OPERATION & PARTS MANUAL

Gas Detection System

GDS GasMax II
Zellweger Analytics

Publication No. 050006A

Rev. No. 30404 R080516

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SERVICE • RELIABILITY • INNOVATION

Introduction

This manual contains important safety, operation, maintenance, and parts information for your Akkerman Gas Detection System. This system includes the remote relay module, non-intrusive transmitter, sensor, and low voltage lighting. You must read and understand this manual, any of the system manuals (TBM, Pump Unit, Haul Unit, etc.), and the gas detection system manuals (Zellweger Analytics or Global Detection Systems) before you operate and maintain this equipment. The Zellweger Analytics manuals are located in sections 17 through 19, and the Global Detection Systems manual is located in section 20. 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. The Akkerman system also provides for low voltage lighting for the boring head operator.

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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PARTS MANUAL

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Safety

BE ALERT FOR SAFETY INFORMATION

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

Read all safety information.

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

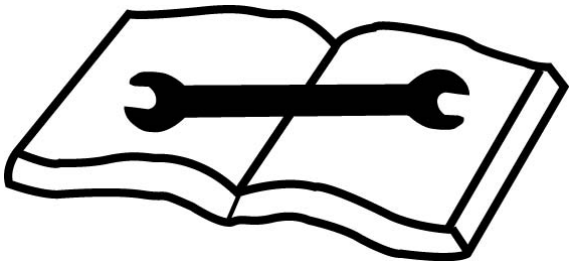
ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

READ OPERATOR'S MANUAL

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

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

Any unauthorized modifications will void the warranty.

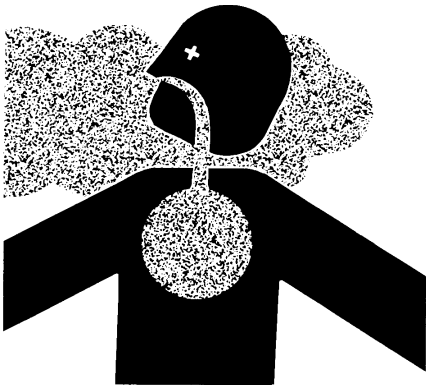


WEAR PROTECTIVE CLOTHING

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

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

TEST TUNNEL VENTILATION



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

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

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

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

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

Gases must be removed before reentering tunnel.

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

LOCKOUT POWER BEFORE SERVICING

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

LOCKOUT 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.

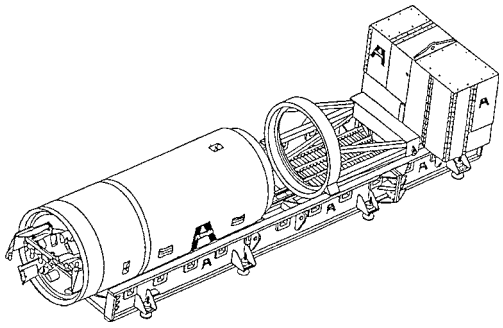
If a hydraulic hose, chain, or cable from the boom of a crane or excavator breaks, the boom and/or load can fall instantly.

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

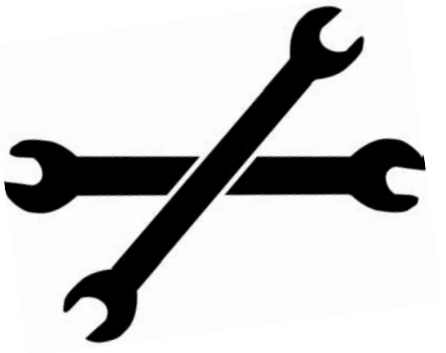


Remove any grease, oil, or debris buildup to avoid potential injury or equipment damage.

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.

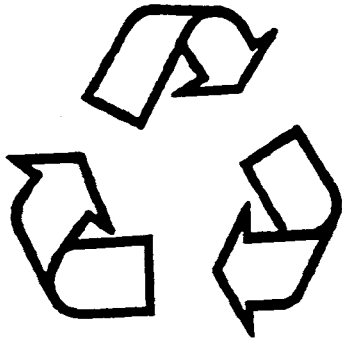
Only trained and qualified personnel should perform any maintenance or repairs.

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.

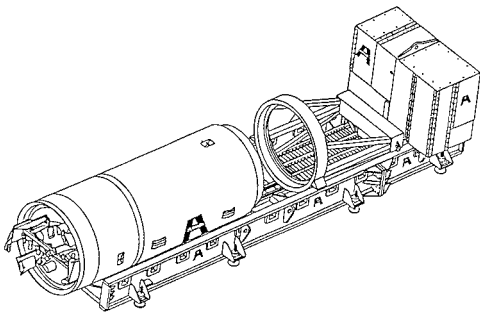
RECYCLE WASTE



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.

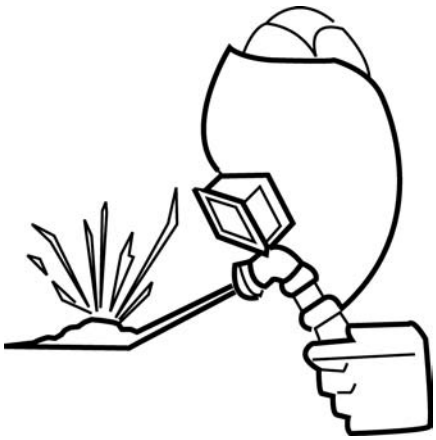
NO RIDERS ON EQUIPMENT



⚠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.

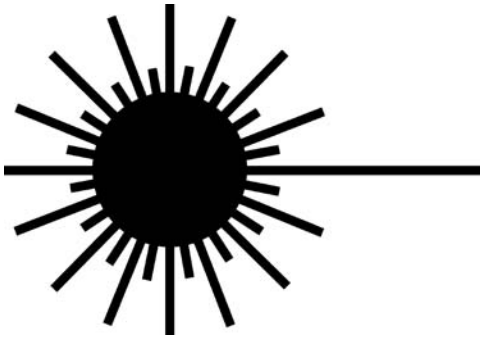
Keep hands, body, and objects clear of operating auger and conveyor.

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.

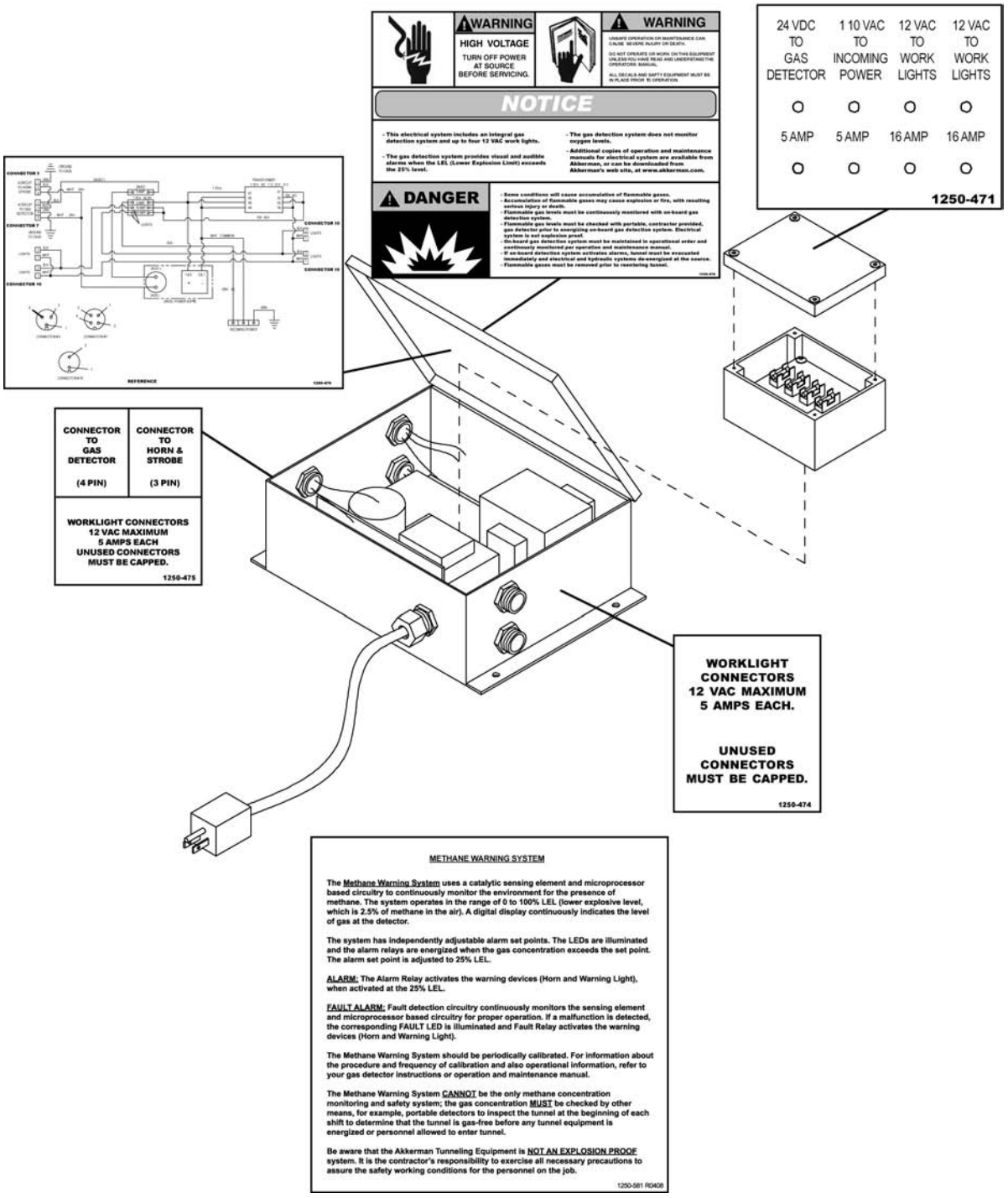
To avoid possible exposure to radiation in excess of acceptable emission limits, all repairs to laser must be performed by the original manufacturer or an authorized service technician.

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.

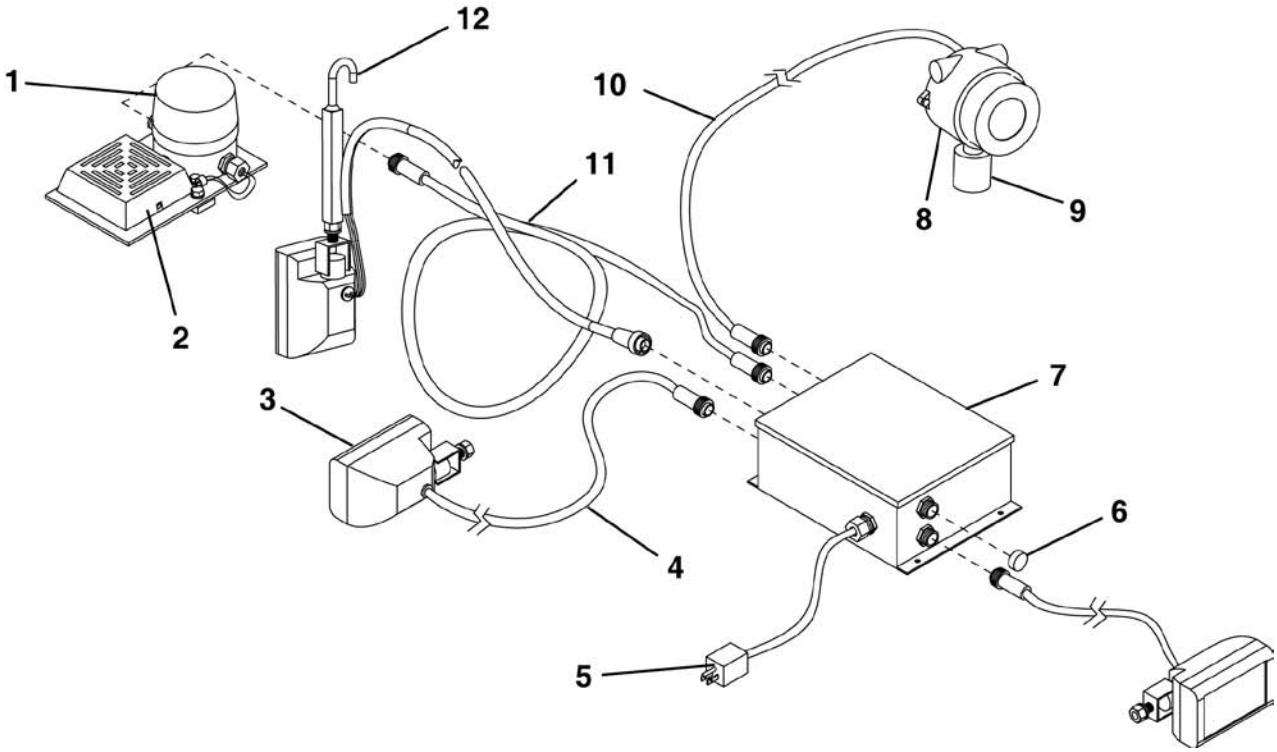


Mounted Inside TBM

NOTES

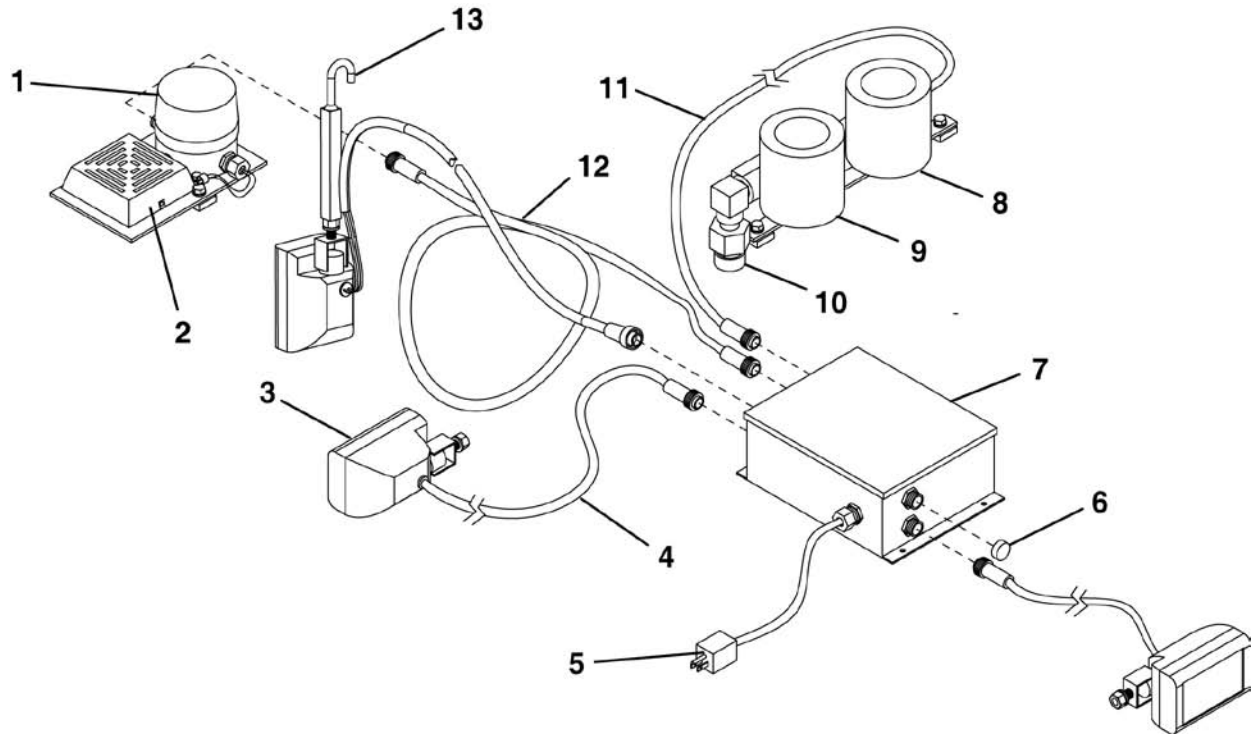
Terminology

GAS DETECTION SYSTEM (GDS GASMAX II)



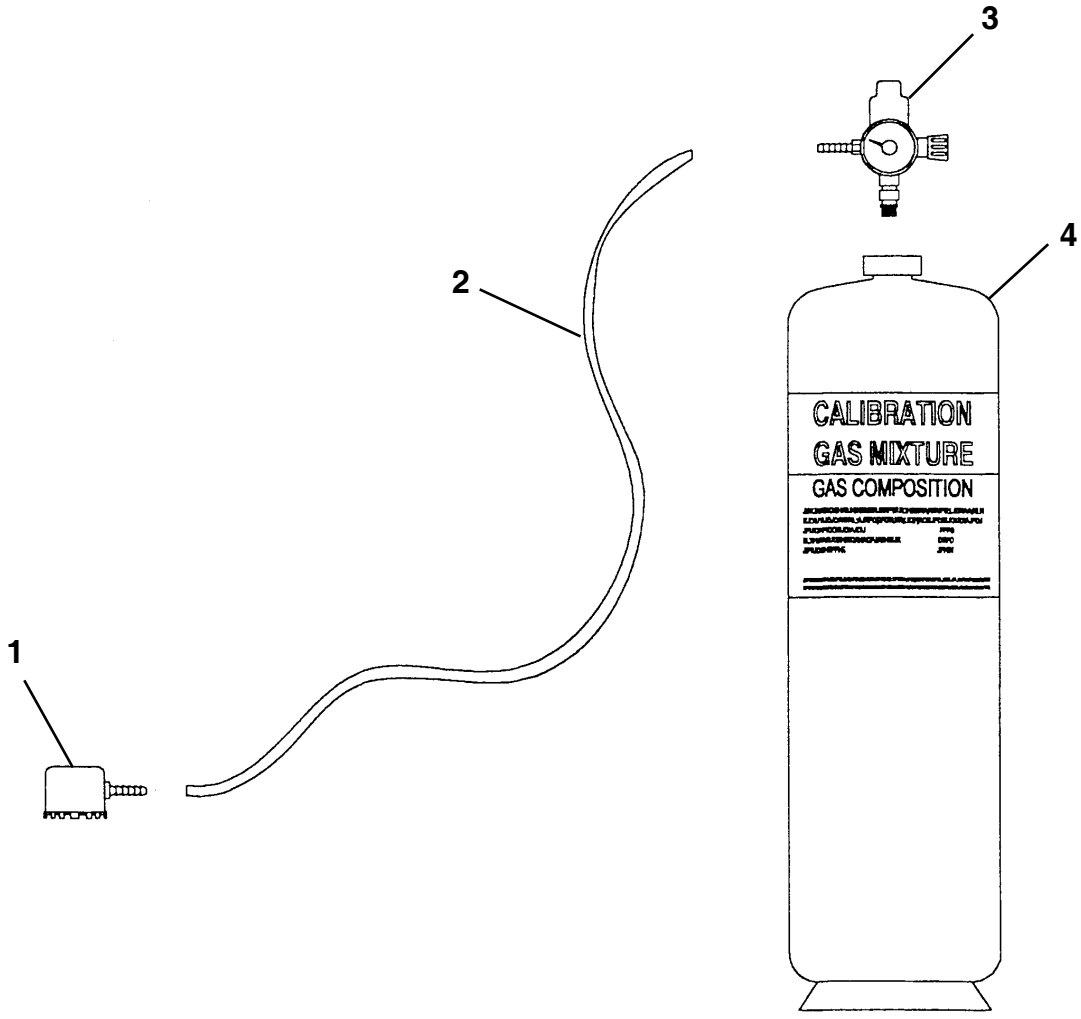
1. Strobe Light
2. Horn
3. Light
4. Cable Assembly
5. 110 VAC Outlet
6. Cap
7. Electrical Box Assembly
8. Transmitter/Relay
9. Combustible Gas Sensor
10. Cable Assembly
11. Cable
12. Extension Light

GAS DETECTION SYSTEM (ZELLWEGER ANALYTICS)



1. Strobe Light
2. Horn
3. Light
4. Cable Assembly
5. 110 VAC Outlet
6. Cap
7. Electrical Box Assembly
8. Relay Module
9. Transmitter
10. Combustible Gas Sensor
11. Cable Assembly
12. Cable
13. Extension Light

GAS CHALLENGE KIT



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

NOTES

Controls & Instruments

GAS DETECTION SYSTEM

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

NOTICE For more information, refer to sections 17, 18, and 19 for the Zellweger Analytics manuals or section 20 for the Global Detection Systems manual.

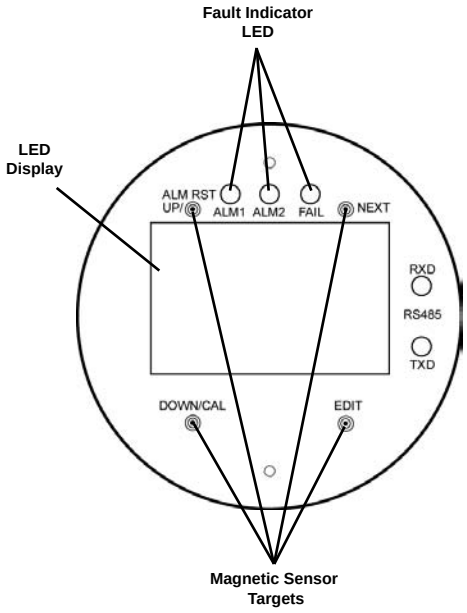
(GDS GasMaxII) The transmitter LCD display shows calibrated engineering values, bargraph data, 30 minute tread, calibration, sensor fault, and setup information. During normal operation, the current gas concentration is indicated on the display.

(Zellweger) The transmitter LED display is a 4 digit display. During normal operation, the current gas concentration is indicated on the display. It is also used to scroll messages when in calibration mode or when a sensor fault is detected.

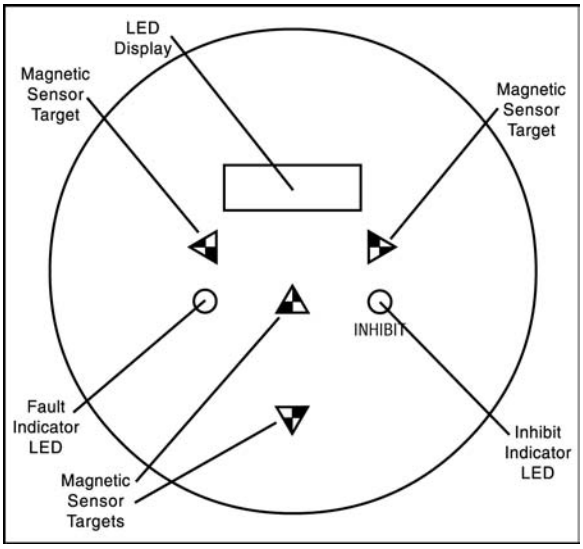
The four magnetic sensor controls are activated by a magnetic wand. Holding the magnetic wand over one of the magnetic sensor targets will activate that sensor. It may take several seconds for the magnetic sensor to activate. If the transmitter does not respond, remove the magnetic wand for several seconds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

GDS GasMax II

Zellweger Analytics



GDS GasMax II Transmitter Display



Zellweger Analytics Transmitter Display

NOTES

Pre-Start Inspection

⚠WARNING Do not operate this equipment until you read, study, and understand this manual, the Zellweger Analytics manuals (included in sections 17 through 19 of this manual) or Global Detection Systems GasMax II manual (included in section 20 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/LED 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, or the Zellweger Transmitter manual in section 18 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 Global Detection Systems or Zellweger Analytics 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.

14. (Zellweger Analytics) If the message "Span too low" scrolls across the gas detection transmitter display, the sensor or sensor element should be replaced 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)

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

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

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

METHANE GAS DETECTION SYSTEM

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

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

The Akkerman gas detection system includes the following primary components; the gas sensor and transmitter/relay. The Zellweger Analytic manuals are located in sections 17, 18, and 19 and the Global Detection Systems manual is located in section 20 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.

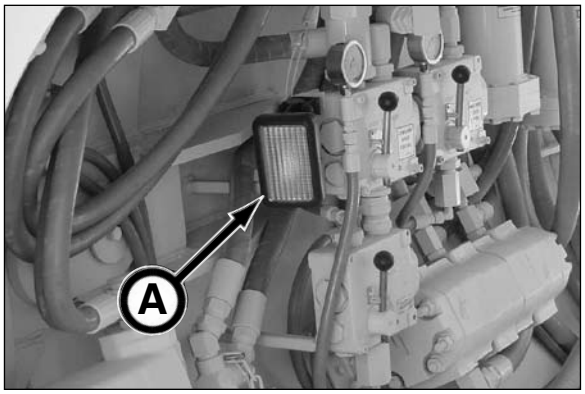
To operate correctly, and provide the intended protection, the system must be maintained and operated per the instructions in this manual.

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

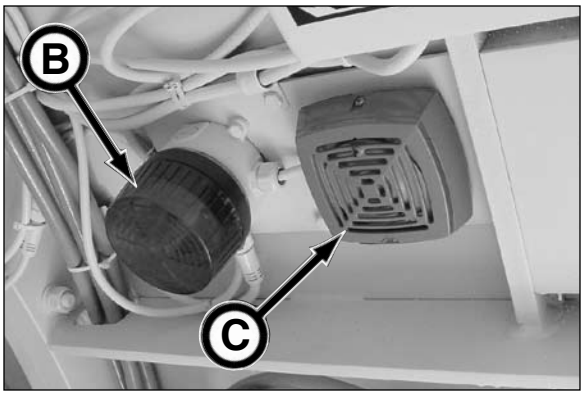
Prior to energizing the system, the tunnel must be checked for concentrations of combustible gases and oxygen deficiency. This must be done with a separate contractor supplied gas detector. Once acceptable combustible gas and oxygen levels are confirmed, the system is energized by applying 110 VAC power at the standard three prong plug.

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 the Zellweger Analytics Transmitter Operating Instructions located in section 18 of this manual or the GDS GasMax II Operation and Maintenance manual in section 20 of this manual.



(Zellweger) During start up, the low voltage work lights (A) will come on immediately, and the audible (horn) and visual (strobe) alarms will be ON for a short period of time.

(GDS GasMaxII) During start up, the low voltage work lights (A) will come on immediately, and the LCD display will illuminate.



(Zellweger) The horn (B) and strobe (C) must come on for a few seconds to confirm proper operation. If this does not occur, or if there are errors on the display, the problem (s) must be corrected prior to allowing people in the tunnel and before the boring head operation.

(GDS GasMax II) If the horn (B) and strobe (C) 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 (s) must be corrected prior to allowing people in the tunnel and before the boring head operation.

(continued on next page)

START UP (Continued)

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.

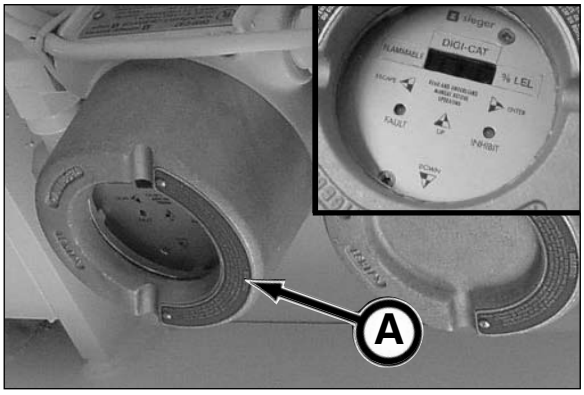
GDS GasMax II

The gas detection system transmitter (A) includes a LCD/LED (Global Detection Systems) or LED (Zellweger Analytics) 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 transmitter manual in section 18 for troubleshooting instructions for the Zellweger Analytics system, or section 20 for the Global Detection Systems GasMax II detector system in this manual.

Contact the Akkerman Aftermarket Support Department for assistance.



Zellweger Analytics

SYSTEM OPERATION

NOTICE The GasMax II housing was removed for photographic purposes only. NEVER operate a gas detector without all guards and housings in place.

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.

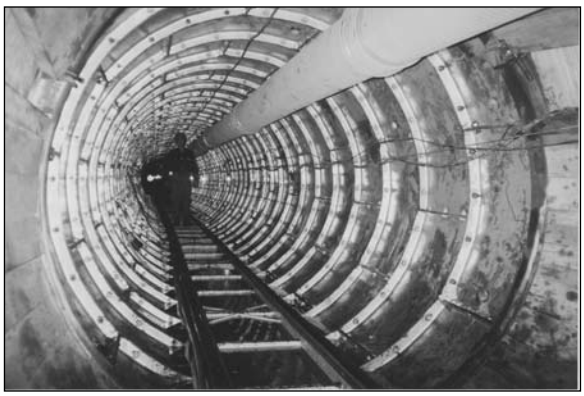
If the fault alarm and horn activate, evacuate the tunnel immediately. Be sure tunnel is well ventilated using portable detectors before anyone is allowed to return into tunnel, and contact your electrician to check gas detection system operation. Repair or replace as necessary.

GDS GasMax II Shown

SYSTEM SHUTDOWN

⚠WARNING NEVER shut down or unplug 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 (unplugged) 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.

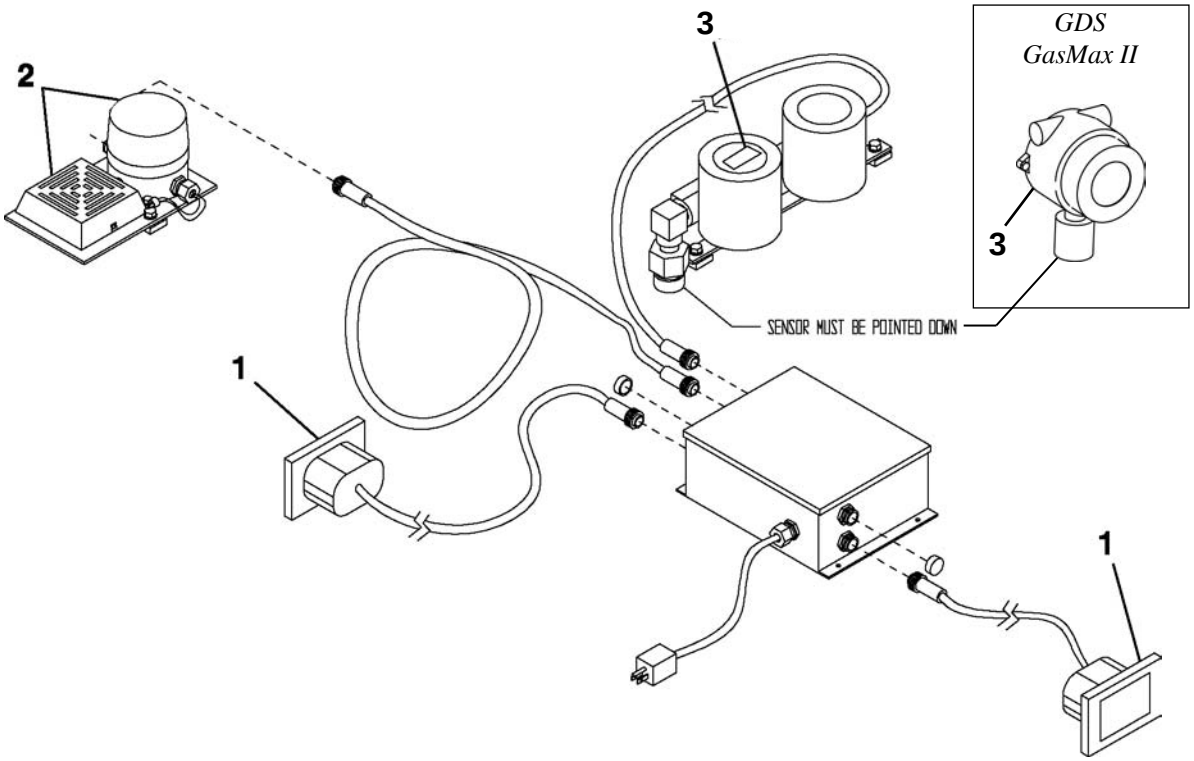
LOCKOUT POWER BEFORE SERVICING

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

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

MAINTENANCE CHARTS

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

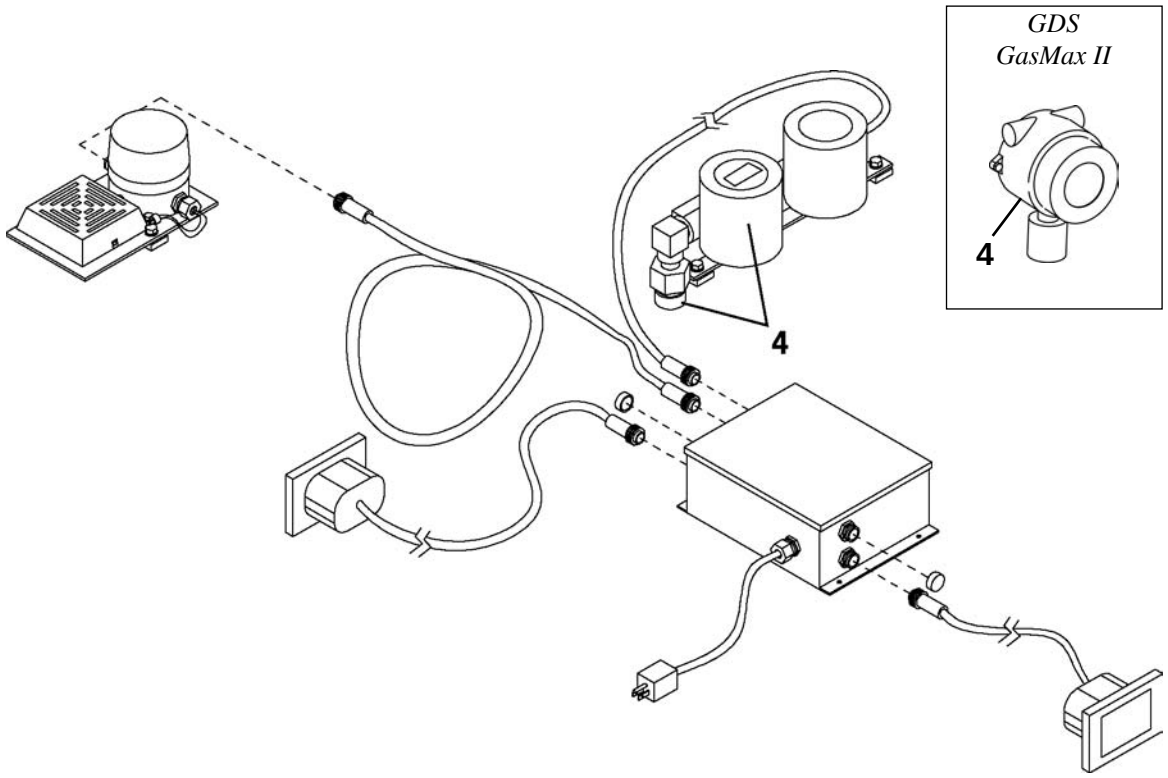


START UP

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Working Lights	Check	Must operate immediately.	
2.	Audible/Visual Alarms	Check	See detail in this section.	
3.	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 Zellweger Analytics manuals in sections 17, 18, and 19 or section 20 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.

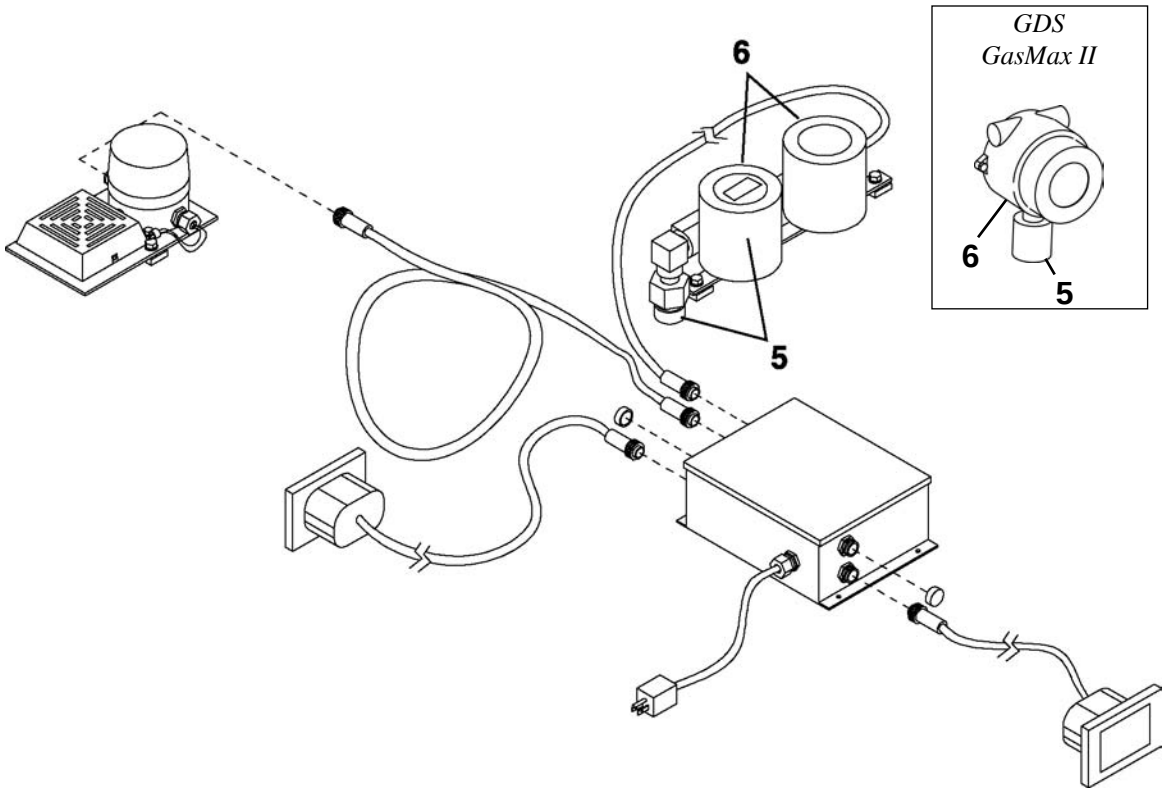


START OF NEW DRIVE AND EVERY 40 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
4.	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 Zellweger Analytics manuals in sections 17, 18, and 19 or section 20 for the Global Detection Systems GasMax manual.

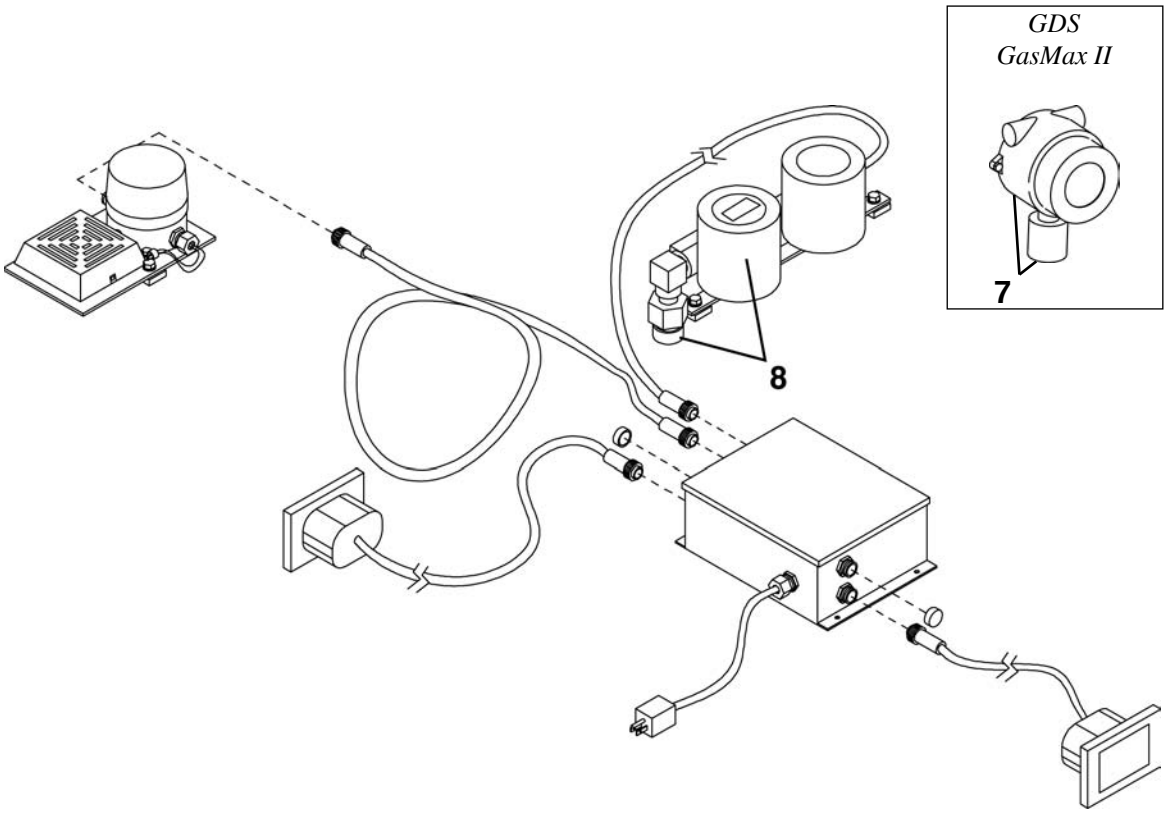
NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
5.	Transmitter/Sensor	Check	If “Span Fail - Error Code 5” (GDS) or “Span Too Low” (Zellweger) appears, sensor must be replaced.	
6.	Sensor Head (GDS GasMax II)	Inspect	Clean	

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
7.	Transmitter/Sensor (GDS GasMax II)	Check	Calibrate	
8.	Transmitter/Relay (Zellweger)	Check	Calibrate	

NOTICE For the operation and maintenance information on the transmitter/relay, and sensor, refer to the Zellweger Analytics manuals in sections 17, 18, and 19 or section 20 for the Global Detection Systems GasMax manual.

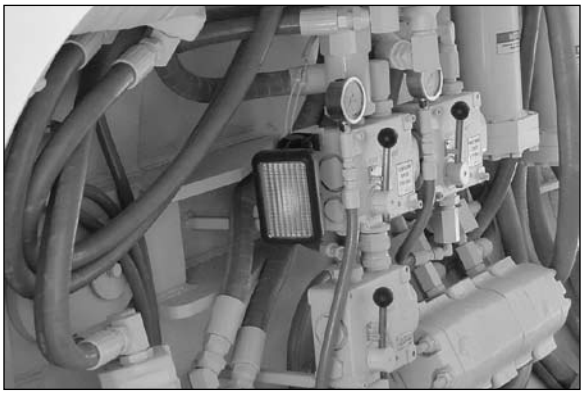
START UP

⚠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 Zellweger Analytics manuals in sections 17, 18, and 19 or section 20 for the Global Detection Systems GasMax manual.

1. CHECK WORKING LIGHTS

When the Akkerman gas detection system is activated, the working lights will come on immediately.



If the lights do not come on immediately, be sure the lights are properly connected to the system electrical box. Otherwise, have a qualified electrician troubleshoot and repair the problem.

This troubleshooting should include checking of the fuses in the system electrical box. The electrical power must be disconnected at the source prior to any work on the system. One of the fuses in the box is energized with 110VAC power.

2. CHECK AUDIBLE & VISUAL ALARMS

(Zellweger) When the Akkerman gas detection system is activated, the audible (horn) and visual (strobe) alarms will operate briefly to indicate they are operational.

Zellweger Analytics

If the alarms do not operate briefly at start-up, be sure the horn and strobe are properly connected to the system electrical box. Otherwise, have a qualified electrician troubleshoot and repair the problem BEFORE using the TBM.

Also, test for the correct operation of the system's alarm setpoints by exposing the monitor to a targeted gas concentration above the high alarm setpoint. If the audible and visual alarms do not work properly, have a qualified electrician troubleshoot and repair the problem BEFORE using the TBM.

(GDS GasMax II) 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.

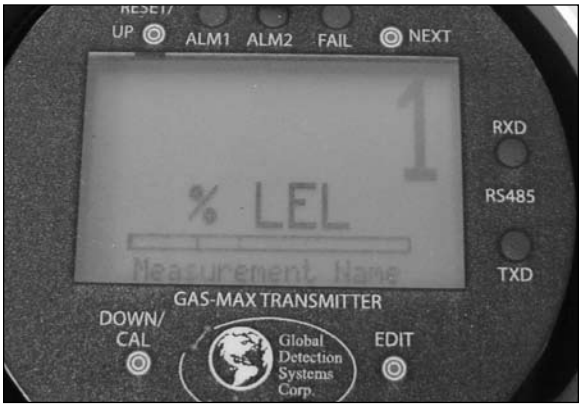
GDS GasMax II

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

3. 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 Zellweger Analytics transmitter manual in section 18 of this manual or section 20 for the Global Detection Systems GasMax manual.



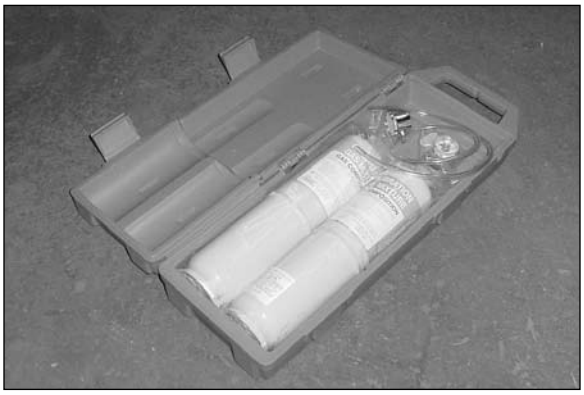
GDS GasMax II (Shown)

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 Zellweger Analytics manuals in sections 17, 18, and 19 or section 20 for the Global Detections Systems GasMax manual.

4. 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 Zellweger Analytics sensor and transmitter manuals in sections 17 and 18 of this manual for more information.

A Gas Challenge Kit (Part No. P0310-266) is available from Akkerman which provides a known concentration of gas (2.5% Methane, 50% LEL) and the equipment to apply this gas to the sensor.

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

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

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

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

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

(continued on next page)

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

4. Screw the regulator valve onto the cylinder.

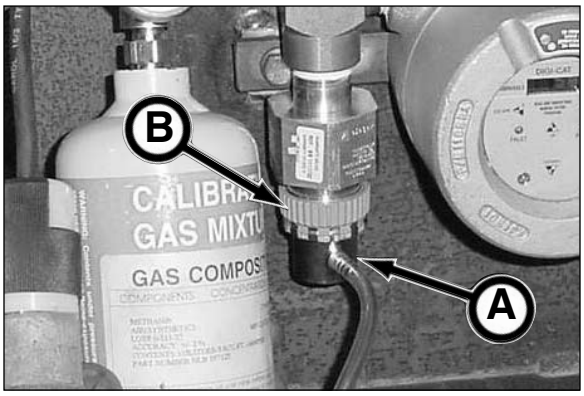
5. Attach one end of the plastic hose to the regulator. Attach the calibration nozzle/adapter to the other end.

Zellweger Analytics Calibration Nozzle Shown

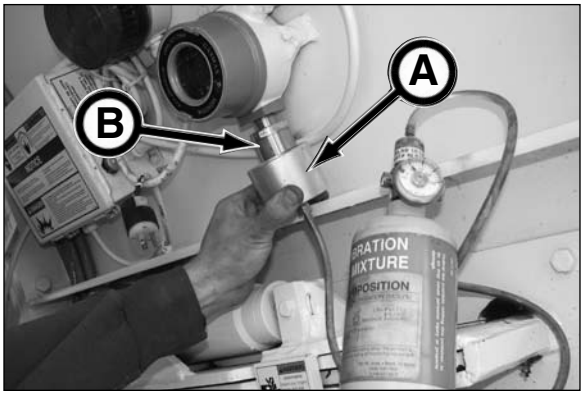
6. Disable the strobe and horn by disconnecting the strobe/horn connector. **When gas challenge process is complete, the strobe and horn MUST be reconnected to the system.**

(continued on next page)

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



Zellweger Analytics



GDS GasMax II

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

(continued on next page)

9. 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 Zellweger Analytics transmitter manual, located in section 18 of this manual or the Global Detection Systems GasMax manual in section 20 of this manual.

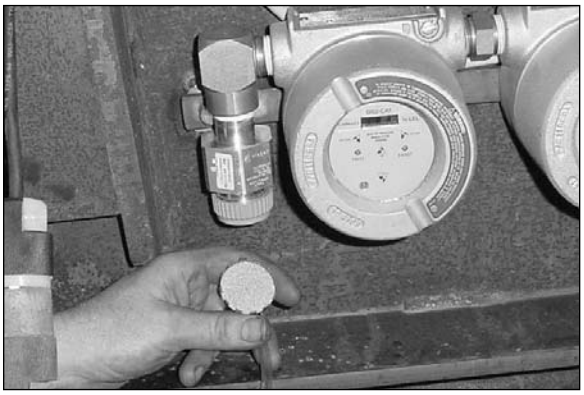
GDS GasMax II

Zellweger Analytics

10. Close regulator valve by turning the knob clockwise.

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

GDS GasMax II



Zellweger Analytics

12. Disconnect plastic hose from regulator and nozzle.

13. Remove regulator valve from cylinder.

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

⚠WARNING Failure to reconnect strobe/ horn connector to electrical box can result in serious personal injury or death due to being unaware that there are accumulating gases.

15. Reconnect the strobe/horn connector to the horn/strobe assembly.

DAILY OR EVERY 10 HOURS OF OPERATION

5. 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.

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

GDS GasMax II

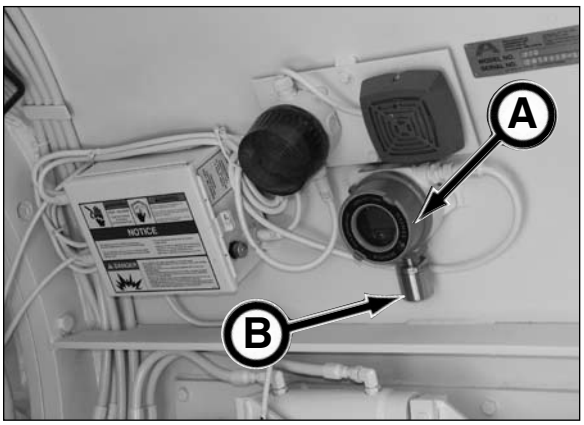
Zellweger Analytics
The message “SPAN TOO LOW” will scroll across the display.

Zellweger Analytics

A qualified technician must replace the sensor/ sensor element.

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

6. INSPECT SENSOR HEAD, FILTER & COVER (GDS GASMAX II ONLY)



GDS GasMax II

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

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

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

If grease is on the sensor filter or cover:

1. Remove the sensor cover from the sensor head.

2. Clean filter or cover with a mild solvent to remove grease.

3. After cleaning, it is important that the filter/cover is dry before replacing on the sensor head.

⚠WARNING If the filter/cover 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.

EVERY THREE MONTHS OF OPERATION OR AS REQUIRED

NOTICE Refer to the Zellweger Analytics manuals in sections 17, 18, and 19 or the GDS GasMax manual in section 20 in this manaul for the operation and maintenance information on the transmitter/relay, and sensor.

7. CALIBRATE TRANSMITTER SENSOR (GDS GASMAX II)

NOTICE Refer to the GDS GasMax manual in section 20 of this manual for more information.

GDS GasMax II

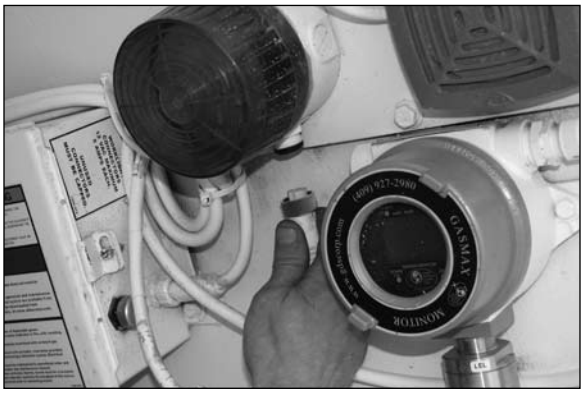
Calibration is the most important function for insuring correct operation of the GasMax II.

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

Follow these GasMax calibration guidelines:

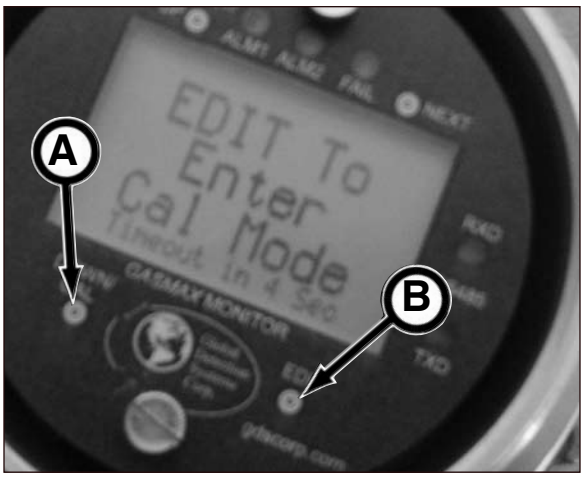
- Calibration accuracy is only as good as the calibration gas accuracy.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate only in a clean atmosphere, which is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

Use the following procedure to perform ZERO and SPAN calibrations.



1. Disable strobe and horn by disconnecting the strobe/horn connector. When the calibration process is complete, the strobe and horn MUST be reconnected to the system

2. Power up gas detection system.



3. 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).

(continued on next page)

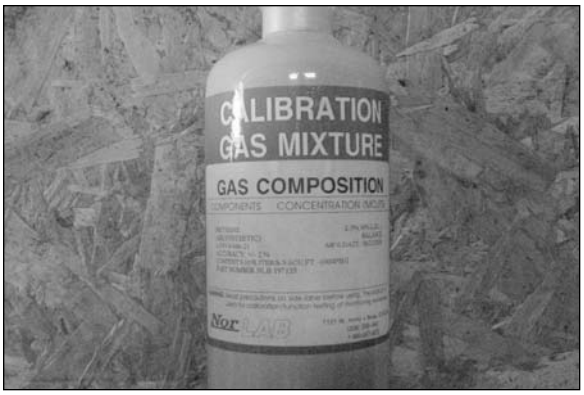
4. Using an optional process cover (Cal Cup), apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable (approximately 1 minute), press the EDIT key (A) to perform a ZERO calibration.

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

5. If the ZERO calibration is successful, press the NEXT key (B) to proceed to the SPAN check.

6. 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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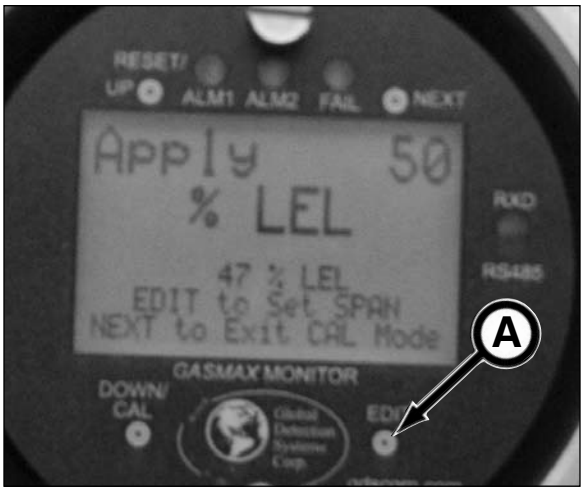
d. Attach one end of the plastic hose to the regulator.

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

f. Attach calibration nozzle adapter to sensor.



