GAS
SECURE

GasSecure GS01

Wireless Infrared Hydrocarbon

Gas Detector

User Manual

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Contact info
GasSecure AS
Hoffsveien 70 C
N-0377 Oslo
Norway
www.gassecure.com
post@gassecure.com

Note

Those who have or will have the responsibility for the operation or maintenance of this product must carefully read this manual. The product may not perform as designed if it is not used and maintained in accordance with the manufacturer's instructions.

Please read the complete manual and particularly note the paragraphs having an exclamation mark in the margin.

This manual covers installation, operation and maintenance of the GS01 wireless hydrocarbon detector and its battery pack.

The product warranty issued by GasSecure is voided if the product is not used and maintained as described in this manual.

Please read also the safety instructions in Section 6.

PRODUCT DATA

Manufacturer	GasSecure AS
Country of origin	Norway
Model	GS01
Gases and range	Hydrocarbons, 0 – 100% LEL[1]
Environmental conditions	
Certified temperature[2]	-40°C to +65°C
Humidity	0 to 100% RH
Pressure influence, 700 – 1300 hPa	≤ 0.15% of reading per hPa (at 50% LEL)
Protection classification	IP 66 and IP 67
Electrical	
RF power	10 dBm (10 mW)
Battery type	Lithium-Thionyl Chloride
Battery cells	Tadiran SL-2780/S or TL-5930/S
Average power	5 mW
Explosion Protection	II 2G Ex ib IIC T4 Gb

[1] Available configurations: Methane, Propane, Methanol
[2] Battery temperature limitation -30°C

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1. PRODUCT DESCRIPTION

1.1 General

The GS01 is a wireless, battery powered point detector that monitors the concentration of hydrocarbon gases.
It uses a combination of two sensors:

1. An ultrasonic speed-of-sound sensor that continuously monitors changes in the ambient air composition.
2. An optical (infrared) absorption sensor that is used for accurate measurements of the hydrocarbon gas concentration.

The infrared sensor uses more power than the ultrasonic and is therefore kept in hibernation if the ultrasonic sensor does not detect any changes in the air composition. The infrared sensor applies optical MEMS (micro electromechanical system) technology to enable intermittent operation with fast start-up and measurement, and thus a low average battery consumption.
The measured gas concentration is transmitted wireless using the ISA100 Wireless™ standard. This manual does not cover the wireless router or gateway and the connected control system (please refer to the list of references in Section 9 providing examples of relevant documentation).
The detector is intrinsically safe, with equipment protection level Gb (Ex ib) (see Section 7) intended for use in zone 1 and 2 areas.

1.2 Measuring principle

The GS01 detector utilises infrared absorption spectroscopy. The fundament is the Beer-Lambert Law, which relates the absorption of light to the properties of the material through which the light is travelling.

The internal radiation source emits infrared radiation through a lens and a sapphire window into the measuring cell (cf. Figure 1-1 and Figure 1-3). A mirror at the opposite end of this cell returns the beam back through the sapphire window into the internal volume of the detector and onto a filter that disperses, focuses, and modulates the incident light. This filter is a patented silicon MEMS component proprietary to GasSecure.
By applying a control voltage to the MEMS chip it is switched between the so-called gas state and the reference state. In the gas state a wavelength where hydrocarbons do absorb light is focused onto the detector, whereas two wavelengths where hydrocarbons do not absorb are focused onto the detector in the reference state. The GS01 detector uses the same light source, light path and photodetector for both measurements.
This single beam, triple wavelength detection is unique to the GS01 from GasSecure.

1.3 Instrument description

The GS01 consists of the main housing (316L stainless steel) with mounting bracket, the measuring cell, an antenna, and the battery compartment (cf. Figure 1-1). Attached to the main housing are the following detachable parts:

- Weather cap (Polyamide 6)
- Battery cap (Polyamide 6)
- Battery package (Polyamide 6)

Except for these detachable parts, the user shall not disassemble the sensor any further. When the weather cap is removed, the infrared measuring cell with the sapphire window on the main housing and the mirror at the outer end, is open and accessible for cleaning. The ultrasonic sensor is protected by a perforated steel sheet, which shall not be removed.

1.4 Battery

The GS01 may only be used with the GasSecure battery pack (Part number 10055). The battery pack is designed for two Lithium-Thionyl Chloride size D cells in series, and has a nominal output voltage of 7.2V. The battery pack has an internal charge counter. The battery pack is intrinsically safe as well (see Section 7).

1.5 Outline dimensions

Figure 1-1 shows the sensor buildup with an exploded drawing, and Figure 1-2 depicts the GS01 dimensions.

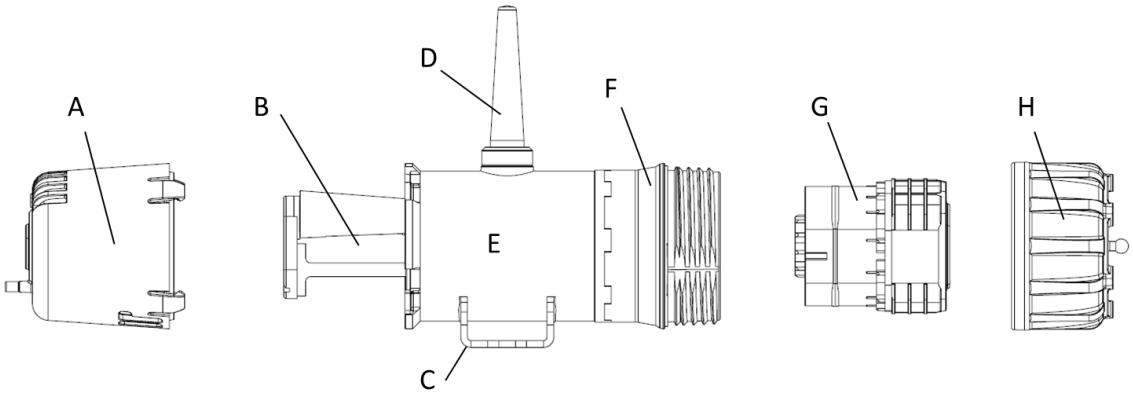

Figure 1-1: GS01 detector layout

with A) Weather cap, B) Measuring cell, C) Mounting bracket, D) Antenna, E) Stainless steel housing, F) Battery compartment, G) Battery pack, H) Battery cap

