DESIGN MANUAL

MODEL GIR900
INFRARED COMBUSTIBLE GAS SENSOR

70086

The information in this doucment is applicable to sensors built in September, 2008 or later (Firmware 3.0)

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MODEL GIR900 INFRARED COMBUSTIBLE GAS SENSOR

DESCRIPTION

The SST Model GIR900 Infrared Combustible Gas Sensor is a completely self-contained device that measures and displays the concentration of gas accumulated in a protected area and transmits this information to a central control point.

Figure 900-1 GIR900 Sensor

Principle of Operation

The GIR900 uses the absorption of hydrocarbons in the 3.3 µm to 3.5 µm range for the detection of any hydrocarbon gas. The absorption of the hydrocarbon compounds is a result of the oscillation of the H-C structure when exposed to energy. The GIR900 uses an incandescent lamp pulsed at 4 Hz in conjunction with two piezoelectric light sensors all contained in a stainless steel plug-in housing. In a patented configuration, the sensors are close to each other and are exposed to the direct light from the lamp, with no mirrors or other optical structures involved. In addition, almost no light is reflected by the walls of the housing thus eliminating all possible influences from wall contamination. The active sensor has an optical filter tuned to 3.4 µm; the reference sensor sees the wide-band infrared signal from the lamp.

The presence of hydrocarbons will decrease the signal to the active sensor significantly, while the signal to the reference sensor is almost unchanged. The electronics module contained in the GIR900 constantly measures the signals from both sensors, averages them to filter out noise and then calculates the ratio of the averaged active and reference signals. With a constant length of the optical axis, the relation between the active/reference ratio and the actual gas concentration is logarithmic. The length of the optical path yields an output for hydrocarbons that allows measurements with a resolution of 1%-2% of reading. The ratiometric principle makes it possible to eliminate almost all effects of temperature, aging, or fogging that would otherwise spoil the measurement. The optical operation principle has the following advantages:

Readings independent of Oxygen, wind, etc.
Readings NOT influenced by cross-sensitivity and poisoning
No burnout, saturation, shift or drift when the detector is exposed to high gas concentrations

Each SST Sensor includes a high reliability microcontroller based transmitter in the explosion proof sensor housing. The transmitter is continuously calculating the concentration of gas present in percentage of the Lower Explosive Limit (%LEL). The transmitter then converts this reading to a standard 4-20 mA signal. This signal may be connected to a suitable SST NOVA-5000 Gas Detection Module, or to any other device with a standard 4-20 mA input. Connections between the transmitter and control device are normally made with 3 conductor cable [+24 VDC, 24 V return, 4-20 mA signal].

Detectable Gases

As a rule, most members of the hydrocarbon family are indiscriminately detected by the GIR900. In contrast to the catalytic detector, long-chained hydrocarbons are detected with greater sensitivity than Methane and Ethane. The sensor will not detect gases that do not contain hydrocarbon elements, such as hydrogen, oxygen, carbon monoxide, or helium. See Tables 1 and 2.

TABLE 1
GIR900 Detectable gases
with sensitivity relative to Methane

Methanol	(10)
Propane	(9.3)
Butane	(8.6)
Ethane	(8.0)
Diesel	7.5)
Ethanol	(7.1)
Hexane	(5.8)
Octane	(5.7)
Iso-propanol	(3.4)
Pentane	(2.5)
Methane	(1.0)
Acetone	(0.7)
Toluene	(0.5)
Ethene	(0.3)

TABLE 2
GIR900
Gases that can not be detected

Carbon Disulfide	(no HC absorption)
Hydrogen	(no HC absorption)
Ammonia	(no HC absorption)
Acetylene	(HC absorption at 3.05 µm)
Benzene	*HC absorption below 3.30* µm)
Carbon Monoxide	*absorption at 4.7* µm)

TECHNICAL SPECIFICATIONS

Power Supply ..... 24 volts DC nominal. Will operate within specifications at any supply voltage between 16 and 30 volts @ 120 mA

Range ..... 0 to 100% LEL Hydrocarbon

Warm-up time ..... 90 seconds operational
20 minutes to specification

Operating Temperature ..... -40 to +158° F. -40 to +70° C

Relative Humidity ..... 0-95% non-condensing

Ingress Protection ..... IP40, IP52 with optional dust cover, IP66 with optional spray shield

