

Operation & Maintenance Manual

GDS-SmartIR Infrared Detector Gas Sensor

For Detection of Hydrocarbon / Combustible Gases
or Carbon Dioxide

Important: Read and understand contents prior to first use. Improper use or operation could result in instrument malfunction or serious injury.

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Table of Contents

SECTION 1 – SAFETY INFORMATION	5
1.1 Safety Information – Read Before Installation & Applying Power	5
1.2 Contacting Global Detection Systems Corp.	5
SECTION 2 – SMARTIR SPECIFICATIONS	6
SECTION 3 - GENERAL DESCRIPTION	7
3.1 GDS SmartIR Infrared Detector for Combustibles & Carbon Dioxide	7
3.2 Features (Installed in GDS-48 Remote Sensor Housing)	7
3.3 Features (Installed with GASMAX II Gas Monitor)	7
3.4 Infrared Detection Technology	8
SECTION 4 - OPERATION	10
4.1 Installation and Startup	10
4.2 Warm-up	11
4.3 Normal Operation	11
SECTION 5 - CALIBRATION	12
5.1 Calibration	12
5.2 Calibration with Target Gas	12
SECTION 6 – SENSOR MAINTENANCE	13
6.1 GDS-PID Maintenance	13
SECTION 7 – PARTS LISTS & DRAWINGS	14
APPENDIX A – UEL & LEL LEVELS FOR SELECTED GASES	15

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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 GDS-SmartIR operating and maintenance instructions. Use the GDS-SmartIR 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

- Do not paint the sensor assembly.
- Do not use the GDS-SmartIR if its enclosure is damaged or cracked or has missing components.
- Make sure the cover and field wiring are securely in place before operation.
- Periodically test for correct operation of the system's alarm events by exposing the monitor / sensor system to a targeted gas concentration above the High Alarm setpoint.
- Do not expose the GDS SmartIR to electrical shock or continuous severe mechanical shock.
- Protect the GDS SmartIR 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 Global Detection Systems Corp.

To contact Global Detection Systems Corp, please call 409-927-2980, FAX 409-927-4180 or visit us on the web at www.gdscorp.com For sales information, send email to sales@gdscorp.com or for technical support email us at tech@gdscorp.com Our headquarters are located at 2513 Hwy 6 in Santa Fe, Texas 77510.

SECTION 2 – SmartIR SPECIFICATIONS

- Model:** Global Detection Systems Corp. SmartIR Infrared Detector Gas Sensor
- Available gases:** Methane: 0-100% LEL
Propane 0-100% LEL
Methane 0-100% by Volume
Carbon Dioxide: 0-5% by Volume
NOTE: This list is not all-inclusive. The GDS SmartIR can be calibrated for other hydrocarbons; please contact GDS Corp for more information.
- Detection Method:** Diffusion
- Output (analog):** Installed in GDS-48 Universal Sensor Head: Bridge output similar to traditional catalytic bead sensor
Installed in GASMAX II Gas Monitor: 4-20 mA (Source type) max. 600 Ohm load at 24 VDC supply voltage
- Response Time:** T90 < 20 seconds at 20°C ambient
- Operating Temperature Rating:** Remote installation using GDS-48 Universal Sensor: 0°C to +50°C
Local installation with GASMAX II Gas Monitor (Arctic Monitor option): -40°C to +50°C
- Operating Voltage:** Installed in GDS-48 Universal Sensor Head: 3.3 to 5.0V DC measured at the detector head
Installed in GASMAX II Gas Monitor: 10-30 VDC measured at the detector head
- Power Consumption:** Sensor only: < 100mA DC
- Hazardous Environment Certification:** Installed in GDS-48 Universal Sensor Head: CSA Certified Class 1, Division 1, Groups B, C, D
Installed in GASMAX II Gas Monitor: CSA Certified Class 1, Division 1 Groups B, C, D
- Warranty:** Electronics (GASMAX II) – Two years from date of purchase
Sensor: (SmartIR) – One year from date of purchase

