



Latest MSA Fire & Gas detection solutions and technologies

20th of November, Kuwait





Agenda

1. History
2. MSA UltimaX 5000 and GM S5000
3. Open path gas detectors
4. UGLD Observer-I ultrasonic leak detector
5. Flame detectors
6. Controllers
7. Q&A



History

- MSA Safety – fixed gas & flame detection and a wide range of PPE
 - Established in 1914 near Pittsburgh, USA
 - Bought Auer AG in 1957
 - Bought GM in 2010
 - Bought Senscient (UK) in 2016
 - Bought Sierra Monitors (USA) in 2019
 - Bought Bacharach (USA) 2021

Together, more than 300 years of experience!

The largest fixed gas and flame detector manufacturer in the world!

Ultima X5000 & General Monitors S5000

XCell[®]
PERMANENT

TruCal[™]



MSA
The Safety Company

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SAFEGUARDING
PEOPLE, PLACES & THE PLANET

Agenda



- ***UltimaX5000 & GM S5000 features***
 - *Display/housing*
 - *Bluetooth connectivity*
 - *State Of The Art Sensor Technology*
 - *Dual Sensing*
 - *Safe swap*
 - *Upgrade from S4000 series to S5000*

- ***Cost of Ownership***

What if you...

BI-ANNUAL
CALIBRATIONS CAN
LOWER LABOUR
COSTS BY >75%



- Didn't have to calibrate sensors every quarter and instead could schedule it during an annual or even biannual shutdown?
- Could **guarantee** that your sensors were working between calibrations?
- Could see the transmitter status at a glance and **work without special tools** or training to use the gas detector as the menu was easy to understand?
- Only needed to **replace sensors every 5 years** instead of every 12 to 18 months or maybe 24 months?
- Could cut installation costs on new systems in half by using two sensors connected to a single transmitter?

Traditional Gas Detection Today is More Challenging Than Ever

Productivity Loss

Labor can cost **6 times** more than the hardware over 10 years

Time spent on your gas detection system is time not spent meeting operational targets

REQUIREMENT TO CALIBRATE SENSORS EVERY 90 DAYS

Safety

40% of leaks go undetected*

A gas detection system that is not working properly can lead to costly production shutdowns or undetected gas leaks

INABILITY TO TELL FOR SURE THAT YOUR DETECTORS WORK

Maintenance Cost

SENSOR LIFE

O ₂		2 years
Toxic		2.5 years
Comb.		3.5 years

WARRANTIES

	1 year
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MAINTENANCE COSTS

Sensors with a short operating life dramatically affect your maintenance costs. Shelf life starts from when it is made – the longer it's on the shelf, the shorter its operating life

FREQUENT SENSOR REPLACEMENTS

Training

Most detectors require repetitive training for technicians because they are not intuitive

CONSEQUENCES
Costly and more difficult to maintain; technicians not focusing on production activities

DIFFICULT OPERATION AND MAINTENANCE

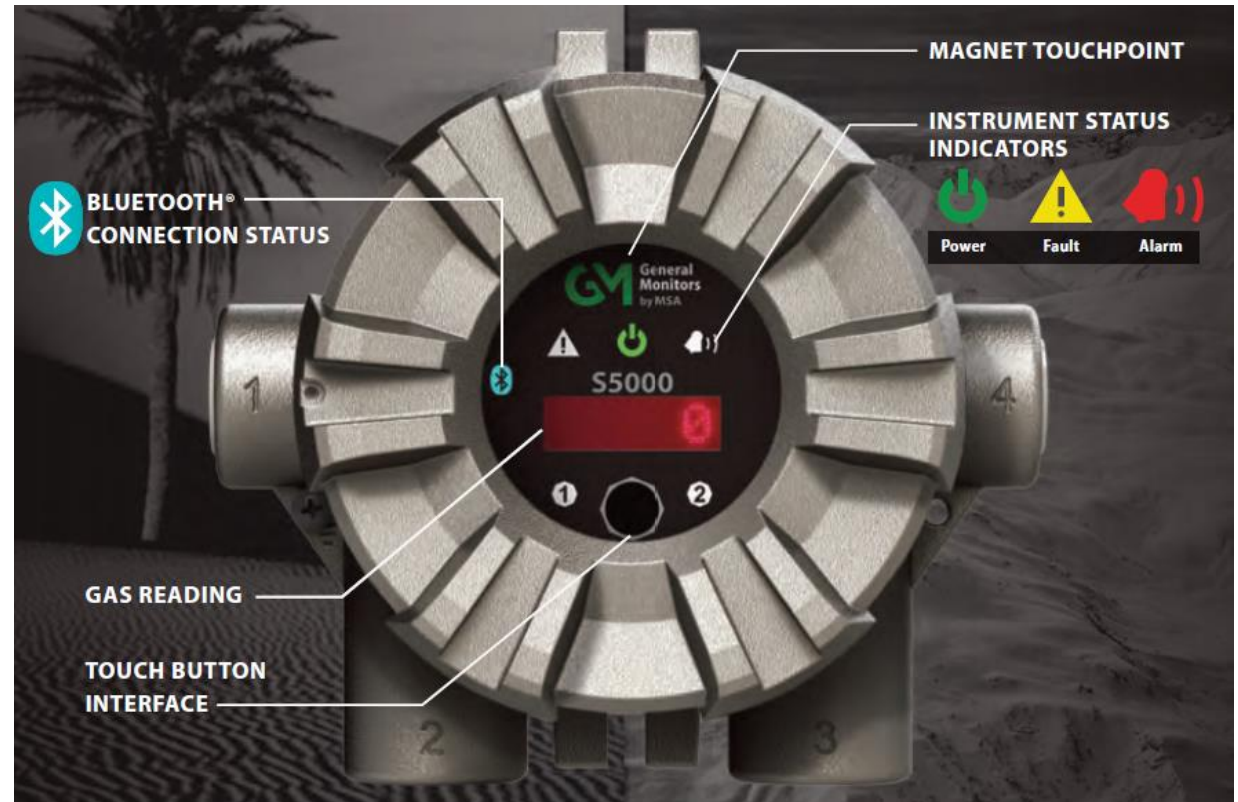
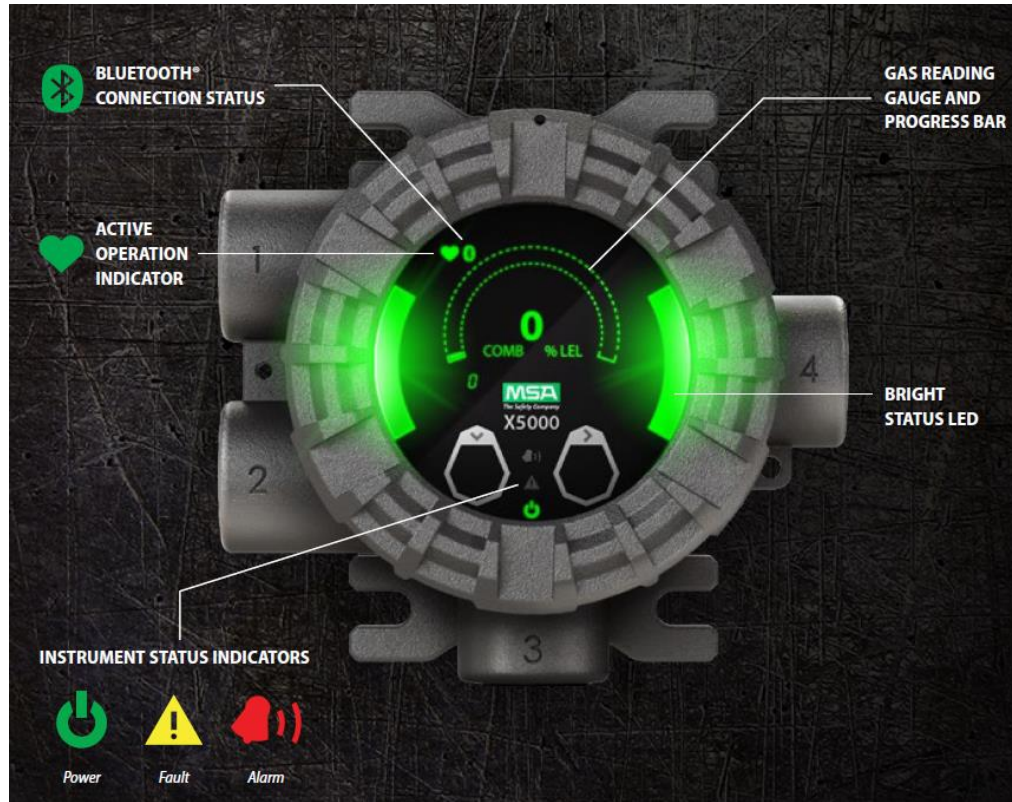
*Offshore Hydrocarbon Release Statistics, HSE UK



Intuitive user interfaces

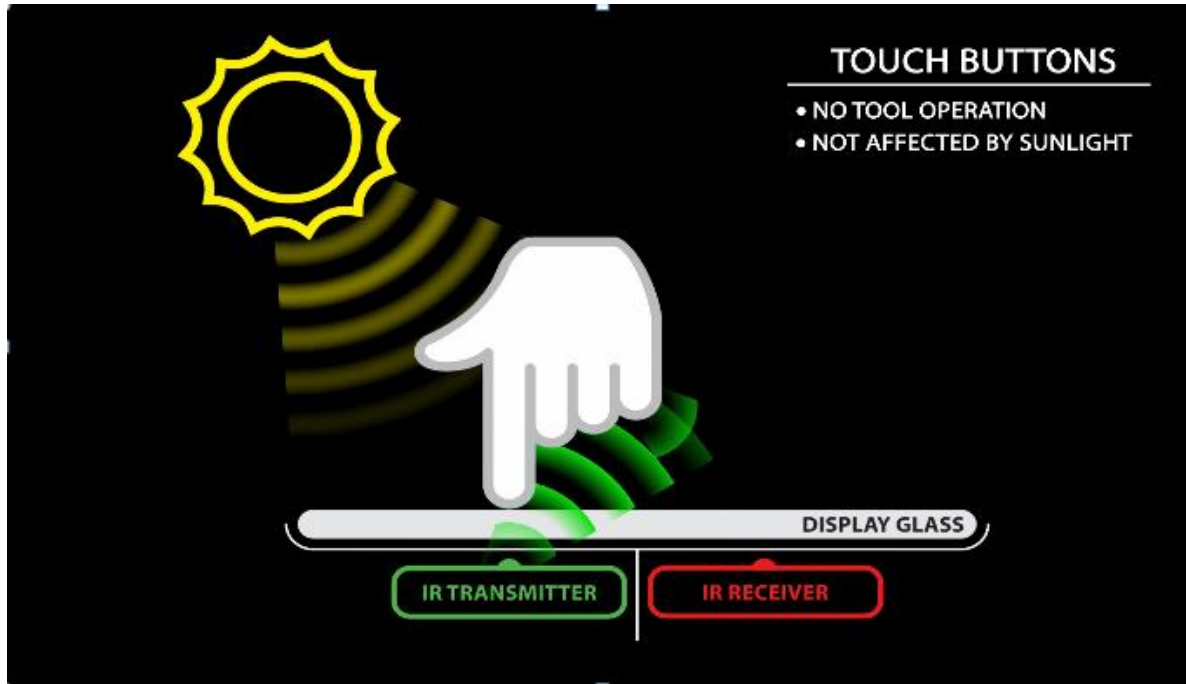
Gas detection should be easier!

EASY AND INTUITIVE USER INTERFACE OPTIONS



Gas detection should be easier!

NON-INTRUSIVE OLED



- Touch buttons for intuitive menu navigation
- Very bright, full text - easy to read menu

MSA APP

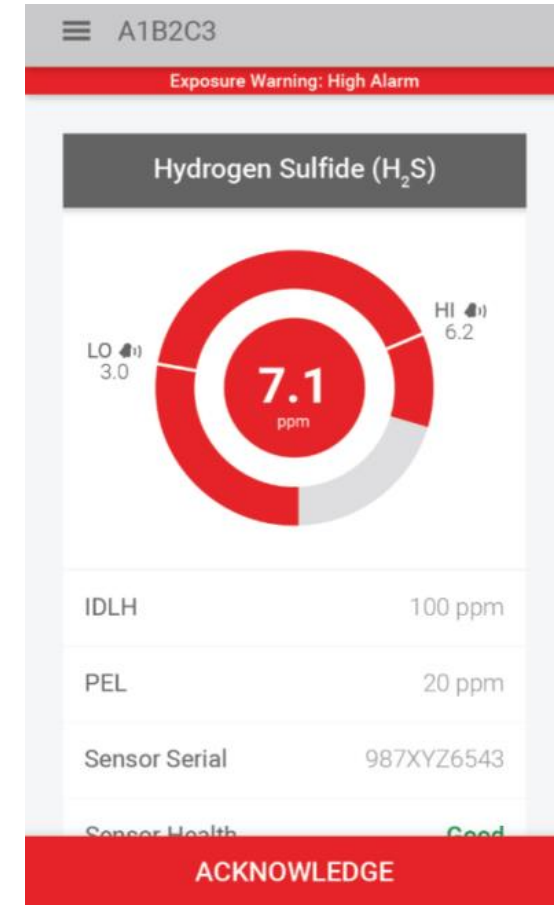
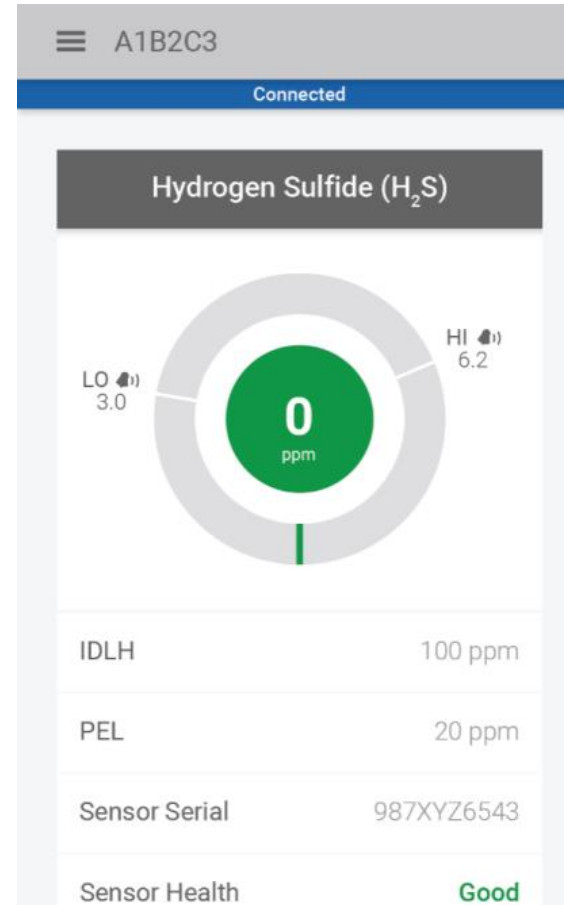
REALTIME DATA IN THE PALM OF YOUR HAND

Improve efficiency with Bluetooth device and MSA App



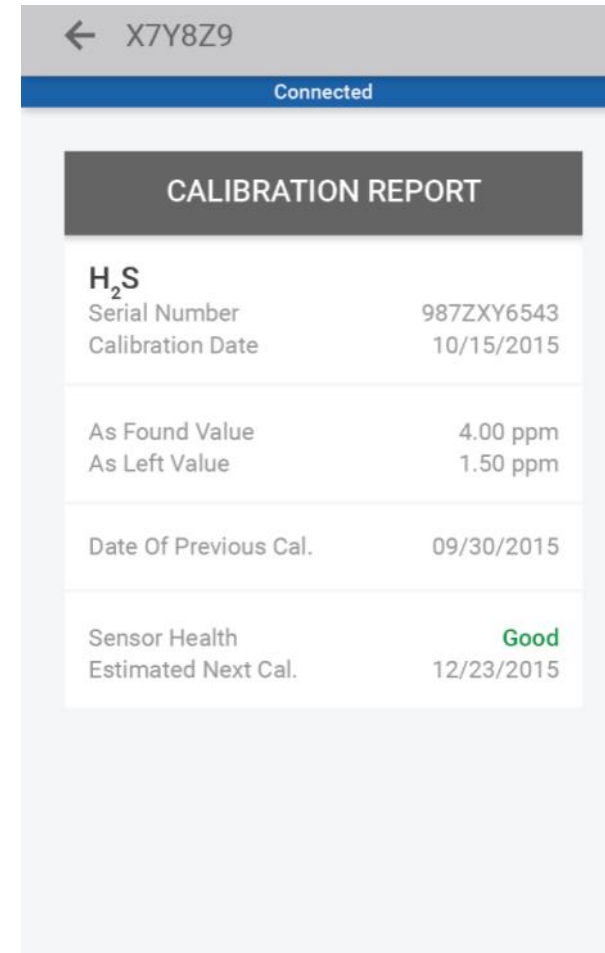
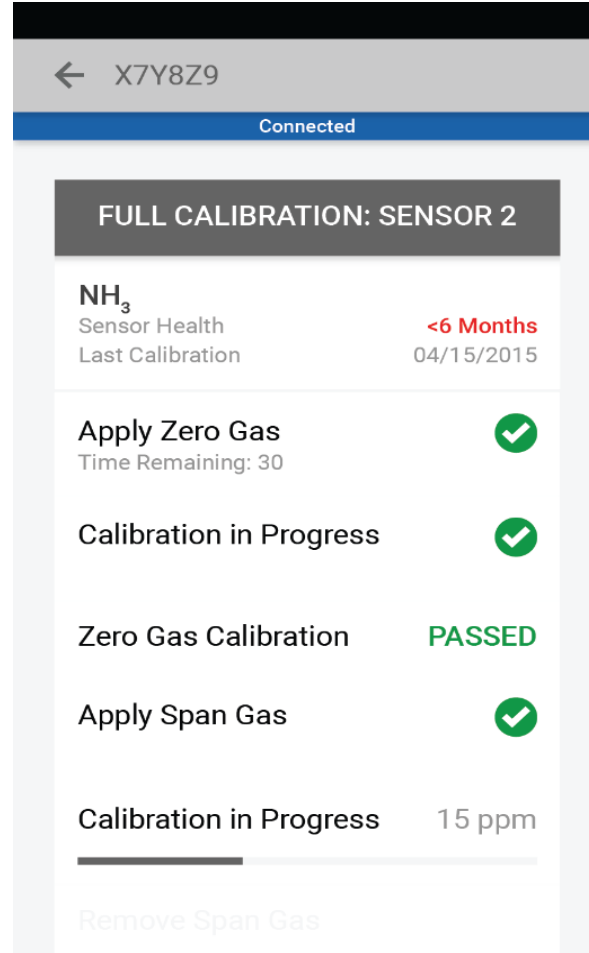
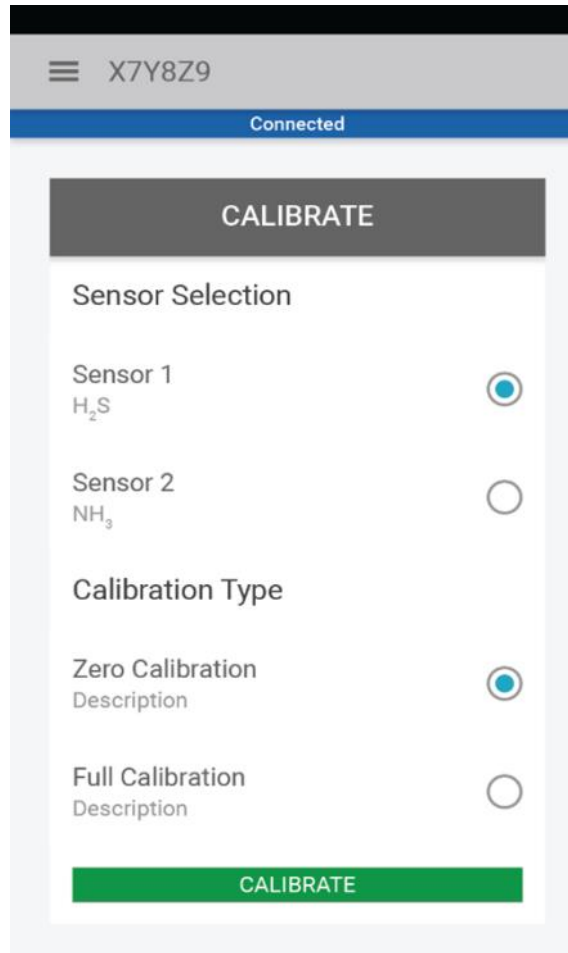
**STAY CONNECTED.
WORK SMARTER.**

- Bluetooth enabled
- Check status and get alerts up to 21m
- Modify settings/set points/alarms
- Initiate calibration and view progress
- Reduce set-up time by at least 50%



MSA APP

INITIATING CALIBRATION





X/S5000 sensing technologies

STATE OF THE ART SENSOR TECHNOLOGY

EXPECT MORE FROM YOUR SENSOR!



TruCal Technology – H₂S & CO sensors



Sensor self test every 6 hours, checking:

- Sensor condition – functionality, status (electrolyte, electronics, sensor life, inlet condition), measurement accuracy
- Initiates a fault signal if the sensor is not able to detect gas
- Alerts the user through a mA signal, if a manual gas calibration is required

Adaptive Environmental Compensation – compensates for any measurement drift

Diffusion Supervision – monitors sensor inlet for blockages, preventing gas detection

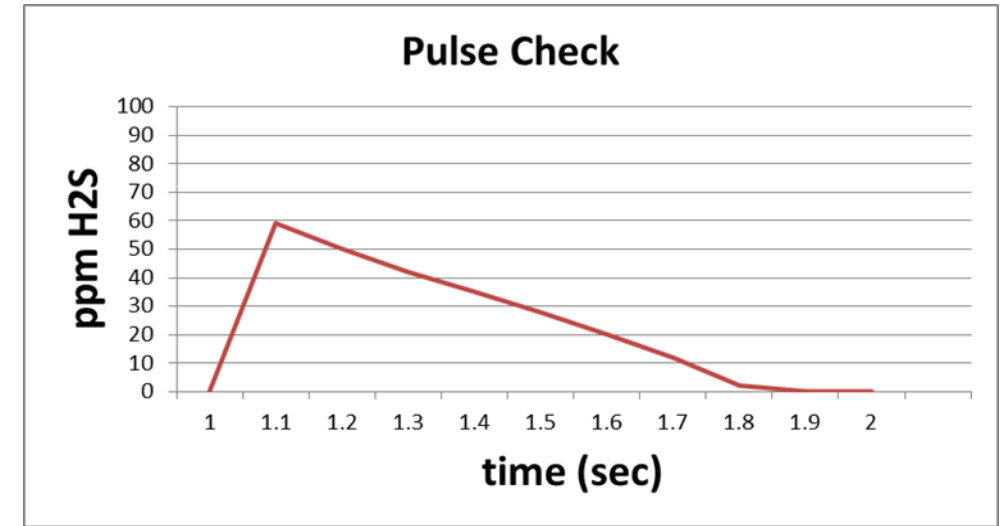
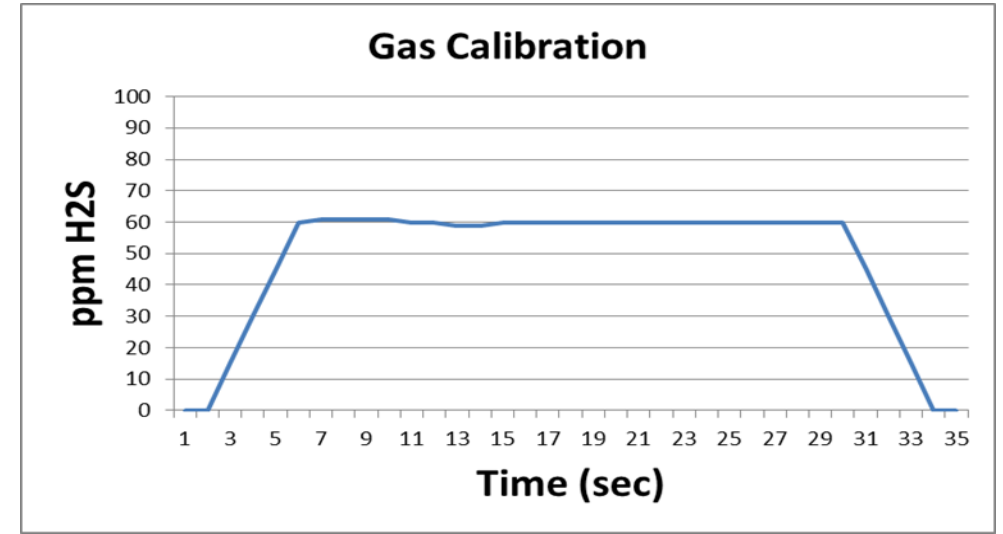
Other H₂S sensors only “report” a sensor failure during a manual calibration or functional test (bump test)

- Traditional sensors often go several months without being able to detect gas
- Cannot give a fault signal to alert the user of this dangerous condition

XCell H₂S sensors are the safest sensors currently available

Adaptive Environmental Compensation

- A manual gas calibration sets the sensor response equal to the span value (mV)
- The sensor's microprocessor initiates the “**Pulse Check**” – a short electric pulse through the sensor circuitry
- The response of the sensor to the Pulse Check is compared to the previous gas response
- If required, the measurement reading will be adjusted. This is called **Adaptive Environmental Compensation**
- It takes less than 1 sec and is performed 4 times a day, without any change in the analog output





Diffusion Supervision – H₂S & CO sensors

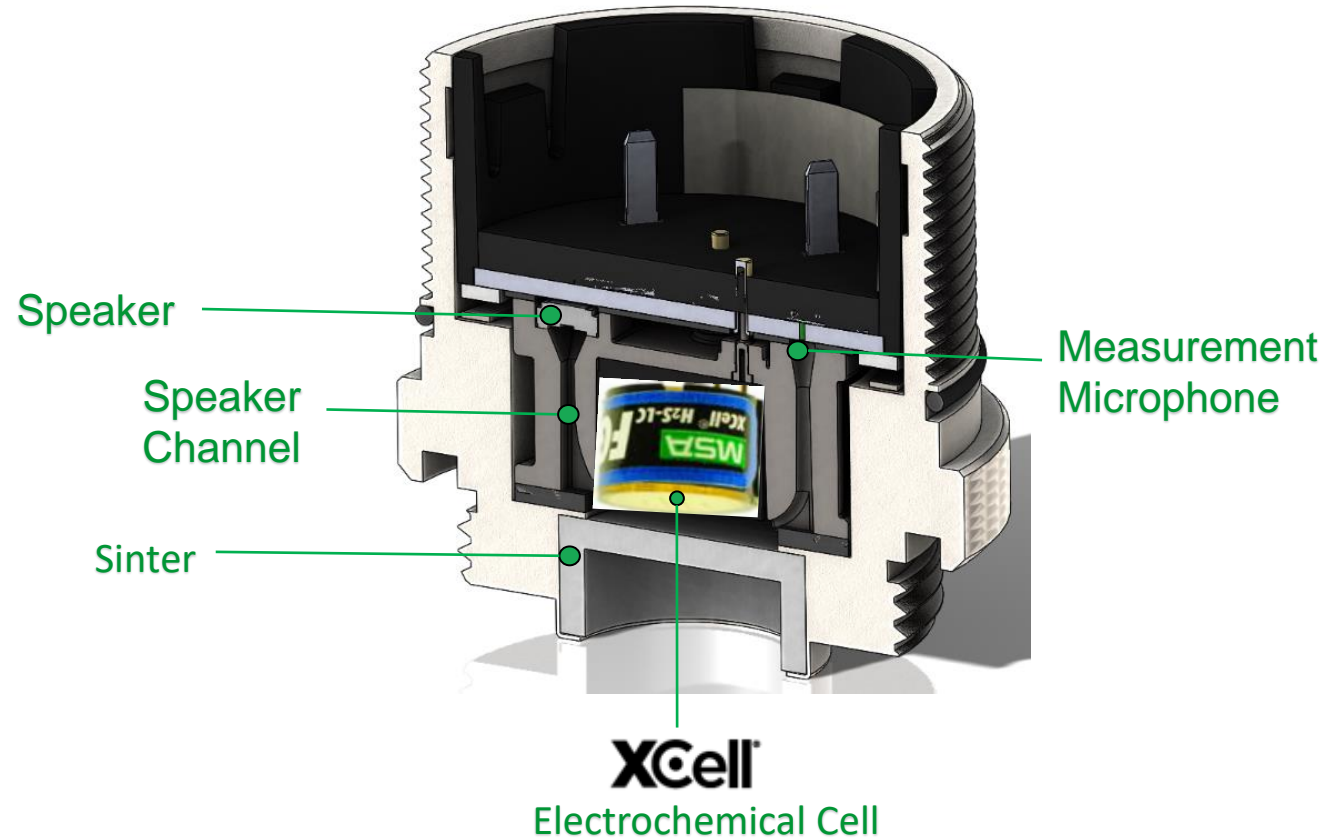
- A patented system to monitor the sensor inlet
- Part of the TruCal[®] sensor check, every 6 hours
- DS monitors the sensor inlet for blockages, which will prevent gas from reaching the sensor and being detected
- XCell sensors with DS do not require any scheduled maintenance for up to **2 years**

How does Diffusion Supervision work?