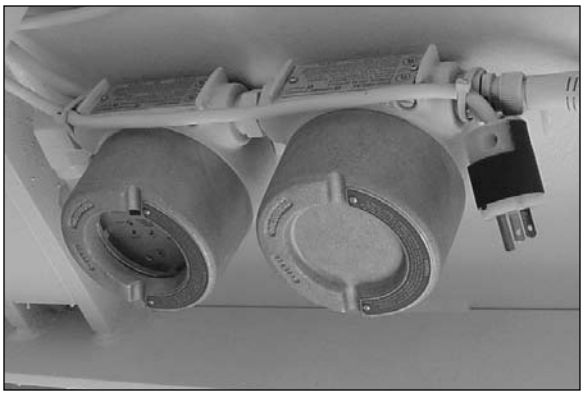
7. Apply the calibration methane 2.5% (50% LEL) gas mixture at .5 liters/min by opening the regulator valve by turning the knob counterclockwise. After the reading is stable (approximately 1 minute) press the EDIT key to perform a SPAN calibration.

(continued on next page)

8. If the SPAN calibration is successful, the display flashes “REMOVE CAL GAS” and starts the CAL PURGE delay.

9. The CAL MODE will be complete after the end of the CAL PURGE delay.

8. CALIBRATE TRANSMITTER (ZELLWEGER ANALYTICS ONLY)



The Zellweger DIGI Series transmitters and relays do not require scheduled calibration. However, the materials used in your sensor are consumed in normal operation, even if they are not exposed to the target gas. Calibration of the transmitter compensates for this sensor degradation.

Calibration Procedure:
In this procedure you will notice the symbol/words <ESCAPE>, <UP>, <DOWN>, and <ENTER>. These are the four magnetic sensor targets on the transmitter display to activate the sensor controls. 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 sensor does not respond, remove the magnetic wand for several seconds and try again.

NOTICE Any time during the calibration procedure, you can back up one step at a time by using the magnetic wand on the <ESCAPE> target on the transmitter. Repeatedly using the magnetic wand on the <ESCAPE> target will take you to an exit dialog. Exiting the calibration process this way results in discarding all changes and reverting to the previous settings.

If the DIGI Series transmitter is in FAULT, you may not be able to enter the calibration mode. Refer to Troubleshooting in the Zellweger Analytics transmitter manual located in section 18 of this manual.

1. Disable strobe and horn by disconnecting the strobe/horn connector.

(continued on next page)

2. Touch the magnetic wand to the glass over the target marked <ENTER> until "Enter passcode" scrolls across display.

Once "Enter passcode" is displayed, "???" is automatically displayed with the first "?" flashing.

NOTICE If no activity is sensed for fifteen (15) seconds during the passcode entry mode or after the passcode is entered, the transmitter will automatically exit the calibration mode and return to normal monitoring mode.

3. Enter the calibration passcode "555" as follows. Touch the magnetic wand to the glass over the targets marked <UP> and/or <DOWN> until the number "5" is displayed.

Once "5??" is displayed, touch the magnetic wand to the glass over the target <ENTER>.

The next "?" will start flashing.

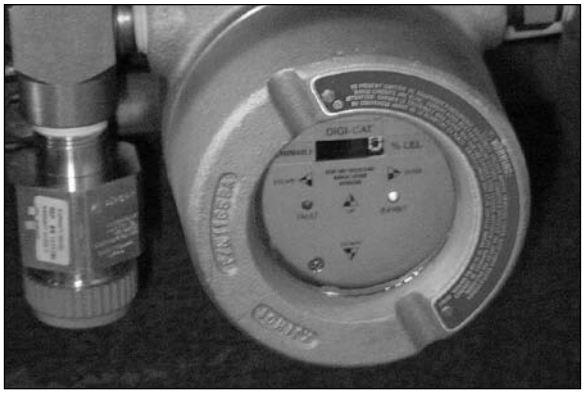
(continued on next page)

4. Repeat step 3 to enter the rest of the passcode 555.

Once the passcode is entered, "Inhibited" scrolls across display and the INHIBIT LED illuminates. The current gas reading is displayed.

5. Touch the magnetic wand to the glass over the target marked <ENTER>.

   "Apply zero" scrolls across display followed by the current gas reading.



6. Apply zero air to the sensor and wait for the display to stabilize.

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

The current gas reading is displayed.

If the message "Zero Too High" scrolls across the display, see Troubleshooting in the Zellweger Analytics transmitter manual located in section 18 of this manual.

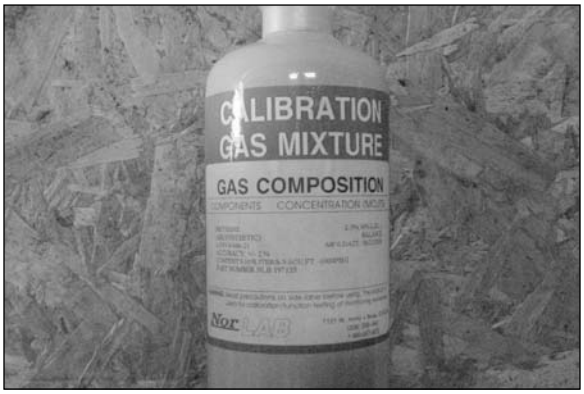
7. When the display has stabilized, touch the magnetic wand to the glass over the target marked <ENTER> to accept the current reading as zero.

   "Apply span" scrolls across display followed by the current gas reading.

(continued on next page)

8. Apply span gas to the sensor as follows.

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



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

c. Screw the regulator valve onto the cylinder.

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

e. Attach the calibration nozzle to the other end.

(continued on next page)

f. Attach the calibration nozzle to the sensor.

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

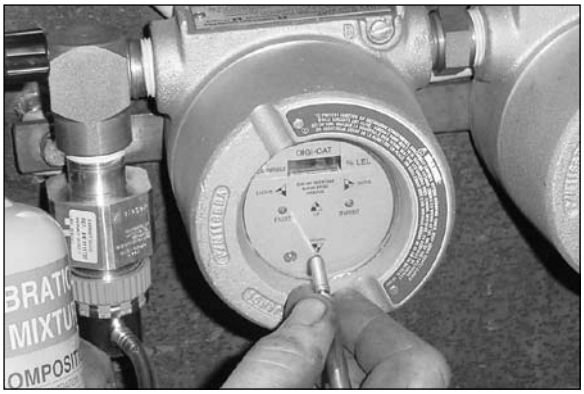
Wait approximately three (3) minutes for the reading to stabilize.

The display will show the current gas reading.

9. If the transmitter is not displaying the correct span value, adjust the reading by using the magnetic wand on the <UP> and/or <DOWN> targets until the correct value is displayed.

10. When the correct span value is displayed, touch the magnetic wand to the glass over the target marked <ENTER>.

"Re-cal y/n" continuously scrolls across display. If the message "Span Too Low" scrolls across the display, refer to Troubleshooting in the Zellweger Analytics transmitter manual in section 18 of this manual.



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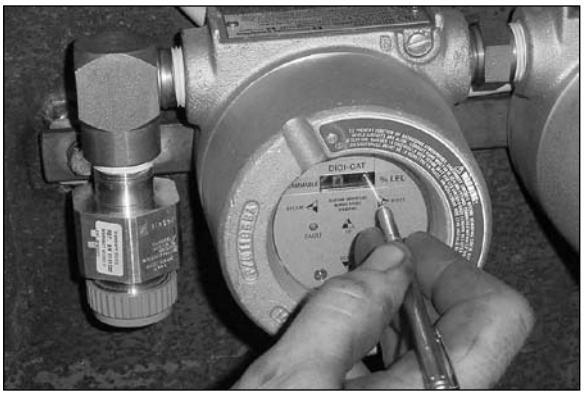
11. If you want to go through the spanning procedure again, touch the magnetic wand to the glass over the target marked <ENTER> and go back to step 8.

If you want to accept the calibration you just performed, touch the magnetic wand to the glass over the target marked <ESCAPE>.

"Exit y/n" continuously scrolls across display.

12. Touch the magnetic wand to the glass over the target marked <ESCAPE> to return to step 11 or touch the magnetic wand to the glass over the target marked <ENTER> to accept the calibration and exit the calibration mode.

The message "Warning GAS present" scrolls across the display alternating with "Exit y/n".



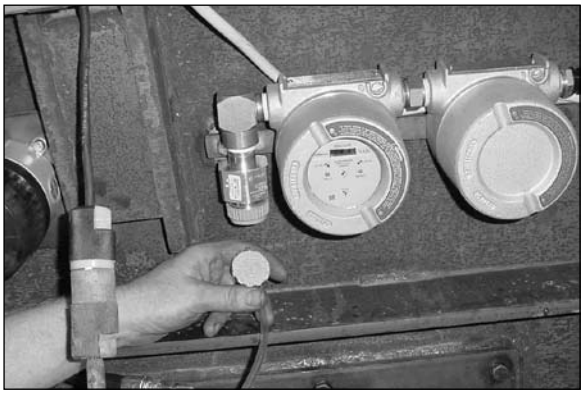
13. Remove the calibration gas from the sensor as follows:

a. Close regulator valve by turning the knob clockwise.

b. Remove the calibration nozzle from the gas sensor.

c. Disconnect plastic hose from regulator and nozzle.

d. Remove regulator valve from cylinder.

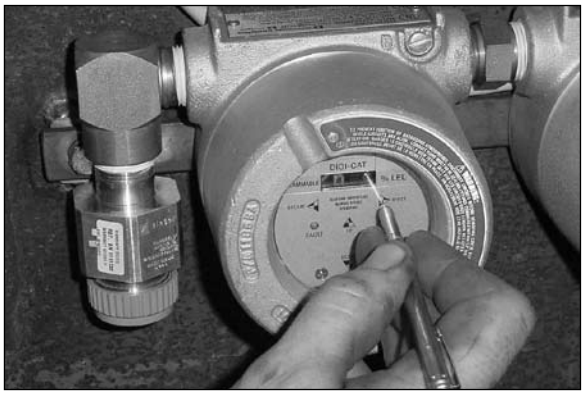


e. Properly replace the cylinder, regulator valve, plastic hose, and calibration nozzle into the protective case and secure case.

(continued on next page)

⚠WARNING Failure to reconnect strobe/horn connector to electrical box can result in serious personal injury or death due to being unaware that there are accumulating gases.

f. Reconnect the strobe/horn connector to strobe/horn assembly.



14. Touch the magnetic wand to the glass over the target marked <ESCAPE> to return to step 11 or touch the magnetic wand to the glass over the target marked <ENTER> to acknowledge the warning and exit the calibration process.

    The transmitter resets itself to the new calibration and resumes normal operation.

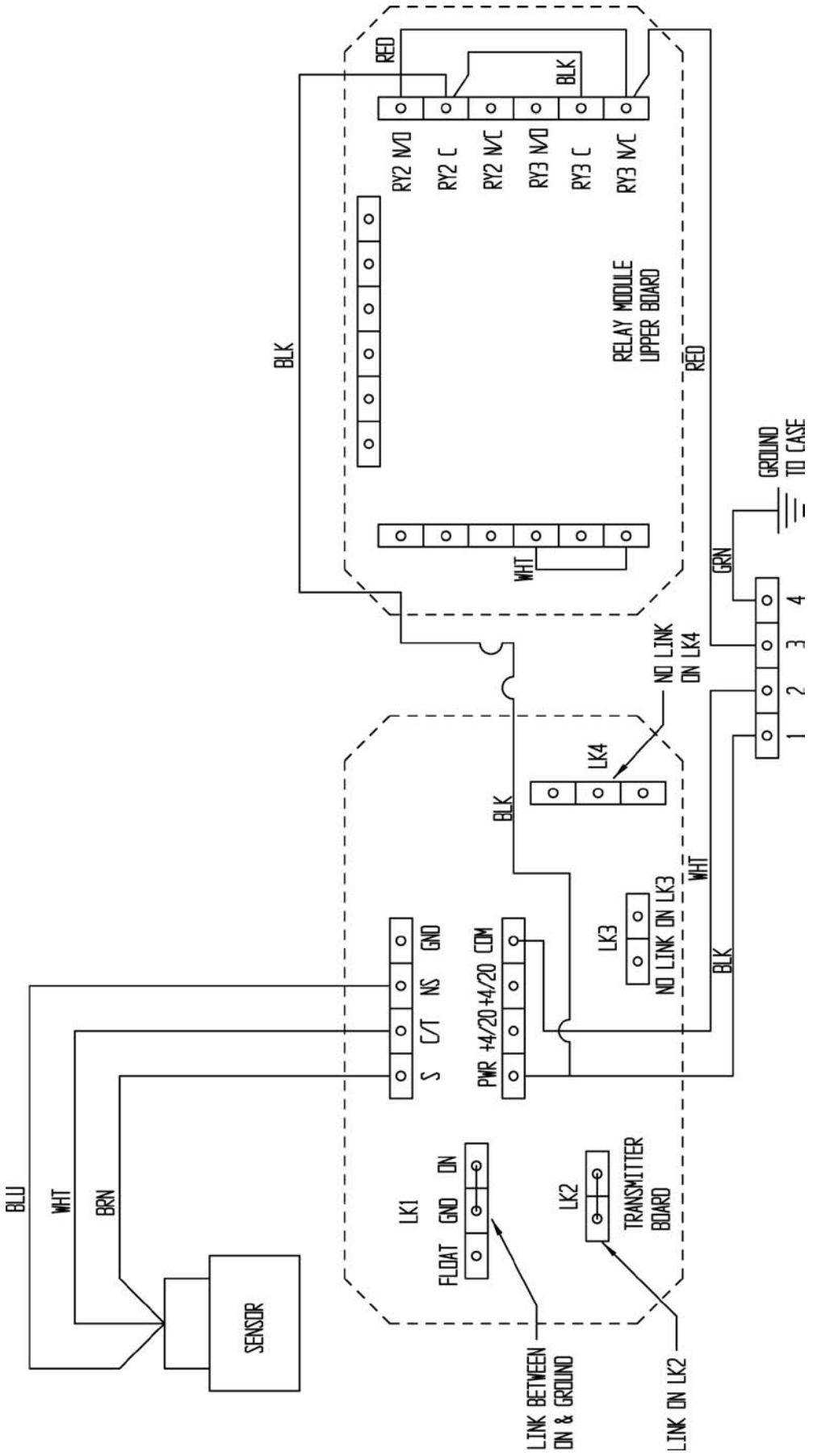
Troubleshooting

NOTICE To troubleshoot the GDS GasMax II gas detector, refer to the GDS GasMax II Operation and Maintenance Manual located in section 20 of this manual.

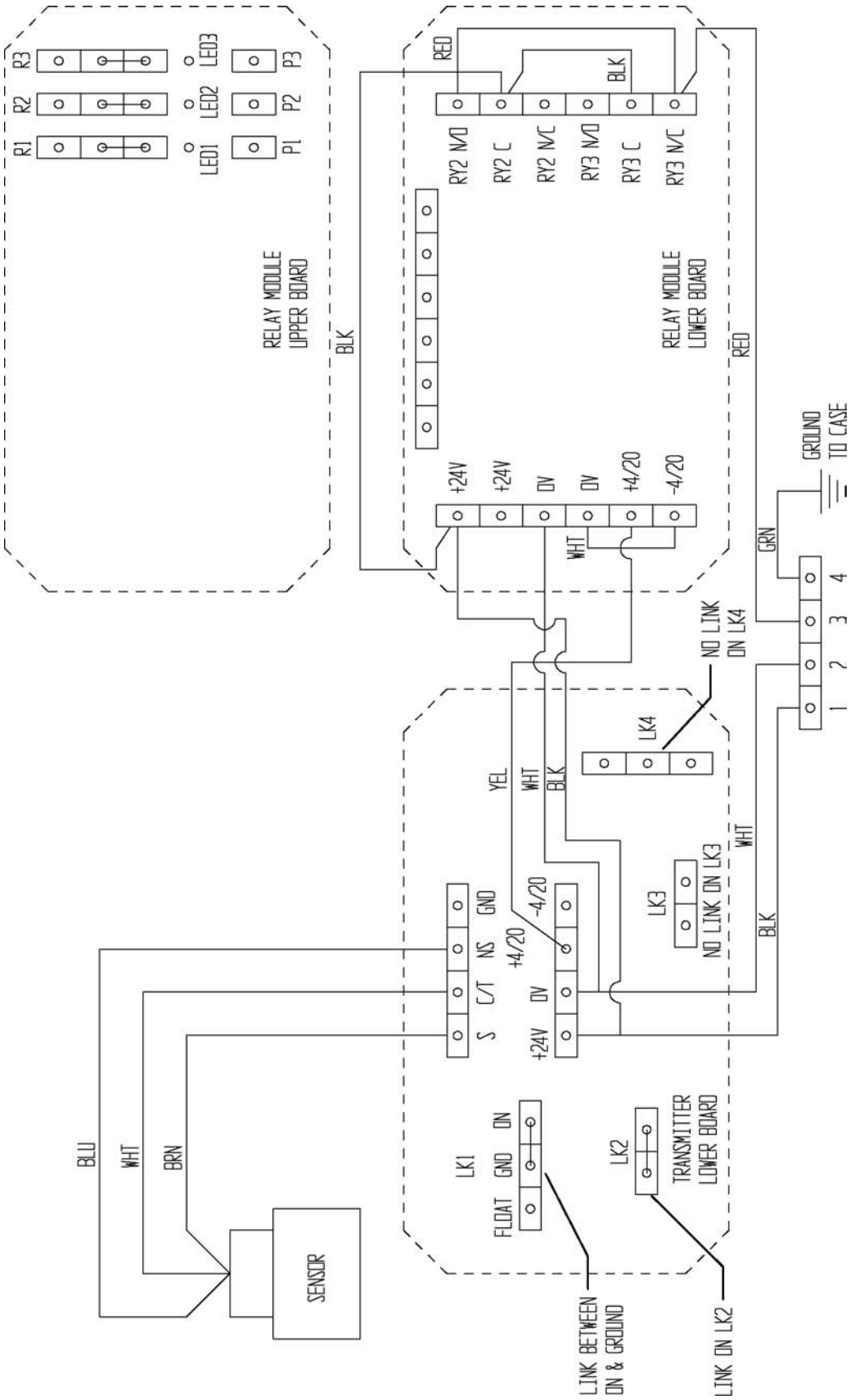
To troubleshoot the Zellweger Analytics gas detector, refer to the Zellweger Analytics Operating Instructions manuals located in sections 17, 18, and 19 of this manual.

Problem	Cause	Solution
Gas Detection System does not operate.	System is not connected to 110 VAC.	Connect system to 110 VAC.
	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.	
Working lights do not work.	System is not connected to 110 VAC.	Connect system to 110 VAC.
	Light(s) not plugged into system	Connect light cable to working light connections on electrical box.
	Light bulb is burned out.	Replace light bulb.
	Cable is damaged.	Replace cable.
	If working lights still do not work, contact your Akkerman Aftermarket Support Representative.	

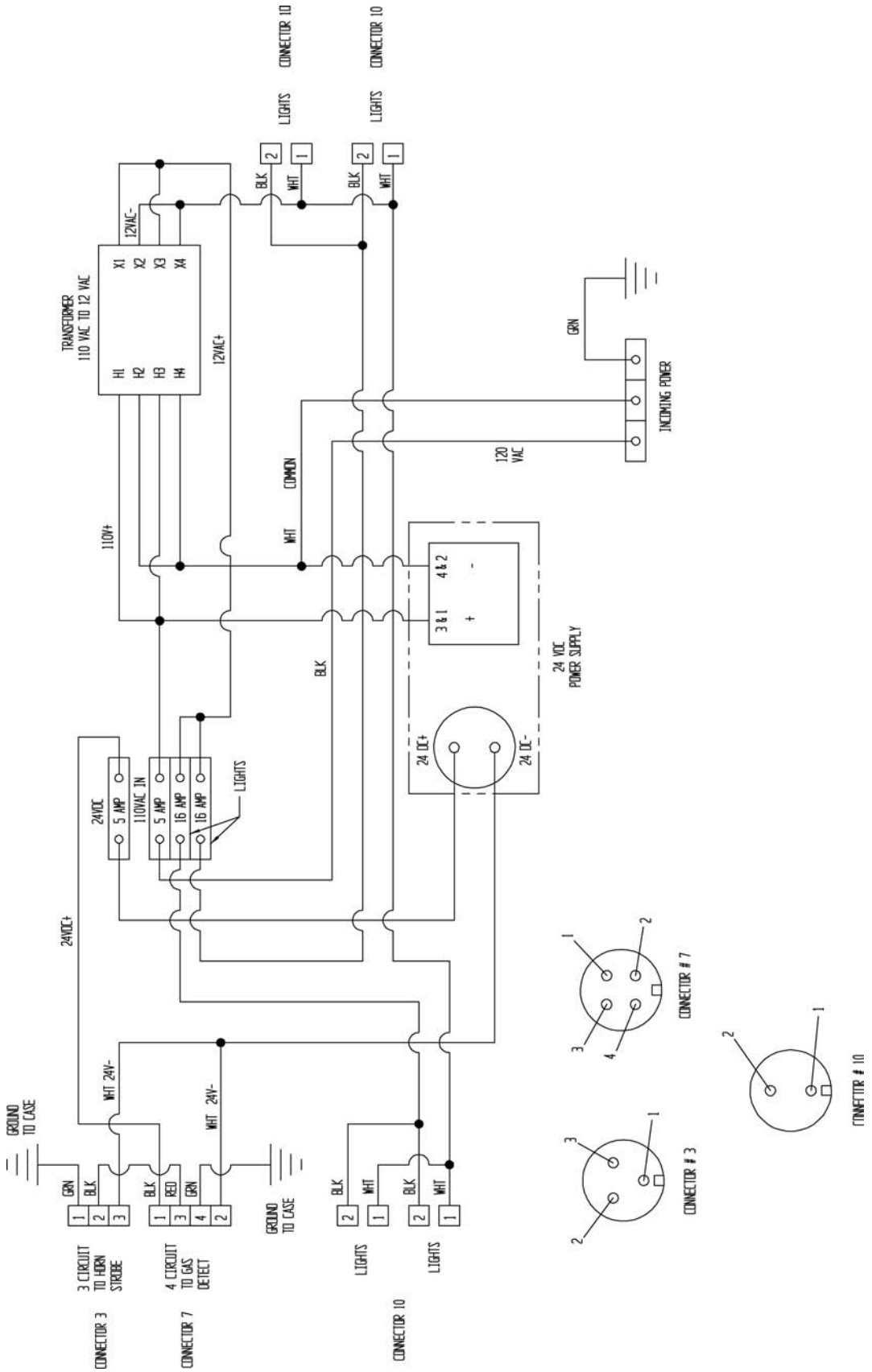
GAS DETECTOR ASSEMBLY SCHEMATIC (GDS GASMAX II)



GAS DETECTOR ASSEMBLY SCHEMATIC (ZELLWEGER ANALYTICS)



ELECTRICAL BOX SCHEMATIC



GASMAX II GAS DETECTOR FAULT CODES

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

GDS GASMAX II

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

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

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

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

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

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

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

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

Optional RS-485 2 wire MODBUS®

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

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

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

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

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

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

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

Relay 3 is always normally energized for failsafe operation so loss of power to the GasMax II will be indicated as a “FAULT” condition.

ZELLWEGER ANALYTICS

TRANSMITTER

Mechanical (with mounting strap)
- Size .....6-1/8 W x 5-1/4 H x 5-1/2 D (156 mm W x 134 mm H x 140 mm D)

Weight .....3.75 lbs. (1.7 kg)

Temperature Range
- Operational ..... -5 to +105°F (-20 to +40°C)
- Storage ..... -75 to +175°F (-60 to +80°C)

Electrical
- Supply Voltage ..... 18VDC to 32VDC
- Repeatability ..... ±0.1% FSD
- Zero Drift ..... ±0.2% FSD Non-Accumulative
- Span Drift ..... ±0.2% FSD Non-Accumulative
- Response Time ..... Less than 0.5 seconds
- Output Signal
  - ..Floating isolated 4-20 mA (500V isolation) Non-isolated 4-20 mA current source or .....current sink
- Fault Output ..... <0.1 mA
- Inhibit Output ..... 2.0 mA
- Calibrator Output..... 0.1 mA to 25.0 mA in 0.1 mA steps
- FSD - Full Scale Deflection

Enclosure
- Material .....Copper-free Aluminum
- Entries ..... Two (2), 3/4 NPT

Certification
- UL and C-UL Explosion-Proof, Class I, Div 1, groups B, C, D

DIGI-CAT Specifications
- Power Consumption .....80 mA @ 24 VDC (2.0 Watts) (includes sensor)
- Start-Up Current ..... 3A max. for 150 microseconds
- Input Signal ..... Bridge input for catalytic bead sensor 10 mV to 180 mV
- Sensor Current ..... 145 mA to 225 mA (Factory Adjustable), 7 ohms maximum loop resistance

RELAY

Mechanical (with mounting strap)
- Size .....6-1/8 W x 5-1/4 H x 5-1/2 D (156 mm W x 134 mm H x 140 mm D)

Weight .....3.75 lbs. (1.7 kg)

Temperature Range
- Operational ..... -4 to +122°F (-20 to +50°C)
- Storage ..... -40 to +176°F (-60 to +80°C)

Electrical
- Power
  - Supply Voltage ..... 10VDC to 35 VDC
  - Power Consumption .....104 mA @24 VDC (2.5 Watts)
  - Start-Up Current .....0.3A @ 10VDC, 0.1A @ 24 VDC
- Input Signal
  - Input Signal Range ..... 0.75 mA to 24 mA
  - Input Signal Loss ..... 1.0V @ 20 mA

Alarms
- Alarm Set Range ..... 0.75 mA to 24 mA
- Alarm Set Accuracy ..... ± 0.1 mA (± 0.5% FSD of 20 mA)
- Accuracy vs. Temp ..... ± 3% FSD (-20°C to +65°C)
- Alarm Hysteresis ..± 4% FSD (± 0.64 mA) max.
- Test Point Accuracy ..... ± 3% of signal

Relays
- Relay Contacts ..... Double Pole, 1 NO, 1 NC
- Relay Contact Rating .....3.0A @ 250 VAC 3.0A@ 32 VDC

Enclosure
- Material .....Copper-free Aluminum
- Entries ..... Two (2), 3/4 NPT

Certification
- UL and C-UL Explosion-Proof, Class I, Div 1, groups B, C, D

SENSOR

Certification
- UL Explosion-Proof, Class I, Div 1, groups B, C, D

Drive Current ..... 200 mA Certification ..... (from control equipment)

Maximum Power Dissipation ..... Less than 1 W

Response Time
- Time to reach 90% of a step change in gas concentration of 100% LEL methane - 13 seconds. Measured in accordance with the Canadian Standards Association (CSA) method of testing.

Ambient Temperature Range
- Operating ..... -40°C to +55°C
- Storage ..... -40°C to +55°C

Temperature Coefficient of Zero Point
- Approximately 0.05% LEL Methane per °C (maximum)

Humidity Range
- Intermittent 0 to 100% RH non-condensing.
- Continuous 0 to 90% RH non-condensing.

Identification Numbers

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

TRANSMITTER (A)

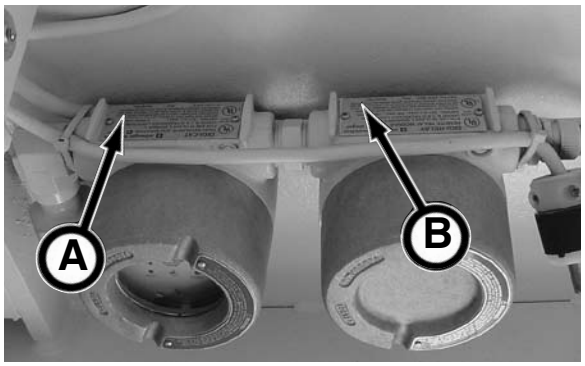
Model Number _____

Serial Number _____

RELAY (ZELLWEGER ONLY) (B)

Model Number _____

Serial Number _____

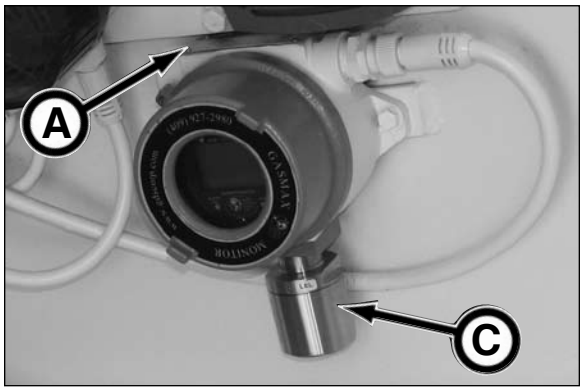


Zellweger Analytics

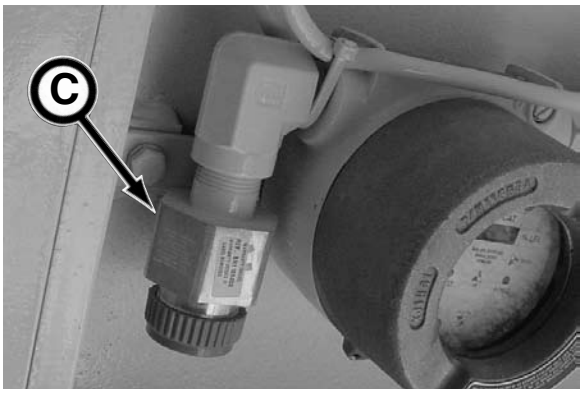
SENSOR (C)

Model Number _____

Serial Number _____



GDS GasMax II



Zellweger Analytics

NOTES

Material Safety Data Sheets

The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific material safety data sheets (MSDS) 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, MSDS which apply to its product line. Simply contact your Akkerman Aftermarket Support representative for a copy.

To ensure a prompt response to your MSDS 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 Inc. warrants that all equipment manufactured by it be free from defects due to workmanship or material under normal use and service for a period of 90 days. This warranty does not apply to normal wear items such as cutter teeth, filters, etc. Akkerman Inc. does not warrant the fitness of its equipment for a particular purpose or application.

NOTES

Index

Parts

Contents

INTRODUCTION

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

LOCATING PARTS

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

USE GENUINE AKKERMAN PARTS

The use of second-rate parts could affect the efficient performance of 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.

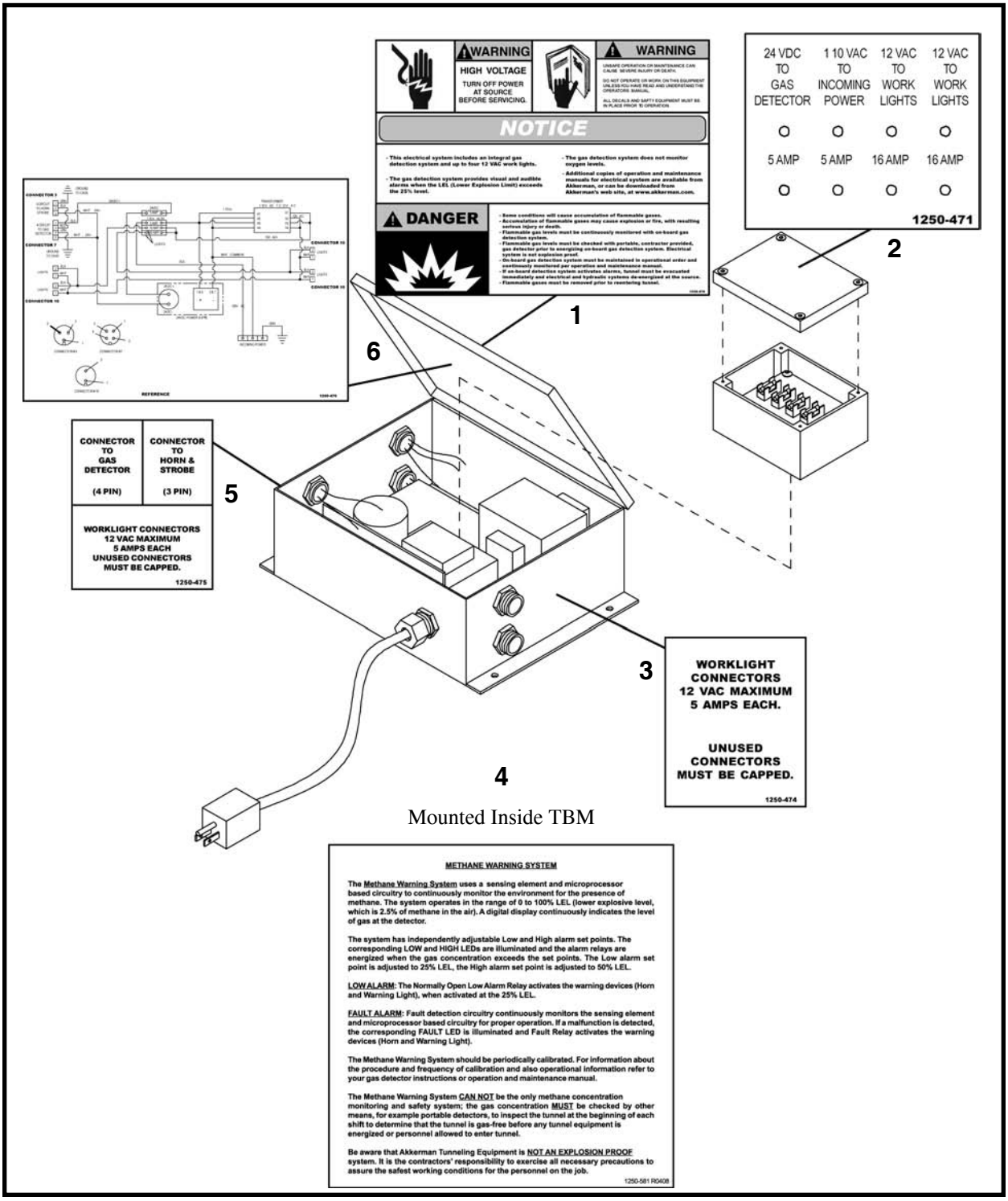
HARDWARE SPECIFICATION

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



Mounted Inside TBM

METHANE WARNING SYSTEM

The Methane Warning System uses a 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 2.5% 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 50% 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 your gas detector instructions or operation and maintenance manual.

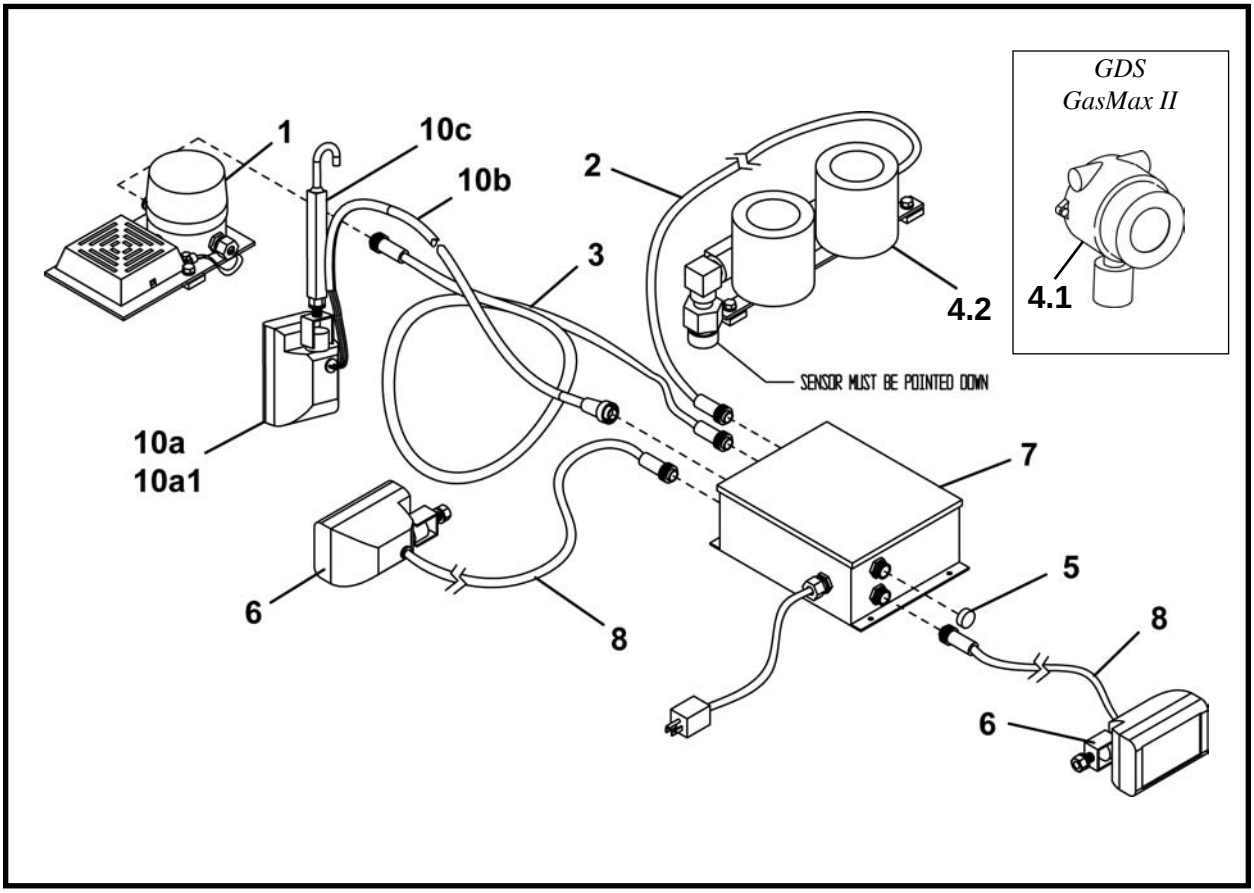
The Methane Warning System CAN NOT be the only methane concentration monitoring and safety system; the gas concentration MUST be checked by other means, for example portable detectors, to inspect the tunnel at the beginning of each shift to determine that the tunnel is gas-free before any tunnel equipment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

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

1250-581 R0408

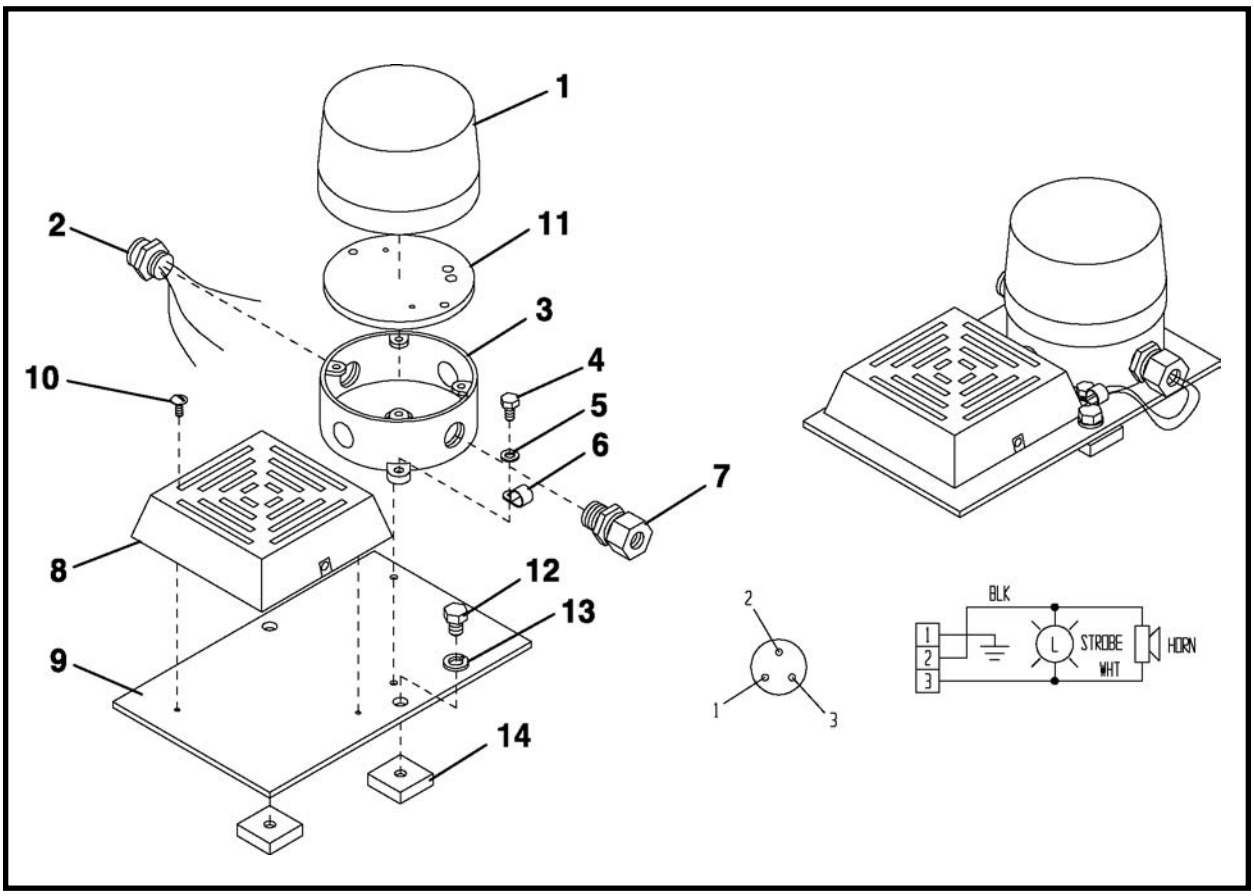
ITEM	QTY	PART NO.	DESCRIPTION
1	1	1250-478	DECAL, Danger, Warning, Notice
2	1	1250-471	DECAL, Fuse Locator
3	1	1250-474	DECAL, Work Light Max. Amp.
4	1	1250-581	DECAL, Methane Warning System
5	1	1250-475	DECAL, Connector Designator
6	1	1250-470	DECAL, Schematic

ELECTRICAL SYSTEM ASSEMBLY, 016400A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	016400A	ELECTRICAL SYSTEM ASSEMBLY
1	1	016404A	STROBE-HORN ASSEMBLY
2	1	P0054-287	CABLE
3	1	P0054-087	CABLE
4.1	1	016420A	GAS DETECTOR ASSEMBLY - GasMax II
4.2	1	016401A	GAS DETECTOR ASSEMBLY - Zellweger Analytics
5	1	P0054-090	CAP
6	2	016409A	LIGHT ASSEMBLY (Includes items 6a and 6b)
6a	1	P0053-026	LIGHT (Includes item 6b)
6b	1	P0053-026A	BULB, Light
7	1	016402A	ELECTRICAL BOX ASSEMBLY
8	2	016410A	CABLE ASSEMBLY
9	-	-	-
10	1	016415A	EXTENSION LIGHT ASSEMBLY (Includes items 10a - 10b)
10a	1	P0053-026	LIGHT (Includes item 10a1)
10a1	1	P0053-026A	BULB, Light
10b	1	P0054-167A	CABLE ASSEMBLY
10c	1	016416A	LIGHT HANDLE

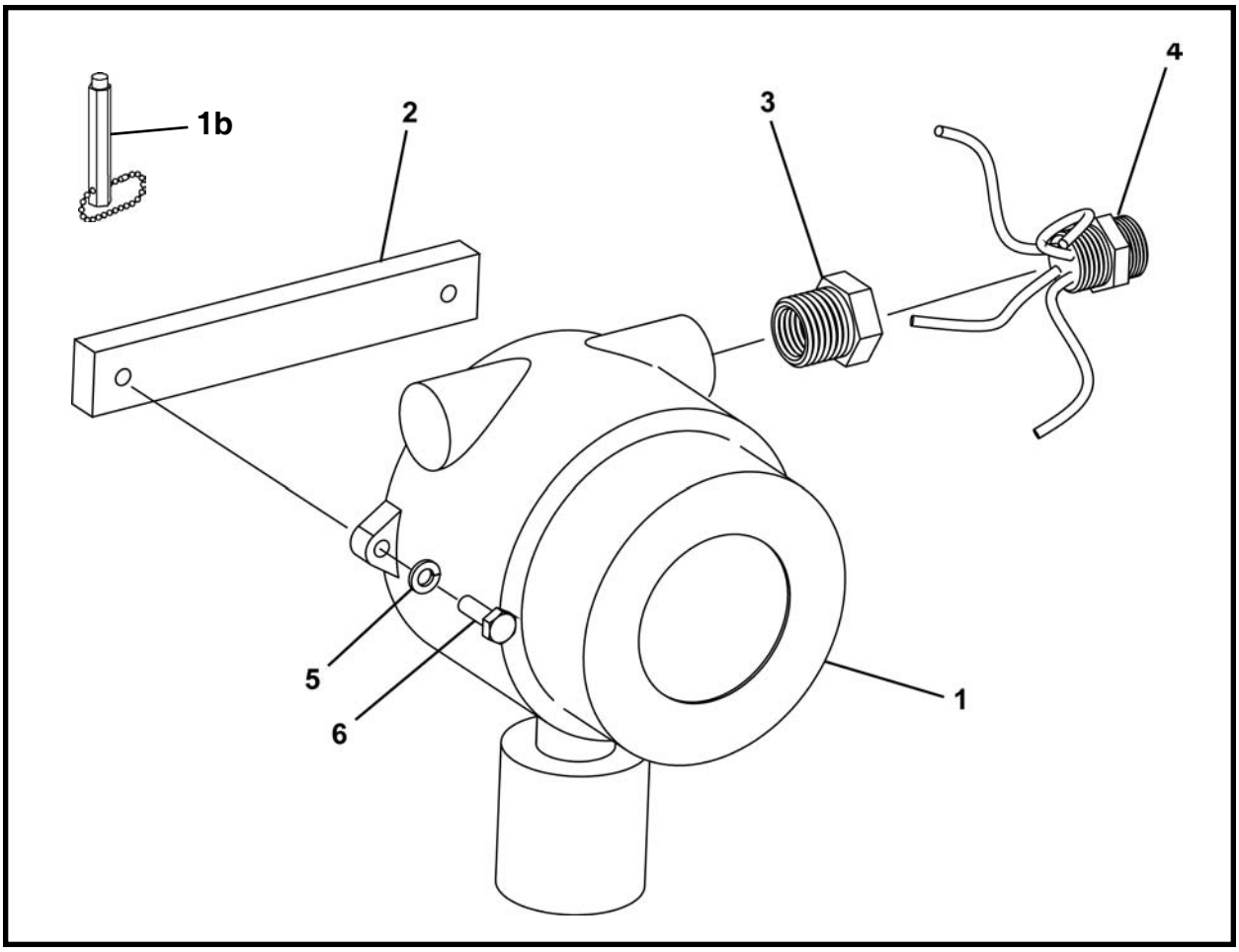
STROBE - HORN ASSEMBLY, 016404A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	016404A	STROBE - HORN ASSEMBLY
1	1	P0310-286B	STROBE LIGHT, Red 24VDC (includes 1a and 1b)
1a*	1	P0310-286A	LENS
1b*	1	P0310-286B	STROBE LIGHT 24VDC
2	1	P0054-069	RECEPTACLE, Mini
3	1	P0310-251	HOLDER BOX
4	2	P0001-04-002	BOLT, 1/4-20 UNC x 1/2
5	2	P0045-004	WASHER, Lock 1/4
6	1	P0055-123	CLAMP, Nylon
7	1	P0311-121	CONNECTOR, Strain Relief
8	1	P0310-287D	HORN, Warning 24VDC
9	1	016405P00	PLATE, Mounting
10	2	P0017-08-323	SCREW, Round Head Machine 8-32 x 1/2
11	1	023534P00	COVER, Back
12	2	P0001-06-002	BOLT, 3/8-16 UNC x 1/2
13	2	P0045-006	WASHER, Lock 3/8
14	2	P0011-006A	NUT, Strut Square

* Not Shown

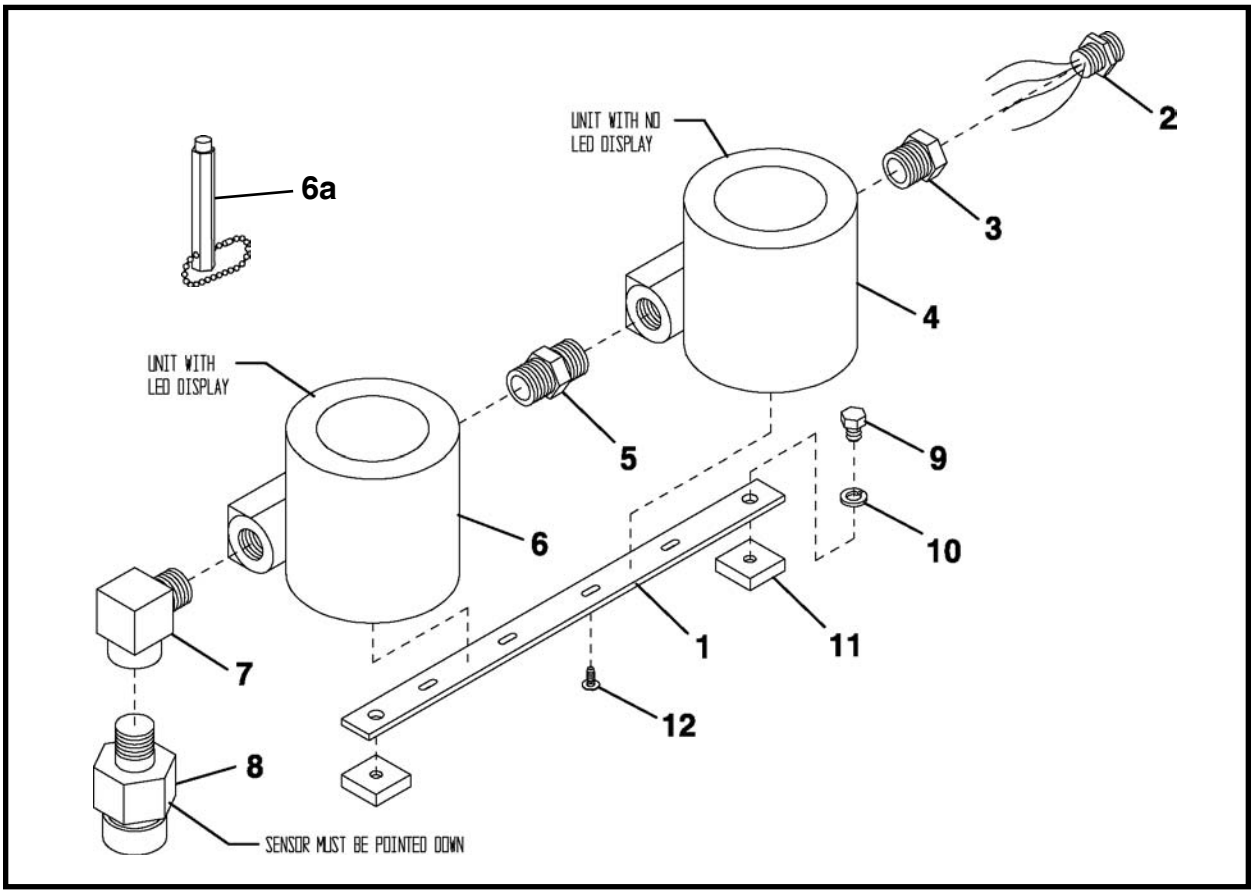
GAS DETECTOR ASSEMBLY, 016420A
GDS GasMax II



ITEM	QTY	PART NO.	DESCRIPTION
0	1	016420A	GAS DETECTOR ASSEMBLY - GasMax II
1	1	P0251-197	DETECTOR, GDS (Includes items 1a and 1b)
1a*	1	P0251-197A	ELEMENT, Sensor
1b	1	P0310-283B	MAGNETIC WAND
2	1	016407P	BRACKET, Mounting
3	1	P0300-012	FITTING, 12MP-08FPS
4	1	P0054-286	RECEPTACLE, 4 Pin Male
5	2	P0045-004	WASHER, Lock 1/4
6	2	P0001-04-003	BOLT, 1/4 UNC x 3/4

* Not Shown

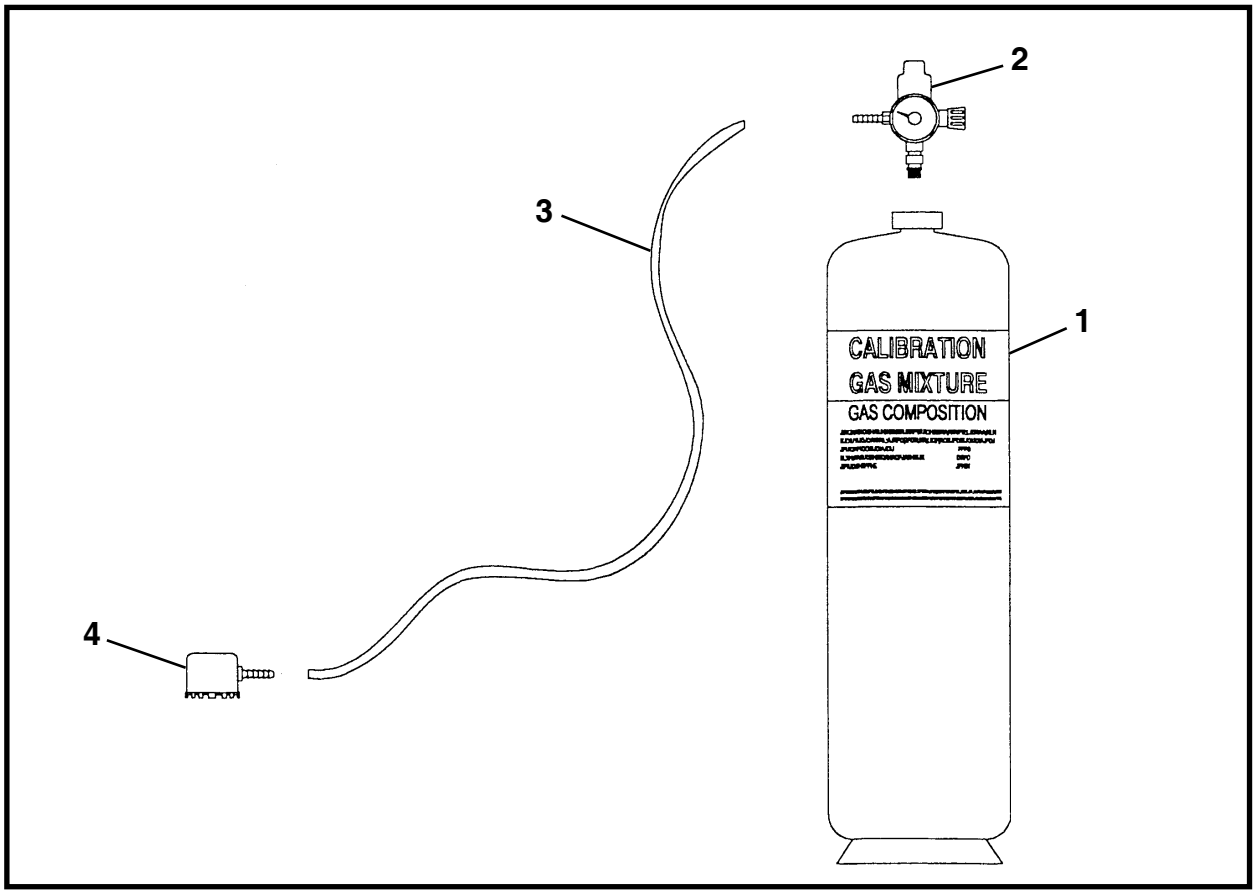
GAS DETECTOR ASSEMBLY, 016401A
ZELLWEGER ANALYTICS



ITEM	QTY	PART NO.	DESCRIPTION
0*	1	016401A	GAS DETECTOR ASSEMBLY
1	1	016403A	BRACKET, Mounting
2	1	P0054-286	RECEPTACLE
3	1	P0300-012	BUSHING, Reducer
4	1	P0310-284E	RELAY MODULE, Gas Detector
5	1	P0300-107	NIPPLE
6	1	P0310-283A	TRANSMITTER, Gas Detector (includes item 6a)
6a	1	P0310-283B	MAGNETIC WAND
7	1	P0300-009	ELBOW, Street 3/4 - 90 Degree
8	1	P0310-284D	SENSOR, Gas Detector
9	2	P0001-06-002	BOLT, 3/8-16 UNC x 1/2
10	2	P0045-006	WASHER, Lock 3/8
11	2	P0011-006A	NUT, Strut Square
12	4	P0017-10-324	SCREW, Round Head Machine 10-32

* Do not use pipe dope or tape on threads, must have good ground.
All fittings must be plated noncorrosive configuration.

