GDS Corp

Gas and Flame Detection

Operation and Maintenance Manual

GDS-IR Infrared Sensor for Combustible Gases & CO_2

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.

REVISION HISTORY

Revision 2.0   5/31/13   Initial rewrite for GDS-IR
Revision 2.1   5/4/14   Update

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1 SAFETY INFORMATION

Important – Read Before Installation

Users should have a detailed understanding of GDS-IR operating and maintenance instructions. Use the GDS-IR 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

- The GDS-IR sensor transmitter described in this manual must be installed, operated and maintained in accordance with information contained herein. Installation in any hazardous area must comply with all applicable restrictions, requirements and guidelines for said hazardous areas. It is the end user customer's final decision to ensure that the GDS-IR is suitable for the intended use.

- The GDS-IR is designed and constructed to measure the level of certain gases in ambient air. Accuracy in atmospheres containing steam or inert gases cannot be guaranteed.

- GDS Corp recommends mounting the sensor vertically or horizontally. Do not mount the sensor upside down.

- Do not paint sensor assembly.

- Do not operate the GDS-IR 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 applying power.

- Do not expose the GDS-IR to electrical shock or continuous severe mechanical shock. Protect the GDS-IR and related sensor assemblies from dripping liquids and high power sprays.

- 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.

- Periodically test for correct operation of the system's alarm events by exposing the monitor to a targeted gas concentration above the High Alarm set point.

- Use only for applications described within this manual.

- Like any infrared detector, **the GDS-IR cannot detect combustible levels of hydrogen gas**.

2 GENERAL INFORMATION

INTRODUCTION

The GDS-IR is a microprocessor based intelligent gas sensor that continuously monitors the atmosphere for combustible hydrocarbon gases and vapors.

The GDS-IR is ideally suited for use in harsh environments and where the cost of required maintenance for conventional catalytic detectors is prohibitive. The GDS-IR Infrared gas detector will perform reliably in the presence of silicone and other catalytic poisoning agents and can also operate in oxygen free environments or where high background gas levels are present. There are no known poisons that affect this technology.

Features

- Standard 4 to 20 mA output (current source)
- Requires no routine span calibration.
- Certified for use in Class I Division 1, Groups B, C & D hazardous areas
- Continuous self-test automatically indicates a fault
- Multi-layered filtering system protects optics from dirt and water ingress
- Straight optical path eliminates the need for mirrors or reflective surfaces
- Performs well in the presence of high concentrations or constant background levels of hydrocarbons
- Does not require oxygen to detect hydrocarbons
- Constructed of 316 stainless steel

GETTING STARTED

Perform the following steps to install and commission a GDS-IR sensor:

Perform the following steps to install and commission a GDS-IR sensor:

1. Install the GDS-IR and connect the power and signal wiring.
2. Apply power and allow the GDS-IR to warm up **for four to eight hours**.
3. Apply zero air (or ensure there is no ambient hydrocarbon gas present) and perform a 'hardware zero' by pressing and HOLDING the IR Zero pushbutton for ten (10) seconds.
4. Challenge the GDS-IR with calibration gas to ensure end-to-end operation of the associated safety system.

3 SPECIFICATIONS

Model:	GDS Corp Infrared Sensor for Combustible Gases and CO2
Power Input:	18 to 36V DC; power consumption less than 5 watts max. Average current 210 mA, 400 mA peak during startup.
Display:	None
Input:	Detects methane, propane, ethane, ethylene, ethylene oxide, hexane, diesel, gasoline, Jet A, methanol, butane, hexane, carbon dioxide and others (see Fig. 3-1)
Accuracy:	± 3% of full scale (typical) at < 50% of scale; ± 5% of full scale > 50% of scale
Calibration:	Output is factory calibrated. The GDS-IR is compatible with all GDS Corp controllers and third-party devices with 4-20mA inputs.
Output:	4-20 mA (current source) max.1000 ohm load at 24 VDC supply voltage
Response Time:	T50 < 5 seconds
	T90 < 10 seconds
Temperature:	Electronics -40° to +70°C
	Extended temperature version for methane & propane available for -40° to +90°C
Fault	Output drops to < 3mA to indicate reference fault, source fault, warm up, optics fault, calibration fault, spanning and zeroing (see chart)
Housing:	Junction box epoxy-coated aluminum, sensor head 316 stainless steel.
	Optional 316 stainless steel flow cell with 1/8" NPT fittings
Approvals:	CSA Class 1, Division 1, Groups B, C and D Explosion Proof with flame arrestor; Performance tested per CSA C 22.2 No. 152
Warranty:	Five years