Components Overview



Sensor Assembly Cross Section

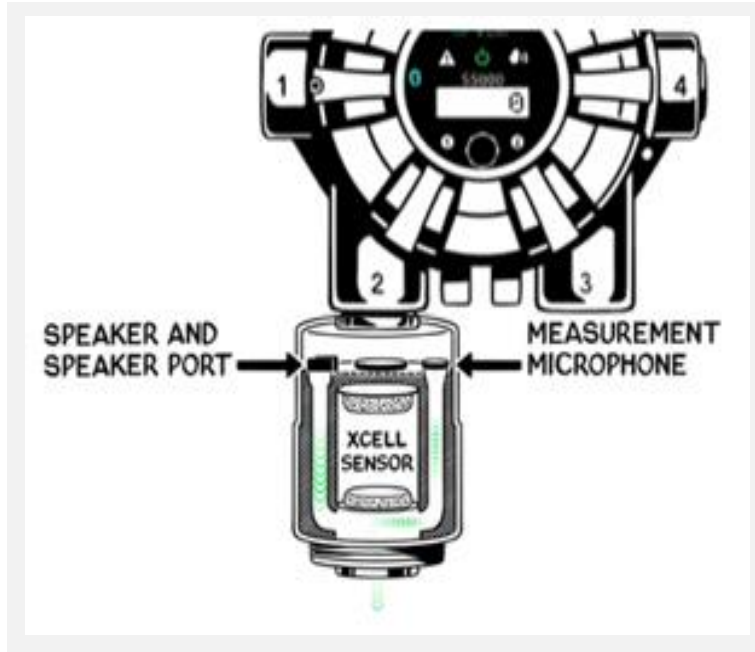


How does Diffusion Supervision work?

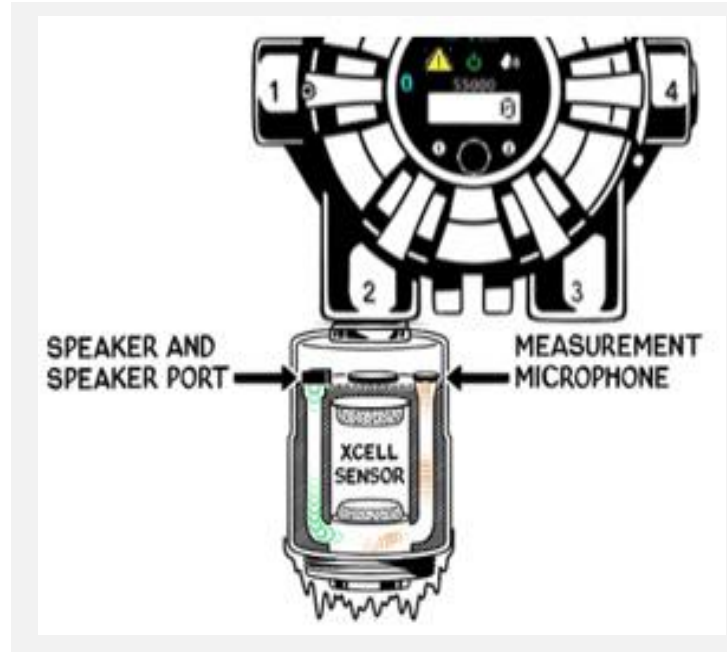
The speaker tone changes if the sensor inlet is sufficiently blocked



Not Blocked



Blocked



Sound Measurement Variables

Amplitude: measurement of signal strength

Frequency: how fast or slow sound travels

TruCal Technology

TRUCAL Video



- TRUCAL Technology is in the sensor itself.
- PULSE CHECK is controlled by the ASIC (Application-Specific Integrated Circuit) in MSA's XCell Sensors.

XCell H₂S Sensor Spec. & Performance



- **Higher operating temperature** - more suitable to the Middle East environment
- Innovative sensor design, with new **non-consuming electrolyte**
- Revolutionary design and performance, extends sensor **operating life >5 years**
- Sensors can be **kept in stock for up to 3 years and have a 3 year Shelf Life**
- Industry leading **3-year manufacturer's standard warranty**
- T-90 response time of **<23 seconds**
- **No "sleeping effect"** if not exposed to gas

-40°C to +60°C



EXPECTED LIFE



WARRANTY

IMPROVED PERFORMANCE

CATALYTIC SENSOR TECHNOLOGY

Beads are 5 times larger than the industry average

1. The unique mechanical support post allows for bigger beads and prevents the platinum wire from breaking
2. Large amounts of surface area for more active sites.

Results in:

- Better resolution
- No drift
- Longer lifetime – typically >5 years

XCell[®]
SENSORS



Years of experience in developing catalytic bead sensors

Ultima® X5000 & S5000 sensor options

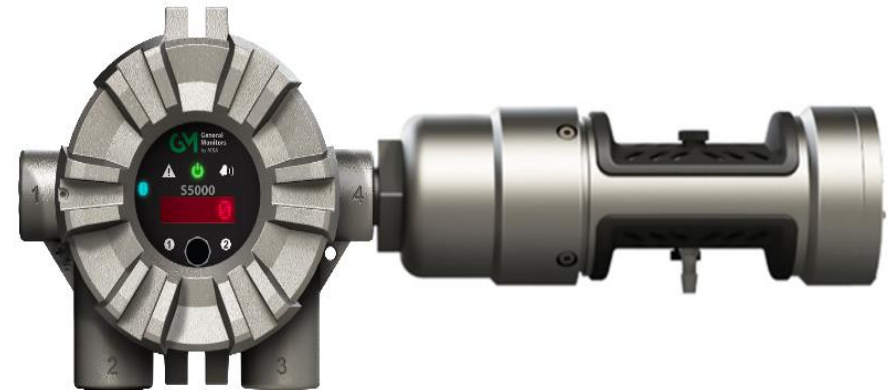
INFRARED SENSORS

The X5000 & S5000 can both be fitted to IR sensors

- The IR sensors are the same as the previous models
 - X5000 with XIR Plus sensor
 - S5000 with IR400
- Neither sensor requires a Span calibration. Only a Zero calibration is required and the sensor self calibrates the span.

Temperature Specs:

- X5000 with XIR+ range -40 to +60C
- S5000 with IR400 range -60 to +75C



SAFE SWAP

ENABLES SENSOR CHANGES WITHIN A CLASSIFIED AREA

MSA Patented SafeSwap used with MSA sensors for *>15 years*

- No need to power down detector
- No need for a hot work permit
- No termination of cables
- No opening of enclosures

Swap delay – Allows the user to replace the sensor in 2 minutes, without a “sensor missing” fault signal.

Possible with full range of Electrochemical and Catalytic Bead sensors



**Reduces labor time
and maintenance costs**



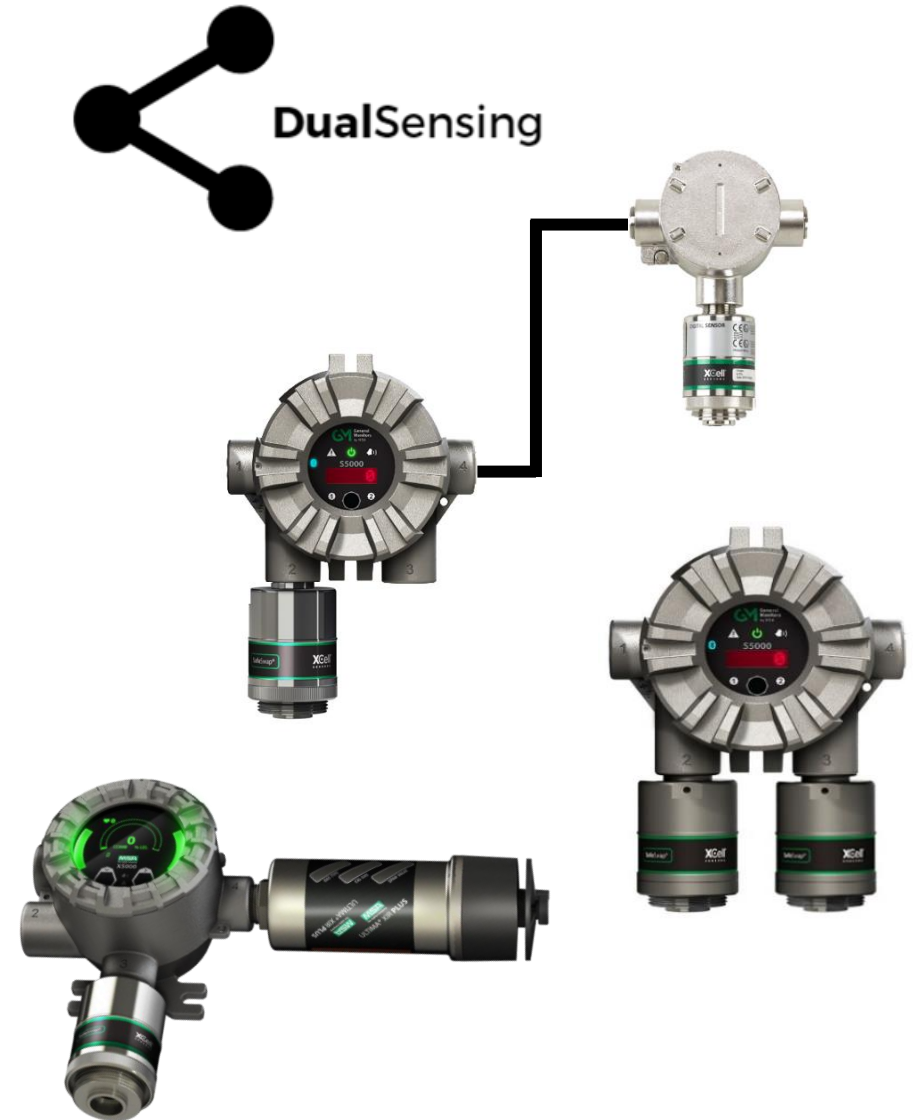
Configurations & Dual sensing

Dual Sensing Technology

FEWER TRANSMITTERS AND LESS CABLING, LESS CONDUIT

ULTIMA® X5000 and General Monitors S5000 can be connected to 2 sensors at the same time, each with an independent analogue output.

- Any combination of sensors for X5000
- GM S5000 can only have 1 IR sensor and only 1 MOS sensor
- Any sensor can be remotely mounted up to 100 metres away

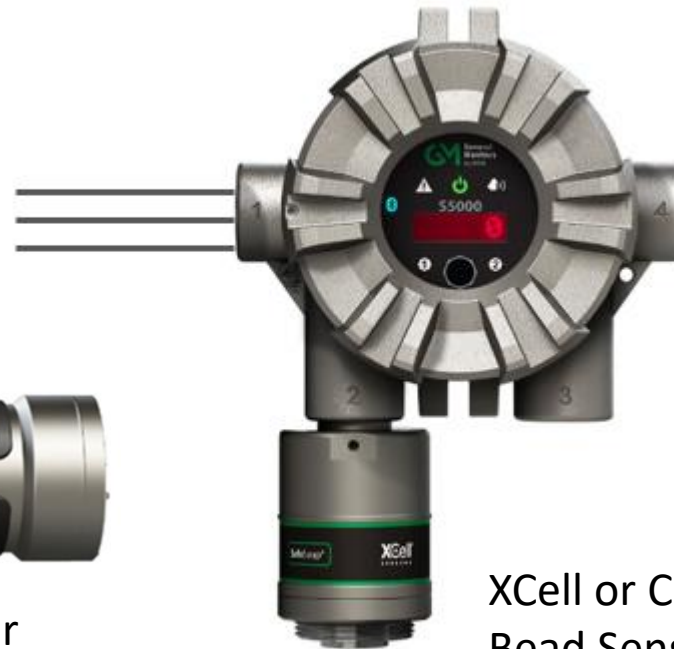


S5000 with EC, CB, IR or MOS X5000 with EC, CB or IR

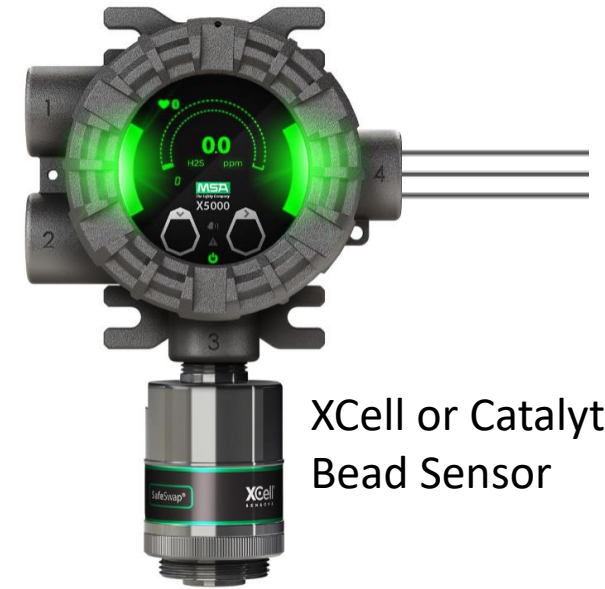
- S5000, with single sensor
- Same footprint as S4000 Series
- 3 cores



Infrared IR400 Sensor



XCell or Catalytic
Bead Sensor



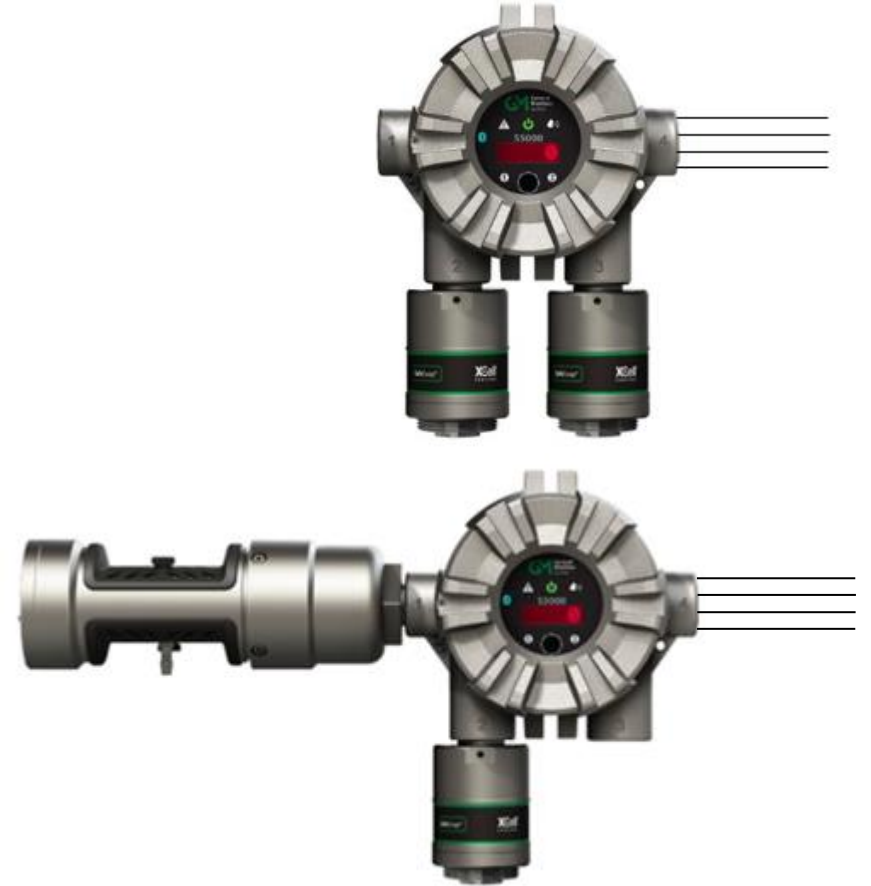
XCell or Catalytic
Bead Sensor

X/S5000 with combination of dual sensors

X/S5000 fitted with 2 EC or 2 CB sensors
or 1 EC & 1 CB sensor
4 cores (2 power, 2 signals)

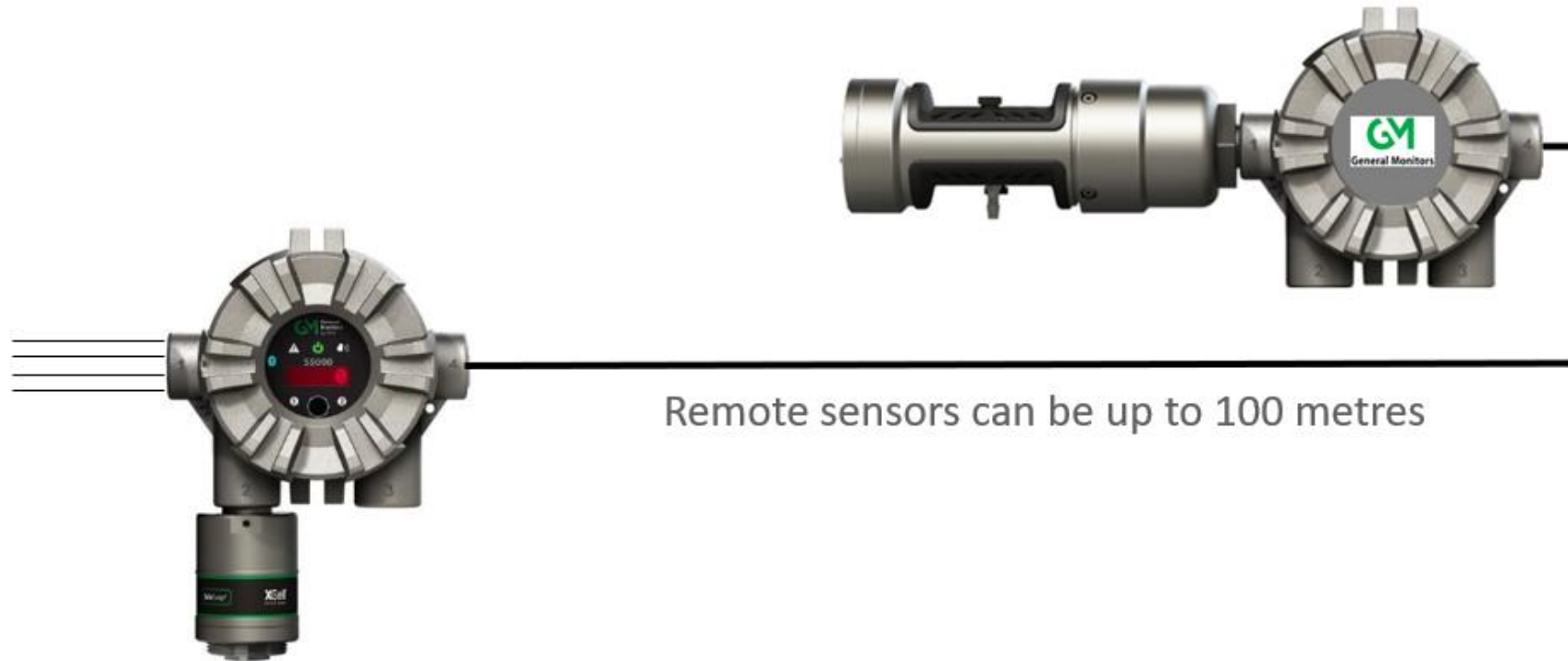
X/S5000 fitted with 1 EC or CB sensor
and an IR sensor
4 cores (2 power, 2 signals)

Note: Only a single MOS sensor can be fitted to S5000



S5000 with dual sensors, 1 or both remote

- S5000, fitted with 1 EC / CB sensor and 1 remote IR



S5000 with combination of sensors

- 4 cores required with 2 sensors, as both sensors require an analogue signal
- Gives the user flexibility and a significant cost saving due to less transmitters, cabling, installation accessories
- Less cabling can also reduce the footprint of the control system
- Significant reduction in weight of cabling for offshore platforms
- 2 IR sensors is not possible due to excess power consumption



Remote Calibration Adapter

CalGard Remote Calibration Adapter

The MSA CalGard RCA for the new XCell Toxic and Catalytic Bead sensors allows the user to perform a **true and accurate calibration** or a simple functional safety test (bump test)

Suitable for Methane, Propane, Hydrogen, H₂S, CO & O₂

At this time, no other manufacturer can offer a similar device that allows the user to perform an accurate calibration

Competitor's devices can only be used for a bump test



CalGard Remote Calibration Adapter

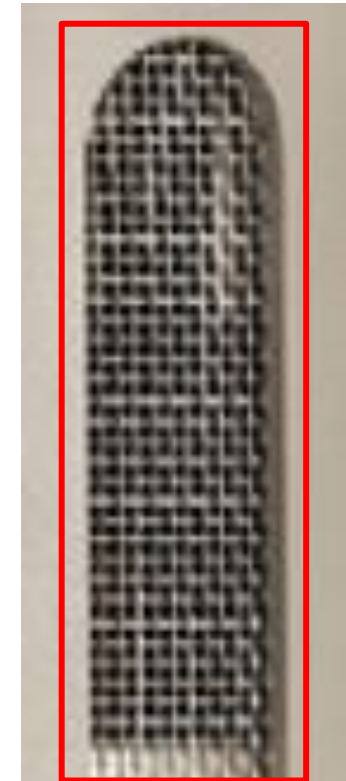
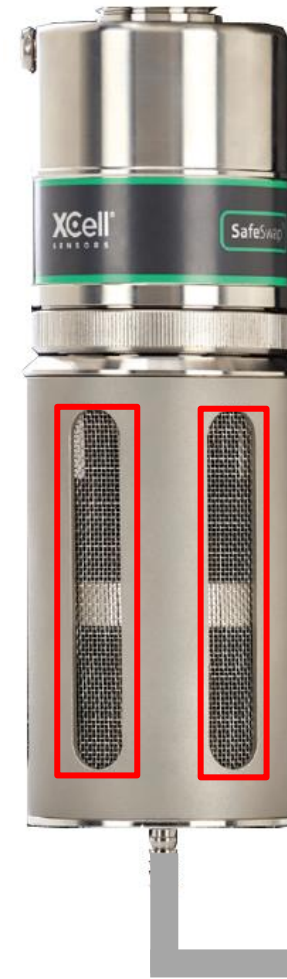
This is possible as when calibration gas reaches the RCA, the gas pressure forces the internal mechanism (bellows) of the RCA to move upwards and it seals around the inlet of the sensor.

This ensures the calibration gas enters the sensor and does not escape through the mesh of the RCA.



CalGard Remote Calibration Adapter

- The RCA is screwed to the bottom of the sensor
- A SS316 tube for the calgas supply is attached to the nipple of the RCA
- During normal operation the target gas passes through the mesh of the RCA and then through the inlet of the sensor housing, where the gas leak is detected by the sensor.



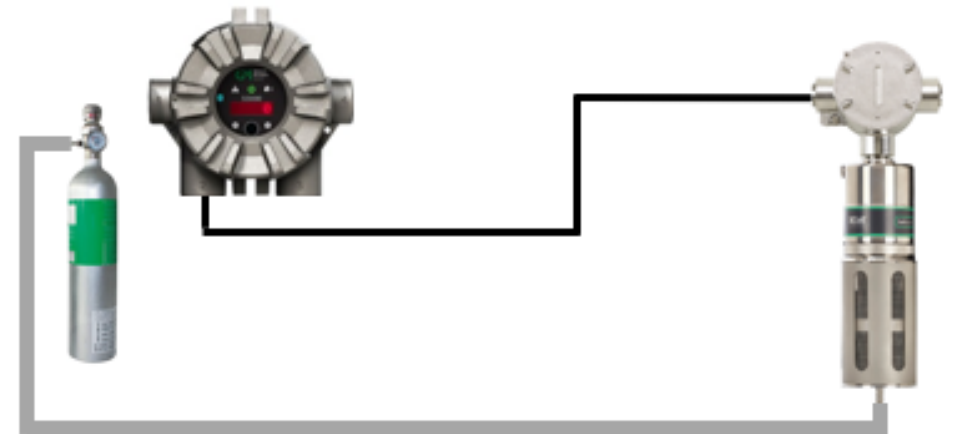
CalGard Remote Calibration Adapter

To perform a calibration, the engineer would access the menu and apply calgas via the gas supply tubing.

As no calgas escapes from the internal chamber within the RCA and ambient air cannot dilute the calgas, a true and accurate calibration can be performed.

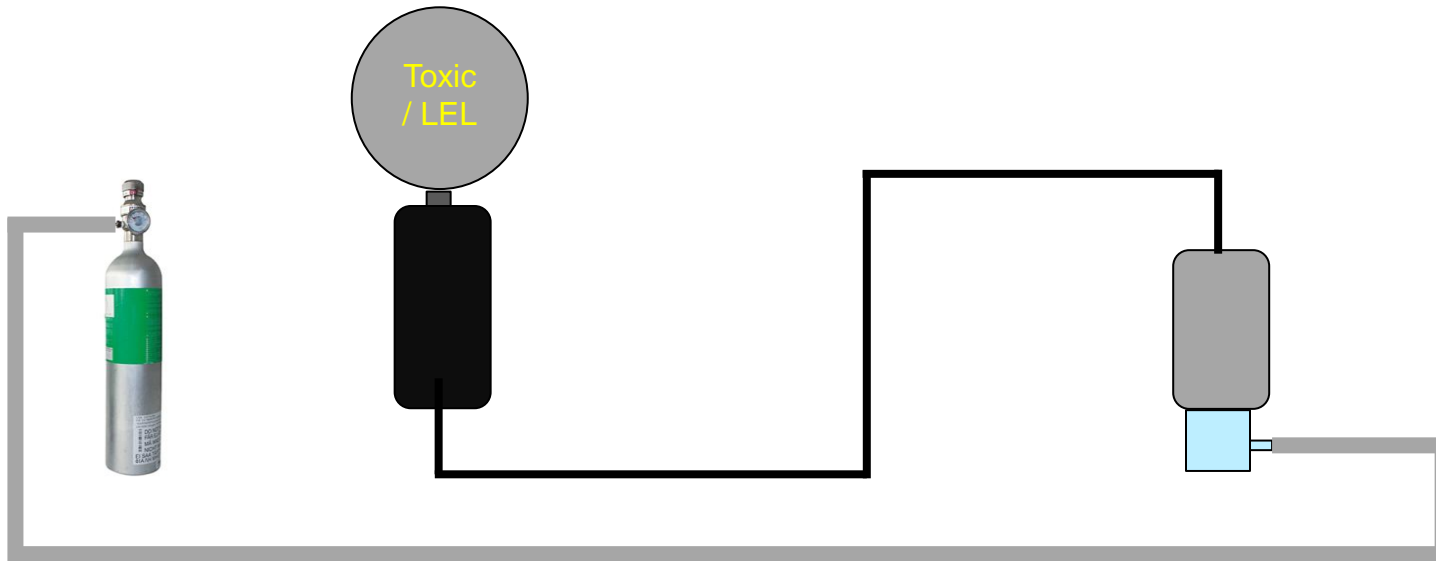
With the RCA from MSA, gaining direct access to the sensor to connect the correct calibration adapter and apply calgas directly to the sensor is not required.

[Video Calgard RCA](#)



Remote Gassing Accessories (RGA)

With an “RGA” that has no mechanism to prevent the calgas from escaping through its inlet, **a calibration cannot be performed**. These RGA’s devices **cannot be called Remote Calibration Adaptors** as they are only suitable for a Bump Test.