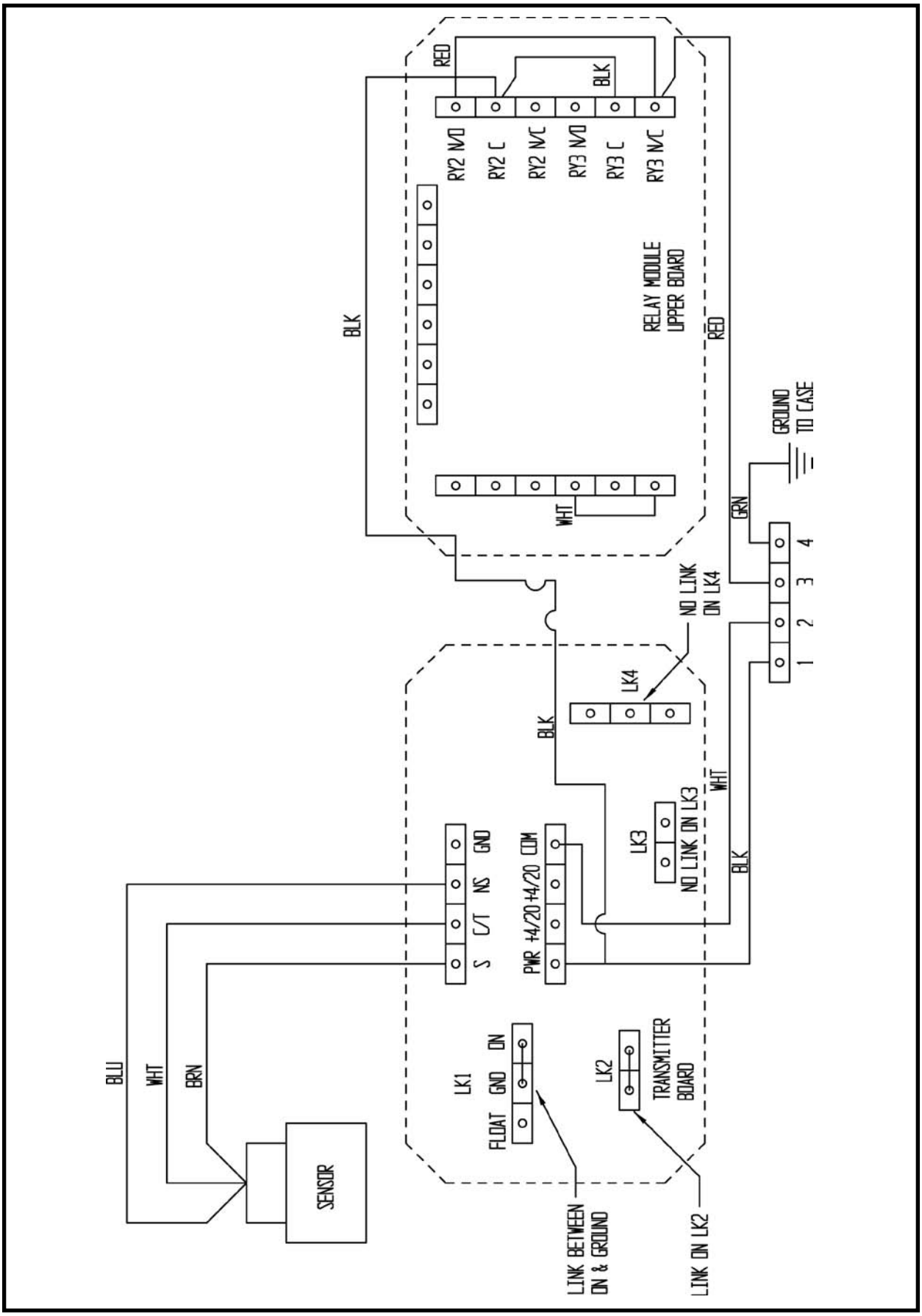
GAS CHALLENGE KIT, P0310-266



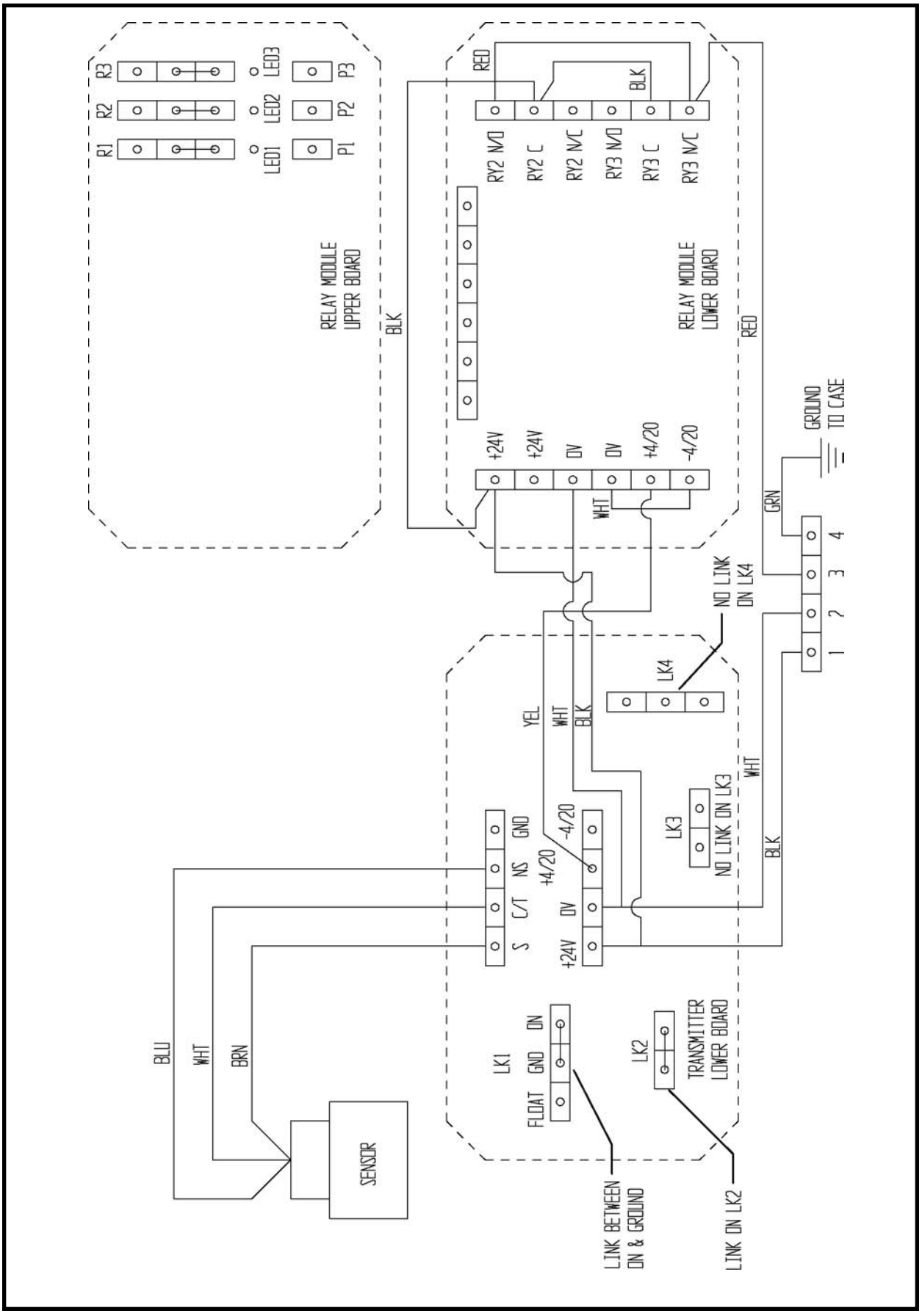
ITEM	QTY	PART NO.	DESCRIPTION
0	1	P0310-266	GAS CHALLENGE KIT
1	2	-	CYLINDER, 50% LEL Methane Gas Concentration
2	1	-	REGULATOR VALVE & GAUGE
3	1	-	TUBE, Plastic
4	1	-	CALIBRATION NOZZLE
5*	1	-	PROTECTIVE CASE

* Not Shown

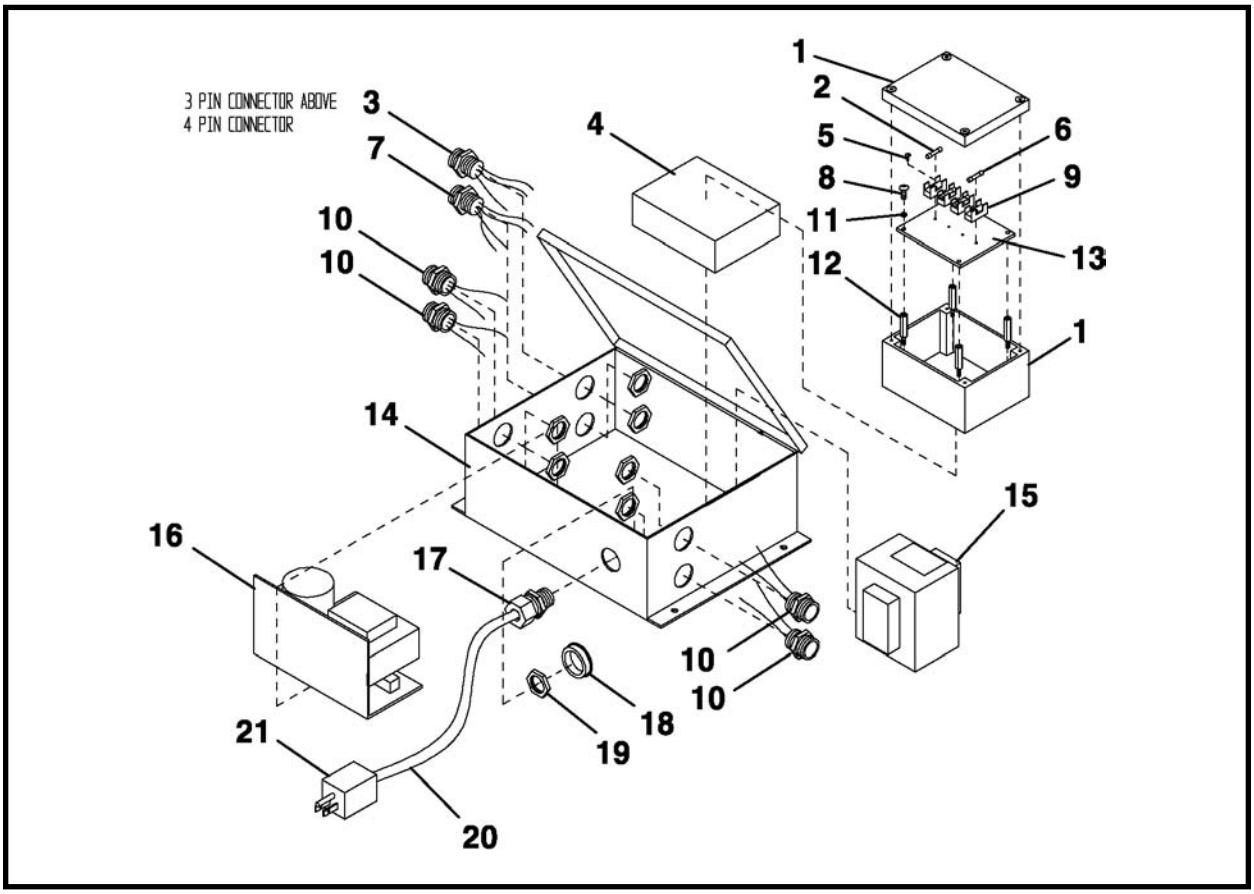
GAS DETECTOR ASSEMBLY SCHEMATIC
(GDS GASMAX II)



GAS DETECTOR ASSEMBLY SCHEMATIC
(ZELLWEGER ANALYTICS)

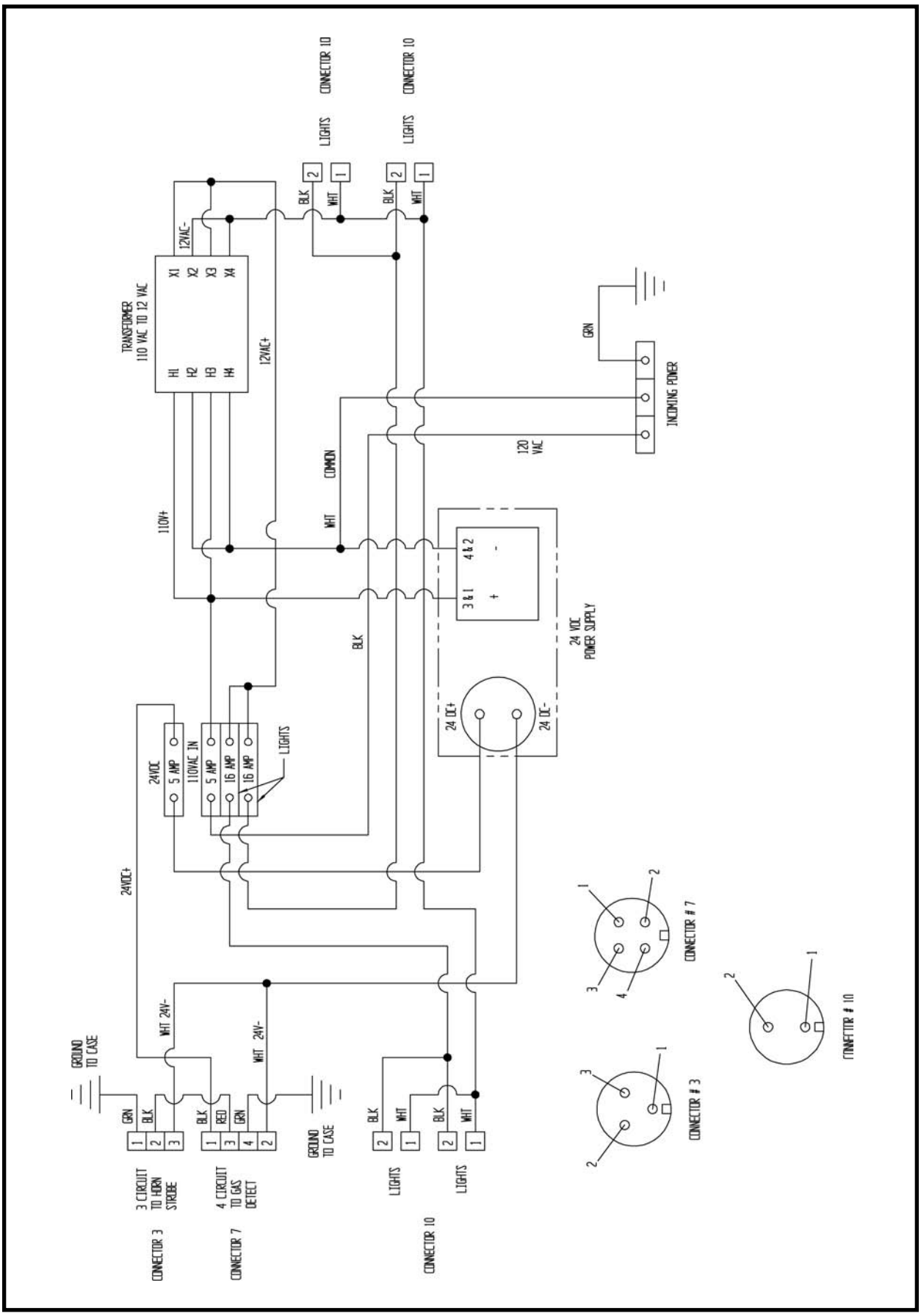


ELECTRICAL BOX ASSEMBLY, 016402A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	016402A	ELECTRICAL BOX ASSEMBLY
1	1	P0310-712	FUSE BOX
2	2	P0310-582	FUSE
3	1	P0054-068	RECEPTACLE, Mini
4	1	REF	REF
5	4	P0031-03-375	SCREW, Slotted Head Cap 4-40 UNC x 1/4
6	2	P0310-579	FUSE
7	1	P0313-049	RECEPTACLE
8	4	P0031-M3-010	SCREW, Slotted Head Cap, M3-.5 x 10mm
9	4	P0310-713	FUSE BLOCK
10	4	P0313-044	RECEPTACLE
11	4	P0043-010	WASHER, #6 Star
12	4	P0027B-12MM	KEYSTONE
13	1	016412P00	PLATE, Fuse Block
14	1	016406P00	ELECTRICAL BOX
15	1	P0310-701	TRANSFORMER
16	1	P0310-285A	POWER SUPPLY
17	1	P0311-121	CONNECTOR, Strain Relief
18	1	P0311-032	BUSHING, Insulating 1/2
19	7	P0311-018	NUT, Lock 1/2
20	1	P0054-021	CONDUIT
21	1	P0311-041	PLUG, Grounding 3 Wire
22	0.5	P0310-390A	SYLGARD SILICONE ELASTOMER
23	0.5	P0310-390B	SYLGARD SILICONE ELASTOMER
24	1	1250-471	DECAL, Fuse Locator
25	1	1250-478	DECAL, Notice, Danger, Warning
26	1	1250-470	DECAL, Schematic
27	1	1250-475	DECAL, Connector Designator
28	1	1250-474	DECAL, Work Light Max. Amp

ELECTRICAL BOX SCHEMATIC



NOTES

Alphabetical Index

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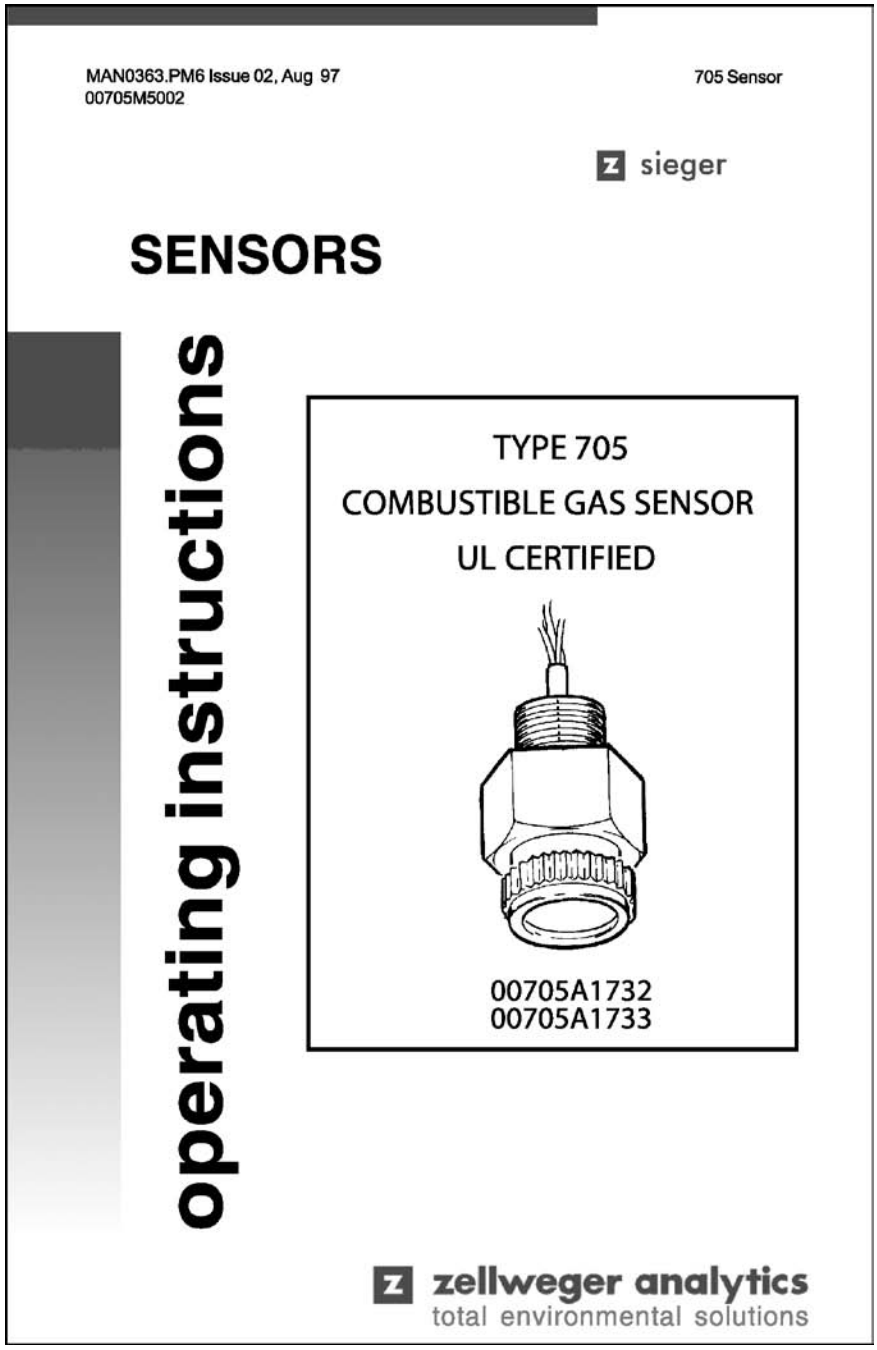
Numerical Index

NOTES

Zellweger Analytics - Type 705 Combustible Gas Sensor Operating Instructions



HELPING TO MAKE A SAFER WORLD

Ensure that you read and understand these operating instructions BEFORE installing or operating any part of the equipment.

Please pay particular attention to the Safety Warnings.

WARNINGS

1. To maintain safety standards, regular maintenance, calibration and operation of this equipment by qualified personnel is essential. Read and understand this manual completely before operating or servicing. If any further details are required which do not appear in this manual contact Zellweger Analytics Limited or their agent.

2. The Code of Practice regarding 'Selection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres' must be complied with at all times. Refer to the appropriate local or national regulations relative to the installation site.

   Elsewhere the appropriate local or national regulations should be used.

3. Operators must be fully aware of the action to be taken if the gas concentration exceeds an alarm level.

CAUTION

To maintain safety standards, regular maintenance, calibration and operation of the equipment by qualified personnel is essential.

HELPING TO MAKE A SAFER WORLD

IMPORTANT NOTICES

1. Zellweger Analytics Limited can take no responsibility for installation and/or use of its equipment if this is not done in accordance with the appropriate issue and/or amendment of the manual.

2. The user of this manual should ensure that it is appropriate in all details to the exact equipment to be installed and/or operated. If in doubt, the user should contact Zellweger Analytics Limited for advice.

3. If further details are required which do not appear in this manual, contact Zellweger Analytics Limited or one of their agents.

HELP US TO HELP YOU

Every effort has been made to ensure the accuracy in the contents of our documents, however, Zellweger Analytics Limited can assume no responsibility for any errors or omissions in our documents or their consequences.

Zellweger Analytics Limited would greatly appreciate being informed of any errors or omissions that may be found in the contents of any of our documents and to this end we include the form opposite for you to photocopy, complete and return to us so that we may take the appropriate action.

HELP US TO HELP YOU

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I suggest the following corrections/changes be made to:
Chapter ..... Section .....

Marked up copies attached (as appropriate): Yes / No

Please inform me of the outcome of this change: Yes / No

For Marketing Communications, Zellweger Analytics Limited:

Actioned By: Date:

Response: Date:

CONTENTS

1. INTRODUCTION

1.1 GENERAL

The 705 Sensor (Figure 1) is a combustible gas detector certified for installation in a hazardous area. This version uses the catalytic principle and in conjunction with electronic control equipment situated in a non-hazardous area it forms a combustible-gas detection system. The type of sensor and the gas to be detected should always be quoted when ordering replacement sensors.

The sensor comprises an aluminum housing containing a pair of poison resistant detector elements, with a sintered stainless steel disc forming the face of the sensor. The housing has a 47mm AF body with a 3/4 NPT mounting thread at one end and an M36 accessory thread on the other end. A plastic Filter Housing screws on to the accessory thread and holds the filter in position, if required. There are a number of accessories available for the 705 Sensor which utilise the M36 accessory thread. Refer to Section 8 for alternative systems to which the 705 Sensor can be connected.

Note: New Sensors are despatched with a protection disc in place of a filter. This disc should not be removed until the sensor is installed or commissioned.

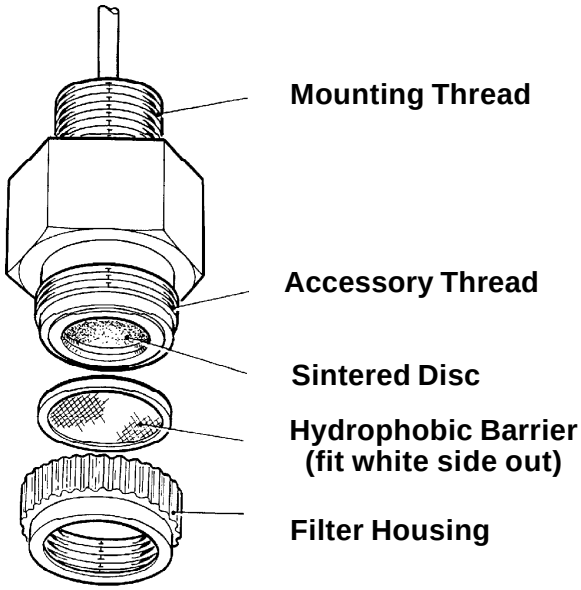


Figure 1 Type 705 Sensor and Filter Housing

1. INTRODUCTION

1.2 PRINCIPLE OF OPERATION

The Sensor contains two elements which are heated by a supply derived from the associated electronic control equipment. One element is sensitive to the presence of combustible gas, the element temperature increasing in response to catalytic oxidation of the gas. The resultant rise in resistance of the sensitive element, proportional to gas concentration, is processed by the associated control module.

The non-sensitive element compensates for effects of changes in ambient temperature.

The sensor drive current is set to a value appropriate to the type of elements used.

1.3 ACCESSORIES

1.3.1 General

The following accessories are available for use with the sensors:

a. Collecting Cone (Figure 2).

b. Weather Protection Housing (Figure 3).

c. Sample Flow Housing (Figure 4).

d. Hydrophobic Barrier.

e. Gassing Point Assembly (Figure 5).

1.3.2 Collecting Cone

The detection of a lighter than air gas is enhanced by the use of a Collecting Cone. The cone fits onto the Sensor accessory thread in place of the Filter Housing and retains the filter. The appropriate filter must be fitted.

1. INTRODUCTION

A nozzle on the cone permits gassing of the Sensor with the cone in position. Test gas is applied either direct to the nozzle or via a permanently connected pipe-line when the Sensor is in an inaccessible location.

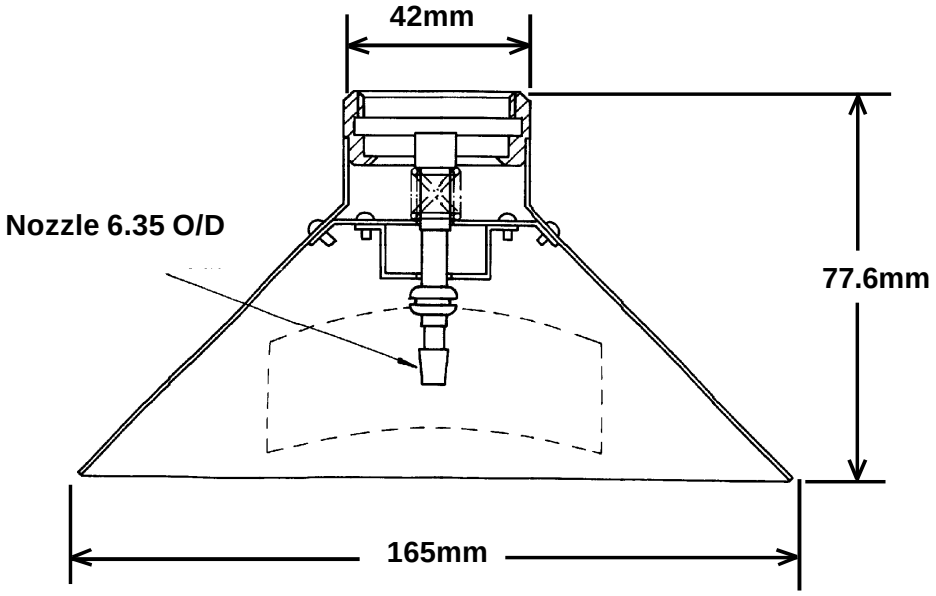


Figure 2 Collecting Cone

1.3.3 Weather Protection Housing

The Weather Protection Housing, fitted to a sensor installed in an exposed location, affords protection from driving rain from vertical to 30° below horizontal. When mounted close to the ground, protection is afforded from heavy rain rebounding off the ground. It also reduces contamination from industrial waste and enables the application of test gas in high wind speeds without significant error.

The housing is fitted to the sensor accessory thread in place of the Filter Housing and retains the Filter.

Incorporated in the housing is a nozzle to facilitate gassing of the sensor with the Weather Protection Housing in position, either by direct application to the nozzle or via a permanently connected pipeline. The nozzle is free to rotate within the housing to allow removal from the sensor without disconnecting a permanently connected pipeline, when changing the Hydrophobic Barrier and cleaning the sensor.

1. INTRODUCTION

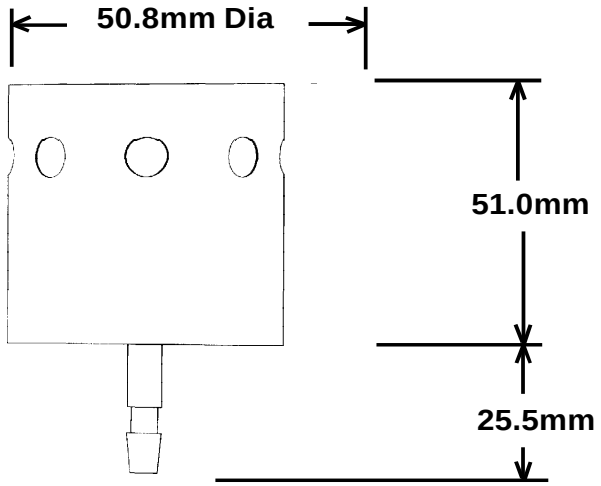


Figure 3 Weather Protection Housing

1.3.4 Sample Flow Housing

A Sample Flow Housing provides a facility to allow sampling of a closed system by means of two pipelines. The flow housing is fitted to the sensor accessory thread by a locking ring that enables the housing to be removed without disconnecting the pipeline. The Filter is retained by the housing and interfaces with a gasket bonded to the housing.

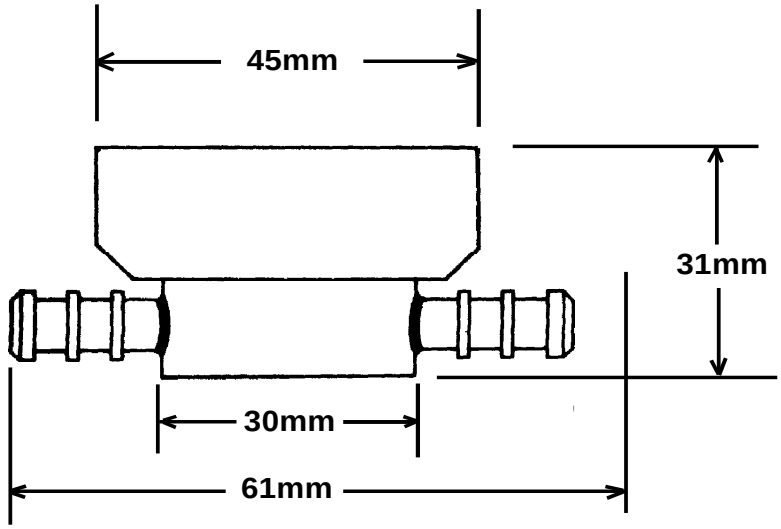


Figure 4 Sample Flow Housing

1. INTRODUCTION

1.3.5 Gassing Point Assembly

The Gassing Point Assembl assembly can be fixed in a convenient position and permanently connected by suitable tubing to an inaccessible sensor, thus simplifying the application of test gas when checking sensor calibration. A DIN Rail Mounting Assembly (00785-A-0069) is available to enable five gassing point assemblies to be mounted side by side.

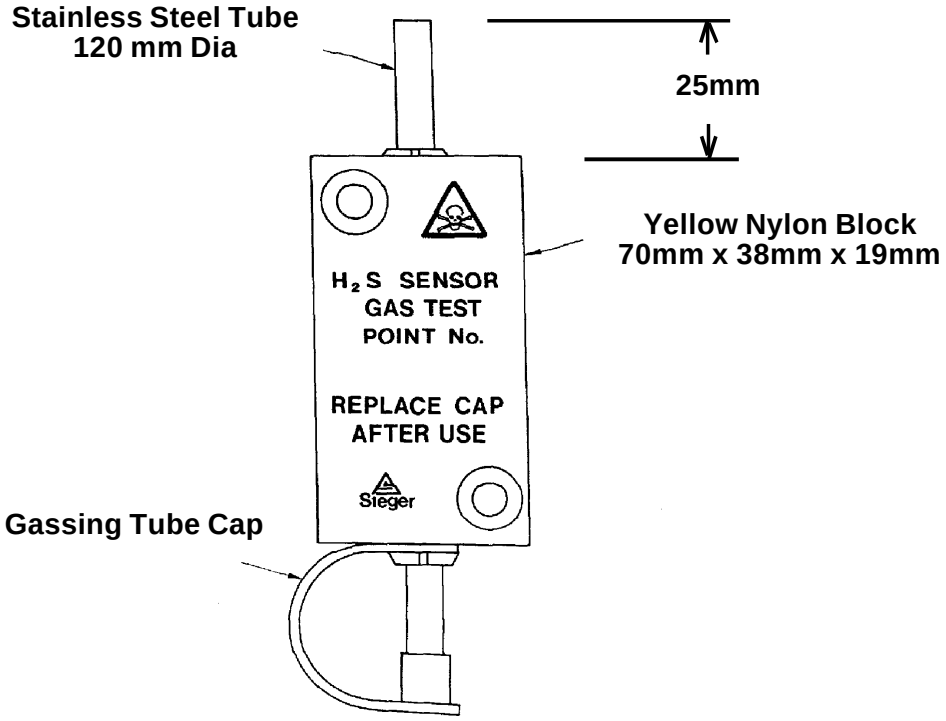


Figure 5 Gassing Point Assembly

1.3.6 Filters

In a clean atmosphere, and where no accessories are to be fitted, a filter is not needed. It is however mandatory that a filter should be fitted to provide protection appropriate to the environment and to complete the seal when a Weather Protection Housing or Collecting Cone is fitted.

1.3.7 Stainless Steel Filter

Two layers of stainless steel mesh in the form of a disc with a rubber rim to provide mechanical protection of the sinter and exclude large dust particles.

2. INSTALLATION

WARNING

The Code of Practice regarding 'Selection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres' must be complied with at all times. Refer to the appropriate local or national regulations relative to the installation site.

CAUTIONS

1. The catalytic detector element is resistant to catalyst poisons, however, abnormally high concentrations of halogenated hydrocarbons, vapours of heavy metals or compounds, some silicone compounds and sulphur compounds may cause loss of sensitivity.

2. The type 705 Sensor must never be used in conditions where there is insufficient Oxygen to totally oxidise the combustible gas. For most combustible gases, an Oxygen level of at least 15% is sufficient.

3. The sintered disc on the sensor assembly must be kept free from contaminants. ie. Oil and dirt.

2.1 UNPACKING

On receipt the equipment must be carefully unpacked,, observing any instructions printed on the packaging, and the contents checked for deficiencies and transit damage.

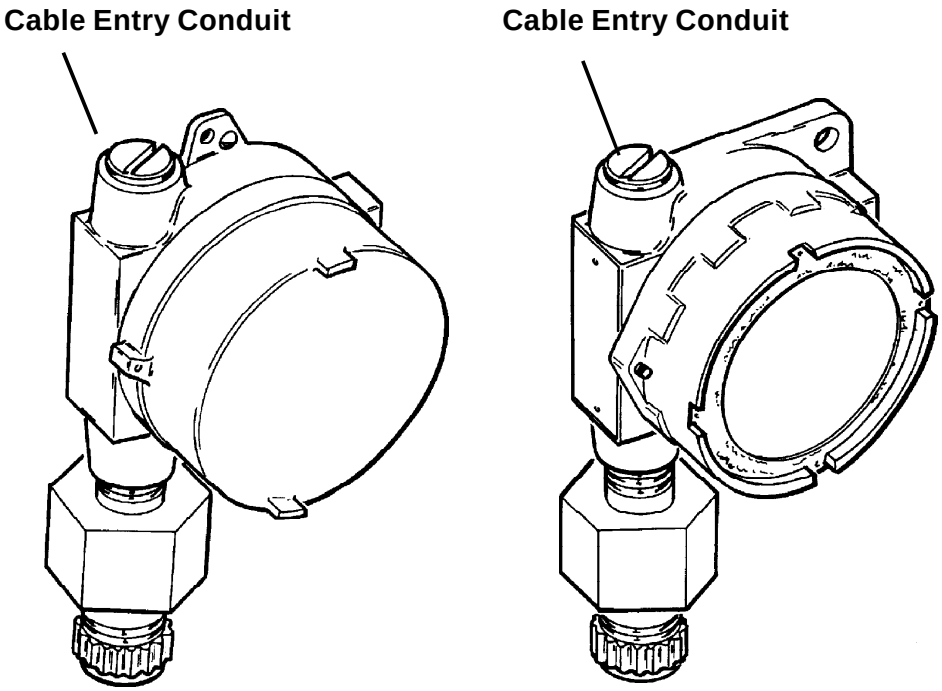
2.2 SENSOR ORIENTATION

The sensor must be installed with the Sensor facing downwards. In exposed locations a Weather Protection Housing should be fitted.

2.3 TERMINAL HOUSINGS

A Terminal Housing (Figure 6) provides a mounting base for the sensor and contains the associated electronic circuit. The installation wiring enters the Terminal Housing via conduit.

2. INSTALLATION



Killark Box with 705 Sensor

Adalet X1HFC3L Terminal Housing

Figure 6 Terminal Housings

2.4 CABLE CONNECTIONS

The sensor is connected by three wires:

Connections		Colour Code
Sensitive	(S)	Brown
Non-sensitive	(NS)	Blue
Common	(01)	White

A 3-way terminal block is provided in the terminal enclosure to enable connection to be made to the control unit. Earthing facilities are available if required.

2. INSTALLATION

2.5 FITTING SENSORS

WARNINGS

Before installing the sensors, isolate the power supply by disconnecting or removing the associated control module from the installation.

CAUTION

1. The sensitivity of catalytic sensors is impaired by silicone compounds. Do not expose the sensors to silicones or silicone-based products.

2. The sintered disc on the sensor assembly must be kept free from contaminents. eg. Oil and dirt.

3. The relevant site procedures must be obeyed at all times when opening the Terminal Housing or removing the sensor in a hazardous areas

When fitting a sensor to a metal thread, it is recommended that the mounting thread should be coated with an approved anti-seize compound, such as a light petroleum grease.

Refer to Section 8 for alternative systems to which the sensor can be connected. If replacing a sensor refer to CAUTION 1 in the Maintenance section.

To fit the 705 Sensor proceed as follows:

(1) Remove the protection disc and fit the accessories as required. (Refer to Section 3).

(2) Isolate the power supply and wait for five minutes.

(3) Remove the Terminal Housing lid.

(4) Pass the cable into the Terminal Housing and fit the sensor to housing. To comply with the certification requirements, a minimum of five threads must be engaged.

2. INSTALLATION

(5) Connect the sensor cable to the terminal block. (See label adjacent to connector).

(6) After mounting the Terminal Housing in the required location, connect the associated Control Module wiring to the terminal block (see label).

(7) Replace and secure Terminal Housing lid.

(8) If not already replaced by accessories, unscrew the Filter Housing, remove the protection disc and replace Filter Housing and gasket.

Note: The Hydrophobic Barrier is retained in position by the Filter Housing, or one of the accessories.

(9) Connect power supply to the Sensor by reconnecting or replacing the associated Control Module.

(10) Calibrate the system as detailed in the control equipment manual.

3. FITTING ACCESSORIES

3.1 COLLECTING CONE (00780-A-0032)

To fit the Collecting Cone Assembly to a sensor, carry out the following:

(1) Remove the Filter Housing and gasket from the sensor.

(2) Fit the Stainless Steel Filter.

(3) Screw the Collecting Cone assembly onto the sensor accessory thread and tighten firmly by hand.

3.2 WEATHER PROTECTION HOUSING (00780-A-2076)

To fit a Weather Protection Housing to a sensor carry out the following:

(1) Remove the Filter Housing and gasket from the sensor.

(2) Fit the Stainless Steel Filter.

(3) Screw the Weather Protection Housing on to sensor accessory thread and tighten firmly by hand.

3.3 SAMPLE FLOW HOUSING (00780-A-0035)

To fit a Sample Flow Housing to the sensor, carry out the following:

(1) Remove the Filter Housing and gasket from the sensor.

(2) Ensure that the Sample Flow Housing is fitted with its gasket (00780-C-0017).

(3) Apply a thin coating of anti-seize compound, such as a light petroleum grease, to the sensor accessory thread.

3. FITTING ACCESSORIES

(4) If required fit the Stainless Steel Filter, screw the Sample Flow Housing on to the sensor and tighten with a 40mm A/F spanner.

(5) Set the sample flow rate to 1.5 ± 0.1 litres per minute, unless otherwise directed in System installation instructions.

3.4 FILTER

The filter is retained in position on the sensor by either the Filter Housing, or one of the above accessories. When fitting a filter, keep it free from oil and dirt and other contaminants.

4. MAINTENANCE

4.1 GENERAL

Maintenance consists of cleaning the sensor and accessories, replacing gasket and the Hydrophobic Barrier and gassing the sensor when testing the system.

CAUTIONS

1. The sensitivity of Catalytic Sensors is impaired by silicone compounds. Do not expose to silicones or silicone based products.

2. Dismantling of a sensor or a sensor installation by other than authorised engineers invalidates certification.

In the event of exposure to contaminant or prolonged exposure to high concentration of gas, the sensor should be operated for 24 hours in a clean environment and then recalibrated.

Note: If the sensor is found to be faulty, or cannot be calibrated, the complete sensor must be discarded and replaced.

4.2 CLEANING

Sensor and accessories may be cleaned using an industrial grade of methanol, providing the appropriate safety precautions are taken when handling this solvent. Whenever cleaning takes place, a new Filter must be fitted and the following precautions must be observed:

a. Isolate power supply from the sensor by withdrawing the associated Control Module from the installation.

b. Do not remove sensor from the installation.

5. GASSING THE SENSOR

5.1 SENSOR WITHOUT ACCESSORIES

Where there are no accessories fitted, it is recommended that a Sample Flow Housing is used when gassing the sensor. Where this is not possible, a suitable plastic bag may be used.

5.2 SENSOR WITH COLLECTING CONE OR WEATHER PROTECTION HOUSING

(1) Using the rubber tubing, connect the test gas to the gassing nozzle or to the permanently connected tubing if fitted.

CAUTIONS

1. Upward pressure on the gassing nozzle of a Weather Protection Housing forces the nozzle against the sinter. Rotation of the nozzle may damage the sinter if a filter is not fitted.

2. Direct gassing of the sensor via the nozzle on the Collecting Cone in wind speeds of greater than 5 metres per second may cause errors.

(2) Set the flow rate to 1.5 ± 0.1 litres per minute and test the system in accordance with the instructions in the appropriate system equipment manual.

(3) On completion, shut off the test gas and disconnect the rubber tubing.

5.3 SENSOR WITH SAMPLE FLOW HOUSING

(1) Shut off the sample flow to the flow housing.

(2) Disconnect the input pipeline from the input nozzle of the flow housing.

5. GASSING THE SENSOR

(3) Using the rubber tubing, connect the test gas to the flow housing input nozzle.

(4) Set the flow rate to 1.5 ± 0.1 litres per minute and test the system in accordance with the instructions in the appropriate system equipment manual.

(5) On completion, shut off the test gas and disconnect the rubber tubing.

(6) Reconnect the input pipeline to the flow housing input nozzle and restore the sample flow.

6. REPLACEMENT PARTS

6.1 TERMINAL HOUSINGS

Note: When ordering replacements, always quote the complete part number. Where a part number is not listed or known, state type, material, cable entry size and other relevant details.

Part Number	Description	Cable Entry Thread
00704-A-1755	Adalet X1HFC3L Box Bulkhead mounting.*	3/4 NPT (2 entries)
00704-A-1756	Killark HKB-BC Box Bulkhead mounting.*	3/4 NPT (2 entries)

* These two items may be sourced locally.

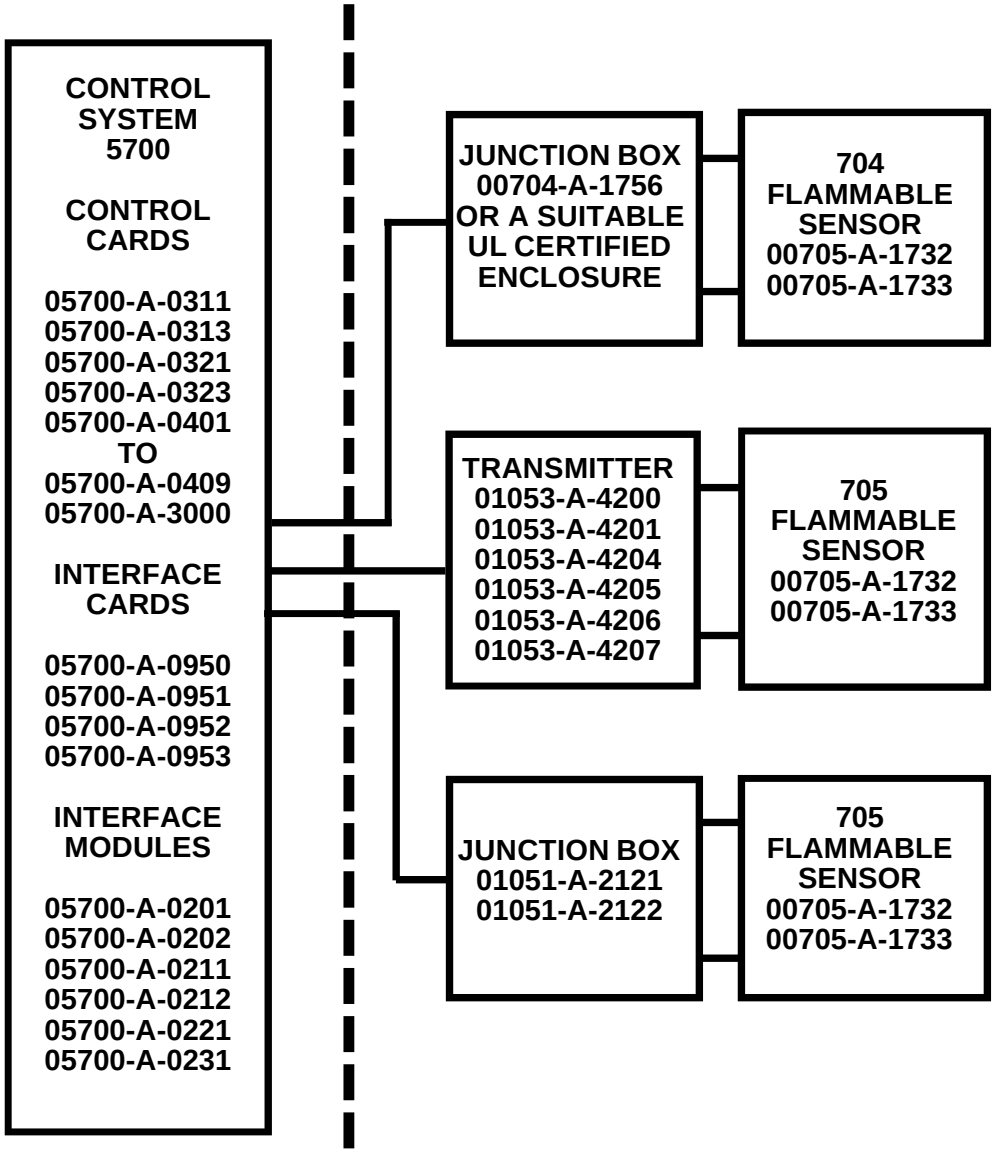
6.2 MAINTENANCE SPARES

When ordering replacements, always quote the complete part number.

Part Number	Description
00705-A-1732	Sensor Assembly (SG7B)
00705-A-1733	Sensor Assembly (SG16B)
00780-A-0032	Collecting Cone
00780-A-0035	Sample Flow Housing
00780-C-0048	Gasket (Flow Housing)
00780-A-2076	Weather Protection Housing
00780-F-0018	Filter Stainless Steel
00780-C-0038	Filter Housing
00780-C-0048	Gasket for use with Filter Housing when a filter is not fitted

7. TYPE 705 SENSOR ALTERNATIVE SYSTEMS

TOXIC SYSTEMS



8. SPECIFICATION

CERTIFICATION APPROVALS

Certified for Class 1, Division 1, Groups B, C and D

DRIVE CURRENT

200mA ± 2mA (From control equipment).

LINE RESISTANCE

Refer to Control Module Manual.

MAXIMUM POWER DISSIPATION

Less than 1W.

RESPONSE TIME

Time to reach 90% of a step change in gas concentration of 100% LEL methane - 13s.

Measured in accordance with the Canadian Standards Association (CSA) method of testing.

AMBIENT TEMPERATURE RANGE

Operating: -40°C to +55°C.

Storage: -40°C to +55°C.

TEMPERATURE COEFFICIENT OF ZERO POINT

Approximately 0.05% LEL Methane per °C (maximum).

8. SPECIFICATION

HUMIDITY RANGE

Intermittent 0 to 100% RH non-condensing. Continuous 0 to 90% RH non-condensing.

OVERALL DIMENSIONS AND WEIGHTS

Sensor:

Dimensions: 78mm x 55mm (47.2mm across flats).

Weight: 270g.

Killark HKB-BC Terminal Housing

Dimensions: 155mm x 135mm x 100mm.

Weight: 1.13kg.

Adalet X1HFC3LTerminal Housing

Dimensions: 115mm x 130mm x 88mm.

Weight: 1.2kg.

Collecting Cone:

Dimensions: 87mm x 165mm dia.

Weight: 175g.

Weather Protection Housing :

Dimensions: 76.5mm x 50.8mm dia.

Weight: 52.4g

Sample Flow Housing:

Dimensions: 61mm x 45mm x 31mm.

Weight: 110g

TERMINALS

Screw clamped and accepting cable up to 2.5mm^2.

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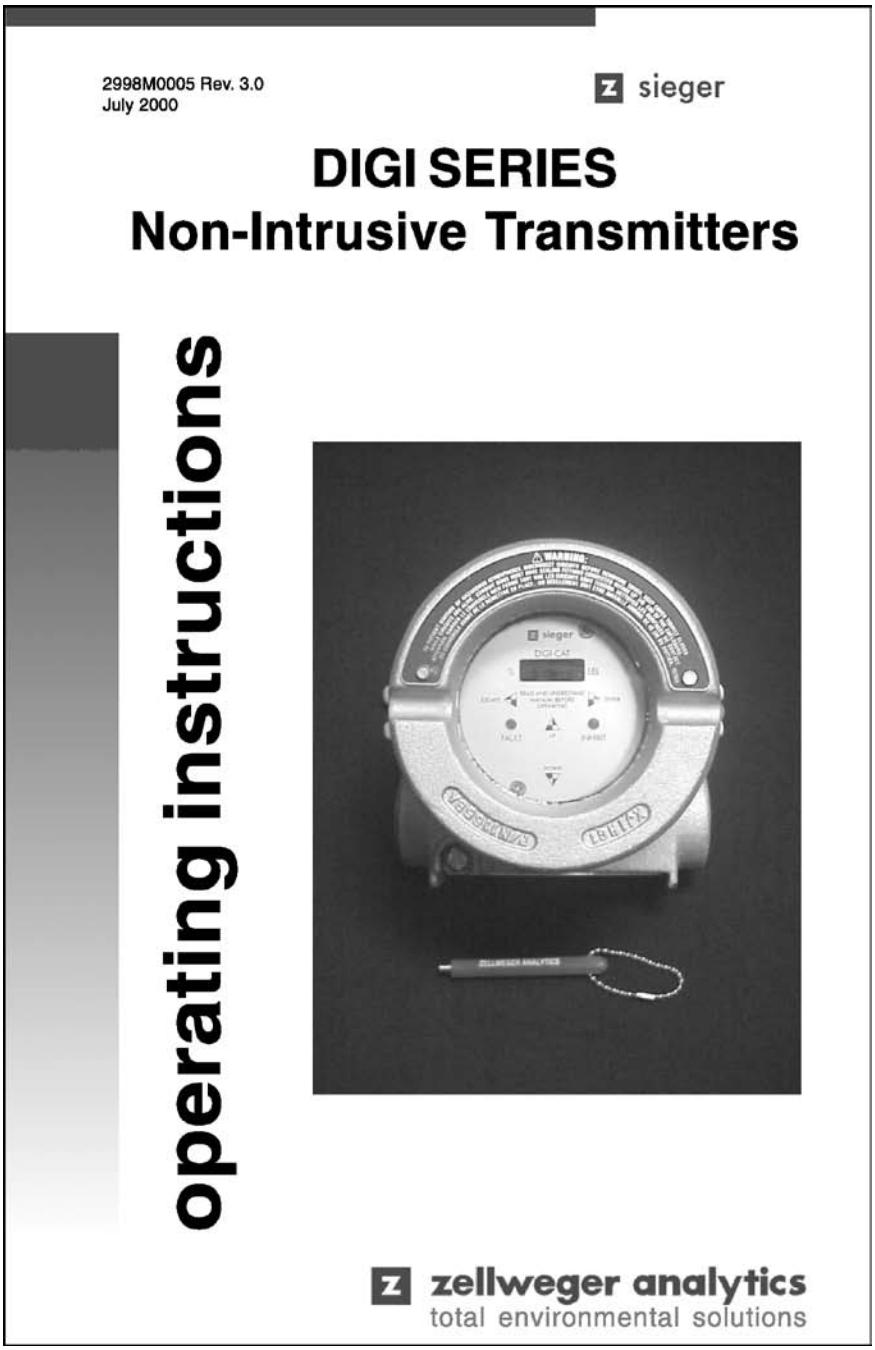
Zellweger Analytics - Non-Intrusive Transmitters Operating Instructions

NOTICE The areas of this Zellweger Analytics manual that does not pertain to the Akkerman Gas Detection System have been “grayed-out.”



NOTES

Your Uptime Is Our Top Priority

Congratulations on your purchase of the *DIGI Series Non-Intrusive Transmitter*. It will provide you with years of reliable operation. Because your uptime is our top priority, Zellweger Analytics provides you with both local service and a 24-hour Emergency Service Hotline.

During Business Hours:

Zellweger Analytics, Inc.