Type	Target Gas	Temperature	Comments
108	Ethane, 0-100% LEL	-40°C to + 60°C	
109	Acetylene, 0-100% LEL	-40°C to + 60°C	
110	Methane, 0-100% LEL	-40°C to + 60°C	
1HT	Methane, 0-100% LEL	-40°C to + 90°C	Extended Temperature Range
111	Propane 0-100% LEL	-40°C to + 60°C	
112	Isobutane 0-100% LEL	-40°C to + 60°C	
113	Pentane 0-100% LEL	-40°C to + 60°C	
114	Cyclopentane 0-100% LEL	-40°C to + 60°C	
115	n-Butane 0-100% LEL	-40°C to + 60°C	
116	Ethanol 0-100% LEL	-40°C to + 60°C	
117	Methanol 0-100% LEL	-40°C to + 60°C	
118	Propylene 0-100% LEL	-40°C to + 60°C	
119	Ethylene 0-100% LEL	-40°C to + 60°C	
120	Hexane 0-100% LEL	-40°C to + 60°C	
121	Jet-A 0-100% LEL	-40°C to + 60°C	
122	Diesel 0-100% LEL	-40°C to + 60°C	
123	Gasoline 0-100% LEL	-40°C to + 60°C	
124	Isopropyl Alcohol 0-100% LEL	-40°C to + 60°C	
125	Acetone 0-100% LEL	-40°C to + 60°C	
126	p-Xylene 0-100% LEL	-40°C to + 60°C	
127	Ethylene Oxide 0-50% LEL	-40°C to + 60°C	
128	MEK 0-100% LEL	-40°C to + 60°C	
129	Styrene, 0-50% LEL	-40°C to + 60°C	
130	Methane 0-100% by volume	-40°C to + 60°C	
131	Propane 0-100% by volume	-40°C to + 60°C	
132	Carbon Dioxide 0-5% v/v	-40°C to + 60°C	
133	Carbon Dioxide 0-3.5% v/v	-40°C to + 60°C	

Figure 3-1: GDS-IR Sensor Types

4 INFRARED DETECTION FUNDAMENTALS

The GDS-IR Infrared gas detector uses infrared absorption to detect hydrocarbon gases. Specifically, the infrared energy is absorbed by the hydrogen-carbon bonds found in all hydrocarbon gases, and is a result of a resonance between the frequency of the light and the vibration characteristics of the chemical bonds.   As a result, the concentration of a gas can be approximated by the difference in transmittance between a measurement beam that is absorbed by the target gas and a reference beam that is not absorbed. The GDS-IR uses a collimated infrared light source that passes through a waveguide and impacts dual channel receiver. The dual channel receiver measures the intensity of two specific wavelengths, one at an active wavelength and another at the reference wavelength. The gas concentration is determined by a comparison of these two values.

The dual channel receiver is a single wafer, double filtered receiver with an internal optical barrier. The elements are perfectly matched resulting in overall stability and superior performance throughout the entire temperature range. Using a dual channel receiver ensures there is no need for special lenses or beam splitters that can become misaligned or dirty.
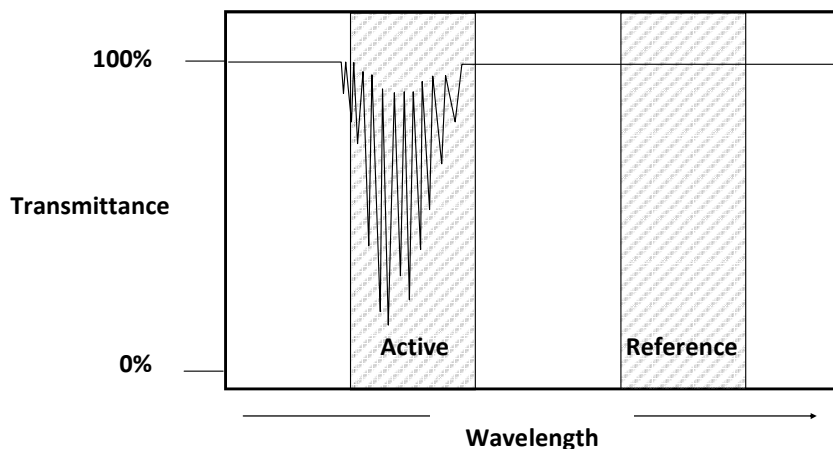
Figure 4-1: Methane Absorption Spectrum

Although hydrocarbon gases all share similar hydrogen-carbon bonds, the number of bonds and the orientation in the gas molecule will have an effect on the sensor's response. To compensate for these differences, the GDS-IR microprocessor is pre-programmed with a response table that converts the transmittance into a linear 4-20mA output (See Fig. 3-1).

5 INSTALLATION

SELECTING A LOCATION

Factors such as air movement, gas density, emission sources and environmental variables affect 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 cm) above the potential gas leak and heavier than air gases should be this distance below. Even though the GDS-IR sensor transmitter is designed for rugged service, it should be protected from environmental damage from water, snow, shock, vibration and dirt.