Upgrade from S4000 to S5000

- Identical mounting locations and dimensions as previous General Monitors S4000 Series
- Allows for quick and easy upgrades
- Existing fittings, accessories, and cables can be reused





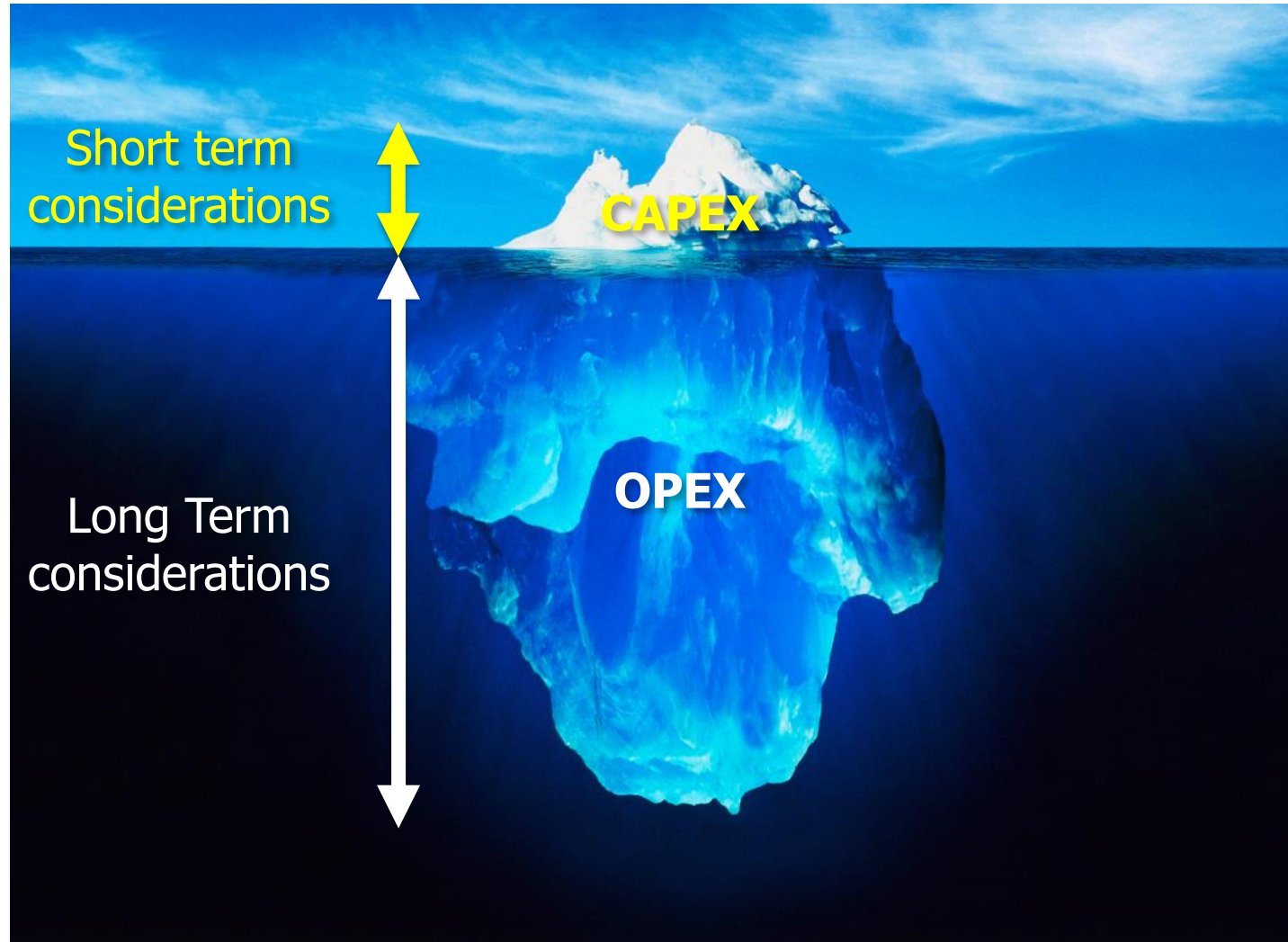
Cost of Ownership

EPC/Contractors vs. End Users requirements

Short term vs. long term expenditure considerations

EPC: Pays the lowest price for a detector that meets the user's specification

User: Pays the highest price for the long term maintenance of the system over 20-25 years



Maintenance cost over the detector's life

- Over the expected 20-year life of the detectors, the costs of the traditional and next generation H2S sensors would be approximately:
 - Traditional MOS / EC: \$9,000 to \$10,000 / detector
 - Next Generation XCell EC: \$3,240 / detector

Large O&G companies may have more than 5,000 H2S detectors

Overall cost of maintenance 5,000 detectors during the 20-year operating life:

- Traditional MOS / EC: \$45 to \$50 Million
- Next Generation XCell EC: \$16 Million overall cost of maintenance

MSA's XCell sensors offer a saving of \$29 to \$34 Million

Cost Calculations

Costs over 20-year life of detectors:

MSA XCell: 5 year sensor life
 2 year calibrations
 \$900 sensor cost

Traditional Sensor technology:

EC sensor: 2 year sensor life
 3 month calibrations
 \$600 sensor cost

MOS sensor: 3 year sensor life
 3 month calibrations
 \$700 sensor cost

Cost of single calibration: \$60

Year	XCell	XCell	EC	EC	MOS	MOS
	Calibration	Sensors	Calibration	Sensors	Calibration	Sensors
	24 months	5 years	3 months	2 years	3 months	3 years
1			240		240	
2	60		240	600	240	
3			240		240	700
4	60		240	600	240	
5		900	240		240	
6	60		240	600	240	700
7			240		240	
8	60		240	600	240	
9			240		240	700
10	60	900	240	600	240	
11			240		240	
12	60		240	600	240	700
13			240		240	
14	60		240	600	240	
15		900	240		240	700
16	60		240	600	240	
17			240		240	
18	60		240	600	240	700
19			240		240	
20			240		240	
	\$540	\$2,700	\$4,800	\$5,400	\$4,800	\$4,200
Totals	\$3,240		\$10,200		\$9,000	





Conclusions

With MSA you can achieve operational efficiency!

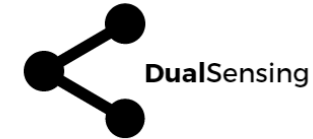
We will help you to improve gas detection performance over time by:



- ✓ **Eliminating frequent manual calibrations in your maintenance program and reducing your costs:**
 - TruCal, SafeSwap, Dual Sensing technologies, Calgard RCA
- ✓ **Extending sensor life providing the lowest cost of ownership:**
 - XCell sensors - industry leading lifetime and warranty
- ✓ **Giving you the assurance that the detector is working – guaranteed!**
 - TruCal - self testing and self calibrating technology

SafeSwap®

XCell
SENSORS
TruCal®



A photograph of an industrial facility at night, illuminated by various lights. The scene shows tall distillation columns, pipes, and structural steel. A green semi-transparent banner is overlaid on the middle of the image, containing the main title and subtitle. The bottom of the image shows a different part of the facility with large storage tanks and more piping.

Open Path Gas Detectors

Gas Detection for better coverage, earlier gas detection and a safety facility

Why OPGD technologies got developed?

- Point Gas Detectors (PGD) can miss gas leaks, sometimes for minutes, sometimes for far longer. It is no longer recommended to only use PGD for high risk OGP applications.
- To increase the probability of detecting the gas leak in open area when only using PGD, the number of additional PGD required is unrealistic and calls for higher CAPEX and OPEX. So, OPGD not only reduces the nos. of PGDs but also increases the probability of detection.
- This also reduces the number of I/Os at the control System as well as the OPEX costs.
- PGDs are still required to give a better indication of the leak source and also the concentration of the gas cloud . OPGD were developed to compliment Point gas detectors and increase the probability of detecting the gas leak.
- Studies and post gas release investigations have found that many gas leaks go undetected.

Findings of the HSE report RR1123

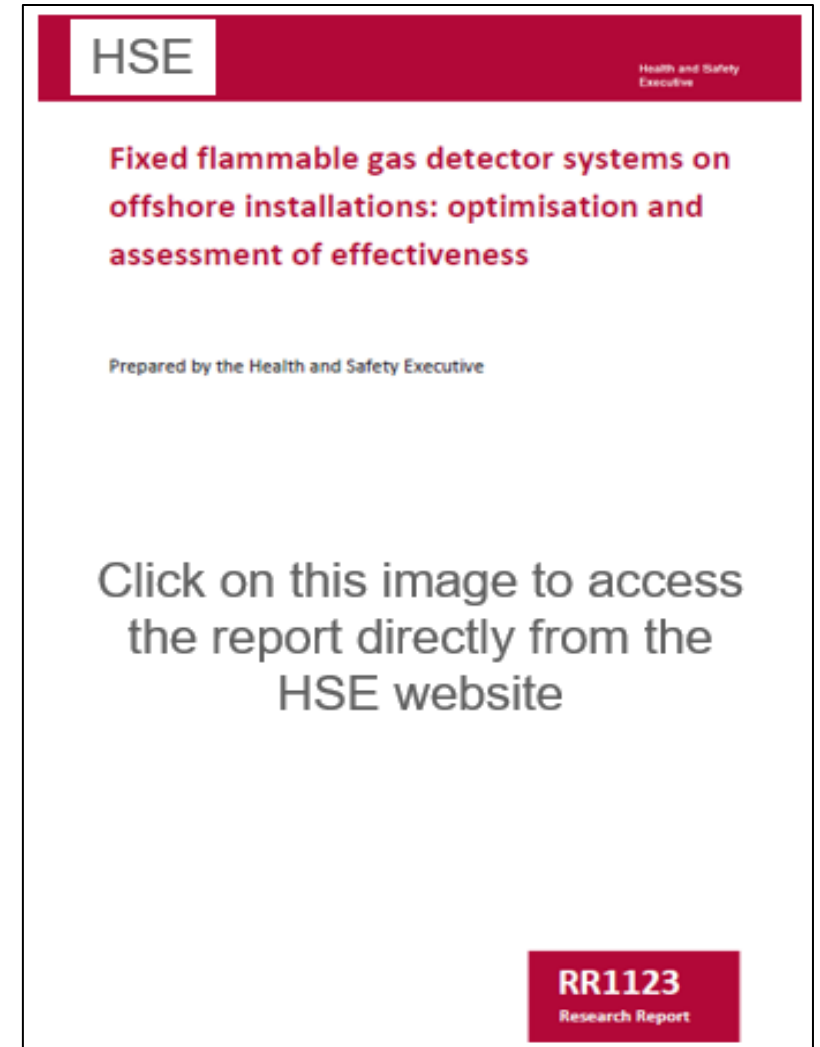
This 2017 report by the HSE states:-

An analysis of Offshore Hydrocarbons Release database (2001-2008) reveals that approximately 36% of major gas releases and 69% of significant gas releases were undetected by gas detectors.

HSE Definitions:

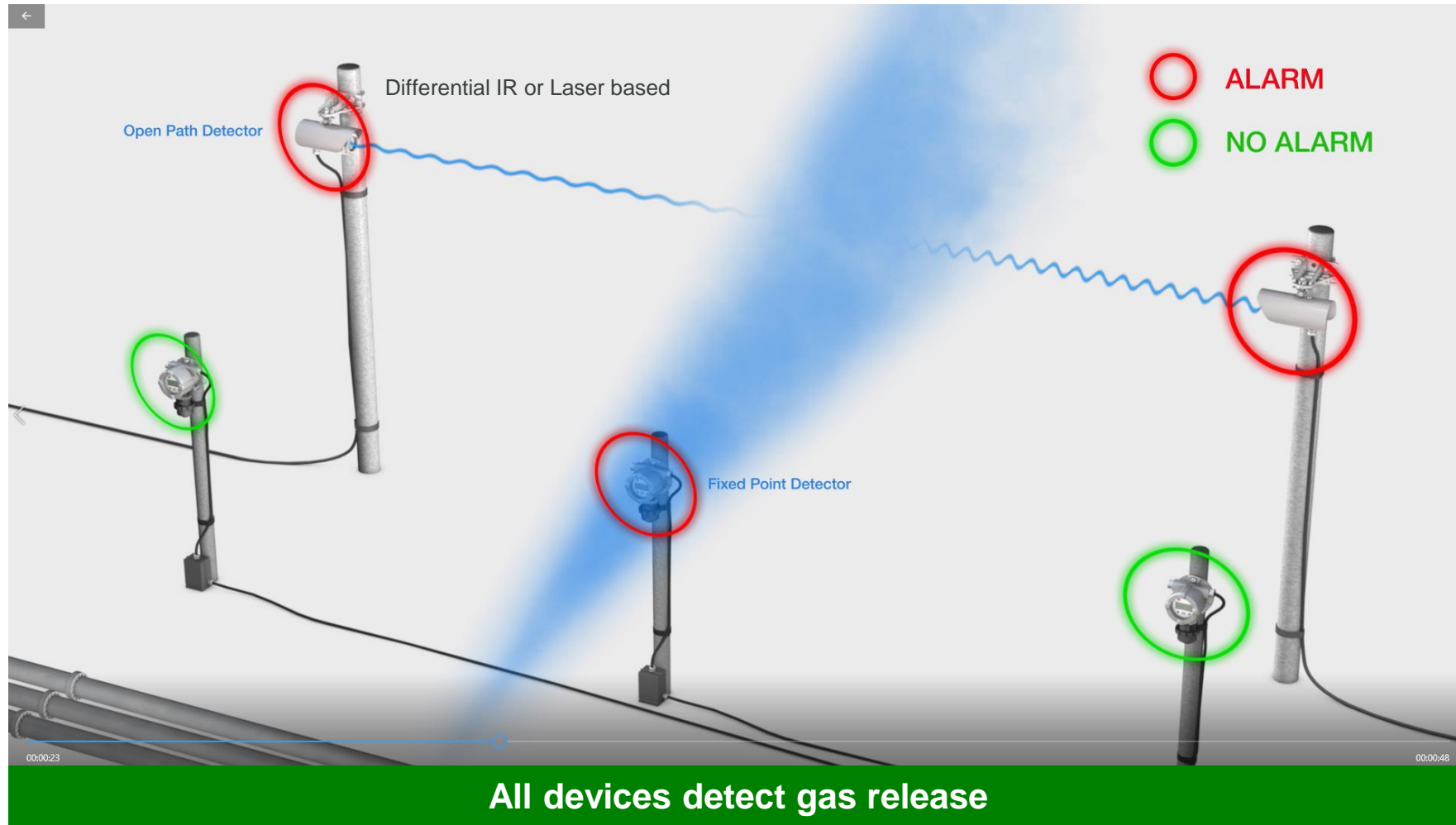
Major: >1kg/s release rate and duration >5 min or 300Kg of gas

Significant: release rates between 0.1 to 1 kg/s lasting 2 to 5 min



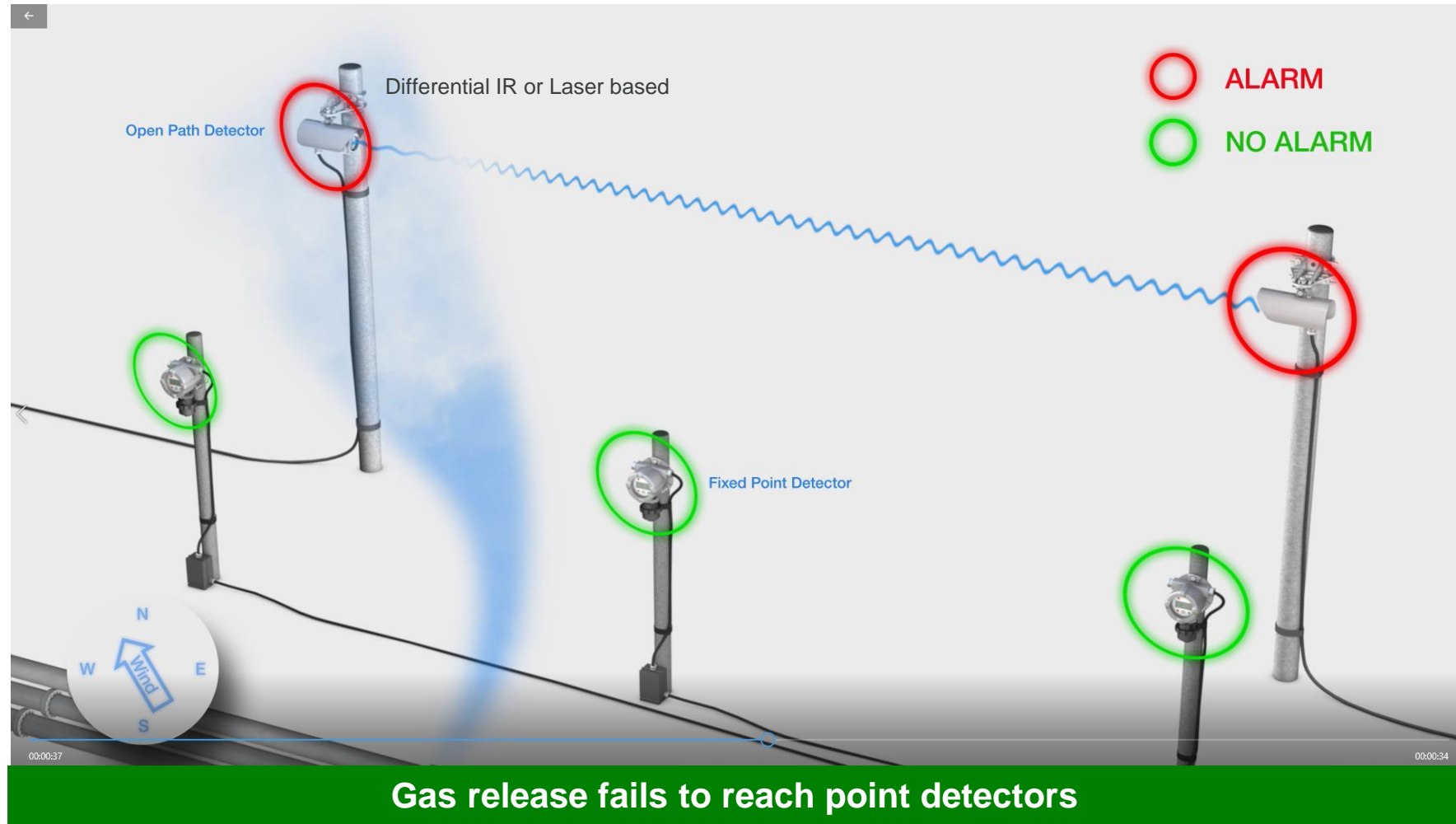
Ideal Gas Detection Scenario for Fixed Gas Detectors vs OPGD

High Pressure Release- Running into the Post & gas leak detected



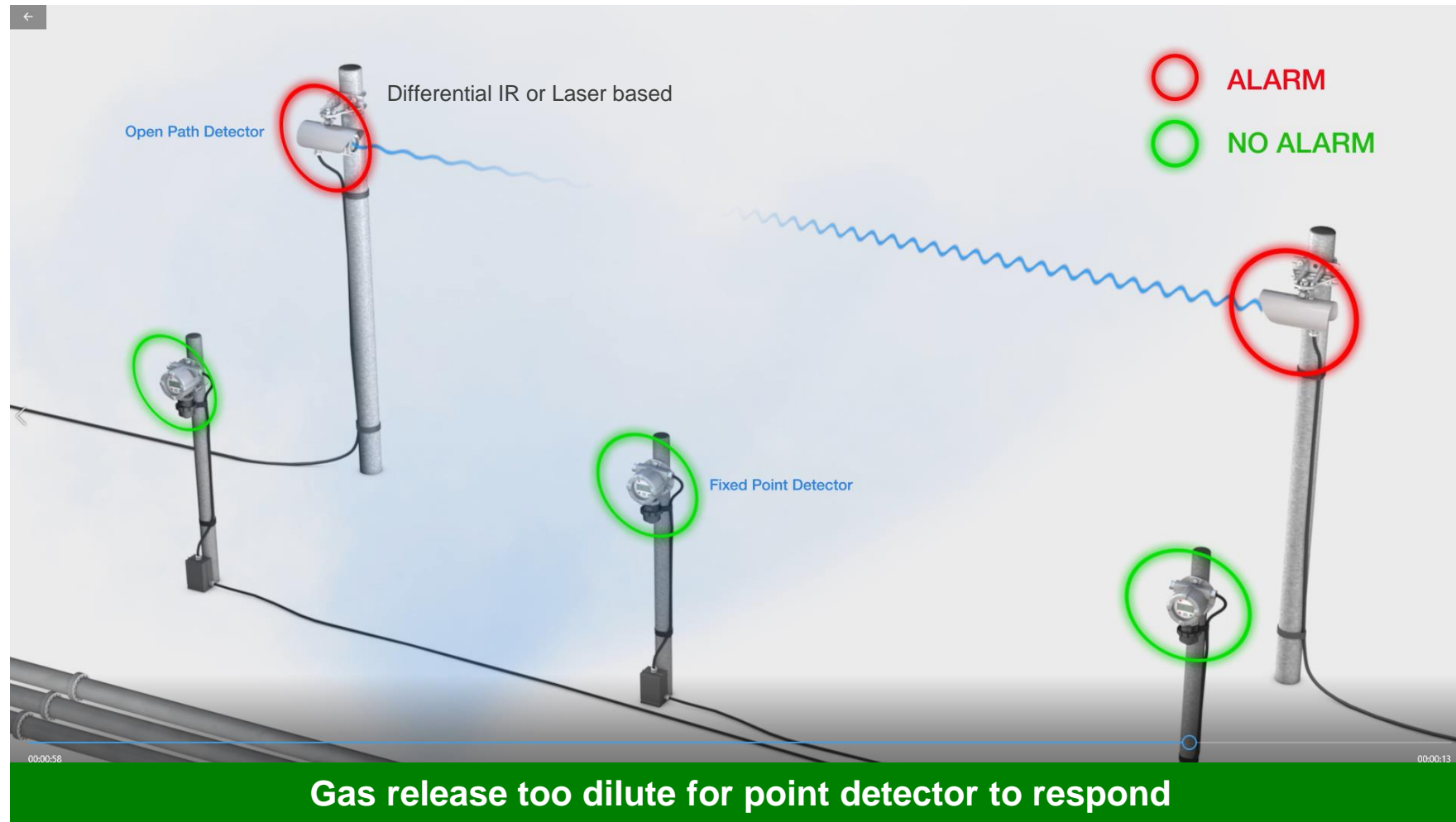
High Pressure Release

Changing Wind Direction- – Sneaking out between the Posts



Low Pressure Release

Rapid Dilution-



Effectiveness and suitability of 3 types of gas detectors

Stages of release and detection approach		Suitability of detector		
		UGLD	OPGD	POINT GD
Incipient	Detect releases before the formation of gas plumes	✓ ✓		
Dispersing	Detect dispersing gas plumes along dispersion paths		✓ ✓	✓
Accumulating	Detect gas in accumulation zones		✓	✓ ✓

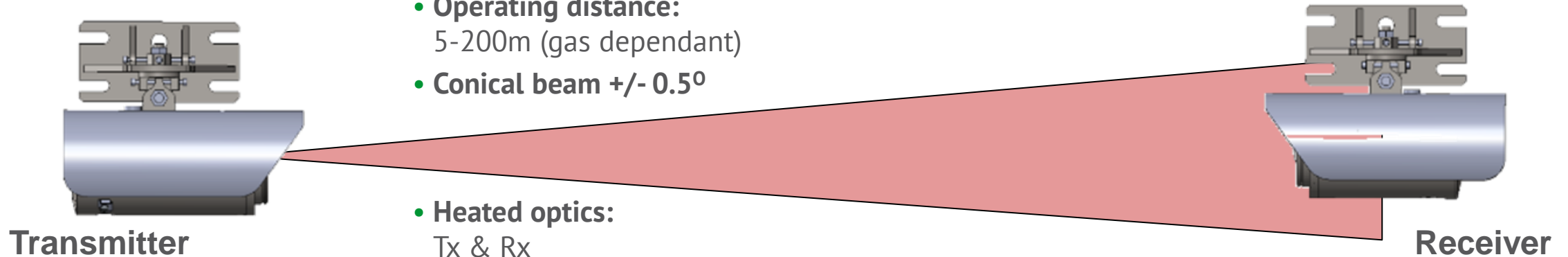
No single perfect solution !
Open Path the preferred choice for open areas ...

For high pressure gas systems / applications, UGLD devices increase the detection probability even higher.



Typical OPGD System Architecture

- **Hazardous area approved:**
ATEX, IECEx, FM/CSA/UL + Others
- **Construction:**
316 Stainless steel, IP 66/67
- **Operating distance:**
5-200m (gas dependant)
- **Conical beam +/- 0.5°**

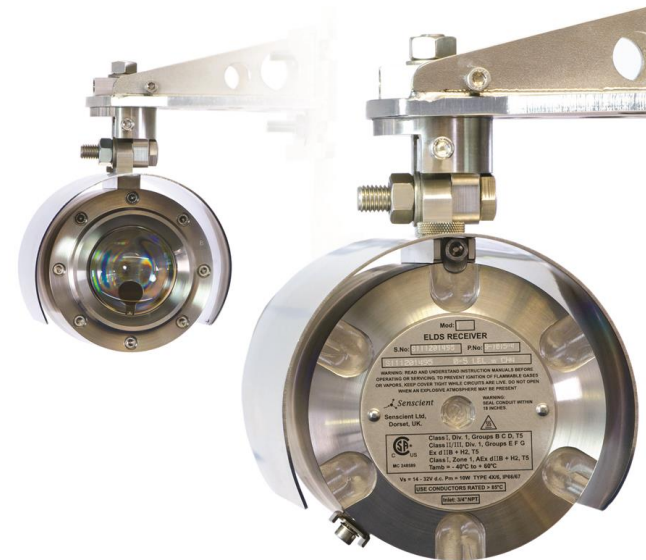


Differential IR
or
Laser based

- **Heated optics:**
Tx & Rx
- **Units of measure:**
ppm.m & LEL.m (gas dependant)
- **Mounting:**
Pole/surface bracket with alignment screws
- **Electrical:**
24V DC operation of Tx & Rx
(no interconnecting communication cable)
- **Outputs:**
4-20mA (Low signal, Beam block & Fault) + HART. Relays: IR5500 only

Open Path Gas Detectors

- IR5500 Infrared OPGD
 - Hydrocarbons

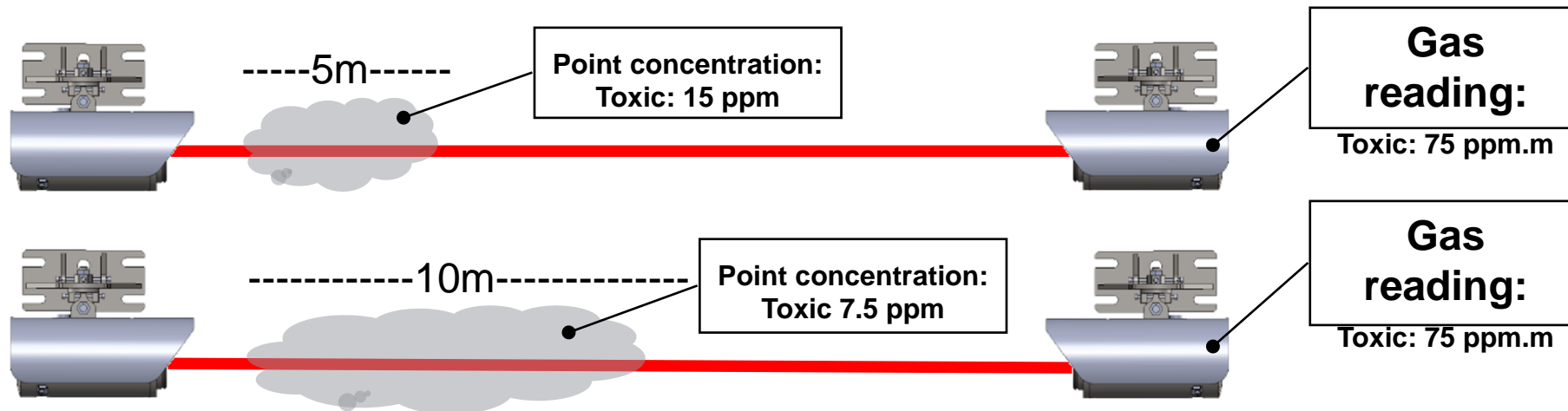


- Senscient ELDS - Laser OPGD
 - H₂S and other toxic gases, Methane and a Combination H₂S+CH₄ (sour gas)

Open Path Detectors – how do they measure?