SECTION 3 - GENERAL DESCRIPTION

3.1 *GDS SmartIR Infrared Detector for Combustibles & Carbon Dioxide*

The GDS SmartIR infrared gas detector is a permanently-mounted microprocessor based smart sensor that continuously monitors for a wide range of combustible gases or carbon dioxide gas (depending on model chosen). With an output similar to a traditional catalytic bead combustible gas sensor, the GDS SmartIR can be connected to a GDS Corp **C1 Protector** sixteen-channel controller, a GDS Corp **C2 Protector** two-channel controller, a single or dual channel **GASMAX II** Gas Monitor, or other instrumentation device that supports a standard Whetstone bridge input that can provide 3.5 - 5VDC excitation voltage. When used locally with the GASMAX II monitor, a standard 4-20mA output, an isolated 4-20mA output, a MODBUS digital output and local alarm relay contacts are available.

3.2 *Features (Installed in GDS-48 Remote Sensor Housing)*

- Output compatible with standard 3-wire catalytic bead bridge-type circuit (3.5 – 5 VDC excitation)
- Complete infrared sensor, containing detector cell, IR source, lamp driver, amplifier and filter
- Direct replacement for industry-standard Catalytic Bead combustible gas sensor
- Replaceable, self-adhesive microporous 1 micron PTFE filter
- Ranges available: 0-100% LEL, 0-100% by Volume; 0-5% by Volume Carbon Dioxide
- Can be factory-calibrated to other gases – contact GDS Corp for more details.

3.3 *Features (Installed with GASMAX II Gas Monitor)*

- All above features plus the following:
- Smart Sensor interface records serial number, born-on date and other sensor information
- Graphic alphanumeric display in engineering units with alarm LEDs
- Optional isolated 4-20mA output, MODBUS digital serial output
- Optional alarm relay contacts (3 separate levels + Fault)
- Magnetic interface allows setup without declassifying hazardous area
- Second GASMAX channel supports simultaneous monitoring of toxic gas using electrochemical sensor

3.4 Infrared Detection Technology

Optical detectors for combustible gas detection provide an increasingly popular alternative to traditional pellistor-based combustible gas detectors. In the past, infrared sensors have tended to be large and expensive. The advent of microprocessors and mechanical miniaturization has enabled GDS Corporation to bring infrared sensor technology to the mainstream user. The GDS SmartIR contains a long life tungsten filament infrared light source, an optical cavity, dual temperature-compensated pyroelectric infrared detector, an integral semiconductor temperature sensor and electronics to process the signals from the sensor.

Most combustible gases absorb infrared light energy at defined wavelengths, providing an adsorption signature for that gas. The principle of an infrared detector is based upon the adsorption of the infrared light at a specific wavelength as it passes through the gas. The more of the adsorbing gas that is present, the more light is adsorbed. The sensor compares the energy emitted by the light source to that received by the detector resulting in the amount of light adsorbed by the gas.

The infrared light source is a thin-walled tungsten filament lamp with an MTBF of 100,000 hours. The thin wall of the lamp increases the emission of infrared wavelengths, especially in the range of 1-5 microns. In operation the light source is pulsed at 4Hz with a 50% duty cycle in order to present dark and light contrast states to the dual wavelength detector.

The detector is a dual pyro-electric detector with each element optically filtered by integral windows to respond to specific bands of infrared light. The optical filter associated with the active element transmits radiation within a wavelength band that is absorbed by the target gas, while the optical filter associated with the reference element transmits radiation associated with a neutral band not affected by the target gas. The reference element acts as a monitor for the infrared radiation and is used to compensate for changes that affect both the reference and active detectors simultaneously. The electronics package in the sensor constantly monitors the active and reference detectors and outputs a signal proportional to the difference.