MOUNTING THE GDS-IR

The GDS-IR should always be mounted facing down or at most a 90° angle from the vertical. Do not mount the GDS-IR facing up. Be sure to leave sufficient room (~ 12") below the sensor to allow for removal of the sensor cover for cleaning and maintenance.
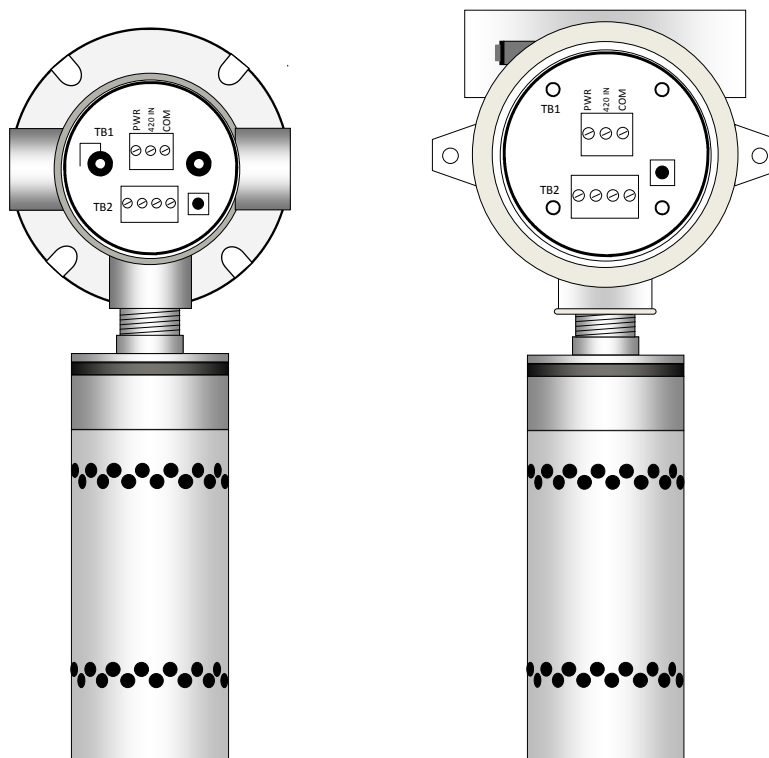
Figure 5-1: GDS-IR Infrared Sensor

Old Style Gray Junction Box & New Style Yellow Enclosure

POWER & SIGNAL WIRING

The GDS-IR is a three-wire, DC-powered self-contained infrared sensor. The electronics require approximately 5 watts to operate properly. Connect a source of 18 to 36 VDC to TB1 "PWR" (+) and "COM" (-). The sensor's 4-20mA output is available on TB1 "4-20MA" (source).

GDS-IR In / Output

PWR	+24V In
4-20MA	4-20 mA Out
COM	Common

Hardware Zero Pushbutton

Pre-wired to GDS-IR:

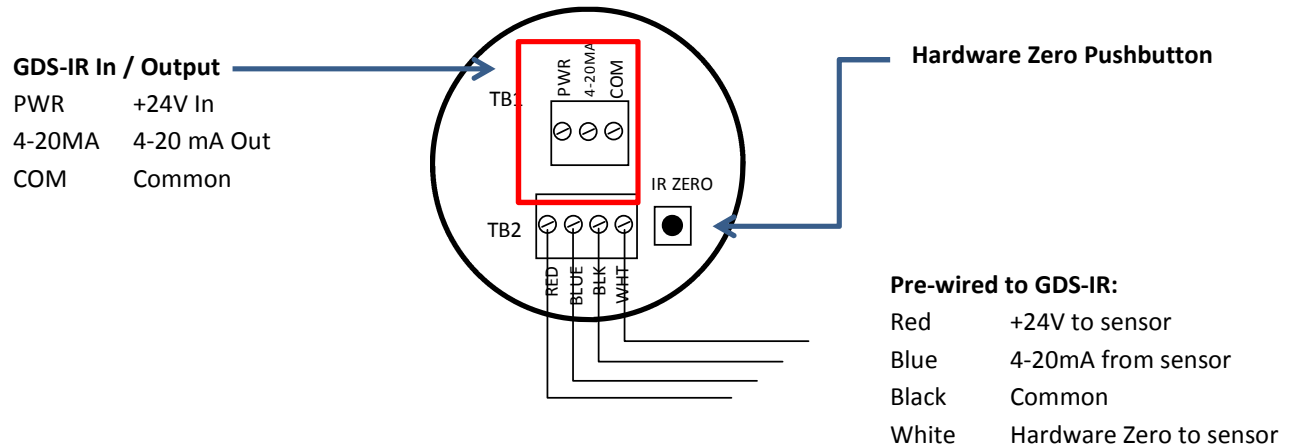|	
Red	+24V to sensor
Blue	4-20mA from sensor
Black	Common
White	Hardware Zero to sensor

Figure 5-2: GDS-IR Wiring Connections

Shielded cable is always recommended. Wiring should be installed in metal conduit not shared by high voltage AC or DC wiring. When power is initially applied to the GDS-IR the 4-20mA output may momentarily indicate a temporary off-scale low (FAULT) or off-scale high (OVERRANGE) value before settling down.

Wire Size Recommendations:	
Up to 500 ft.	#16 AWG
>500 ft.	#14 AWG

USE IN HAZARDOUS AREAS

The GDS-IR is CSA certified for use in hazardous areas rated Class I Division 1, Groups B, C and D. The junction box or yellow enclosure is also CSA certified for use in hazardous areas rated Class I Division 1, Groups B, C and D.

GETTING STARTED

Perform the following steps to install and commission a GDS-IR sensor:

5. Install the GDS-IR and connect the power and signal wiring.

6. Apply power and allow the GDS-IR to warm up **for four to eight hours**.

7. Apply zero air (or ensure there is no ambient hydrocarbon gas present) and perform a 'hardware zero' by pressing and HOLDING the IR Zero pushbutton for ten (10) seconds.