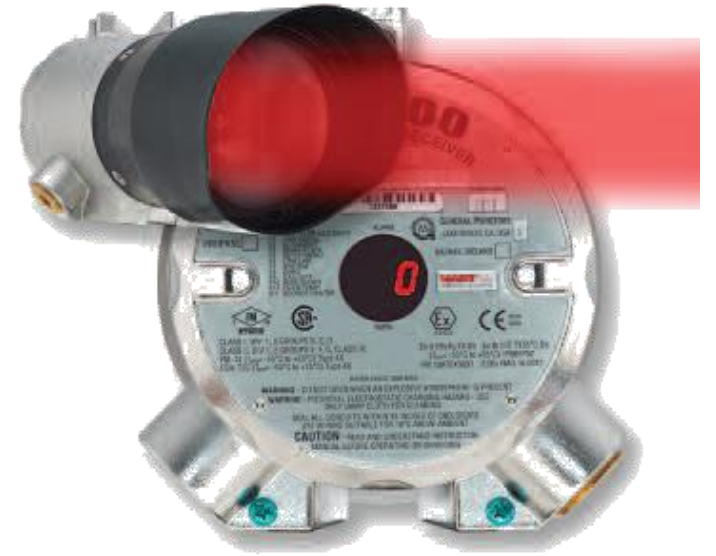
OPGD gas readings: point concentration x distance

- OPGD able to detect: Small / High concentration and Large / Low concentration clouds.
- Benefits over point detection:
 - Detects Large / Low concentration clouds
 - Greater area of coverage / Reduced quantity of field devices and lower maintenance costs.



IR5500 Key / Differentiating Features

- Dual measuring range (ppm.m & LEL.m)
 - Methane range: 0-5,000 ppm.m & 0-5 LEL.m
 - Propane range: 0-2,000 ppm.m & 0-1 LEL.m
 - **PPM.m is recommended for detection of very low concentrations, giving the earliest and most reliable detection**
- Outputs
 - 2 x Analogue outputs + HART & Modbus
 - Optional split range single mA output
 - Integral gas concentration display
 - 4x 8A SPDT relays
- Temp Range
 - -55°C to +65°C
- Approvals
 - SIL3 certified
 - Performance (FM6325 / IEC 60079-24-4)



Limitation : Reduced availability in rain & fog
Routine manual testing



Senscient ELDS

Laser open path gas detection technology



Open path detectors - ELDS

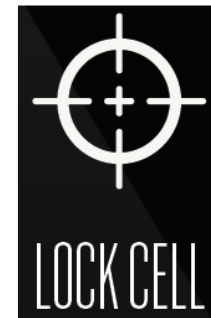
■ Senscient Laser OPGD

- Enhanced Laser Diode Spectroscopy (ELDS™)
- Toxics: H_2S , HCl , NH_3 , CO_2
- Combustibles: Methane, Ethylene
- Combination, dual gas: $\text{H}_2\text{S}+\text{CH}_4$
- Measurement range in LEL.m and PPM.m
- T-90 between 1 and 3 seconds – model / gas dependent
- No calibration, no testing, no time in hazardous area
- Target gas specific – no unwanted False alarms
- Path length up to 200 metres, CH_4 & C_2H_4
- Duct mount option for Methane (only)

Open Path Detectors – ELDS

Senscient ELDS

- Target gas specific
 - No interferences from other substances/gases
 - Extra low concentration measurement range
- Operation
 - Easy / accurate optical alignment
 - No Tx - Rx interconnecting cable required
 - Multiple harmonic verification – No false alarms
 - Gas filled reference cell - Ensuring laser lock
 - Daily auto self test (SimuGas) – Reduced OPEX
 - High misalignment tolerance



Light Source	Laser
Response time	T90 > 3s
Technology	IR - 4 harmonics
Wavelengths	~1.5 micron
Toxic gas:	Ammonia
Path lengths	5-40m, 40-120m

Senscient ELDS™ Gases & Ranges



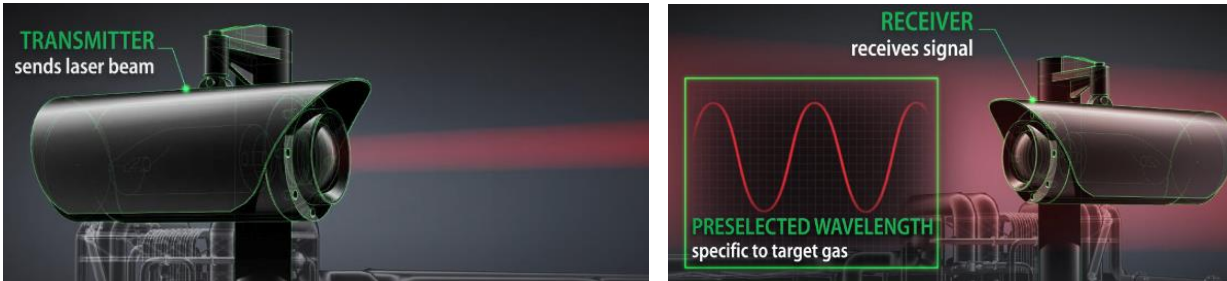
Gas/es	Detection ranges	Path length (metres)					T90 < (sec)
		0.5-5	5-40	5-60	40-120	120-200	
CH ₄	0-10, 25, 100% LFL (HVAC intake)	✓					1
CH ₄	0-1000 ppm.m, 0-1, 0-5 LEL.m		✓		✓	✓	3
CH ₄ + H ₂ S	0-1 LEL.m + 0-250, 500, 15000 ppm.m			✓			5
Ethylene	0-10,000 ppm.m, 0-1 LEL.m		✓		✓	✓	3
CO ₂	0-300,000 ppm.m		✓		✓		3
H ₂ S	0-250, 500, 1000, 1500, 5000, 15000 ppm.m			✓			5
HCL	0-50 ppm.m			✓			3
HF	0-25, 50, 200, 1000 ppm.m			✓	✓		3
NH ₃	0- 200, 1000, 5000, 15,000 ppm.m		✓		✓		3

Fastest toxic gas detection – Faster executive action – Increased safety ...

How the Senscient ELDS Works

Harmonic Fingerprint

- 1 Laser beam traverses the open path from the Transmitter (Tx) to the Receiver (Rx)



- 2 The pre-selected wavelength is specific to a single target gas

HARMONIC
FINGERPRINT™



LOCK CELL

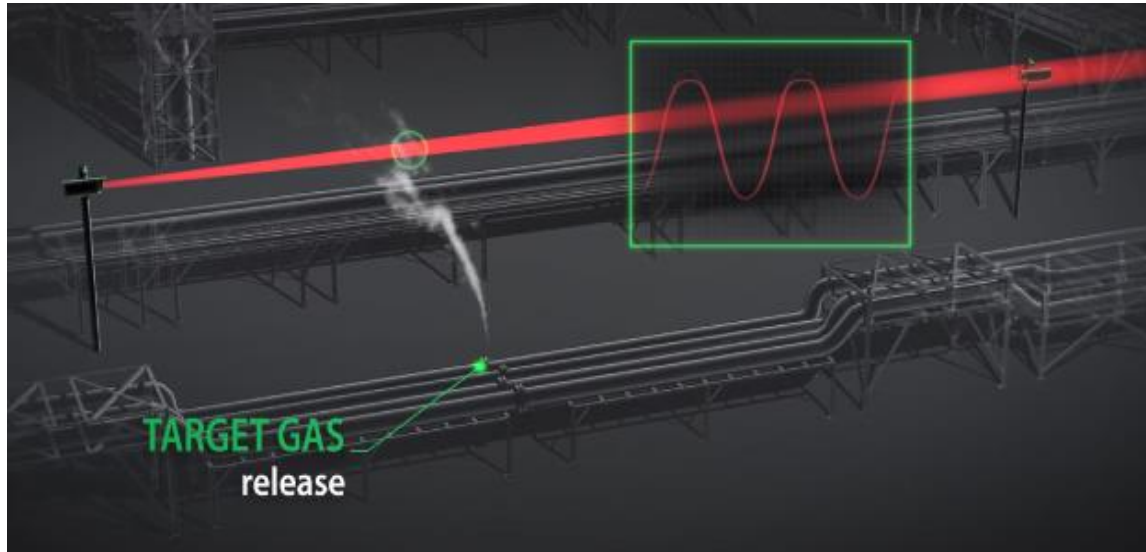
SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 3 Gas migrates into the laser beam



- 4 Wavelength is unaffected until the gas reaches the laser beam

HARMONIC
FINGERPRINT™



LOCK CELL

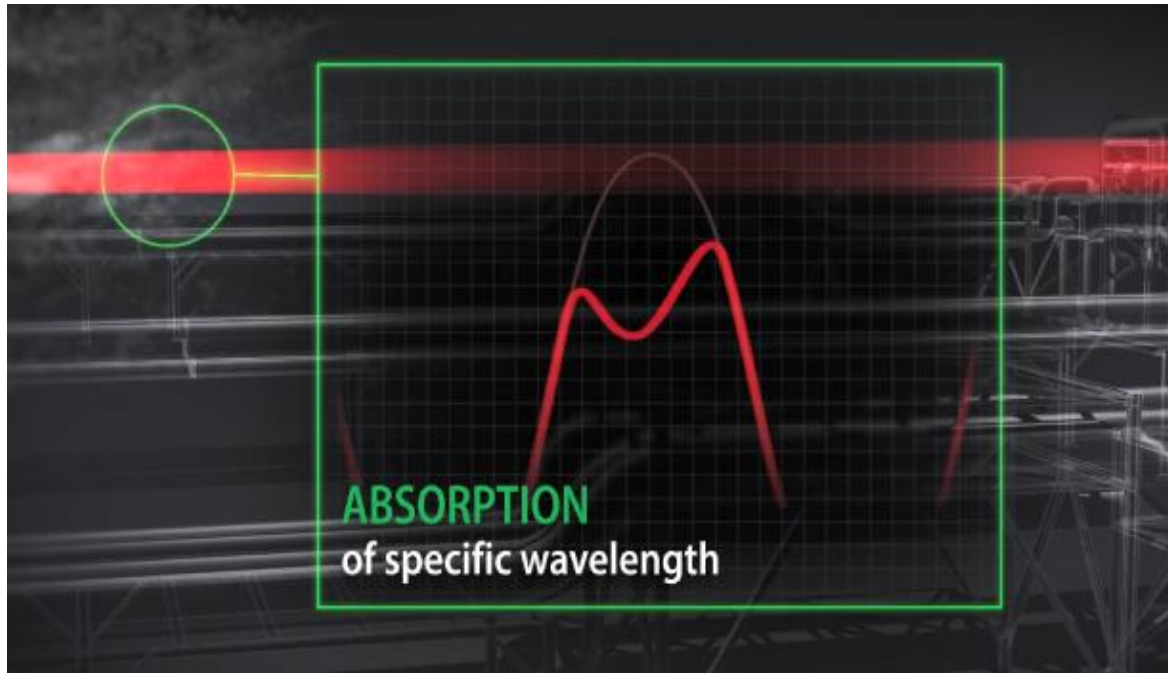
SimuGas™
SAFETY INTEGRITY



How the Senscient ELDS Works

Harmonic Fingerprint

- 5 Absorption of specific wavelength by the target gas



HARMONIC
FINGERPRINT™



LOCK CELL

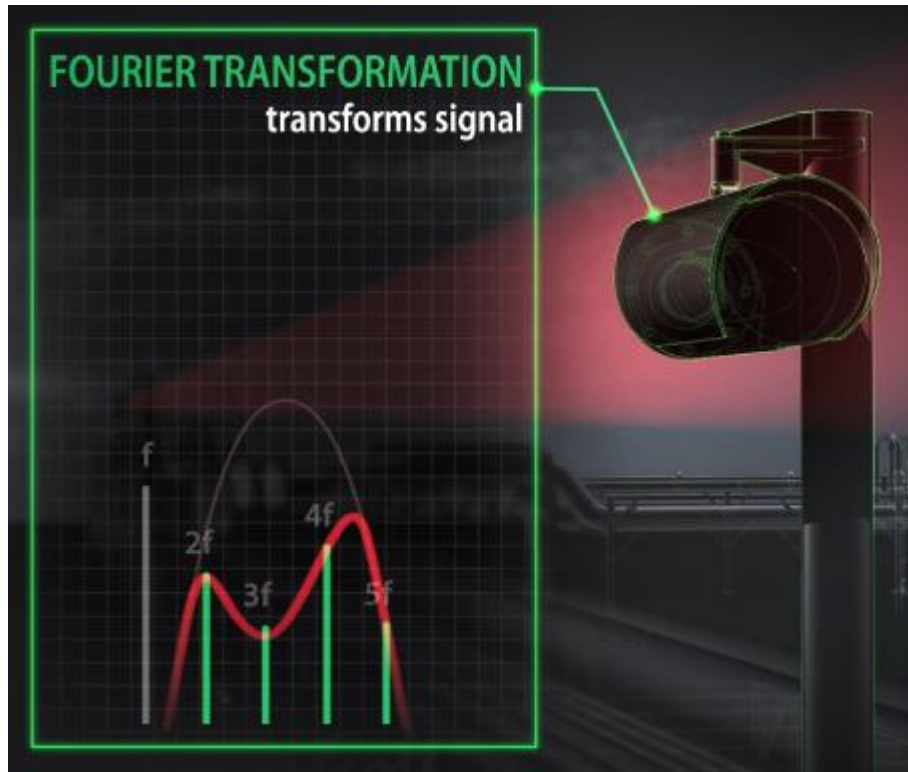
SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 6 Fourier transform converts the absorption signal into four component harmonics (Harmonic Fingerprint)



HARMONIC
FINGERPRINT™



LOCK CELL

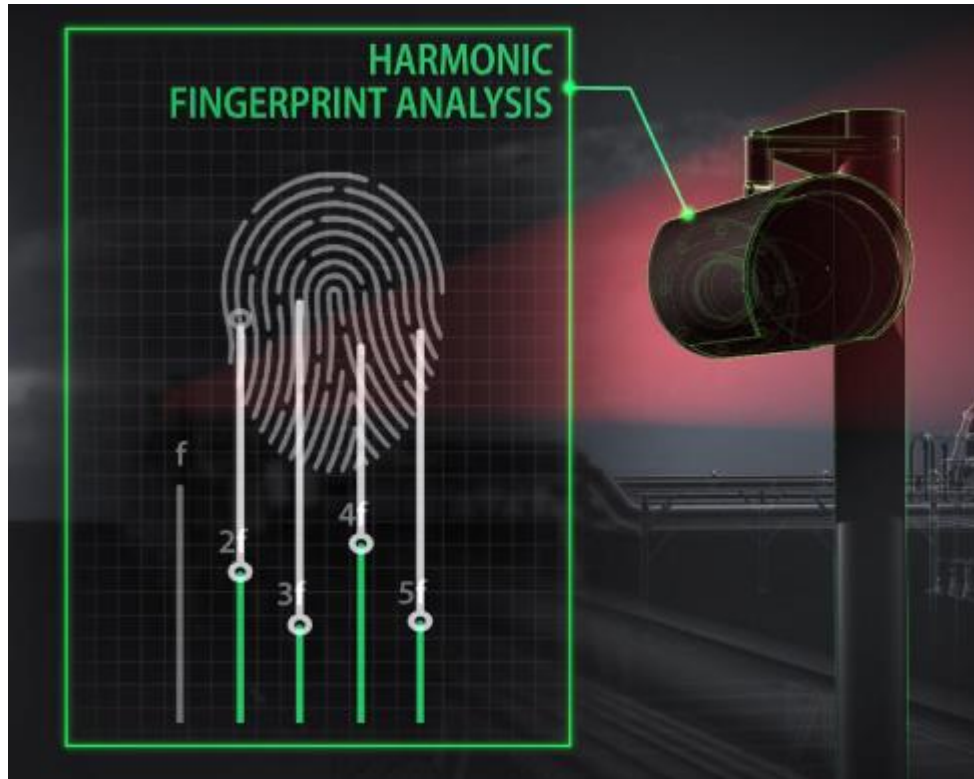
SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 7 The Receiver fingerprint analysis compares signal fingerprint with a pre-programmed fingerprint



HARMONIC
FINGERPRINT™



LOCK CELL

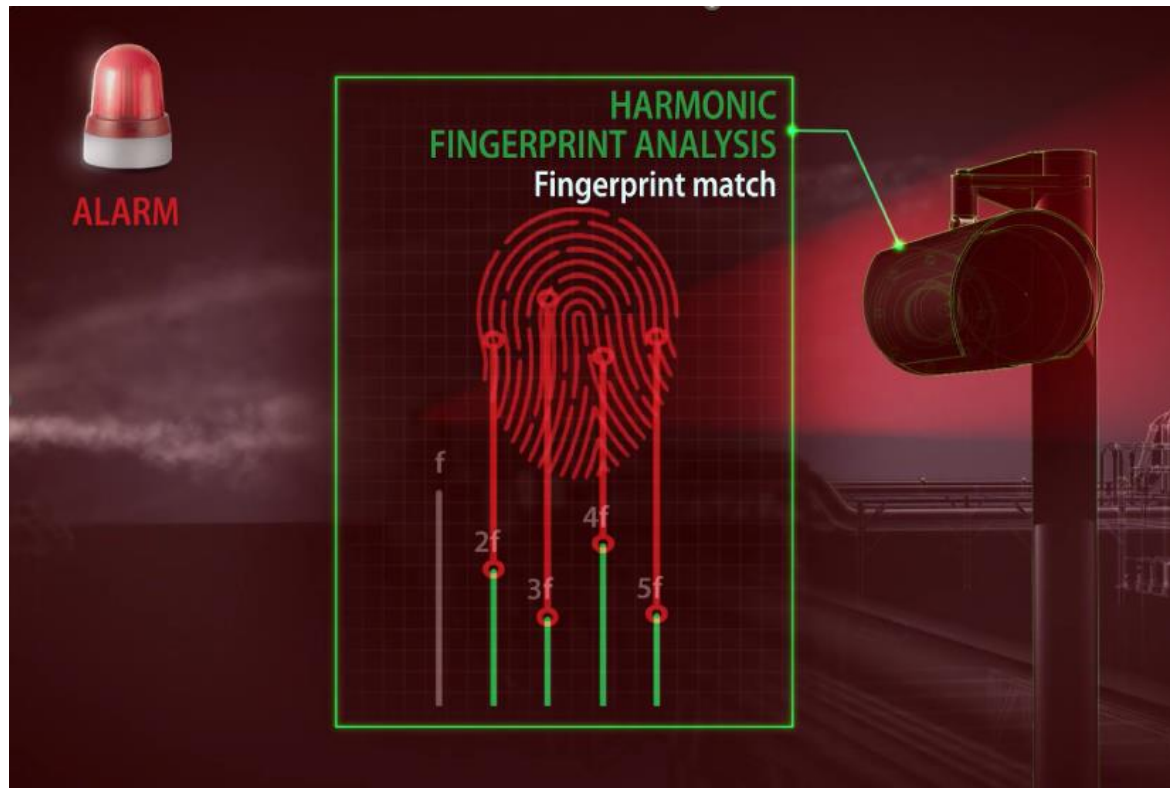
SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 8 If signal and pre-programmed fingerprints match, then an alarm output is initiated



HARMONIC
FINGERPRINT™



LOCK CELL

SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 9 The H₂S and Sour Gas (H₂S + CH₄) versions are based on the same principle but have 2 lasers. The lasers of the H₂S model are set to different wavelengths.



Requiring the harmonics on both wavelengths to match before an alarm output is initiated, increases reliability and reduces the probability of a false alarm.

HARMONIC
FINGERPRINT™



LOCK CELL

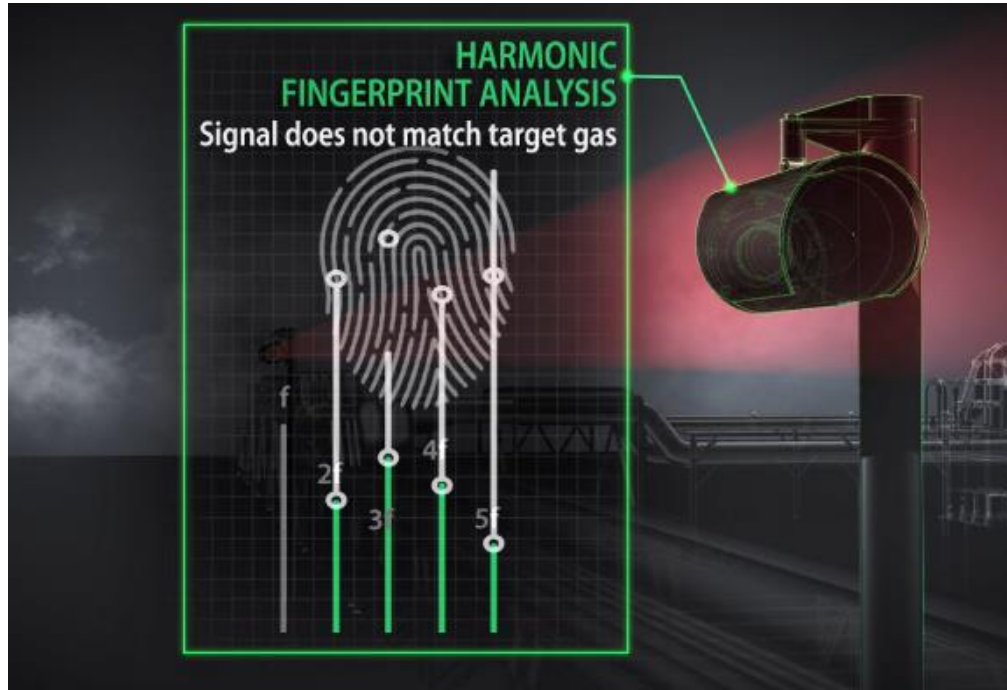
SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Harmonic Fingerprint

- 10 Absorption signals resulting from interferent gases or adverse environmental conditions will have different harmonic fingerprints and are ignored



Being able to reject substances other than the single specific target gas means less false alarms, less unwanted shutdowns, and less loss of production

HARMONIC
FINGERPRINT™



LOCK CELL

SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

Lock Cell

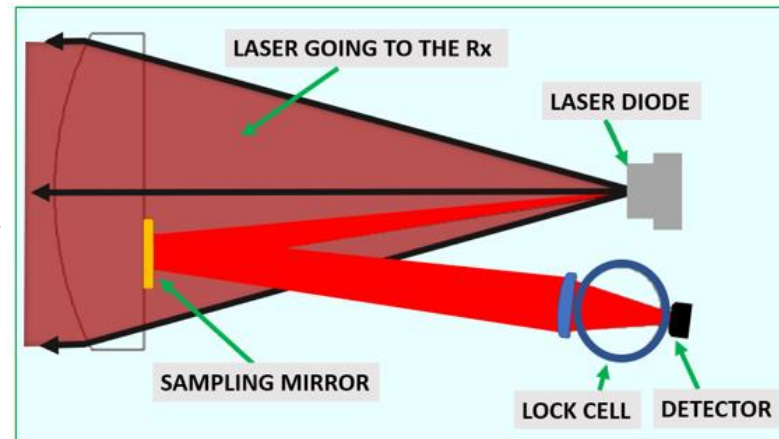
- Open Path Gas Detectors are factory calibrated requiring no field re-calibration
- All lasers naturally drift from their operating wavelength
- ELDS uses a target gas filled reference cell "Lock Cell" to ensure the laser remains locked on the detection wavelength
- The Lock Cell is part of a feed back control loop within each transmitter
- The control loop ensures the laser remains locked on its detection wavelength
- This technique removes the possibility of an unrevealed failure associated to laser systems that don't use the target gas as a locking reference



The Lock Cell
for different

Company Confidential | © Copyright of MSA | 2023-2024

Diagram of
Transmitter
optical path



HARMONIC
FINGERPRINT™

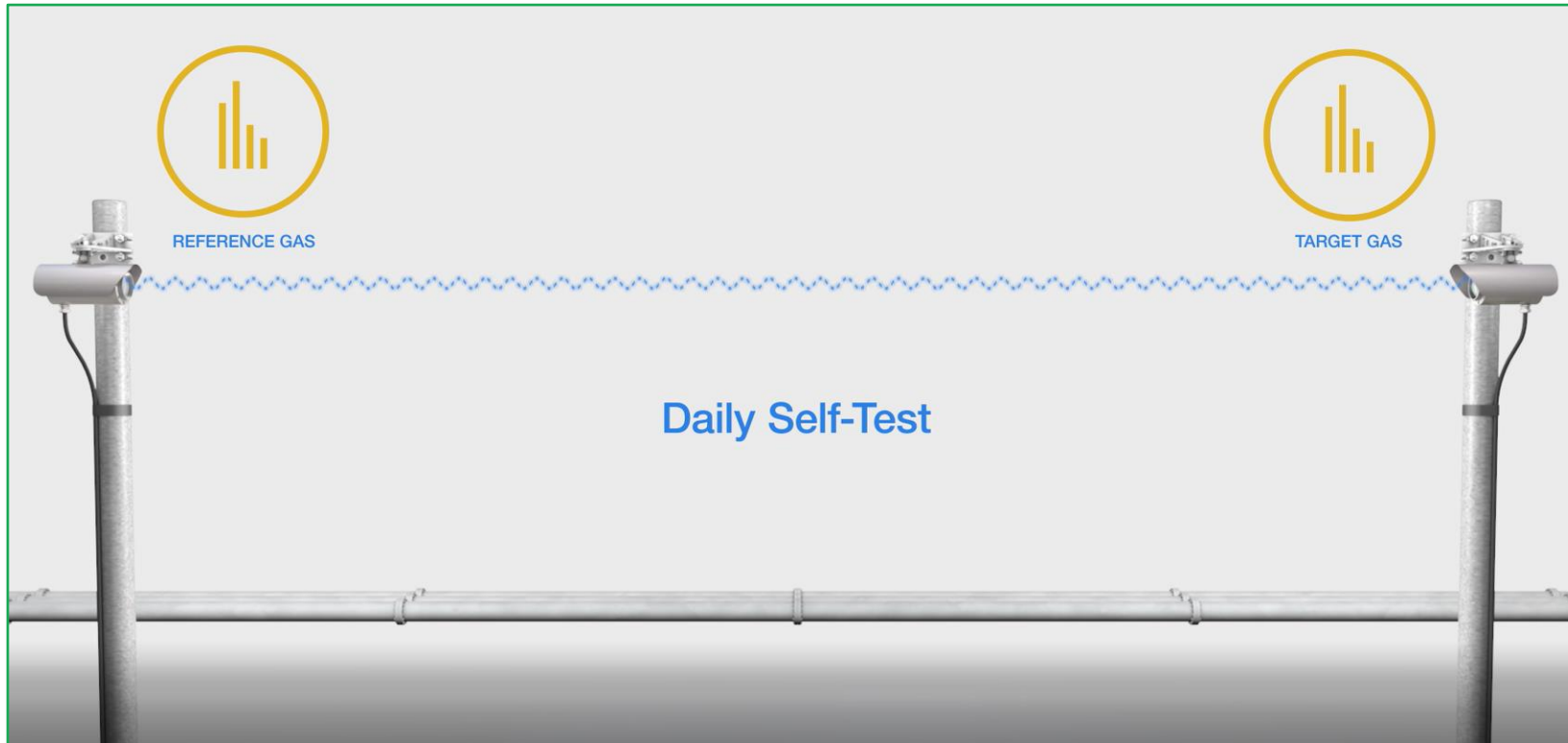


How the Senscient ELDS Works

SimuGas™

Routine functional testing of any gas detector is common practice

To avoid service engineers frequently going into the hazardous area, the ELDS performs an automatic end to end test - called SimuGas - every 24 hours