MDA Scientific Products:	(Toll-Free)	800-323-2000
Headquarters:		847-955-8200
Mid-Atlantic:		610-560-6000
Gulf Coast:		512-452-9718
Southwest:		760-942-3142
West Coast:		408-261-8802
Northwest:		503-639-3202
Zellweger Analytics, Ltd. (UK):		44-1-202-676-161
Zellweger Analytics Co., Ltd. (Japan):		81-3-5484-8711

24-Hour Emergency Hotline (U.S.A.): 847-634-2840

Record your serial number and installation date here for easy reference:

_____ _____

(To save time when calling for service, please have the serial number of your instrument available.)

Symbols Used in this Manual

Overview

Zellweger Analytics manuals use several symbols to draw attention to important information. Each symbol provides a graphic representation of equivalent words. The symbols are easily recognizable in any language.

Below is a listing of symbols used in Zellweger Analytics manuals and a brief description of what the symbols represent. (This manual might not use all of the symbols listed here.)

Symbols

Caution - Refer to accompanying documents. Caution statements are used to indicate hazards or unsafe practices which could result in minor personal injury or product or property damage.

Warning - Refer to accompanying documents. Warning statements are used to indicate hazards or unsafe practices which could result in severe personal injury or death.

Caution - Risk of electrical shock.

EMC Considerations

Overview

Your Zellweger Analytics instrument has been designed to comply with applicable EMC standards at the time of manufacture. The design includes filtering, shielding, and bypassing techniques. At the time of certification, simulated customer Input/Output (I/O) schemes were tested.

All methods used in your equipment for emission suppression and reduction of susceptibility are interactive. Modifications to the instrument will most likely result in increased emissions and higher vulnerability to other radiated fields.

Following the guidelines in this EMC Considerations section will ensure your instrument maintains the highest degree of EMC integrity. The guidelines listed apply only to I/O emissions, and do not apply to A.C. and D.C. instrument power connections.

Cabling

At a very minimum, all cables should include a braided shield. Ideal results have been obtained with twisted pair cabling which has a foil shield surrounding each pair plus foil and 90% braid shielding around the bundle. While this yields the best results, it can be very expensive. In addition, ensure local electrical code requirements are met.

Cabling Type

Twisted pair: Provides for cancelling of magnetic fields

Stranded pair: Provides the greatest surface area

Braid: Must have a minimum 90% coverage

Foil: When used with braid, provides 100% coverage.

Note: Do not use foil alone. It has a tendency to break.

(continued)

Zellweger Analytics product testing uses >90% braid with foil (around the bundle); twisted pair; stranded 24 AWG (minimum wiring for all qualification and certification testing).

Shield Termination

Continuation of the shield to the enclosure earth ground is most important. For long cable runs greater than 20 feet (6 meters), it is recommended that the shield connection is made at only one end to prevent ground loop problems.

For discrete wire terminations, pigtails to the enclosure ground should be extremely short (absolutely no greater than three inches).

Safety-Related Cautions

Caution

This manual deals with safety related products. The equipment must be installed and operated in compliance with this manual.

If this product is to be used in a hazardous area, installation must comply with your local codes of practice or national standards.

If installed in a hazardous area, the enclosure lid must not be removed for service unless the area is classified “gas free”. Refer to your local codes of practice or national standards.

Warranty

Each new *DIGI Series* transmitter manufactured and/or sold by Zellweger Analytics or its authorized agents is warranted to be free from defects in material and workmanship. Our responsibility is limited to repairing or replacing any instrument or part thereof for a period of one year after the start-up or 18 months after shipment, whichever comes first, when, in our opinion, the repair or replacement is covered by this warranty. Any defective equipment must be returned prepaid to the Zellweger Analytics factory for service. Field service is not included.

This warranty does not cover components that are expendable in normal use and thus have an unpredictable life, such as filters and fuses.

Instruments which have been repaired or replaced during the warranty period are warranted for the remainder of the unexpired portion of the original warranty period.

Zellweger Analytics is released from all obligations under its warranty in the event repairs or modifications are made by persons other than its own authorized personnel, unless such work is authorized in writing by Zellweger Analytics.

Contents

NOTES

Chapter 1: Introduction

Overview

The *DIGI Series* is a series of certified explosion-proof, non-intrusive transmitters used with various sensors to detect the presence of toxic or flammable gas.

Current gas concentrations and operating status can be read directly from the unit's display.

A 4-20mA output from these transmitters can be sent to a controller system, a programmable logic controller (PLC), or an external relay module to activate alarms or other signaling devices. In addition, the *DIGI Series* transmitters can be placed in a "Current Calibrator" mode for easy calibration of the controller equipment.

All of the *DIGI Series* transmitters can be easily installed and operated with minimum maintenance.

The product line consists of five types of transmitters to provide service for a wide range of locations and applications.

DIGI-ANA

The DIGI-ANA is designed to work with sensors or transmitters which have their own 4-20 mA output. It can be used with 2-wire loop powered sensors and 3-wire current source sensors or transmitters. The DIGI-ANA can be used as a local display/ calibration point, a remote display/calibration point, or as a repeater between very distant monitoring points and the control area.

DIGI-CAT

The DIGI-CAT is designed to work with single-pair catalytic bead sensors for the detection of LEL levels of flammable gases and vapors.

DIGI-CHEM

The DIGI-CHEM is designed to work with electrochemical cell-based sensors for the detection of PPM levels of toxic gases.

DIGI-CHEM for OXYGEN

A version of the DIGI-CHEM modified to work with an electrochemical cell-based 0-25% Volume oxygen sensor for the detection of atmospheric oxygen enrichment or deficiency.

DIGI-OPTIMA

The DIGI-OPTIMA is specifically designed to work with the Searchpoint Optima Infrared Point Gas Detector. The DIGI-OPTIMA can be used as a local display/calibration point.

This manual provides instructions to install, operate, and maintain the *DIGI Series* transmitters.

Safety Notices

There are three levels of safety notices used in this manual: warning, caution, and note. Below are examples of each of these safety notices and the conventions used in this manual:

WARNING:

A WARNING indicates a situation in which personal injury may occur.

Caution:

A **Caution** indicates a condition in which damage may occur to equipment or material.

Note:

A note provides helpful information for proper operation of your *DIGI Series* transmitter.

Chapter 2: Installation

Mounting the Transmitter

Note:

Gas detection devices must be installed in the correct locations. Failure to do so will render the sensors ineffective. Refer to your local codes of practice or national standards for advice.

All models of the *DIGI Series* transmitter come with a wall mount bracket attached.

The transmitter itself may be mounted in any orientation. However, if a sensor is screwed directly into the transmitter, the transmitter must be mounted to provide for proper operation of the sensor.

If an electrochemical (ECC) or catalytic sensor is screwed into the *DIGI Series* transmitter, the transmitter must be mounted vertically as demonstrated in Figure 1.

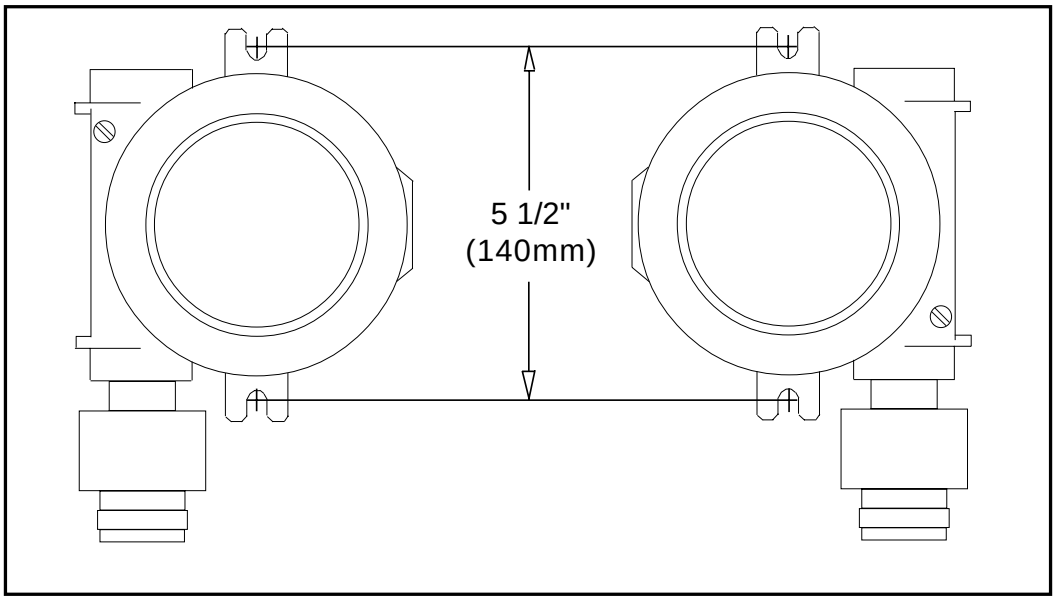


Figure 1. Mounting the Transmitter with ECC or Catalytic Sensor

If a Searchpoint Optima infrared detector is screwed into the *DIGI Series* transmitter, the transmitter must be mounted horizontally. See examples in Figure 2.

(continued)

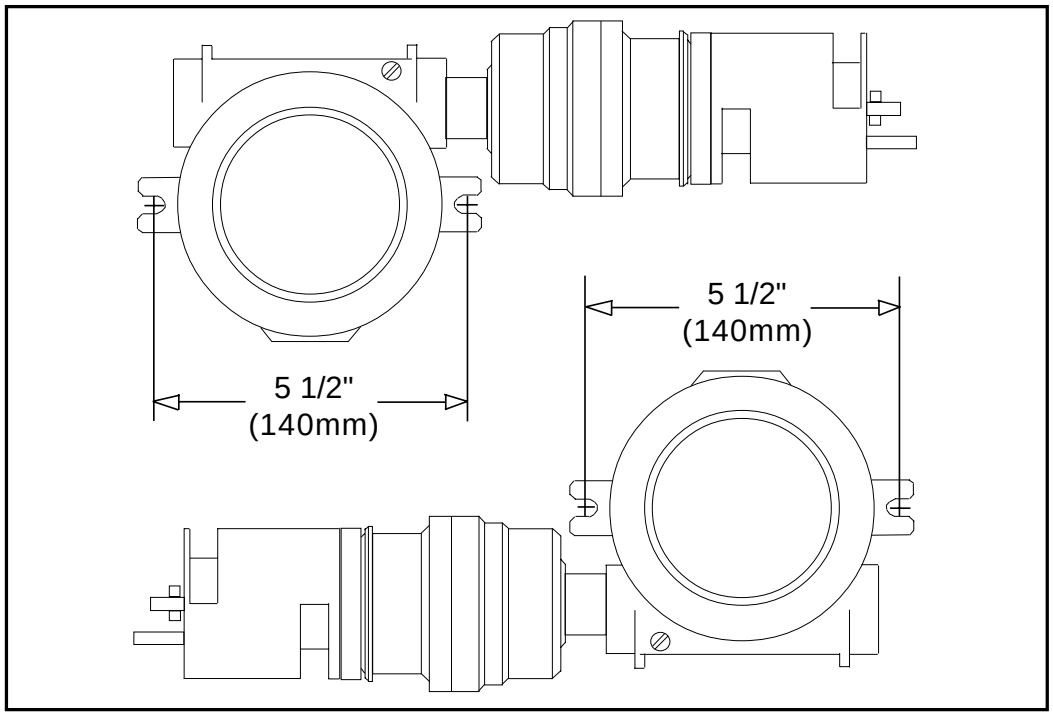


Figure 2. Mounting the Transmitter with Searchpoint Optima

The overall dimensions of the *DIGI Series* transmitter are in Figure 3. The dimensions of the various sensors can be found in their respective manuals.

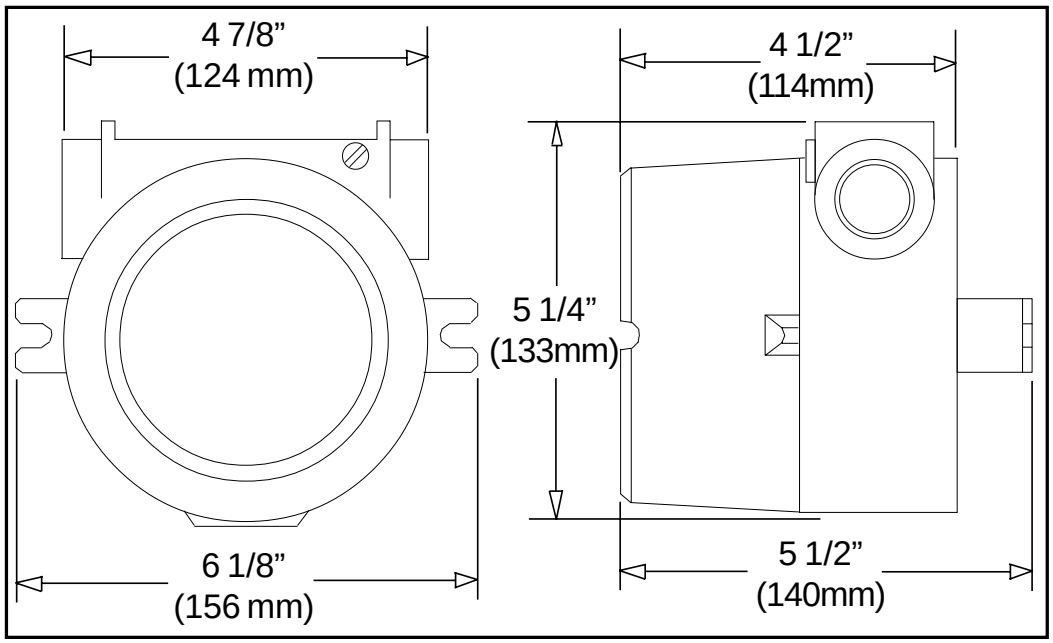


Figure 3. Overall Dimensions of the DIGI Series Transmitter

Appropriate hardware (not included) should be used to secure the bracket to a wall. The slots in the mounting bracket will accommodate up to 1/4” screws or bolts.

Wiring

Wiring Requirements

It is strongly recommended that shielded cable be used. Shielded cable helps prevent electromagnetic interference (EMI) and radio frequency interference (RFI). Refer to “EMC Considerations” on page *iii* for more information.

The *DIGI Series* transmitters will accommodate 14-22 AWG wire, either stranded or solid. The following Belden cables are examples:

Belden # 83652:

2-conductor, 18 AWG stranded, 100% shield coverage

Belden # 83653:

3-conductor, 18 AWG stranded, 100% shield coverage

Belden # 83654:

4-conductor, 18 AWG stranded, 100% shield coverage

Wiring Lengths

The *DIGI Series* transmitters can be located up to 1000 feet from the controller equipment using a 24VDC power supply and 18AWG wire.

Certification Requirements

The *DIGI Series* transmitters are certified for use in Class I, Division 1, Groups B, C and D hazardous areas. Equipment must be installed in accordance with national and / or local codes. In the U.S.A., the National Electrical Code (NEC) requires a sealed fitting within 18” of the enclosure.

Accessing the Terminal Board

The terminal board is located under the display assembly. Access to the terminal board is achieved as follows:

1. Remove the enclosure lid by unscrewing it counterclockwise.

Note:

If the lid is difficult to unscrew, make sure the setscrew in the tab is loosened.

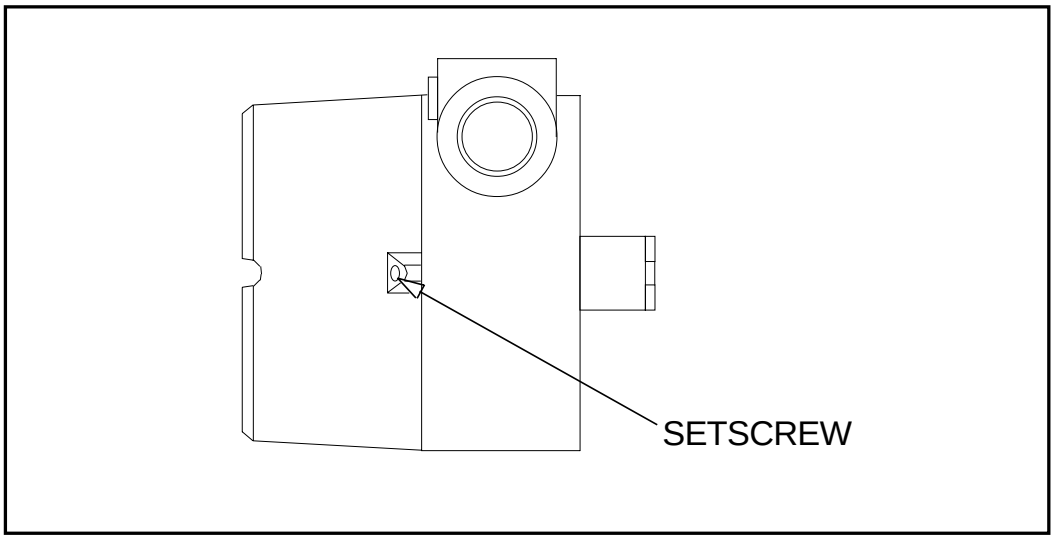


Figure 4. Location of Setscrew

2. Remove the display assembly by gripping the faceplate and carefully pulling directly upwards.

Caution:

The display assembly is attached to the terminal board by means of a ribbon cable. Excessive force in removing the display assembly will result in damage to this cable, rendering the transmitter inoperable.

3. Disconnect the ribbon cable from the terminal board and set the display assembly aside.

Grounding Configuration

On the terminal board, there is a link (LK1) which controls grounding of the incoming 0VDC connection.

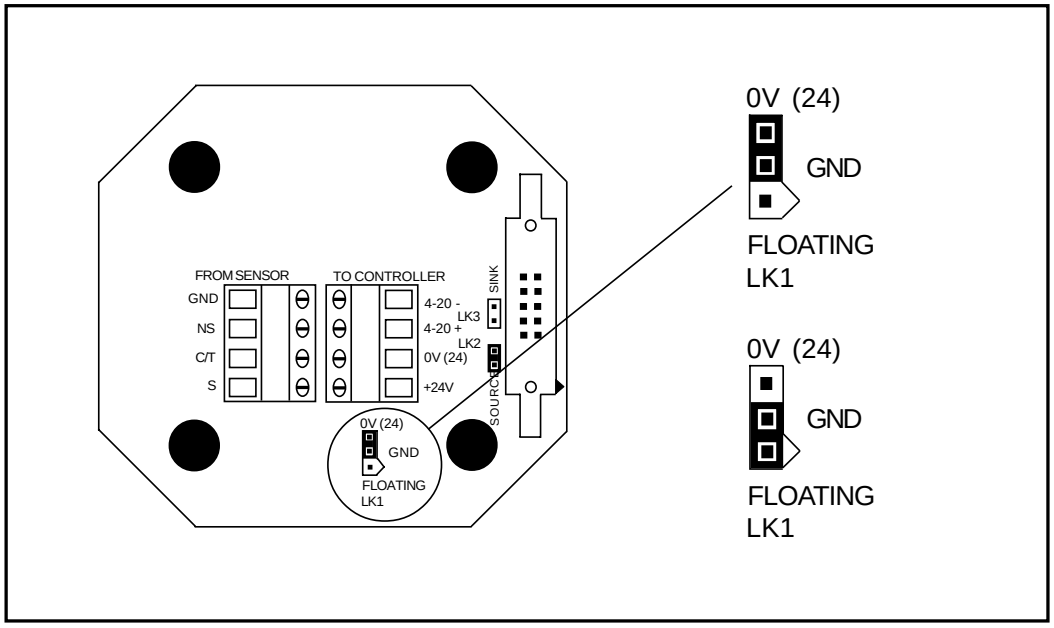


Figure 5. Location of Link LK1

When link LK1 is installed between the GND and 0V(24) pins, the incoming 0VDC terminal is connected to the enclosure (earth ground). While this configuration does not affect operation of the transmitter, it may, in some instances, affect operation of the overall system.

Note:

Make sure connecting 0VDC to earth ground does not violate your local codes of practice or national standards.

When link LK1 is installed between the GND and FLOATING pins, the incoming 0VDC terminal is isolated from the enclosure (earth ground) by a surge protection device.

Power Connections

Power Requirements

The *DIGI Series* transmitters operate at the following voltages and power ratings (voltages are measured at the transmitter):

DIGI-CAT (includes sensor):	18 - 32 VDC, 2.0 W
DIGI-CHEM (includes sensor):	18 - 32 VDC, 0.6 W
DIGI-ANA (without sensor):	18 - 32 VDC, 0.6 W
DIGI-OPTIMA (without sensor):	18 - 32 VDC, 0.6 W

Wiring Terminations

Caution:

Incorrect wiring could damage the transmitter. Follow the wiring instructions shown in Figure 6 to ensure correct terminal locations.

All *DIGI Series* transmitters have identical power connections.

Connect the positive side of the power supply to the terminal labeled “+24V”.

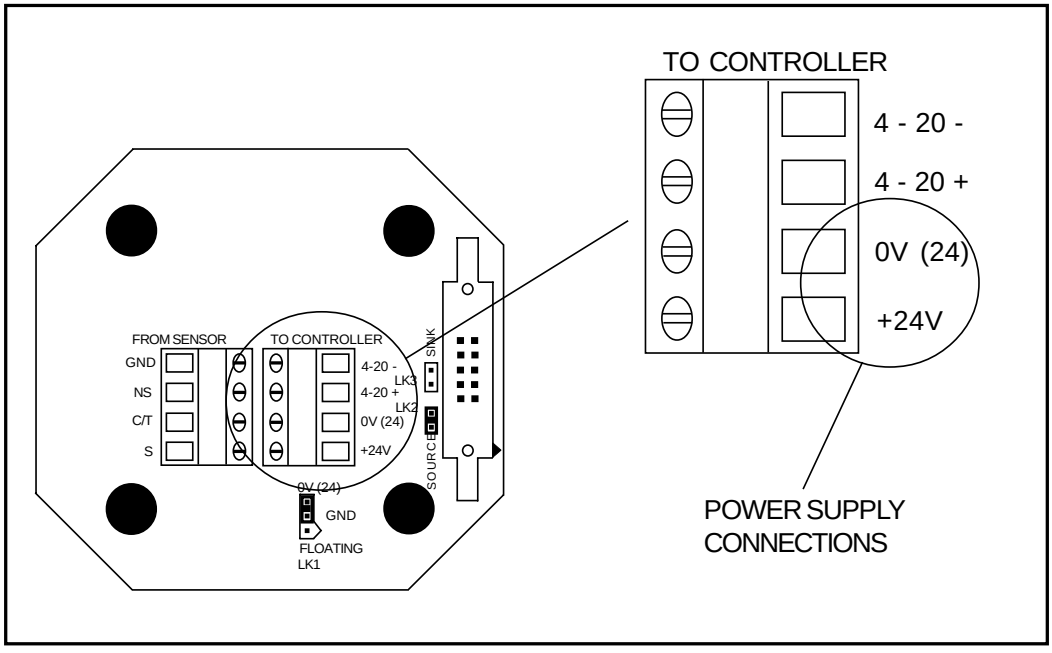


Figure 6. Power Connections

Output Signal Configuration

On the terminal board, there are two links (LK2 and LK3) which configure the *DIGI Series* transmitter's 4-20 mA output signal.

Caution:

Never install both LK2 and LK3 at the same time! Permanent damage will occur to the output signal circuitry.

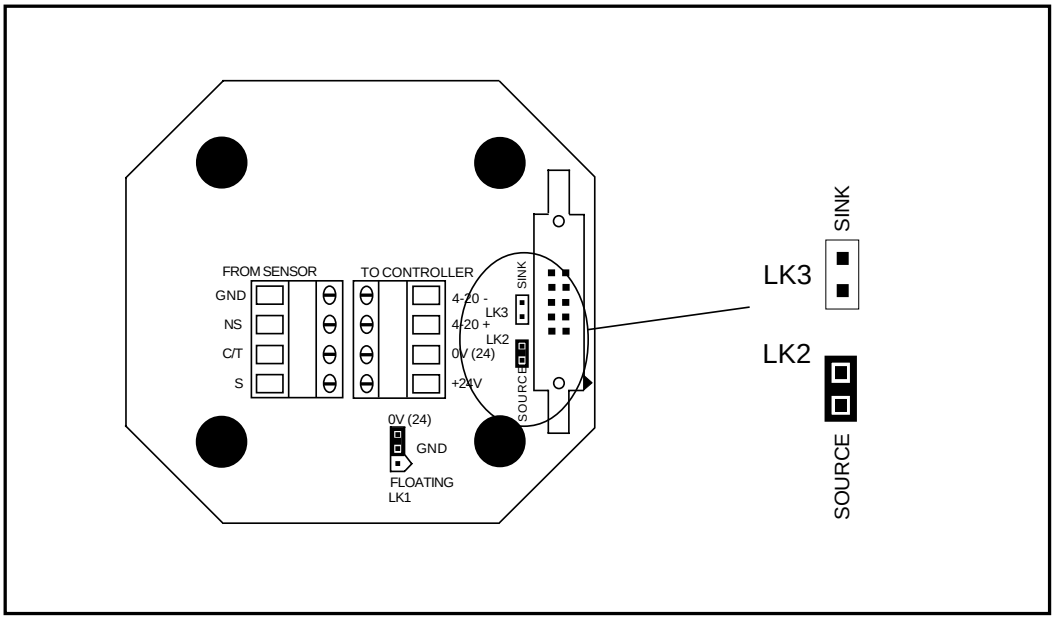


Figure 7. Location of Links LK2 and LK3

The output signal can be configured as a *Current Source,* a *Current Sink*, or an *Isolated Output*.

Current Source and *Current Sink* configurations are used when the *DIGI Series* transmitter is receiving its operating power from the controller equipment. Since both pieces of equipment share the same power source, only a single signal line is required for the *DIGI Series* transmitter's output. This is often referred to as a "Three-Wire Configuration" since only three wires are needed for the *DIGI Series* transmitter (+24V, 0V, and signal).

(continued)

Current Source

To configure the *DIGI Series* transmitter for a *Current Source* output signal, install LK2 (see Figure 7). Make sure LK3 is NOT installed. The output signal will be present at the “4-20 +” terminal.

Current Sink

To configure the *DIGI Series* transmitter for a *Current Sink* output signal, install LK3 (see Figure 8). Make sure LK2 is NOT installed. The output signal will be present at the terminal labeled “4-20 -”.

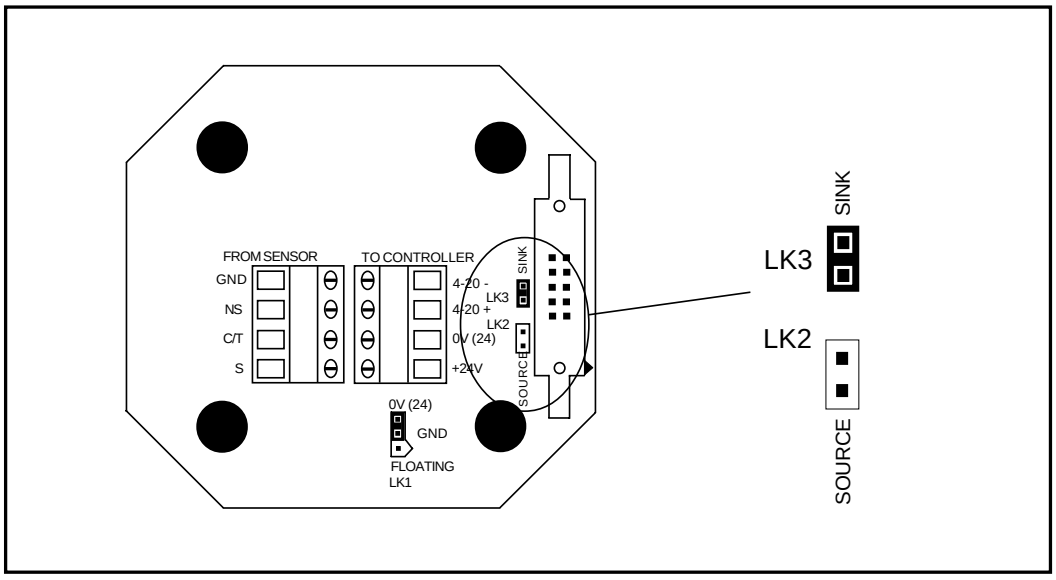


Figure 8. Current Sink Link Configuration

Isolated Output

The *Isolated Output* configuration is used when the *DIGI* transmitter does NOT share the same power source as the controller equipment.

Separate power sources can cause incorrect readings at the controller equipment. To ensure correct readings at the controller equipment, the output signal of the *DIGI Series* transmitter must share the same power source as the controller equipment.

This requires two wires for the signal output of the *DIGI Series* transmitter. The *Isolated Output* configuration is also referred to as

(continued)

a “Four-Wire Configuration” since four wires are needed for the *DIGI* transmitter (+24V, 0V, signal + and signal -).

To configure the *DIGI Series* transmitter for an *Isolated Output* signal, remove both LK2 and LK3 (see Figure 9). The output signal will use the terminals labeled “4-20 -” and “4-20 +”.

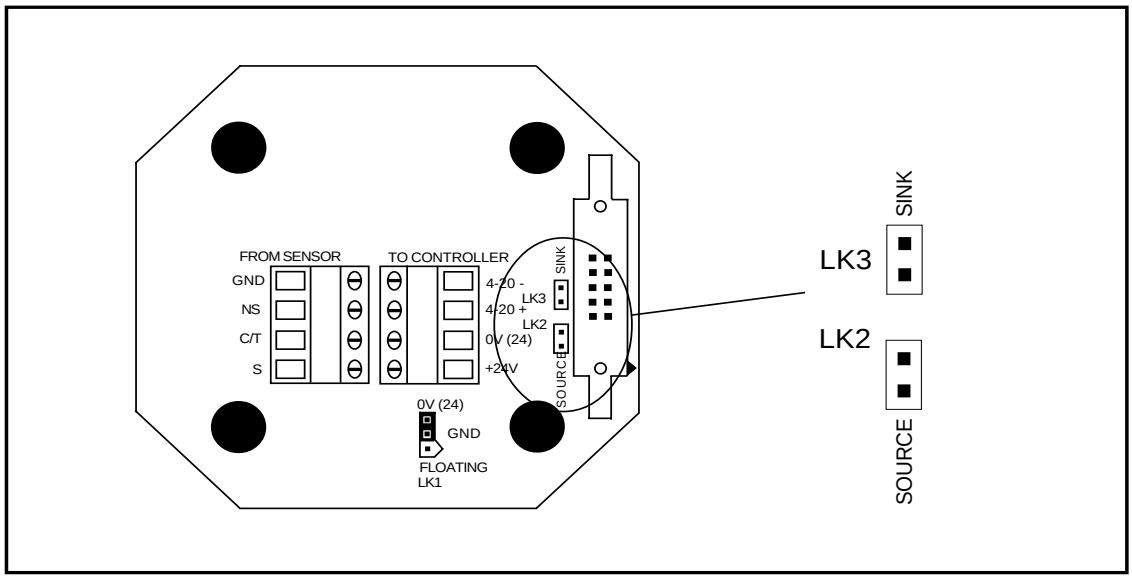


Figure 9. Isolated Output Link Configuration

Output Signal Connections

Current Source

Note:

Refer to “Output Signal Configuration”, page 9, to determine the proper configuration for your application and to verify the configuration of your transmitter.

All *DIGI Series* transmitters have identical output signal connections.

In the Current Source configuration, the output signal uses the “4-20 +” terminal. Use Figure 10 for connection to a System 57 or model 5700 controller. Use Figure 11 for connection to a PLC analog input module.

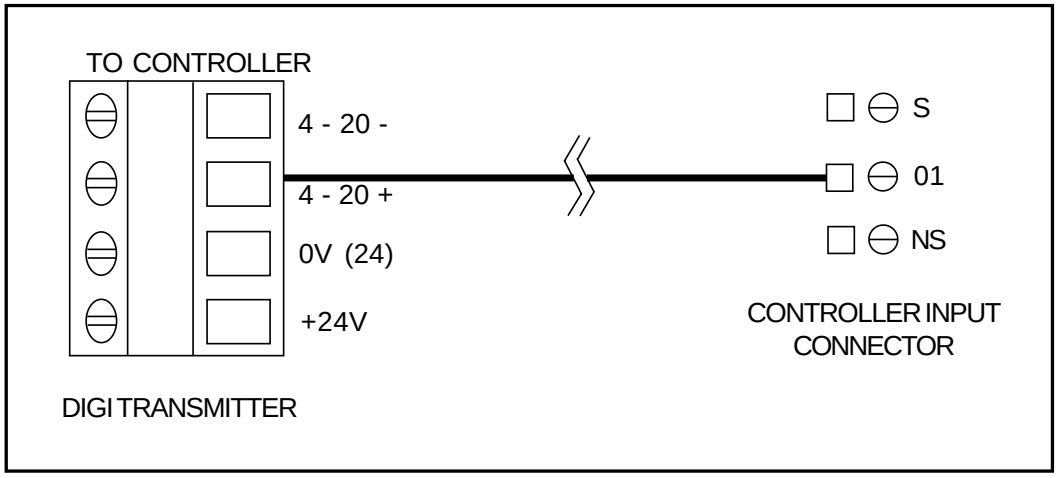


Figure 10. Current Source Connection to Controller

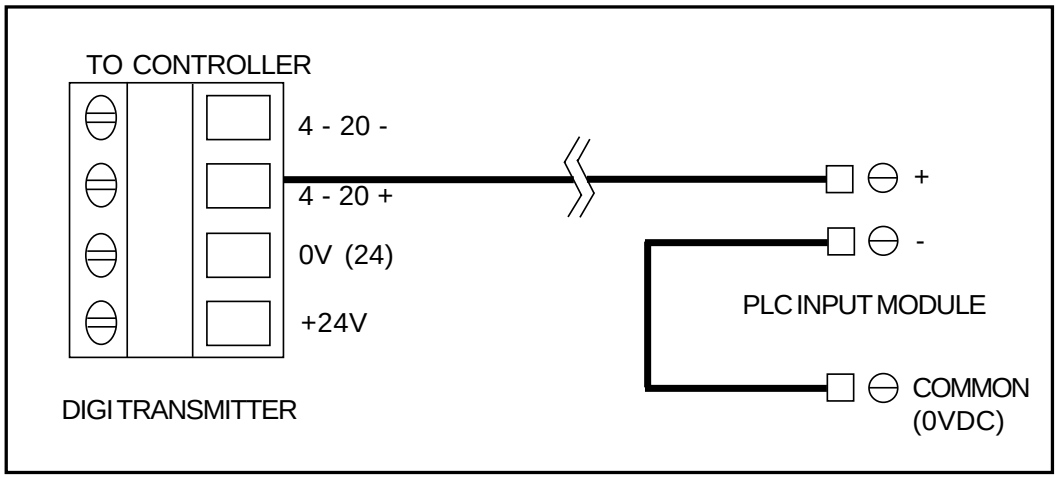


Figure 11. Current Source Connection to PLC

Current Sink

Note:

Refer to “Output Signal Configuration”, page 9, to determine the proper configuration for your application and to verify the configuration of your transmitter.

All *DIGI Series* transmitters have identical output signal connections.

In the Current Sink configuration, the output signal uses the “4-20 -” terminal. Use Figure 12 for connection to a System 57 or model 5700 controller. Use Figure 13 for connection to a PLC analog input module.

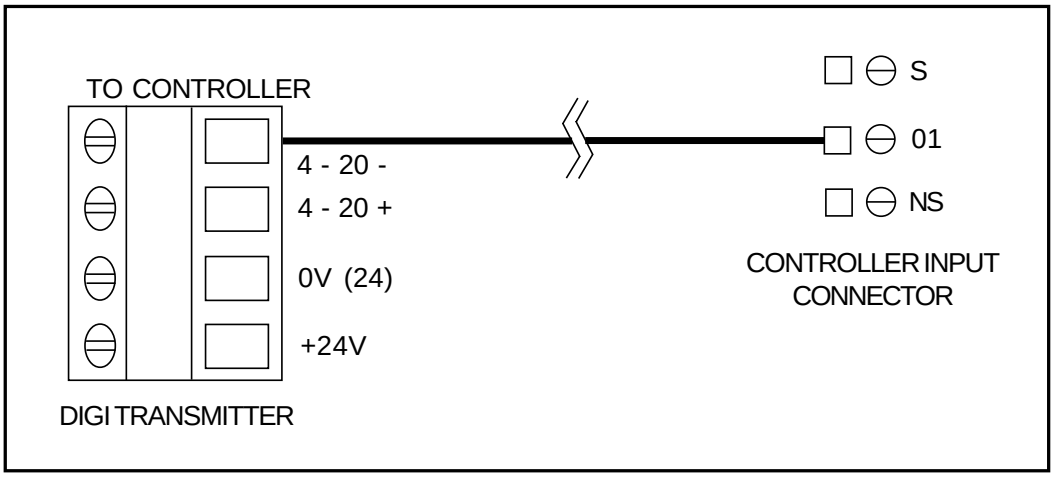


Figure 12. Current Sink Connection to Controller

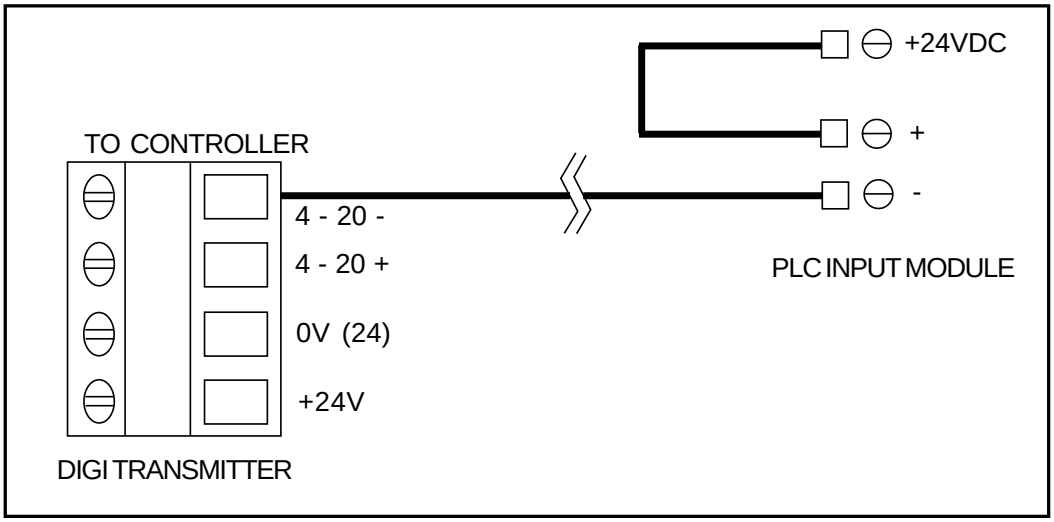


Figure 13. Current Sink Connection to PLC

Isolated Output

Note:

Refer to “Output Signal Configuration”, page 9, to determine the proper configuration for your application and to verify the configuration of your transmitter.

All *DIGI Series* transmitters have identical output signal connections.

In the Isolated Output configuration, the output signal uses both “4-20” terminals. Use Figure 14 for connection to a System 57 or model 5700 controller. Use Figure 15 for connection to a PLC analog input module.

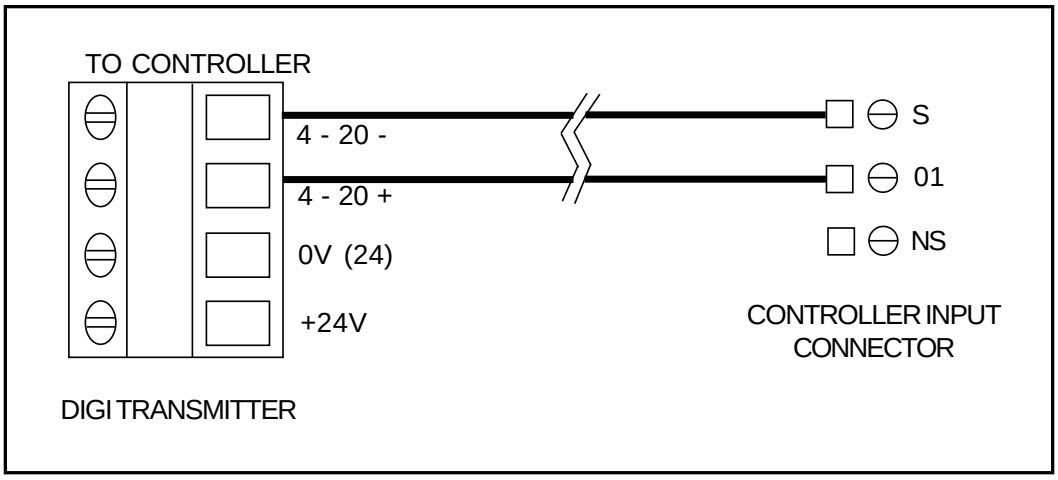


Figure 14. Isolated Output Connection to Controller

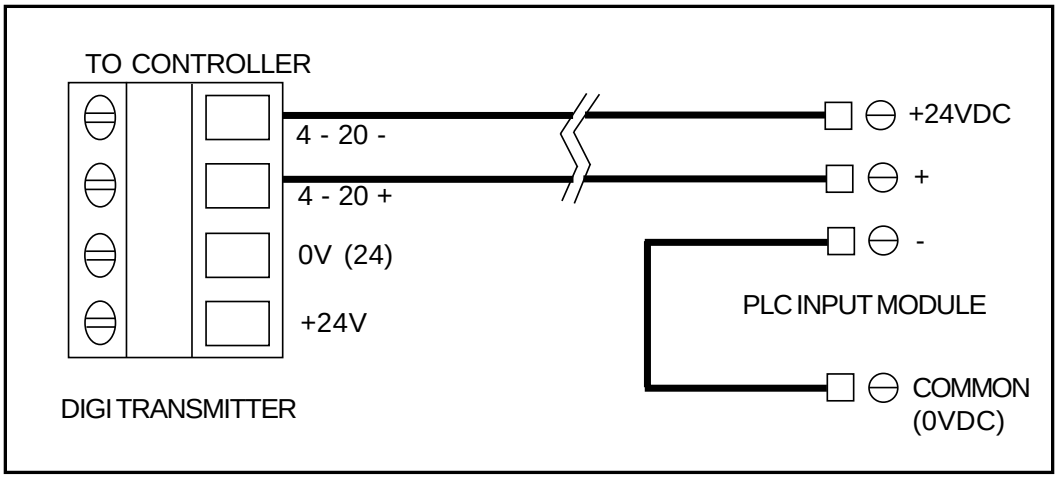


Figure 15. Isolated Output Connection to PLC

Sensor Connections

DIGI-ANA (2-Wire)

Caution:

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

Figure 16 shows the connections for a loop powered (2-wire) sensor.

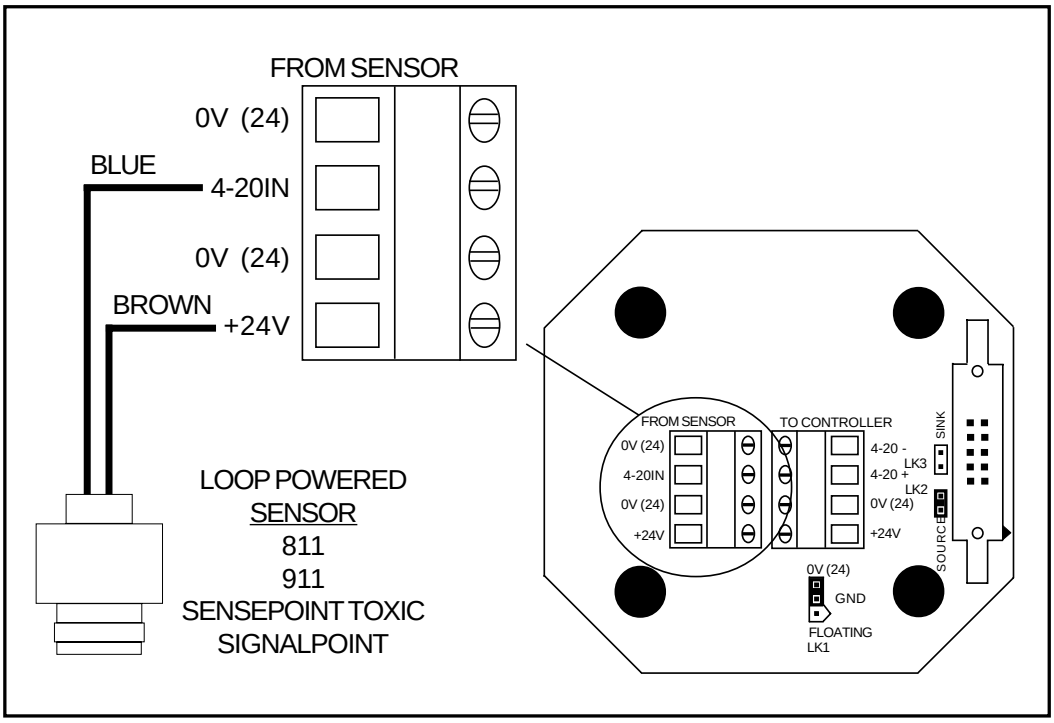


Figure 16. Sensor Connections - DIGI-ANA with 2-Wire Sensor

Note:

The terminals marked “0V (24)” are NOT connected to earth ground and should not be used for a shield connection. Placing LK1 in the “0V (24)” position connects these terminals to earth ground.

DIGI-ANA (3-Wire)

Caution:

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

Figure 17 shows the connections for a 3-wire sensor or transmitter.

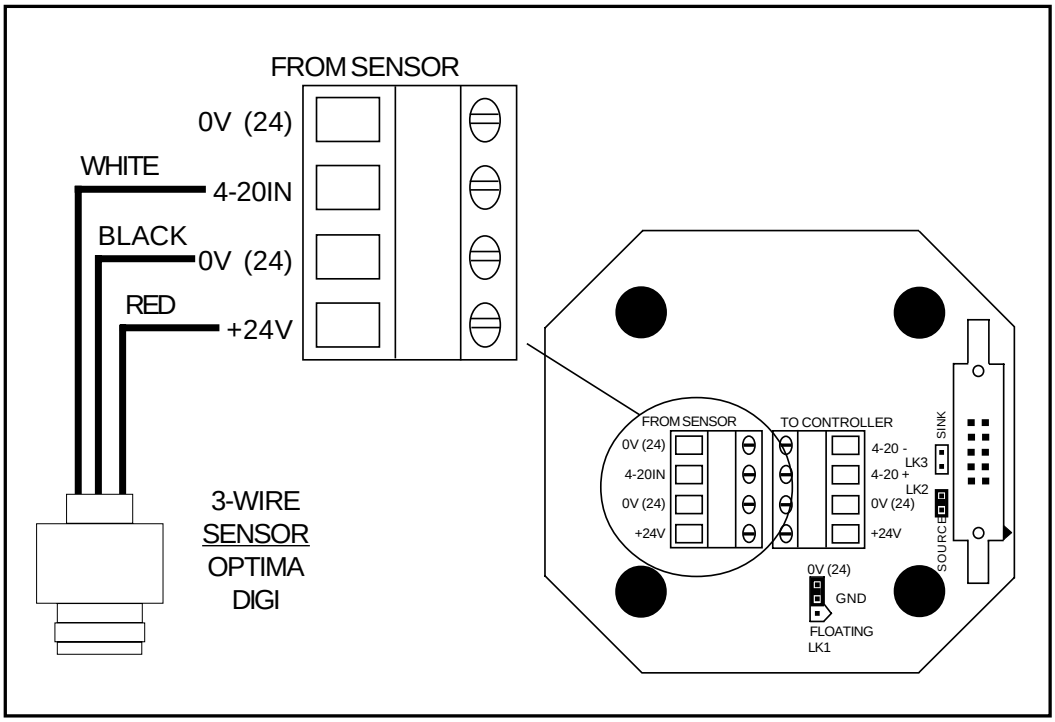


Figure 17. Sensor Connections - DIGI-ANA with 3-Wire Sensor

Note:

The terminals marked “0V (24)” are NOT connected to earth ground and should not be used for a shield connection. Placing LK1 in the “0V (24)” position connects these terminals to earth ground.

DIGI-CAT

Caution:

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

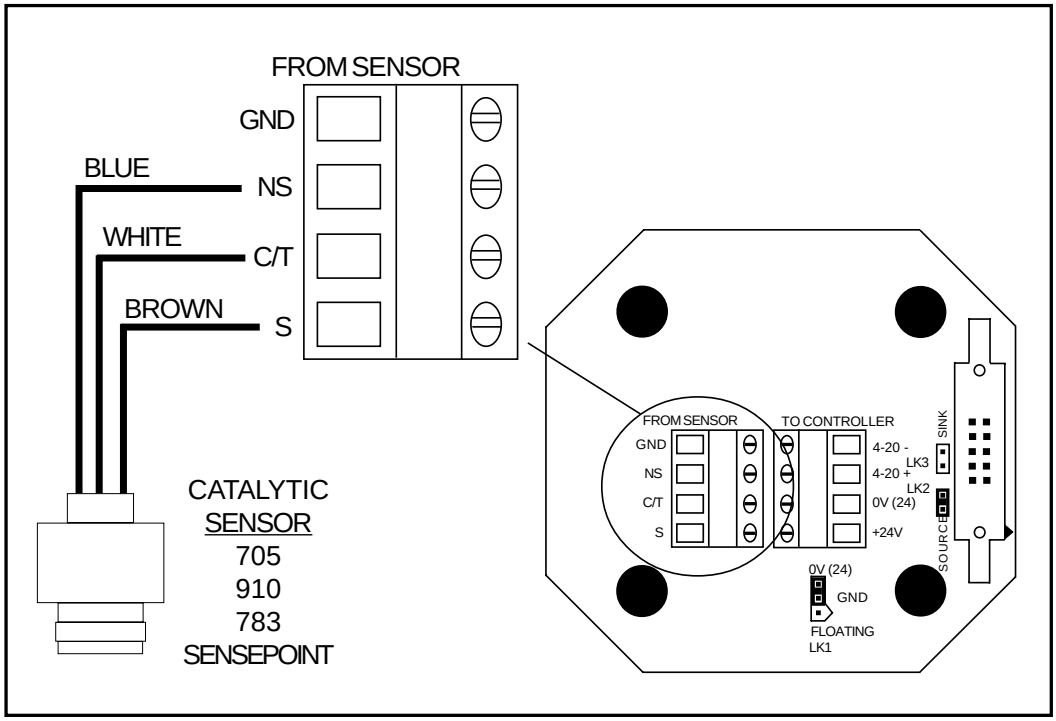


Figure 18. Sensor Connections - DIGI-CAT

Note:

The terminal marked “GND” is connected to earth ground. This terminal may be used for a shield connection.

DIGI-CHEM

Caution:

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

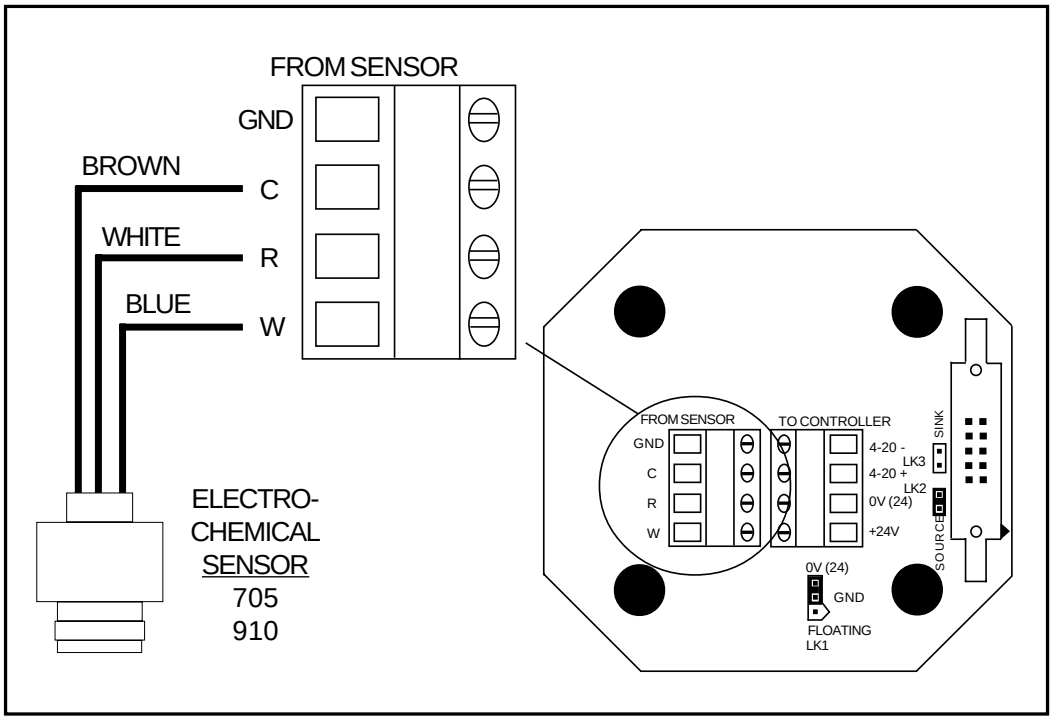


Figure 19. Sensor Connections - DIGI-CHEM

Note:

The terminal marked “GND” is connected to earth ground. This terminal may be used for a shield connection.

DIGI-CHEM for OXYGEN

Caution:

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

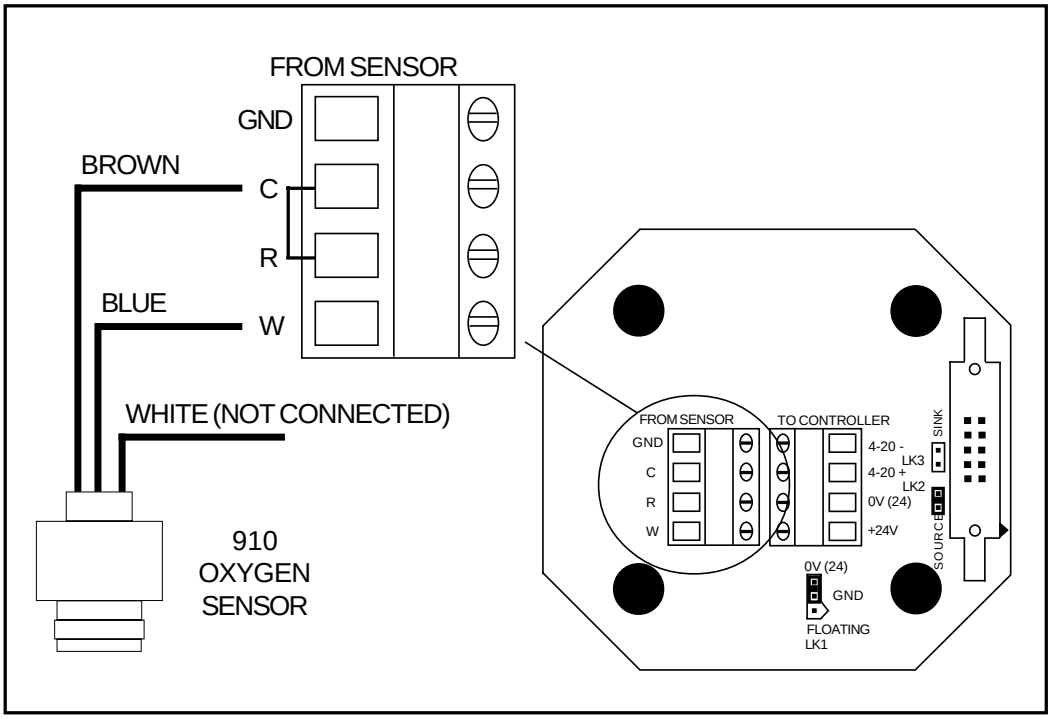


Figure 20. Sensor Connections - DIGI-CHEM for OXYGEN

Notes:

1. The terminal marked “GND” is connected to earth ground. This terminal may be used for a shield connection.
2. The white wire is not used. Trim this wire so it does not contact the enclosure.
3. Make sure a link, jumper or wire is connected between the “C” and “R” terminals.

