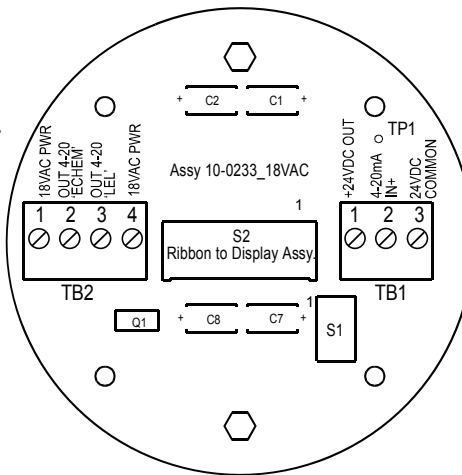
REVISION. The 10-0232 Display Assembly is the standard revision and Smart or Simple electrochemical Toxic / Oxygen sensors may still be connected as described in this manual.

Figure 7-2 shows physical and electrical wiring diagrams.



*10-0233_18VAC is a special configuration allowing power from an 18VAC~ power source and is available by special order. DO NOT APPLY 18VAC~ TO STANDARD UNITS!

*Apply 18VAC between 18VAC Terms. on TB2. 4-20 OUT +SIG Term. on TB2 sources output. Use 24VDC COMMON term. on TB1 for 4-20 OUT -SIG Term.

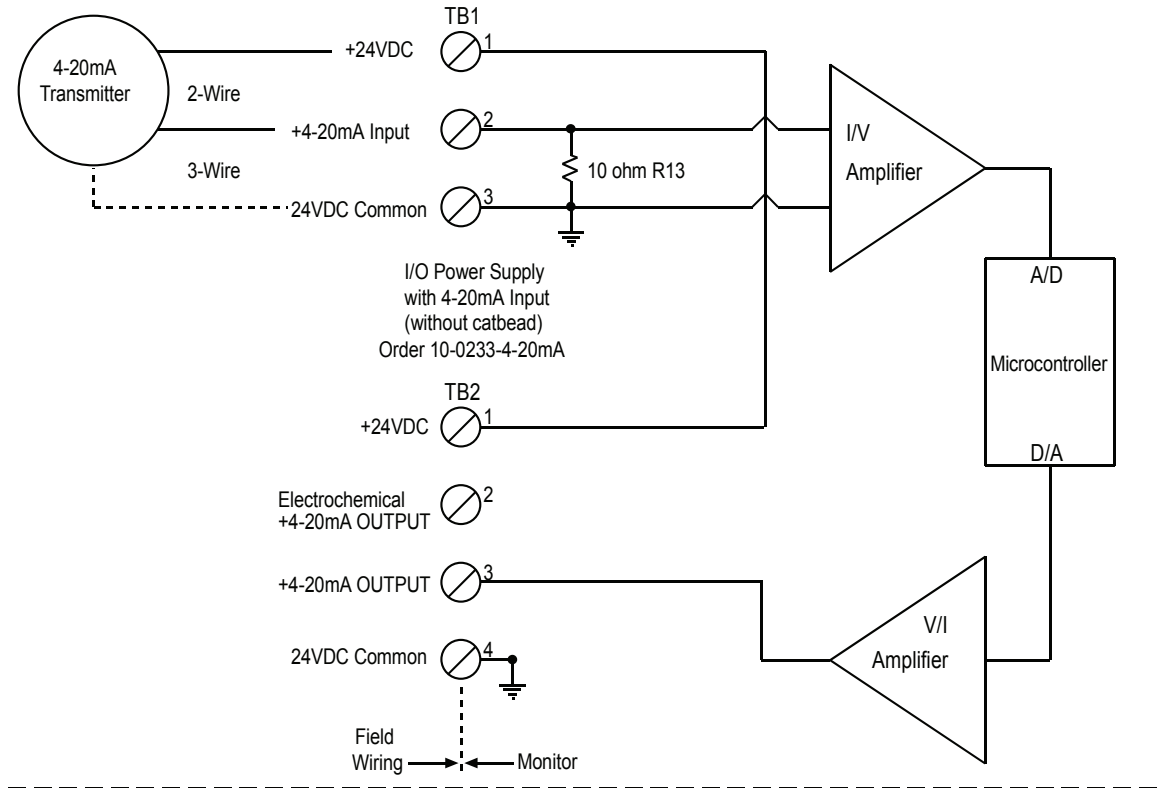


24VDC OUT is unregulated DC power generated from 18VAC~ input power.
4-20mA IN+ accepts milliamp signal inputs.
24VDC COMMON is "RETURN" rail for both 4-20mA Input and Output.
(See Block / Wiring diagram)

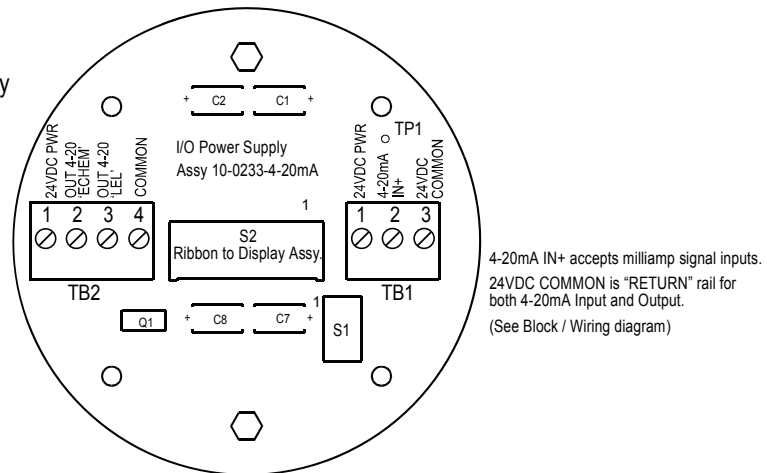
Figure 7-2: 10-00233-18VAC Block / Wiring Diagram

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.



*10-0233-4-20mA is a special configuration allowing 4-20mA Input to TB1 and is available by special order.



4-20mA IN+ accepts milliamp signal inputs.
24VDC COMMON is "RETURN" rail for both 4-20mA Input and Output.
(See Block / Wiring diagram)

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 (± 2 mA) 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.**

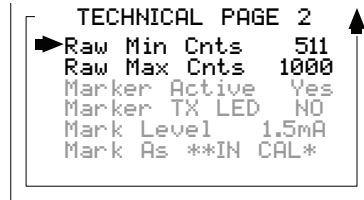


Figure 7-4: 4-20mA Input "MARKER" Menus

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.

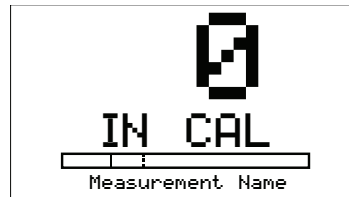


Figure 7-5: 4-20mA Input Type "MARKER" Message