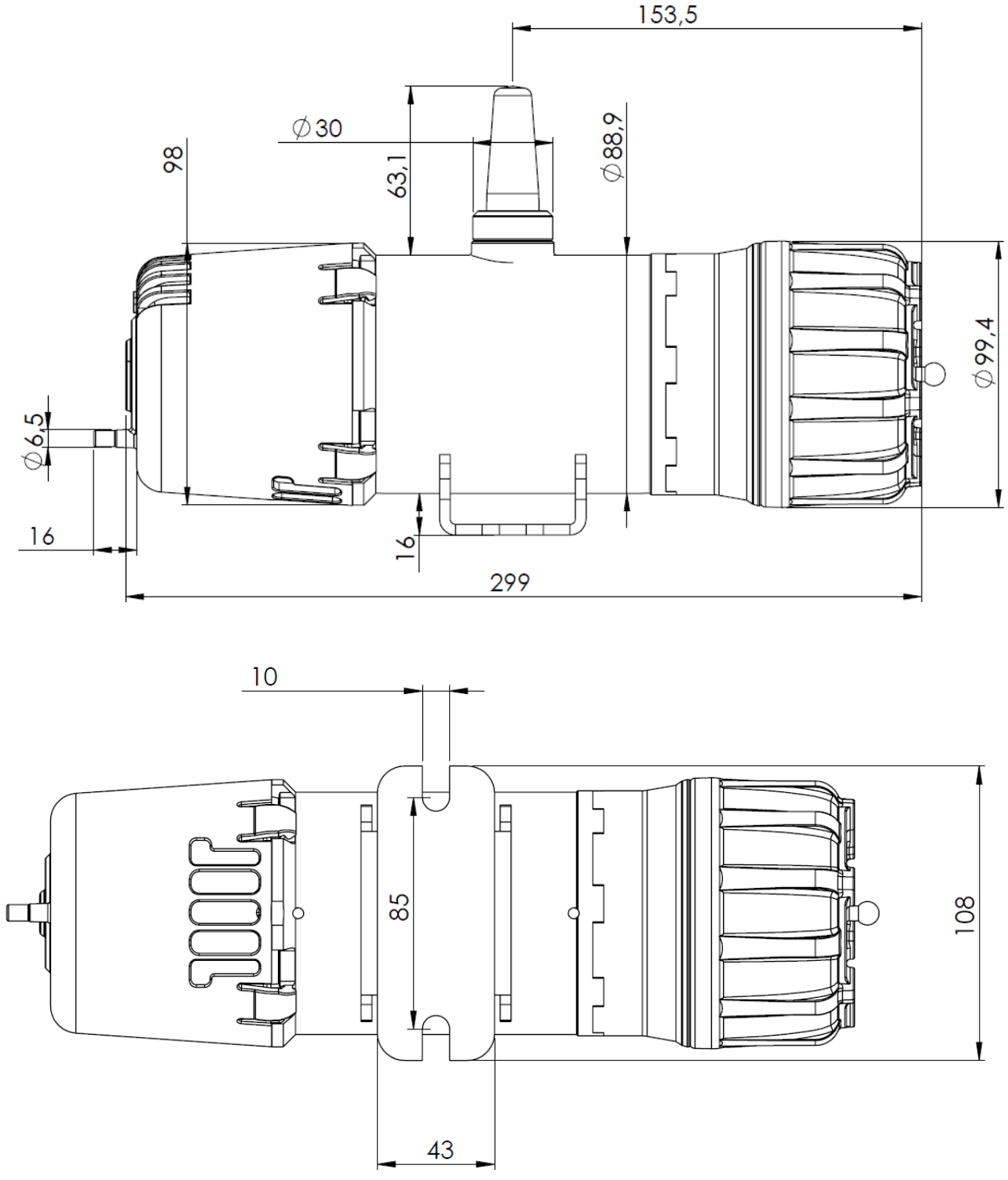

Figure 1-2: GS01 detector with dimensions in [mm]

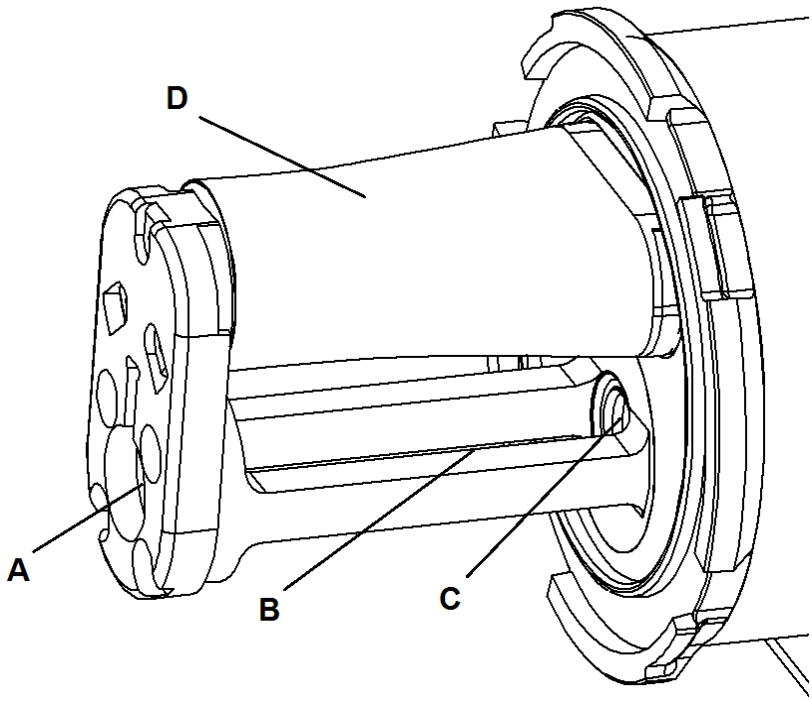

Figure 1-3: GS01 measuring cell details

showing A) External mirror, B) Infrared beam path, C) Sapphire window, D) Ultrasonic sensor with protective sheet

2. INSTALLATION

Note: The GS01 gas detector certification must comply with the legal requirements following the area classification at the installation point.

The detector shall be installed where it is most likely to detect gas in the event of a leakage.

For battery pack installation see Section 5.4.

In areas with significant exposure to direct sunlight and the risk of temperatures beyond the operating temperature range, a sunshade should be considered (see list of spare parts in Table 5-1).

2.1 Tools

The following tools are needed to install the instrument:

- Open-end spanner for M8 bolts (alternatively 5/16” bolts)
- Face spanner with two pins in size 75x6 (distance x pin diameter) as optional tool to remove the battery cap

2.2 Mounting

The detector is mounted with its long axis horizontally. Make sure, to the extent possible, that the antenna is vertical (pointing up or down) and that local radio shadowing is kept at a minimum.
Two M8 bolts (alternatively 5/16” bolts) with washers under the head are used to attach the bracket. The bolts should be spaced from 85 to 95 mm to easily fit the slots when mounting the detector.

The weather cap must be mounted with the arrow on the cap pointing upwards, regardless if the antenna is pointing up or down (cf. Figure 2-1). If possible, mount the GS01 with the weather cap oriented away from the prevailing wind direction.

Do not use the GS01 detector in ventilation ducts or pipes.

Do not mount the detector directly above hot or cold surfaces. If the detector is mounted inside metallic structures or enclosures the need for a GS01 detector with extendable antenna should be considered. Contact GasSecure for more information on this option.