DIGI-OPTIMA

Caution:

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

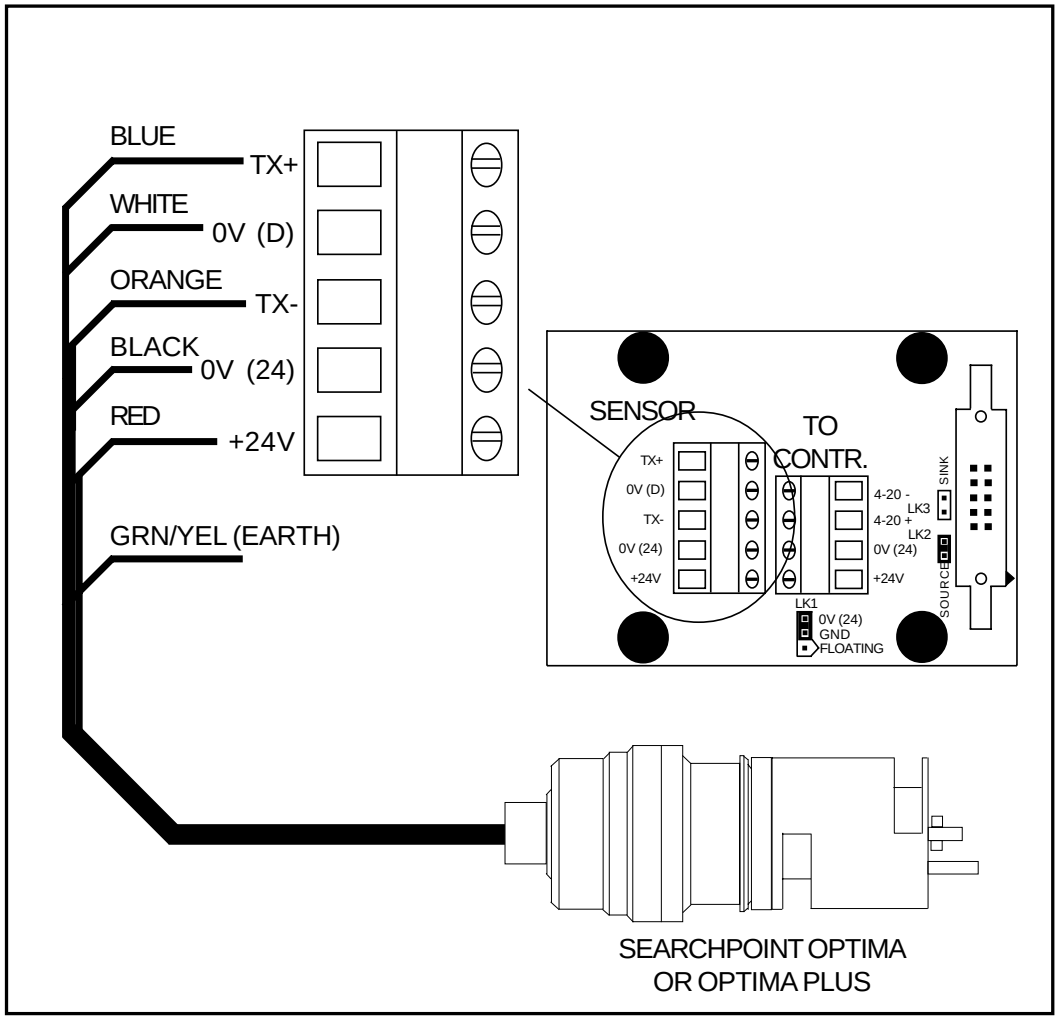


Figure 21. Sensor Connections - DIGI-OPTIMA

Note:

The green/yellow wire is connected to the chassis of the Optima and should be connected to earth ground.

Chapter 3: Operation

Overview

Your *DIGI Series* transmitter can operate as a self-contained gas detection system or as a point monitoring system which transmits its output signal to a controller or programmable logic controller (PLC).

Optional accessories, such as a duct mounting kit and a relay module, give you the flexibility to configure your system to your exact requirements.

This chapter highlights transmitter operation, calibration, and basic troubleshooting.

Factory Configuration and Presets

The *DIGI Series* transmitter is configured at the factory for a specific inhibit level and full scale range. This configuration cannot be altered in the field. If the inhibit level or full scale range is incorrect, return the transmitter to Zellweger Analytics, Inc. for re-configuration.

The DIGI-CAT and DIGI-CHEM have potentiometers on their terminal boards. These are for factory calibrations and are *not* user adjustments. Maladjustment of these potentiometers will require NON-WARRANTY service.

Initial Commissioning

Transmitters are shipped with a general calibration. After you have completed the physical installation of the unit, you must calibrate the transmitter to operate with the specific sensor you have installed.

Stabilization time varies depending on the type of sensor and type of electrochemical cell in a toxic sensor. This time can be as little as 3 minutes and as long as 60 minutes. Refer to the Calibration section of the Operating Instructions for your particular sensor.

Controls and Indicators

The *DIGI Series* transmitters are simple to operate. The controls and indicators are shown below in Figure 22.

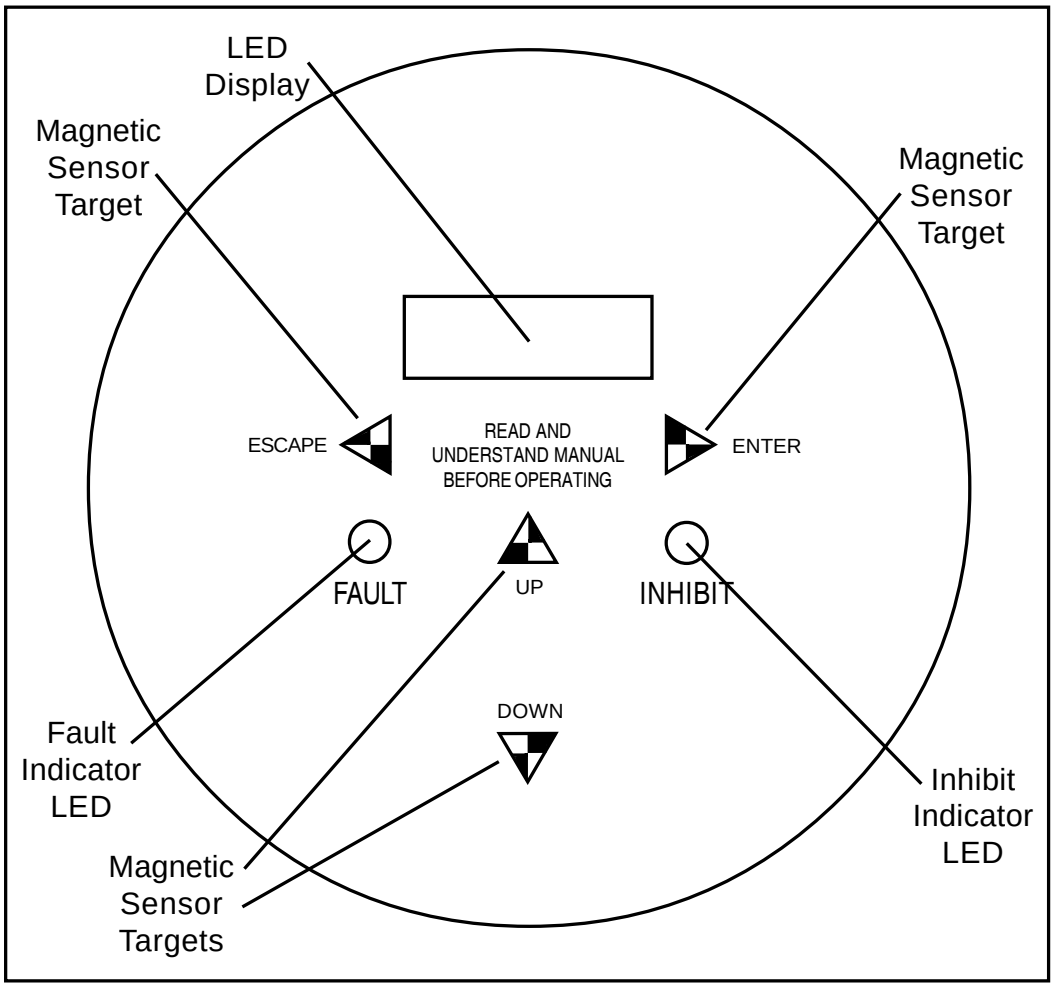


Figure 22. DIGI Series Controls and Indicators

The LED display is a 4 digit display. During normal operation, the current gas concentration is displayed. It is also used to scroll messages when in calibration mode or when a sensor fault is detected.

The four magnetic sensor controls are activated by means of a magnetic wand supplied with the product. 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 DIGI does not respond, remove the magnetic wand for several seconds and try again.

The 4-20 mA Output Signal

When operating a transmitter from a PLC or other controller, it is helpful to know what levels of current are used to indicate various conditions. Figure 23 shows the 4-20 mA scale. The ranges used are as follows:

Fault condition	<1.0 mA
Inhibited	2.0 mA
Gas Concentration	2.4 mA (-10% FSD) to 25.0 mA (131% FSD)

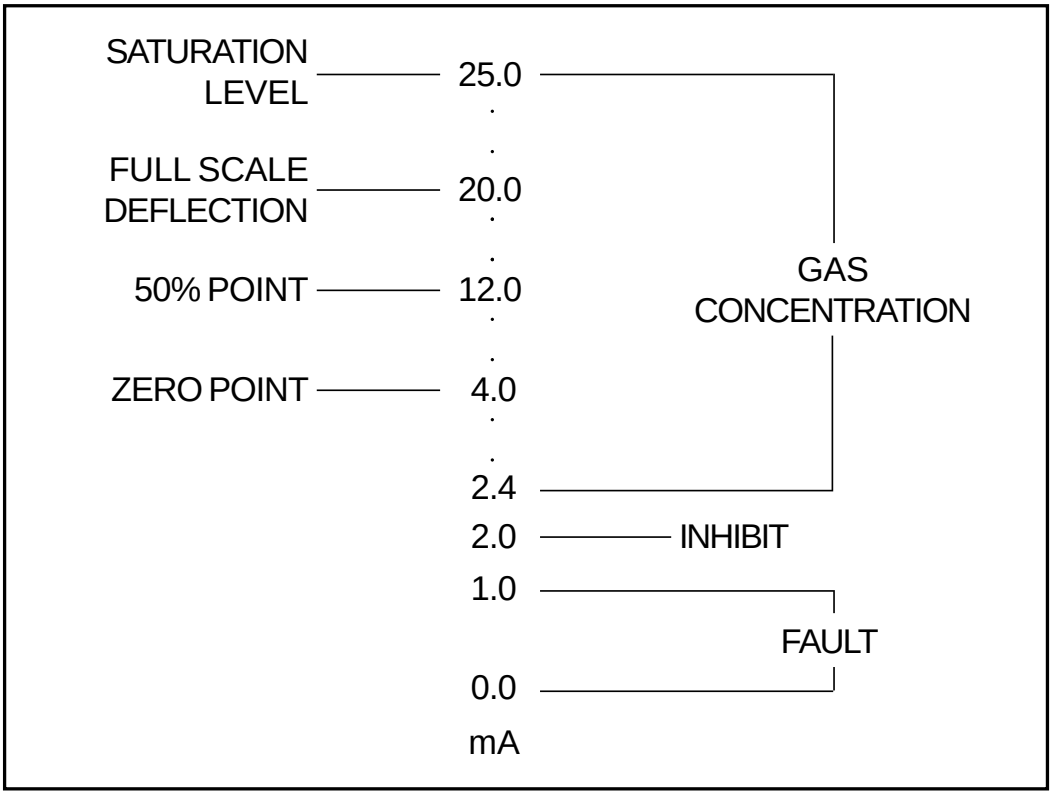


Figure 23. Levels Used on the 4-20 mA Scale

Gas Challenging

Note:

Observe proper safety guidelines while handling toxic or flammable gas mixtures in field situations. Ensure that the challenge gas can be safely extracted.

A “Gas Challenge” is simply applying a known concentration of gas to a monitoring point and ensuring that the gas monitor detects the proper level of the applied gas.

Gas challenges to sensors may be required for occupancy permits, or by local fire department officials on an annual or periodic basis.

A concentration at 50% Full Scale Deflection of the target gas will permit the challenge to be quick and effective.

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 sensor’s manual for the proper flow rate.

To gas challenge a unit without setting off alarms, follow these steps:

1. Disable or inhibit the appropriate channel of the Control System (DCS / PLC / Controller). Refer to the Control System’s manual.
2. Apply a known concentration of gas to the sensor. A Flow Housing will ensure a more accurate reading of the sample gas. Refer to the sensor manual.
3. Make sure the *DIGI Series* transmitter displays the proper concentration of gas.
4. Remove the sample gas from the sensor.
5. When the *DIGI Series* transmitter displays a safe concentration of gas, enable the Control System channel.

Calibration

General

The *DIGI Series* transmitters do not require scheduled calibration. Each transmitter's analog output is calibrated at the factory.

However, the materials used in catalytic and electrochemical sensors *are* consumed in normal operation, even if they are not exposed to the target gas. Calibration of the *DIGI Series* transmitter compensates for this sensor degradation.

Note:

Eventually, the sensor will degrade to the point where the *DIGI Series* transmitter can no longer compensate. If this point is reached, the message "**Span too low**" will scroll across the display. The sensor or sensor element should be replaced.

Some local codes may require periodic challenging of all life-safety equipment. Refer to "Gas Challenging" on page 24.

The calibration procedure is the same for the DIGI-ANA, DIGI-CAT and DIGI-CHEM. This procedure is described beginning on page 28.

The DIGI-CHEM for OXYGEN requires a slightly different procedure due to the constant presence of the target gas. This procedure is described beginning on page 32.

The DIGI-OPTIMA calibration procedure is also different. When calibrating the DIGI-OPTIMA, it is actually the Optima that is being calibrated, not the transmitter. This procedure is described beginning on page 36.

(continued)

Calibration Gas

For accuracy, the span calibration should be performed using the specific gas that the sensor is being used to detect (the “target gas”).

It is recommended that the gas concentration be 50% of the Full Scale Deflection of the transmitter. Most sensors have a nonlinear response to most gases. Calibrating the *DIGI Series* transmitter at mid-range will provide the greatest accuracy across the entire range.

Gas must be presented to the sensor at a level that will not over-pressurize the membrane surface of the electrochemical sensor cell. Too strong a gas stream can lead to erroneous reporting of concentrations. Refer to the sensor’s manual for the recommended flow rate.

Gas mixtures should be generated with humidity present at or near what would be observed in your facility. While lower levels of humidity will generally improve response times, they should not be used for calibration. Sensors would tend to inaccurately report events if they were calibrated in a dry atmosphere, when detection must later occur in a “real life” humidified environment.

Cross-Calibration

Sometimes a cross-calibration gas can be used for catalytic sensors. Be aware that although a cross-calibration gas has a similar response, it does not have an identical response.

Calibrating a *DIGI Series* transmitter with a gas that is “*similar to*” the target gas will result in a displayed value that is “*similar to*” the actual concentration of the target gas. For some applications this level of accuracy is quite sufficient since the actual target gas concentration is typically within 10% of the displayed concentration.

(continued)

Example: A DIGI-CAT configured for 0-100% LEL Hydrogen is calibrated using 50% LEL Methane. Later, in normal operation, the DIGI-CAT is displaying 28% LEL. It is known that the gas present is Hydrogen, not Methane. The actual concentration of Hydrogen is between 25-31% LEL.

Calibration Accessories

Use of a Flow Housing with catalytic and electrochemical sensors or the Calibration Cap with the Optima is recommended for gas calibration.

These housings are specially designed to fit onto the sensors and concentrate the calibration gas directly on the sensor while blocking external factors such as wind and other gases which may be present.

They also provide for connection of tubing from the calibration gas source to the sensor and from the sensor to exhaust venting. Refer to the sensor manual.

DIGI-ANA, DIGI-CAT and DIGI-CHEM Calibration Procedure

At any time during calibration, you can back up one step at a time by using the magnetic wand on the **<ESCAPE>** target. Repeatedly using the magnetic wand on the **<ESCAPE>** target will take you to an exit dialog. Exiting the calibration mode this way results in discarding all changes and reverting to the previous settings.

If the *DIGI Series* transmitter is in FAULT, you may not be able to enter the calibration mode. Refer to “Troubleshooting” on page 43.

An explanation of messages that may be seen begins on page 43.

1. Disable or inhibit the appropriate channel of the Control System (DCS / PLC / Controller). Refer to the Control System’s manual.

2. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI Response:

   “**Enter passcode**” scrolls across display.

   “**???**” is displayed with the first “**?**” flashing.

   Note:

   If no activity is sensed for fifteen (15) seconds during the passcode entry mode or after the passcode is entered, the *DIGI Series* transmitter will automatically exit the calibration mode and return to normal monitoring mode.

3. Enter the calibration passcode (“555”).

   a. Touch the magnetic wand to the glass over the targets marked **<UP>** and / or **<DOWN>** until the number “5” is displayed.

   b. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

(continued)

DIGI Response:

The next "**?**" will start flashing.

4. Repeat step 3 to enter the rest of the passcode.

   DIGI Response:

   "**Inhibited**" scrolls across display.

   The **<INHIBIT>** LED illuminates.

   The output of the *DIGI Series* transmitter changes to 2.0 mA.

   The current gas reading is displayed.

5. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI Response:

   "**Apply zero**" scrolls across display followed by the current gas reading.

6. Apply zero air to the sensor and wait for the display to stabilize.

   Note:

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

   DIGI Response:

   The current gas reading is displayed.

   If the message "**Zero too high**" scrolls across the display, see "Troubleshooting" on page 43.

7. When the display has stabilized, touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the current reading as zero.

   DIGI Response:

   "**Apply span**" scrolls across display followed by the current gas reading.

(continued)

8. Apply span gas to the sensor. Wait approximately three (3) minutes for the reading to stabilize.

   DIGI Response:

   The display will show the current gas reading.

9. If the *DIGI Series* transmitter is not displaying the correct span value, adjust the reading by using the magnetic wand on the **<UP>** and / or **<DOWN>** targets until the correct value is displayed.

10. When the correct span value is displayed, touch the magnetic wand to the glass over the target marked **<ENTER>**.

    DIGI Response:

    "**Re-cal y/n**" continuously scrolls across display.

    If the message "**Span too low**" scrolls across the display, see "Troubleshooting" on page 43.

11. If you want to go through the spanning procedure again, touch the magnetic wand to the glass over the target marked **<ENTER>** and go to step 8.

    If you want to accept the calibration you just performed, touch the magnetic wand to the glass over the target marked **<ESCAPE>**.

    DIGI Response:

    "**Exit y/n**" continuously scrolls across display.

12. Touch the magnetic wand to the glass over the target marked **<ESCAPE>** to return to step 11 or touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the calibration and exit the calibration mode.

    DIGI Response:

    The message "**Warning GAS present**" scrolls across the display alternating with "**Exit y/n**".

(continued)

13. Remove the calibration gas from the sensor.

14. Touch the magnetic wand to the glass over the target marked **<ESCAPE>** to return to step 11 or touch the magnetic wand to the glass over the target marked **<ENTER>** to acknowledge the warning and exit the calibration mode.

    DIGI Response:

    The *DIGI Series* transmitter resets itself and resumes normal operation.

15. When the *DIGI Series* transmitter displays a safe concentration of gas, enable the Control System channel.

DIGI-CHEM for OXYGEN Calibration Procedure

At any time during calibration, you can back up one step at a time by using the magnetic wand on the **<ESCAPE>** target.

Repeatedly using the magnetic wand on the **<ESCAPE>** target will take you to an exit dialog. Exiting the calibration mode this way results in discarding all changes and reverting to the previous settings.

If the DIGI-CHEM is in FAULT, you may not be able to enter the calibration mode. Refer to “Troubleshooting” on page 43.

An explanation of messages that may be seen begins on page 43.

1. Disable or inhibit the appropriate channel of the Control System (DCS / PLC / Controller). Refer to the Control System’s manual.

2. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI-CHEM Response:

   “**Enter passcode**” scrolls across display.

   “**???**” is displayed with the first “**?**” flashing.

   Note:

   If no activity is sensed for fifteen (15) seconds during the passcode entry mode or after the passcode is entered, the *DIGI-CHEM* will automatically exit the calibration mode and return to normal monitoring mode.

3. Enter the calibration passcode (“555”).

   a. Touch the magnetic wand to the glass over the targets marked **<UP>** and / or **<DOWN>** until the number “5” is displayed.

   b. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

(continued)

DIGI-CHEM Response:

The next "?" will start flashing.

4. Repeat step 3 to enter the rest of the passcode.

   DIGI-CHEM Response:

   "**Inhibited**" scrolls across display.

   The **<INHIBIT>** LED illuminates.

   The output of the DIGI-CHEM changes to 2.0 mA.

   The current gas reading is displayed.

5. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI-CHEM Response:

   "**Apply zero**" scrolls across display followed by the current gas reading.

6. Apply Nitrogen to the sensor and wait for the display to stabilize.

   Note:

   As an alternative to applying Nitrogen, disconnect the sensor by removing the blue wire from the "W" terminal. Be sure the area is declared a "safe area" before opening the DIGI-CHEM.

   DIGI-CHEM Response:

   The current gas reading is displayed.

   If the message "**Zero too high**" scrolls across the display, see "Troubleshooting" on page 43.

7. When the display has stabilized, touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the current reading as zero.

   DIGI-CHEM Response:

   "**Apply span**" scrolls across display followed by the current gas reading.

(continued)

8. Remove the Nitrogen from the sensor. If the blue wire was disconnected in step 6, reconnect the blue wire to the “W” terminal.

9. Apply zero air to the sensor. Wait approximately three (3) minutes for the reading to stabilize.

   DIGI-CHEM Response:

   The display will increase to show the current gas reading.

   Note:

   If it is known for sure that there is no Oxygen deficiency or enrichment present, ambient air may be used to set the span.

10. If the DIGI-CHEM is not displaying the correct value (20.8%), adjust the reading by using the magnetic wand on the **<UP>** and / or **<DOWN>** targets until the correct value is displayed.

11. When the correct value is displayed, touch the magnetic wand to the glass over the target marked **<ENTER>**.

    DIGI-CHEM Response:

    “**Re-cal y/n**” continuously scrolls across display.

    If the message “**Span too low**” scrolls across the display, see “Troubleshooting” on page 43.

12. If you want to go through the spanning procedure again, touch the magnetic wand to the glass over the target marked **<ENTER>** and go to step 9. If you want to accept the calibration you just performed, touch the magnetic wand to the glass over the target marked **<ESCAPE>**.

    DIGI-CHEM Response:

    “**Exit y/n**” continuously scrolls across display.

13. Touch the magnetic wand to the glass over the target marked **<ESCAPE>** to return to step 12 or touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the calibration and exit the calibration mode.

(continued)

DIGI-CHEM Response:

The message "**Warning GAS present**" scrolls across the display alternating with "**Exit y/n**".

14. Touch the magnetic wand to the glass over the target marked **<ESCAPE>** to return to step 12 or touch the magnetic wand to the glass over the target marked **<ENTER>** to acknowledge the warning and exit the calibration mode.

    DIGI-CHEM Response:

    The DIGI-CHEM resets itself and resumes normal operation.

15. Remove the zero air from the sensor.

16. When the DIGI-CHEM displays a safe concentration of gas, enable the Control System channel.

DIGI-OPTIMA Calibration Procedure

At any time during calibration, you can back up one step at a time by using the magnetic wand on the **<ESCAPE>** target.

Repeatedly using the magnetic wand on the **<ESCAPE>** target will take you to an exit dialog. If this is done before accepting the zero, all changes are discarded and the previous settings are used.

If the DIGI-OPTIMA is in FAULT, you may not be able to enter the calibration mode. Refer to “Troubleshooting” on page 43.

An explanation of messages that may be seen begins on page 43.

1. Disable or inhibit the appropriate channel of the Control System (DCS / PLC / Controller). Refer to the Control System’s manual.
2. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI-OPTIMA Response:

   “**Enter passcode**” scrolls across display.

   “**???**” is displayed with the first “**?**” flashing.

   Note:

   If no activity is sensed for fifteen (15) seconds during the passcode entry mode or after the passcode is entered, the DIGI-OPTIMA will automatically exit the calibration mode and return to normal monitoring mode.

3. Enter the calibration passcode (“555”).

   a. Touch the magnetic wand to the glass over the targets marked **<UP>** and / or **<DOWN>** until the number “5” is displayed.

   b. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

(continued)

DIGI-OPTIMA Response:

The next "**?**" will start flashing.

4. Repeat step 3 to enter the rest of the passcode.

   DIGI-OPTIMA Response:

   "**Inhibited**" scrolls across display.

   The **<INHIBIT>** LED illuminates.

   The output of the *DIGI Series* transmitter changes to 2.0 mA.

   The current gas reading is displayed.

5. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI-OPTIMA Response:

   "**Apply zero**" scrolls across display followed by the current gas reading.

6. Apply zero air to the sensor and wait for the display to stabilize.

   Note:

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

   DIGI-OPTIMA Response:

   The current gas reading is displayed.

   If the message "**Zero too high**" scrolls across the display, see "Troubleshooting" on page 43.

7. When the display has stabilized, touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the current reading as zero.

   DIGI-OPTIMA Response:

   "**BUSY**" appears on the display.

   "**Zero accepted**" scrolls across display.

   The current gas reading is displayed.

(continued)

Note:

If it is desired to leave the calibration mode at this point, repeatedly using the magnetic wand on the **<ESCAPE>** target will take you to an exit dialog. Exiting the calibration mode at this point results in saving the new zero and using the previous span setting.

8. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI-OPTIMA Response:

   "**Enter span**" scrolls across display.

   The display defaults to 50% FSD.

9. Adjust the reading to match the concentration of calibration gas which will be applied by using the magnetic wand on the **<UP>** and **<DOWN>** targets.

   Note:

   The display will change in 0.5% FSD increments. If necessary, adjust the display for the reading which is closest to the actual span gas concentration.

10. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

    DIGI-OPTIMA Response:

    "**Apply span**" scrolls across display.

    The current gas reading is displayed.

11. Apply span gas to the Optima.

    DIGI-OPTIMA Response:

    The display will increase to show the current gas reading.

12. When the display has stabilized, touch the magnetic wand to the glass over the target marked **<ENTER>**.

(continued)

DIGI-OPTIMA Response:

"**BUSY**" appears on the display.

"**Factor out of range**" scrolls across display if the span is not within predetermined limits. The DIGI-OPTIMA automatically returns to the beginning of the span routine (step 9).

"**Span accepted**" scrolls across display.

The current gas reading is steadily displayed.

13. Remove the calibration gas from the Optima. Wait until the reading drops to a safe level. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

    DIGI-OPTIMA Response:

    "**Re-span y/n**" continuously scrolls across display.

14. If you want to go through the spanning procedure again, touch the magnetic wand to the glass over the target marked **<ENTER>** and go to step 9. If you want to accept the calibration you just performed, touch the magnetic wand to the glass over the target marked **<ESCAPE>**.

    DIGI-OPTIMA Response:

    "**Exit y/n**" scrolls across display.

15. Touch the magnetic wand to the glass over the target marked **<ESCAPE>** to return to step 14 or touch the magnetic wand to the glass over the target marked **<ENTER>** to accept the calibration and exit the calibration mode.

    DIGI-OPTIMA Response:

    The DIGI-OPTIMA resets itself and resumes normal operation.

16. Enable the Control System channel.

Current Calibrator Mode

General

The *DIGI Series* transmitters may be used as current calibrators to calibrate the control equipment or auxiliary equipment such as a relay module or chart recorder.

In the Current Calibrator mode, the mA output signal of the *DIGI Series* transmitter can be adjusted from 0.1 mA to 25.0 mA in 0.1 mA steps.

The advantage of using this Current Calibrator mode is that it is not dependent on the sensor, the gas calibration of the *DIGI Series* transmitter, or the accuracy of the calibration gas. This removes three potentially inaccurate factors.

If the *DIGI Series* transmitter is in FAULT, you may not be able to enter the Current Calibrator mode. Refer to “Troubleshooting” on page 43.

Entering the Current Calibrator Mode

Entering the Current Calibrator mode is very similar to entering the Calibration Mode.

1. Place the appropriate channel of the Control System (DCS / PLC / Controller) into calibration mode. Refer to the Control System’s manual.

2. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI Response:

   “**Enter passcode**” scrolls across display.

   “**???**” is displayed with the first “**?**” flashing.

   Note:

   If no activity is sensed for fifteen (15) seconds during the passcode entry mode, the *DIGI Series* transmitter will

(continued)

automatically exit the passcode entry mode and return to normal monitoring mode.

3. Enter the Current Calibrator passcode (“191”).

   a. Touch the magnetic wand to the glass over the targets marked **<UP>** and / or **<DOWN>** until the correct number is displayed.

   b. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI Response:

   The next “**?**” will start flashing.

4. Repeat step 3 to enter the rest of the passcode.

   DIGI Response:

   “**mA Calibrator**” scrolls across display.

   The **<INHIBIT>** and **<FAULT>** LEDs flash alternately.

   The output of the *DIGI Series* transmitter changes to 2.0 mA.

   The display shows the value of the mA output.

Adjusting the Current Output

To adjust the output signal, touch the magnetic wand to the glass over the targets marked **<UP>** and / or **<DOWN>** until the desired value is displayed.

Each time the magnetic wand is used on a target, the output will change by 0.1 mA. If the magnetic wand is held on a target, the output will increase by 0.1 mA steps for 20 steps, then increase in 1.0 mA steps. Removing the magnetic wand from the target and placing it back on the target will cause the transmitter to revert to 0.1 mA steps.

Every 30 (thirty) seconds, the message “**mA Calibrator**” will scroll across the screen. The rest of the time, the value of the output signal is displayed.

(continued)

Exiting the Current Calibrator Mode

1. Touch the magnetic wand to the glass over the target marked **<ENTER>**.

   DIGI Response:

   The message "**Exit y/n**" scrolls across the display.

2. Touch the magnetic wand to the glass over the target marked <**ESCAPE**> to return to the Current Calibrator mode or touch the magnetic wand to the glass over the target marked <**ENTER**> to exit the Current Calibrator mode.

   DIGI Response:

   The *DIGI Series* transmitter resumes normal operation.

3. When the *DIGI Series* transmitter displays a safe concentration of gas, enable the Control System channel.

Troubleshooting

DIGI Series Messages

This section provides a listing of messages which may scroll across the DIGI Series transmitter's display. The possible cause and remedies are also provided.

In addition to these standard messages, the DIGI-OPTIMA has unique messages resulting from its communication with an intelligent sensor. These messages can be found beginning on page 48.

Zellweger Analytics, Inc. Service Department

Normal Business Hours (7:30 am to 5:00 pm Central Time):

800-323-2000 or 847-955-8200

24-Hour Emergency Service Hotline: 847-634-2840

Burning defaults

Cause: The EEPROM is read and checked at power-up. If the data is found to be corrupt or a different version of the DIGI software is being used for the first time, the default values are written to the EEPROM.

Remedy: The mA output signal will have to be re-calibrated. Contact Service.

EEPROM failure

Cause: The EEPROM is read and checked at power-up. The DIGI EEPROM is not working correctly.

Remedy: Replace the display board assembly.

(continued)

Sensor open circuit

Cause: The DIGI-CAT has detected a high resistance in either the “S” or “NS” leads which will prevent proper operation. This may be caused by a loose sensor connection, an incorrect sensor connection, or a burned-out catalytic bead.

Remedy: Check sensor connections. Replace sensor if necessary.

Sensor short circuit

Cause: The DIGI-CAT has detected a low resistance in either the “S” or “NS” leads which will prevent proper operation. This may be caused by an incorrect sensor connection or a short circuit in the sensor.

Remedy: Check sensor connections. Replace sensor if necessary.

Sensor unstable

Cause: The DIGI has detected a very erratic sensor input for a prolonged period of time. This may be caused by a loose sensor connection or a bad sensor.

Remedy: Check sensor connections. Replace sensor if necessary.

Span too high

Cause: While calibrating the span of the DIGI, the input signal is too high to be used as a valid span.

Remedy: Check span gas to verify it is the correct gas and is between 25% and 100% FSD.

(continued)

Span too low

Cause: While calibrating the span of the DIGI, the input signal is too low to be used as a valid span.

Remedy: Check span gas to verify it is the correct gas and is between 25% and 100% FSD.

Warning GAS present

Cause: While exiting the DIGI calibration procedure, the input signal is high enough to (>10% Full Scale Deflection) to possibly cause an alarm.

Remedy: Wait several minutes for the residual calibration gas in the sensor to dissipate.

Zero too high

Cause: While calibrating the zero of the DIGI, the input signal is too high to be used as a valid zero. This may be caused by a concentration of gas present in the ambient air, incorrect sensor connections, or by a bad sensor.

Remedy: Check sensor connections. Use zero air. If message is still present, replace sensor.

Zero too low

Cause: While calibrating the zero of the DIGI, the input signal is too low to be used as a valid zero. This may be caused by a concentration of an interferant gas present in the ambient air, incorrect sensor connections, or by a bad sensor.

Remedy: Check sensor connections. Use zero air. If message is still present, replace sensor.

DIGI-OPTIMA / Optima Messages

The DIGI-OPTIMA communicates with the Optima via data lines. Because of this, messages displayed by the DIGI-OPTIMA can be produced by either the Optima or the DIGI-OPTIMA itself. The source of the message is identified in brackets following the message.

Many of the messages produced by the Optima have no user remedy. In these cases, the only recourse is to replace the Optima and call the Service department:

Zellweger Analytics, Inc. Service Department

Normal Business Hours (7:30 am to 5:00 pm Central Time):

800-323-2000 or 847-955-8200

24-Hour Emergency Service Hotline: 847-634-2840

Some of the messages displayed by the DIGI-OPTIMA are described in the previous section.

Bad message format [DIGI-OPTIMA]

Cause: A reply from the Optima did not contain data in the expected format.

Remedy: If problem persists, call Service.

Bad gas selector [DIGI-OPTIMA]

Cause: A glitch in software version 1V01 erroneously sent an illegal command to the Optima.

Remedy: No action was taken by the Optima. This message may be ignored.

COMMS error [DIGI-OPTIMA]

Cause: The DIGI-OPTIMA did not receive a valid reply from the Optima. This is usually caused by incorrect connections or a fault in the Optima.

(continued)

Remedy: Check Optima connections. If they are correct, call Service.

Factor out of range [Optima]

Cause: The calculated calibration factor was out of range. This is likely to be due to the presence of a different concentration of gas to that specified.

Remedy: Re-calibrate the span.

Hardware fault [Optima]

Cause: A hardware fault has been detected.

Remedy: Replace Optima.

Machine state fault [DIGI-OPTIMA]

Cause: There is an error in the DIGI-OPTIMA software.

Remedy: Replace the DIGI-OPTIMA display board.

No gas reading available [Optima]

Cause: At start-up, the Optima has a longer diagnostic period than the DIGI-OPTIMA. In normal operation, the Optima is unable to calculate a gas reading.

Remedy: If problem persists, call Service.

Span not calibrated [Optima]

Cause: The unit has not been span gas calibrated and an operation has been requested that relies on the span calibration.

Remedy: Calibrate the Optima.

Zero not calibrated [Optima]

Cause: The unit has not been zero gas calibrated and an operation has been requested that relies on the zero calibration.

Remedy: Calibrate the Optima.

DIGI Series General Troubleshooting

Display does not illuminate when power applied.

Cause: Incorrect power connections, incorrect operating voltage, or malfunctioning display board assembly.

Remedy: Check power connections. Check voltage at the DIGI terminals. Replace display board assembly.

Unrecognizable characters on display.

Cause: Malfunctioning display board assembly.

Remedy: Replace display board assembly.

Span will not adjust high / low enough.

Cause: Incorrect span gas concentration, wrong gas, or a problem with the sensor.

Remedy: Make sure gas is the correct concentration (25% to 100% FSD) and the right type. If correct, replace sensor.

DIGI goes crazy when a portable radio is used nearby.

Cause: The radio is interfering with normal operation. This only happens in certain frequency ranges.

Remedy: Connect a jumper wire from the metal faceplate of the DIGI display board assembly to earth ground. This will eliminate most, if not all, of the interference.

Span gas shows an initial response on the DIGI-CAT and then drops to zero.

Cause: The catalytic sensor operates by burning the flammable gas. If the calibration gas is not mixed with air, the sensor cannot burn the gas.

Remedy: Use a span gas with a balance of air.

(continued)

DIGI does not respond to magnetic wand.

Cause: Magnetic wand is not close enough to display. Magnetic wand has become demagnetized. Malfunction of the magnetic sensor(s).

Remedy: Make sure the magnetic wand is touching the glass. Make sure the enclosure lid is screwed on as far as it will go. Replace magnetic wand. Replace display board assembly.

Display is frozen and "FAULT" LED is lit.

Cause: Typically caused by the input to the DIGI being more negative than the DIGI can display (i.e. -1000 PPM).

Remedy: Check sensor connections.

Chapter 4 Spare Parts

DIGI Series Replacement Items

Notes:

1. When ordering a DIGI-ANA/CAT/CHEM Display Assembly, be sure to also order the appropriate Configuration Table. This is required to install the proper software.

2. When ordering a DIGI-CHEM Terminal Board Assembly, be sure to identify the target gas and range. This is required for proper hardware configuration.

Description:	Part Number:
DIGI-ANA/CAT/CHEM Display Assembly	2414-0041
DIGI-ANA Terminal Board Assembly	2460-0008
DIGI-CAT Terminal Board Assembly	2414-0012
DIGI-CHEM Terminal Board Assembly	2415-0036
DIGI-CHEM Oxygen Terminal Board Assy	2415-0039
DIGI-OPTIMA Display Assembly	2442-0042
DIGI-OPTIMA Terminal Board Assembly	2442-0006
Magnetic Wand	2414-0015

DIGI-ANA Configuration Tables

Note:

DIGI-ANA Configuration Tables do not require a target gas or vapor, only Range and Unit of Measure.

Description:	Part Number:
0 - 5 PPM	2460-1010
0 - 15 PPM	2460-1015
0 - 25% Vol	2460-1011
0 - 50 PPM	2460-1012
0 - 100 PPM	2460-1013
0 - 500 PPM	2460-1014
0 - 1000 PPM	2460-1016
0 - 2000 PPM	2460-1017

DIGI-CAT Configuration Tables

Notes:

1. Due to the large number of different combustible gases and vapors, and the differences in response of the various sensors, it is impractical to list all the possible combinations in this manual. Contact Zellweger Analytics for the appropriate Configuration Table part number.

Description:	Part Number:
0 - 100% LEL, Table #1	2414-1021
0 - 100% LEL, Table #2	2414-1022
0 - 100% LEL, Table #3	2414-1023
0 - 100% LEL, Table #4	2414-1024
0 - 100% LEL, Table #5	2414-1025

The most requested configurations are for 0 - 100% LEL Hydrogen and 0 - 100% LEL Methane:

Sensor Model:	Table Number:
704, 705, 783 and 910 sensors	Table #3
SensePoint sensors	Table #5

DIGI-CHEM Configuration Tables

Description:	Part Number:
0 - 100 PPM Carbon Monoxide (CO)	2415-1020
0 - 200 PPM Carbon Monoxide (CO)	2415-1021
0 - 500 PPM Carbon Monoxide (CO)	2415-1022
0 - 25 PPM Hydrogen Sulfide (H_2S)	2415-1023
0 - 50 PPM Hydrogen Sulfide (H_2S)	2415-1024
0 - 100 PPM Hydrogen Sulfide (H_2S)	2415-1025
0 - 25% Vol Oxygen (O_2)	2415-1026
0 - 50 PPM Sulfur Dioxide (SO	2415-1027

Chapter 5 Specifications

Common Specifications

The following specifications are the same for all *DIGI Series* transmitters.

Mechanical (with Mounting Strap):

Size:	6 1/8” (156 mm) W x 5 1/4” (134 mm) H x 5 1/2” (140 mm) D
Weight:	3.75 lbs (1.7 kg)

Temperature Range:

Operational:	-5 to +105 °F (-20 to +40 °C)
Storage:	-75 to +175 °F (-60 to +80 °C)

Electrical:

Supply Voltage:	18VDC to 32VDC
Repeatability:	± 0.1% Full Scale Deflection (FSD)
Zero Drift:	± 0.2% FSD Non-Accumulative
Span Drift:	± 0.2% FSD Non-Accumulative
Response Time:	Less than 0.5 seconds
Output Signal:	Floating isolated 4-20 mA (500V isolation) Non-isolated 4-20 mA current source or current sink
Fault Output:	<0.1 mA
Inhibit Output:	2.0 mA
Calibrator Output:	0.1 mA to 25.0 mA in 0.1 mA steps

Enclosure:

Material:	Copper-free Aluminum
Entries:	Two (2), 3/4NPT

Certification:

UL:	Explosion-Proof, Class I, Div 1, Groups B, C and D
C-UL:	Explosion-Proof, Class I, Div 1, Groups B, C and D

Individual Specifications

DIGI-ANA Specifications:

Power Consumption: 25 mA @ 24VDC (0.6 Watts)

Start-Up Current: 2A maximum for 150 microseconds

Input Signal: Standard 4 - 20 mA signal, current source

DIGI-CAT Specifications:

Power Consumption: 80 mA @ 24VDC (2.0 Watts) (includes sensor)

Start-Up Current: 3A maximum for 150 microseconds

Input Signal: Bridge input for catalytic bead sensor 10 mV to 180 mV

Sensor Current: 145 mA to 225 mA (Factory adjustable), 7 ohms maximum loop resistance

DIGI-CHEM Specifications:

Power Consumption: 25 mA @ 24VDC (0.6 Watts) (includes sensor)

Start-Up Current: 2A maximum for 150 microseconds

Input Signal: Microampere signal from electrochemical sensor

Sensor Current: 9.0 mA to 55 mA, 7 ohms maximum loop resistance

DIGI-OPTIMA Specifications:

Power Consumption: 25 mA @ 24VDC (0.6 Watts)

Start-Up Current: 2A maximum for 150 microseconds

Input Signal: RS485 data

Zellweger Analytics, Inc.
405 Barclay Boulevard
Lincolnshire, IL 60069

For more information contact Zellweger Analytics' Service Department during normal business hours at:

800-323-2000
or 847-955-8200

24-Hour Emergency Service Hotline:
847-634-2840

(To save time when calling for service, please have the serial number of your instrument available.)

ISO 9001 Registered Company
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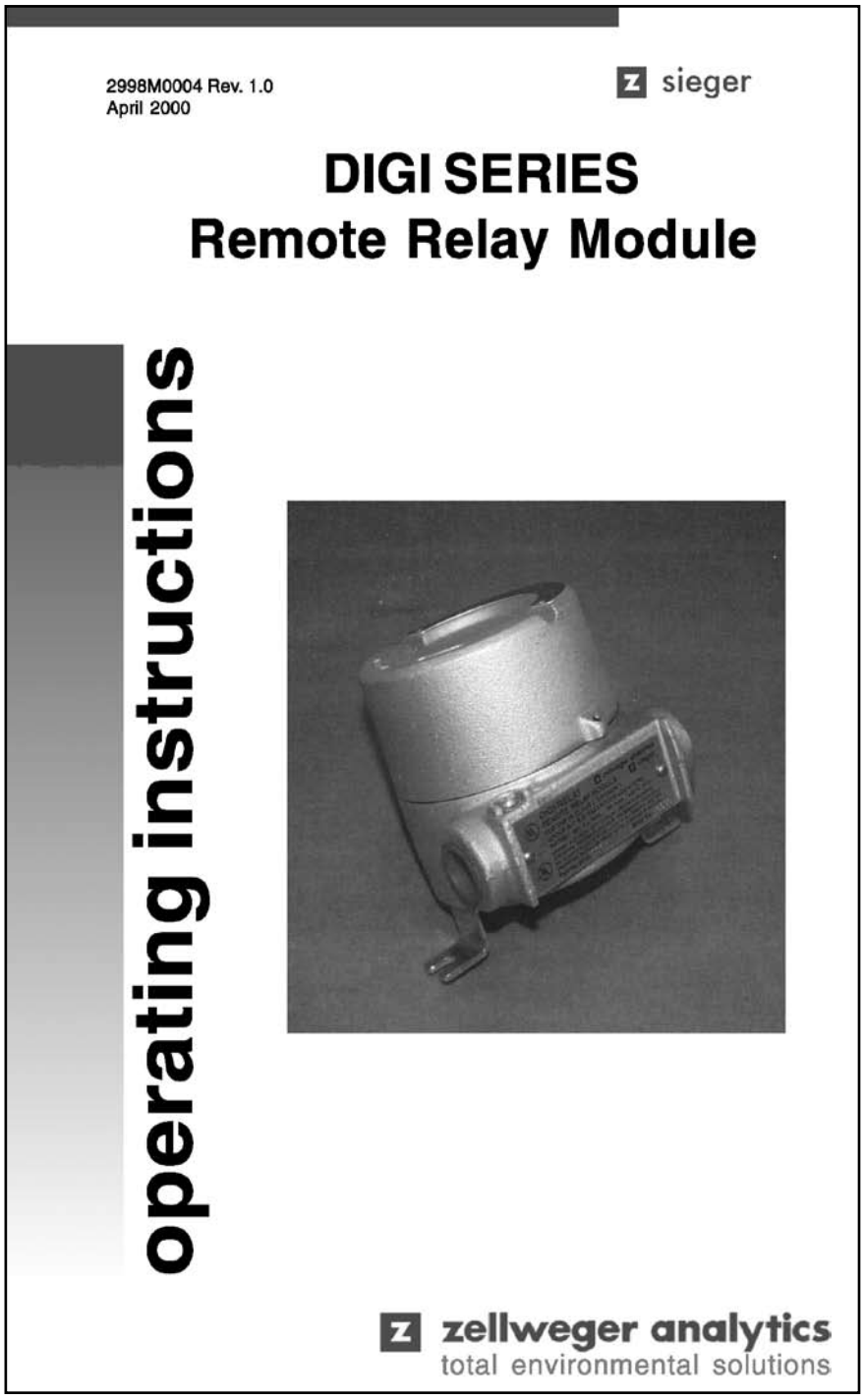
Zellweger Analytics - Remote Relay Module Operating Instructions

NOTICE The areas of this Zellweger Analytics manual that does not pertain to the Akkerman Gas Detection System have been “grayed-out.”



Your Uptime Is Our Top Priority

Congratulations on your purchase of the *Digi-Relay Remote Relay Module*. It will provide you with years of reliable operation. Because your uptime is our top priority, Zellweger Analytics provides you with both local service and a 24-hour Emergency Service Hotline.

During Business Hours:

Zellweger Analytics, Inc.

MDA Scientific Products:	(Toll-Free)	800-323-2000
Headquarters:		847-955-8200
Mid-Atlantic:		610-560-6000
Gulf Coast:		512-452-9718
Southwest:		760-942-3142
West Coast:		408-261-8802
Northwest:		503-639-3202
Zellweger Analytics, Ltd. (UK):		44-1-202-676-161
Zellweger Analytics Co., Ltd. (Japan):		81-3-5484-8711

24-Hour Emergency Hotline (U.S.A.): 847-634-2840

Record your serial number and installation date here for easy reference:

_____ _____

(To save time when calling for service, please have the serial number of your instrument available.)

Symbols Used in this Manual

Overview

Zellweger Analytics manuals use several symbols to draw attention to important information. Each symbol provides a graphic representation of equivalent words. The symbols are easily recognizable in any language.

Below is a listing of symbols used in Zellweger Analytics manuals and a brief description of what the symbols represent. (This manual might not use all of the symbols listed here.)

Symbols

Caution - Refer to accompanying documents. Caution statements are used to indicate hazards or unsafe practices which could result in minor personal injury or product or property damage.

Warning - Refer to accompanying documents. Warning statements are used to indicate hazards or unsafe practices which could result in severe personal injury or death.

Caution - Risk of electrical shock.

EMC Considerations

Overview

Your Zellweger Analytics instrument has been designed to comply with applicable EMC standards at the time of manufacture. The design includes filtering, shielding, and bypassing techniques. At the time of certification, simulated customer Input/Output (I/O) schemes were tested.

All methods used in your equipment for emission suppression and reduction of susceptibility are interactive. Modifications to the instrument will most likely result in increased emissions and higher vulnerability to other radiated fields.

Following the guidelines in this EMC Considerations section will ensure your instrument maintains the highest degree of EMC integrity. The guidelines listed apply only to I/O emissions, and do not apply to A.C. and D.C. instrument power connections.

Cabling

At a very minimum, all cables should include a braided shield. Ideal results have been obtained with twisted pair cabling which has a foil shield surrounding each pair plus foil and 90% braid shielding around the bundle. While this yields the best results, it can be very expensive. In addition, ensure local electrical code requirements are met.

Cabling Type

Twisted pair: Provides for cancelling of magnetic fields

Stranded pair: Provides the greatest surface area

Braid: Must have a minimum 90% coverage

Foil: When used with braid, provides 100% coverage.

Note: Do not use foil alone. It has a tendency to break.

(continued)

Zellweger Analytics product testing uses >90% braid with foil (around the bundle); twisted pair; stranded 24 AWG (minimum wiring for all qualification and certification testing).

Shield Termination

Continuation of the shield to the enclosure earth ground is most important. For long cable runs greater than 20 feet (6 meters), it is recommended that the shield connection is made at only one end to prevent ground loop problems.

For discrete wire terminations, pigtails to the enclosure ground should be extremely short (absolutely no greater than three inches).

Safety-Related Cautions

Caution

This manual deals with safety related products. The equipment must be installed and operated in compliance with this manual.

If this product is to be used in a hazardous area, installation must comply with your local codes of practice or national standards.

If installed in a hazardous area, the enclosure lid must not be removed for service unless the area is classified “gas free”. Refer to your local codes of practice or national standards.

Warranty

Each new *Digi-Relay* manufactured and/or sold by Zellweger Analytics or its authorized agents is warranted to be free from defects in material and workmanship. Our responsibility is limited to repairing or replacing any instrument or part thereof for a period of one year after the start-up or 18 months after shipment, whichever comes first, when, in our opinion, the repair or replacement is covered by this warranty. Any defective equipment must be returned prepaid to the Zellweger Analytics factory for service. Field service is not included.

This warranty does not cover components that are expendable in normal use and thus have an unpredictable life, such as filters and fuses.

Instruments which have been repaired or replaced during the warranty period are warranted for the remainder of the unexpired portion of the original warranty period.

Zellweger Analytics is released from all obligations under its warranty in the event repairs or modifications are made by persons other than its own authorized personnel, unless such work is authorized in writing by Zellweger Analytics.

Contents

Chapter 1: Introduction

Overview

The *Digi-Relay* is a relay module with three independent non-latching relays. Each relay has two contacts (one normally open, one normally closed), an independently adjustable trip level, and can be configured as normally energized or normally de-energized.

The copper-free aluminum enclosure has two access ports with 3/4" NPT threading. Field wiring connections are made using connectors which plug into the bottom circuit board assembly.

The *Digi-Relay* is UL and C-UL certified for use in Class I Division 1 Groups B, C and D hazardous areas.

Modes of Operation

The *Digi-Relay* can be used as part of a “stand-alone” gas monitoring point or as an “in-line” relay module in a more complex system.

In-Line Operation

When used as an “in-line” relay module, the 4-20 mA signal from a remote sensor to the control room can be routed through the *Digi-Relay*. This will add 50 ohms to the system wiring or 1.0 Volt @ 20 mA loss to the overhead voltage. When configured in this mode, the 4-20 mA signal line is fully isolated from the *Digi-Relay’s* power supply.

Stand-Alone Operation

As part of a stand-alone gas monitoring point, the *Digi-Relay* becomes the termination point for the 4-20 mA signal. The input circuit can be connected either to the +24V supply or to the 0V supply, allowing sink or source operation with the remote sensor.

In either mode of operation, the *Digi-Relay* supports loop powered two-wire transmitters and sensors, three-wire transmitters in either current source or current sink mode, and four-wire transmitters providing an isolated 4-20 mA output. Wiring details are in “Installation”.

Relays

Three independent relays are provided. Each relay has it's own trip point adjustment, an LED to indicate if the relay is tripped, and a link to select whether the relay is operated in the normally energized or normally de-energized mode.

Each relay has a Normally Closed (NC) contact and a Normally Open (NO) contact. These terms describe the connection with the Common (C) contact when the relay is de-energized. The relay contacts are rated for 3 Amps at 250VAC and 3 Amps at 32VDC.

Field wiring to the relays is connected via TB2 and TB3 on the Terminal Board.

Relay Trip Points

For the purpose of this document, the term "trip point" is defined as the level of input signal which causes the relay to toggle states.

Each relay can be adjusted to trip at any input signal between 0.75 mA and 24.0 mA. The method of adjusting the trip point is described in "Commissioning".

The relay control circuits are designed with a hysteresis to prevent the "relay chatter" which would occur if the input signal fluctuates around a trip point. This hysteresis is a maximum of 4% Full Scale Deflection (0.64 mA).

To provide a FAULT warning of signal failure or power supply failure, one of the relays should be operated in the normally de-energized mode with the alarm trip level set for 1.5 mA. This is the factory default for Relay 3. A closure of the Normally Closed contact will indicate either an input signal of less than 1.0 mA or a loss of power to the Digi-Relay.

Note:
The 0.5 mA difference between the trip level of 1.5 mA and the actual trip point of 1.0 mA is due to the hysteresis of the circuit.

LED Indicators

Each relay has it's own LED to indicate whether or not the relay is energized. These LEDs are independent of the Mode of Operation. When the relay is not energized, the LED will be off. The LED will turn on when the input signal reaches the trip point for the associated relay. The enclosure for the Digi-Relay includes a solid cover, so the LEDs would not be visible when the *Digi-Relay* is in normal operation.

Mode of Operation Links

The relays may be set to energize on alarm (normally de-energized) or de-energize on alarm (normally energized). Each relay has it's own link which can be fitted as required to the normally energized or normally de-energized positions. Details concerning setting the link positions can be found in "Commissioning".

This manual provides instructions to install, operate, and maintain the *Digi-Relay* Remote Relay Module.

Safety Notices

There are three levels of safety notices used in this manual: warning, caution, and note. Below are examples of each of these safety notices and the conventions used in this manual:

WARNING:

A WARNING indicates a situation in which personal injury may occur.

Caution:

A **Caution** indicates a condition in which damage may occur to equipment or material.

Note:
A note provides helpful information for proper operation of your *Digi-Relay* Remote Relay Module.

Chapter 2: Installation

Certification Requirements

The *Digi-Relay* is certified for use in Class I, Division 1, Groups B, C and D areas. Equipment must be installed in accordance with national and / or local codes. In the U.S.A., the National Electrical Code (N.E.C.) requires a sealed fitting within 18" of the enclosure.

Mounting the Relay Module

The *Digi-Relay* may be installed anywhere within the range of the 4-20 mA signal. There are many factors that determine the maximum distance between the source of the 4-20 mA signal and its termination point. The following chart indicates general distances for several Sieger products. It assumes that the *Digi-Relay* is the termination point of the 4-20 mA signal ("stand-alone" operation) and the source of +24VDC power for the sensor.