8. Challenge the GDS-IR with calibration gas to ensure end-to-end operation of the associated safety system.
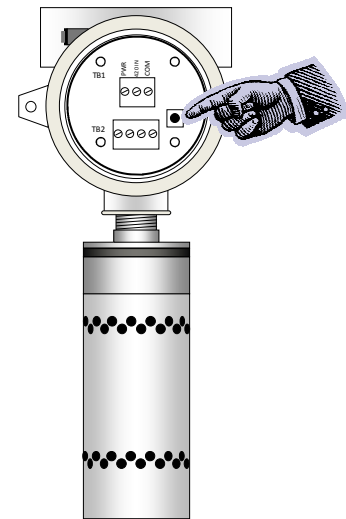
6 CALIBRATION

CALIBRATION OVERVIEW

The GDS-IR is factory calibrated for a specific hydrocarbon gas and should only need a periodic "Hardware Zero" approximately every six months.

Follow these GDS-IR calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy. GDS Corp calibration gases are traceable to NIST standards (National Institute of Standards and Technology).

- **Never use calibration gas that has passed its expiration date.**

- Be sure to use ZERO AIR, a mixture of 21% oxygen and 79% nitrogen, as a zero reference unless you are certain that no target gas exists in the area. Ambient gas may result in an 'elevated zero' condition that will result in erroneous readings and may cause a FAULT to occur once the ambient gas is no longer present.

- When using the GDS-IR with a GASMAX monitor, GDS Corp recommends using a span gas that is between 25% and 75% of full scale. GDS Corp does not recommend using full scale as the span set point.

- **Always challenge a new sensor with calibration gas before depending on the device for personnel or equipment safety**

HARDWARE ZERO

When first installed, and approximately once every six months, the GDS-IR 'hardware zero' should be set to compensate for shifts in the sensor's optics or other hardware. When setting hardware zero, first **make certain that no residual hydrocarbon gas is present**. GDS Corp recommends applying zero air during this process. **Press and HOLD the Set Zero pushbutton for ten (10) seconds**. The sensor output will momentarily drop to 2.2mA to indicate Unit Zeroing and then return to 4mA.

GENERALIZED CALIBRATION PROCEDURE

In general, calibration involves applying a zero reference gas and telling the receiving device to accept that output as 'zero', followed by the application of a span reference gas and then telling the receiving device to accept the new output as 'span' once the output has stabilized. This is generally performed by two persons, one at the sensor transmitter and one at the receiving device. Actual procedures, time intervals and techniques for indicating zero and span values depend on the specific receiving device. All GDS Corp display and alarm controllers provide the necessary local calibration capability.

Before beginning calibration, make sure you have the following items: A cylinder of calibration gas, fixed flow regulator and an appropriate calibration cup connected to the regulator via a length of flexible tubing. If necessary, a cylinder of 'zero air' may be necessary if the absence of target gas cannot be confirmed.

The actual steps involved in calibration vary depending on the receiving device, but can be generalized as follows:

1. Select the appropriate channel on the controller or receiver and enable Calibration Mode. This should disable alarms during the calibration process. Make sure that the controller's Cal Span value matches the cylinder of calibration gas.

2. Apply zero air to the sensor as shown in Fig. 6-1 or confirm the absence of any target gas.

3. At the controller or receiver, press the "Set Zero" button to confirm that the current reading is 'zero'.

4. Apply span gas to the sensor as shown in Fig 6-1.

5. At the controller or receiver, monitor the output until it stabilizes. When stable, press the "Set Span" button to confirm that the current reading corresponds to the Span value.

6. Turn off the regulator and remote the calibration cup from the sensor head.

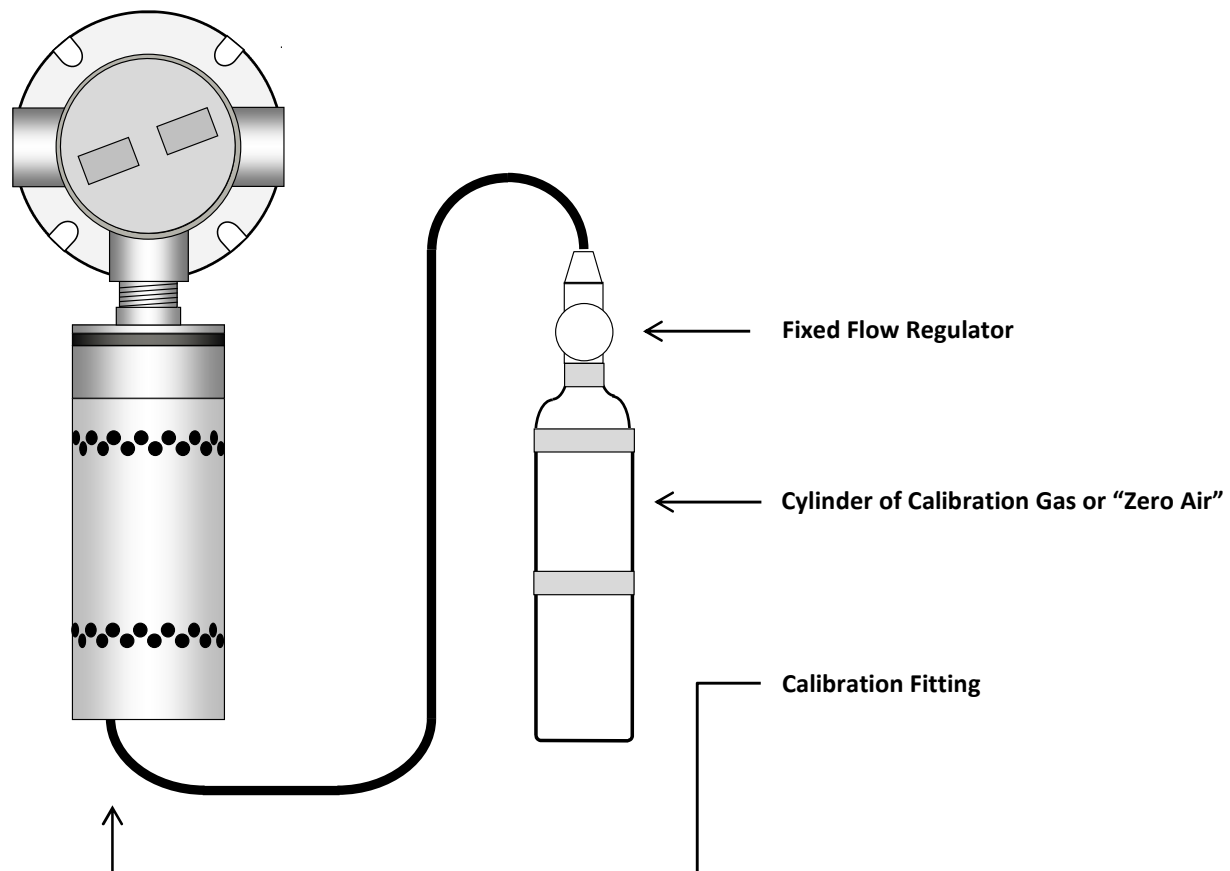7. At the controller or receiver, exit Cal Mode and resume normal operation.