2.3 Grounding

The detector housing must be connected to ground for operation in hazardous areas. This to avoid possible static charge build-up, which may arise from

electrically isolated metal parts. Ground the detector either by mounting it on a grounded metallic structure or by connecting a grounded wire to the screw holes in the mounting bracket (cf. Figure 2-1). For the latter the wire should be minimum 4 mm^2 (AWG 8) and as short as possible.

2.4 Sun shade / weather protection

The sun shade is available as optional accessory and recommended for locations with high ambient temperature and / or direct sunlight exposure. It may also be used as weather protection for instance in locations with frequent heavy precipitation. The shade is fixed to the gas detector bracket with the same M8 (or 5/16") bolts which are used for detector mounting. Make sure that the sun shade is mounted the correct way so that the detector identification plate remains visible.

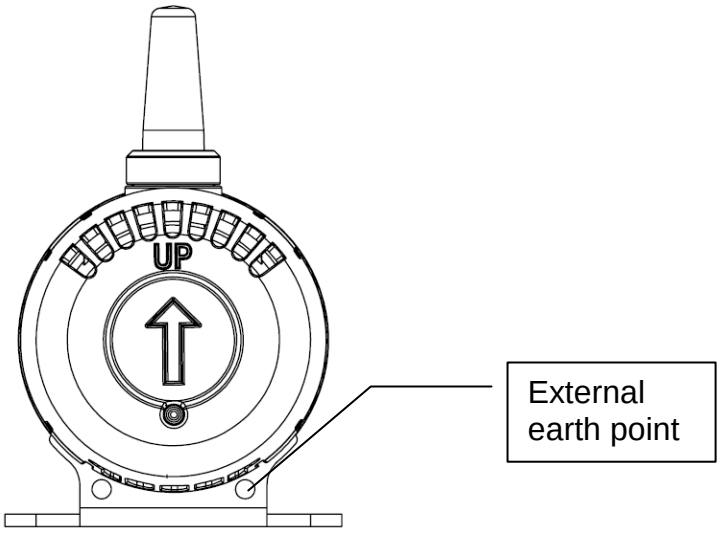

Figure 2-1: Correct position of the weather cap and location of earth point.

The arrow must always point up even if the antenna is pointing down.

3. COMMISSIONING

The GS01 detector(s) is (are) set up in a wireless sensor network with a gateway and router. The exact commissioning procedure depends on the selected type of gateway. Therefore this manual must be used together with the relevant documentation written for the respective gateway. Some references for such documentation are provided in Section 9.

3.1 Communication

The GS01 detector complies with the ISA100 Wireless™ standard for wireless communication.
Each GS01 detector must be paired with a single gateway, before it can communicate with the network. The gateway is the interface between the wireless and plant networks. It marks the transition between communications compliant to the standard and other communications, and acts as a translator between ISA100 Wireless™ and other protocols (Modbus, PROFInet, etc.).
The pairing process, where the device obtains the appropriate security credentials and network-specific information, is referred to as provisioning and is explained in Section 3.6.

3.2 ISA100 Wireless™ standard

ISA100 Wireless™ is a wireless networking technology standard developed by the International Society of Automation (ISA).
This ISA standard is intended to provide reliable and secure wireless operation for safety, control, and monitoring applications. This standard defines the protocol suite, system management, gateway, and security specifications for low-data-rate wireless connectivity with fixed, portable, and moving field devices supporting very limited power consumption requirements. The application focus is to address the performance needs for periodic monitoring and process control where latencies on the order of 100 ms can be tolerated with optional behaviour for shorter latency.

3.3 ISA100 objects

ISA100.11a defines a communication protocol, with an application layer that includes a simple but extensible set of input and output objects.
The GS01 detector publishes the measured values and diagnostic information as ISA100 objects and attributes. It is distinguished between standard attributes and GS01 device specific attributes.

3.3.1 Standard objects

The GS01 publishes ISA100 standard objects and attributes for process value and diagnostic status as outlined in Table 3-1 below. The gas measurement value is sent as User Application - Analog Input Object with the attribute “Process Value”

(PV). The device health information is compiled and sent as User Application Management Object with the attribute “Diagnostic Status” (DIAG_STATUS).

The concentrator of the gas detector is per default set up to publish the gas measurement and the diagnostic status. The concentrator can be configured differently in the gateway interface.

For short detector response time (<5 sec as per GS01 datasheet), the gateway must be set up with a 2 sec sampling interval (also referred to as publication period). In the absence of hydrocarbon gas, the detector will not publish on all available time slots, but publish at approximately 1/4 of the timeout time defined by the stale limit. (cf. Section 3.5) in order to save battery power. In the presence of hydrocarbon gas of sufficient concentration (defined by the internal low alarm limit see Table 8-1), all time slots will be used.

Table 3-1 ISA100 objects

Descriptive name	**Access-ibility**	**Octet no.**	**Content**	**Modbus input registers**	**Data type**
PV	READ	1	PV_Status	Register N	UINT 16 bit
		2	PV_Value (1/4)	Register N+1	32 bit (4 octets) float, according to IEEE 754_Float32
		3	PV_Value (2/4)		
		4	PV_Value (3/4)	Register N+2	
		5	PV_Value (4/4)		
DIAG_STATUS	READ	1	Diag_Status (1/4)	Register M	UINT 16 bit
		2	Diag_Status (2/4)		
		3	Diag_Status (3/4)	Register M+1	
		4	Diag_Status (4/4)		

Note that the content of the PV_Status byte (PV = process value) is explained in Table 10-1 in the Appendix.

The full mapping of the content of the DIAG_STATUS attribute is explained in Table 10-2 in the Appendix.
Recommendations for which status and diagnostic information to integrate in the control and maintenance loop are also provided in the Appendix.

3.3.2 GS01 specific objects

In addition to the standard objects, the GS01 can be configured to publish and subscribe to custom data objects. These objects are used for PROFIsafe communication over PROFInet via the gateway. Contact GasSecure for further information about GS01 specific objects if this option is considered.

3.4 GS01 data format details

The GS01 data objects can be mapped into 16 bit Modbus input registers.
The “PV” object (cf. Section 3.3.1) normally populates three registers; the PV_Status byte populates the last 8 bits of the first register and the 32 bit float number populates the following two registers.

The “UAPMO.DIAG_STATUS” object (cf. Section 3.3.1) is normally mapped into two 16 bit registers. Some gateways will also add a status byte into the preceding register. This status byte may be ignored, because its information is already contained in the PV_status byte.

The procedure for Modbus register mapping depends on the specific gateway, please consult the respective gateway manual on how to achieve this mapping. GasSecure can assist with advice if needed.

3.5 Communication monitoring

The PV_Status byte (see Table 3-1) can be used for monitoring the communication status and the data integrity. See Table 10-1 in the Appendix for all details. If the detector communicates with the gateway, the status byte will be decimal value 64 or higher; please refer to Table 3-2 below for the three main classes of data integrity.