HARMONIC
FINGERPRINT™



LOCK CELL

SimuGas™
SAFETY INTEGRITY

Bluetooth®

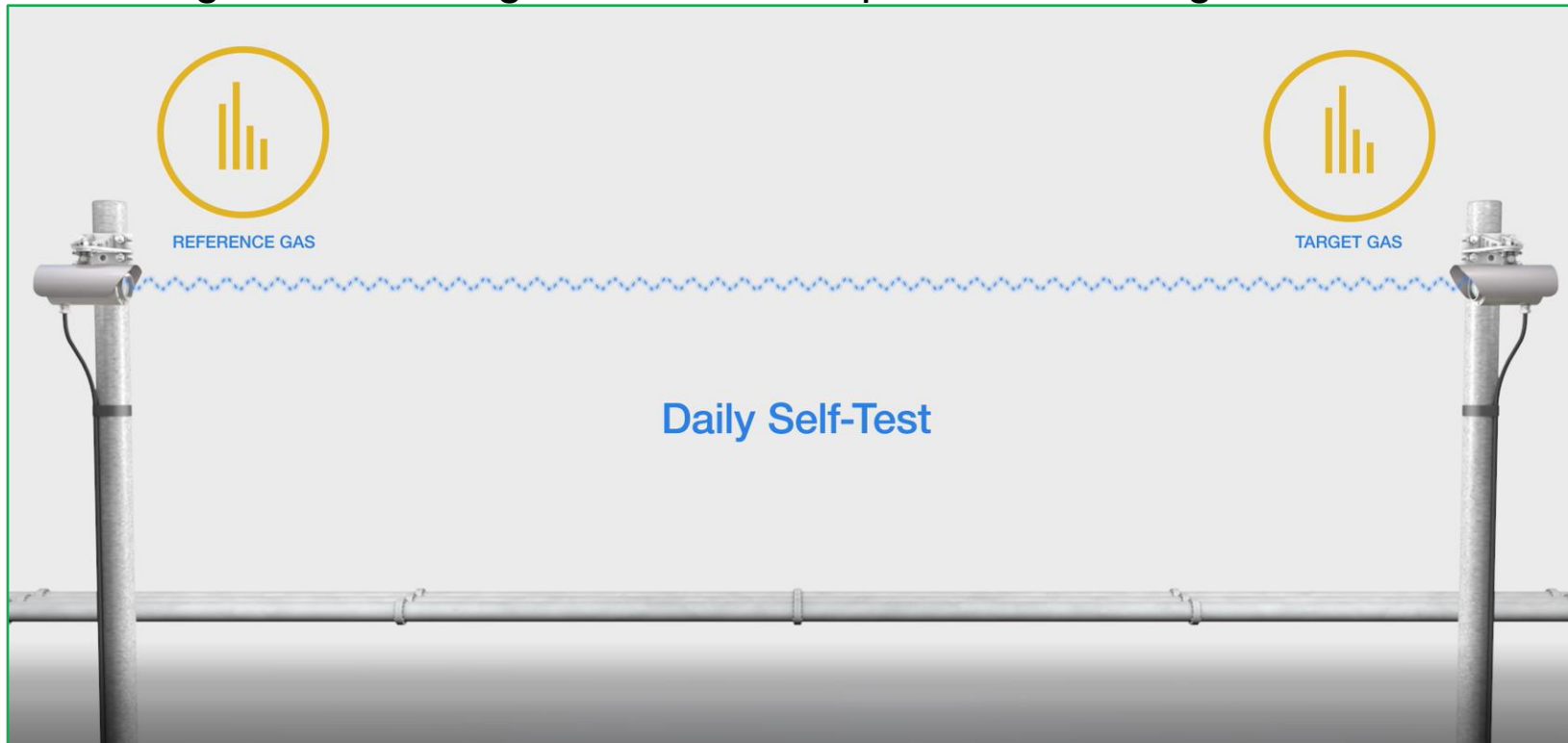
How the Senscient ELDS Works

SimuGas™

The ELDS self-test is called SimuGas and tests the system for 50 seconds

A signal is sent from the Tx to inform the Rx to expect what will appear to be the laser having been absorbed by the target gas

To avoid a gas alarm being initiated, the output is held during the test



HARMONIC
FINGERPRINT™



LOCK CELL

SimuGas™
SAFETY INTEGRITY

Bluetooth®

How the Senscient ELDS Works

SimuGas™ using Bluetooth

Testing can also be on demand using the Bluetooth Tablet

- SimuGas Auto – analog output held during the test
- SimuGas Live – full functional test with alarm signal initiated to the control system



ELDS Force 4-20

Rx H2S-H2S (OPGD/SHORT/ATEX) S03722 Tx H2S-H2S (OPGD/SHORT/ATEX) S03283

Gas Level H2S 0

0-250 ppm.m: 4.0 mA 0-500 ppm.m: 4.0 mA

Signal Levels
Sig1: 1227.36
Sig2: 909.15

Info
3 Low Gain
System Running Status
28/01/16 11:49:23 Time

SimuGas Auto

Info
03:58:39 Time To SimuGas
System Running Status
28/01/16 11:49:25 Time

HARMONIC
FINGERPRINT



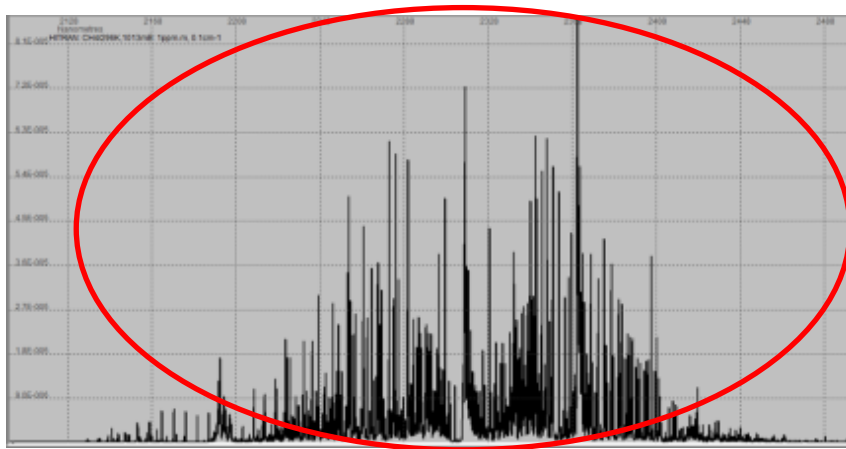
LOCK CELL

SimuGas™
SAFETY INTEGRITY



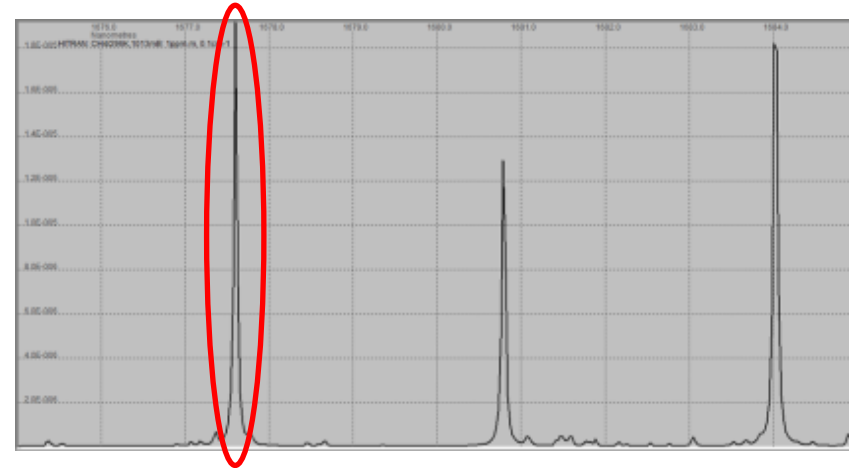
ELDS OPGD vs Differential IR OPGD – Gas Specific

Differential IR CH₄ absorption



- A traditional IR OPGD detects multiple hydrocarbon gases, over a wide absorption band width ~ 150 nm
- Best solution when multiple hydrocarbon gases need detecting in the same area
- Reduced availability in rain & fog

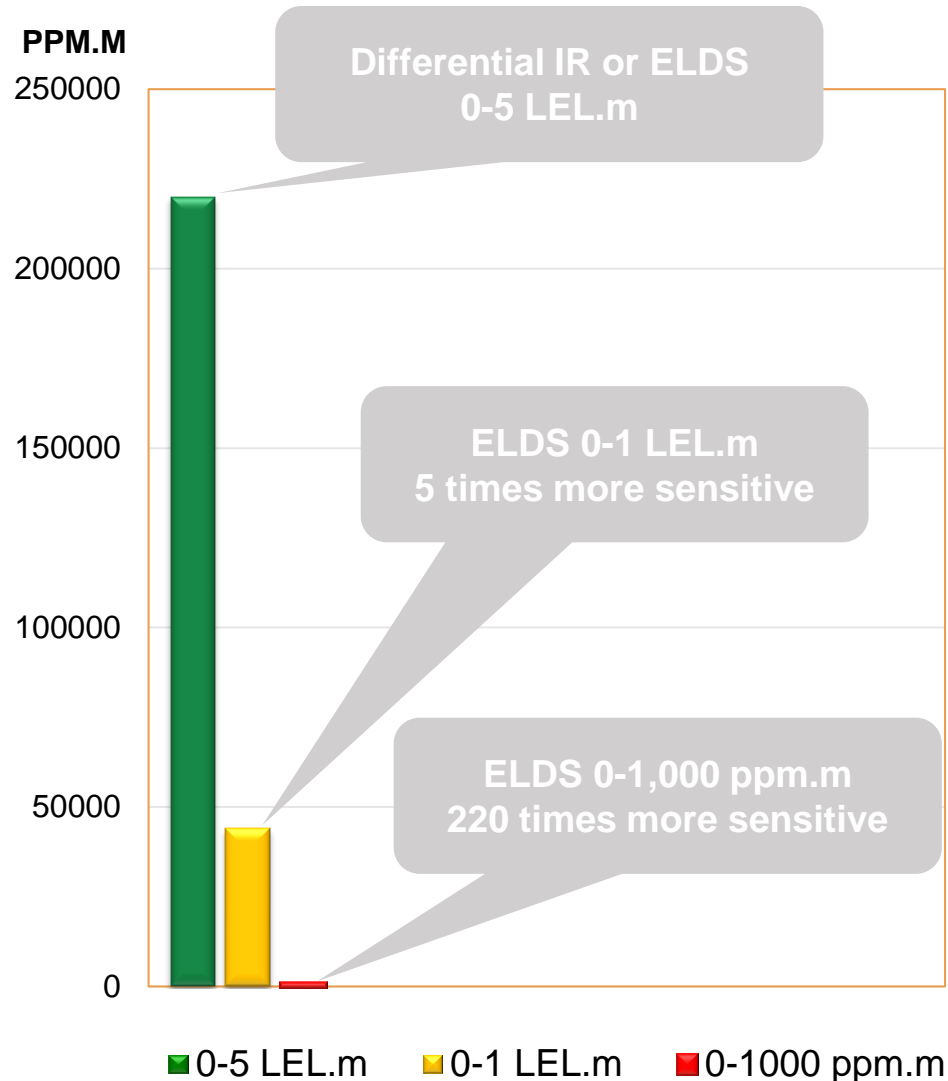
ELDS™ CH₄ absorption



- ELDS detects a single absorption line bandwidth ~ 0.1 nm (1,500 x better discrimination)
- No cross interference from other Hydrocarbon gases
- When Methane (or Ethylene) is the only gas risk, ELDS is the best solution
- Improved availability in rain & fog

ELDS: Best solution for single specific Hydrocarbon detection, when either Methane or Ethylene is the target gas

ELDS OPGD vs Differential IR OPGD – Sensitivity



- ELDS is up to 220 x more sensitive than IR OPGD
- Able to detect more diluted, lower concentration gas leaks
- Provides fastest response time and earlier alarms/plant shutdown
- Quicker Mitigation action = less gas released = lower risk of explosion

1% v/v = 10,000 ppm
CH₄ LEL = 4.4% v/v = 44,000 ppm
44,000 ppm = 1 LEL.m

ELDS OPGD vs Differential IR OPGD – Comparison

	Senscient ELDS	Differential IR
Gases	Methane specific or Ethylene specific	Detects various Hydrocarbons
Measuring ranges	0-1, 0-5* LEL.m 0-1,000*, 0-10,000** ppm.m	0-5 LEL.m
Speed of response	<3 seconds	<5 seconds
Fog resilience	Good	Poor
Routine testing	Daily auto test	3 month manual test

The ELDS benefits

- Target gas specific detection (CH₄ or C₂H₄)
- Ventilation inlets (2% LEL alarm capability)
- Faster shutdown (increased sensitivity)
- Improved uptime in fog (Lowest H₂O absorption)
- Lower cost of ownership

* Methane specific, ** Ethylene specific

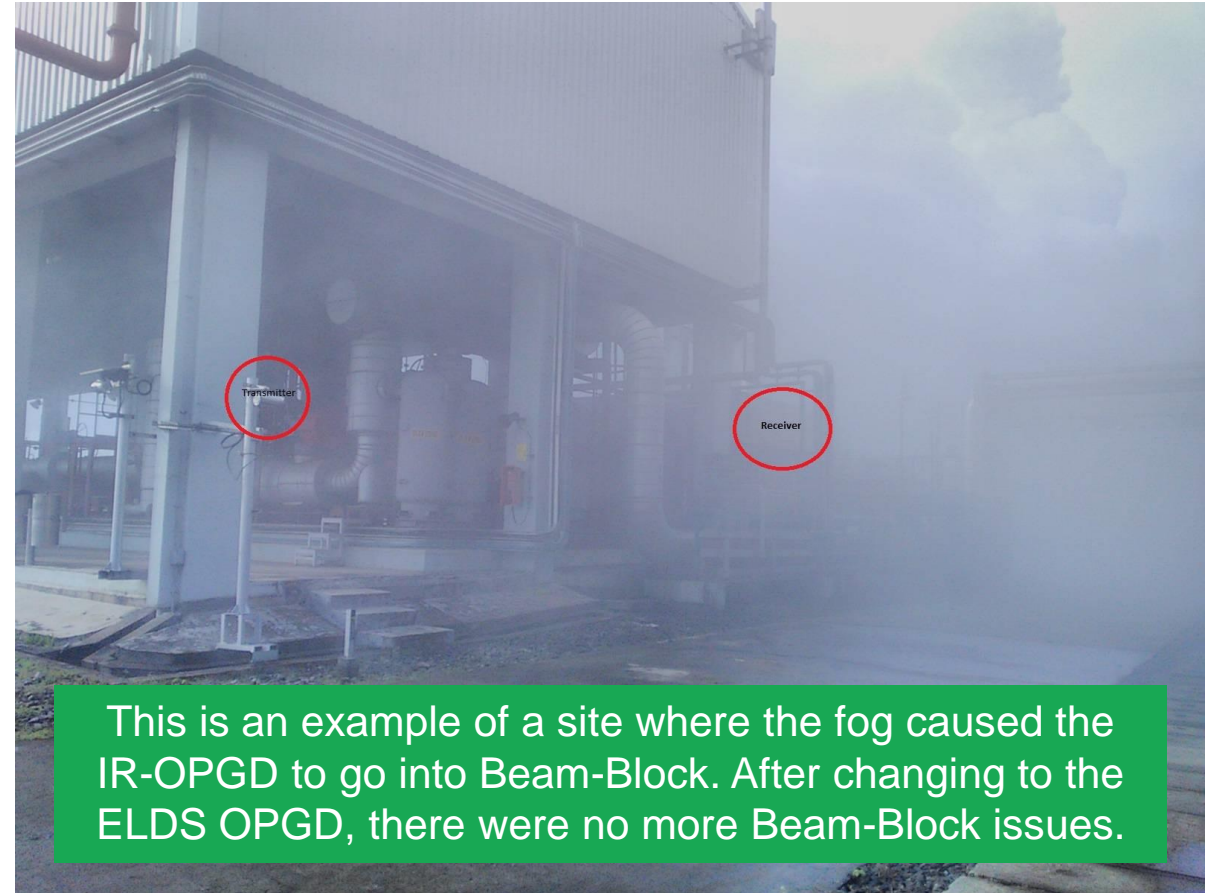
ELDS OPGD vs Differential IR OPGD

Performance in Rain / Fog

The IR beam of all Differential IR OPGD is absorbed by moisture i.e. fog or rain

In these conditions, the OPGD will go into Beam-Block and not be able to detect gas

ELDS lasers operate at different wavelengths to that of differential IR detectors making it less prone to water vapour absorption



ELDS Applications

Sour gas (H₂S)

- Sour oil & gas production
- Gas sweetening plants
- Refineries
- Waste water treatment



High risk, harsh weather (CH₄: OPGD, VZ, XD)

- Oil & gas production
- Gas terminals
- Gas treatment plants
- Gas compressor stations
- Gas fired power stations
- FPSOs



Exotic Toxics (NH₃, HCl, CO₂)

- Fertilizer plants
- Tank Farm storage area
- Chemical plants
- Aluminium plants
- Refrigeration plants
- Brewing
- Carbon capture plants



ELDS Applications

Open Area / Multiple
HVAC intakes



Cross Duct (Methane
only)
0.5 to 5m path length



HVAC inlets - Gas detection requirements



Application requirements

- Fast damper closure
- Simplified routine testing
- Fail safe operation
- Minimal maintenance
- Ease of maintenance
- No unwanted damper closure
- High detection reliability

Detection solution requirements

- Fast speed of response, high sensitivity
- Remote Calibration/Self testing
- Self diagnosing detection failure
- Longer sensor life/No consumable parts
- Mounting position and accessibility w/o opening the duct & Shut down
- Target gas specific
- Voted 2003

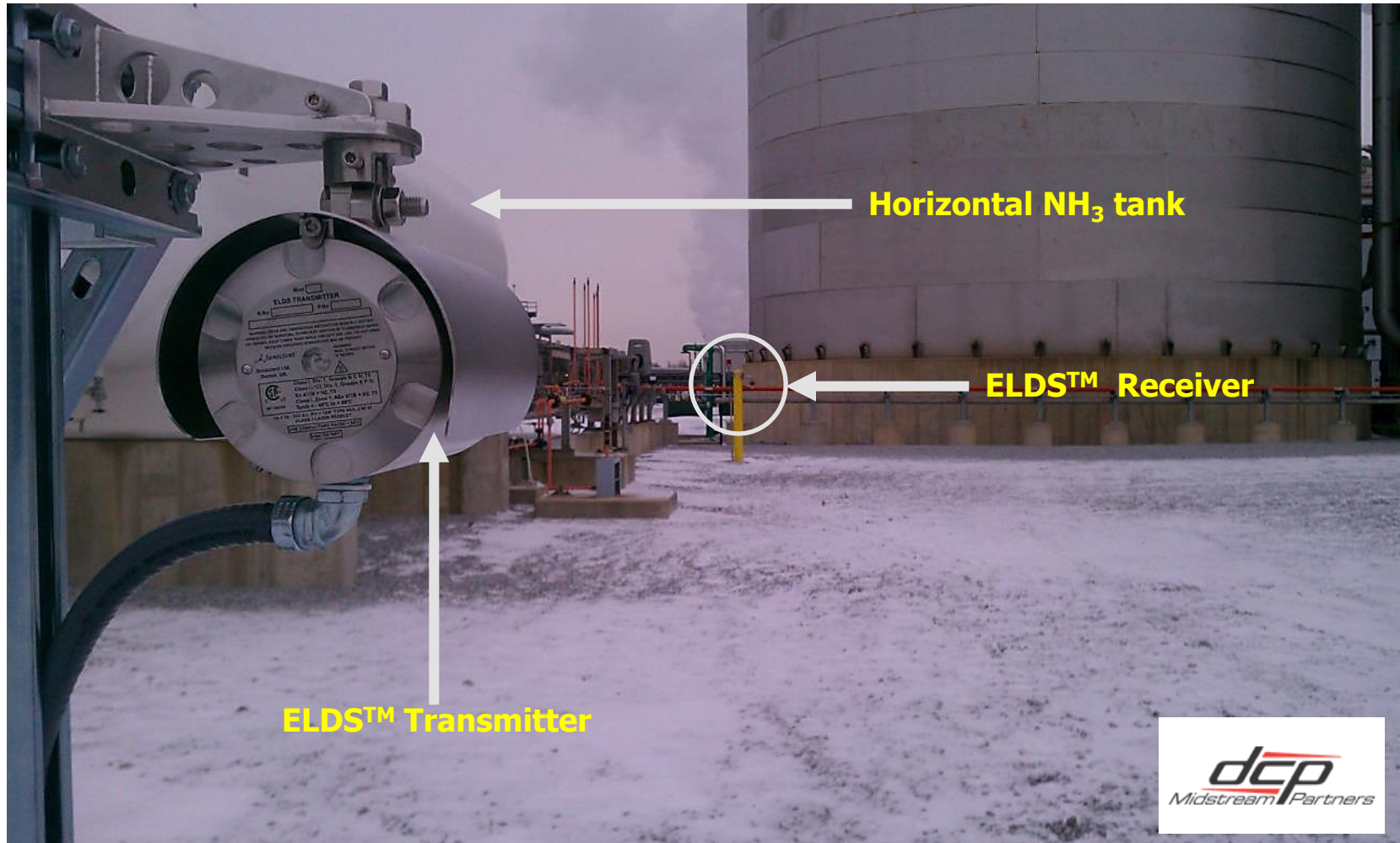
A demanding application requiring an effective solution ...

Typical Fence Line Monitoring

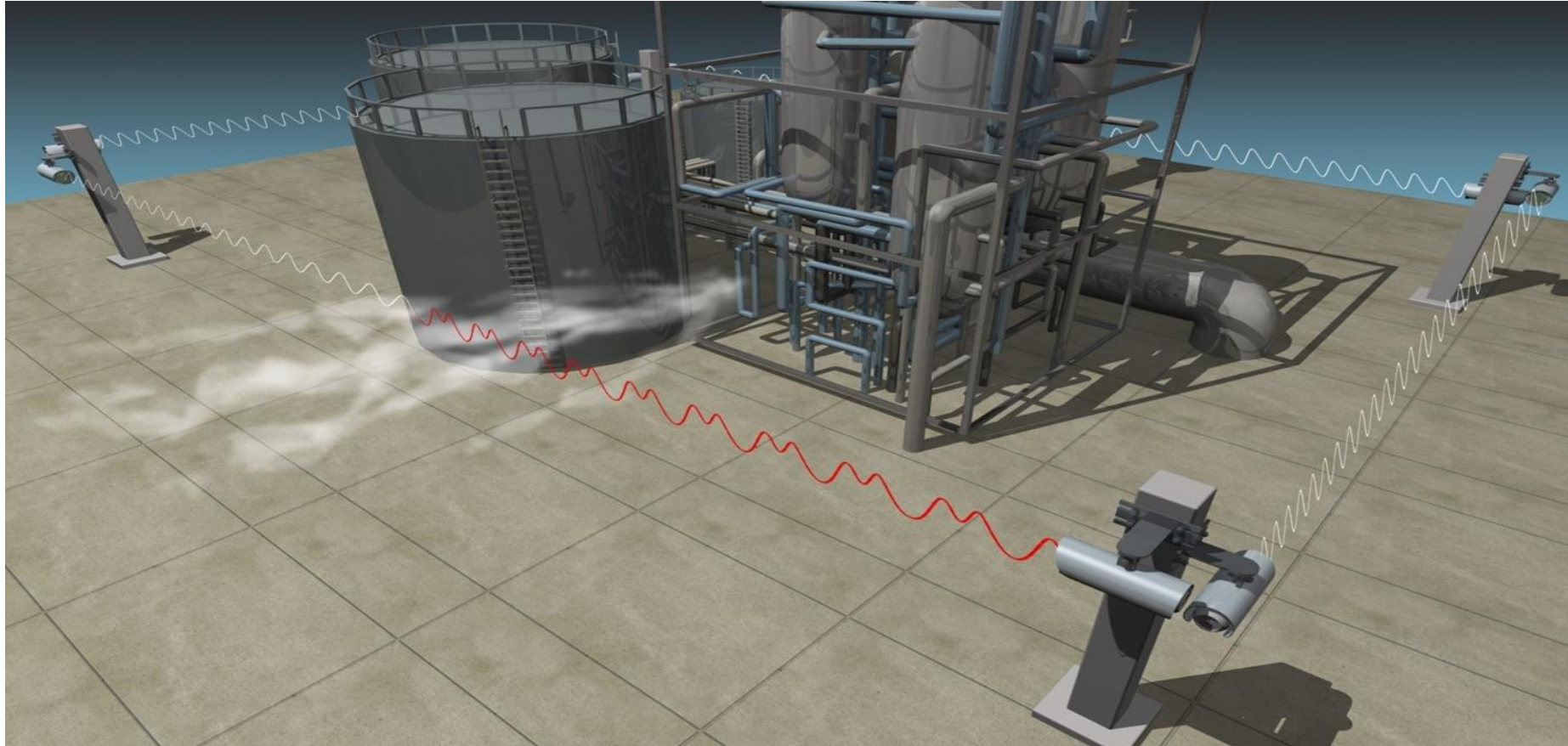


ELDS™ open path gas detector

NH₃ detection at a Fertilizer plant



Process unit –OPGD Application



ELDS™ open path gas detector

H₂S detection in UAE – Sour Gas Fields

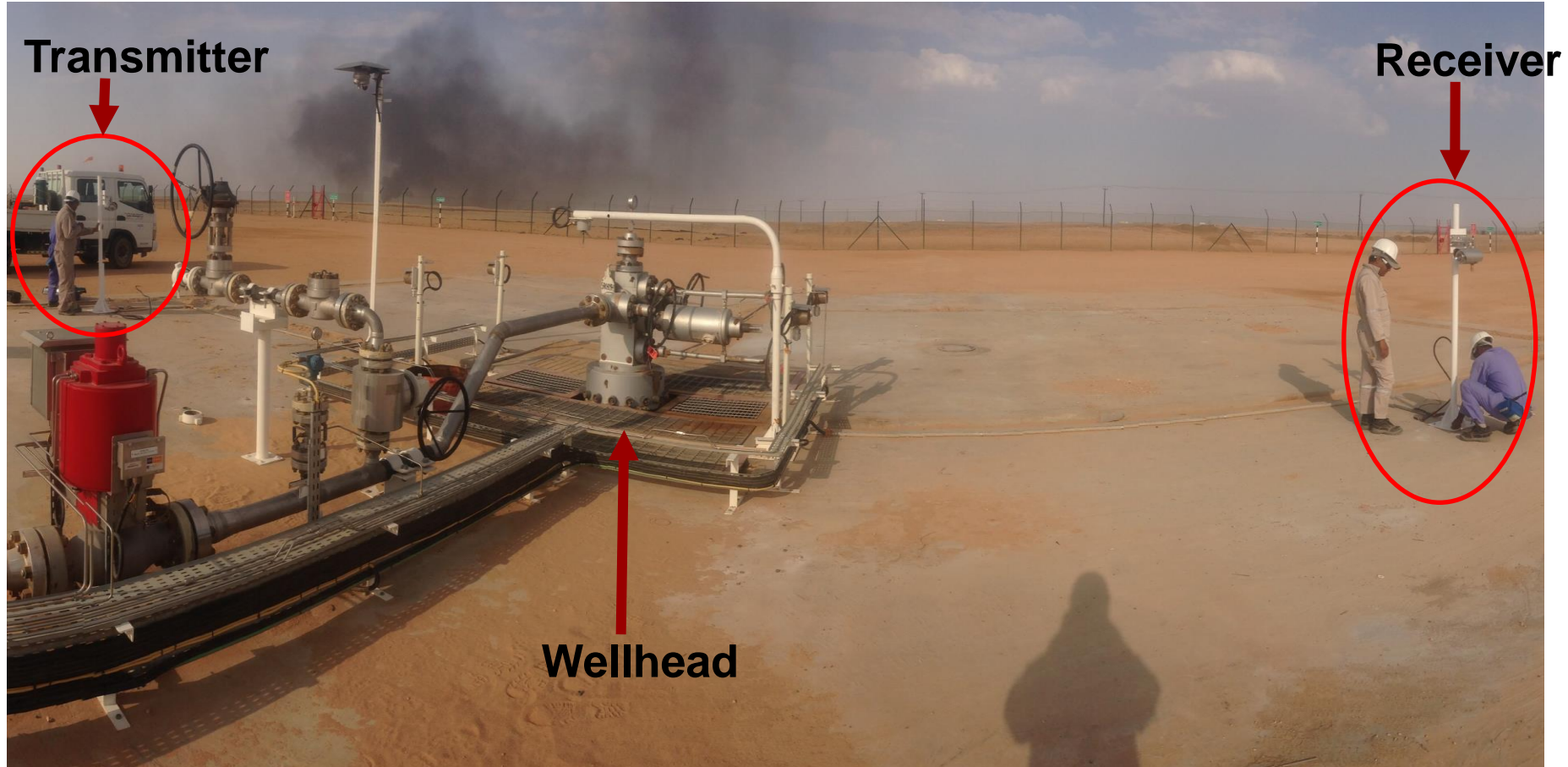
Shah Gas Development

United Arab Emirates, 2011-2013

- US\$10b investment
- Four trains of sulfur recovery units that process one billion cubic feet of sour gas per day
- H₂S concentration in feed gas > 23%
- > 100 units of ELDS™ H₂S



Installation – On shore / Wellhead



Benefits of OPGD

- **Reduced Capex (OPGD):**
 - Wide area of coverage
 - Reduces point detection count
 - Reduced system I/O count
- **Reduced Opex (ELDS):**
 - Reduced routine manual testing
 - No routine calibration
 - No need for test gas
- **Increased safety (ELDS):**
 - Target gas specific* – no unwanted alarms
 - SimuGas* – removes personnel from risk areas
- **Increased performance (OPGD):**
 - Increased sensitivity – fastest plant shut down
 - Best uptime in rain & fog (ELDS)



MSA ELDS & IR5500 The Widest Capability in Open path Gas Detection...