Changes in ambient temperature affect the on-chip detectors, electronic components and infrared light source. Rapid changes in temperature can also result in transient signals and noise on the detector outputs. The GDS SmartIR contains a temperature reference that compensates for these changes; however, it is important to limit the rate of change to no more than 0.5°C per minute.

Unless otherwise specified, GDS Corp SmartIR sensors are calibrated to provide a signal linearized for methane (CH₄). However, the SmartIR will respond to a range of hydrocarbon gases. The response curves shown below demonstrate the SmartIR relative response to some of the more common hydrocarbons.

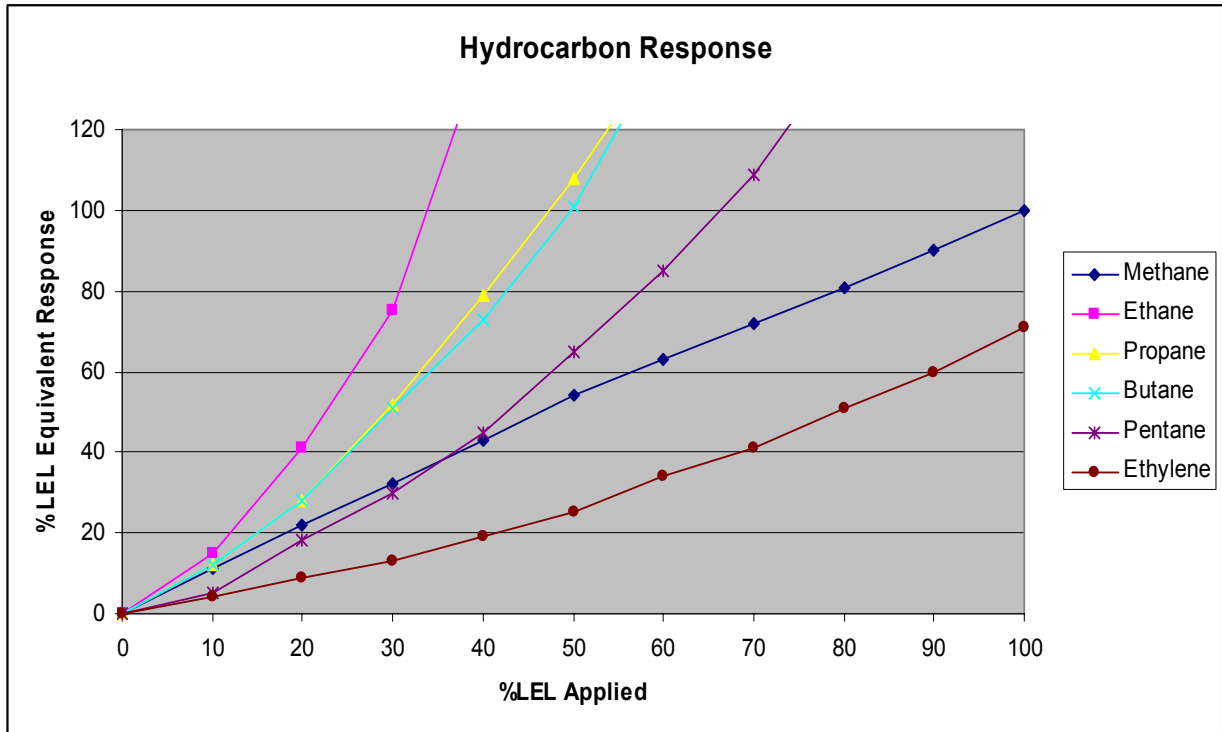


Figure 1 – GDS SmartIR (Methane) Relative Response to Hydrocarbon Gases

SECTION 4 - OPERATION

4.1 *Installation and Startup*

Warning: *The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.*

The first step in the installation process is to establish a mounting location for the GDS SmartIR. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a target gas.

It is very important that the GDS SmartIR be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air or for vapors resulting from flammable liquid spills. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.
- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.
- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.
- The sensor should be accessible for maintenance.
- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices.