Table 3-2 PV Gas measurement data integrity

Data integrity	**Octet decimal number**	**Explanation and actions**
Bad	< 64	No communication or hardware failure. Check communication. Contact GasSecure if this failure persists.
Uncertain	64 to 127	The integrity of the data is uncertain. As example the sensor range or temperature range may be exceeded.
Good	= 128	Normal operation. The detector is providing reliable gas measurements.

The status byte is updated by the gateway if the communication with the detector is lost. The time from reception of the last packet and until the status byte is updated to flag “lost communication” is defined via the stale limit parameter. Please consult the gateway manual for information about setting this stale limit.

GasSecure’s recommendation is a sampling interval of 2 sec (see Section 3.3.1) together with a stale limit of 30 times, so that “lost communication” is flagged after maximum 60 sec. Under no circumstances the product of sampling interval and stale limit must be set to less than 10 sec, because this would disable communication between detector and gateway.

Note that the timeout, as defined by the stale limit, can be checked by removing the battery and monitoring the time until the PV_Status byte is updated.

3.6 GS01 detector provisioning

All GS01 detectors have to be provisioned so that they will join the correct network. Provisioning the GS01 requires the following:

- An USB serial adapter interface to GS01 together with GS Provisioning Tool software (both accessories from GasSecure)
- The network (or subnet) ID of the gateway or backbone router

This procedure can be carried out with an unprovisioned GS01 or with a GS01 that earlier has been provisioned to another gateway.

3.6.1 Yokogawa gateways

a) Connect the GS01 to a PC with the GS Provisioning Tool installed using the USB serial adapter interface. Allow 20 sec. for the booting of the device.

b) Run the GS Provisioning Tool and select the correct COM port. Press the “Connect” button and verify that the device info is displayed, cf. Figure 3-1.

c) Enter the required network ID (make sure the correct number format is selected: Decimal, Hex, Octal or Binary) and device tag, cf. Figure 3-1.

d) Verify that “randomize join key” is selected and specify the destination folder for the YPIF file. This file must be uploaded to the gateway (explained in reference [RD 4]) to enable communication. Press the “do provisioning” button. Verify that the “Provisioning is done!” message is displayed in the command window.

e) Close and exit the GS Provisioning Tool and disconnect the GS01 detector from the PC.

f) Power up the GS01 by inserting the battery pack.

g) The GS01 device should join the network within 5-20 minutes, if it is within radio distance to the gateway and the gateway is set up properly (refer to reference [RD 4]).

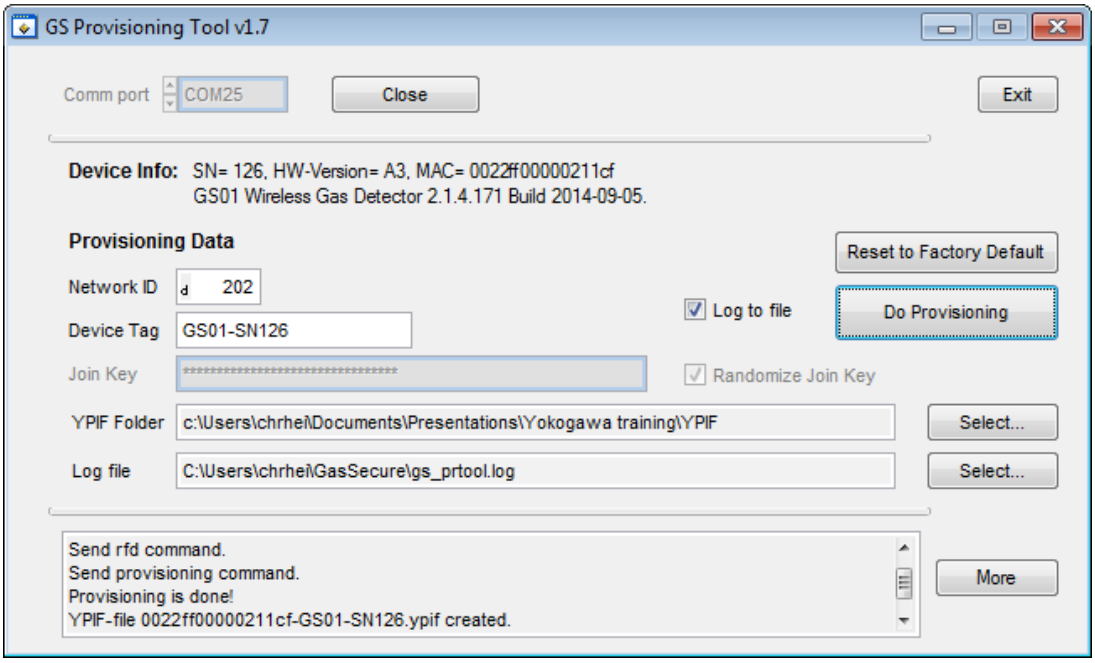

Figure 3-1: GS Provisioning Tool

3.6.2 Other ISA100 Wireless gateways

a) Connect the GS01 to a PC with the GS Provisioning Tool installed using the USB serial adapter interface. Allow 20 sec. for the booting of the device.

b) Run the GS Provisioning Tool and select the correct COM port. Press the “Connect” button and verify that the device info is displayed.

c) Press the “Reset to Factory Default” button.

d) Close and exit the GS Provisioning Tool and disconnect the GS01 detector from the PC.

e) Power up the GS01 by inserting the battery pack.

f) The GS01 can now be provisioned over the air (OTA) using either special field tools or the field wireless access points. Refer to references [RD6] or [RD 8] for possible solutions from different vendors.

g) The GS01 device should join the network within 5-20 minutes, if it is within radio distance to the gateway and the gateway is set up properly.

3.7 Modifications to an existing network

1. Add a detector
   Provision the GS01 as described in Section 3.6.
   Mount the GS01 with battery.
   Re-configure the gateway to accommodate the additional detector(s) (cf. Section 9 for gateway relevant documentation).

2. Replace a detector
   Power down the GS01 in question by removing its battery.
   Provision the replacement GS01 by following all steps in Section 3.6.
   Mount the replacement GS01 with battery.
   Re-configure the gateway to accommodate the replacement detector(s) (cf. Section 9 for gateway relevant documentation).

3. Remove a detector
   Power down the GS01 in question by removing its battery pack.
   Optional: Re-configure the gateway in order to remove the detector from the list of publishers (cf. Section 9 for gateway relevant documentation).

3.8 Visual and functional check

The following activities are recommended before putting into operation the GS01 detector:

- The axis of the detector shall be horizontal.
- Verify the correct orientation of the weather cap (cf. Figure 2-1).
- Check that all bolts and screws are securely tightened.
- Carry out a validation as described in Section 4.2.

4. OPERATION

The GS01 has no user adjustable parts. Do not open the instrument. Opening the GS01 detector voids the warranty issued by the manufacturer.