Product	24 AWG [0.5 mm^2]	22 AWG [0.75 mm^2]	20 AWG [1.0 mm^2]	18 AWG [1.5 mm^2]	16 AWG [2.0 mm^2]
911 Sensor	18,400 ft [5,600 m]	27,500 ft [8,400 m]	38,700 ft [11,800 m]	58,000 ft [17,700 m]	92,100 ft [28,100 m]
811 Sensor	18,400 ft [5,600 m]	27,500 ft [8,400 m]	38,700 ft [11,800 m]	58,000 ft [17,700 m]	92,100 ft [28,100 m]
Lifeline	10,500 ft [3,200 m]	15,000 ft [4,600 m]	21,300 ft [6,500 m]	31,900 ft [9,750 m]	49,200 ft [15,000 m]
Sensepoint Toxic	3,280 ft [1,000 m]	4,920 ft [1,500 m]	6,560 ft [2,000 m]	10,100 ft [3,100 m]	15,700 ft [4,800 m]
Series 2000	5,250 ft [1,600 m]	7,850 ft [2,400 m]	10,800 ft [3,300 m]	16,400 ft [5,000 m]	25,500 ft [7,800 m]
Searchpoint Optima	590 ft [180 m]	850 ft [260 m]	1,180 ft [360 m]	1,770 ft [540 m]	2,820 ft [860 m]
Digi-Optima + Optima	590 ft [180 m]	850 ft [260 m]	1,180 ft [360 m]	1,770 ft [540 m]	2,820 ft [860 m]
Digi-Cat	1,310 ft [400 m]	1,870 ft [570 m]	2,620 ft [800 m]	3,770 ft [1,150 m]	6,070 ft [1,850 m]
Digi-Chem	3,280 ft [1,000 m]	4,920 ft [1,500 m]	6,560 ft [2,000 m]	10,100 ft [3,100 m]	15,700 ft [4,800 m]

(continued)

Digi-Ana (Note 1)	3,280 ft [1,000 m]	4,920 ft [1,500 m]	6,560 ft [2,000 m]	10,100 ft [3,100 m]	15,700 ft [4,800 m]

Note 1 - The Digi-Ana distances assume the connection of a two-wire sensor/ transmitter. These figures do not apply to a three-wire transmitter (Digi, Optima, etc.).

The *Digi-Relay* should be secured to a vertical surface using the mounting bracket provided. The *Digi-Relay* location and installation material must comply with your local codes of practice and/or national standards. Dimensions of the enclosure and mounting feet can be found in Figure 1.

Appropriate hardware (not included) should be used to secure the bracket to a wall. The slots in the mounting bracket will accommodate up to 1/4” (M6) screws or bolts.

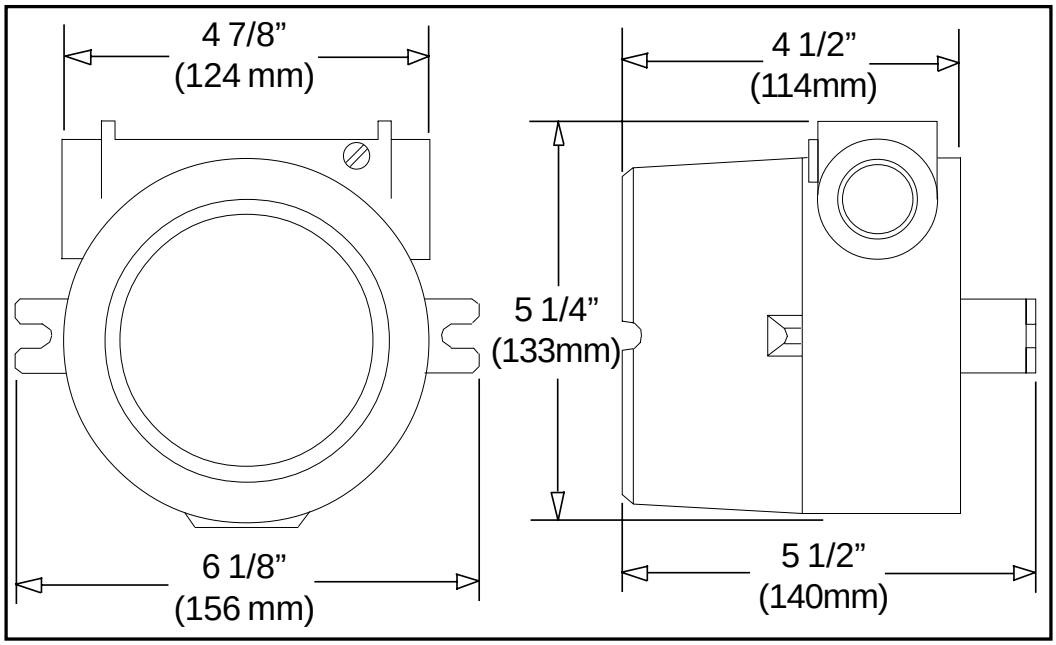


Figure 1. Overall Dimensions of the Digi-Relay Enclosure

Accessing the Terminal Board

The Terminal Board is located under the Signal Board assembly. Access to the Terminal Board is achieved as follows:

1. Remove the enclosure lid by unscrewing it counterclockwise.

Note:

If the lid is difficult to unscrew, make sure the setscrew in the tab is loosened.

(continued)

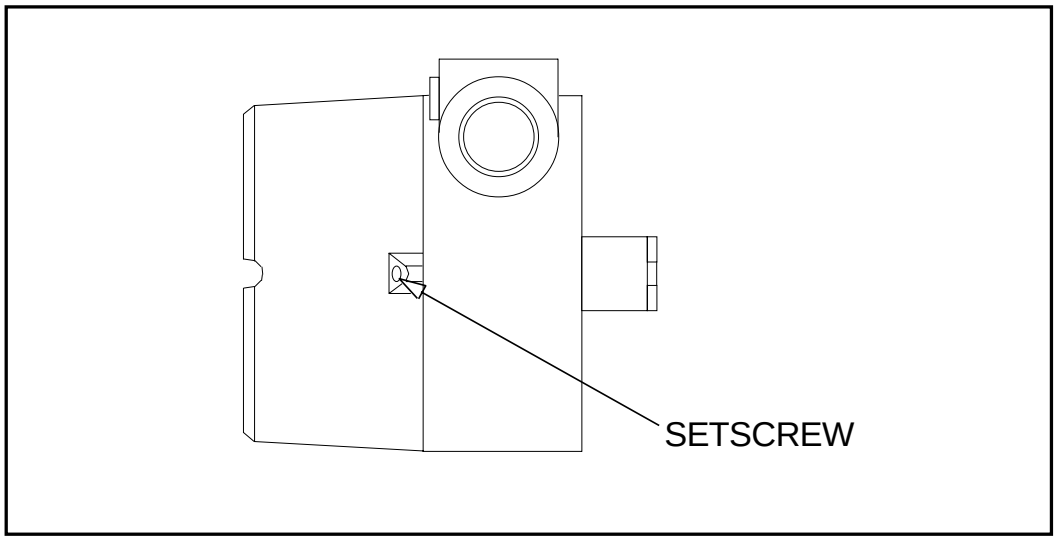


Figure 2. Location of Setscrew

2. Remove the Signal Board assembly by gripping the sides and carefully pulling directly upwards. A slight rocking motion may ease removal of the assembly.

Caution:

The Signal Board assembly is attached to the Terminal Board by means of a ribbon cable. Excessive force in removing the Signal Board assembly will result in damage to this cable, rendering the *Digi-Relay* inoperable.

3. Disconnect the ribbon cable from the terminal board and set the Signal Board assembly aside.

Grounding Considerations

It is recommended that the *Digi-Relay* enclosure be connected to earth ground to help shield the electronics from electromagnetic interference. There is a ground screw inside the enclosure for this connection.

Note:

There is an external screw for connection of earth ground to the enclosure. It is there for CENELEC and ATEX certifications. N.E.C. does not allow external grounding connections.

(continued)

There is a link on the Terminal (bottom) Board that allows connection of the power supply 0V to the enclosure.

When link LK1 is installed on pins 1 & 2, the incoming 0VDC terminal is isolated from the enclosure (earth ground). This is the factory default position.

When link LK1 is installed on pins 2 & 3, the incoming 0VDC terminal is connected to the enclosure (earth ground). While this configuration does not affect operation of the relay module, it may, in some instances, affect operation of the overall system.

Note:
Make sure connecting 0VDC to earth ground does not violate your local codes of practice or national standards.

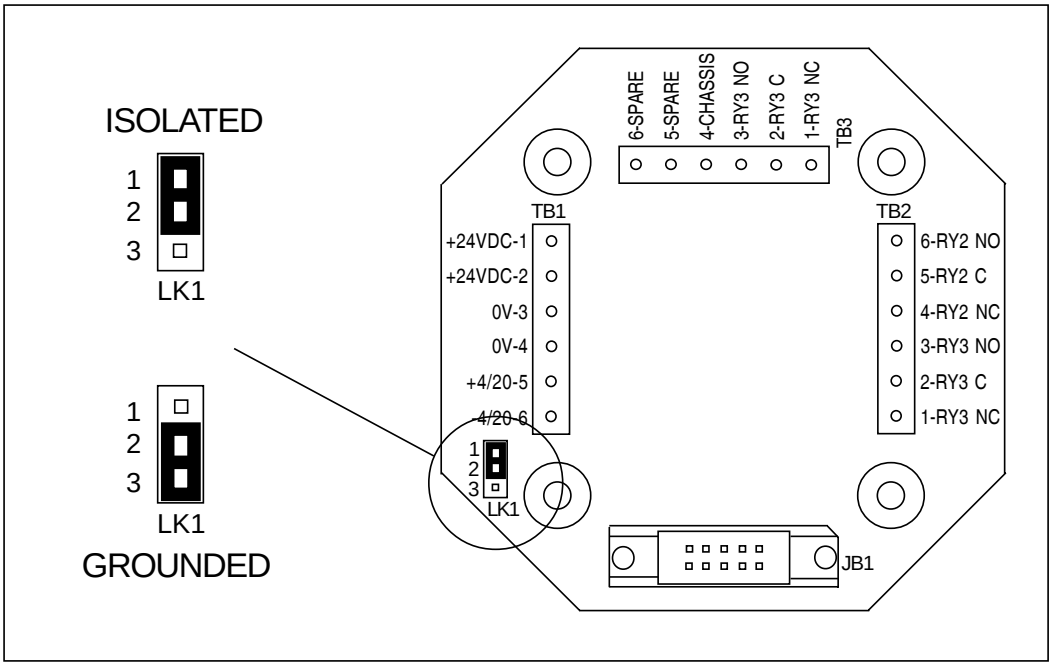


Figure 3. Location and Positions of Link LK1

Power Requirements

The relay module requires a nominal 24VDC supply provided by the host control system or a separate independent power supply. The maximum operating current is 104 mA (2.5 Watts) and the maximum initial surge current is 0.3A (7.5 Watts).

Wiring Requirements

It is strongly recommended that shielded cable be used. Shielded cable helps prevent electromagnetic interference (EMI) and radio frequency interference (RFI), which are common problems in an industrial environment. Refer to “EMC Considerations” on page *iii* for more information.

The *Digi-Relay* will accommodate 14-22 AWG wire, either stranded or solid. The following Belden cables are examples:

Belden # 83652:

2-conductor, 18 AWG stranded, 100% shield coverage

Belden # 83653:

3-conductor, 18 AWG stranded, 100% shield coverage

Belden # 83654:

4-conductor, 18 AWG stranded, 100% shield coverage

Field Wiring

Connectors

There are three six-position connectors provided for the connection of the field wiring. These connectors are packaged separately in a plastic bag.

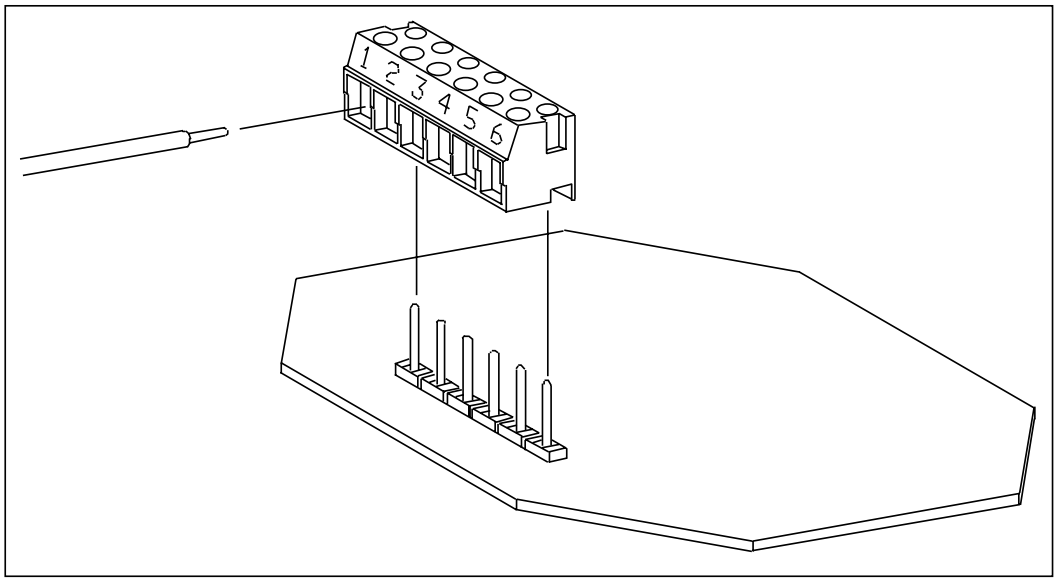


Figure 4. Field Wiring Connectors

When the field wiring is attached to the connector, the connector plugs onto a pin strip on the Terminal Board. The Terminal Board is marked to identify the orientation of the connector. Press the connector firmly onto the pin strip until it seats completely.

Power Connections

Terminal TB1 is for the power and signal connections. Note that there are two terminals for +24VDC (TB1, pins 1 & 2) and two terminals for 0V (TB1, pins 3 & 4). The +24VDC pins are linked on the circuit board, as are the 0V pins, and either terminal may be used to connect the *Digi-Relay* to the power supply.

Caution:

Incorrect wiring could damage the relay module. Follow the wiring instructions shown to ensure correct terminal locations.

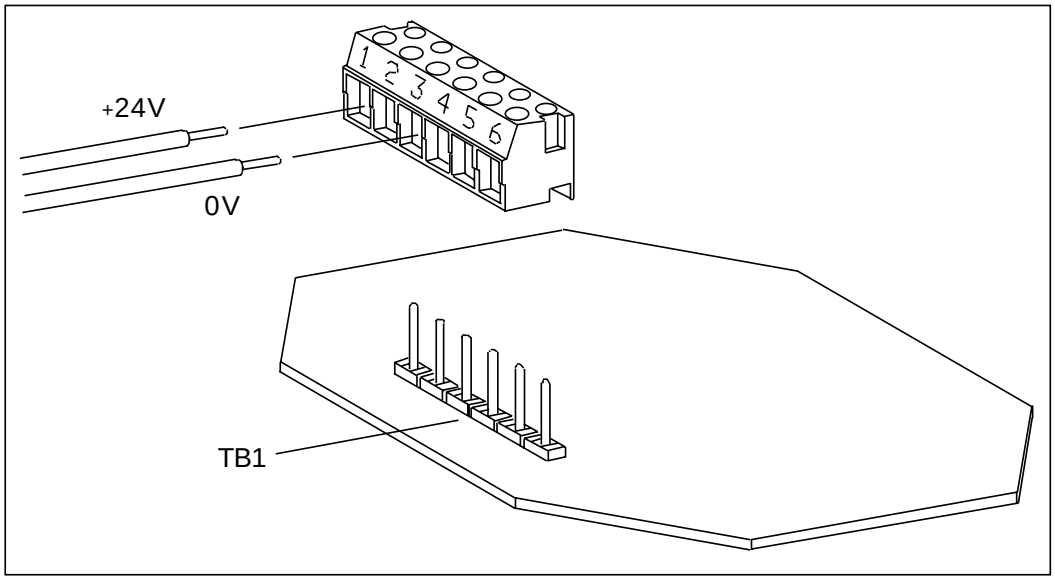


Figure 5. Power Supply Connections

Connect the positive side (+24V) of the power supply to pin 1 or 2 of the connector.

Connect the negative side (0V) of the power supply to pin 3 or 4 of the connector.

Signal Connections - “In-Line”

If the *Digi-Relay* is to be installed as an “in-line” relay module with the 4-20 mA signal continuing on to another piece of equipment, the incoming signal from the transmitter / sensor is connected to TB1 pin 5 or 6, depending on the sensor configuration.

Current Source and Loop Powered Sensors

The incoming signal from the transmitter / sensor is connected to pin 5. The signal is then taken from pin 6 for connection to the next piece of equipment.

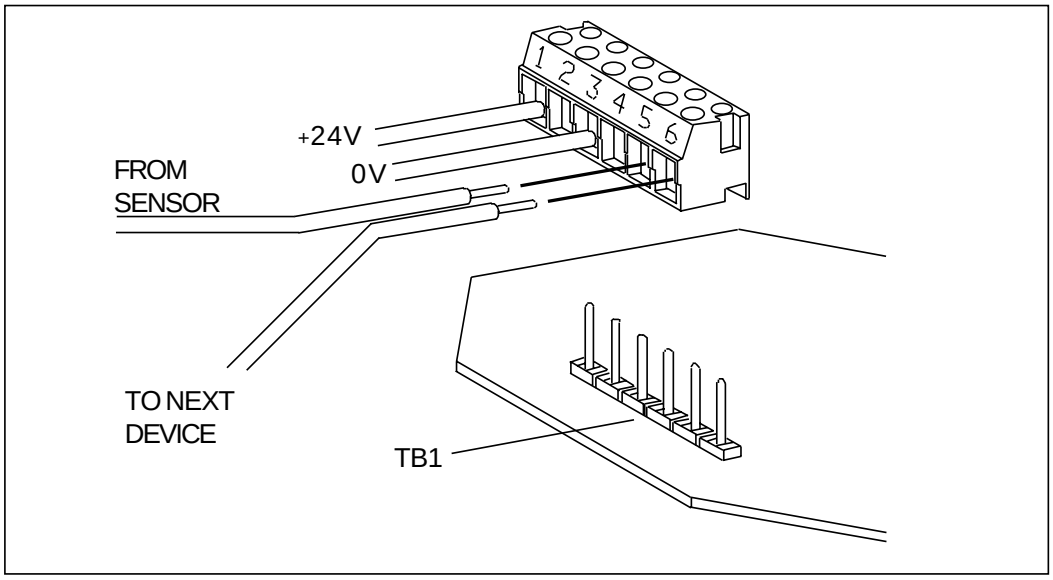


Figure 6. Signal Connections - “In-Line” - Current Source

Current Sink Sensors

The incoming signal from the transmitter / sensor is connected to pin 6. The signal is then taken from pin 5 for connection to the next piece of equipment.

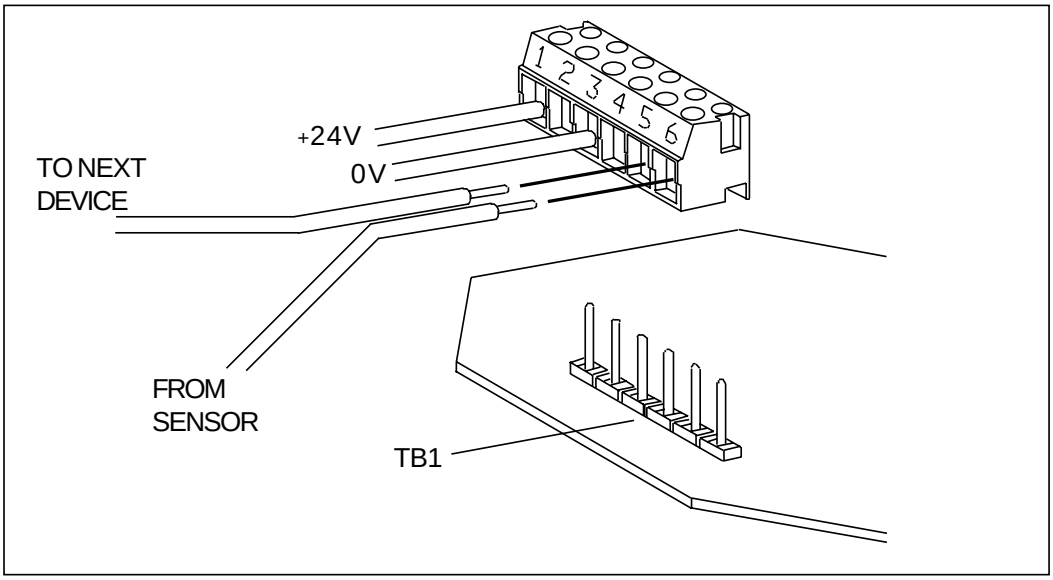


Figure 7. Signal Connections - "In-Line" - Current Sink

Signal Connections - "Stand-Alone"

If the *Digi-Relay* is to be installed as part of a "stand-alone" system with the 4-20 mA signal terminating at the module, the signal connections depend on the configuration of the transmitter / sensor providing the signal:

Current Source and Loop Powered Sensors

The signal wire is connected to TB1 pin 5. A jumper wire must be installed between TB1 pin 6 and 0V.

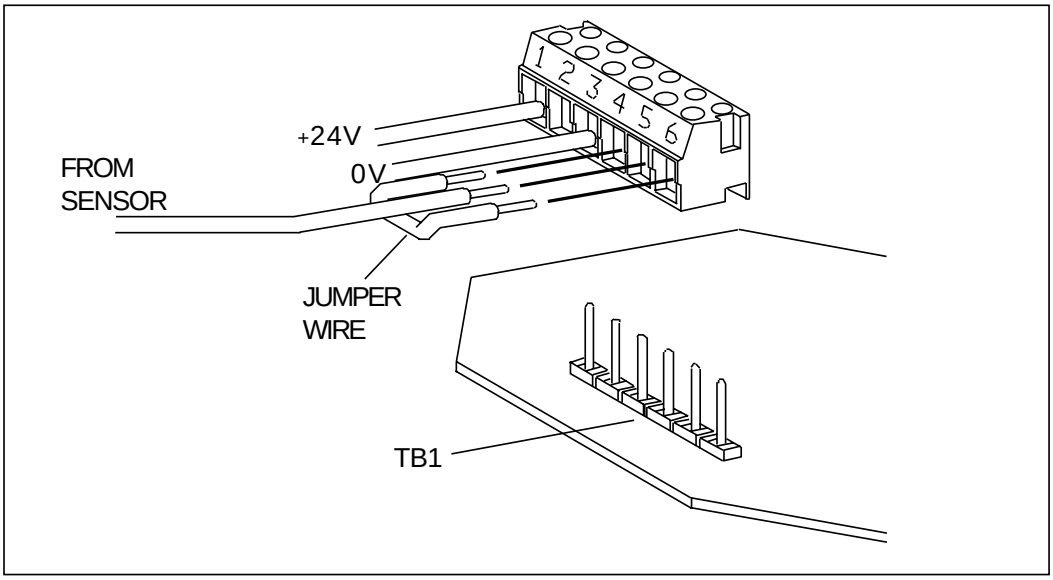


Figure 8. Signal Connections - "Stand-Alone" - Current Source

Current Sink Sensors

The signal wire is connected to TB1 pin 6. A jumper wire must be installed between TB1 pin 5 and +24VDC.

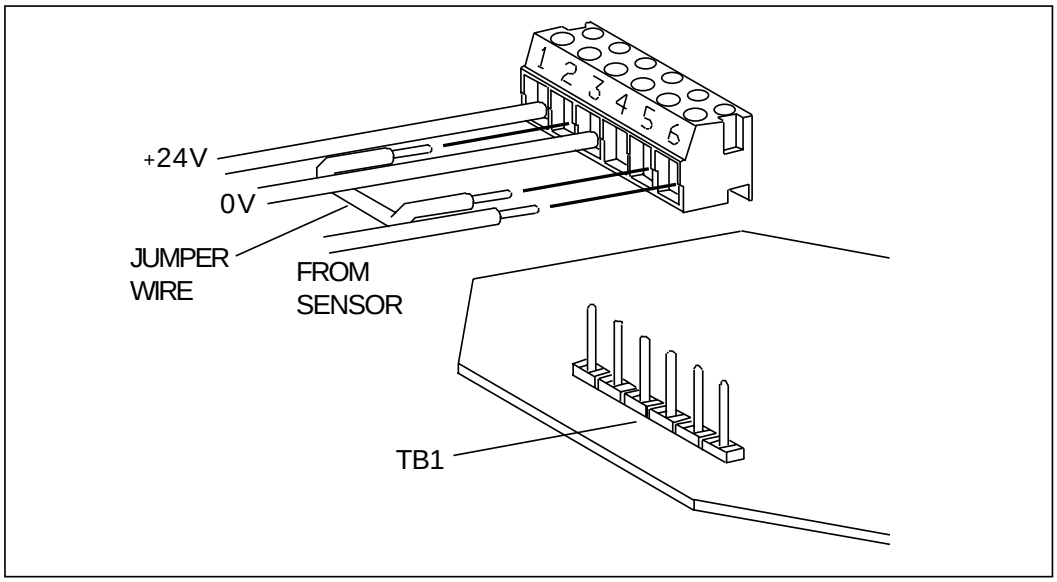


Figure 9. Signal Connections - "Stand-Alone" - Current Sink

Isolated Output Transmitter

Two wires are involved in this configuration. The positive (high) side is connected to +24VDC. The negative (low) side is connected to TB1 pin 5. A jumper wire must be installed between TB1 pin 6 and 0V.

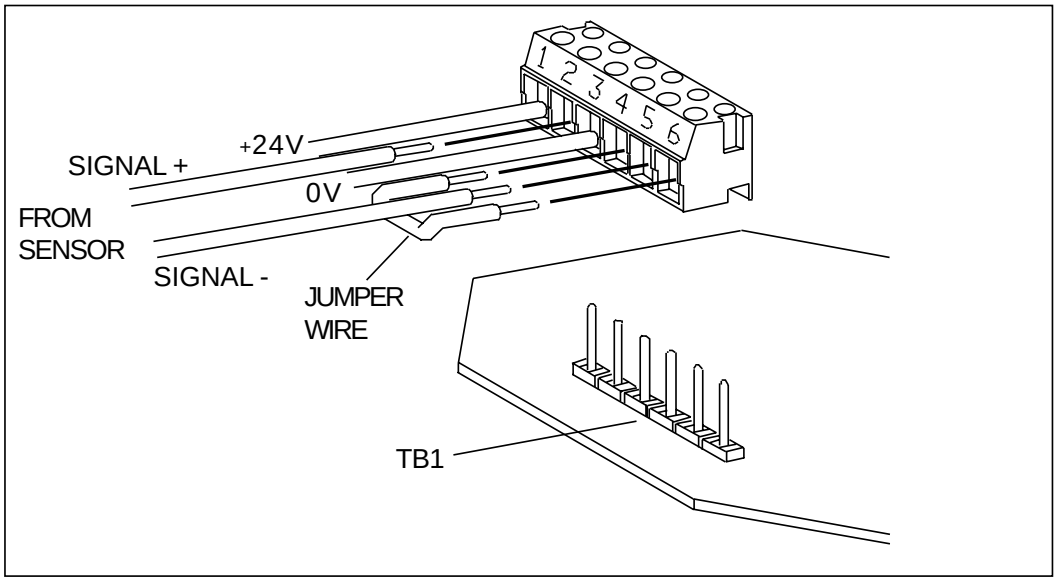


Figure 10. Signal Connections - "Stand-Alone" - Isolated Output

Relay Connections

The relay connections are made on TB2 and TB3. Each relay has three connection points; “C”, “NC” and “NO”.

“C” is the Common contact. This is the contact that switches between the other two contacts as the relay energizes and de-energizes.

“NC” is the Normally Closed contact. A connection exists between the Common and the Normally Closed contacts when the relay is de-energized.

“NO” is the Normally Open contact. A connection exists between the Common and the Normally Open contacts when the relay is energized.

Auxiliary Connections

TB2 contains some auxiliary connections:

Pin 4 is a connection to the Chassis. The chassis (enclosure) should be connected to earth ground.

Pins 5 and 6 are tied together as a Spare Link. This provides extra connection points for any purpose the customer chooses.

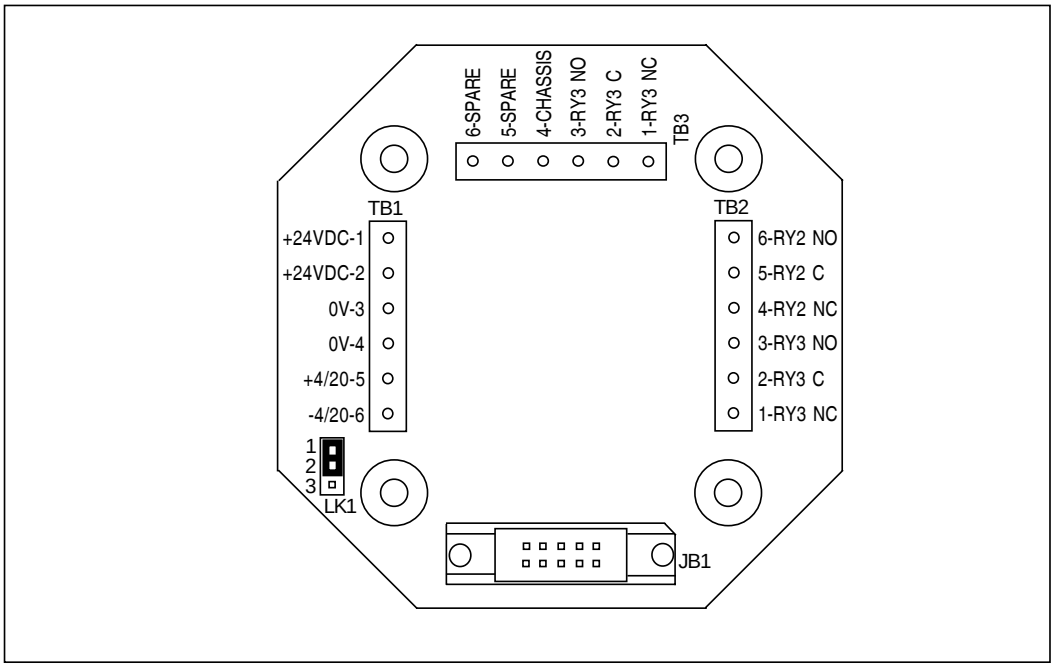


Figure 11. Terminal Identification

System Connection Diagrams

Specific wiring diagrams for different types of equipment and configurations are on the following pages. These diagrams use the Zellweger Analytics Digi Series transmitter as the model for the three-wire transmitter and the Zellweger Analytics Series 2000 transmitter as the model for the two-wire (loop powered) transmitter. The nomenclature of the terminals and actual physical connection may be different for other equipment.

In the following drawings, only TB1 of the Digi-Relay is shown as this is the only terminal with power and signal connections.

"In-Line" Installation

Figures 12 - 15 are for In-Line Operation. This type of installation terminates the 4-20 mA signal at another device after passing through the *Digi-Relay*. These drawings assume the terminating device for the 4-20 mA signal is a Controller or PLC.

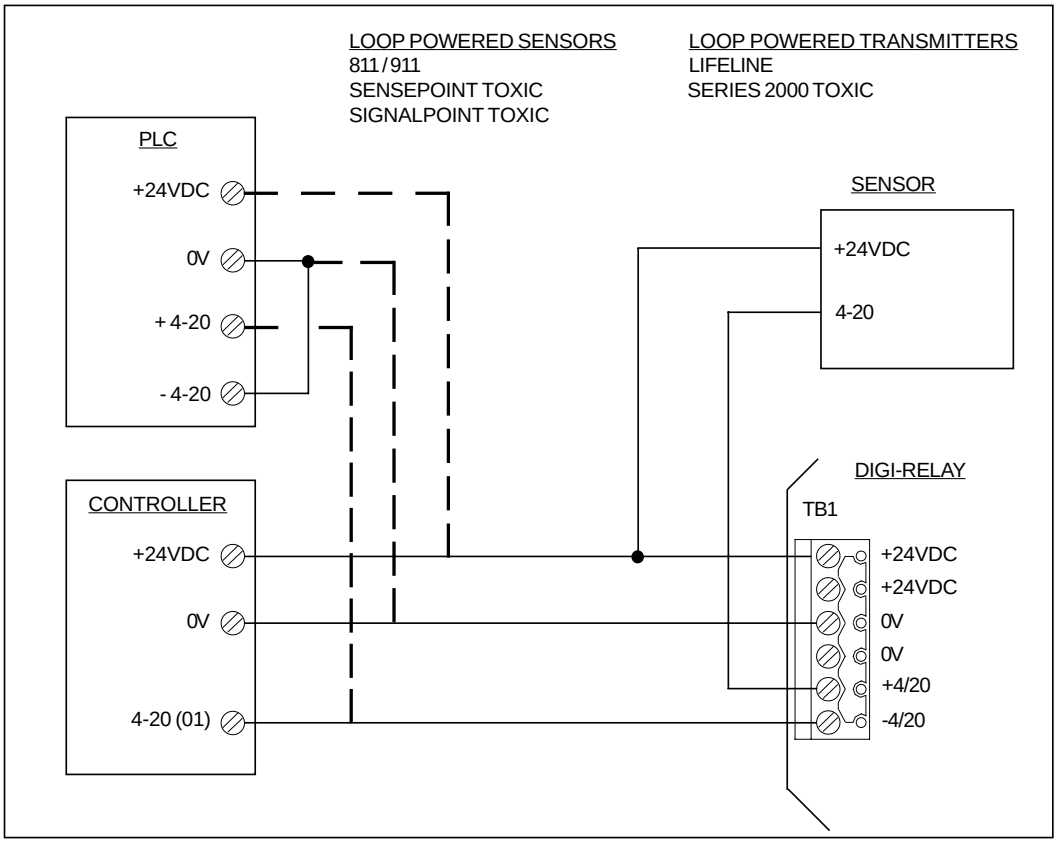


Figure 12. System Connections - "In-Line" - Loop Powered Sensor

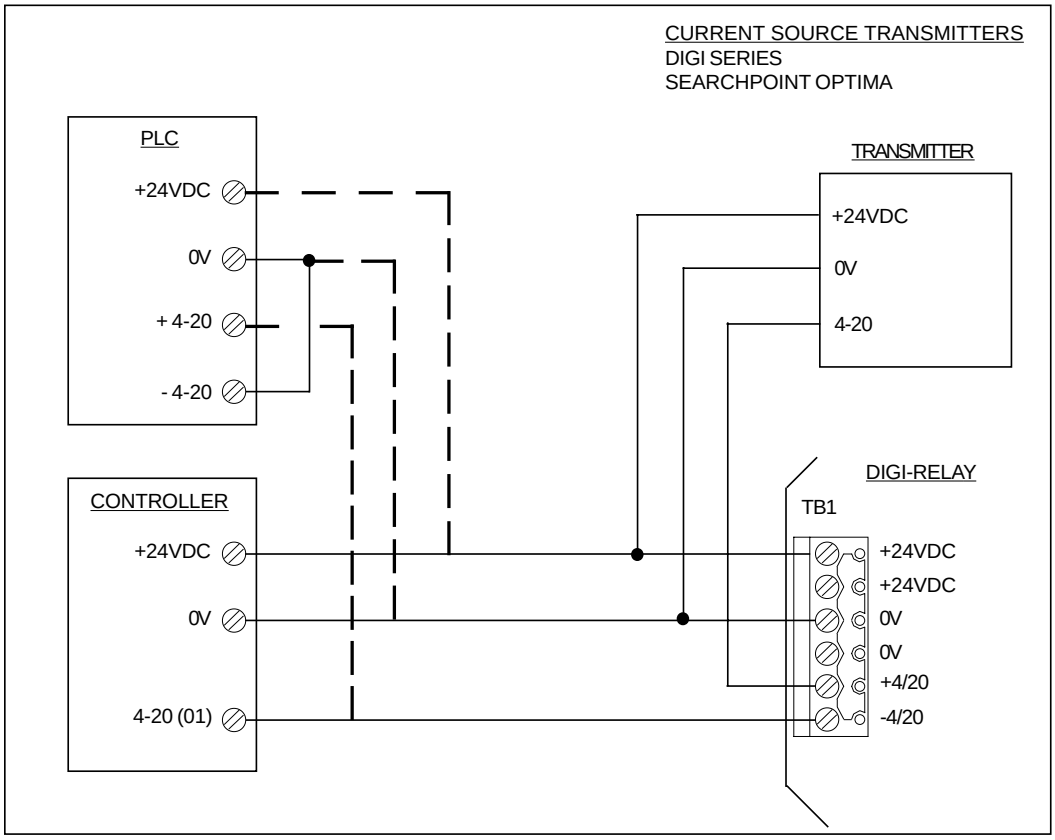


Figure 13. System Connections - "In-Line" - Current Source Transmitter

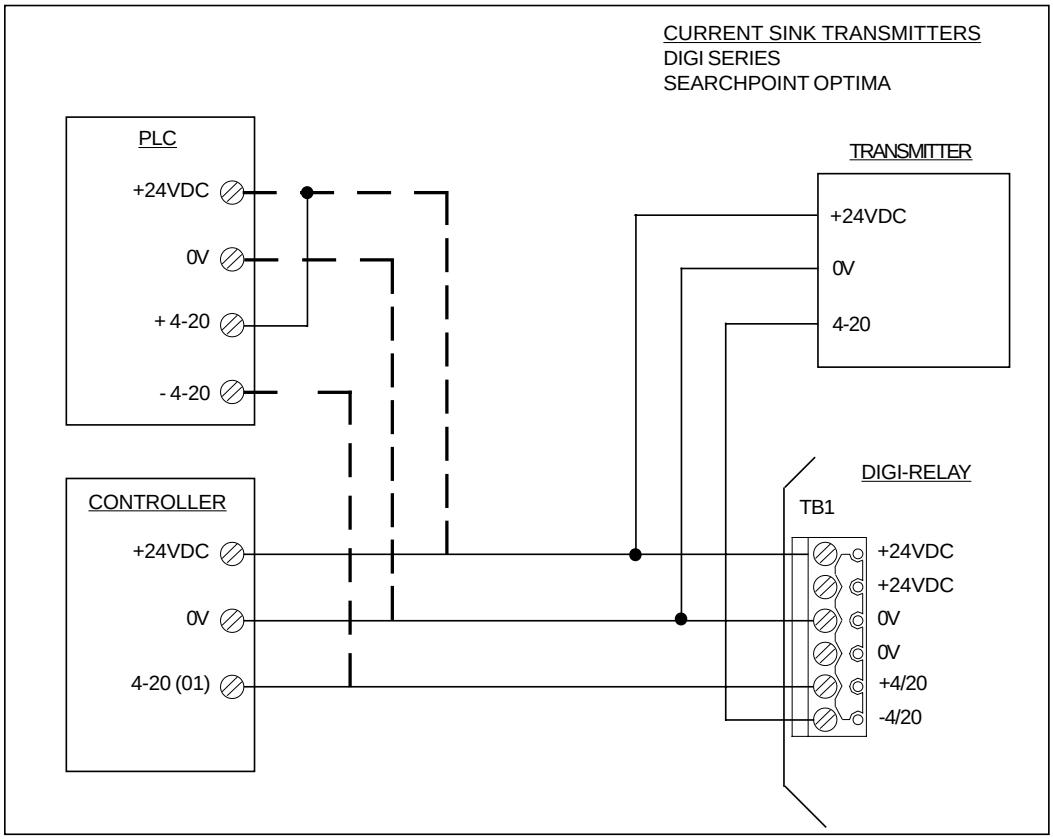


Figure 14. System Connections - "In-Line" - Current Sink Transmitter

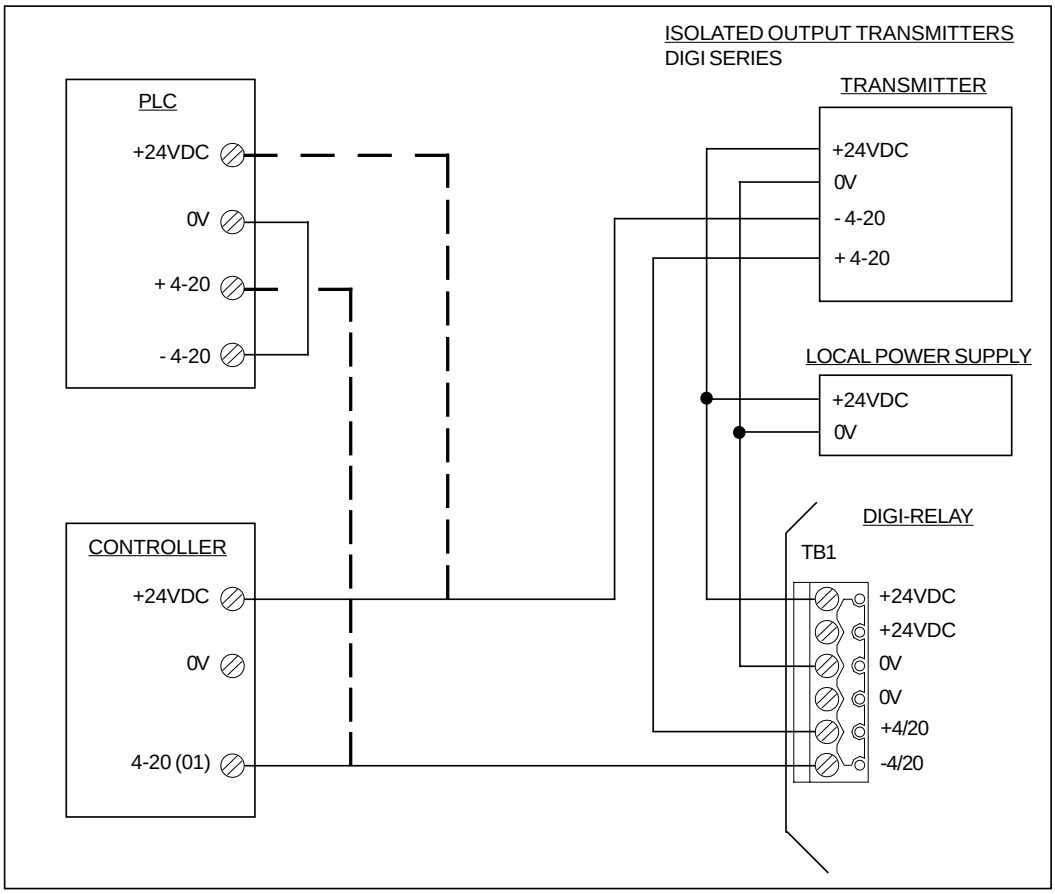


Figure 15. System Connections - "In-Line" - Isolated Output Transmitter

"Stand-Alone" Installation

Figures 16 - 19 are for Stand-Alone Operation. This type of installation terminates the 4-20 mA signal at the *Digi-Relay*.

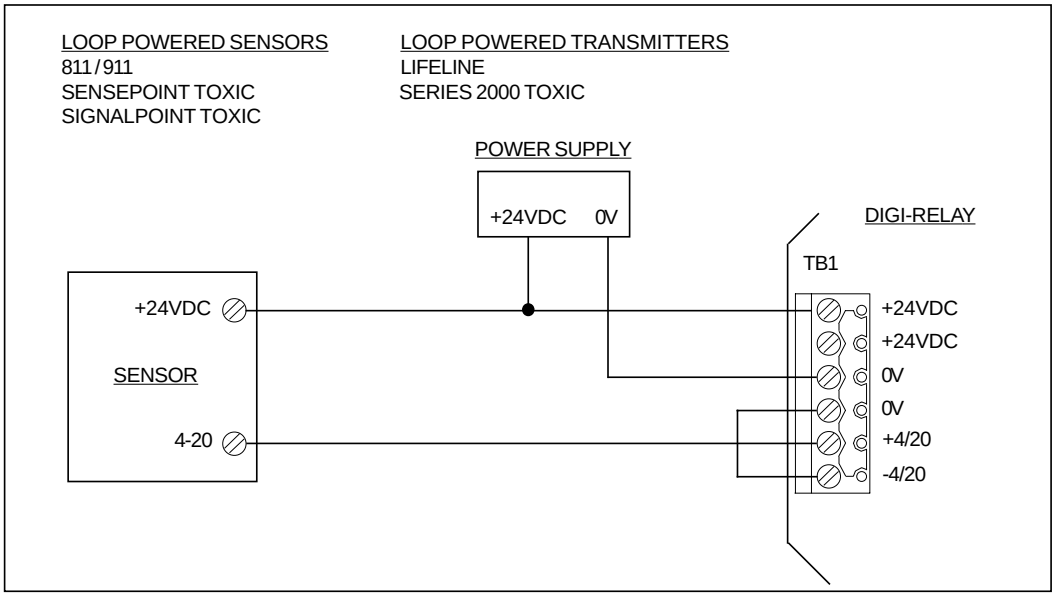


Figure 16. System Connections - "Stand-Alone" - Loop Powered Sensor

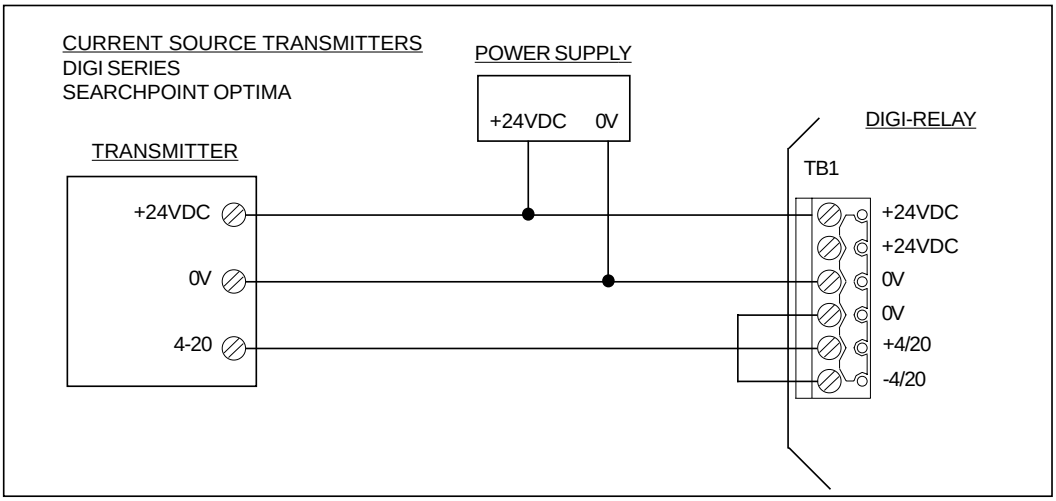


Figure 17. System Connections - "Stand-Alone" - Current Source Transmitter

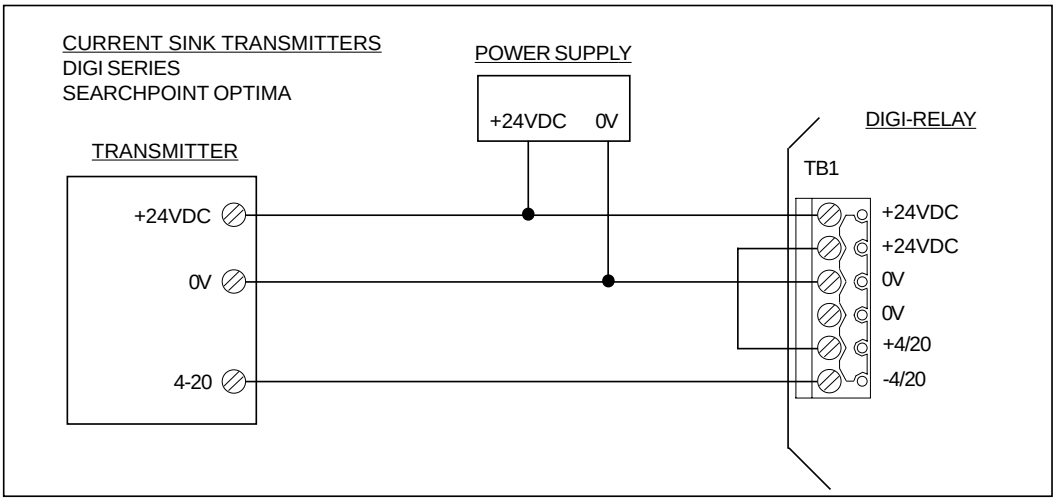


Figure 18. System Connections - "Stand-Alone" - Current Sink Transmitter

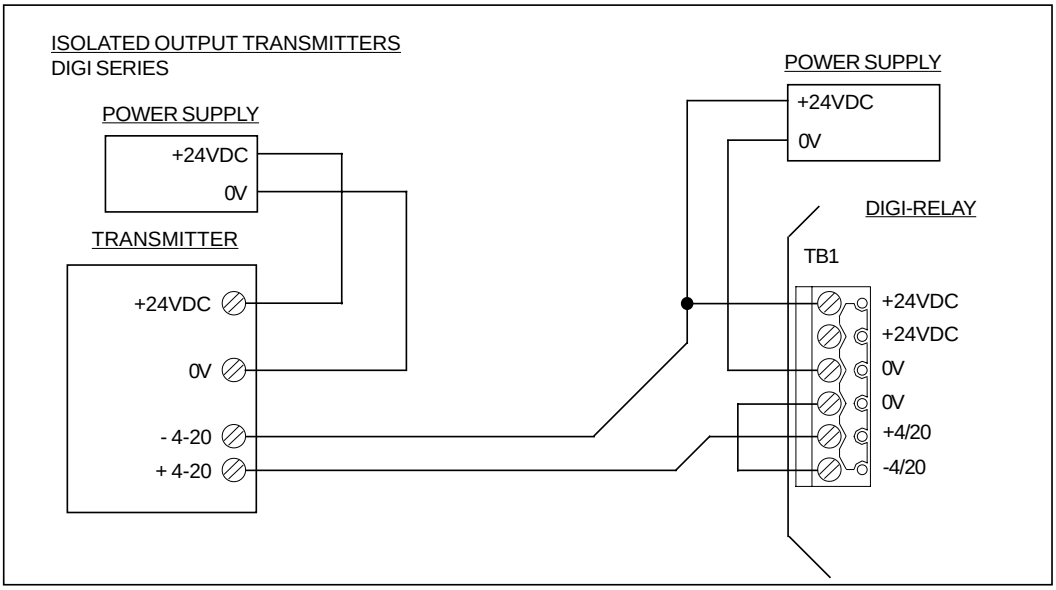


Figure 19. System Connections - "Stand-Alone" - Isolated Output Transmitter

Chapter 3: Operation

Overview

Operation of the *Digi-Relay* remote relay module consists solely of setting the relay trip points and mode of operation links.

Controls and Indicators

All of the controls and indicators are located on the top circuit board (the Signal Board). Each relay control circuit has a potentiometer, an LED and a link.

Potentiometer

Each relay's trip point is independently adjustable. The adjustment is made using the potentiometers ("pots") on the signal board. A clockwise adjustment will raise the trip point and a counterclockwise adjustment will lower the trip point. The trip point adjustment procedure is detailed in "Commissioning".

LED

An LED is included in each relay control circuit to provide a visual indication of the state of the circuit. If the input signal exceeds the relay's trip point, the LED will turn on.

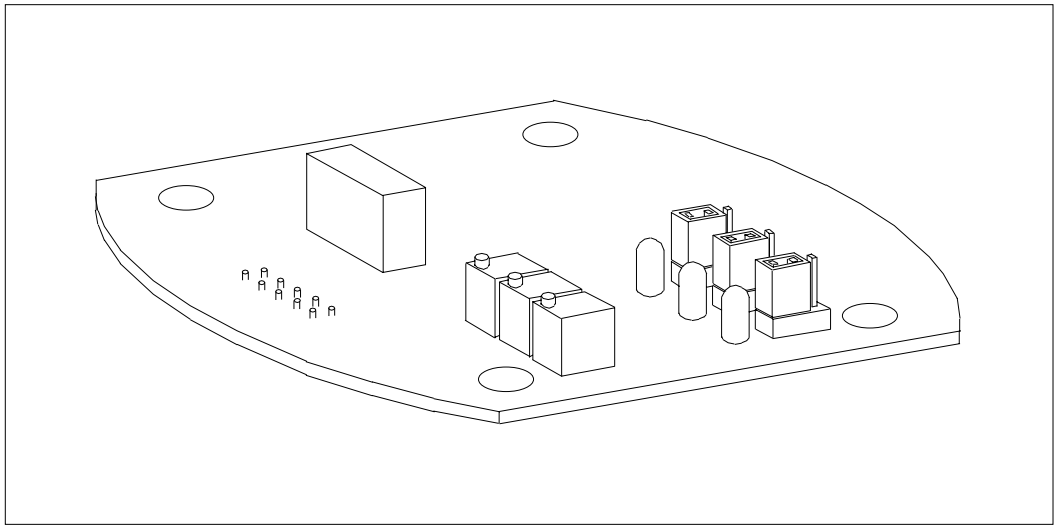


Figure 20. Controls and Indicators

Link

The links are used to configure the relay as normally de-energized or normally energized. Normally de-energized (link on pins 2 & 3) means the relay does not activate until the input signal exceeds the trip point. Normally energized (link on pins 1 & 2) means the relay is activated until the input signal exceeds the trip point, at which point it deactivates.

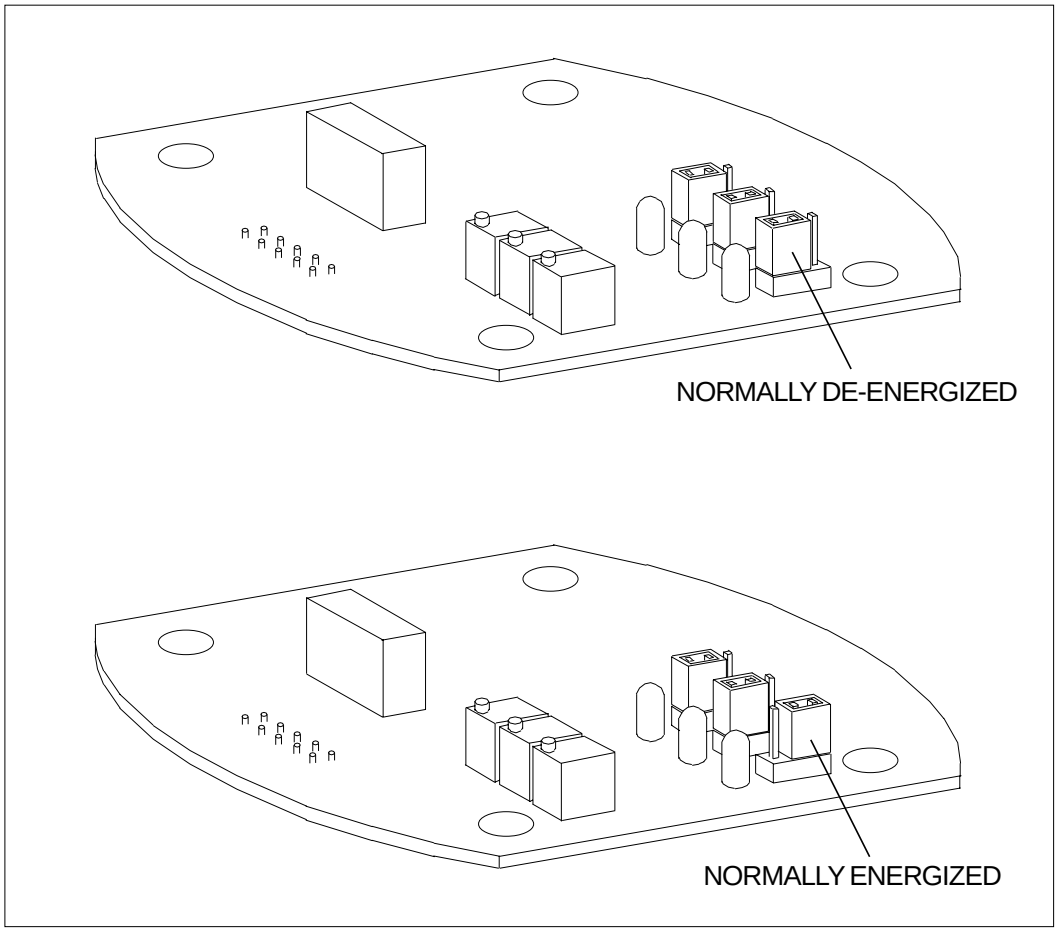


Figure 21. Controls and Indicators - Link Settings

VR1, LED1 and LK1 are associated with relay RY1.