Both the GDS-48 Universal Sensor housing and GASMAX II Gas Monitor provide a 3/4" NPT threaded connector for installation with conduit or shielded cable. **Shielded cable is recommended.** Wiring should be installed in metal conduit with no other cabling in the same conduit.

4.2 Warm-up

The GDS SmartIR gas detector is a very sensitive device, and if the sensor has been stored for a significant amount of time, it may become contaminated with trace amounts of ambient detectable compounds. This in turn may cause drift of the background signal during warm-up. Therefore, it is highly recommended to run the sensor for some period of time after prolonged storage, especially if it going to be used for the low level applications. An overnight burn-in period should be sufficient in most cases. During this time, the detector will clean itself and the baseline signal will drop and stabilize. If the sensor is used on a daily basis, it should be allowed to stabilize for 10-20 minutes before use. If high accuracy is not important (for example, in leak detection) or in the case of measuring relatively high concentrations (> 50% LEL), this stabilization procedure can be skipped.

4.3 Normal Operation

The operation of any gas sensor should be checked periodically to ensure proper operation. When first installed, the GDS SmartIR should be challenged with a calibration gas (either methane or carbon dioxide as appropriate) to make certain that the detector and any associated alarm systems are functional. Periodically thereafter, the GDS SmartIR should be tested and/or recalibrated as necessary. Normally, initial calibration tests should be done at least monthly, and may be done on a more extended basis once some experience with the sensor and surrounding environment is obtained.

SECTION 5 - CALIBRATION

5.1 Calibration

The GDS SmartIR sensors are available factory-programmed for the ranges 0-100% LEL Methane (p/n 10-9050), 0-100% LEL Propane (p/n 10-9051), 0-100% by Volume Methane (p/n 10-9052) or 0-5% by Volume Carbon Dioxide (p/n 10-9053) and cannot be changed in the field. Within these ranges, however, the SmartIR should be calibrated for best accuracy as described below using clean ambient air (or 'zero air' if hydrocarbons are present) for zero calibration and the appropriate reference gas for span calibration.

After installation, allow the GDS SmartIR to stabilize for a period of 8 hours or more, preferably overnight. After stabilization, calibrate the unit as described below. During the first several weeks of operation, periodically calibrate the unit to ensure there are no localized sources of contamination or environmental effects that may block the sensor window or otherwise cause the unit to drift or become inaccurate. It is recommended that the eventual period between calibrations be no longer than 60 days.

5.2 Calibration with Target Gas

If a known concentration sample of the desired target gas is available, the GDS SmartIR sensor can be calibrated like any typical sensor.

If the GDS SmartIR is connected to a GASMAX II gas monitor, the standard built-in GASMAX II calibration procedure should be used. See the GASMAX family manual for further details on sensor calibration procedures.

In the case of a GDS SmartIR installed remotely using a GDS-48 Universal Remote Sensor assembly, the calibration procedure associated with the assigned controller should be used. For example, the C1 *Protector* sixteen-channel controller provides an option for "Local Calibration" that allows the necessary zero and span adjustments to be performed. See the C1 *Protector* Controller manual for further details.

IMPORTANT: *Calibrating the GDS SmartIR for a specific gas does not make it selective to that gas. An infrared detector is a relatively wideband detector and may respond to a range of hydrocarbon gases should they be present.*