4.1 Normal operation

After provisioning the GS01 detector with an ISA100 Wireless™ gateway, it will perform the following tasks:

- Measure gas concentration
- Publish gas concentration to the gateway
- Publish other diagnostic information to the gateway

4.2 Validation

Note that the GS01 is calibrated according to IEC60079-20, which states an LEL value of 4.4 %vol for Methane.
Although no re-calibration of the GS01 is necessary, it is recommended to check the response of the detector once per year by applying pressurized test gas.
The weather cap is designed for validation, as it includes a 6 mm diameter tube fitting for efficiently filling the GS01 measuring cell with a test gas mixture. Note however that the test gas will leak out during testing and leakage will depend on the wind speed. Therefore, the measured gas concentration is normally lower than stated on the test gas cylinder. It is not recommended to carry out validation in stronger wind, or alternatively the weather cap has to be covered on the outside in this case, i.e. by applying tape to the openings.
The function of the detector is positively validated as long as it responds to the test gas.

Please refer to Table 4-1 for the recommended gas mixtures and expected instrument readings. Apply the test gas through a 6 mm tube from a gas cylinder with pressure regulator. It is recommended to adjust the pressure to 0.6 – 0.8 bar relative or alternatively the flow to 5 – 8 l/min.

Table 4-1 Recommended gas concentrations for validation

Detector version	Recommended test gas	Expected reading
Methane 0-100%LEL	Methane 2.2 % vol in synthetic air Or alt. 2.5 % vol in synth. air	50 % LEL 57 %LEL
Propane 0-100%LEL	Propane 0.42 % vol in synthetic air	25 % LEL
Methanol 0-100%LEL		17 % LEL

5. MAINTENANCE

The GS01 detector is designed to reduce maintenance to a minimum.

The instrument does not have user adjustable parts. Do not attempt to open or disassemble the instrument. This can compromise safety and performance. Opening the GS01 voids the warranty issued by the manufacturer. All repairs have to be done by the manufacturer or by an authorised dealer.

5.1 Routine maintenance

For best performance it is recommended to routinely carry out the following steps:

- Clean the window and mirror when necessary (see Section 5.3 below). The optical transmission of the infrared sensor maybe monitored with the DIAG_STATUS attribute explained in Table 5-2 and Table 10-2.
- Check the weather cap regularly to make sure it is not clogged (see Section 5.3 below).
- Check battery status regularly. Replace low batteries in due time (see Section 5.4 below). The battery status maybe monitored with the DIAG_STATUS attribute explained in Table 5-2 and Table 10-2.
- Check the detector response every year (see Section 4.2).

5.2 Spare parts

Table 5-1: Important spare parts for the GS01

Description	Part number
Battery pack (type Li-$SOCl_2$ 2xD)	10055
Weather cap	10078
Battery cap	10022
Sunshade	10123

5.3 Cleaning

In the event of low or blocked optical transmission of the IR sensor, the optical window and external mirror (see Figure 1-3 for their exact location) should be cleaned. The detector functionality is still as normal.
Please proceed as follows:

- Remove battery to avoid unwanted alarms while cleaning.

- Use soft tissue or a cotton swab and a lens cleaning fluid based on pure water and isopropyl alcohol (IPA) and/or other alcohols.
- Flush or wipe with pure water afterwards, and dry off with a soft dry tissue.
- Reinstall the battery.
- Note that gas alarms are likely to occur during and shortly after cleaning due to the detector's sensitivity to alcohol. This is avoided by removing the battery while cleaning.
- Other cleaning agents are not recommended, but if lens cleaning fluid or IPA is not available, a diluted dishwasher detergent may be used if followed by a thorough flushing with pure water. Dry off any remaining water droplets.

The inside of the ultrasonic sensor does not need cleaning. If the perforated sheet is clogged with dirt, clean compressed air may be used for removal.
If the detector is installed in an area where the weather cap may become clogged (for instance by insects, leaves, ice or snow), it is recommended that this cap is inspected regularly to make sure that air flows freely through the openings.

5.4 Battery pack

Note that the GS01 may only be operated with the GasSecure battery pack (p/n 10055).

5.4.1 Battery pack replacement

The battery pack is installed or replaced simply by twisting off the battery cap, pulling out the old pack, pushing the new one in place, and putting back the cap. The battery pack will only fit one way, so that correct polarity is ensured. After inserting the battery pack, it may take up to 15 minutes before the detector is transmitting data, depending on how the network is set up.

5.4.2 Battery cell replacement

The battery cells in the battery pack can be replaced. Assemble the battery pack as described below.

Caution!
Only use battery packs that

- are designed for battery cell replacement. They will contain the label depicted in Figure 5-1. Battery packs without this label may not be opened.
- are clean and free of contamination.
- are visually intact (particularly no damage around the screw holes).
- have no visible corrosion on the terminal contacts.

Battery cell replacement and opening the battery pack must take place in a safe area, where a potential explosive atmosphere is not present.

Figure 5-1: Battery pack warning label

Replacement:

- Loosen the two battery pack mounting screws, see Figure 5-2. Note that the spring force is high, have therefore a firm grip around the pack while unscrewing.
- Remove both used cells and dispose according to the battery cell safety datasheet (see Section 5.4.3 for more information). Do not disassemble the battery pack any further.
- Verify that new cells are of the correct type (cf. Section 5.4.3). Be sure to replace both battery cells at the same time and only use fresh (previously unused) cells.
- Place both battery cells in the battery pack, leaf contact facing the positive (+) terminal and spring contact facing the negative (-) terminal, cf. Figure 5-3.
- Assemble lid and bottom of the pack by tightening the two screws with a torque of approximately 0.7 Nm. Have a firm grip around the pack until the screws are tight.
- Press the button on the pack, see Figure 5-2. This will indicate to the gas detector that fresh batteries are in place and re-set the charge counter. Note that only gas detectors with firmware 3.0 or later will recognize this button operation. Please contact GasSecure should the detector in question contain an older firmware version or should you be uncertain about the firmware of this detector.