Resolution ..... 2% LEL

Typical Combustible Gasses ..... See Table 1

Repeatability ..... Zero: ±0.1% of full scale
Signal: ±0.05% of full scale

Analog Output ..... Sensor will source 0 to 20 mA DC into a load of 700 ohms or less

INSTALLATION

A complete GIR900 unit consists of an explosion-proof stainless steel housing with self-contained Infrared gas sensor element and transmitter electronics that converts the sensor signal to the standard 0 to 20 milliamp signal. The sensor is normally installed on an accessory junction box, which contains a terminal block for use in connecting the sensor wires to the required 24 volt DC power source and the measuring equipment. The incoming wires may be installed in rigid metal electrical conduit, or a ¾ inch NPT cable gland may be installed in the junction box to permit wiring with incoming multi-conductor cable.

Figure 900-2 Wall Mounting

Mounting the enclosure

When used inside a building, the sensor may be mounted on the ceiling of a room, or on a wall. Use the two mounting holes in the junction box to secure the unit. When used outside where the sensor can be subject to rain, wind or dust, the sensor should always be mounted with the porous metal filter for gas entry pointed downward. You may need a mounting bracket to do this.

The location of the sensor is important. For lighter than air gasses, such as methane, the sensor should be located **above** the spot where a leak is likely. For heavier than air gasses, such as propane, locate the sensor **below** the expected leak. However, always locate the sensors at least one foot (30.5 cm) above the floor to prevent damage from water, dust, etc.

Figure 900-3 Ceiling Mounting

Wiring

A typical installation is shown in the schematic diagram. This setup uses three wires between the Sensor and the associated control modules. These wires carry the 24 VDC operating power for the sensor, and transmit the 20 mA signal to the controls. Note that the "COM" wire is the common return for DC power and the 4-20 mA signal. The connection wires should be shielded or installed in metal conduit to prevent undesirable noise pickup.

Remove the 4 screws from the junction box cover for access to the wiring terminals. The sensor may be mounted in the box cover, or in one of the side outlets of the junction box. If the sensor is mounted in the box cover, use the provided nylon strap to temporarily hold the cover while connecting the sensor wires to the terminal block. Do not let the cover and sensor hang on the connection wires, as the wires may be loosened from the terminal blocks due to the weight of the stainless steel housing. Then connect 24 volt DC power supply and monitoring equipment wires to the screw terminals in the junction box as shown in the drawing.

Figure 900-4 Wiring

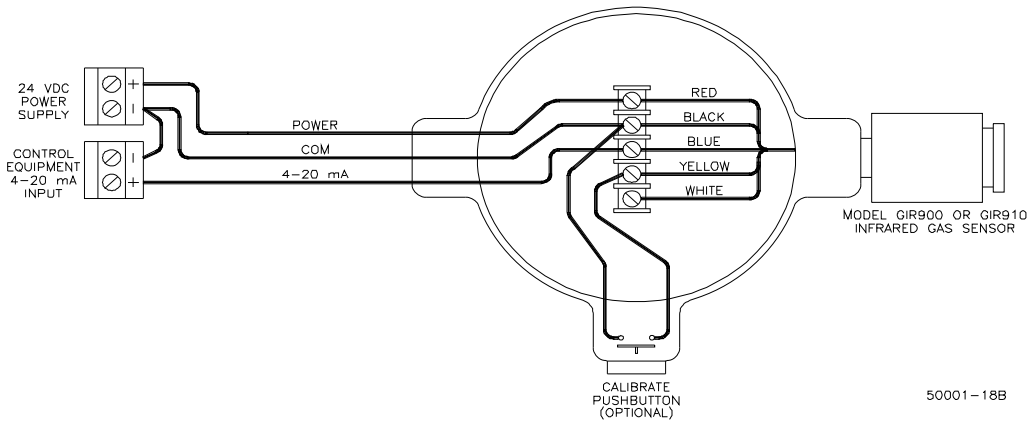

Figure 900-5 Typical Installation Schematic

IMPORTANT: The location of the sensor wires on the terminal block in the junction box is not important, and may be different than as shown on this drawing. Be sure to connect the external devices to the correct ***insulation color of the sensor wires*** to prevent damage to the sensor.