VR2, LED2 and LK2 are associated with relay RY2.

VR3, LED3 and LK3 are associated with relay RY3.

The 4-20 mA Signal

When setting the relay trip points, it is helpful to know what levels of current are used to indicate various conditions. Figure 22 shows a typical 4-20 mA scale. Refer to the Operations manual for your particular transmitter / sensor. The ranges used are as follows:

Fault condition	<1.0 mA
Inhibited	2.0 mA
Gas Concentration	2.4 (-10% FSD) to 25.0 mA (131% FSD)

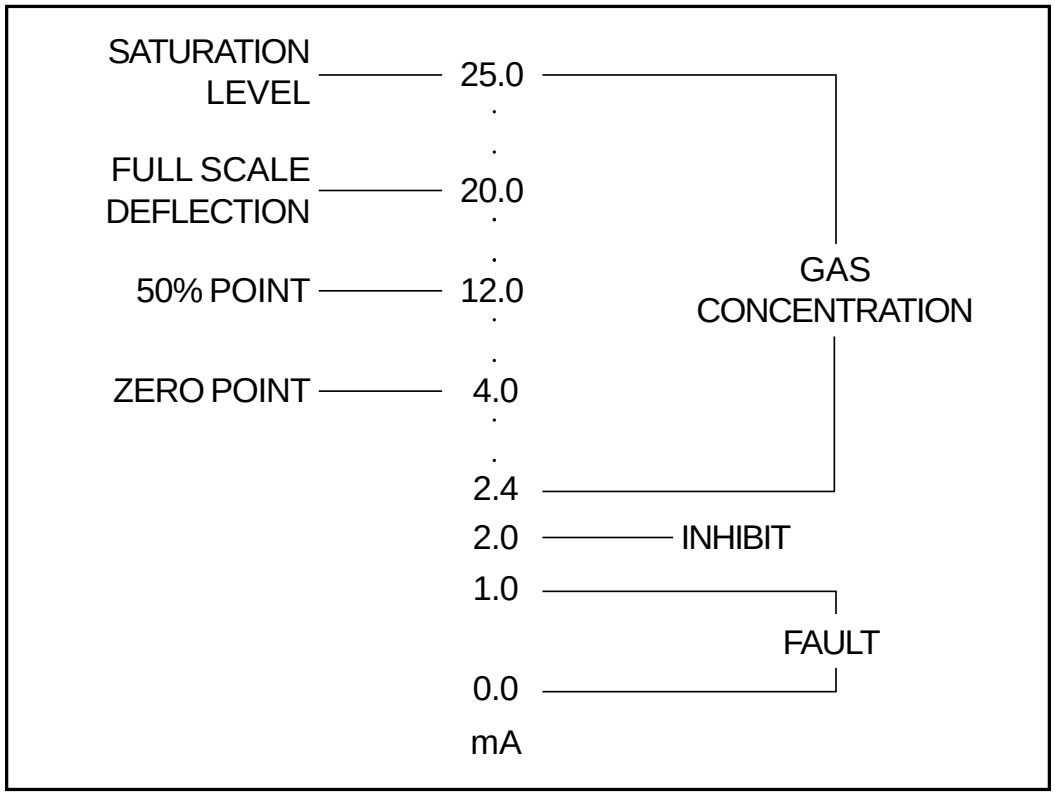


Figure 22. Levels Used on the 4-20 mA Scale

To calculate what signal value corresponds with a particular gas concentration level, use the formula:

X = ((gas level/FSD) x 16) + 4 mA

Examples:

What is the signal level for 20.8% Vol. Oxygen from a 0-25% Vol. Oxygen detector?

X = ((gas level/FSD) x 16) + 4 mA

X = ((20.8/25) x 16) + 4 mA

X = (0.832 x 16) + 4 mA

X = (13.3) + 4 mA

X = 17.3 mA

What is the signal level for 10 ppm H_2S from a 0-50 ppm H_2S detector?

X = ((gas level/FSD) x 16) + 4 mA

X = ((10/50) x 16) + 4 mA

X = (0.2 x 16) + 4 mA

X = (3.2) + 4 mA

X = 7.2 mA

Factory Configuration and Presets

Following is the default factory configuration for all *Digi-Relays* unless specifically requested for Oxygen deficiency:

Relay 1

Low Alarm — Trip Point is 25% FSD, Normally De-energized

The relay will energize if the input signal exceeds 8.0 mA.

Relay 2

High Alarm — Trip Point is 50% FSD, Normally De-energized

The relay will energize if the input signal exceeds 12.0 mA.

Relay 3

Fault/Power Failure Alarm — Trip Point is 1.5 mA, Normally De-energized

The relay will de-energize if the input signal falls below 1.0 mA (Fault Condition) or if power is removed (Power Failure).

For Oxygen Deficiency (O_2):

Defaults for the relays are assuming that the 4-20 mA signal is coming from a transmitter set up to detect 0% - 25% Vol. Oxygen, with 4.0 mA representing 0% Vol. Oxygen and 20 mA representing 25% Vol. Oxygen.

Relay 1

Low Alarm — Trip Point is 19% Vol. O_2, Normally De-energized

The relay will de-energize if the input signal falls below 16.2 mA

Relay 2

High Alarm — Trip Point is 17.5% Vol. O_2, Normally De-energized

The relay will de-energize if the input signal falls below 15.2 mA

Relay 3

Set as Fault/Power Failure Alarm — Trip Point is 1.5 mA, Normally De-energized

The relay will de-energize if the input signal falls below 1.0 mA (Fault Condition) or if power is removed (Power Failure).

Commissioning

Commissioning of the *Digi-Relay* consists of adjusting the alarm trip points (if other than the defaults) and testing operation when the entire system is installed.

Operation testing can be done using a current calibrator or gassing the sensor “live” (not in CALIBRATE mode).

To adjust the relay trip points, the following equipment is needed:

+24VDC Power Source

Current Calibrator

Small screwdriver

Note:

If the *Digi-Relay* is installed in conjunction with a Digi Series transmitter, the transmitter can be used as the current calibrator. Refer to the Digi manual for details.

If desired, the 4-20 mA signal can be monitored at the test points TP1 (+) and TP2 (-) with a multimeter on the 2 Volt range. The voltage reading between these points is a linear representation of the input milliampere signal, with 2.0V = 20 mA, 0.2V = 2.0 mA, etc.

Using one of the connectors included with the *Digi-Relay*, make all the wiring connections as shown in the appropriate Stand-Alone Operation diagram, substituting the Current Calibrator for the transmitter. Refer to “Installation” for disassembly and connection details.

Plug the connector onto TB1.

The relay trip points are set by the adjustment of the controls VR1, VR2 and VR3. The alarm state is indicated by the associated light emitting diode LED1, LED2 and LED3. The LED will illuminate when the trip point is exceeded.

To set up Relay 1:

1. Adjust the current calibrator for the milliampere output which corresponds to the desired trip level.

2. Adjust VR1 until LED1 just comes on. A clockwise adjustment will raise the trip point (if LED1 is already on) and a counterclockwise adjustment will lower the trip point (if LED1 is off). If this adjustment is made too quickly, the setting may be off by as much as 1% FSD.

3. Set link LK1 for normally energized or normally de-energized operation as desired.

Relay 2 can be adjusted using VR2, LED2 and LK2.

Relay 3 can be adjusted using VR3, LED3 and LK3.

Calibration

Calibration of the *Digi-Relay* consists of adjusting the alarm trip points. It may be performed at the same time as the sensor is calibrated. Since there are no parts in the *Digi-Relay* which rapidly degrade with normal use, periodic calibration is not required.

Troubleshooting

The *Digi-Relay* is functionally a very simple device. There are very few easily defined symptoms, and very few things to check. If the following checks do not identify the problem, call Service.

Unable to adjust relay trip points; LED never turns on.

Check: Signal at test points.

Input signal connections.

Power connections.

LED turns on but relay does not activate.

Check: Link setting.

Most problems in the field are not caused by product failure but rather the integration of several pieces of equipment into a system. Normally this type of problem can be resolved over the telephone.

Service / Technical Support

All our products are safety related. Uncompromising performance cannot be assured unless staff are properly trained with access to specialized test equipment. For this reason, Zellweger Analytics, Inc. does not provide comprehensive circuit diagrams in their manuals nor do we encourage component level field service. In recognition of our position on service, we offer a very comprehensive sales support network with approved service centers in North America and around the world.

All service in North America is carried out in field service centers and at our main plant in Lincolnshire, Illinois (near Chicago). Please

contact your local representative or the Lincolnshire office for current repair costs.

Zellweger Analytics, Inc.

405 Barclay Boulevard

Lincolnshire, IL 60069

Telephone: +1-800-323-2000

24 Hours: +1-847-634-2840

Facsimile: +1-847-955-8210

Before product can be accepted for repair, a Return Service Request (RSR) number must be issued by the Service Department. This number must be displayed on the exterior of the package, preferably on the shipping label.

Chapter 4 Spare Parts

Digi-Relay Replacement Items

Note:
Signal Board assemblies ordered as spares are shipped unconfigured. These boards must be commissioned before being used.

Description:	Part Number:
Terminal Board Assembly	02042-A-0050
Signal Board Assembly	02042-A-0060
Connector, 6-Position	0150-3000

Chapter 5 Specifications

Mechanical (with Mounting Strap):

Size: 6 1/8” W x 5 1/4” H x 5 1/2” D
156 mm W x 134 mm H x 140 mm D

Weight: 3.75 lbs (1.7 kg)

Temperature Range:

Operational: -4 to +122 °F (-20 to +50 °C)

Storage: -40 to +176 °F (-60 to +80 °C)

Electrical:

Power

Supply Voltage: 10VDC to 35VDC

Power Consumption: 104 mA @ 24VDC (2.5 Watts)

Start-Up Current: 0.3A @ 10VDC, 0.1A @ 24VDC

Input Signal

Input Signal Range: 0.75 mA to 24 mA

Input Signal Loss: 1.0V @ 20 mA

Alarms:

Alarm Set Range: 0.75 mA to 24 mA

Alarm Set Accuracy: ± 0.1 mA (± 0.5% FSD of 20 mA)

Accuracy vs. Temp: ± 3% FSD (-20 °C to +65 °C)

Alarm Hysteresis: ± 4% FSD (± 0.64 mA) max.

Test Point Accuracy: ± 3% of signal

Relays:

Relay Contacts: Double Pole, 1 NO, 1 NC

Relay Contact Rating: 3.0A @ 250VAC 3.0A @ 32VDC

Enclosure:

Material: Copper-free Aluminum

Entries: Two (2), 3/4” NPT

Certification:

UL: Explosion-Proof

Class I, Division 1, Groups B, C and D

C-UL: Explosion-Proof

Class I, Division 1, Groups B, C and D

NOTES

Operation & Maintenance Manual

GASMAX
Product Family

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

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

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

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

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SECTION 1 – SAFETY INFORMATION

1.1 Safety Information – Read Before Installation & Applying Power

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

WARNINGS

- Calibrate with known target gas at start-up and check on a regular schedule, at least every 90 days. More frequent inspections are encouraged to spot problems such as dirt, oil, paint, grease or other foreign materials on the sensor head.
- Do not paint the sensor assembly or the Transmitter.
- Do not use the GASMAX if its enclosure is damaged or cracked or has missing components.
- Make sure the cover, internal PCB's and field wiring are securely in place before operation.
- Use only a sensor assembly compatible with the GASMAX and approved by Global Detection Systems Corp. (See the section ____ for Replacement Parts.) *Not Available this printing*
- Periodically test for correct operation of the system's alarm events by exposing the monitor to a targeted gas concentration above the High Alarm setpoint.
- Do not expose the GASMAX to electrical shock or continuous severe mechanical shock.
- Protect the GASMAX from dripping liquids and high power sprays.
- Use only for applications described within this manual.

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

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

1.2 Contacting GDS Corp.

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

SECTION 2 – INSTALLATION INSTRUCTIONS

2.1 Introduction

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

The GASMAX is a single or dual channel fixed-point monitor designed to provide continuous monitoring of hazardous gases in the workplace. Monitored values are displayed in their engineering units as well as graphically as a bar graphs or 30-minute trends (Figure 2.1). Input types include Electrochemical toxic / oxygen sensors, catalytic bead combustible sensors, MOS solid-state sensors, as well as various millivolts, volt and 4-20mA inputs. Sensors supplied by the factory include an 8-wire *Smart Sensor* interface capable of configuration data uploads to the GASMAX. Traditional 3-wire *Simple* sensors, without the smart interface, are also supported by

the GASMAX. Its advanced microcontroller electronics and superior graphic LCD operator interface offers enhanced diagnostics and fault analysis not possible in competing products. The GASMAX provides a standard 4-20 mA output signal for connection to control systems or other alarm instrumentation. Available options include an Alarm Relay / RS-485-Modbus board or an Isolated 4-20mA output. Non-volatile memory retains all configuration data during power interruptions. The magnetic, non-intrusive calibration can be easily performed by one person without opening the enclosure. A standard "real time clock & calendar" feature allows data logging of calibrations and alarm events for recall to the LCD readout or over the serial port.

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

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

Only periodic calibration checks are needed to assure dependable performance. Operator interface is very intuitive with the LCD displaying data both graphically as bar-graphs / trends and in engineering units (Figure 2-1). Additional features include:

- No potentiometer or jumper settings required. All setup is with menus accessed via the LCD / magnetic keypad operator interface without opening the enclosure.
- Field adjustable alarm levels may be high, low, fault, fail-safe, latching and acknowledgeable.
- New alarms cause front LED's to flash and become steady after acknowledge.
- CAL MODE advises when to apply gas during calibrations
- One half hour trend screen shows rate of change of gas exposures
- Sensor life bar-graph updates after each SPAN calibration.
- Modular design affords efficient installation and plug in sensors allow changing target gases after installation
- New smart sensors are recognized by the GASMAX and prompts users to either upload new configuration data or continue with data from the previous smart sensor.
- Sensors are industry proven for fast response and long life.

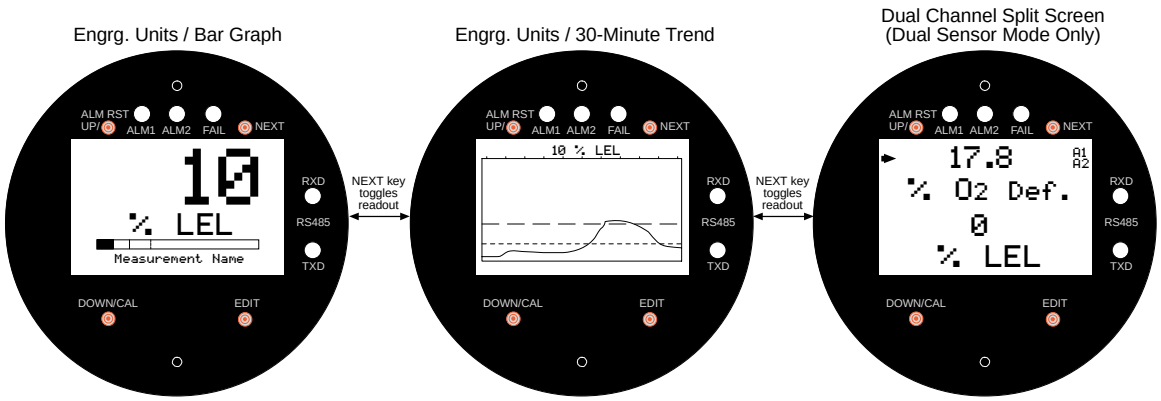


Figure 2-1: Data Displays

2.2 Ratings and Certifications

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

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

2.3 Sensor Location

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

2.4 Mounting the Enclosure

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

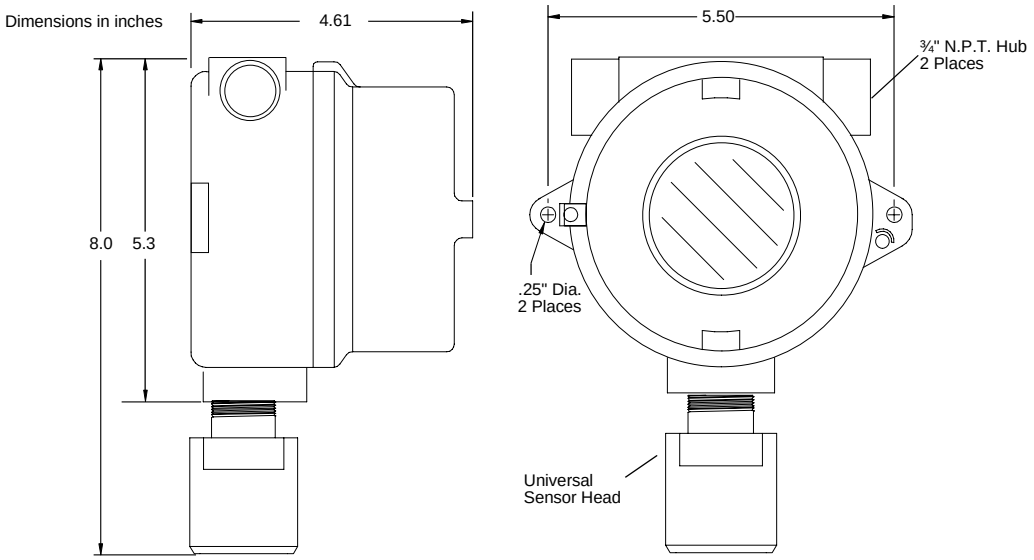


Figure 2-2: GASMAX Explosion-Proof Housing

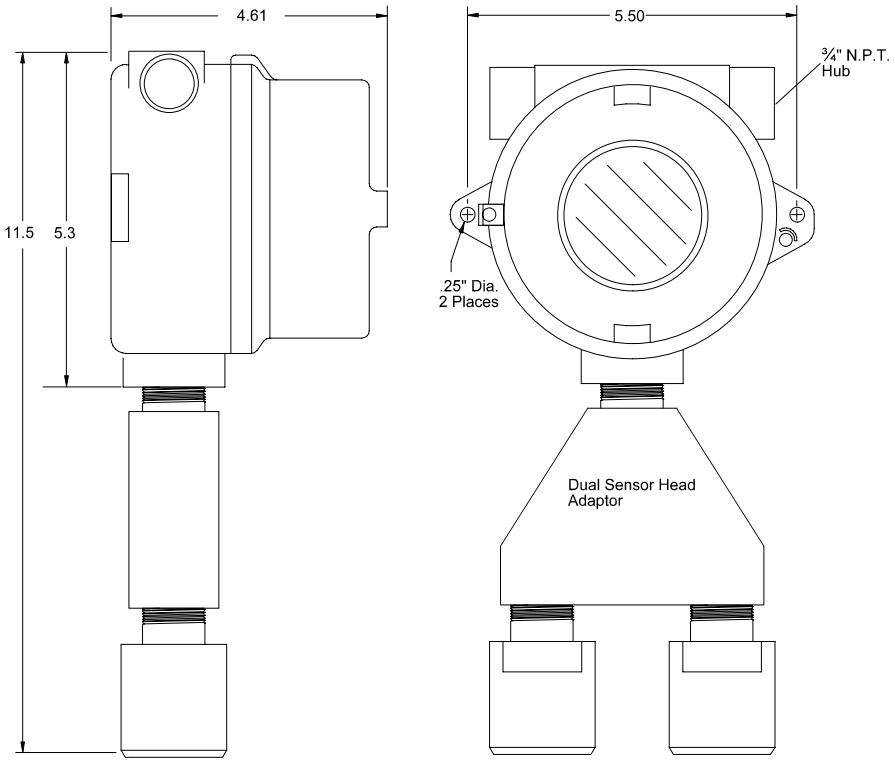


Figure 2-2a: GASMAX Explosion-Proof Housing with Dual Sensor Head Adaptor

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

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Insure correct cabling and sealing fitting practices are implemented. Do not aim the sensor pointing upward. Install the GASMAX to a wall or bracket using the predrilled mounting flanges with I.D. 0.25 on 5.5 inch centers (Figure 2-2). If conduit is rigid and able to support the weight of the GASMAX, the mounting bolts may be omitted.

CAUTION: The sensor should never be installed pointing upwards.

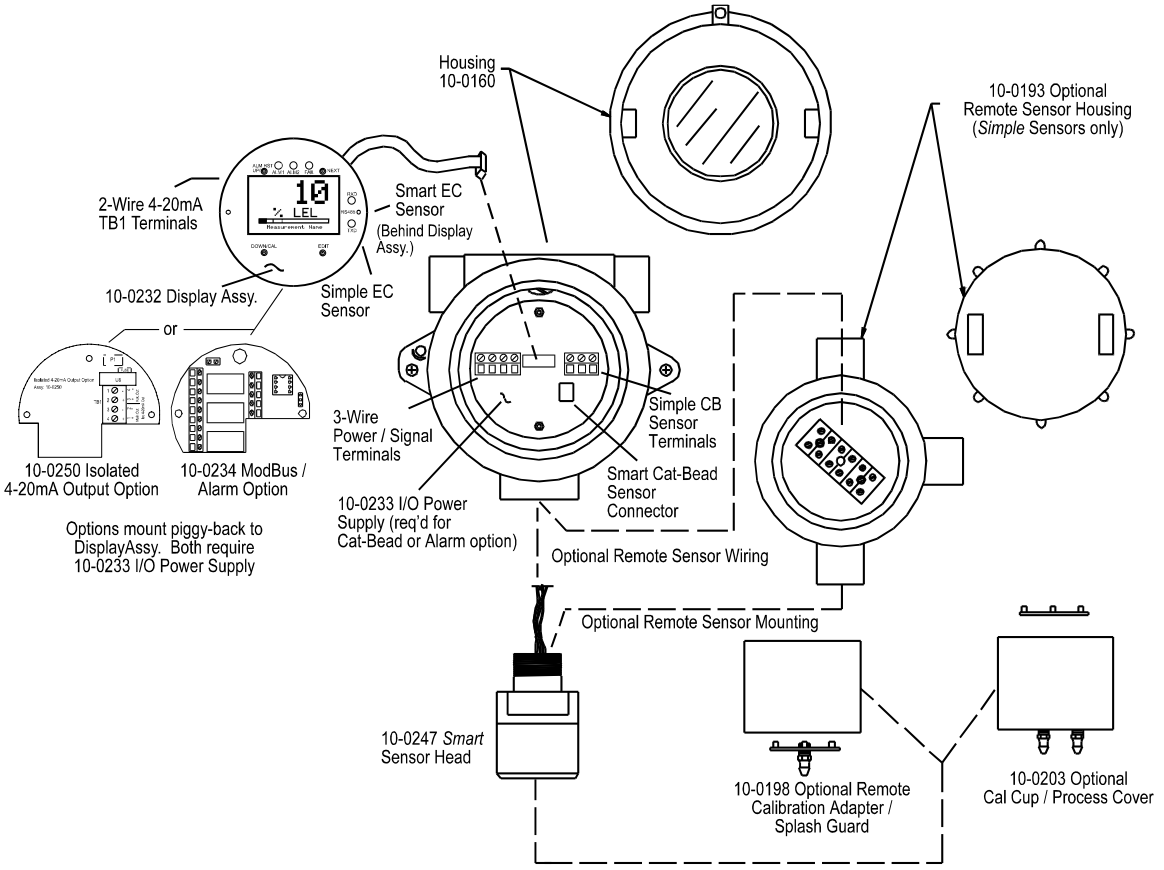


Figure 2-3: Outline Drawing

2.5 System Design Specifications

Supply Voltage:
10 to 30 volts

Power Consumption:

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

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

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

Relays (Optional):
Three configurable form C (SPDT) relays rated for 5 amp at 30 VDC or 240 ~VAC **RESISTIVE**.

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

Relay 3 is always normally energized for failsafe operation so loss of power to the GASMAX II will be indicated as a “FAULT” condition.

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

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

2.6 Field Wiring Installation

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

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

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

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

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

Instructions:
Unscrew the cover on the GASMAX/EC explosion-proof enclosure. Loosen the 2 thumbscrews holding the display assembly in place and remove it. A small sensor cable is attached with sufficient length to allow access to the back of the display assembly where 2 position TB1 is located. Route the receiver wires through the conduit entry and connect to TB1. Steering diodes in the GASMAX/EC 2-wire 4-20mA output automatically correct for polarity so positive and negative are interchangeable. Reassemble the GASMAX/EC. Follow the procedures and recommendations in the receiver manual to complete the installation. Be sure the GASMAX/EC enclosure and conduit are properly grounded. Apply loop power by appropriately powering the receiver device (DCS, PLC, Controller, etc) and the GASMAX/EC should function. Proceed to section-3.

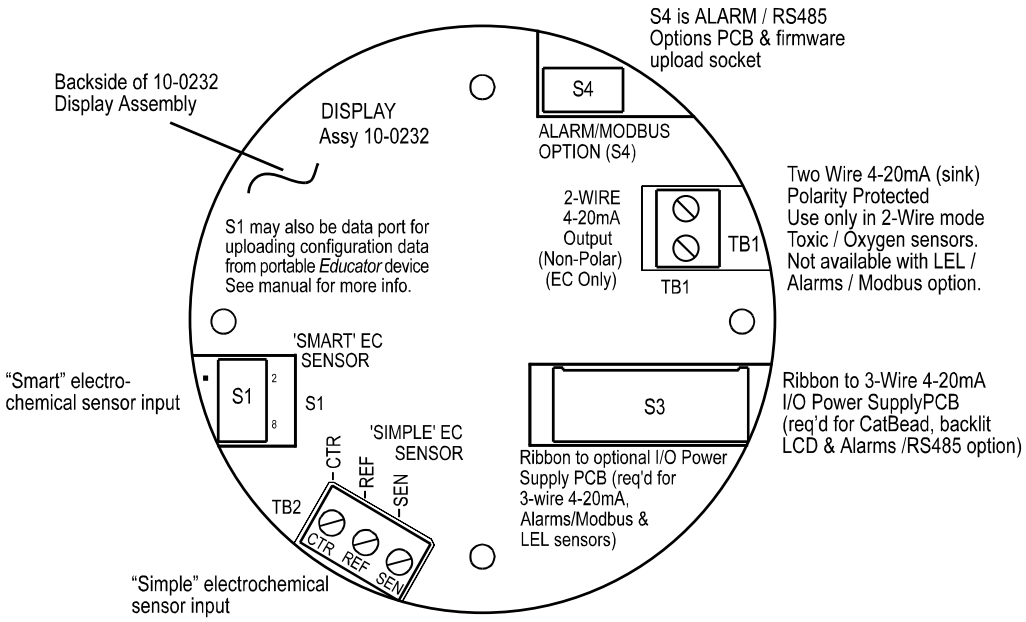
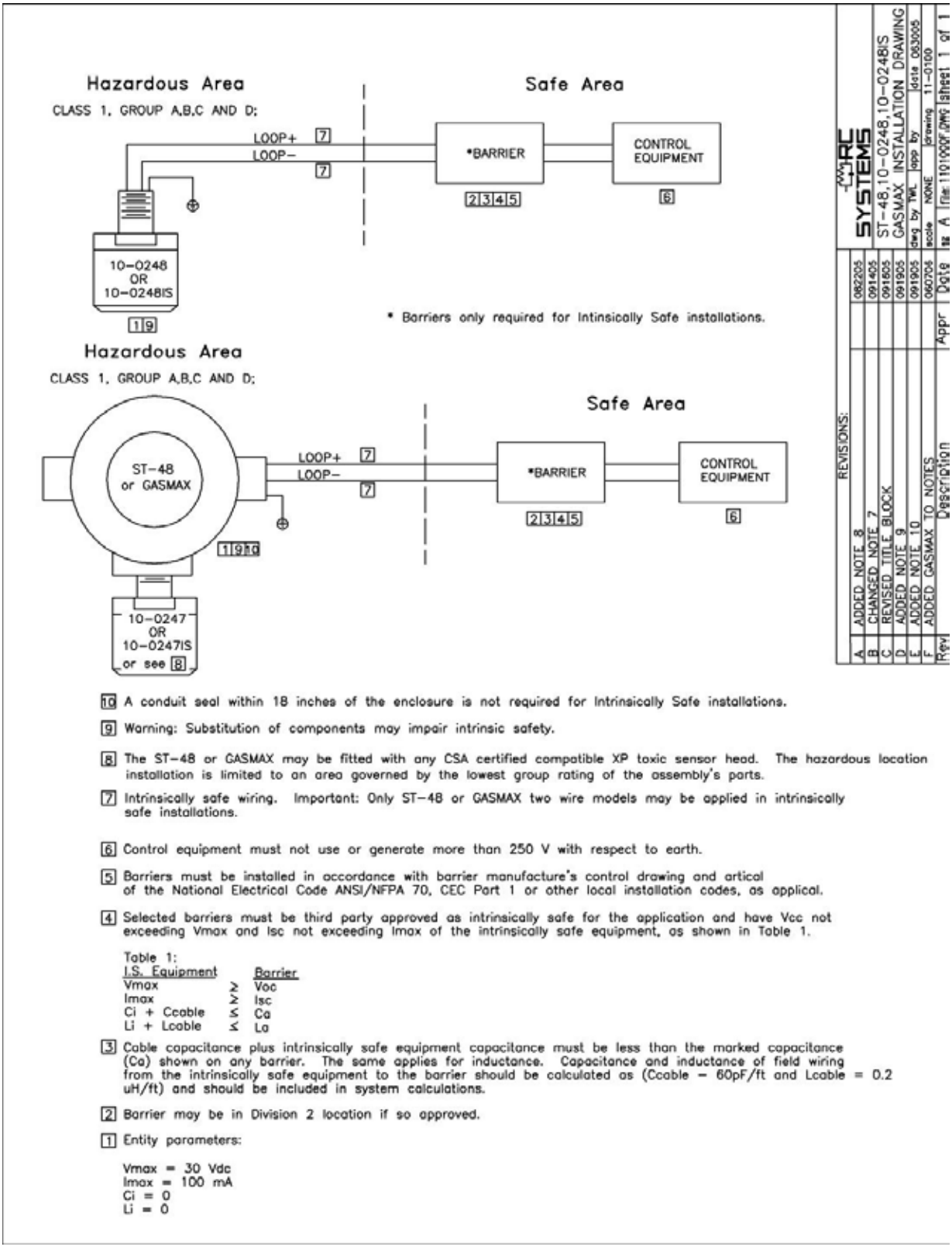


Figure 2-4: 10-0232 Display / 2-Wire 4-20mA Assembly

2.7a Installation Drawing # 11-0100



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

9 Warning: Substitution of components may impair intrinsic safety.

8 The ST−48 or GASMAX may be fitted with any CSA certified compatible XP toxic sensor head. The hazardous location installation is limited to an area governed by the lowest group rating of the assembly's parts.

7 Intrinsically safe wiring. Important: Only ST−48 or GASMAX two wire models may be applied in intrinsically safe installations.

6 Control equipment must not use or generate more than 250 V with respect to earth.

5 Barriers must be installed in accordance with barrier manufacture's control drawing and artical of the National Electrical Code ANSI/NFPA 70, CEC Part 1 or other local installation codes, as applical.

4 Selected barriers must be third party approved as intrinsically safe for the application and have Vcc not exceeding Vmax and Isc not exceeding Imax of the intrinsically safe equipment, as shown in Table 1.

Table 1:

I.S. Equipment		Barrier
Vmax	≥	Voc
Imax	≥	Isc
Ci + Ccable	≤	Ca
Li + Lcable	≤	La

3 Cable capacitance plus intrinsically safe equipment capacitance must be less than the marked capacitance (Ca) shown on any barrier. The same applies for inductance. Capacitance and inductance of field wiring from the intrinsically safe equipment to the barrier should be calculated as (Ccable = 60pF/ft and Lcable = 0.2 uH/ft) and should be included in system calculations.

2 Barrier may be in Division 2 location if so approved.

1 Entity parameters:

Vmax = 30 Vdc
Imax = 100 mA
Ci = 0
Li = 0

2.8 3-Wire 4-20mA Explosion Proof Installation

CAUTION: GASMAX II's are equipped with the 10-0233 I/O Power Supply board and only operate as 3 or 4-wire 4-20mA transmitters and are not compatible with 2-wire intrinsically safe installations (see sections 2.7 and 2.7a). Such units should not be combined with 10-0247IS Sensor Heads without flame arrestors unless the area is classified as non-hazardous.

GASMAX II's equipped with the 10-0233 I/O Power Supply and 10-0234 Alarms / Modbus option are NRTL certified as suitable for Div 1 & 2 Groups B,C,D explosion proof installations with the 10-0247 or with any sensor head with an equivalent CSA certification.

Description:
3-wire sourcing transmitters require an additional dedicated 24 VDC wire. The 4-20mA loop current is then delivered, or sourced, from the transmitter output and the receiver device must not provide 24 VDC from its input terminal. When the GASMAX is equipped with the bottom 10-0233 I/O Power Supply board shown in Figure 2-5, the 2-wire 4-20mA output is disabled and one of the 10-0233's 3-wire outputs must be used. TB2 terminal 2 is for ECHEM toxic / oxygen 3-wire 4-20mA output signals and TB2 terminal 3 is for LEL 3-wire 4-20mA output signals.

Instructions:
Unscrew the cover on the GASMAX II explosion-proof enclosure. Loosen the 2 thumbscrews holding the display assembly in place and remove it. A small ribbon cable is attached with sufficient length to allow access to the I/O PCB mounted in the bottom of the enclosure (Figure 2-5). Power and signal connections are to TB2 where 24 VDC, Signal and Common wires must be connected. A blocking diode protects the GASMAX if polarity of the power supply is reversed but it will not operate. Reassemble the GASMAX. Follow the procedures and recommendations in the receiver and power supply manuals to complete the installation. Be sure the GASMAX enclosure and conduit are properly grounded. Apply power and the GASMAX II should function. Proceed to section-3.

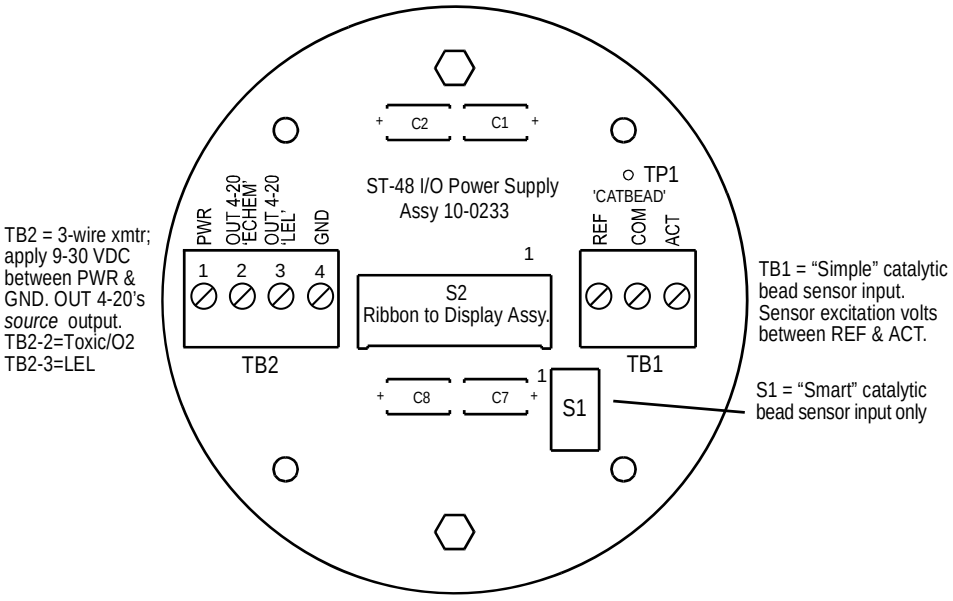


Figure 2-5: 10-0233 I/O Power Supply / 3-Wire 4-20mA Assembly

2.9 Alarms / RS-485 Modbus 10-0234 Option Installation

Description:
The optional 10-0234 Alarms/RS-485 Modbus board supplies two level alarm relays, a FAULT relay and an RS-485 Modbus RTU slave port (Figure 2-6). This board is "piggybacked" behind the 10-0232 Display Assembly (Figure 2-3). Addition of this option requires 3-wire mode 4-20mA

operation and thereby requires the 10-0233 I/O Power Supply board (Figure 2-5). This is since relays and RS-485 circuits require much more power than 2-wire 4-20mA loops can deliver.

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

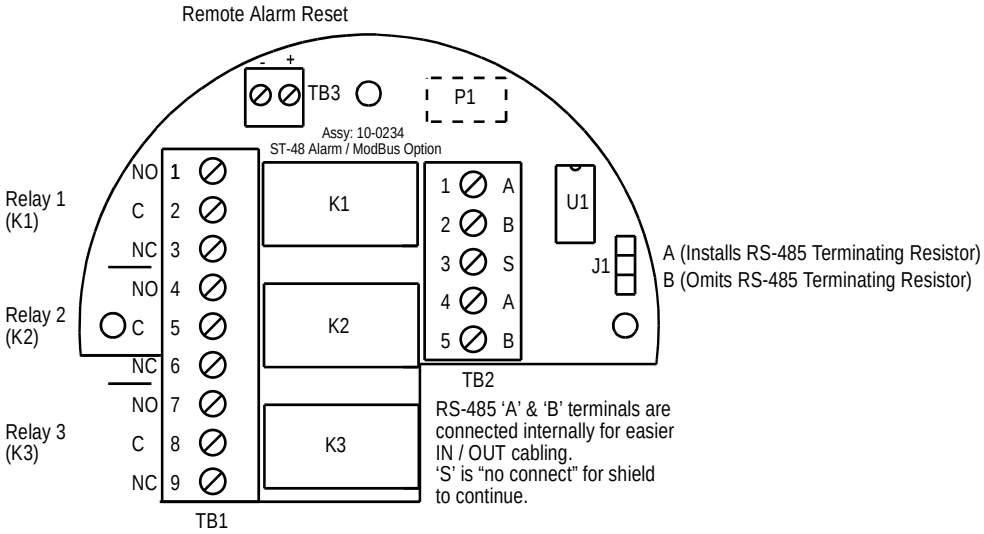


Figure 2-6: 10-0234 Alarm Relays / Modbus Option

Instructions:

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

RS-485 Modbus networks should be wired as shown in Figure 2-7. Each GASMAX connected represents an RTU and must have a unique RTU address. RTU addresses are assigned in the Modbus setup menu described in section 4.10. Cabling must be a "daisy chain" as opposed to a "star" pattern for reliable operation. The "end of line" unit should have J1 installed in the 'A' position for terminating resistor installation. All others should have J1 in the 'B' position. Front panel Rx / Tx LEDs are helpful troubleshooting tools.

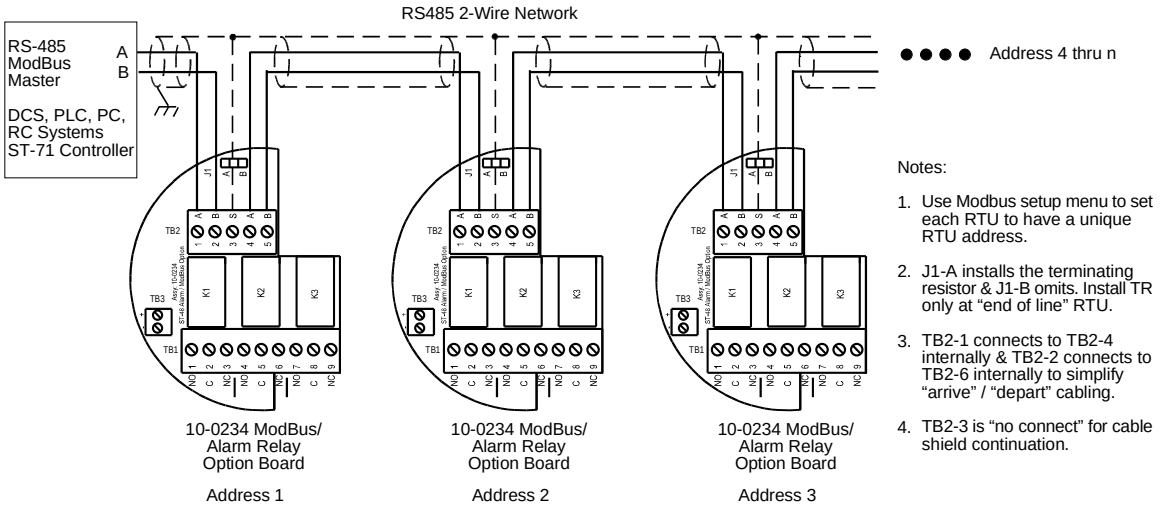


Figure 2-7: RS-485 Modbus Wiring

2.10 Isolated 4-20mA Output 10-0250 Option

Description:
The optional 10-0250 Isolated 4-20mA option (Figure 2-8) provides dual 4-20mA outputs that are electrically isolated from sensor inputs and the 24 VDC power source. Each 4-20mA output share the same common terminal and are not isolated from each other. This board is "piggybacked" behind the 10-0232 Display Assembly (Figure 2-3). Addition of this option requires 4-wire mode 4-20mA operation and thereby requires the I/O Power Supply board (Figure 2-5).

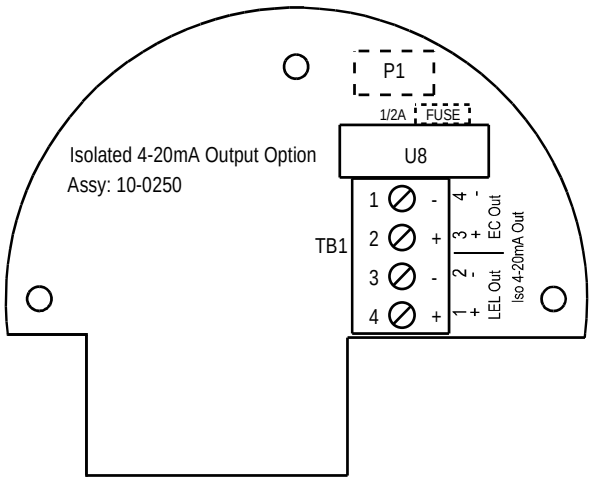


Figure 2-8: 10-0250 Isolated 4-20mA Output Option

2.11 Sensor Installation (with Smart / Simple Sensor Definition)

Many manufacturers offer industry standard electrochemical and catalytic bead sensors for toxic / oxygen and LEL combustible gas detection. These are referred to as ***Simple*** sensors in this manual. The GASMAX design accommodates users wishing to continue use of their existing simple sensors by accepting electrochemical types into TB2 of the 10-0232 Display Assembly or catalytic bead types into TB1 of the 10-0233 I/O Power Supply (mounted to the bottom of the enclosure). The GASMAX *Smart Sensor* interface also uses proven electrochemical technology for toxic / oxygen and catalytic bead for LEL combustibles BUT has taken this technology a step further. A tiny memory IC is incorporated into GASMAX factory supplied Smart sensors allowing

them to contain the entire database of GASMAX parameters onboard the replaceable Smart Sensor assembly (Figure 2-9). This unique ***Smart Sensor Interface*** may be used to configure smart sensors and / or GASMAX's from a PC rather than entering all variables via the magnetic keypad.

Electrochemical and catalytic bead smart sensors both plug into the 10-0247 ***Smart Sensor Head*** that connects to GASMAX electronics with its 8-conductor Smart Sensor Interface cable (Figure 2-9).
CAUTION: 10-0247 Smart sensor heads with electrochemical toxic / oxygen sensors must connect to S1 located on the back of the 10-0232 Display Assembly (Figure 2-4). 10-0247 Smart sensor heads with catalytic bead combustible sensors must connect to S1 located on the optional I/O PCB assembly (Figure 2-5).

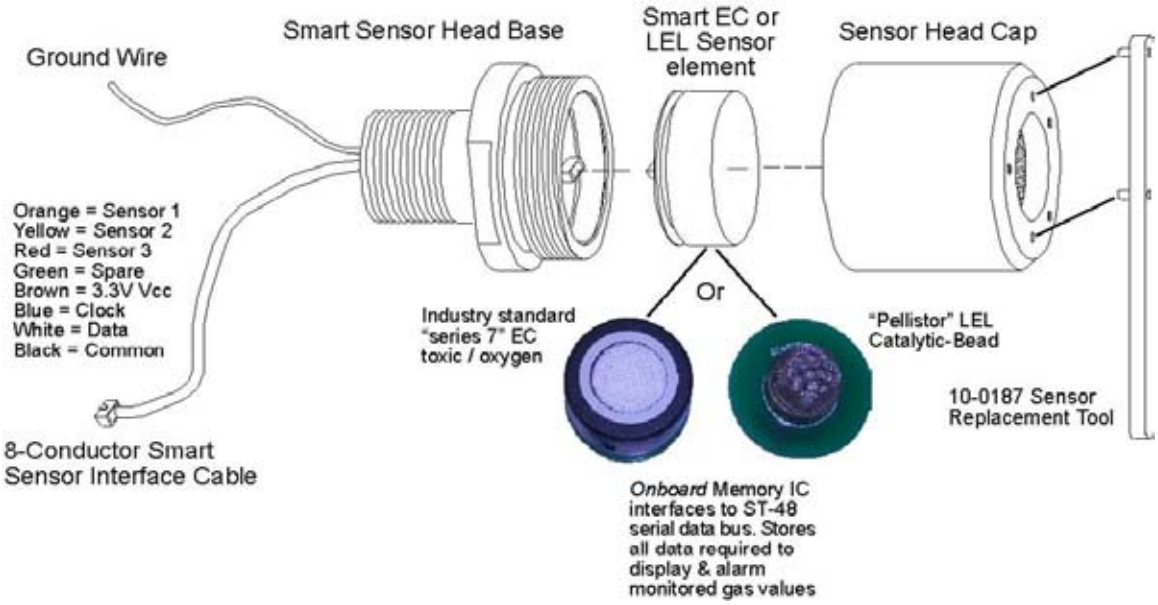


Figure 2-9: 10-0247 Smart Sensor Head Assembly

Smart Sensors are automatically recognized by the GASMAX. The Smart Sensor identification screen in Figure 2-10 is shown after power-up, upon installation of a new smart sensor or by viewing INPUT type in the SENSOR SETTINGS / INFO menu (section 5-5).

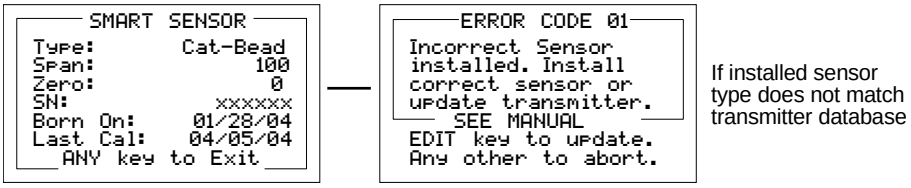


Figure 2-10: Smart Sensor Info / ERROR Screens

2.11 "Sensor Type" and GASMAX Signal Conditioning

Catalytic bead and electrochemical sensors obviously have different signal conditioning requirements. In addition, same sensor types have different response coefficients, signal strength and gain and offset requirements. The block / wiring diagram in Figure 2-11 illustrates how GASMAX's are able to accept many sensor types without the need of manual potentiometers or jumpers. Smart Sensors carry this setup information with each sensor.

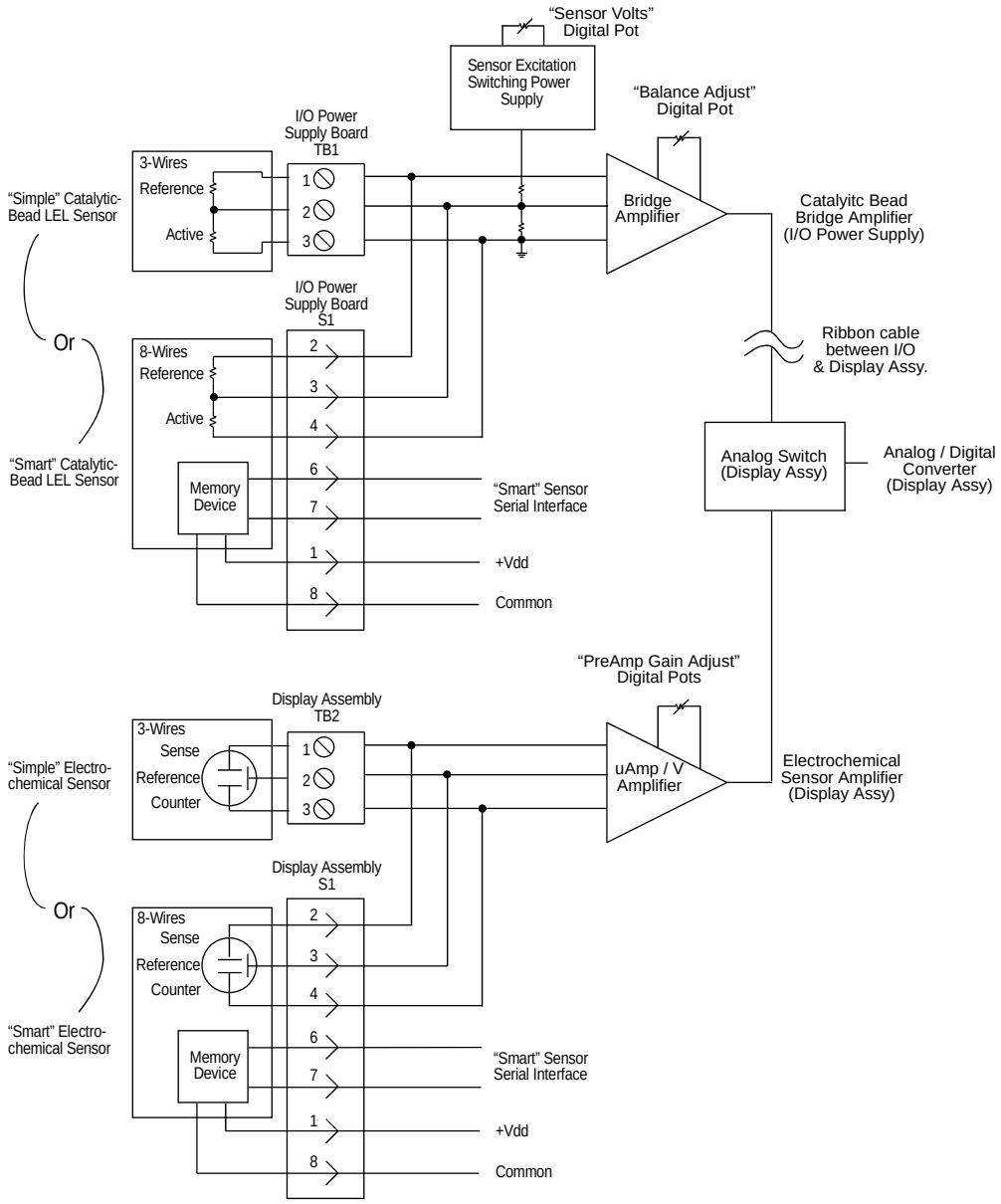


Figure 2-11: GASMAX Block / Wiring Diagram

SECTION 3 – INITIAL START-UP

3.1 "Transmitter Configuration" Menu

Figure 3-1shows the GASMAX XMITTER CONFIG menu used to activate channels, precisely calibrate 4-20mA outputs and set time / date. Its menus are set at the factory and typically not needed by the user. To access from any data display, press and hold the NEXT key for 5-seconds until the screen appears requesting a special key sequence (4-UP keystrokes).

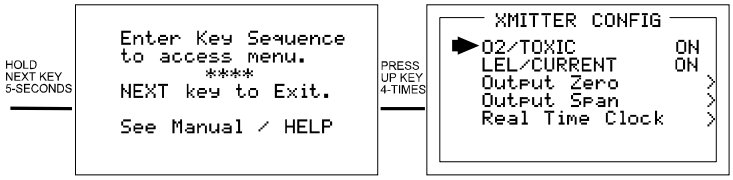


Figure 3-1: Transmitter Configuration Menu

3.1.1 Single / Dual Gas Monitor Configuration

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

3.1.2 Output Zero / Output Span Trims (Factory Preset, Technicians only!):

The **Output Zero Trim / Output Span Trim** entries are digital to analog (D2A) values that determine the GASMAX's final 4-20mA output. Their purpose is to provide precise GASMAX 4mA and 20mA outputs. To trim these values, attach a precision milliamp meter to the GASMAX 4-20mA output being used. Enter the correct OUTPUT ZERO TRIM menu shown in Figure 3-2. Use the UP/DOWN keys to trim the milliamp value to 4.00mA. Next, enter the correct OUTPUT SPAN TRIM menu and use the UP/DOWN keys to trim the milliamp value to 20.00mA. Press the NEXT key to exit this menu. The GASMAX stores these new D2A values and uses them as the 0 & 100% of full-scale endpoints.

WARNING: Target gas monitoring and alarm processing are halted during these adjustments.

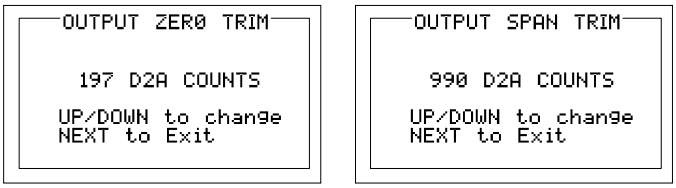


Figure 3-2: Output ZERO / SPAN Trim Menus

3.2 Initial Catalytic Bead LEL Monitor Start-Up

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

3.2.1 Initial Catalytic Bead LEL Monitor "Sensor Volts" Check

CAUTION: Sensor Volts in excess of the rated values may destroy catalytic bead sensors. GASMAX sensors are rated for 2 volts.

Section 6.2 describes reading and setting "sensor volts" using the GASMAX LCD. The voltage displayed on the LCD is monitored across TB1-REF and TB1-ACT on the GASMAX Power Supply board (Figure 2.4) and may be confirmed with a voltmeter. This TB-1 value is correct for locally mounted sensors only. Sensors mounted more than a few feet away from the GASMAX may receive a lower voltage due to the inherent voltage drop across sensor wiring. Remote mounted sensors must have their sensor voltage (across ACTIVE and REFERENCE beads)

measured AT THE SENSOR end of the cable. The GASMAX setting will require a higher value in order to achieve the correct voltage at the sensor. Correct sensor voltage should be confirmed after start-up for locally and remotely mounted catalytic bead sensors.

3.2.2 Initial Catalytic Bead LEL Monitor "Balance" Check

Catalytic bead sensors connect to a bridge circuit that may require a balance adjustment after installation especially when the sensor is remote mounted from the GASMAX. Section 6.2 describes using the LCD to read and adjust BALANCE settings. Correct BALANCE setting should be confirmed after start-up for locally and remotely mounted catalytic bead sensors.