Fixed Flow Regulator

Cylinder of Calibration Gas or "Zero Air"

Calibration Fitting

Figure 6-1: Applying Calibration Gas to GDS-IR

7 OPERATION AND MAINTENANCE

NORMAL OPERATION

When power is applied to the GDS-IR, it enters a one-minute warm-up period. The output current will be 0.8 mA during the warm up time period. At the end of the warm-up period with no faults present, the GDS-IR automatically enters normal operating mode and outputs 4.0 mA. If a fault is present after warm-up, the detector current output will indicate a fault.

In the normal operating mode, the 4-20 mA signal level corresponds to the detected gas concentration. In the event of an overrange gas release, the GDS-IR will indicate an overrange condition up to approximately 23mA. Excessive gas will not harm the sensor and the output will return to normal once the gas dissipates. In the event that the internal microprocessor detects a fault condition, the output will be set to a specific mA reading that corresponds to the type of fault detected.

Sensor Output:		
0.0	mA	Unit Fault
0.2	mA	Reference channel fault
0.4	mA	Analytical channel fault
0.8	mA	Unit warm up
1.0	mA	Optics fault
1.2	mA	Zero drift fault
1.6	mA	Calibration fault
2.0	mA	Unit spanning
2.2	mA	Unit zeroing
4.0	mA	Zero gas level (0%LEL)
5.6	mA	(10%LEL)
8.0	mA	(25%LEL)
12	mA	(50%LEL)
16	mA	(75%LEL)
20	mA	Full scale (100% LEL)
20.1- 23 mA		Over-range (> 100% LEL)

MAINTENANCE

The GDS-IR should be checked regularly for damage, water ingress or hydrophobic filter clogging due to excessive dust or dirt. If the hydrophobic filter has become contaminated by dust, dirt or moisture, unscrew the sensor head cover, remove the set screw and gently slide the filter down to remove (See Fig. 7-1). Carefully clean the filter with compressed air and reinstall. The GDS-IR can operate without the hydrophobic filter installed if the atmosphere contains little dust or moisture. There are no user-serviceable components.

CLEANING THE GDS-IR OPTICS

If necessary, the GDS-IR can be partially disassembled to allow cleaning of the optical windows covering the IR source and IR receiver. To disassemble the GDS-IR, perform the following steps (See Fig. 7-1):

1. Unscrew the outer cover in a counter-clockwise direction (looking up from underneath)

2. Locate the small set screw that holds the hydrophobic filter in place. Carefully remove the screw using a flat-blade screwdriver.

3. Gently slide the hydrophobic filter down and set aside.

4. Place one Allen wrench in the hole marked "A" to hold the top section of the optical waveguide in place. Place another through the hole marked "B" in the lower section of the optical waveguide. Using the two wrenches, rotate the lower section of the optical waveguide such that it screws into the upper section. This will eventually allow the waveguide assembly to be removed from the GDS-IR.