Acoustic Gas Detection

Supplementary Gas Detection for better coverage, earlier gas detection and a safety facility

About UGLD by MSA

- 1995 – Originated at Gassonic in Denmark
- 2006 – Acquired by General Monitors
- 2010 – Gassonic & GM acquired by MSA

Over 4,000 detectors installed in the field



Ultrasonic Gas Leak Detector

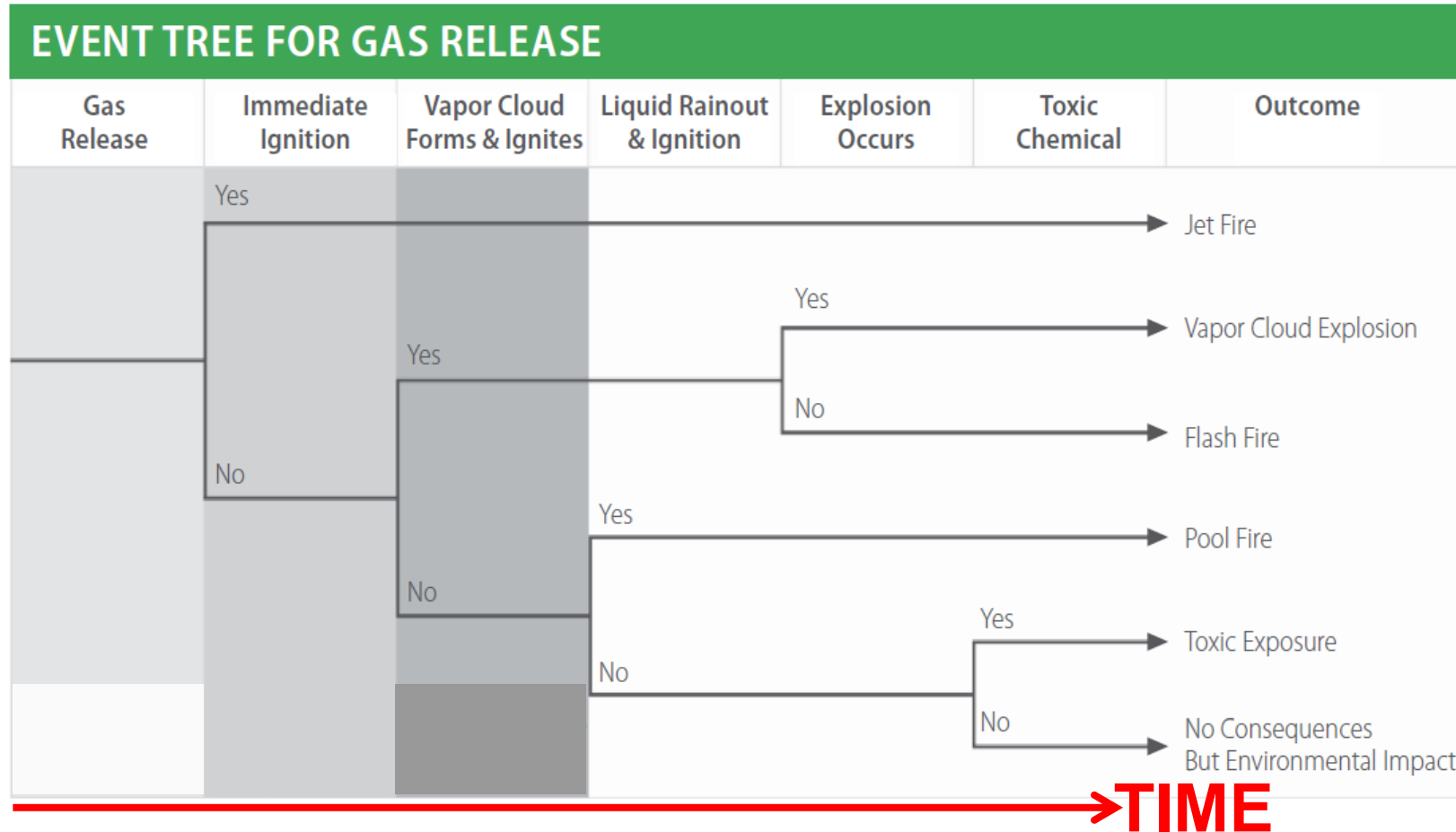
Application Area

- Instant detection of flammable gas leaks
- Faster detection, irrespective of wind direction
- Earlier warning, reduces risk, faster shutdown
- For pressurized gas installations
- Outdoor or ventilated areas
- Hazardous areas
- Fixed installations



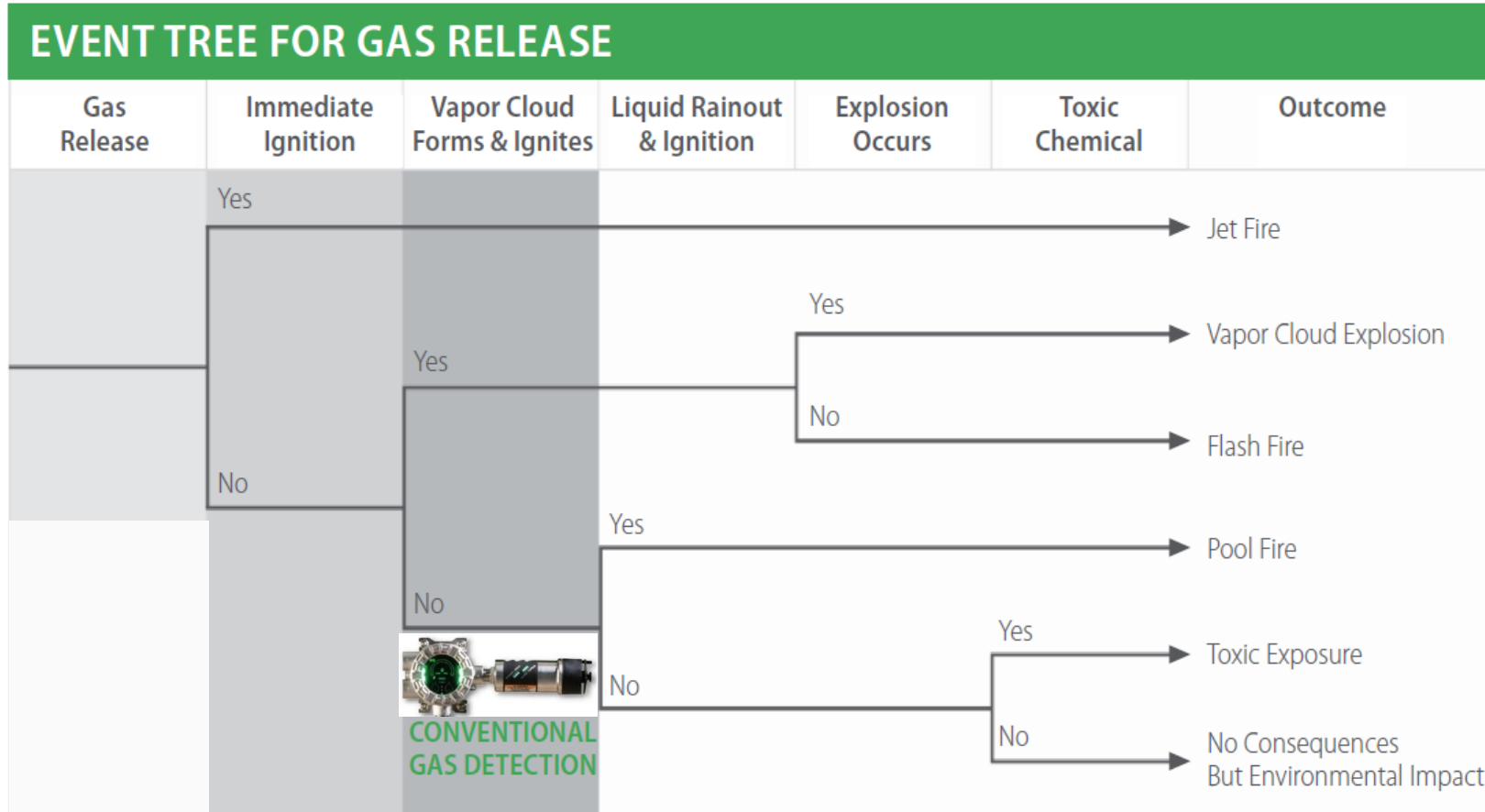
Gas Release Event Tree

Deployment of early response to improve hazard management



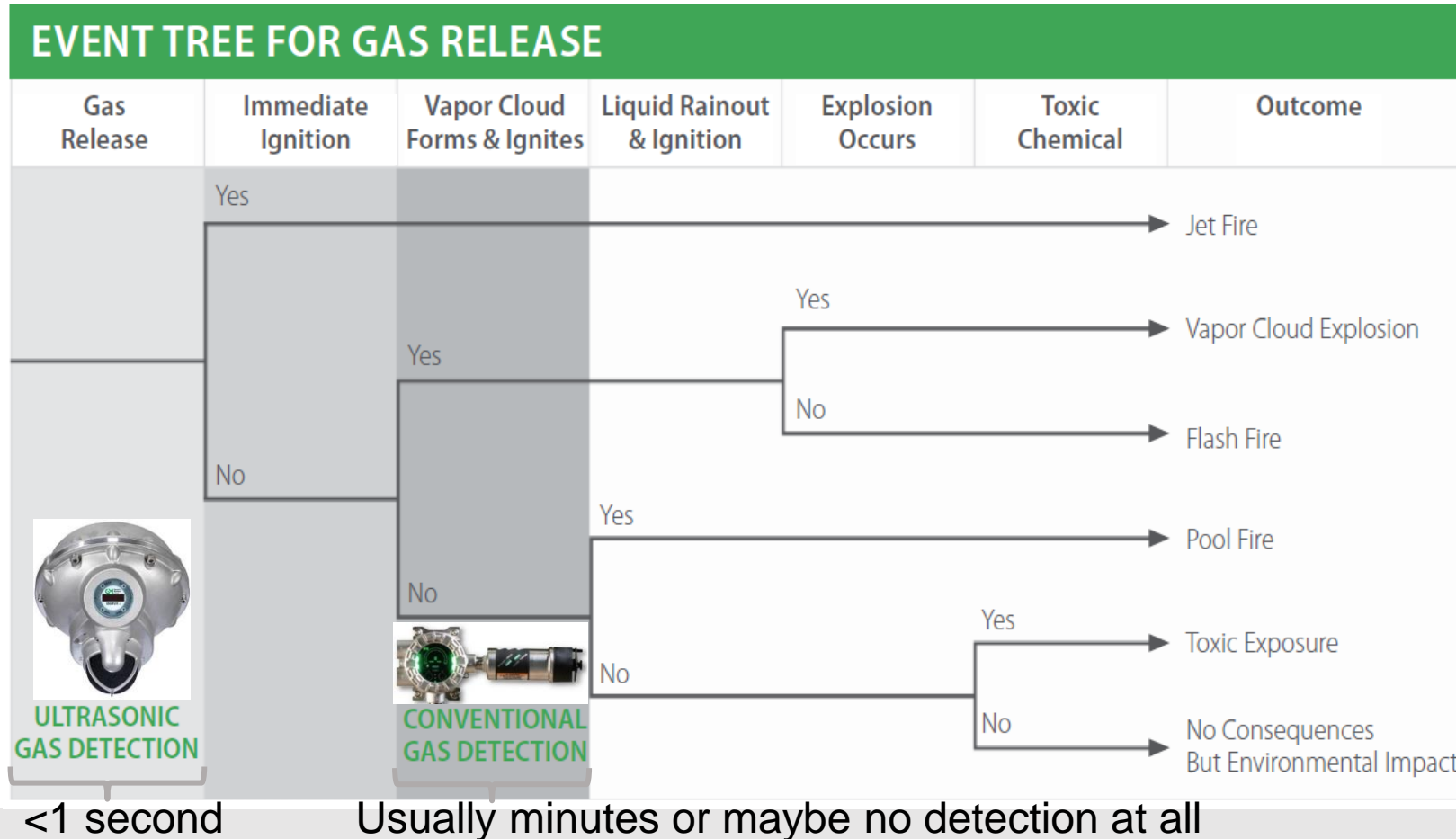
Gas Release Event Tree

Deployment of early response to improve hazard management



Gas Release Event Tree

Deployment of early response to improve hazard management



What is a Leak?

- Performance standard is 0.1 kg/sec (minimum)
- Leak rate (mass flow rate) categories for methane based gas leaks (Ref: HSE from UK):
 - Minor gas leak: 0 – 0.1 kg/s
 - Significant gas leak: 0.1 – 1 kg/s
 - Major gas leak: 1 kg/s or larger
- A 0.1 kg/sec Methane leak:
4 mm hole size at 45 Bar (653 psi) gas pressure

OBSERVER-i

- Dynamic Range (58-104 dB)
- Detects gas leaks from 2 BAR (29 psi) pressure
- Artificial Neural Network minimises false alarms
- Integrated acoustic self-test means minimal calibration and maintenance
- 4-20 mA analogue output with HART
- Modbus digital interface
- Alarm / Fault relays
- Suitable up to SIL 3

1701 Portable Test & Calibration Unit

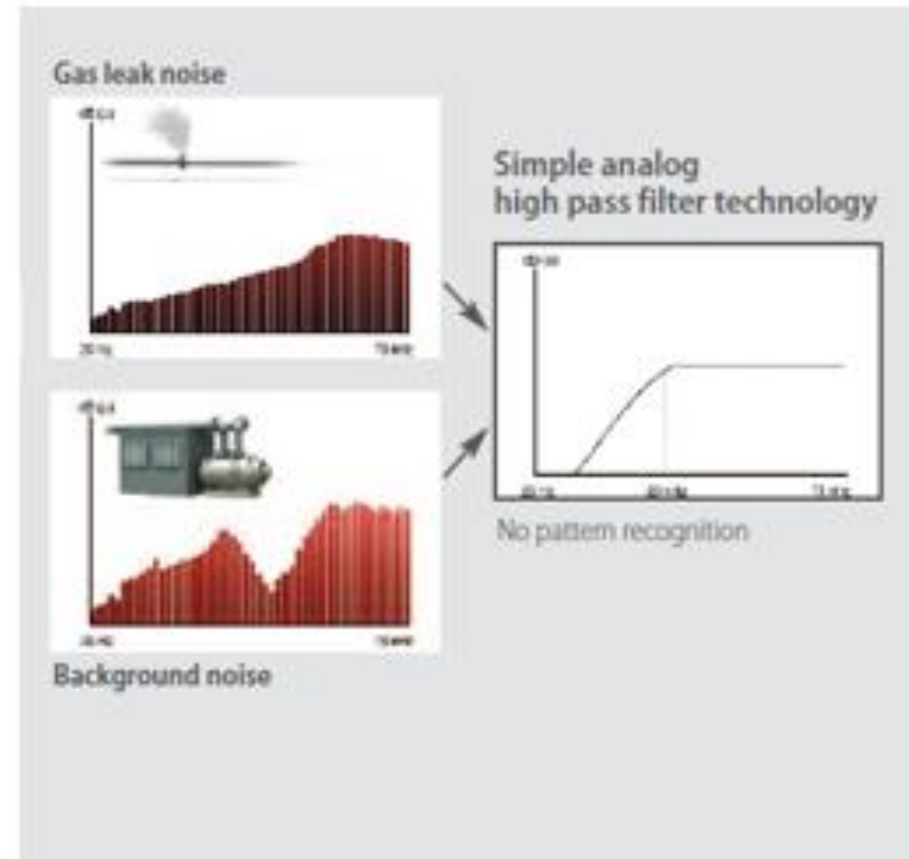
- Onsite calibration unit
- To verify operation
- Satisfies requirements for regular plant maintenance



The Generations of UGLD

First Generation

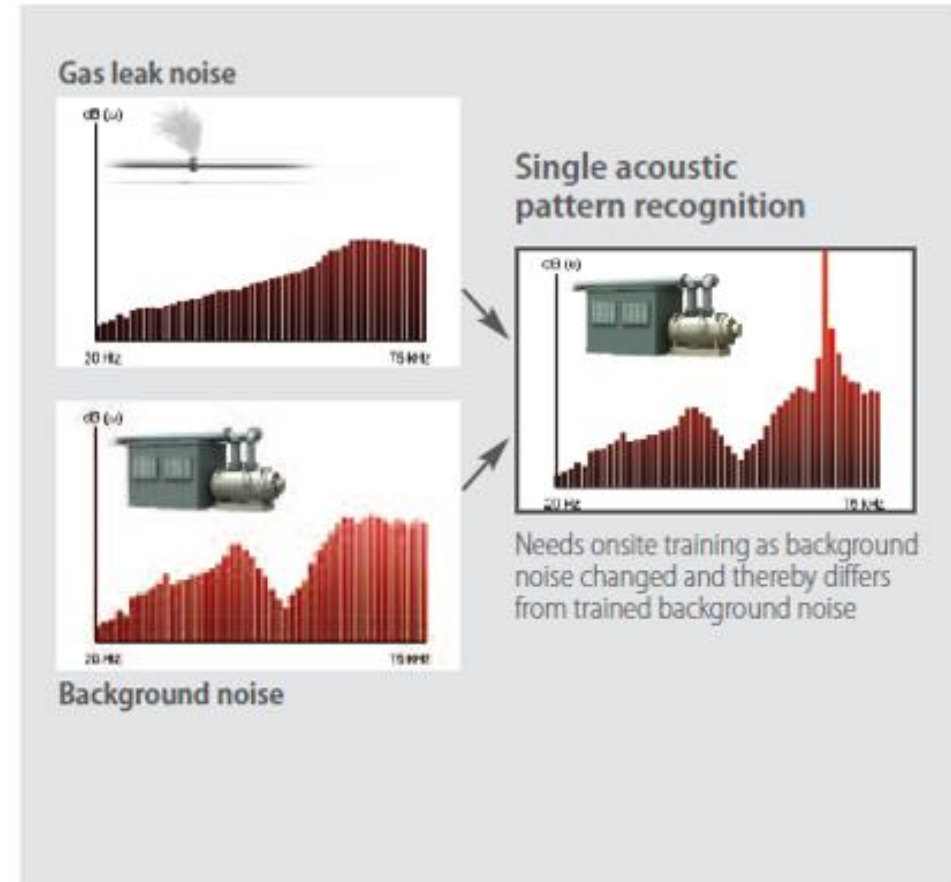
- Simple analog high pass filters
- Suppress low frequency acoustic noise
- Trigger Levels depending on background noise
- In very noisy areas the detection range is reduced



The Generations of UGLD

Second Generation

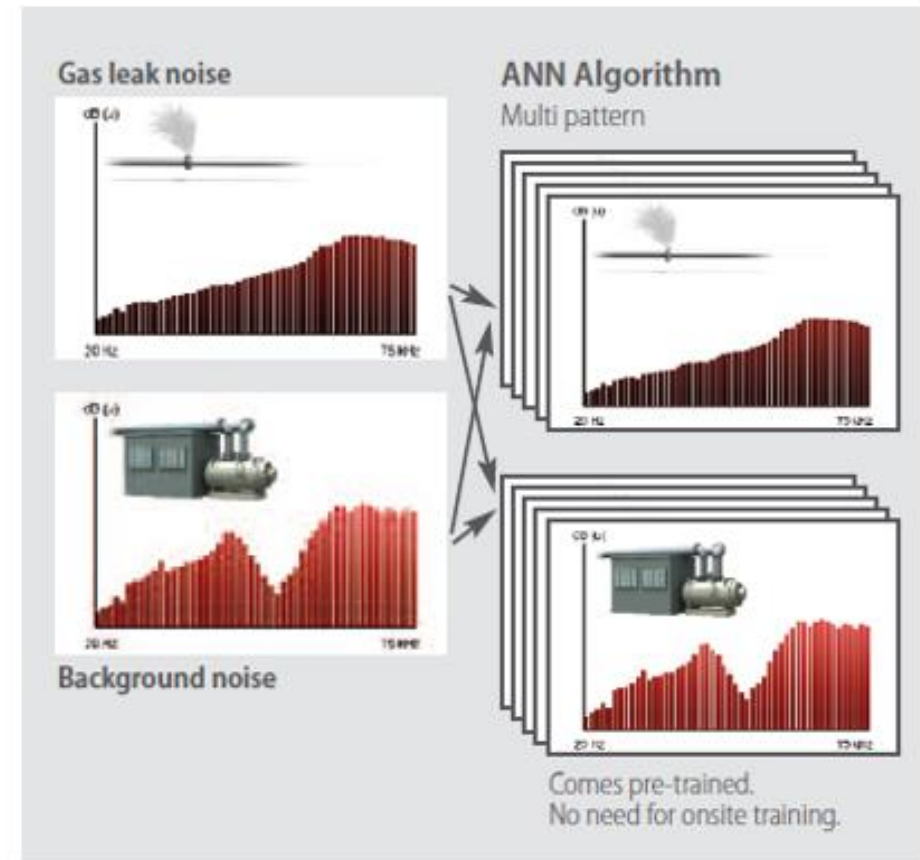
- Single pattern recognition
- Each detector is trained after installation
- Suppress only the specific acoustic background noise
- Trigger Levels still needed
- If the background noise signature changes false alarms can occur
- New training is required



The Generations of UGLD

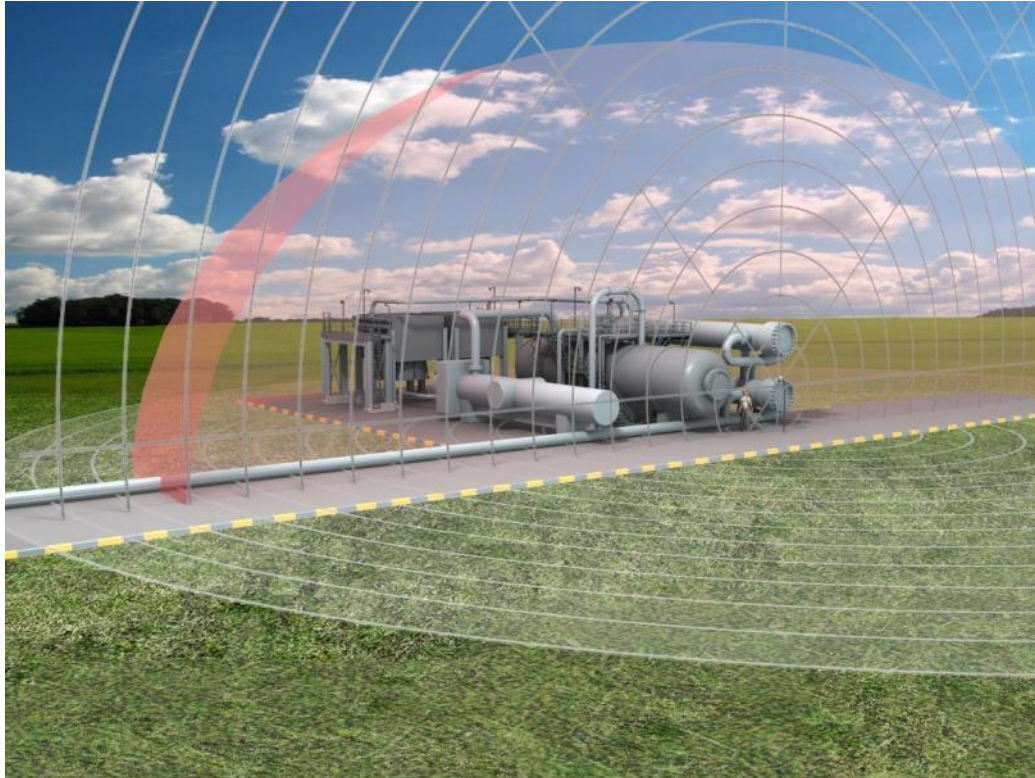
Third Generation

- Utilizes Artificial Neural Network (ANN) technology
- ANN algorithms are pre-trained with real gas leak noise and background noise signatures
- No Trigger Levels needed
- Maximum coverage in all areas
- Plug and play and no need for re-training



Detection Coverage for UGLD

3rd Generation UGLD



Detection is based on ANN algorithms and not trigger levels in Enhanced Mode.

Maximum coverage of 28 meters can be achieved in all background noise levels.

OBSERVER-*i*

A photograph of an industrial facility at night, illuminated by bright lights. The scene shows several tall distillation columns and complex piping systems. A large green banner is overlaid across the middle of the image, containing the title text.

Observer-i Specification

OBSERVER-i

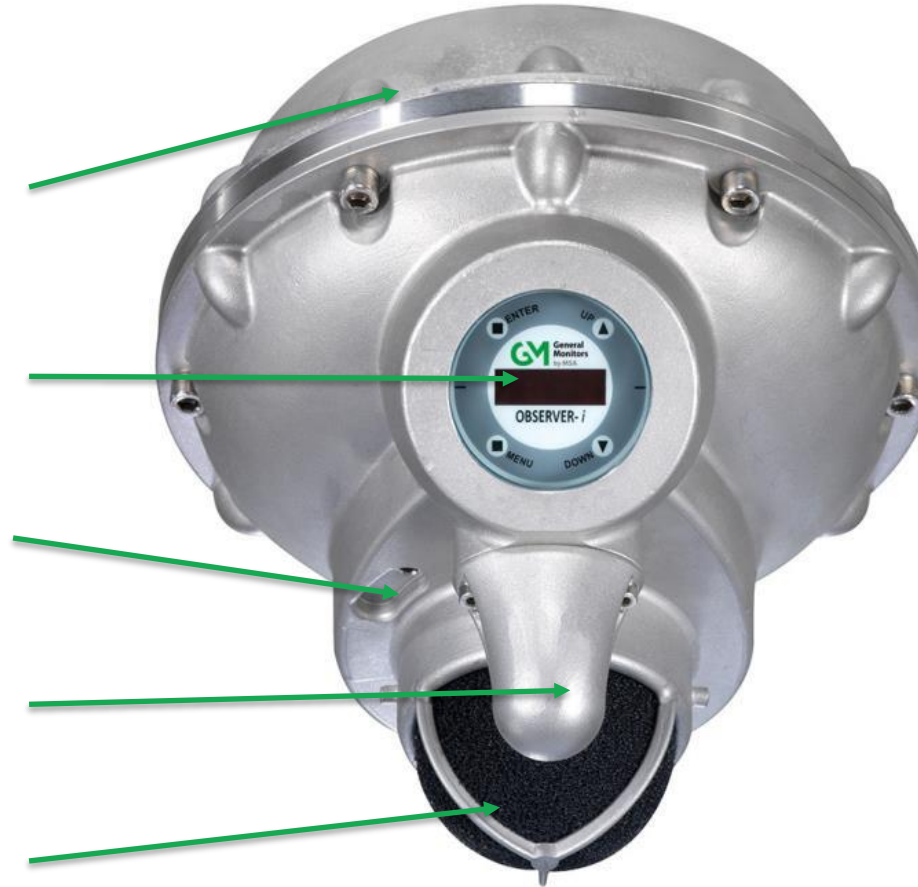
Top chamber with terminals

User interface and display

Optical link window

Test sound source

Windscreen and stainless steel microphone



Physical Features

OBSERVER-i features

- Artificial Neural Network (ANN)
- 15 year field proven Electret Microphone technology
- SENSSONIC™ integrated acoustic self-test
- Backwards compatible with older models
- Standard 4-20 mA analog
- HART
- Dual Modbus serial digital interface
- Alarm Relay and Error Relay outputs
- Explosion proof housing (Exd)
- 316L stainless steel
- Minimal calibration and low maintenance
- FM, CSA, ATEX, IECEx certification
- SIL 3 suitable (FM certified to IEC 61508)



OBSERVER-i

Optimal Microphone Technology

Why Electret microphones instead of Piezo microphones?

