

The first intrinsically safe IR transmitter for Ex Zone 0

Non-dispersive infrared (IR) sensors are increasingly seen as the detection technology of choice for many fixed combustible gas measurement applications. IR sensors offer a number of advantages over traditional catalytic LEL sensors. IR sensors are extremely stable, have longer operational life spans, and are not subject to damage or loss of sensitivity due to exposure to sensor poisons or inhibitors.

Traditional LEL sensors

Traditional catalytic LEL sensors detect gas by oxidizing (burning) it on an active bead that is heated to a very high temperature (550°C) and protected behind a flame arrestor. The sensor can only detect gas that is able to reach and penetrate the bead. The larger the molecule, the slower it diffuses through the flame arrestor and into the active bead of the sensor. Small combustible gas molecules like methane (CH₄) and propane (C₃H₈) diffuse very rapidly into the sensor, and are detected quickly. Larger molecules like hexane (C₆H₁₄) or octane (C₈H₁₈) are still detected accurately, but take longer to detect, and have a much lower relative response. The even larger hydrocarbon molecules in "heavy" fuels such as diesel, kerosene and jet fuel may not be able to reach and penetrate the active bead at all in appreciable quantities. This is one of the reasons that catalytic LEL sensors show such a low response when exposed to the vapors from these fuels.

Traditional LEL sensors need the presence of oxygen to detect gas, and are highly vulnerable to sensor poisons like volatile silicones, high concentration sulphides, and tetra-ethyl lead. Because they lose sensitivity so easily, catalytic LEL sensors need to be tested and adjusted on a regular basis.

How IR sensors detect gas

IR sensors measure gas as a function of the absorbance of infrared light. When a chemical bond absorbs infrared radiation the bond continues to vibrate at the same frequency but with greater amplitude after the transfer of energy. When infrared radiation passes through a sensing chamber that contains gas, only those wavelengths that match the vibration modes of the chemical bonds in the molecules of gas are absorbed. The rest of the light is transmitted through the chamber without hindrance. IR sensors measure the amount of light that is absorbed by the molecules in the sensing chamber.

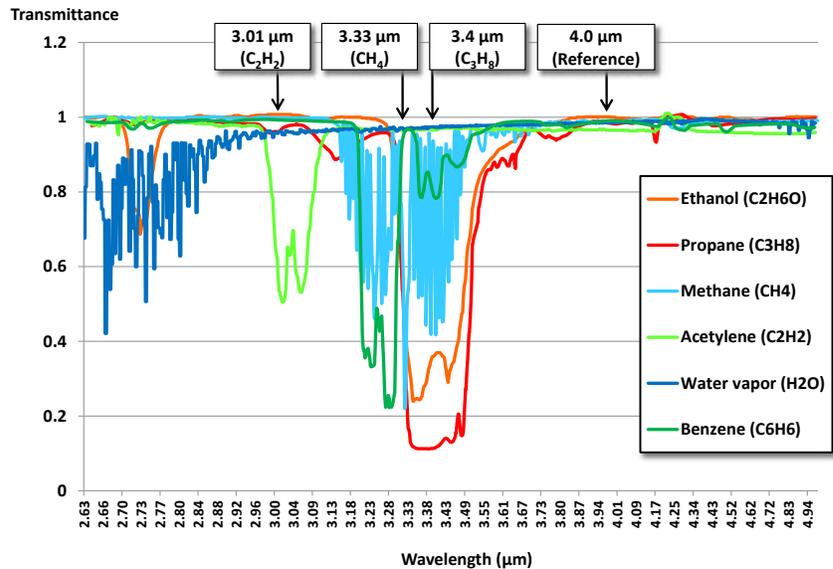


Figure 1: The IR spectra of several commonly measured combustible gases. No single wavelength range is perfect for all measurable gases. While 3.33 µm is best for methane, 3.4 µm is better for propane. Acetylene does not absorb at either of these wavelengths, and is measured at 3.01 µm.

What is the best wavelength for measurement?

The best wavelength to use for measurement depends on the gas, or mixture of gases that is being measured. GFG's patented "4-beam 4-wavelength" IR 29 gas transmitter is able to measure at up to four wavelengths at the same time. Using multiple wavelength ranges for measurement provides a much more accurate reading than systems that are based on measurement at a single wavelength.

Figure 1 shows the "spectrograms" of the wavelengths at which a number of common gases absorb IR light. The wavelengths most frequently used for general combustible gas measurement are near 3.33µm or 3.4µm. Acetylene (C₂H₂) requires a different wavelength, and is measured at 3.01µm. A reference detector measures the amount of light at a wavelength (4.0µm) where there is no absorbance by combustible gas.