3.2.3 Initial Catalytic Bead LEL Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 4.1, a coarse SPAN gas reading verification should be performed after installation. After correct Sensor Volts and BALANCE have been verified, apply an upscale gas value such as 50% LEL to the sensor. The indicated value should read between 35 and 65% LEL with 50% LEL gas applied. Larger errors may indicate incorrect sensor wiring or defective sensor. Remember that this is only a coarse check and precision calibrations are performed in *Routine Sensor Calibrations* described in the following section 4.1. Section 6.4 describes PREAMP GAIN adjustments that may be required if full-scale ranges are changed.

3.3 Initial Toxic / Oxygen Monitor Start-Up

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

3.3.1 Initial Toxic / Oxygen Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in section 4.1, a coarse SPAN gas reading verification should be performed after installation. Apply an upscale gas value of at least 25% of full scale to the sensor. For example, if 0-100ppm H2S is the measurement range, apply at least 25ppm but not more than 100ppm. The indicated value should read within 15% of full scale. Remember that this is only a coarse check and precision calibrations are performed in *Routine Sensor Calibrations* described in the following section 4.1. Section 6.4 describes PREAMP GAIN adjustments that may be required if full-scale ranges are changed.

SECTION 4 – OPERATING INSTRUCTIONS

4.1 Routine Sensor Calibrations

Calibration is the most important function for insuring correct operation of the GASMAX. The CAL MODE (flow chart shown in Figure 4-2) is designed to make calibration quick, easy and error free. A successful ZERO and SPAN calibration requires only four keystrokes. The 4-20mA output transmits 3mA during CAL MODE and 4mA during the subsequent CAL PURGE delay to prevent external alarms during calibration. Local GASMAX alarm relays (if equipped) are inhibited during CAL MODE. CAL MODE automatically exits if no keystrokes are detected after 5 minutes.

Follow these GASMAX calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy. GDS Corp. recommends calibration gases with NIST (National Institute of Standards and Technology) traceable accuracy to increase the validity of the calibration.
- Do not use a gas cylinder beyond its expiration date.

- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate on a regular schedule. (GDS Corp. recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.)
- Calibrate only in a clean atmosphere, which is free of background gas.

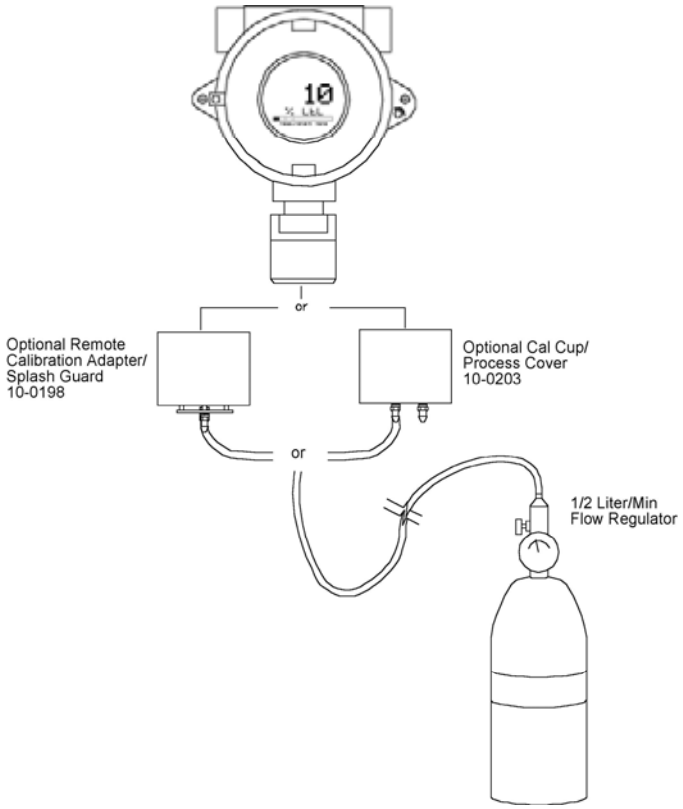


Figure 4-1: Calibration Gas Input

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

1. To enter the CAL MODE from either data display, press the DOWN / CAL key and within 5 seconds press the EDIT key.
2. Using the Cal-Cup, apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a ZERO calibration.
3. If the ZERO calibration is successful, press the NEXT key to proceed to the SPAN check.
4. Apply the **correct** SPAN gas at .5 liters/min. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a SPAN calibration.
   WARNING: The SPAN gas used must match the value specified since this is what the GASMAX will indicate after a successful SPAN calibration. The ***Cal Span Value*** may be edited if it becomes necessary to apply a different gas concentration (see ***Cal Span Value*** in section 3.4).
5. If the SPAN calibration is successful, the display flashes “REMOVE CAL GAS” and starts the CAL PURGE delay.
6. CAL MODE will be complete after the end of the CAL PURGE delay.

The flow chart in Figure 4-2 illustrates the above procedure. UP, CAL, NEXT & EDIT labels indicate keystrokes using the magnetic wand. The CAL MODE information screen (top of the chart) is available for advanced users to see Offset / Gain calibration constants and live analog to digital converter (A/D) counts. Span Gas calibration values may also be edited from this screen. Holding the UP key, for 5 seconds during CAL MODE, displays this screen.

Calibration history records are logged and may be viewed in the *Sensor Information* menu (see section 5-5).

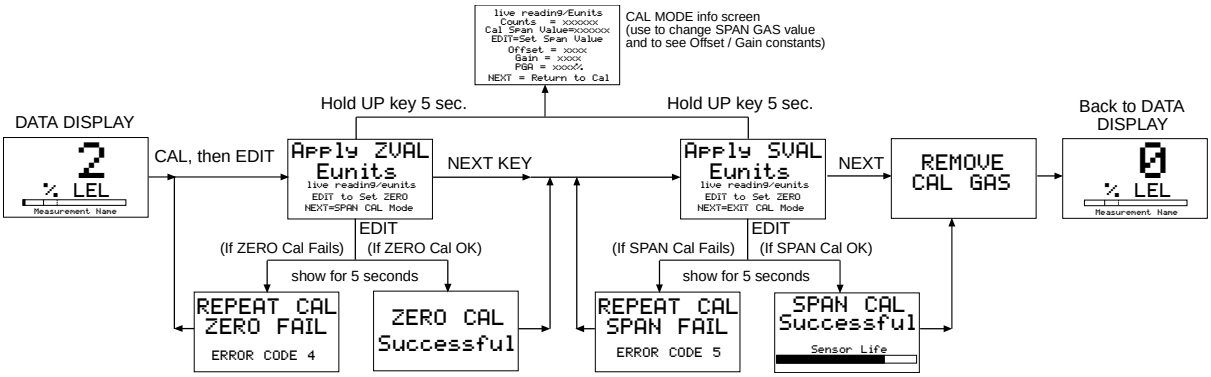


Figure 4-2: Cal-Mode Flow Chart and Menus

4.2 ALARM OPERATION

GASMAX's have front panel LED indicators for Alarm 1, Alarm 2 and Alarm 3. An optional 10-0234 Relay/Modbus board adds K1, K2 & K3 relays for these alarms.
CAUTION: GASMAX Alarm LED indicators function even without the presence of the 10-0234 Relay option. With 2-Wire 4-20mA operation, to conserve power, alarm LED's only flash during alarm events. With 3-Wire 4-20mA operation, alarm LED's flash when new, and become steady after an operator ACKNOWLEDGE - pressing the UP/RESET key.

4.2.1 ALARM 3 – UNDERSTANDING FAULT / LEVEL OPERATION

The "A3" alarm is typically dedicated to FAULT conditions indicating sensor failures or "out of measurement range" conditions. However, some applications require a third level alarm. The A3 menu is identical to A1 & A2 and may be set to trip at an upscale level value. A3 WILL ALSO TRIP WITH MISSING OR FAILED SENSORS REGARDLESS OF THE LEVEL VALUE!
CAUTION: Missing or failed sensors always trip Alarm 3 and relay K3 (if equipped). This is true even with A3 configured as a level alarm and it must be accepted that A3 level alarm events might be caused by the monitored level, or, by a missing or failed sensor.

SECTION 5 – SETUP MENU CONFIGURATION

5.1 Menus Database Configuration

All GASMAX configuration variables are stored in its menu database. Many menu items will contain default values from the factory and require changes to better match a user's particular application. GASMAX menus may be configured from the magnetic keypad in 5-10 minutes per transmitter. For installations consisting of numerous points, an interface device is offered to allow *Smart* sensors, GASMAX's or GASMAX *Educators* to be configured from a PC's USB port. This is useful when GASMAX's are not yet installed or if a portable computer may be carried to each unit. The *Educator* allows configuring up to six GASMAX's at the PC and transporting their configuration data to each location. This is useful when numerous installed units must be configured.

The GASMAX's configuration menus are shown in Figure 5-1.

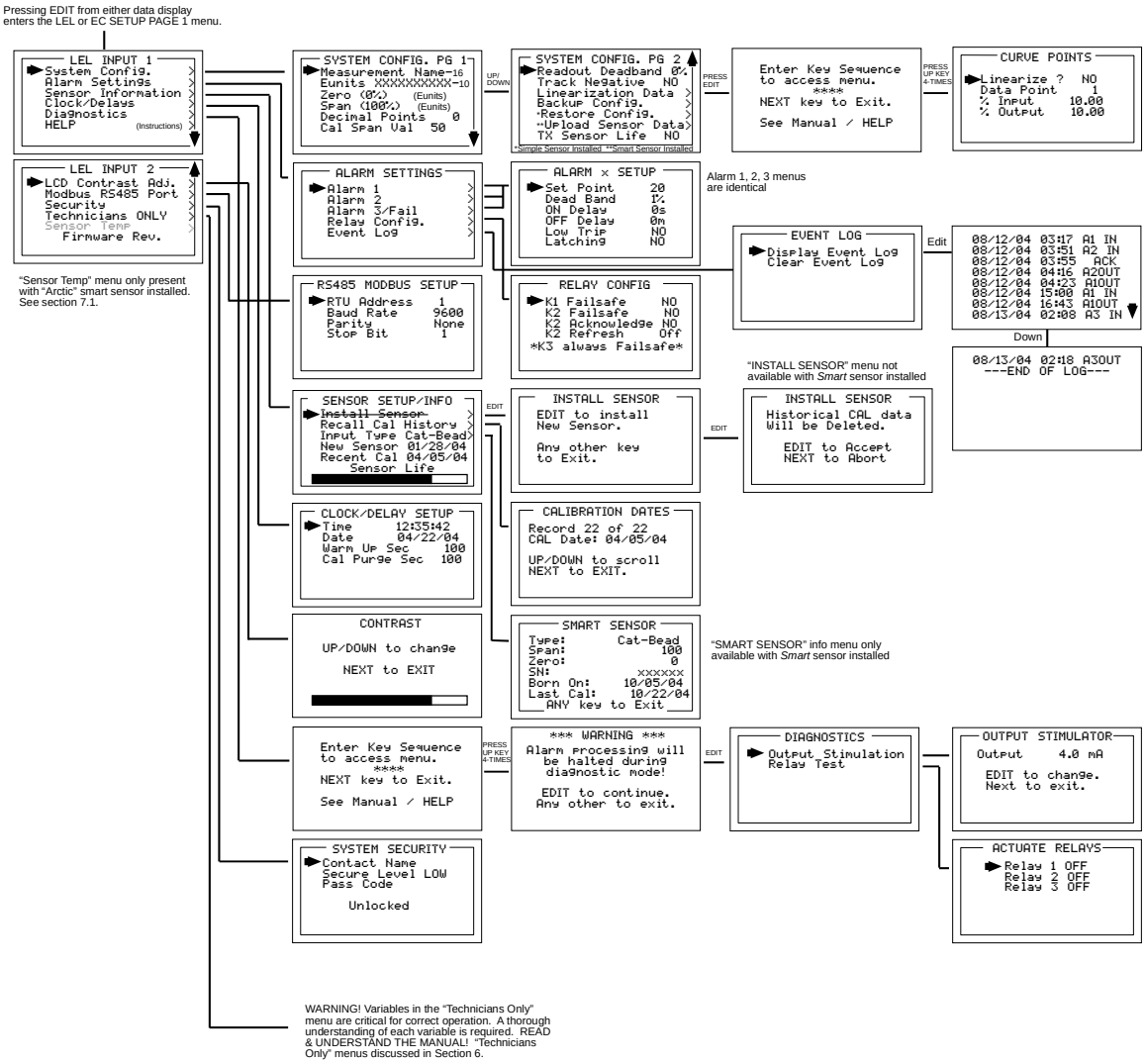
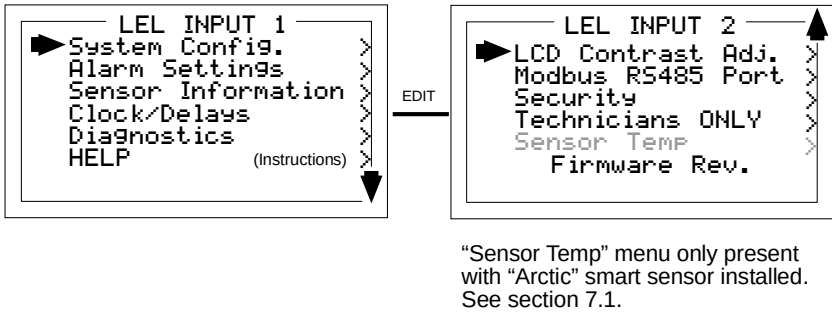


Figure 5-1: Configuration Menu Tree

5.2 Configuration Using the Magnetic Wand:

Passing the magnetic wand past the EDIT key, from either data display, displays SETUP PAGE 1 as shown in Figure 5-2. The UP / DOWN keys maneuver the pointer while EDIT enters sub-levels of menu items. All SETUP menu items have at least one page of sub-menus. Items with sub-menus are indicated by the > symbol (right hand pointing arrow) at the end of each line. Edit menu items by pointing to them, press the EDIT key to display the cursor, press UP / DOWN to change that character, press NEXT to move the cursor, then press EDIT again to load the new item and remove the cursor. Press NEXT to reverse out of the sub-menu. To view **SETUP PAGE 2**, press the DOWN key with the pointer aimed at the bottom item on PAGE 1.

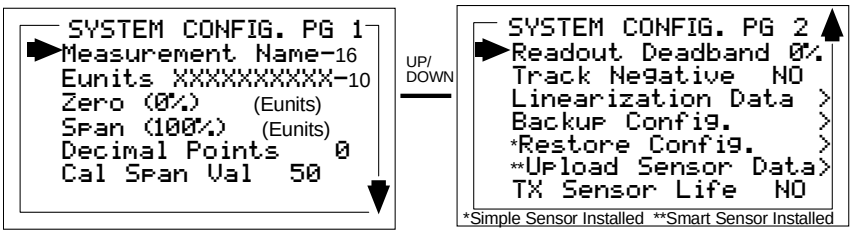


"Sensor Temp" menu only present with "Arctic" smart sensor installed. See section 7.1.

Figure 5-2: Setup Menu Entry

5.3 System Configuration Menus:

The **System Config**. group consists of two pages of menus as shown in Figure 5-3. Each item's description follows in this section.



*"Restore" available only without smart sensor installed.

**"Upload" available only with smart sensor installed.

Figure 5-3: System Config. Menus

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

Eunits (engineering units) may have up to a 10 character ASCII field. Many common gases have pre-configured Eunits based upon the sensor type and each may be edited in this menu as described in *Configuration Using the Magnetic Wand* section 5-2.

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

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

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

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

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

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

Linearization Data allows nonlinear signals to be linearized by entering the correct curve into the GASMAX (Figure 5-4). If Linearize is set for NO, the CURVE POINTS menu data is not used

and no linearization is applied. When YES, the CURVE POINT entries are used and a straight-line approximation is calculated between each of the 9 entries. 0% input always provides 0% output and 100% input always provides 100% output. To prevent accidental data entry, a special keystroke sequence of 4 consecutive UP keys are required to enter this menu.

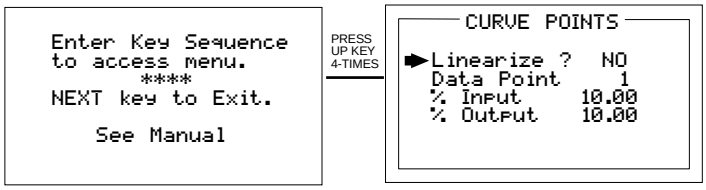


Figure 5-4: Linearization Menu

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

Restore Config. restores the GASMAX menu database to the values from the most recent Backup Config. This menu item is only available if a smart sensor is not installed. The special keystroke sequence of 4 consecutive UP keys is also required to perform backup and restore operations.

Upload Sensor Data allows manually uploading the entire smart sensor database to the GASMAX from the smart sensor.

TX Sensor Life set for YES, causes the GASMAX 4-20mA output to transmit a sensor life value after successful calibrations during the CAL PURGE delay (see section 4.1). Normal operation is the GASMAX transmits 4mA during the CAL PURGE delay. But with ***TX Sensor Life*** = **YES** it transmits 4mA for the first 10-seconds, then for 5-seconds transmits a value between 4mA and 5mA, with 4mA equal to 0% sensor life and 5mA equal to 100% sensor life (see Figure 5-5). The output then returns to 4mA for the remainder of the CAL PURGE delay. For example, if after a calibration sensor life is 75%, the GASMAX transmits 4.75mA during the 5-second interval.
Note: ***TX Sensor Life*** should always be set for NO unless the 4-20mA receiver is capable of interpreting the sensor life signal. The GDS Corp. C1 Controller is capable of this function.

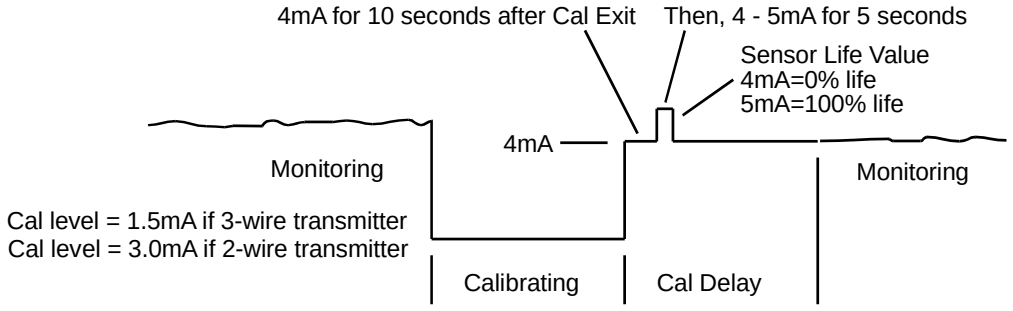


Figure 5-5: Transmit Sensor Life Timing Diagram

5.4 Alarm Settings:

The **Alarm Settings** page has the **Alarm 1, 2, 3 Setups, Relays** and **Event Log** submenus shown in Figure 5-6. Alarm 1, Alarm 2 and Alarm 3/Fail menus are identical and therefore described only once in this section.
IMPORTANT: Alarm functions and their associated LED's are active without the 10-0234 Relay / Modbus option installed.

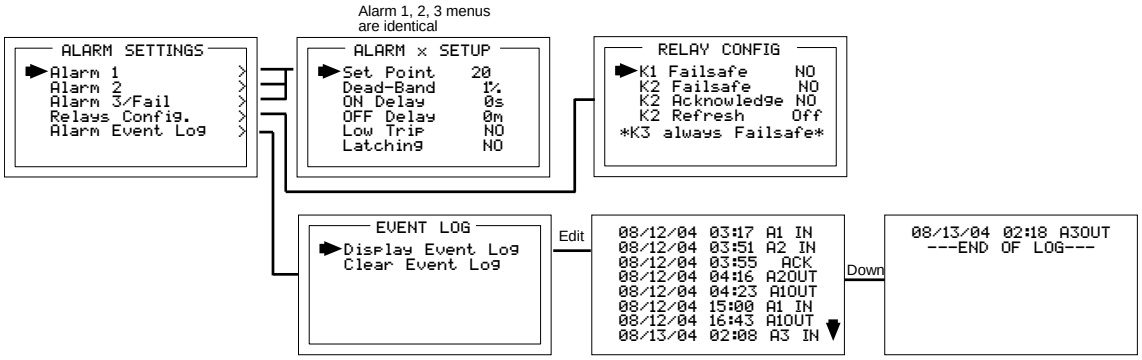


Figure 5-6: Alarm Settings Menus

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

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

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

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

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

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

5.4.1 Relay Configuration (if equipped):

Relay Config has the submenu shown in Figure 5-7. The optional relay PCB must be installed to access this menu or a "HARDWARE NOT PRESENT" message appears.

Figure 5-7: Relay Config. Menu

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

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

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

5.5 Sensor Information:

Sensor Information has the **SENSOR SETUP/INFO** menus shown in Figure 5-8

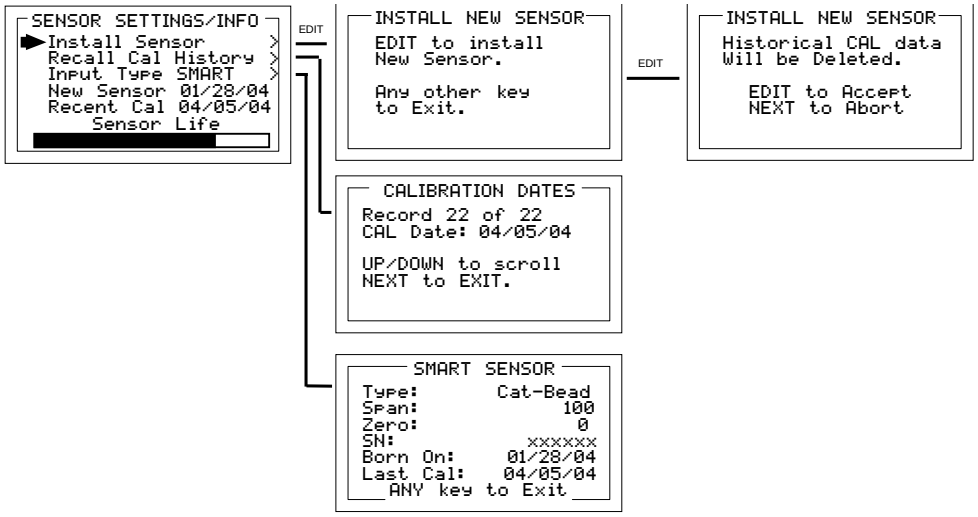


Figure 5-8: Sensor Information Menus

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

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

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

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

Recent Cal displays the most recent calibration date.

5.6 CLOCK/DELAY SETUP:

Since the GASMAX is equipped with a Real Time Clock & Calendar **Time** and **Date** must be set to correctly match its location. They are set at the factory in a 24 hour format but may require adjustment to match the location's time & date after shipment. Follow the procedure in *Configuration Using the Magnetic Wand* in section 3.3.

Warm Up and **Cal Purge** time delays are also available to prevent unwanted alarm trips. Figure 5-9 shows the menu for these items.

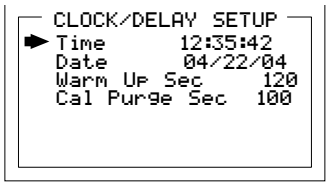


Figure 5-9: Clock & Calendar / Delay Timer Menu

5.7 LCD Contrast Adj:

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

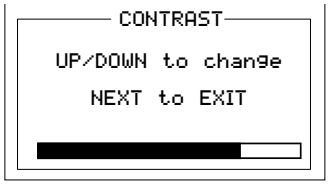


Figure 5-10: LCD Contrast Adjust Menu

5.8 HELP Screen:

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

5.9 Diagnostics:

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

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

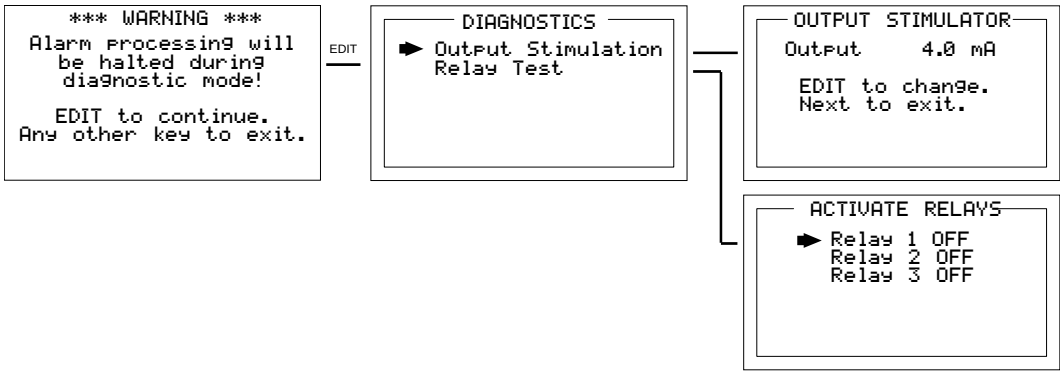


Figure 5-11: Diagnostics Menus

5.10 RS-485 / MODBUS SETUP:

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

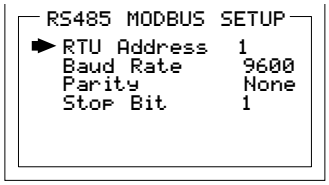


Figure 5-12: Modbus RS-485 Setup Menu

5.10.1 MODBUS REGISTER AND FUNCTION CODE SUMMARY

The following table identifies GASMAX Modbus register locations and function codes. "Chan 1" designations represent the EC channel while "Chan 2" represent the LEL / 4-20mA Input channel.

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Read Only Discretes:			
Chan 1 Alarm 1	2001	2	NA
Chan 1 Alarm 2	2002	2	NA
Chan 1 Fault	2003	2	NA
Chan 2 Alarm 1	2004	2	NA
Chan 2 Alarm 2	2005	2	NA
Chan 2 Fault	2006	2	NA
K1	2007	2	NA
K2	2008	2	NA
K3	2009	2	NA
Chan 1 Cal Mode	2010	2	NA
Chan 2 Cal Mode	2011	2	NA
Read/Write Coils:			
Alarm Ack/Reset	12001	1	5

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

Read Only Registers:			
D2A Raw Chan 1	31001	4	NA
D2A Raw Chan 2	31002	4	NA

Calibrated 10 bit value representing the D2A value of 0 to 1023 for -25 to 105 %FS (200=0% & 1000=100%).

IMPORTANT: READ REGISTERS 31001 / 31002 TO CREATE READINGS THAT MATCH GASMAX DISPLAY VALUES! THESE SHOULD ALSO BE READ BY C1 MODBUS MASTERS.

A2D Raw Chan 1	31003	4	NA
A2D Raw Chan 2	31004	4	NA

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

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

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

ALARM1_BELOW	BIT0
ALARM2_BELOW	BIT1
ALARM3_BELOW	BIT2
ALARM1_LATCH	BIT3
ALARM2_LATCH	BIT4

ALARM3_LATCH	BIT5
ALARM3_ACTIVE	BIT6
CHANNEL_DISABLED	BIT7
CHANNEL_CAL	BIT8
CHANNEL_LINEARIZE	BIT9
FAULT_RELAY_LATCH	BIT10
DISPLAY_NEGATIVE	BIT11
TRANSMIT SENSOR LIFE ENABLED	BIT12

Alarm Status Word	31007	4	NA

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

CH1_ALM1	BIT0
CH1_ALM2	BIT1
CH1_FAULT	BIT2
CH2_ALAM1	BIT4
CH2_ALM2	BIT5
CH2_FAULT	BIT6
K1_STATUS	BIT8
K2_STATUS	BIT9
K3_STATUS	BIT10

Transmitter Status Word	31008	4	NA

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

CHAN_1_ACTIVE	BIT0
CHAN_2_ACTIVE	BIT1
SECURE_LEVEL	BIT2
MARKER Tx LED	BIT3
K1_FAILSAFE	BIT12
K2_FAILSAFE	BIT13
K2_ACK	BIT14
LOCK	BIT15

Chan 1 Sensor Life	31009	4	NA
Chan 2 Sensor Life	31010	4	NA

(16 bit signed integer ranging from –1 to 100 where -1 indicates Cal Required)

Chan 1 Sensor Temperature	31011	4	NA
Chan 2 Sensor Temperature	31012	4	NA

(16 bit integer ranging from 1 to 4095 scaled for –55 to +125 degrees C)

Memory Floating Point:

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

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

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

Memory ASCII Strings:

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

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

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

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

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

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

Byte Variables:

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

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

Firmware Version:

Version	40435-40436	3	NA

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

Memory Reals:

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

Chan 1 Cal Zero Real	41001	4	NA
Chan 1 Cal Zero Devisor	41002	4	NA
Chan 1 Cal Span Real	41003	4	NA
Chan 1 Cal Span Devisor	41004	4	NA
Chan 1 Zero Real	41005	4	NA
Chan 1 Zero Devisor	41006	4	NA
Chan 1 Span Real	41007	4	NA
Chan 1 Span Devisor	41008	4	NA
Chan 1 Fault Real	41009	4	NA
Chan 1 Fault Devisor	41010	4	NA
Chan 1 Alarm 1 Real	41011	4	NA
Chan 1 Alarm 1 Devisor	41012	4	NA
Chan 1 Alarm 2 Real	41013	4	NA
Chan 1 Alarm 2 Devisor	41014	4	NA
Chan 1 Alarm 3 Real	41015	4	NA
Chan 1 Alarm 3 Devisor	41016	4	NA
Chan 1 Manual Gain Real	41017	4	NA
Chan 1 Manual Gain Devisor	41018	4	NA
Chan 1 Manual Offset Real	41019	4	NA
Chan 1 Manual Offset Devisor	41020	4	NA
Chan 2 Cal Zero Real	41021	4	NA
Chan 2 Cal Zero Devisor	41022	4	NA
Chan 2 Cal Span Real	41023	4	NA
Chan 2 Cal Span Devisor	41024	4	NA
Chan 2 Zero Real	41025	4	NA
Chan 2 Zero Devisor	41026	4	NA
Chan 2 Span Real	41027	4	NA
Chan 2 Span Devisor	41028	4	NA
Chan 2 Fault Real	41029	4	NA
Chan 2 Fault Devisor	41030	4	NA
Chan 2 Alarm 1 Real	41031	4	NA
Chan 2 Alarm 1 Devisor	41032	4	NA
Chan 2 Alarm 2 Real	41033	4	NA
Chan 2 Alarm 2 Devisor	41034	4	NA
Chan 2 Alarm 3 Real	41035	4	NA
Chan 2 Alarm 3 Devisor	41036	4	NA
Chan 2 Manual Gain Real	41037	4	NA

Chan 2 Manual Gain Devisor	41038	4	NA
Chan 2 Manual Offset Real	41039	4	NA
Chan 2 Manual Offset Devisor	41040	4	NA

Binary Cal Data:

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

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

5.11 SYSTEM SECURITY:

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

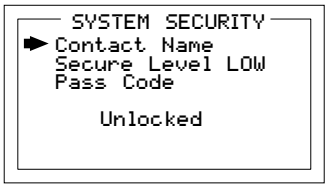


Figure 5-13: System Security Menu

SECTION 6 – TECHNICIANS ONLY MENUS

6.1 Introduction:

WARNING! Users of these menus must have a detailed understanding of their functions. While editing, monitoring of target gases, processing of alarms, 4-20mA output values and Modbus RS-485 communications should not be relied upon! Back-up the current configuration prior to altering any Technical menus in case Restore is required later (see section 5-3).

The **TECHNICIAN ONLY** menu group contains items that are **factory configured** depending upon the type sensor and input connected to the GASMAX. They should not be tampered with after installation. If configured incorrectly, some items will prevent monitoring of target gases. **The Set Sensor Voltage** menu for setting the catalytic bead sensor excitation voltage could destroy the sensor. **Access requires a special key sequence of four consecutive UP keystrokes** to prevent accidental modification of critical items.

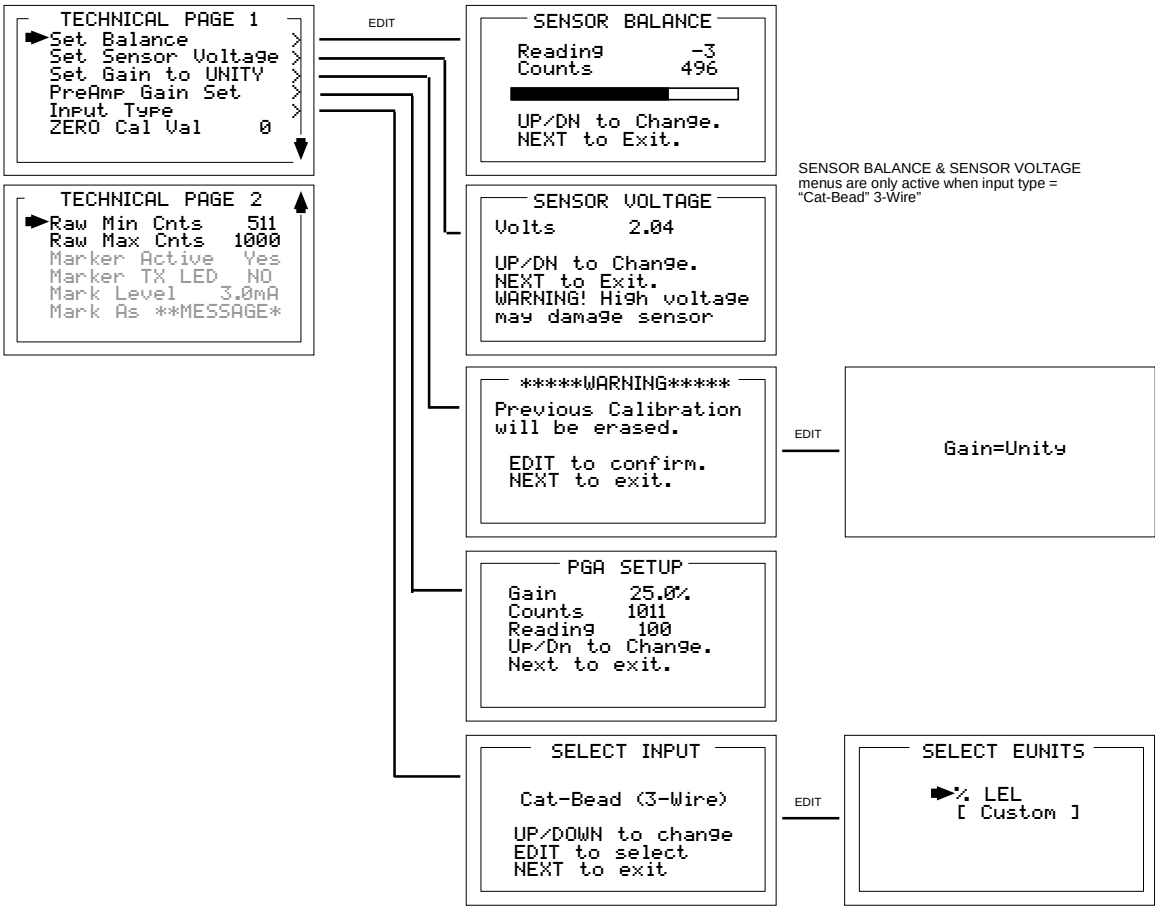


Figure 6-1: Technicians Menu Tree

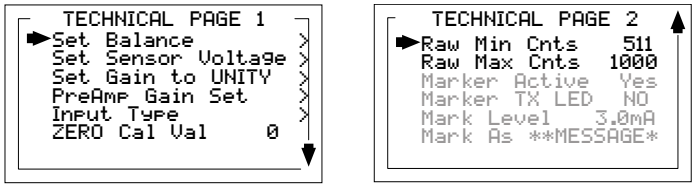


Figure 6-2: Technicians Menu Entry

6.2 Set Balance / Set Sensor Voltage (Technicians only!):

Set Balance and **Set Sensor Voltage** are used when **Input Type** is for *Catalytic Bead LEL* sensors. They are **factory configured** and only require field adjustment if the catalytic bead sensor is mounted remote from the GASMAX or if a new sensor is installed. Other input type entries draw a line through these menus and they are inactive. GASMAX catalytic bead sensors require 2.0 volts excitation voltage ***at the sensor***. This means if the sensor is mounted a long distance away the voltage at the GASMAX may have to be higher than two volts to compensate for losses in field wiring. Be careful not to exceed 2.0 volts at the sensor's A and R terminals.

Set Balance allows balancing of the catalytic bead sensor and must only be performed with ZERO gas on the sensor (Figure XXXX). Balance is similar to a very coarse ZERO calibration and does not need to be precise since subsequent calibrations will correct for small errors. ZERO gas applied to the sensor should provide a Reading of –3 to +3 on the SENSOR BALANCE menu.

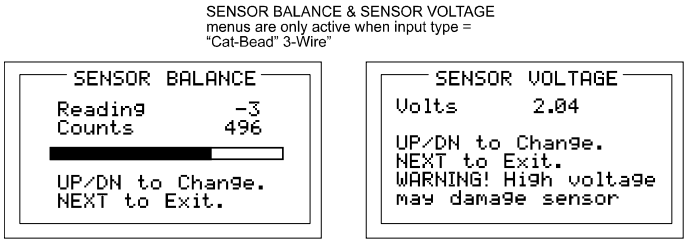


Figure 6-3: Catalytic Bead BALANCE & SENSOR VOLTS Adjust Menus

6.3 Set Gain to Unity (Technicians only!):

Set Gain to UNITY allows resetting previous calibration OFFSET to zero and GAIN to one. This is the definition of UNITY. A calibration should be performed after setting UNITY.

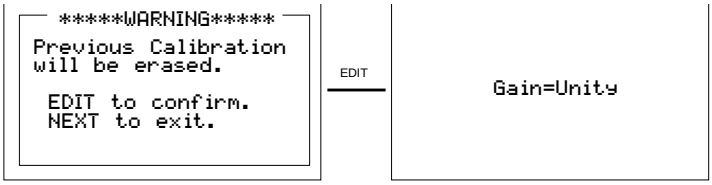


Figure 6-4: Set UNITY GAIN Menu

6.4 PreAmp Gain Adjust (Technicians only!):

Depending upon **Input Type**, GASMAX inputs range from a few micro amps to hundreds of micro amps. **PreAmp Gain Set** is the adjustment that matches the input signal range to the GASMAX input signal conditioning circuits. Altering the PreAmp Gain setting automatically resets previous calibration OFFSET & GAIN values to UNITY as described in section 6.3.

If it is determined the PreAmp Gain value is incorrect, apply the desired up-scale input and use the UP / DOWN keys to obtain the correct ***Reading*** value. ***Counts*** are the 10-bit binary A/D value with an active range value of 0 - 1023.
CAUTION: For standard installations, this is a factory adjustment. Do not use the **PreAmp Gain Set** menu for calibrating sensors. It should only be adjusted if a new measurement gas or input range is required.

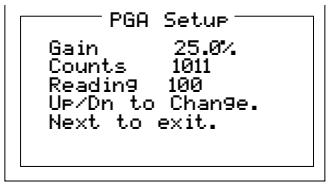


Figure 6-5: PreAmp Gain Adjust (PGA) Menu

6.5 Simple Sensor Input Type (Technicians only!):

Smart sensors automatically configure **Input Type.** *Simple* inputs must be configured manually using the **Input Type** menu. **Input Type** configures GASMAX hardware to accept catalytic-bead sensors, positive coefficient electrochemical sensors, negative coefficient electrochemical sensors or 4-20 mA inputs. Catalytic-bead and 4-20mA inputs require 3-wire operation and the 10-0233 I/O Power Supply. **Note:** Additional factory installed solder-bridge modifications are required for 4-20mA inputs – see Addendum 2. Positive / Negative coefficient electrochemical sensors have several gas types available within each group (see table below). Biased EC sensors require factory installed solder bridge SB1 on the Display Assy PCB - see Addendum 3.

After selecting **Input Type**, a **SELECT EUNITS** screen indicates the default engineering units for this sensor. These EUNITS may be accepted by pressing the EDIT key, or changed by moving the pointer to [Custom] and editing as described in *Configuration Using the Magnetic Wand* in section 5-2.

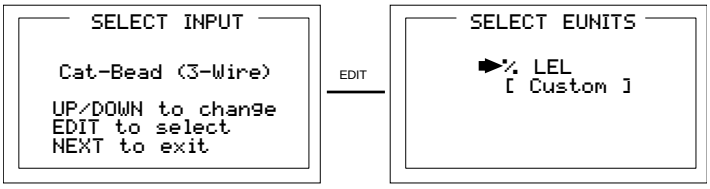


Figure 6-6: Input Type Selection Menu

Coefficient	Electrochemical Sensor Type	Default EUNITS
Negative	Hydrogen Sulfide	ppm H2S
Negative	Oxygen	% Oxygen
Negative	Carbon Monoxide	ppm CO
Negative, Bias	Ammonia	ppm NH3
Negative, Bias	Nitric Oxide	ppm NO
Negative	Ethylene Oxide	ppm Eth O2
Negative	Hydrogen Chloride	ppm HCL
Negative	Hydrazine	ppm N2H4
Negative	Arsine	ppm Arsine
Negative	Sulfur Dioxide	ppm SO2
Negative	Hydrogen	ppm H2
Negative	Hydrogen Cyanide	ppm HCN
Negative	Phosgene	ppm COCl2
Negative	Phosphine	ppm PH3
Negative	Hydrogen Fluoride	ppm HF
Positive	Nitrogen Dioxide	ppm NO2
Positive	Ozone	ppm Ozone
Positive	Chlorine	ppm Cl2

6.6 Zero Cal Value (Technicians only!):

The **Zero Cal Value** menu entry allows the zero calibration value to be set for something other than a zero reading. For example, a GASMAX 4-20mA input may represent a BTU Analyzer range of 500 – 1000 BTU's. In this case, 0% of full scale equals 500 BTU's and may be the desired zero calibration point. Other upscale values may also be used for the zero calibration point by setting this menu item to the desired engineering unit value. Do not exceed 25% of full scale.

6.7 Raw Min / Max Counts (Technicians only!):

The **Raw Min / Max Counts** menus determine the range of 10-bit analog to digital (A/D) converter counts that define 0 & 100% of full scale. Raw Min A/D counts create 0% readings and Raw Max A/D counts create 100% readings. These menus are very useful in application with non-standard input ranges. For example, if instead of a standard 4-20mA input 8-18mA must be accepted by the GASMAX. Set RAW MIN COUNTS to match the 8mA input counts value and RAW MAX COUNTS to match the 18mA input counts value. The corresponding **Zero 0%** and

Span 100% readings are entered in the Configuration Menu describe in section 5.3. Live A/D count values may be viewed from the CAL MODE Information screen described section 4.1.

6.8 4-20mA Input Marker / Message (Technicians only!):

See section 7.3.1 for description of the 4-20mA Input Marker / Message menus. This feature is only available with GASMAX II 4-20mA input models.

SECTION 7 – SPECIAL ORDER CONFIGURATIONS

7.1 ARCTIC Option

GASMAX II 3-wire models may be ordered with a special *ARCTIC* configuration to include a 175 ohm 4-watt heater / temperature controller circuit mounted to the back of the 10-0233 Power Supply PCB (Figure 2-5). In addition, when equipped with a locally mounted 10-0247 Smart Sensor Head (Figure 2-9) ARCTIC Smart sensors are available with a 1-watt heater / temperature controller for warming the sensor compartment. This is important since many electrochemical sensors have a low temperature rating of only -20C. If incoming 10-30VDC power is at least 24VDC, the ARCTIC option extends GASMAX II operation down to -55C.

Important! ARCTIC GASMAX II consumes more power when it is cold! When temperature inside the GASMAX II enclosure is below -25C the 175 ohm 10-0233 PCB heater is connected across the incoming DC power terminals. When an ARCTIC Smart Sensor is installed, its 1-watt heater is connected across the GASMAX II's internal 5VDC power supply when Sensor Temp is below the Setpoint (see section 7.1.1). These additional loads must be considered when sizing the installation's DC power supply.

7.1.1 ARCTIC Smart Sensor Temperature Setpoint Option

Both the O2/TOXIC and LEL/Current channels (see section 3.1.1) are capable of accepting ARCTIC Smart Sensors with 1-watt heater / temperature controller circuits. ARCTIC sensor temperature controllers have a unique address that is automatically detected by the GASMAX II. This activates the **Sensor Temp** menu on page 2 of the channel's main menu as shown below in Figure 7-1. Selecting **Sensor Temp** and pressing EDIT opens a window displaying the sensor's current temperature and the 1-watt heater's **Setpoint**. When the **Sensor Temp** value is below the **Setpoint** value the heater is on. This feature is helpful in applications where the sensor temperature must be higher than the ambient temperature to function properly.

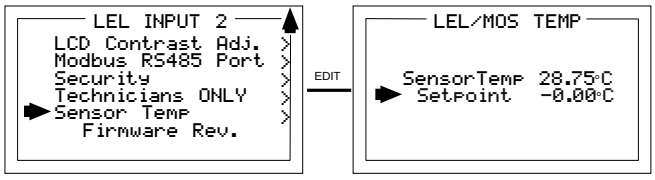


Figure 7-1: ARCTIC Sensor Temperature Menu

7.2 Special Order; 18VAC Primary Power Supply Option

A special revision of the GASMAX II I/O Power Supply is available for applications requiring 18VAC as primary power instead of the standard 10-30VDC (Order I/O Power Supply part # 10-0233-18VAC). 18VAC is applied to a bridge rectifier and filter capacitor to generate unregulated 24VDC.

The 10-0233-18VAC revision is also configured to accept 4-20mA inputs from 2 or 3-Wire 4-20mA Transmitters into terminals normally reserved for Catalytic Bead LEL Sensors. References to Catalytic Bead LEL sensors within the main body of this manual DO NOT APPLY TO THIS

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

Figure 7-2 shows physical and electrical wiring diagrams.

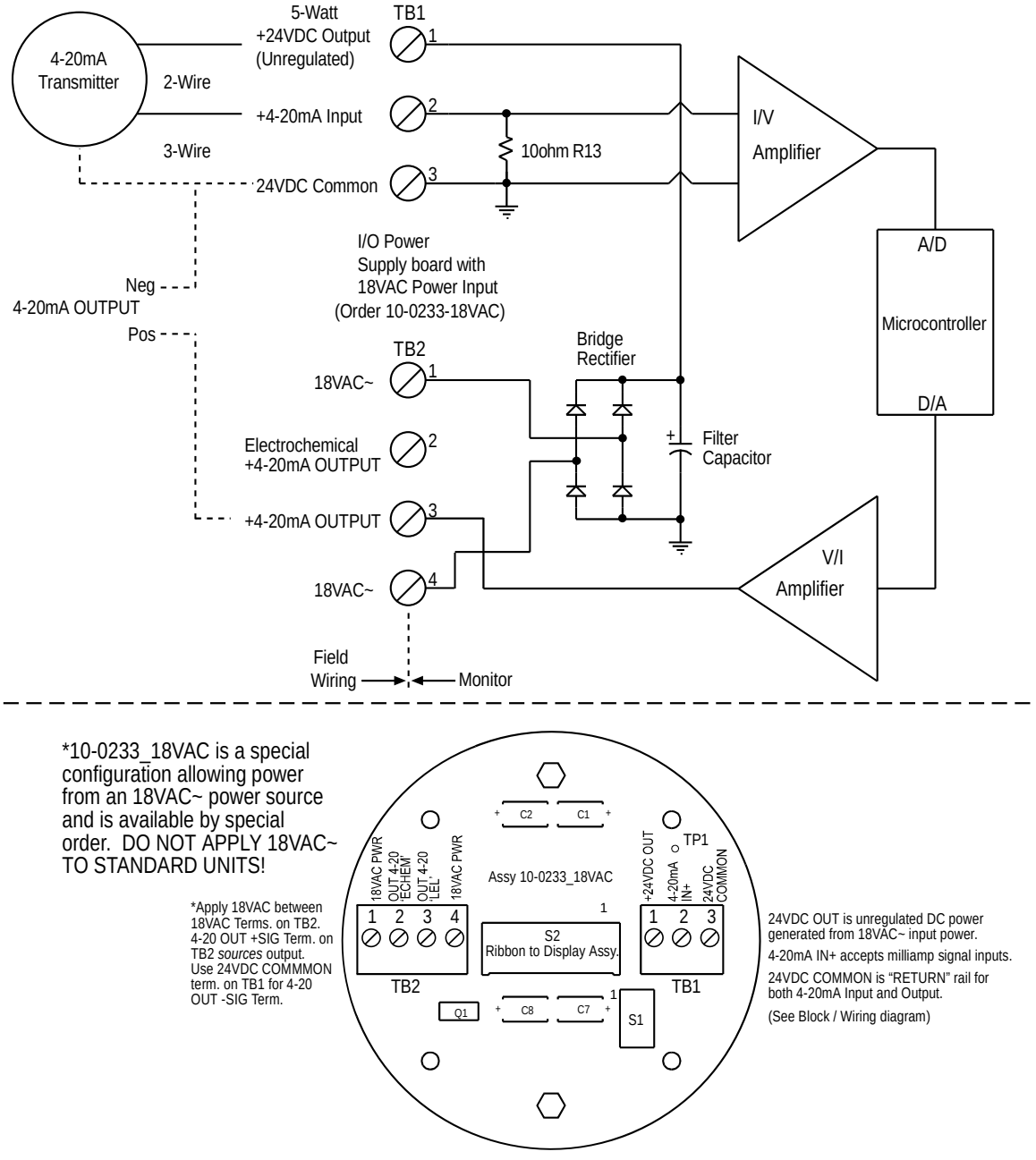


Figure 7-2: 10-00233-18VAC Block / Wiring Diagram

7.3 Special Order; 4-20mA Input to Catbead Channel

A special model GASMAX II is available for applications requiring a 4-20mA input (includes I/O Power Supply part # 10-0233-4-20mA). Solder bridges are factory installed to rewire TB1 to continue 24VDC power on to a 4-20mA transmitter as shown in Figure 7-3 below.

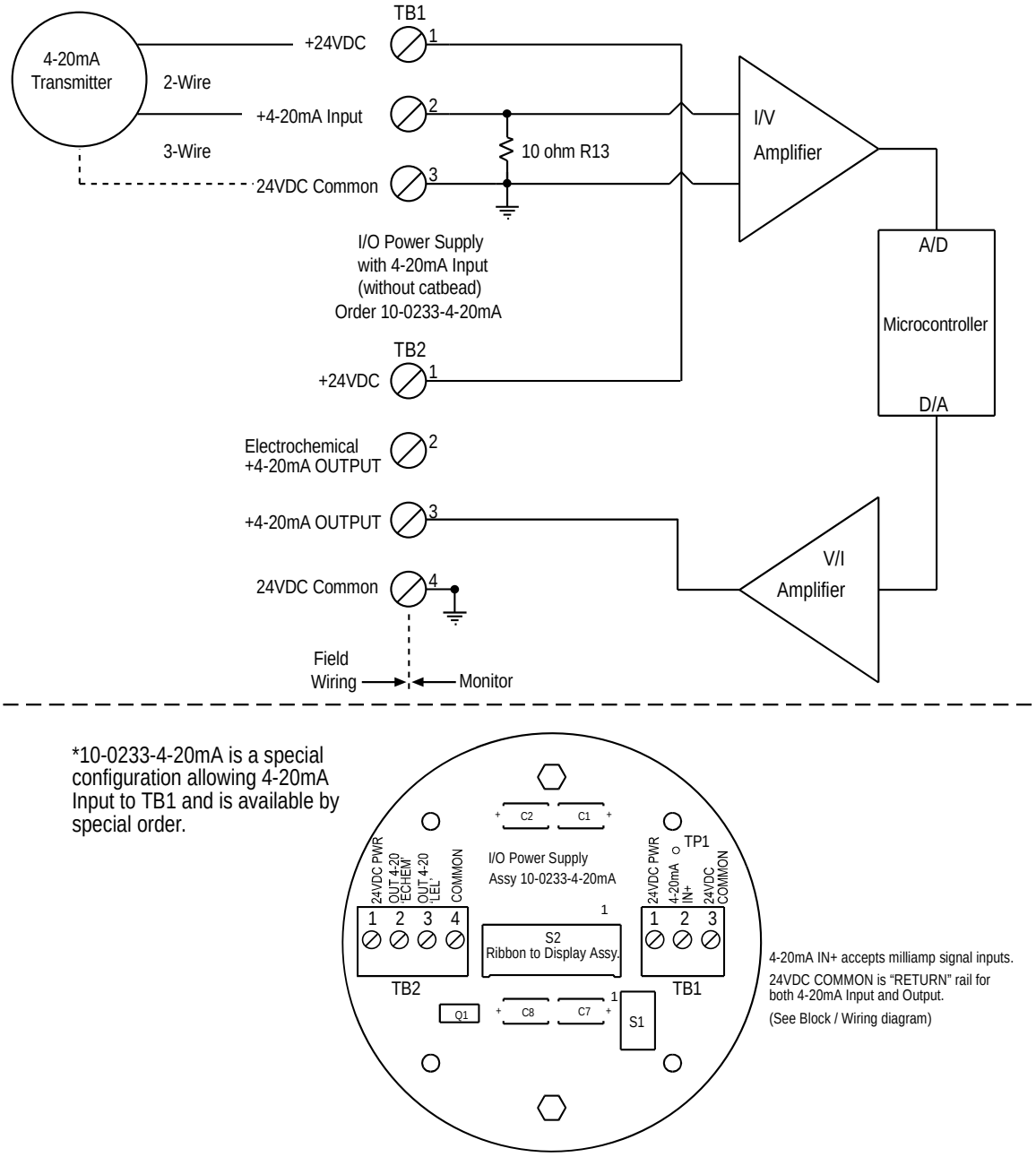


Figure 7-3: 10-00233-4-20mA Block / Wiring Diagram

7.3.1 4-20mA Input Marker / Message (Technicians only!):

Important: GASMAX II Input Marker menus are available only with special 4-20mA input configurations described in sections 7.2 and 7.3 of this manual and when the Input Type menu setting is *4-20mA (3-Wire)* (see section 6.5). Since FAULT alarms are also tripped in the <4mA region it is important to understand that the Marker events override the FAULT alarm (see section 5.4).

Some monitors indicate special modes of operation such as *Calibration* or *Maintenance* by transmitting a special <4mA **"Marker"** value. The GASMAX II offers 4-20mA input "Marker" menus, shown in Figure 7-4, for detecting inputs between 0 and 3.75mA that represent such events. Once detected, the GASMAX II transmits a constant mA output equal to the **Marker** value.

Entering **YES** in the **Marker Active** menu also activates **Marker TX LED**, **Mark Level**, and **Mark As** menus. **Mark Level** allows entering the <3.75mA value (±.2mA) to detect. **Mark As** allows entry of the up to 10 digit ASCII message the LCD readout will display when the **Marker** is detected. **Marker TX LED** menu = YES, causes the front panel TXD LED (see Figure 2-1) to also illuminate when the **Marker** is detected. **Important: Optional 10-0234 RS-485 modbus port will not function if "Marker TX LED" menu must = YES.**

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

A **Marker** application example is as follows: Many gas detection monitors transmit 1.5mA during their calibration mode. Configuring GASMAX II marker menus as shown in Figure 7-4 will provide the LCD readout in Figure 7-5 when 1.5mA is the 4-20mA input. In this example, the GASMAX II 4-20mA output will also transmit a 1.5mA marker signal.

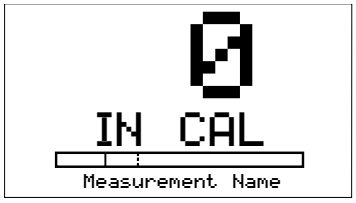


Figure 7-5: 4-20mA Input Type "MARKER" Message