- ✓ Best linear frequency responds
- ✓ Best temperature stability
- ✓ Very wide directional characteristic, wide detection range
- ✓ 15 years field proven technology

Self-test Principles

There are 3 types of self-test principles:

- Electronic self-test
- Semi-acoustic self-test
- Full Senssonic Acoustic self-test – as used with the Observer-i

Acoustic Self-test (SENSSONIC™)

SENSSONIC™ self-test includes full acoustic self-test of the OBSERVER-i

- Real acoustic self-test includes the following tests:
 - All relevant electronic circuits are tested
 - Microphone membrane is tested
 - Windscreen is tested
- Ensures full failsafe operation of detector
- Providing the only **true & safe** test of detector

Acoustic Self-test (SENSSONIC™)

- SENSSONIC™ built-in acoustic integrity test
 - External loop configuration
 - Controlled functionality and integrity test every 15 min
 - No unrevealed failures between inspections
 - Fault indicated on 4-20 mA, Error Relay, Display, Modbus and HART



Observer-i

Field Replaceable Parts

OBSERVER-i can be serviced in the field, and does NOT need to go back to factory for service:

- ✓ Microphone sensor can be replaced in the field
- ✓ SENSSONIC™ self-test sensor can be replaced in the field



Manual Testing



Testing

1701 Portable Test & Calibration Unit

- Verify the operation and if necessary, calibrate the GASSONIC UGLD
- Requires no electrical connection to the UGLD
- Traceable and calibrated to international standards
- Tests full dynamic range as well as delay function
- No need to open up detector or remove parts in the field



1701 UGLD Portable Test & Calibration Unit



Testing 1701 Portable Test & Calibration Unit

- Prior to testing
 - Clean windscreen and optical link window
- Testing/Calibration
 - Traceable to international standards
 - Gain Test (functionality/tolerance)
 - Delay Test (Loop to F&G System)
 - Calibration if required by plant procedures



Installations



Existing Installations - Onshore Wellheads

Ultrasonic detectors installed on wellheads in Europe and Africa



Major gas supplier in Europe using only ultrasonic detectors at its outdoor gas plants

Existing Installations - Offshore Wellheads



7 out of 9 Ultrasonic detectors installed on a Hess weather deck in the North Sea.

Hydrogen Truck Filling Station – Hydrogenics Denmark



2 Observer's installed at Air Liquide H2 filling station (together with SUPREMATouch control system)



Flame detectors

FL500 UV/IR, FL500 UV/IR – H₂, FL5000

What are we trying to detect?

Hydrocarbon (Fuels that contain Carbon)

&

Non-Hydrocarbon based Fires (e.g. Hydrogen)

What are we trying to detect?

- Flame detection systems are designed to detect small flames as soon as the fire starts
- When fires are not detected early, they can develop into a catastrophic fire



What is a “Flame Detector” ?

- Flame Detectors use a combination of infrared, visible, and/or ultraviolet sensors to detect an open flame occurring within the field of view of the detector while ignoring false energy sources occurring
- Flame detectors are ‘aimed’ to cover high risk ignition zones in open areas in order to reliably and quickly detect an open area fire, fast, open area fire detection, notification, & mitigation



Optical Flame Sensing Technologies



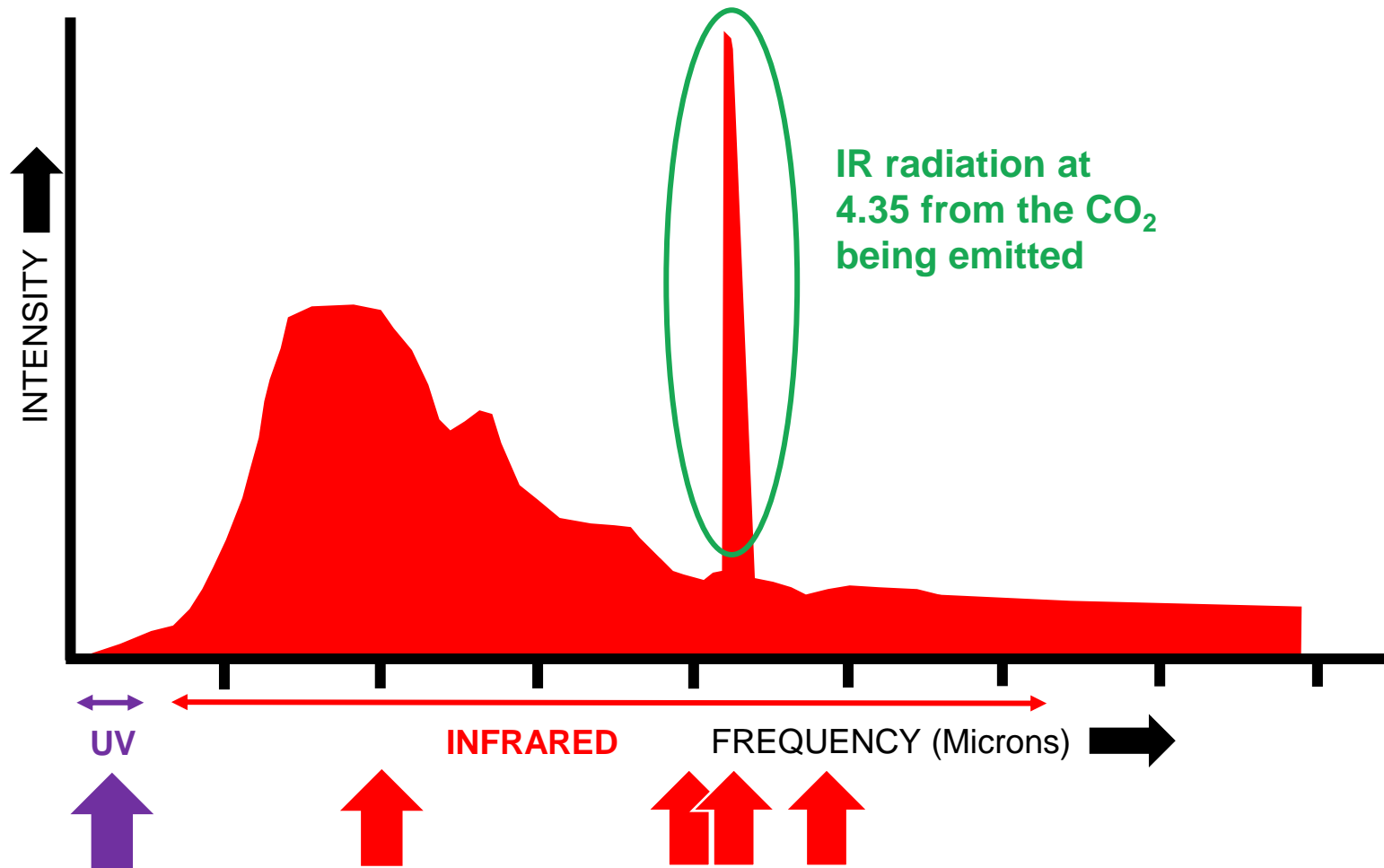
MSIR



UV/IR

Principle of UV/IR and MSIR Flame Detectors (for hydrocarbon fires)

Both UV and IR sensors (or all the 4 IR in case of MSIR) must detect radiation to give an alarm and



Emission summary

- Small amount of UV radiation below 0.5 microns
- IR radiation makes up the large majority of the radiation at varying intensities
- The highest intensity of IR radiation is from the CO₂ that is produced by Hydrocarbon fires

UV/IR Sensor frequencies:

UV sensor: 0.185 to 0.26 microns

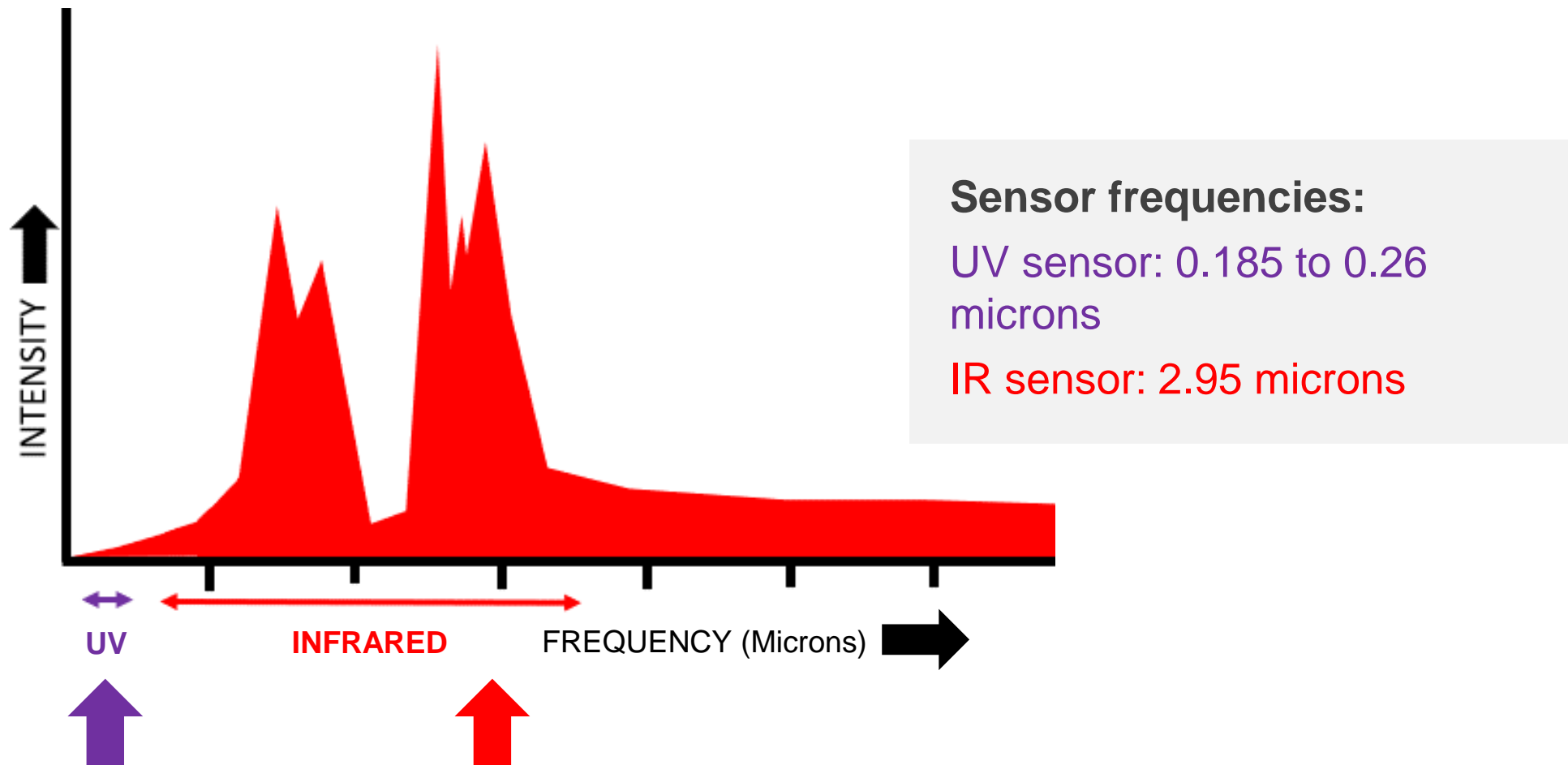
IR sensor: 4.35 microns

MSIR Sensor frequencies:

IR sensors: 2.2; 4.0; 4.35; 4.9 microns

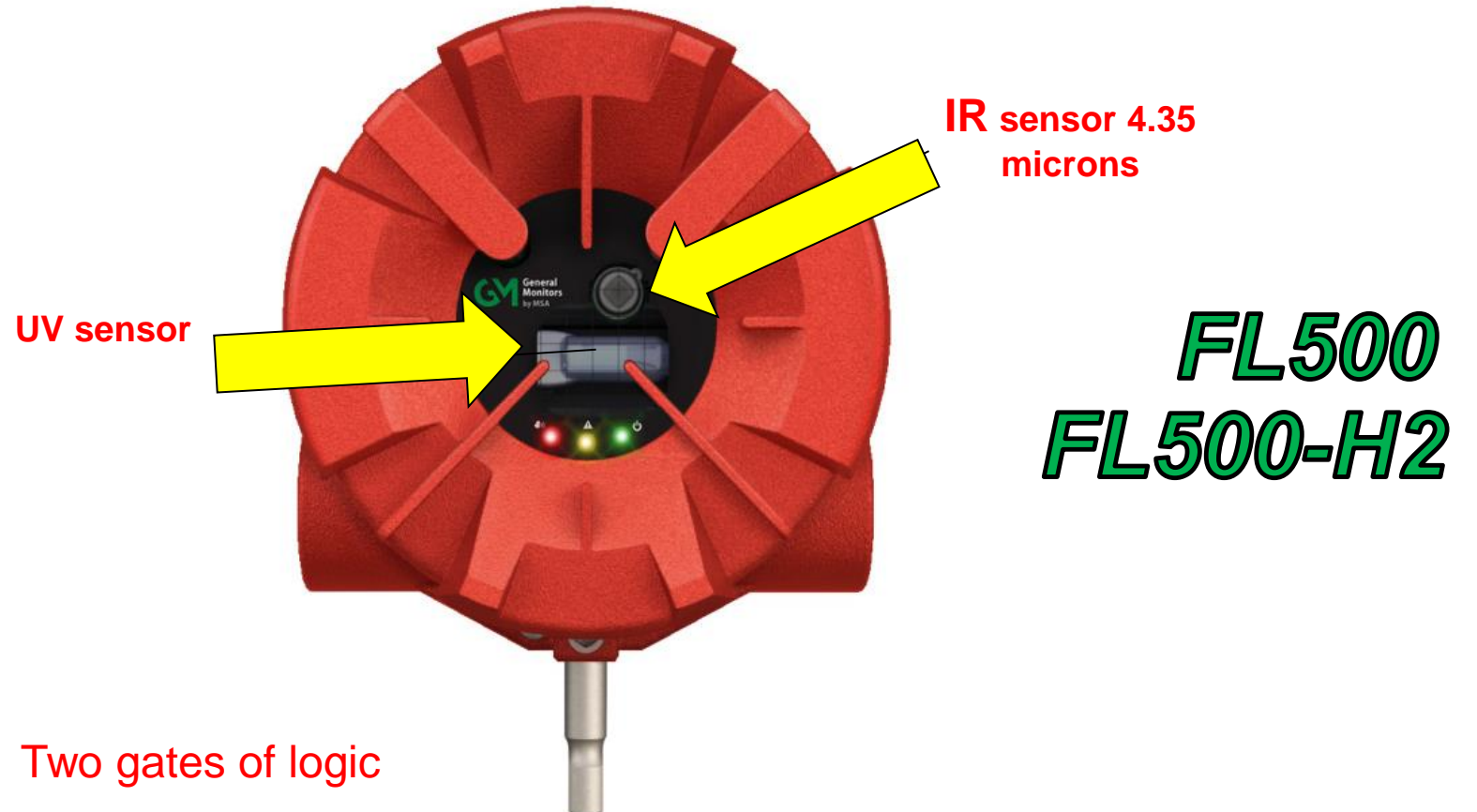
Principle of UV/IR Flame Detectors (for hydrogen fires)

Both UV and IR sensors must detect radiation to give an alarm



UV/IR Flame Sensing Technologies

- Utilize a Geiger-Muller UV phototube & Single Frequency IR (SFIR) Pyroelectric sensor
- Signal processing is “AND” logic gate >> UV + IR must be detected simultaneously for Alarm output
- Hydrocarbon-only & Hydrogen-capable Models



Flame Detectors

FL500 – UV/IR



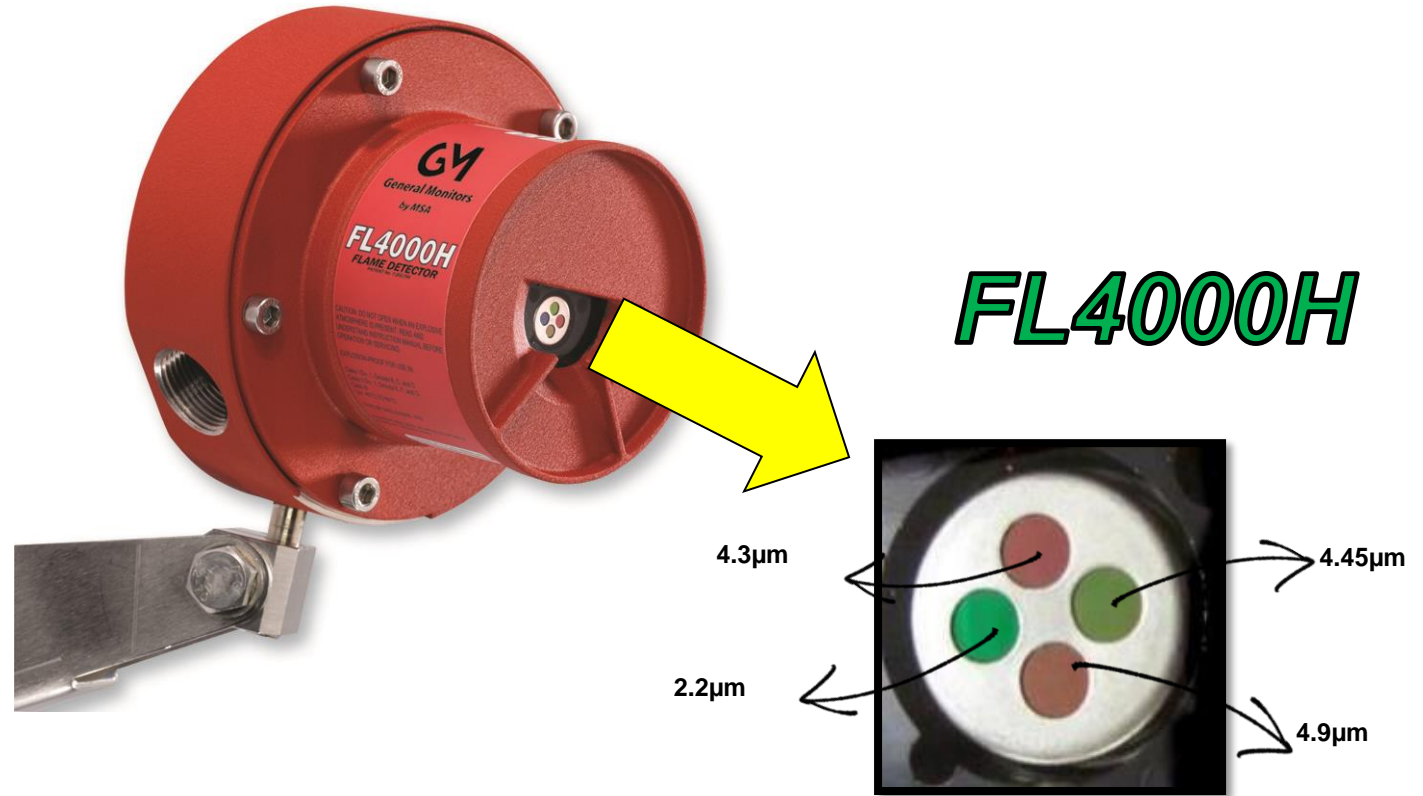
Specification

- Response time: 6 seconds
- Field of view: 130°
- Detection distance: 27 mtrs
- Outputs: 4–20mA, Relays, HART, Modbus
- Operating temp: -55°C to +85°C
- Inbuilt Self Test, every 2 minutes
- FM Performance Approved for:-
 - n-Heptane, Methane, Butane, Ethane, Propane, Methanol
- Housing: SS316

MSIR Flame Sensing Technologies

- 4 Pyroelectric sensors fitted with optical IR filters
- Neural Network Technology Signal Processing
- Hydrocarbon flame detection only – long range

Four gates of logic



Comparative Features

MSIR

- Detects most hydrocarbon fuel fires
- High sensitivity and extended FoV is optimal for large area monitoring
- Good option for dirty, oily areas with infrequent maintenance
- Good option for smoky/sooty fires



**MSIR
Detector**

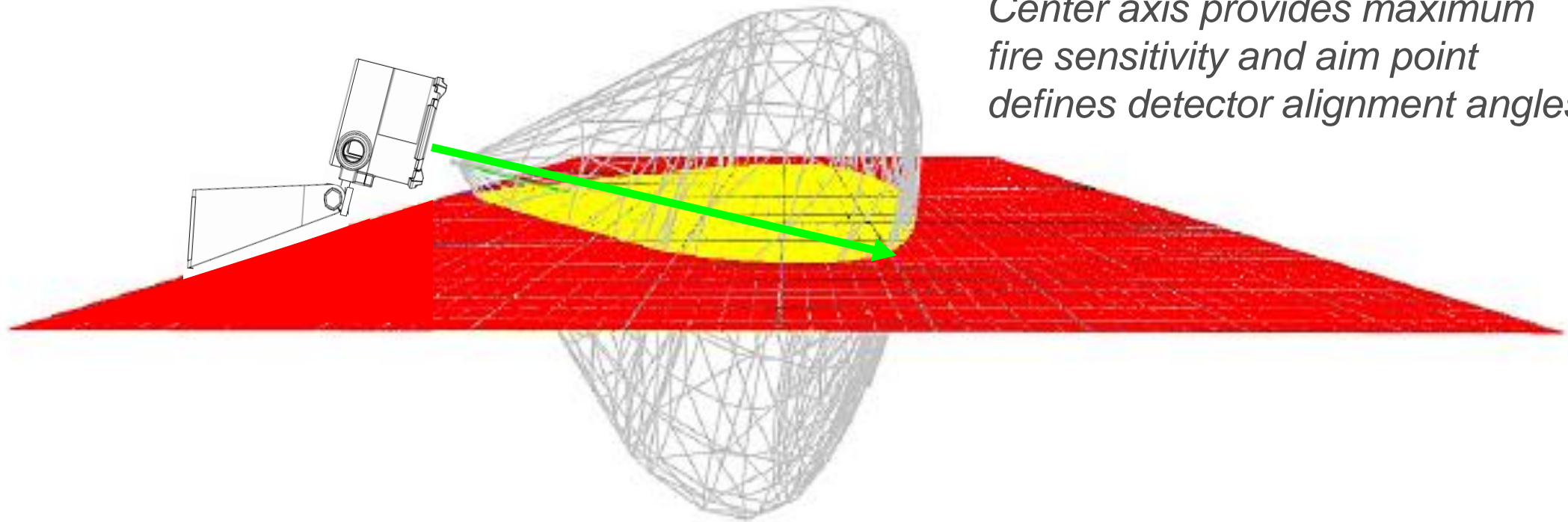
UVIR

- Detects most hydrocarbon fires and some non-HC fires
- Hydrogen-only (–H₂) model available
- Wider FoV optimal for short range, wider physical spaces
- Fast alarm response
- UV & IR only pre-alarm options (Analog output) useful in electrical transformer & electrostatic applications



**UV/IR
Detector**

Adjustable Field of View (FoV)

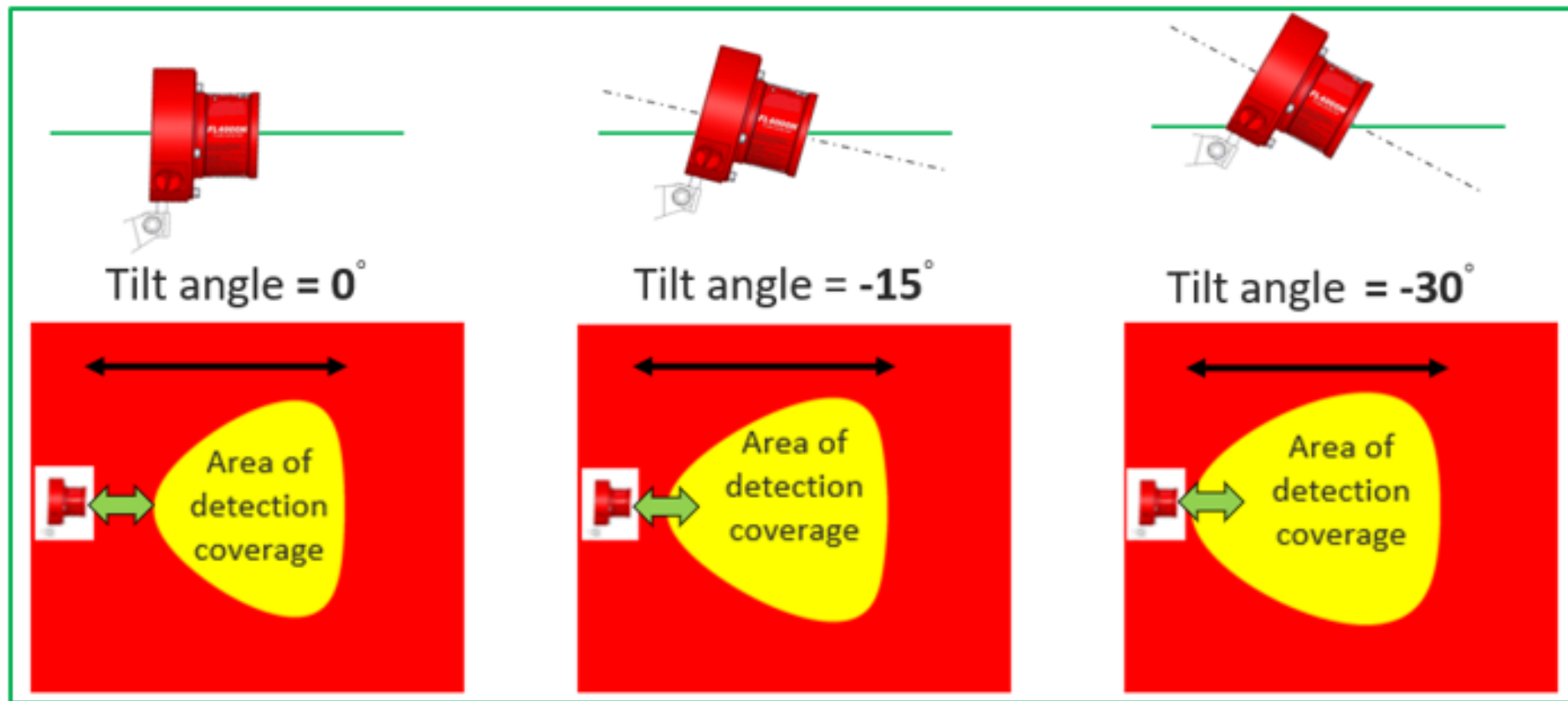


Center axis provides maximum fire sensitivity and aim point defines detector alignment angles

Can the detector see the fire?

Note: tilt angle affects detection coverage

Detection distance (black arrow) remains the same but the coverage area near the detector increases as the tilt angle below horizontal increases – as shown by the green arrow.



Longer detection range

Can flame detectors detect further than the published detection range?