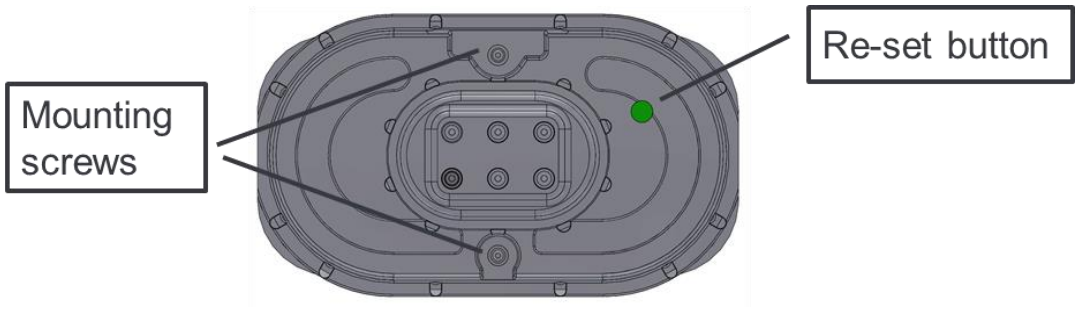

Figure 5-2: Battery pack bottom view

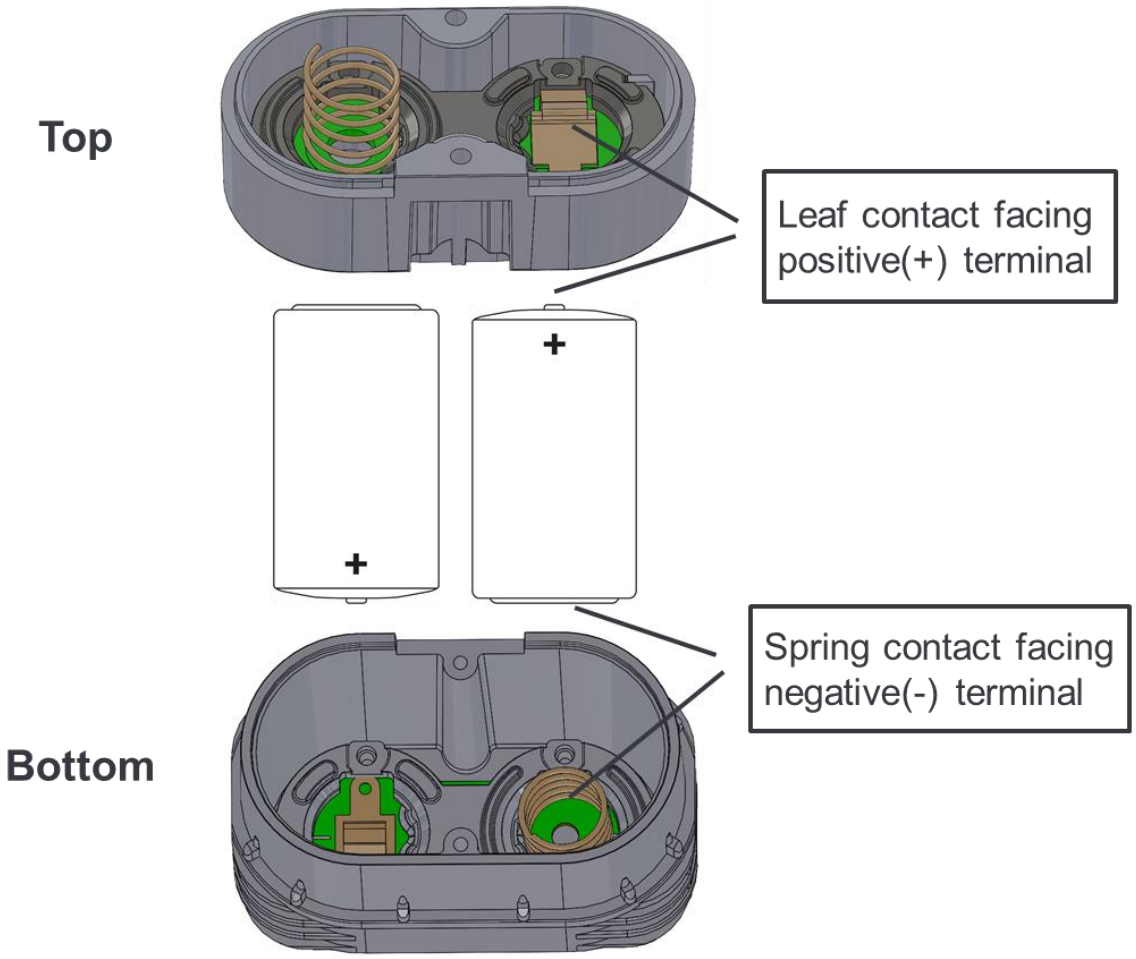

Figure 5-3: Battery pack top and bottom

with leaf and spring contacts facing the battery positive (+) and negative (-) terminal, respectively.

5.4.3 Handling battery packs and cells

The battery pack comprises two primary lithium thionyl chloride battery cells. Under normal conditions, the battery materials are self-contained and are not reactive as long as the battery cell and pack integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Protect the electrode of the battery cells to avoid short circuits. Shorted battery cells may leak fluid and produce excessive heat. Batteries should be stored in a clean and dry area. For maximum battery life, storage temperature should not exceed 25°C.

Warning.Fire, explosion, and severe burn hazard!

- Never recharge a battery pack or cell.
- Do not disassemble the battery cells.
- Do not incinerate, heat above 100°C, or expose battery packs and cells to water.

Please consult the battery cell material safety datasheet for further information.

Use only the following approved battery cells in the battery pack:

- Tadiran model no. SL-2780/S
- Tadiran model no. TL-5930/S

Transport

Batteries used for the GS01 detector contain lithium. Transport of primary lithium batteries is regulated by the U.S. Department of Transportation, the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO), and the European Ground Transportation of Dangerous Goods (ARD). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Consult current regulations and requirements before shipping.
When carried or transported, a battery pack with cells shall be kept in an anti-static bag.

Disposal

The battery pack is considered as hazardous waste. Please dispose of it accordingto laws and regulations for such waste. In the European Union directive 2006/66/EC must be respected.

5.5 Storage

The battery pack shall be disconnected when the detector is stored away or not in service for longer periods. This is to avoid that the batteries are depleted.

5.6 Troubleshooting

Essential instrument status information is provided through the standard ISA100 Wireless object “DIAG_STATUS” (cf. Section 3.3.1). Please refer to the Appendix for a recommended implementation of the GS01 status and diagnostic information. The “Diag_Status” attribute provides the information as outlined in Table 5-2.
For failures (mode F) not explained in Table 5-2, please clean window and mirror (cf. Section 5.3). If the failure persists, contact GasSecure.

Table 5-2: Status messages retrieved from the Diag_Status attribute

Instrument mode (cf. Table 10-2)	**DIAG_STATUS bit set** (cf. Table 10-2)	**Explanation and actions**
M	19	Low battery. The battery must be replaced soon.
F and M	20	Empty battery. Replace battery immediately (see Section 5.4).
M	7	Attenuated optical beam (low optical transmission). The instrument detects low light transmission and infrared signal strength most probably due to dirty optics. Clean the window and mirror if necessary (cf. Section 5.3).
F and M	8	Beam block (optical beam fault). The signal is so weak that the gas concentration cannot be calculated with sufficient accuracy. Check for dirty optics and clean the window and mirror (cf. Section 5.3) if necessary.
O	22	The system temperature is outside the specified operating range. For repeated high temperature warnings the use of a sunshade should be considered.
M	21	Malfunction of the detector. The detector still provides reliable measurements, but has detected one of the following problems: - increased energy consumption and reduced battery lifetime. - increased probability for beam block. - increased probability that the detector periodically will be unable to provide measurements. Clean the window and mirror (cf. Section 5.3). Contact GasSecure if this failure persists.