When needed, one of the channels can be used to directly measure, and deduct the effects of absorbance by water vapor from gas readings in real time, reducing the effects of humidity interference to near zero.

While catalytic LEL sensors are more sensitive to small molecules than to larger molecules; the opposite is true for IR sensors. It is the chemical bonds in the molecules being measured that actually absorb the IR light. Since larger molecules have more chemical bonds, they provide more opportunities for IR to be absorbed. Methane (CH₄) has only four chemical bonds. Pentane (C₅H₁₂) has 12 bonds that can absorb IR. It makes sense that the relative response of the IR sensor to pentane is greater than the response to methane.

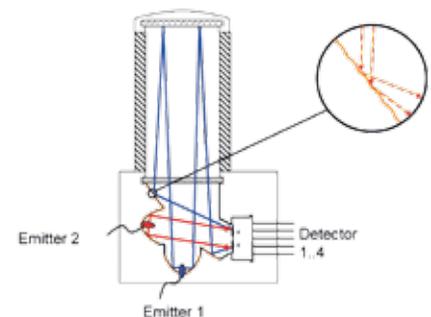


Figure 2: IR 29 patented 4-beam 4-wavelength technology uses a precisely shaped sensing chamber with ultra high reflectivity gold film plating to automatically focus the light on the detectors. No beam splitters or lenses required!

Always be on the safe side with the IR 29

IR 29 Advantages

The patented, intrinsically safe IR 29 transmitter utilizes a unique optical sensing chamber plated with a high-tech gold film mirror (Figure 2) that precisely reflects and focuses the IR light onto the detectors.



Figure 3: The intrinsically safe sensor head can be removed and replaced even while the transmitter is located in fully combustible hazardous atmospheres.

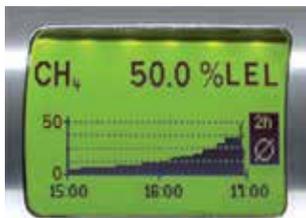


Figure 4: IR 29 transmitters are available with or without a built-in display. In the "Histogram" mode readings are displayed in the form of a constantly updated column chart, making it easy to visually evaluate changes and trends in the gas concentration.



Figure 5: The high contrast easy-to-read display can be flipped 180° for visibility in any position.

Unlike competing designs, the IR 29 does not depend on beam splitters and lenses to direct the path of light through the sensor. Beam splitters and lenses reduce signal strength and introduce noise into the measurement system. By leaving out these hardware elements the IR 29 is able to use lower power IR sources ("emitters") while maintaining higher resolution and accuracy.

Unlike traditional LEL sensors, IR 29 transmitters do not need the presence of oxygen to detect gas. Since they are not affected by sensor poisons they don't require periodic adjustment to make up for lost sensitivity.

IR 29 transmitters can also be used for measurement up to 100% volume (pure) combustible gas.

The IR 29 is the first intrinsically safe IR gas transmitter with patented GfG 4-beam 4-wavelength technology. Because the IR29 is intrinsically safe, there is no need to run transmitter cabling through expensive explosion proof conduit. Because the IS design does not include a flame arrester, even very large molecules such as nonane (C₉H₂₀) can freely diffuse into the sensor, and are easily measured. Since there is no need to install the transmitter in a sealed explosion proof enclosure, the effect of pressure fluctuation on readings is substantially reduced. Optional pressure and temperature transducers provide further compensation for the effects of ambient atmospheric conditions.

Complete safety even in Zone 0

The IR 29 is the first IR gas transmitter that can be installed and used in "Ex Zone 0" hazardous locations in which ignitable concentrations of combustible gas or vapor are assumed to be present at all times. Use of the SB1 safety barrier protects the ATEX Certified system from the possibility of the release of energy that could be the cause of ignition. The energized transmitter head can be removed and replaced for maintenance or calibration without having to declassify the Zone 0 hazardous location!