SECTION 6 – SENSOR MAINTENANCE

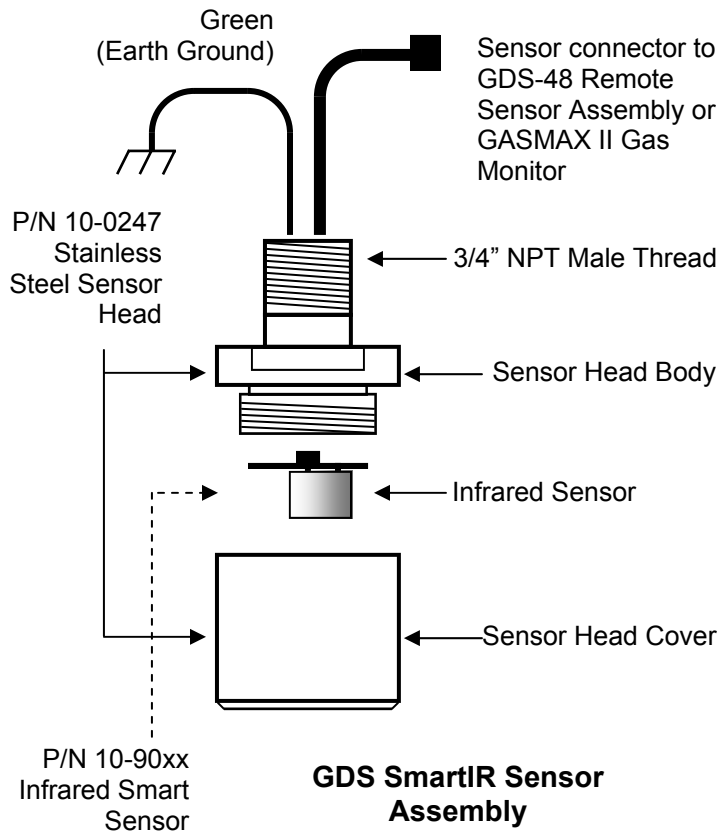
6.1 *GDS SmartIR Maintenance*

The GDS SmartIR sensor is a highly reliable, self-contained infrared detector that requires very little maintenance other than periodic calibration and lamp replacement. There are no user-serviceable parts.

Cleaning – During the course of normal operation, contaminants in the ambient air can cause a reduction in sensitivity due to a build-up of film on the sensor's infrared cell windows. Periodic calibration will compensate for this effect. In the event that the sensor's sensitivity drops excessively, the sensor should be replaced.

Lamp Replacement – The IR source inside the SmartIR has an MTBF in excess of 100,000 hours of normal operation and cannot be replaced.

SECTION 7 – PARTS LISTS & DRAWINGS



Part Number Description

10-9050	SmartIR 0-100% LEL Methane
10-9051	SmartIR 0-100% LEL Propane
10-9052	SmartIR 0-100% by Volume Methane
10-9053	SmartIR 0-5% by Volume CO ₂
10-0247	Remote Stainless Steel Sensor Head w/ Cover
10-0198	Sensor splash guard
10-0205	Sensor flow cell for process monitoring
10-0187	Sensor replacement tool
1000-0078	Large black magnet for GASMAX II

Appendix A – UEL & LEL Levels for Selected Gases

Flammable / Explosive Limits of Various Gases & Vapors (Measured in % of volume by air)			
	Compounds	LFL/LEL	UFL / UEL
Alcohol	Methanol	6.7	36
	Ethanol	3.3	19
	Propanol	2.2	14
Esters	Ethyl Acetate	2.2	11
Ethers	Ethyl Ether	1.9	36
	Methyl Ether	3.4	27
Hydrocarbons	Methane	5.0	15
	Propane	2.1	9.5
	Butane	1.8	8.4
	Hexane	1.2	7.4
	Heptane	1.05	6.7
	Acetylene	2.5	100
	Gasoline (unleaded)	1.2	7.1
	Jet Fuel	1.3	8
	Naphtha	1.7	4.8
	Turpentine	0.7	
Cyclic Compounds	Toluene	1.2	7.1
	Xylene	1.1	6.4
	Ethylene Oxide	3.6	100
Ketones	Acetone	2.6	13
	Methyl Ethyl Ketone	1.4	10
Inorganic Gases	Carbon Monoxide	12.5	74
	Hydrogen Sulfide	4.0	44
	Ammonia	15	28
	Hydrogen	4	75

Note: Data extracted from industry literature; actual data has not been independently validated by GDS Corp.