**Inverse square rule:
Double the distance, fire must be 4 x the size of original fire**

27 metres for FL500

54 metres for FL500



1' x 1' = 0.09 m² fire



2' x 2' = 0.36 m² fire

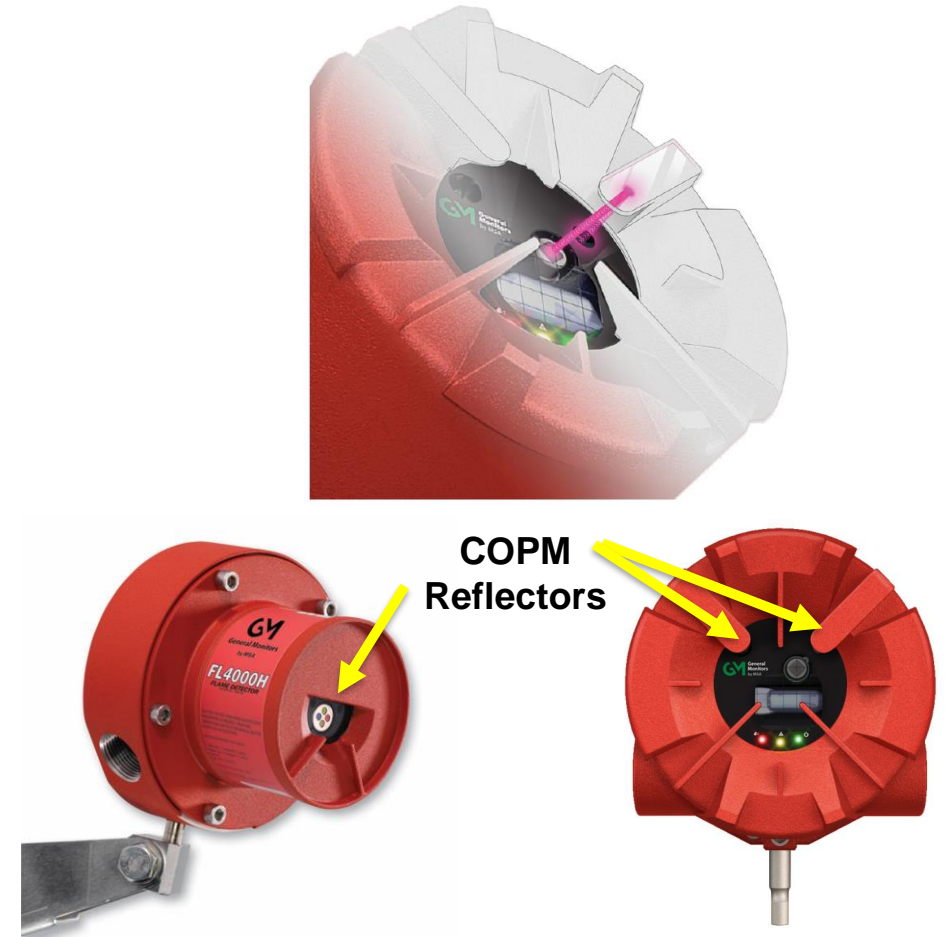
Common False Alarm Sources

- Industrial Customer work sites may include:
 - Flare stacks
 - Jet engine afterburners
 - Arc Welding
 - Truck exhaust, boilers, turbines, reactors
 - Lightning
 - Grinding
 - Corona discharge
 - X-ray operations
- UV Alarm sources



Continuous Optical Path Monitoring (COPM)

- The most common flame detector fault is compromised “dirty” optics which adversely impact detection performance
- COPM test energizes once every 2 minutes to ensure
 - Optical window surfaces are not dirty
 - Validate that sensors and test sources are working properly
 - Successful COPM test (clean optics) goes without report
 - Two continuous test failures results in COPM fault
- Cleaning the optics will clear the COPM fault



Test Lamp TL105

Features:

- Remote testing up to 6.0m (FL500) / 9.0 m (FL500+H2)
- Approvals: ATEX and CSA
- Tri-color LED battery status indicator
- Single tap on / off
- Designed to operate specifically with GM Flame Detectors
- Not designed for testing competitors' products
- A test torch should always be used as it is important to test the detector and the system.
This ensures the system is configured correctly





Fire & Gas Controllers



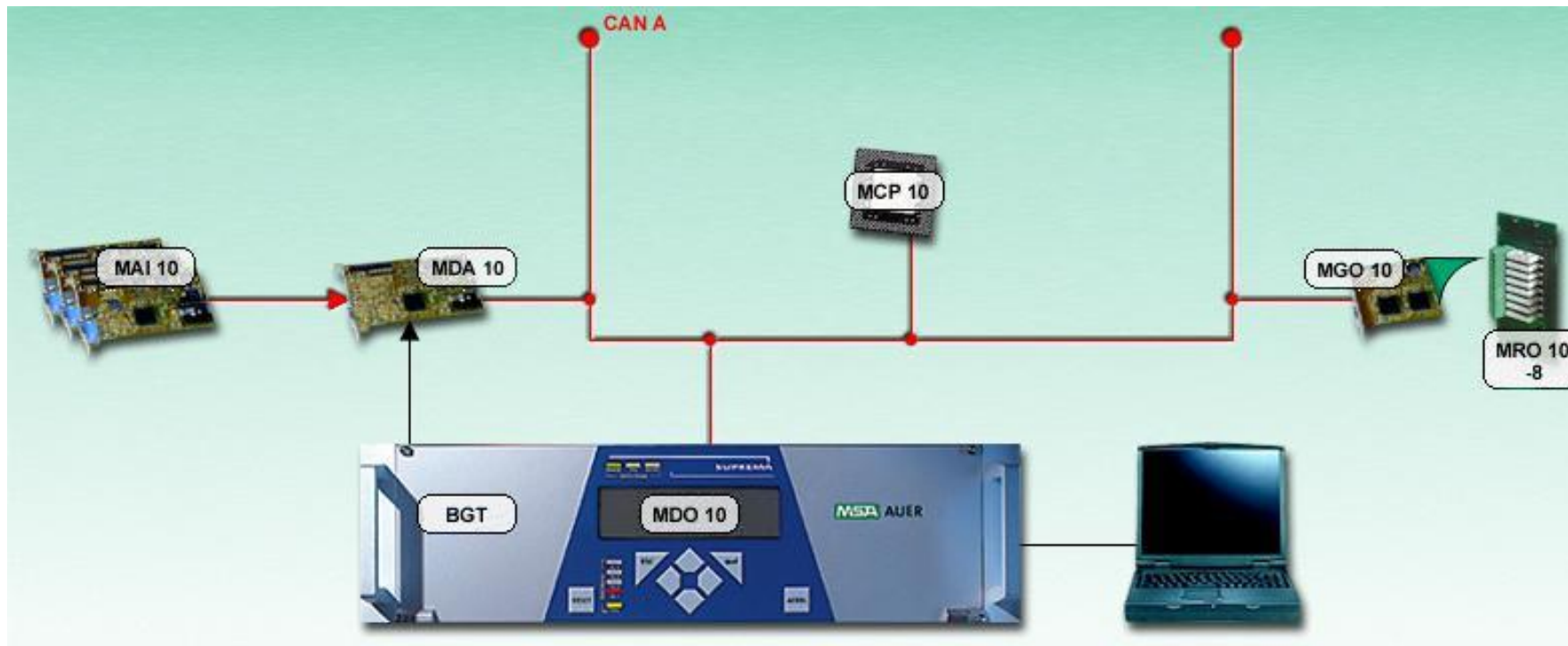
SUPREMATouch

- Compact modular design
 - Decentralized configuration
 - Touchscreen allowing intuitive operation
 - Complies to ATEX EN60079-29-1 & SIL3 suitable
 - HART support
 - Logic Structure enables the use in new areas
 - New calibration options, e.g group calibration
 - SD card support to enable storage of backup configuration
- **SUPREMA Manager Software:**
- Simple and comfortable parametrisation
 - Saves time as set-up can be done offline
 - Facilitates obligatory documentation



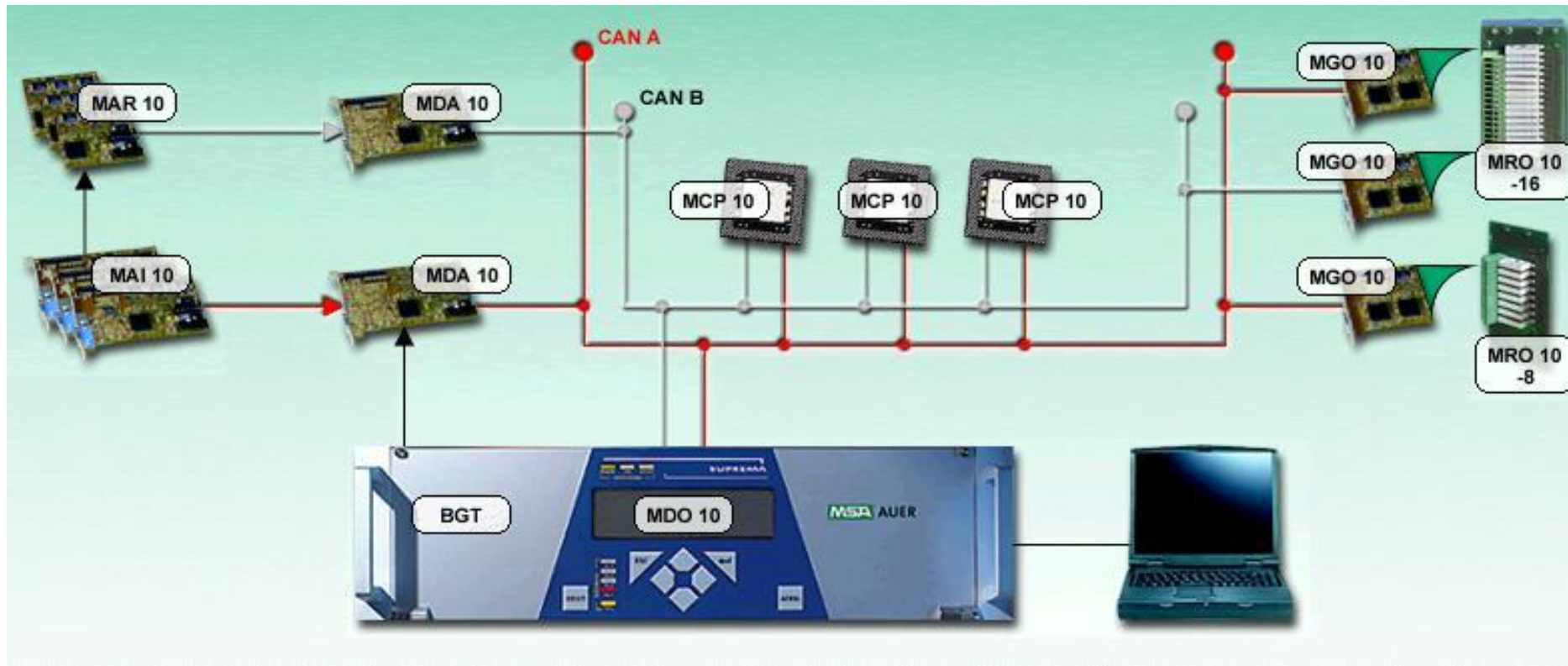
Suprema Touch

Single CanBus architecture



Suprema Touch controller

Double CAN bus architecture. 2 independent redundant lines, SIL3-compatible system

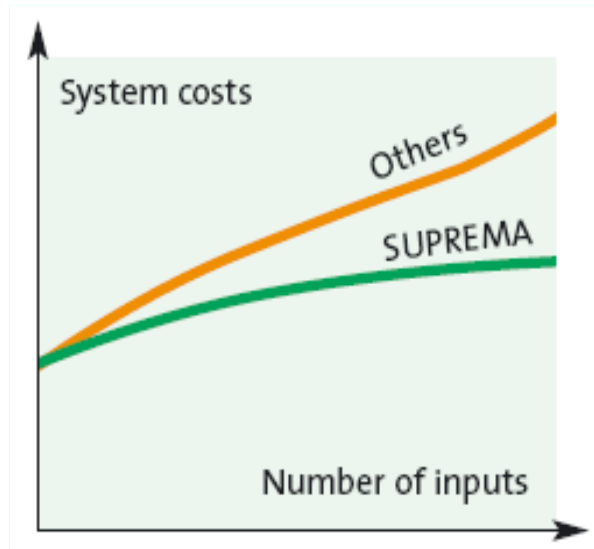


Suprema Touch controller

One rack: 64 channels,
40 relays

One cabinet 128 channels
80 relays

Complete system: 256 channels,
512 relays



Suprema Touch controller

PS-1C Riser Platform - Toxic Alarm - CimEdit

File Edit View Format Tools Frame Help

PS-1C RISER & MANIFOLD PLATFORM

ZONE 5

○1047 00% 00ppm	○1044 00% 00ppm	○1041 00% 00ppm	○1038 00% 15ppm
○1048 00% 00ppm	○1045 00% 00ppm	○1042 00% 00ppm	○1039 00% 00ppm
○1049 00% 00ppm	○1046 00% 00ppm	○1043 00% 00ppm	○1040 00% 00ppm

○1247
00ppm

○1244
00ppm

○1241
00ppm

○1238
15ppm

○1248
00ppm

○1245
00ppm

○1242
00ppm

○1239
00ppm

○1249
00ppm

○1246
00ppm

○1243
00ppm

○1240
00ppm

Bridge

Occidental
Petroleum
of Qatar

Suprema Touch controller

**Compact multi-channel
systems with clear
intuitive blocks
positions and functions
in one cabinet**



9010/9020 SIL Controller

- Monitors up to 20 channels independently
- Options in 19" rack or wall-mount box (one or two channels)
- Works in combination with a wide range of MSA gas sensors
- Large LCD and LED inform about gas concentration, alarm status and more
- RS 485 Modbus RTU, Ethernet for Modbus TCP



9010/9020 SIL Controller

Features & Benefits

- Safety Integrity Level for hardware SIL 2 / for software SIL 3
- Tested and certified according to ATEX directive
- Certified to current LVD and EMC directive!!
 - Improvement on safety functionality, suitable for SIL 2/3 applications
- Improved menu navigation (additional ESC key) and additional failure codes
 - Simplifies parameterization
 - Error and failure messages on the display
- One hardware configuration for all detectors (universal platform)
 - Universal platform allows an operation with a wide range of detectors
 - Satisfies a variety of gas monitoring applications
- Configuration on front menu
 - Time saving for initial configuration & setting

Flexible. Scalable. Intuitive.

7-inch touchscreen provides easy access to multilingual setup and operating workflows

SmartStart Setup Wizard provides simple guided instructions to walk the user through setup

EZ-ID sync and pre-populates details of HART-enabled MSA gas and flame detectors in 1 click



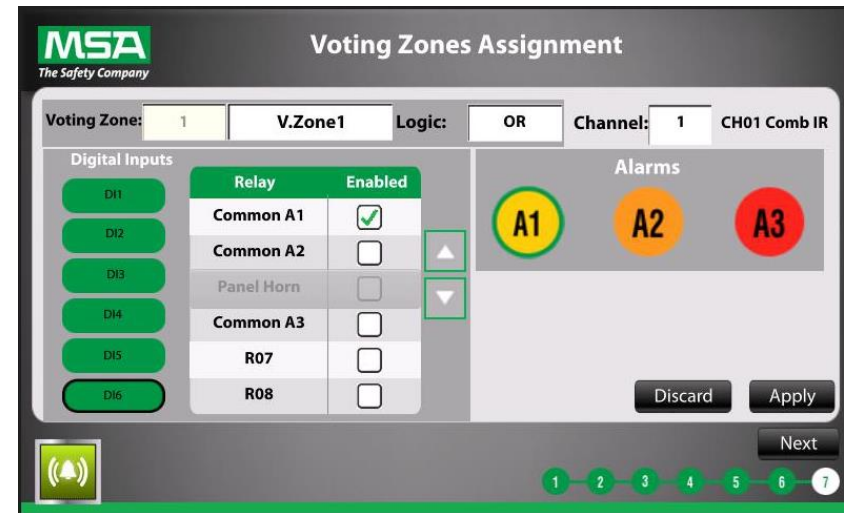
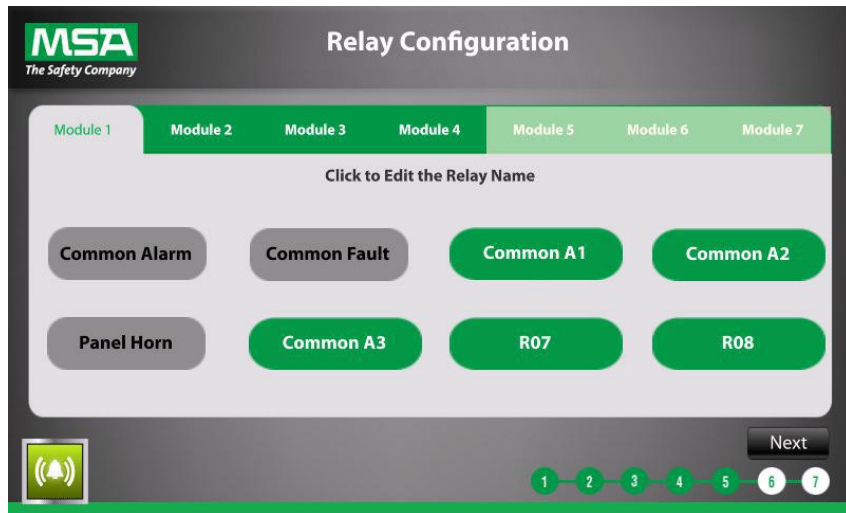
Robust configuration logic enables users to take control of their processes through **Cause & Effect and Voting**

On-board **diagnostic tools** like real time HART diagnostics and channel trends

Advanced networking capabilities allow to scale by linking SENTRY io together through **Allen-Bradley DLR**

Flexible Platform

- Offers 8 or 16 channel configurations with 6 user-assignable discrete inputs and options of up to 56 relays
- Provides multiple output options including Modbus TCP/IP, EtherNet/IP, and optional Modbus RTU and analog output capabilities
- Gives users the capability to easily configure control logic & voting



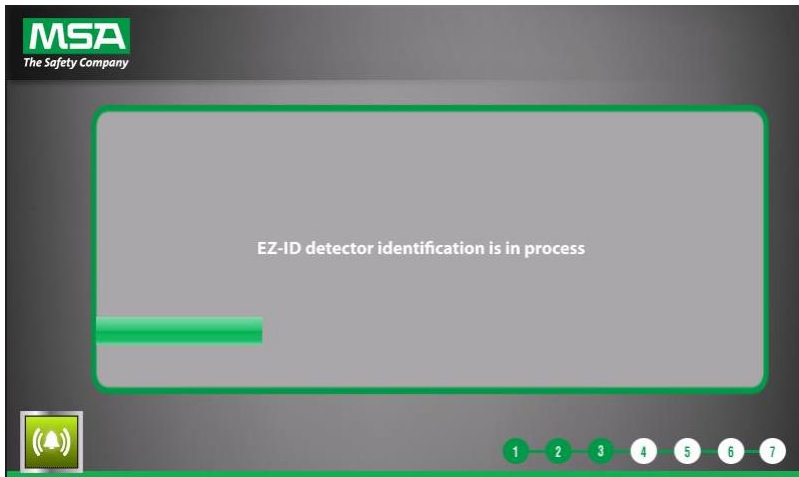
Scalable Platform

- SENTRY io units can be “daisy chained” together to economically connect multiple controllers throughout the facility
 - Equipped with Allen Bradley’s Device Level Ring (DLR) capabilities provides users with economic networking options that deliver financial and schedule savings in projects
 - Saves wiring expenses and complexity by leveraging DLR to allow a loop topology to connect multiple controllers in a single run



Ease of Use

- Guided setup configuration that walks users through the setup process during commissioning, saving valuable time
- Provides auto-recognition for a robust library of MSA devices
- Easy to read operating dashboard that shows important information in a way that can be understood quickly



Channel	Tag	Location	Type	Gas	Units	Scale
1	CH01 Comb	Location 1	S5000	Comb	%LEL	100
2	CH02 Methan	Location 2	Default	Methane	%LEL	100
3	CH03 H2S	Location 3	Default	H2S	ppm	50
4	CH04 Other	Location 4	Default	Other	ppm	25
5	CH05 Methan	Location 5	Default	Methane	%LEL	100
6	CH06 H2S	Location 6	Default	H2S	ppm	100
7	CH07 Comb	Location 7	Ultima X5000	Comb	%LEL	100
8	CH08 NH3	Location 8	Default	NH3	ppm	1000





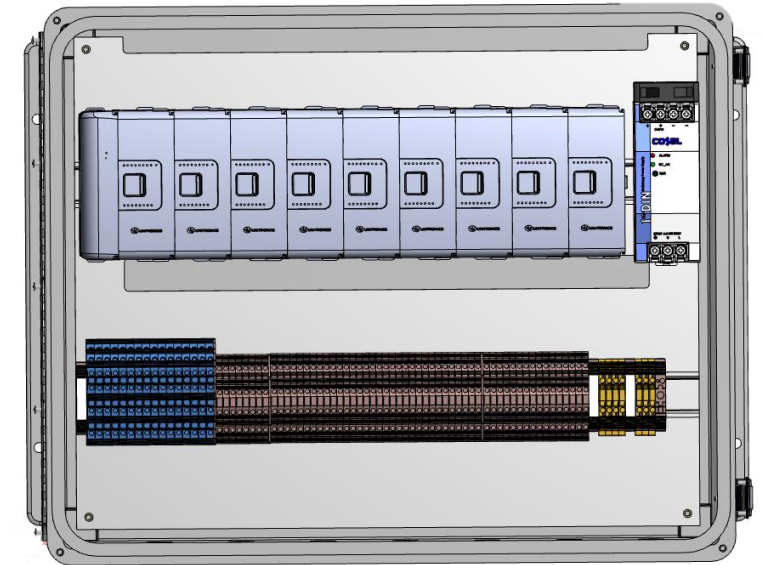
Configurations & Overview

Configurations

- SENTRY io is offered in the following base configurations, each having an Analog Out option
 - 8 or 16 points
 - 6 discrete inputs
 - 32 or 56 relays

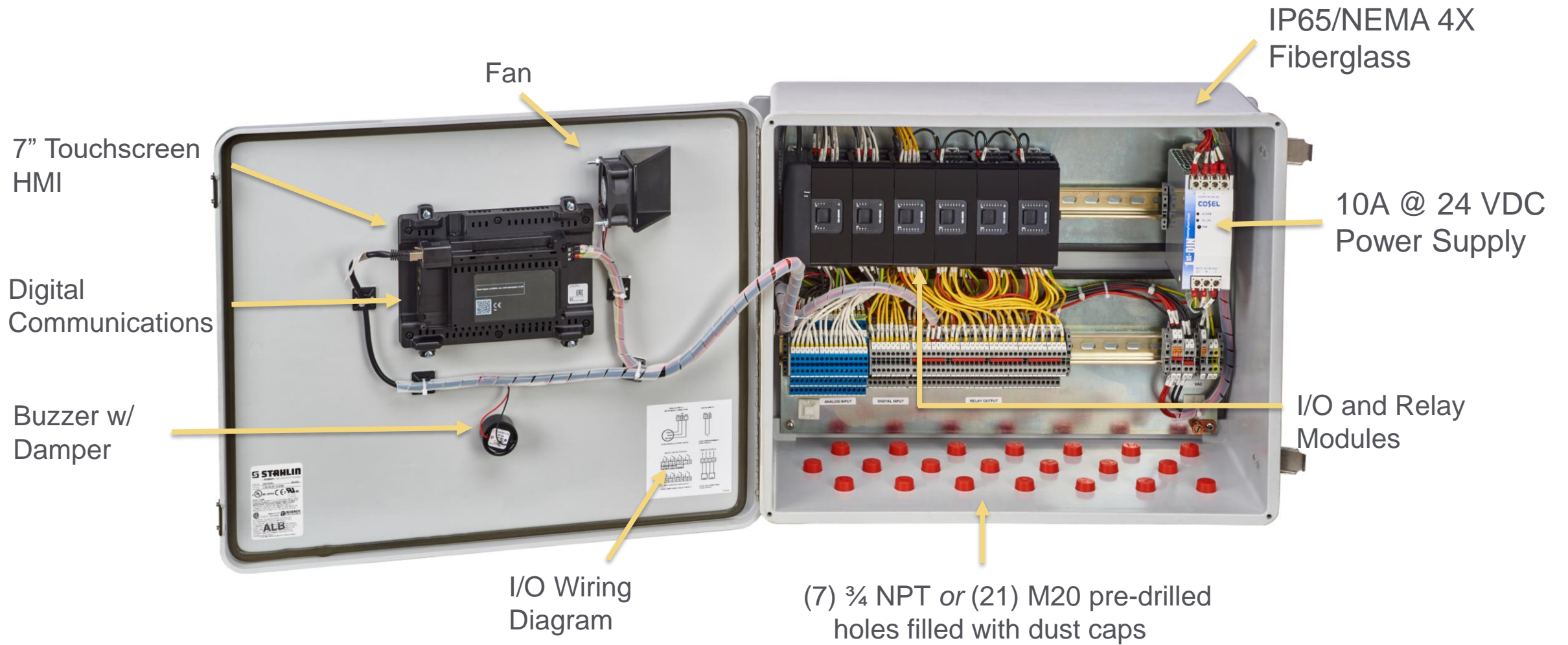
NOTE: 16 point 56 relays 16 Analog out requires an expansion box

- Additional configurations are available as a custom configuration



16 Point 56 Relay – No Analog Out/
16 Point 32 Relay 16 Analog Out

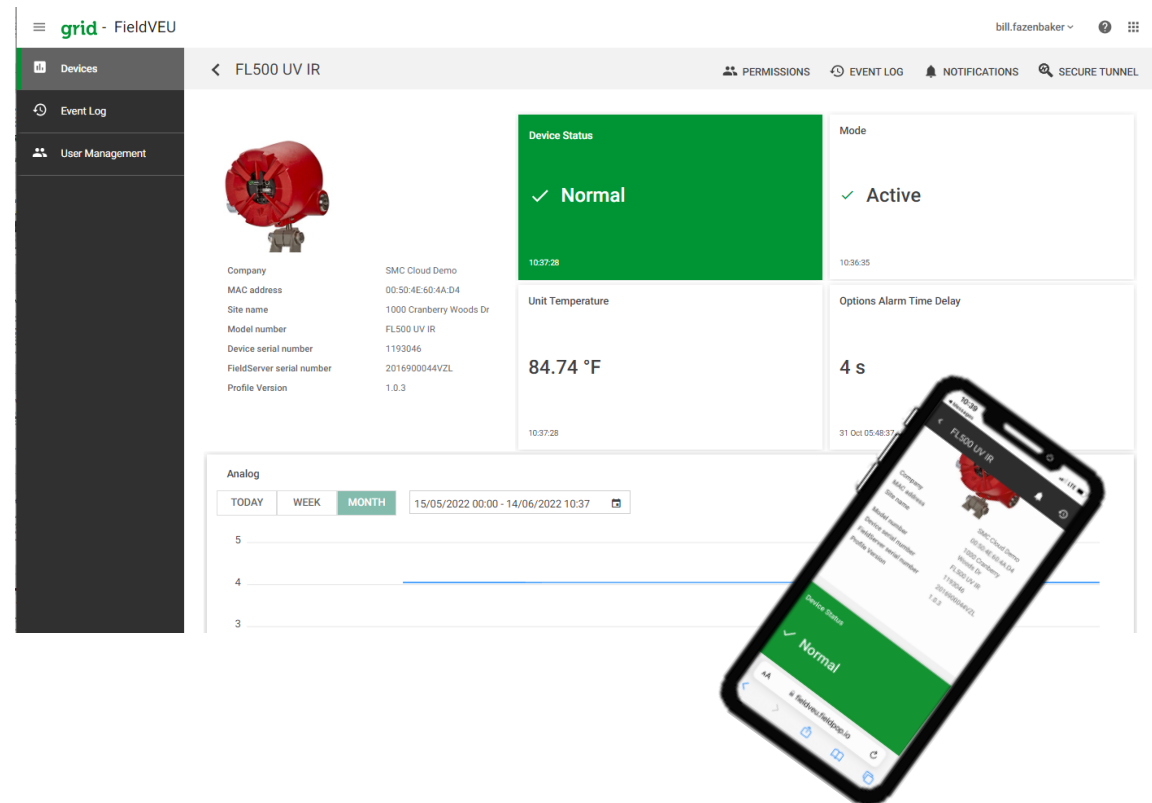
SENTRY io Product Description



Remote Monitoring & Notifications

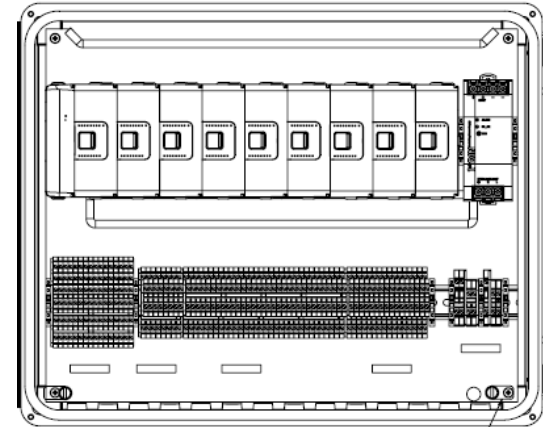
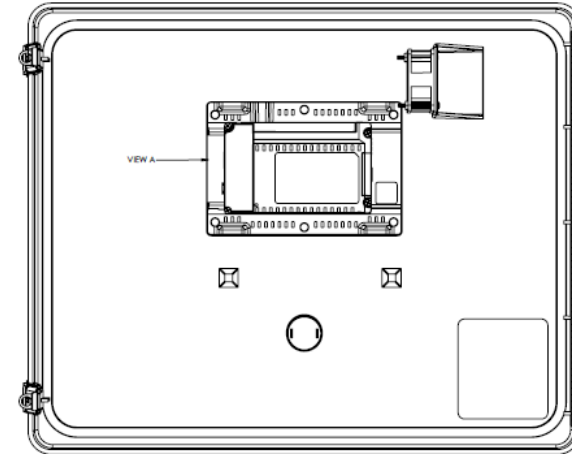


- Cloud-Based Services
- SENTRY io supports integration with MSA Grid FieldServer Manager and FieldVEU, which allows remote visibility, notifications, and troubleshooting
 - Sign up for remote emails and text messages for subscribed events (e.g., elevated gas levels, alarms)
 - Login from anywhere and view the status of the system and detailed logs



Spare Parts/Accessories

- Display (HMI/PLC)
- Modules (Analog In, Analog Out, Relays)
- Power Supply
- Buzzer
- Fan
- Terminal Blocks
- Memory Card
- IP66 Rated Glands & Plugs
- Modbus RTU Adapter



Applications

Multi-channel wall-mount controller

- Municipal facilities and wastewater plants
- Small transit maintenance facilities
- Pipelines and gas transmission sites
- Boiler rooms and utilities
- Laboratories and research facilities
- Small industrial and gas plants



MSA & GM Controllers (F & G Panels)

– NFPA 72 Approved / FM3010



HazardWatch FX-12
12 point



HazardWatch
Modular



Thank You



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SAFEGUARDING
PEOPLE, PLACES & THE PLANET