Calibrate Pushbutton

The optional calibrate pushbutton may be wired to the sensor as shown. Due to the extreme stability of the infrared sensor, recalibration will not regularly be required, so this button would be used only in special cases where more regular calibrations are desired.

OPERATION

Power-Up

When power is first applied, the Sensor begins a 90 second countdown period to allow time for proper temperature stabilization. The sensor will output 4.0 milliamps during this warm up period, but it will not respond to gas during that time. At the end of the warm up, the Sensor begins normal operation.

Do not depress the calibrate button (if installed) during the first 10 seconds of the initial warm up period. Depressing the button during this time erases the previously saved calibration data, and will make recalibration necessary. An output signal of 2.0 mA indicates no calibration data is stored in the memory.

Calibration

The GIR900 Sensor is pre-calibrated at the factory to 50% LEL of the target gas. Recalibration after installation is recommended to verify that the sensor is properly installed and functioning normally. During the calibration procedure, the presence of "clean" air, i.e. air without any combustible components, is absolutely necessary to provide the electronics module with a reference point for 0% LEL gas concentration. In locations where clean air cannot be assured, you may need to "purge" the sensor with clean air from a gas bottle before starting the calibration procedure.

NOTE: The sensor has been factory configured to a specific target gas. To recalibrate, you must use the target gas mixed with air to a concentration of exactly 50% of the lower explosive limit (LEL) of the gas.

IMPORTANT: The sensor **cannot be recalibrated to a different target gas** *without returning it to the factory for reconfiguration.*

The GIR900 must "warm up" for at least 90 seconds after power is first applied before starting calibration. Calibration will be more accurate if you can wait 20 minutes before starting. Do not push the calibrate button on the housing during the first 10 seconds of warm up, or previous calibration data will be erased from the non-volatile memory.

During the calibration procedure, you need to read the signal at the analog output of the sensor. If possible, have someone at the location where the analog signal is monitored read the values (in percent LEL or in milliamps) for you as you apply the test gas. If this is not possible, disconnect the BLUE sensor wire from the terminal block in the junction box and insert a milliamp meter as shown in figure 900-6.

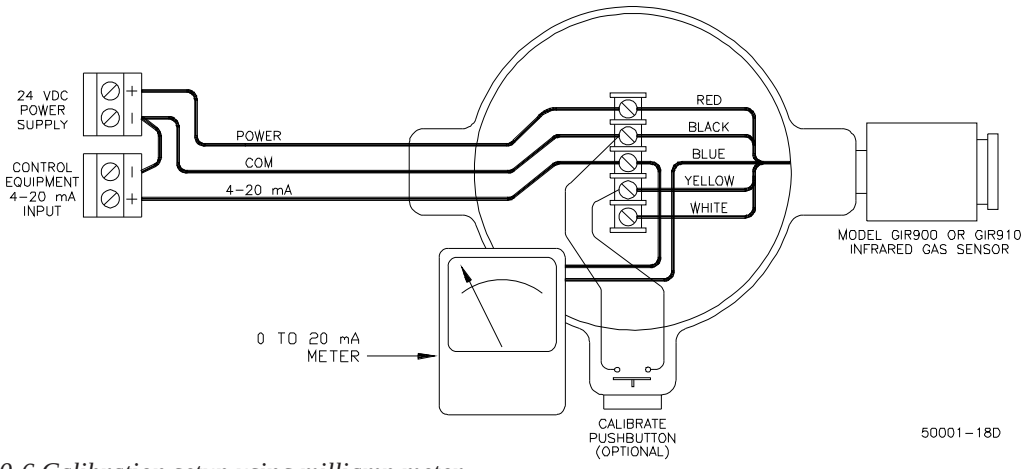

Figure 900-6 Calibration setup using milliamp meter

Calibration Procedure

! During calibration, the sensor will output will increase to 12 milliamps or 50% LEL. Be sure that any alarm equipment connected to the sensor is inhibited or isolated during the calibration procedure.

Carefully follow the below listed steps to properly calibrate the sensor electronics module:

1) Apply power to the Gas Sensor and wait at least 90 seconds for the warm up period to expire. During this 90 second period the sensor will not respond to any gas. The longer the unit is allowed to warm up, the more stable the signal will be and thus more reliable.