5.7 Contact GasSecure for support

You will find our contact information and an updated list of our representatives on our homepage

www.gassecure.com

When contacting the factory for support, the following information should be provided:

- The instrument serial number
- Description of the failure
- The type of gateway used for wireless communication

6. SAFETY INSTRUCTIONS

The GS01 detector from GasSecure is certified for and intended for use in potentially hazardous areas. Install and use the GS01 detector in accordance with the appropriate local or national regulations.

Test gases (for calibration or validation) may be toxic and/or combustible. Refer to the Material Safety Sheets for appropriate warnings.

The gas detector shall be installed and operated by trained and qualified personnel.

Remember to secure the GS01 detector when working at heights.

Do not open the instrument. All warranties void if opened. There are no user serviceable parts or settings inside. The manufacturer or its authorised dealers shall do service or repair.

7. CERTIFICATIONS AND STANDARDS

7.1 Standards

The GS01 has been certified according to the ATEX Directive 94/9/EC, EMC Directive 2004/108/EC, R&TTE Directive 1999/95/EC and is compliant with the standards listed below.

Table 7-1: List of applicable standards for the GS01

Standard	Issue date	Title
EN 60079-0	2012	Electrical apparatus for potentially explosive atmospheres. General requirements.
EN 60079-11	2012	Electrical apparatus for potentially explosive atmospheres. Intrinsic safety “i”.
IEC 60079-0	2011	Explosive atmospheres – Part 0: Equipment. General requirements.
IEC 60079-11	2011	Equipment protection by intrinsic safety "i".
IEC 60079-29-1	2007	Gas detectors – Performance requirements of detectors for flammable gases.
EN 60945	2002	Maritime navigation and radio-communication equipment and systems. General requirements. Methods of testing and required test results.
EN 50270	2006	Electromagnetic compatibility. Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.
EN 61000-6-3: 2007 +A1 (2011)	2007 and 2011	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards. Emission standard for residential, commercial and light-industrial environments.
ETSI/EN 300-328	2012-04	Electromagnetic compatibility and Radio spectrum Matters (ERM).
IEC 61508 Ed. 2.0	2010-04	Functional safety of electrical, electronic, programmable electronic safety-related systems
CFR title 47 Part 15C		Code of federal regulations, telecommunications, radio frequency devices, intentional radiators

7.2 Regulatory compliance of radio

7.2.1 Terminal equipment directive (R&TTE)

GasSecure hereby declares that the GS01 wireless gas detector complies with the essential requirements and provisions of R&TTE Directive 1999/95/EC.

7.2.2 FCC compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to the equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

7.3 Marking

The GS01 detector is marked with a product identification plate (cf. Figure 7-1) and a label for FCC compliance (cf.Figure 7-2). The composition of the identification plate is in accordance with ATEX Directive 94/9/EC. The marking is explained in detail under the figure.

GasSecure, Oslo, Norway GS01	
CE 0575 Ex II 2G Ex ib IIC T4 Gb	
Type: GS01 Part No: 10030 Year: 20YY Serial No: xx	-40°C < T_a < +65°C DNV 12 ATEX 10027 IECEx DNV 12.0013 IP 66/67 U=7,2 V I=100mA
USE ONLY GASSECURE BATTERY PACK PART NO. 10055	

Figure 7-1: GS01 product identification plate

The instrument marking string II 2G Ex ib IIC T4 Gb
means the following

Equipment group II
Electrical apparatus for places with an explosive gas atmosphere other than mines susceptible to firedamp.

Category 2
Equipment designed to be capable of functioning in conformity with the operating parameters established by the manufacturer and of ensuring a high level of protection. Equipment in this category is intended for use in areas in which explosive atmospheres caused by vapours, gases, mists, or air/dust mixtures are likely to occur. The means of protection relating to equipment in this category ensure the requisite level of protection even on the event of frequently occurring disturbances or equipment faults, which normally have to be taken into account.

G
The instrument is approved for use in gas, vapour, and mist atmospheres.

Ex ib
The method of protection is “intrinsic safety”.

Gas group IIC
Not restricted to certain gases.

IP66/67
Ingress protection level (as defined in EN 60529).

Temperature class T4
The maximum surface temperature of components will not exceed 135 ^{o}C.

Gb
Equipment protection level “Gb”: Equipment for explosive gas atmospheres, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions.

FCC ID: **2AEJXGS01AA**

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received,
including interference that may cause undesired operation.

Figure 7-2: FCC compliance label

The GasSecure battery pack is marked with an identification label as shown in Figure 7-3 below.

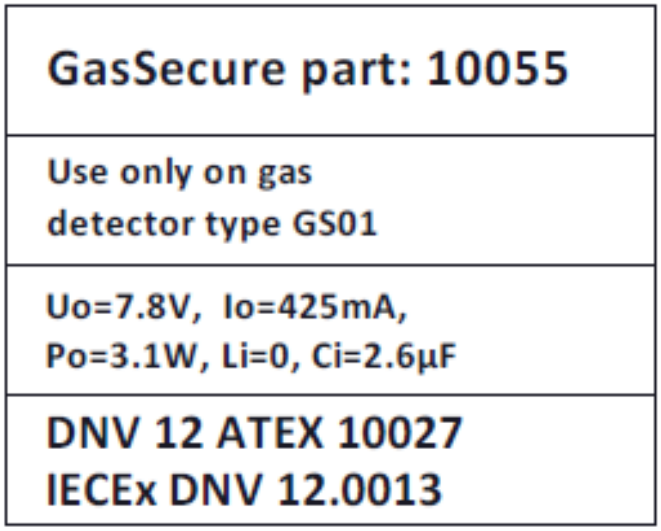

Figure 7-3: Battery pack identification label

8. TECHNICAL DATA

8.1 Performance Characteristics

Table 8-1: Performance characteristics for the GS01

Detector Version		GS01-01A	GS01-02A	GS01-03A
Calibration Gas		Methane	Propane	Methanol
Measuring Range[3]		0 – 100% LEL	0 – 100% LEL	0 – 100% LEL
Internal Low Alarm Limit[4]		10% LEL	10% LEL	10% LEL
Initialization time		30 s		
Response time	Detector	5 s > 10% LEL	5 s > 30% LEL	5 s > 50% LEL
	Incl. wireless comm.[5]	7 s > 10%LEL	7 s > 30%LEL	7 s > 50% LEL
	Maximum for low concentrations[6]	60 s < 10%LEL	60 s < 30%LEL	60 s < 50% LEL
Accuracy[7]		± 3% LEL (< 50% LEL)	± 2% LEL ± 20% of reading whichever is greater	± 2% LEL ± 20% of reading whichever is greater
		± 5% LEL (> 50% LEL)		
Dead band suppression		± 4% LEL	± 3% LEL	± 3% LEL
Typical battery life time[8]		2 years	2 years	2 years

8.2 Cross sensitivities

The GS01 is sensitive to many hydrocarbon gases, and does not distinguish one from another. In the tables below cross sensitivities to important hydrocarbon gases are presented. Please note that these are modelled estimates and shall be used as an indication only. Please contact GasSecure for cross sensitivity estimates for other gases than those listed below.
The tables are read as follows: The instrument reading is looked up in the first column. The estimated actual concentration is found in the same row in the column for the gas to be measured.