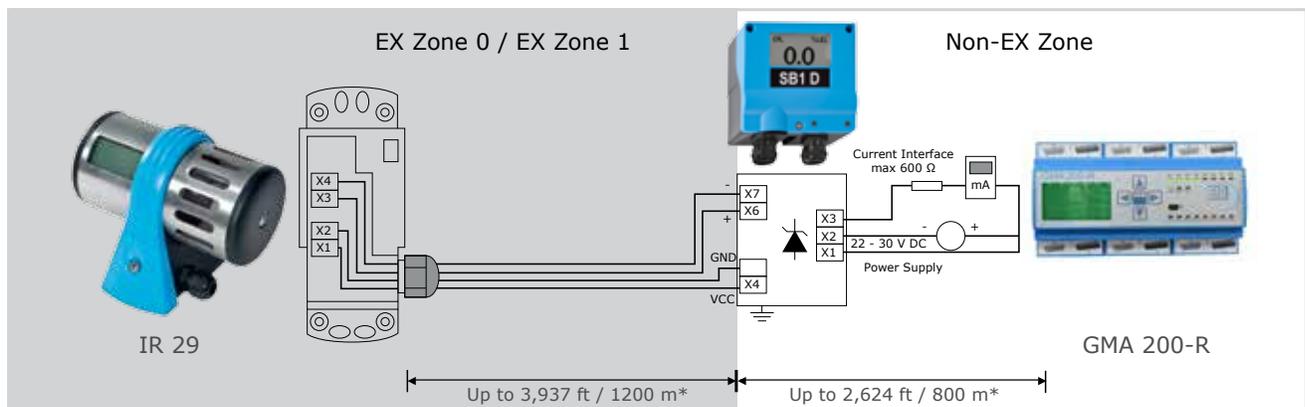


Figure 6: Use of the SB1 Safety Barrier allows IR 29 transmitters to be installed in Ex Zone 0 Hazardous Locations. The SB1 barrier can be equipped with a display that allows workers to see readings without having to enter the hazardous location.

* Maximum values reached on special conditions

Physically robust, electronically advanced

The IR 29 is installed in a robust V4A stainless-steel housing designed to withstand harsh environmental conditions. The IR 29 continuously monitors its functions for proper performance, and can identify and communicate required service procedures. Daily factors affecting performance, such as dust and dirt accumulation, are almost completely eliminated by the innovative design.

Figure 7: IR 29 transmitters with RC2 remote control interface



RC2 Remote Control

To prevent accidental or unauthorized changes, access to the easy-to-use menu driven controls is through the intrinsically safe RC2 remote control. The RC2 can be connected and disconnected even while the IR 29 is located in a Ex Zone 0 Hazardous Location.

Summary of Innovations:

- Suitability for Ex Zone 0 Hazardous Locations
- Energized transmitter can be removed or replaced in Ex Zone 0
- Patented 4-beam 4-wavelength technology
- Available temperature, humidity and pressure compensation
- Graphical display
- Easy-to-use menu driven service and calibration

Technical data

Transmitter IR 29

Gases measured:

Saturated hydrocarbons such as methane, propane, butane, pentane, nonane, etc.
Fuel vapors such as diesel, jet fuel, gasoline, etc.
Alcohols such as methanol, ethanol, isopropanol, etc.
Acetylene
Unsaturated VOCs such as MEK, toluene, butadiene, etc.
CO₂

Measuring ranges:

0 to 100 % LEL or
0 to 100 % volume CH₄
0 to 5% CO₂

Sensor technology:

Non-dispersive IR sensor (NDIR)

Sampling method:

Diffusion
Available motorized pump module

Response time:

t₉₀ ≈ 35-50 seconds

Electrical characteristics:

Supply circuit: 15-30 V DC; 0.6 W

Signal circuit: 0.6 W

Interfaces: 4-20 mA

Power consumption:

I max. = 50 mA total for 24 V = 1.2 W

Display:

1.3" x 2.1" / 33 mm x 53 mm LCD
Graphic display with normal or histogram mode
Available with or without display

Service function:

Connection via remote control RC-2

Wired remote control RC-2

4.9 x 2.4 x 1.5 in; 125 x 60 x 38 mm
Intrinsically safe plug-in connector with cable (33 feet / 10m)
Built-in display with 3 button control
Ex approval: II 2G EEx ia IIC T4

Wireless IR remote control RC3

2.4 x 1.8 x 5 in / 60 x 45 x 13 mm
Range: 19.6 in / 0.5 m
No display; 3 control buttons
Ex approval: II 2G Ex ia IIC T6

Environmental conditions:

Temperature

Operation: -4°F to +131°F / -20°C to +55°C
Storage: -13°F to +131°F / -25°C to +55°C

Air humidity

0 to 99 % RH
0 to 95 % RH non-condensing

Ambient pressure

750 to 1200 kPa, optionally compensated

Housing:

V4A stainless steel (housing)
Polycarbonate (display, front and end cap, foot and bracket)

Transmitter dimensions:

7.3 x 5.3 x 4.6 in / 184 x 134 x 117.5 mm (L x W x H)

Cable connection:

Shielded measuring cable
4 x 0.75 mm² to 1,640 ft / 500 m
4 x 1.5 mm² from 1,640 ft / 500 m
M16*11

Protection class:

IP67
IP56 with rotatable display

Expected average sensor service life:

5 to 10 years

Approvals:

ATEX certification:

Ex II 1G Ex ia IIC T4 Ga
Ex I M1 Ex ia I Ma
CE 0158

EC Type Examination Certificate:

BVS 11 ATEX E 164



Specifications subject to change without notification



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Rev. 10 (03/24/17)