ISA100 Wireless Webinar
Safety Integrated Systems (SIS) with Wireless Gas Detection

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GS01 Wireless Gas Detector
Features and Benefits

Reliable single-beam, triple-wavelength MEMS IR technology ensuring lifetime detection stability, with no need for re-calibration.

SIL2 capable – SIL2 approval covers hardware, software and wireless communication, for seamless integration into safety instrumented systems.

Outstanding performance: Only wireless device to combine 5 sec response time with low power operation and long battery life.

Truly wireless, no cables: Ultra-low power consumption of ~5 mW allows for a battery life of up to 24 months.

Intrinsic safety approval with field-replaceable battery packs.

Significant savings on total project cost due to reduced engineering; wiring, installation and documentation demand.

Hydrocarbon Detection
GS01 Device Alternatives

GS01 (standard)
Fixed 2 dBi antenna

Installed with two 8mm bolts
antenna pointing up or down

GS01-EA
Extended 6 dBi antenna
5, 10 or 20m cable
Improves flexibility in areas
with weak radio coverage
Standard infrared gas detector setup

Principal optical design of traditional infrared point detectors

Focused areas for MEMS
1) Filtering & focusing light on the detection side
2) Light source
GasSecure optical bench replaces conventional infrared components with MEMS.
Single Beam, triple wavelength

Lifelong zero point stability
Expanding the wireless SIL2 portfolio

- Robust design for reliable usage in harsh environments
- A variety of sensors detect a wide range of hazardous gases
- SIL2 capable – SIL2 approval covers hardware, software and wireless communication, for seamless integration into safety instrumented systems
- Intrinsic safety approval with field-replaceable battery packs
- Truly wireless, no cables: Ultra-low power consumption of ~5 mW allows for a battery life of up to 24 months
- Significant savings on total project cost due to reduced engineering; wiring, installation and documentation demand

Polytron 6100 EC WL

Electro Chemical
Polytron 6100 EC WL

- Supports all DrägerSensors (EC, 140 gases)
- ISA 100.11a communication
- SIL 2 capable
- No cable
- Battery Lifetime >24 month (battery pack, soldered)
- Bluetooth interface for easy maintenance
- Hand Held as GUI (Windows 10, Polysoft)
- Intrinsically safe (no hassle with declassifications)
- Extended antenna (5, 10 & 20m)
- Performance certification
- Dust approval
- Local power possible
- Option without sensor compartment as repeater
System Architecture

**Field devices**
GS01 wireless infrared gas detectors

**Network infrastructure**
Access points and gateways, in redundant setup if required

**Central Control Room**
Data acquisition, safety-related controllers and connection to actuators

**Wireless communication**
ISA100 Wireless / PROFIsafe

**Wired communication**
Modbus TCP/RTU PROFINET / PROFIsafe
Wireless Network Range & Size

50m / 160ft Wireless Range
Dense pipework, machinery, structures; eg. offshore platform, pipe racks, etc.

200m / 650ft Wireless Range
Minor structures, machinery; eg. refinery, terminals

500m / 1640ft Wireless Range
Open space without obstacles; eg. tank farms, pipeline facilities

Radio link (or «hop»)
The SIL2 assessment included:

- GS01 Hardware
- GS01 Software
- Wireless communication (PROFIsafe)

Key SIL parameters:

- $\lambda_{DU} = 1.08 \times 10^{-7} \text{ h}^{-1}$
- $SFF = 91 \%$ (for $HFT = 0$)
- $PFD_{AVG} = 1.61 \times 10^{-3}$ (for $T_P = 2 \text{ years}$)

Note:

- $PFD_{AVG}$ is well within the allowed range for SIL2 ($< 0.01$)
- $PFD_{AVG}$ is claiming less than 35% of this range ($< 3.50 \times 10^{-3}$)
Safety function

The detection of potentially explosive gas concentrations in %LEL. The gas concentration is converted into a digital measured value and provided as a PROFIsafe message to a safety controller.

Failsafe values and safe state

- Internal diagnostic functions provide Failsafe Values (NaN*) for gas concentration.
- Communication issues result in a PROFIsafe safe state to flag unavailability of field devices.

Timeout

- Unavailability is flagged within predefined time limits (process safety time typically 60 sec in hydrocarbon gas detection).

* NaN = (0x7FC00000) per float definition in IEEE754
GS01 Wireless Communication

Based on the ISA100 Wireless™ Standard
ISA100 Wireless Strengths

- "Tunnelling" of foreign protocols through the network facilitates the integration of safety protocols.
- Contract based communication (uplink and downlink) guarantees Quality of Service through limits for bandwidth, latency, and priority.
- Superior coexistence with WiFi
- Device interoperability supports communication of devices from multiple vendors on one network.