Example: If a methane detector is exposed to ethanol and a value of 40 %LEL is read, the actual concentration of ethanol is approximately 15 %LEL.
All values in are in % LEL. LEL values as provided in Table 8-2.

[3] LEL limits according to IEC60079-20
[4] Refer to Section 3.3.1 for further explanation
[5] Assuming an optimized network configuration using the default publish period of 2 seconds.
[6] Due to the limited sensitivity of the ultrasonic sensor
[7] Refers to temperature range -20 to +50 ^{o}C
[8] Assuming non-condensing environment.

Table 8-2: LEL values in [% vol] according to IEC60079-20.

Methane	Propane	Methanol	Ethanol	Ethylene	N-butane	Hexane	Styrene	Benzene
4.4	1.7	6.0	3.1	2.3	1.4	1.0	1.0	1.2

8.2.1 GS01-01A Methane detector

Table 8-3 Cross sensitivities for a GS01 Methane detector.

Reading	Propane	Methanol	Ethanol	Ethylene	N-butane	Hexane	Styrene	Benzene
10	6	4	6	27	7	7	16	27
20	9	7	10	42	11	11	25	44
30	11	8	13	54	14	14	31	56
40	14	10	15	63	16	17	37	67
50	15	11	17	71	18	19	42	76
75	19	14	21	89	23	24	51	97
100	23	16	25	100	28	29	59	100

8.2.2 GS01-02A Propane detector

Table 8-4 Cross sensitivities for a GS01 Propane detector.

Reading	Methane	Methanol	Ethanol	Ethylene	N-butane	Hexane	Styrene	Benzene
10	24	7	11	47	12	12	28	49
20	79	14	22	91	24	25	53	99
30	160	20	32	130	36	39	75	150
40	200	26	42	170	49	53	95	200
50	>200	31	51	200	62	68	110	>200
75	>200	42	72	>200	97	110	150	>200
100	>200	51	91	>200	130	170	180	>200

8.2.3 GS01-03A Methanol detector

Table 8-5: Cross sensitivities for a GS01 Methanol detector.

Reading	Methane	Propane	Ethanol	Ethylene	N-butane	Hexane	Styrene	Benzene
10	41	14	15	65	16	17	38	68
20	150	30	32	130	36	38	74	150
30	>200	48	49	190	59	65	110	200
40	>200	70	68	>200	89	100	140	>200
50	>200	97	88	>200	130	170	170	>200
75	>200	200	160	>200	>200	>200	200	>200
100	>200	>200	>200	>200	>200	>200	>200	>200

9. REFERENCES

[RD 1] Nivis ISA100.11a R2.7 Monitoring Control System User Guide Version: 1.2, Date: March 30, 2012

[RD 2] Nivis VersaRouter 900 Hardware User Guide
(VR800 Internal Hardware Rev. C)
Version 1.4, Date: Mar. 18, 2010

[RD 3] Yokogawa YFGW410 Field Wireless Management Station user's manual, IM 01W02D01-01EN

[RD 4] Yokogawa YFGW410 Field Wireless Management Station Startup Guide, TI 01W01A56-01EN

[RD 5] Yokogawa YFGW510 Field Wireless Access Point user's manual, IM 01W02E01-01EN

[RD 6] Honeywell Wireless Device Manager User's Guide, Release 220, OWDOC-X254-en-220A, October 2013

[RD 7] Honeywell Field Device Access Point User's Guide, Release 220, OWDOC-X256-en-220A, October 2013

[RD 8] Nivis ISA100.11a Field Tool User Manual, Version 2.1, Date: October 17, 2013

10. APPENDIX

Table 10-1: PV_Status byte description according to ISA100 Wireless™ standard

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
Quality		**<reserved>**	**Quality dependent substatus**			**Limit condition**	
0 = Bad (value should not be used)		This bit shall always be set to zero	0 = non-specific 1 = configuration error 2 = not connected 3 = device failure 4 = sensor failure 5 = no communication with LUV 6 = no communication no LUV 7 = out of service (value is not being computed) All other values are reserved			0 = Not limited 1 = Low limit 2 = High limit 3 = Constant (both high and low limited)	
1 = Uncertain (value of less than normal quality)			0 = non-specific 1 = last usable value 2 = substituted or manual entry 3 = initial value 4 = sensor conversion inaccurate 5 = range limits exceeded 6 = sub normal All other values are reserved				
2 = Good (quality of value is good, but an alarm condition may exist)			0 = no special conditions exist. All other values are reserved				
3 = Reserved			All values are reserved. Within this standard, this shall always be set to zero				

Table 10-2: Content of the DIAG_STATUS attribute

Note also
F: Failure
C: Function check
O: Out of specification
M: Maintenance required
According to the NAMUR NE107 categorization.

	Bit	DIAG_STATUS	Not supported if bit = 0	NAMUR NE107
Standard settings	31	F: Failure Status		
	30	C: Function check		
	29	O: Out of specification status		
	28	M: Maintenance required status		
	27	Faults in electronics		F
	26	Faults in sensor or actuator element		F
	25	Installation, calibration problem		C
	24	Out out service		C
	23	Outside sensor limits		O
	22	Environmental conditions, out of device spec.		O
	21	Fault Prediction: Maintenance required		M
	20	Power is critical low: maintenance short term		F M
	19	Power is low: maintenance long term		M
	18	Software update incomplete	0	C
	17	Simulation is active	0	C
	16	Faults due to process influence	0	C
	15	Faults due to non-compliance with operation conditions	0	F
	14	Other faults	0	F
Reserved for Baseline Device Profile	13		0	
	12		0	
	11		0	
	10		0	
	09		0	
Vendor specific area	08	Optical beam fault		F M
	07	Attenuated optical beam		M
	06		0	
	05		0	
	04		0	
	03		0	
	02		0	
	01		0	
	00	Detail information available	0	

Recommended implementation of status and diagnostic information

The PV_Status byte and the gas concentration (both published in the PV attribute) are forwarded to the controller. The gas concentration is displayed as long as the status byte reads “Good” (decimal value 128) or “Uncertain” (decimal value 64 to 127). When the status byte reads “Bad” (decimal value < 64) the detector will output NaN 0x7fc00000 (not a number) per float definition in IEEE754.

The diagnostic information as published in the DIAG_STATUS attribute is forwarded to the maintenance system.
Recommended is to read out the following bits:

- Failure status F (bit 31)
- Maintenance required status M (bit 28).
- Environmental conditions (bit 22)
- Power is critical low (bit 20)
- Power is low (bit 19)
- Optical beam fault (bit 08)
- Attenuated optical beam (bit 07)

Refer to Table 5-2 in the trouble shooting section for description of which actions need to be taken for the different bit settings.