2) Verify the sensor output is reading approximately 4 mA (milliamps) or 0% LEL.
If the reading is 2 mA or minus 12% LEL, the unit has never been calibrated, or the last calibration data has been erased.
If the reading is 0 mA or minus 25% LEL, either the test setup is not correct or the sensor electronics has failed.

3) Press and hold the calibrate pushbutton (if installed), or if a pushbutton is not installed, start the calibration sequence by connecting a jumper between the yellow and black sensor wires. Be sure that no combustible gas is present at this time. Do not release the pushbutton or remove the jumper until the meter shows 0 mA or minus 25% LEL

4) Release the button or remove the jumper when the meter shows 0 mA or minus 25% LEL. The sensor is now setting the "zero gas" values into memory. Wait for the meter to read 2 mA or minus 12% LEL.

5) When the meter reads 2 mA or minus 12% LEL, apply calibration gas. Calibration gas should be regulated to a flow rate of 1 liter per minute. Wait for the meter to display 12 mA or 50% LEL.

6) Remove the calibration gas and wait for the sensor output to return to 4 mA or 0% LEL. The calibration is now complete and unit is operational.

Failed or Incomplete Calibrations

If the calibration procedure is aborted (e.g. by not applying calibration gas), the Sensor will return to normal operation after a time-out period of 3½ minutes. In this case the Sensor will use its original, pre-calibration data. Turning the power off will also abort the calibration procedure. Common causes for incomplete calibration are:

1) Calibration gas runs out during calibration. In this case, wait for the Sensor to return to normal operation and repeat procedure with a fresh calibration gas bottle.

2) Gas applied at wrong time. Gas applied during step 4 of the calibration procedure above (too early, during clean air sampling) will result in negative displays and inaccurate readings. If the gas is applied too late (which may occur due to the pipe length when remote sensors are used) it may not reach significant levels before the 3½ minute time-out and thus abort the calibration procedure.

Recalibration Schedule

Due to the extreme stability of the infrared gas sensor, recalibration is rarely required. Under normal operating conditions, SST recommends that the gas detectors should be checked every 90 days per the instructions above. Test gas should be applied to the sensors on a scheduled basis to verify proper sensor operation. Before testing, do a visual inspection to check for contamination of the sintered metal sensor cover, loose parts, etc. *Be sure to deactivate any connected equipment before applying test gas to the detector to prevent false alarms!*

MAINTENANCE

The GIR900 is easy to service. Most service activities will require removal of the sensor front cover or junction box cover for servicing.

CAUTION: Before opening lids or enclosures, the area must be free of any combustible gasses!

Replacing the Infrared Gas Sensor Electronics Module

After extended use, the incandescent lamp in the detection element may fail. In this failure mode, the analog output of the detector will be about 2 mA, and there will be no response when gas is applied to the gas detector. To replace, follow this procedure:

1) Remove the sintered metal cover from the sensor head by loosening the set screw and then turning the front part of the enclosure with the sintered metal cap counterclockwise.

2) Grasp the detection element and pull to remove it, along with the PC board assembly, from the housing. Replace with the new electronics module. Discard the failed module.

3) Replace the sensor cover and tighten set screw.

4) Wait for the 90 second warm up to occur, then complete the calibration of the new element, following all instructions listed under **Calibration** in this manual.

TROUBLESHOOTING

Sensor output constantly 2 mA

This indicates that the IR gas sensing element has failed or that no calibration data is saved in non-volatile memory. Perform a complete calibration per instructions in this manual. If sensor will not calibrate, then the sensor element has failed. Replace the electronics module with a new one.

Sensor output pulses between 0 mA and 2 mA every second

Indicates a thermal fault, which occurs when the sensor is exposed to temperatures greater than 70 degrees C or 158 degrees F. Normal sensor operation will resume when sensor is cooled to lower temperature.

SPARE PARTS

The following spare parts for this item are available from Safety Systems Technology.

Order No.	Description
40900-25-2	Plug-in transmitter module with sensor element, target gas Methane
40900-25-3	Plug-in transmitter module with sensor element, target gas Propane
40900-25-5	Plug-in transmitter module with sensor element, target gas Butane
40900-25-7	Plug-in transmitter module with sensor element, target gas Ethane
40900-25-8	Plug-in transmitter module with sensor element, target gas Pentane