5. Using a cotton swab and alcohol, clean the surfaces of the Receiver and Source as shown.

6. Reassemble the GDS-IR

7. Perform a 'hardware zero' once the sensor is completely reassembled.

NOTE: IT IS NOT NECESSARY TO REMOVE POWER FROM THE GDS-IR TO PERFORM THIS CLEANING PROCESS.
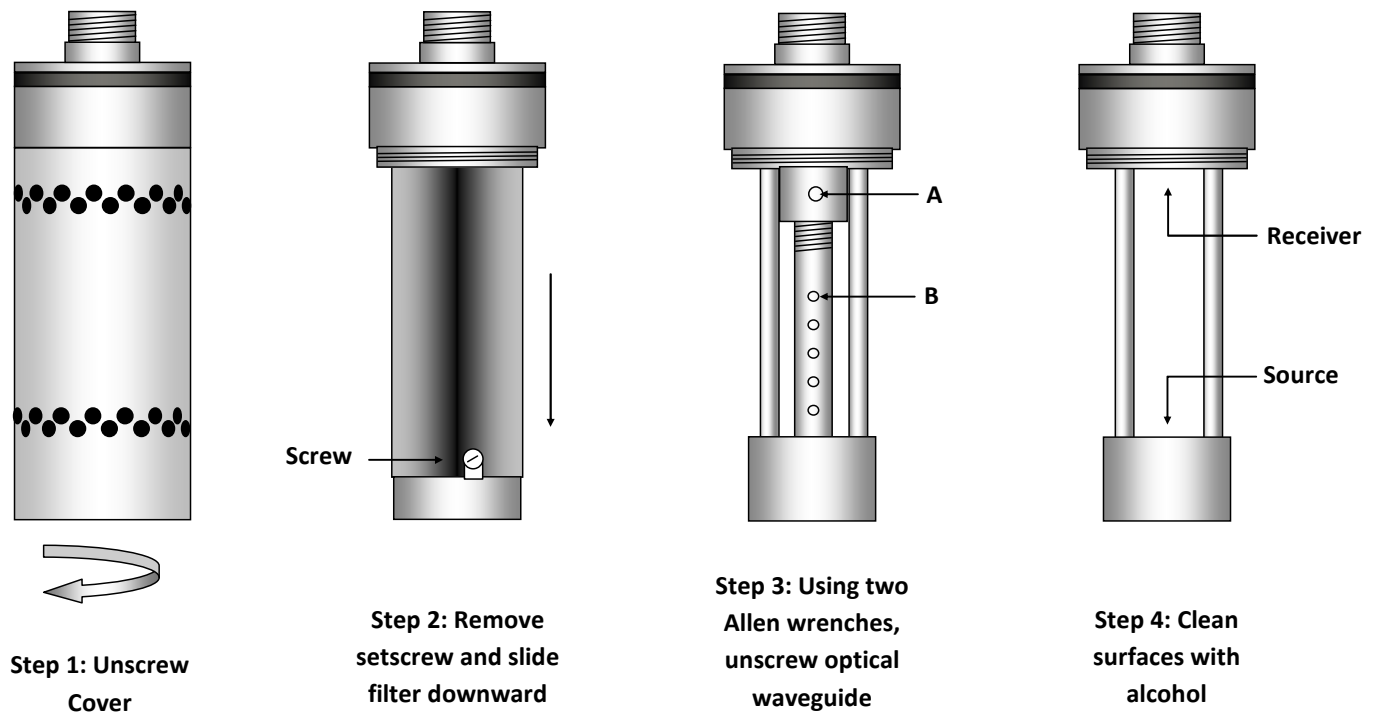
Step 1: Unscrew Cover

Step 2: Remove setscrew and slide filter downward

Screw

Step 3: Using two Allen wrenches, unscrew optical waveguide

A

B

Step 4: Clean surfaces with alcohol

Receiver

Source

Figure 7-1: GDS-IR Disassembly

8 TROUBLESHOOTING

DOES NOT START PROPERLY – UNIT CYCLES ON AND OFF

- Power supply cannot provide sufficient surge current for IR source power-up. Check power rating of power supply. For example, a C2 Quad Protector Controller with standard power supply can provide power for two GDS-IR sensors; adding a third or fourth sensor will cause the power supply to repeatedly shut down and try to restart.

OUTPUT INDICATES FAULT CONDITION (< 4 MA)

- Reference channel fault (0.2 mA) – contact factory
- Analytical channel fault (0.4 mA) – contact factory
- Warm-up (0.8 mA) – this is normal during first one minute of operation
- Optics fault (1.0 mA) – Open and clean sensor; contact factory if fault not cleared
- Zero drift fault (1.2 mA) – Perform Hardware Zero; contact factory if fault not cleared
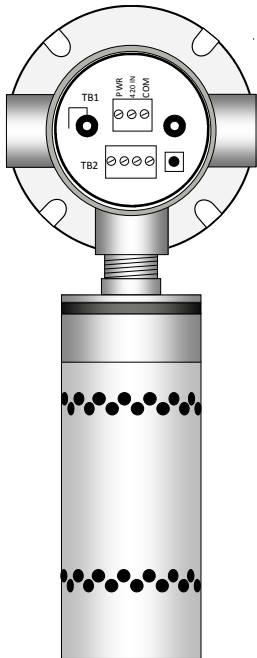- Calibration fault (1.6 mA) – contact factory

EXCESSIVE ZERO DRIFT

- Hardware Zero not performed properly; perform Hardware Zero
- Hydrocarbon gas present when Hardware zero performed; perform Hardware Zero using "zero air" reference

INCORRECT READING WITH SPAN GAS

- Receiving device scale value not set properly
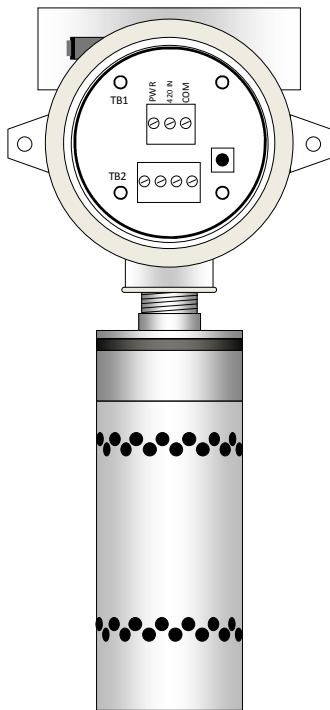
9 SPARE PARTS