Suitable for fast and low-power safety communication
SafeWireless™

SafeWireless is a communication concept to combine low power with short response time developed by GasSecure.

Principle

▪ Different response time in the presence and absence of hydrocarbon gas
  – Short publish rate (all timeslots used) when GAS  Default = 2 sec
  – Longer publish rate (not all timeslots used) when NO GAS  Default = 12 sec

▪ SafeWireless supports cyclic communication, as required for SIS
  – Request from controller must be answered within “process safety time”
  – Detector “armed” with safe downlink packet
  – Response delayed, but instantly when gas detected
SafeWireless™ - Cyclic Communication

Legend

- Uplink slots
- Downlink slots
- Comm. w/o gas
- Comm. with gas
- Non-SIL com
PROFIsafe Protocol

PROFIsafe

- Protocol developed by PROFIBUS and PROFINET International (PI)
- An additional layer on top of PROFINET
- Certified for up to SIL3 use

Black channel principle means

- PROFIsafe is independent of the communication method.
- Covering the entire communication path from the sensor over the controller to the actuator on one channel.
- Protection for all eventual failures in communication.
Wireless Network with PROFIsafe

GS01 gas detectors

ISA100 Wireless

ISA100 gateway with PROFINET

Safety controller

PROFINET

Black Channel

PROFI safe

PROFI safe
Redundancy improves availability and on-time.
Availability requirements are the driver to select redundant devices.
Redundancy does have no impact on the detector safety function.
The SIL rating determines the required average probability of failure on demand.

SIL2: $PFD_{AVG} \geq 1.0E-02$

GS01: $PFD_{AVG} = 1.61E-03$ (for TP = 2 years) / $1.22E-03$ (for TP = 1 year)

The SIL rating does not determine the availability.
Fault-tolerant Wireless Network Design

Redundancy implemented at all levels (GS01, AP, GW)

GS01 Primary link
GS01 Secondary link

Design without any “single point of failure”
Wireless Can Enhance Safety

Flexibility due to simple mounting (two 8mm bolts)
- Freedom for optimal detector placement
- Deployable in hard-to-wire areas (turrets, cranes, confined spaces)
- Easy to rearrange detectors (upgrades, revamps)
- Simple to extend coverage with additional detectors (extensions)
From SIL-capable Detector to Safety Integrated System
Risk Analysis (described in IEC 61508 / 61511)

Risk

- Air inlet positioning
- Ventilation rate
- Emergency shut-down

Gas Detection

Residual risk

- Actual risk reduction
- Necessary risk reduction

Tolerable risk
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<th>Client / Country</th>
<th>Equinor Refining / Denmark (formerly Statoil)</th>
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<td>Project / Facility</td>
<td>Fire &amp; Gas Extension / Kalundborg Refinery</td>
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<tr>
<td>Process / Plant / Application</td>
<td>Fill-in detectors for 3 process areas after risk assessment determined inadequate coverage by current system</td>
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<td>Equipment / Infrastructure</td>
<td>114 units GS01 / 8 units GS01-EA / Other detectors 3 Gateways / 18 Access Points / Siemens S7</td>
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<td>Design</td>
<td>SIL certified detectors and controller, gateway with PROFINET / PROFIsafe, client assessments &amp; verifications → SIL2 capable</td>
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<td>Challenges</td>
<td>Large, congested plant area. Enclosed spaces.</td>
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<td>Key Notes</td>
<td>Significant cost reductions with wireless.</td>
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GS01 Case Study
Aerial View

Area covered with wireless gas detection (about 75.000 sqm)

Project was split into 3 phases (3 geographical areas)
Placement of access points was based on existing knowledge for wireless on this site
Phase 1 Block 1
Detector locations
**Green** = GS01
**Purple** = Other

Block 1 area has wireless challenges due to heavy machinery blocking communication.

Detectors with extended antenna were chosen to overcome this challenge.
Elevated dual access points for good radio coverage

GS01-EA, detector with extended antenna
Summary of Experiences from Kalundborg

- Planning of wireless infrastructure placement can largely be done by visual inspection.
- Recommended to have some extra infrastructure and instruments ready for use in case challenges occur during commissioning.
- Wireless technology increases the flexibility in placing and moving of equipment.
- Expanding wireless installations is very easy.
- Using wireless for safety is a step change for any organization. Local competence of wireless has to be developed.
- We would definitely choose wireless again
Thank you for your attention.

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