Gray Junction Box with PCB

20-0100   Remote XP junction box with PCB

GDS-IR

1200-0811   Replacement hydrophobic filter

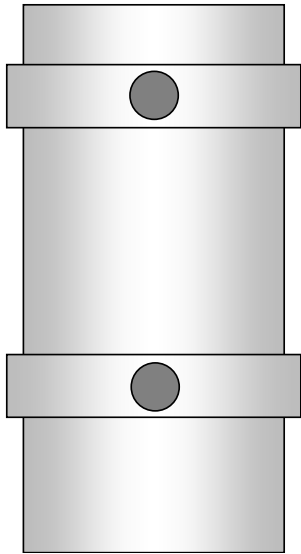**Figure 9-1: GDS-IR with Gray Junction Box (Spare Parts)**

Yellow Enclosure with PCB

20-0157   Full assembly less sensor (yellow)

GDS-IR

1200-0811   Replacement hydrophobic filter
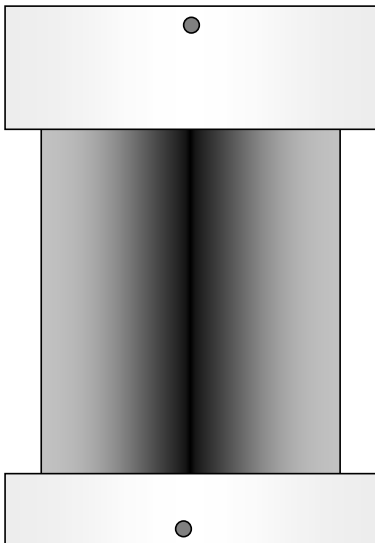
Figure 9-2: GDS-IR with Yellow Enclosure (Spare Parts)

Stainless Steel Flow Cell

10-0271   Stainless steel flow cell with five ¼" NPT ports
               (Does not include fittings)

Figure 9-3: GDS-IR Flow Cell (Spare Parts)

External Splash Guard

1200-0811   Splash guard (slips over sensor)

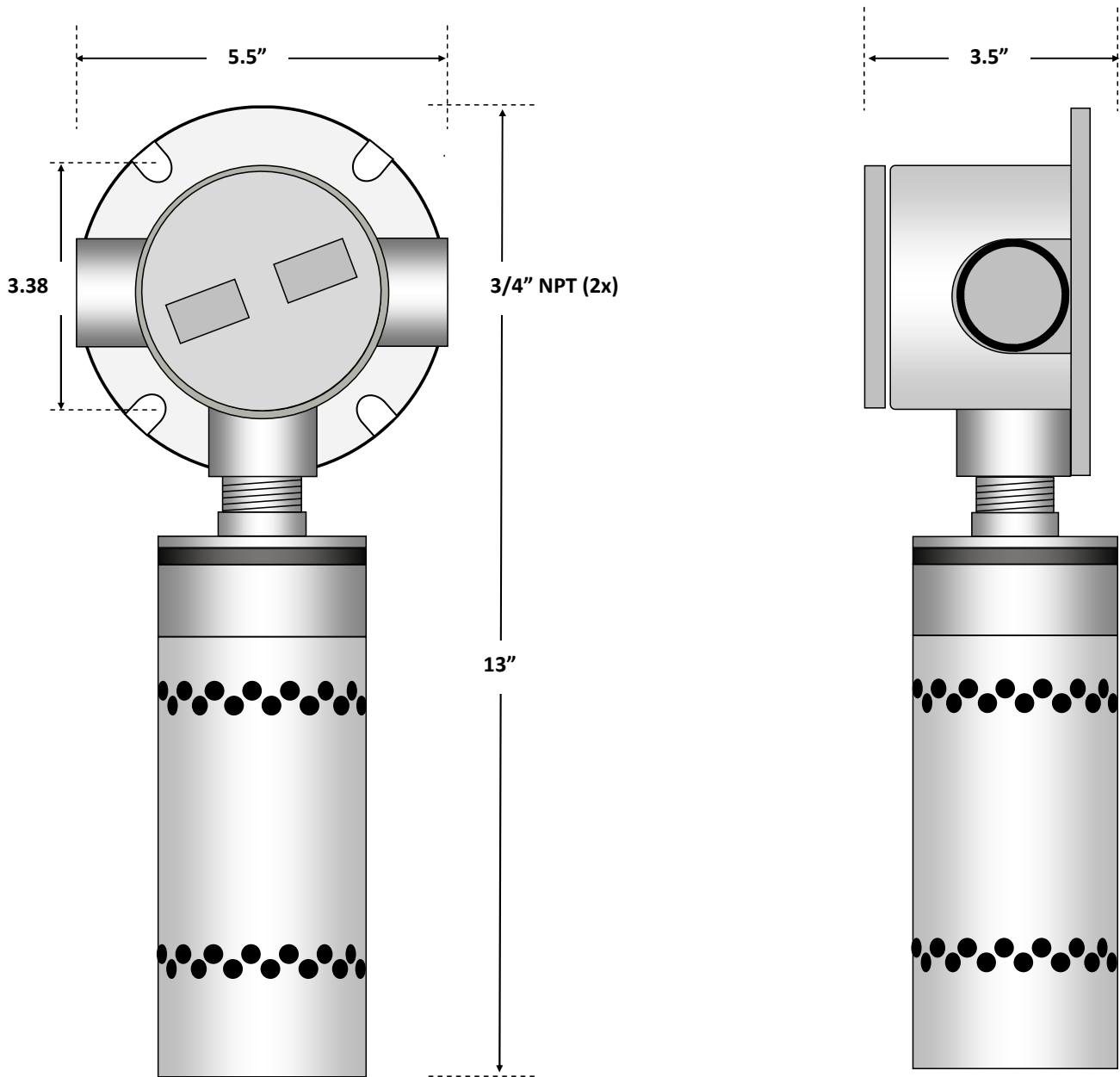**Figure 9-4: GDS-IR External Filter (Spare Parts)**

10 DRAWINGS AND DIMENSIONS

Figure 10-1: GDS-IR with Gray Junction Box (Dimensions)
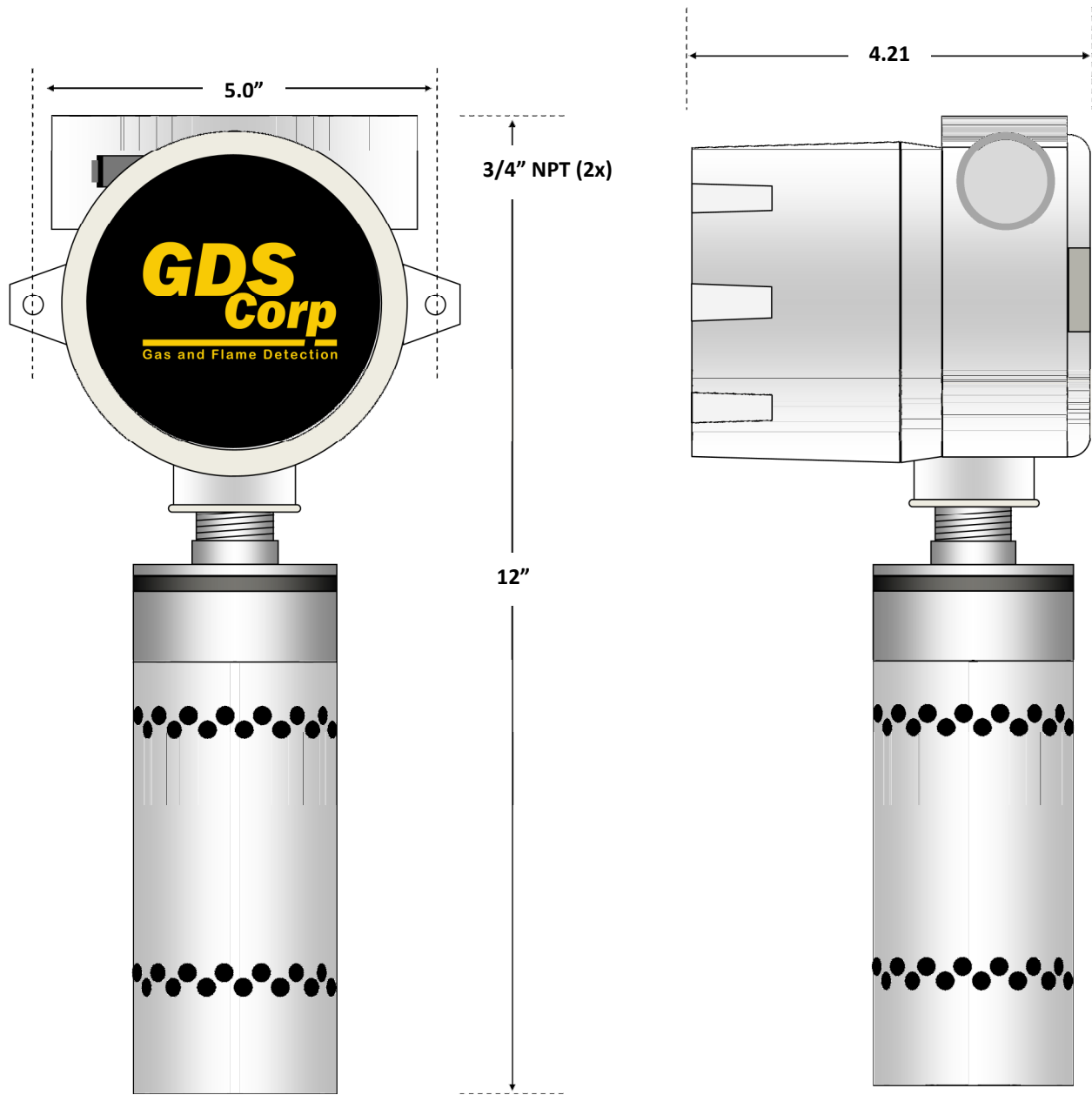
5.0"

3/4" NPT (2x)

4.21

12"

Figure 10-2: GDS-IR with Yellow Enclosure (Dimensions)