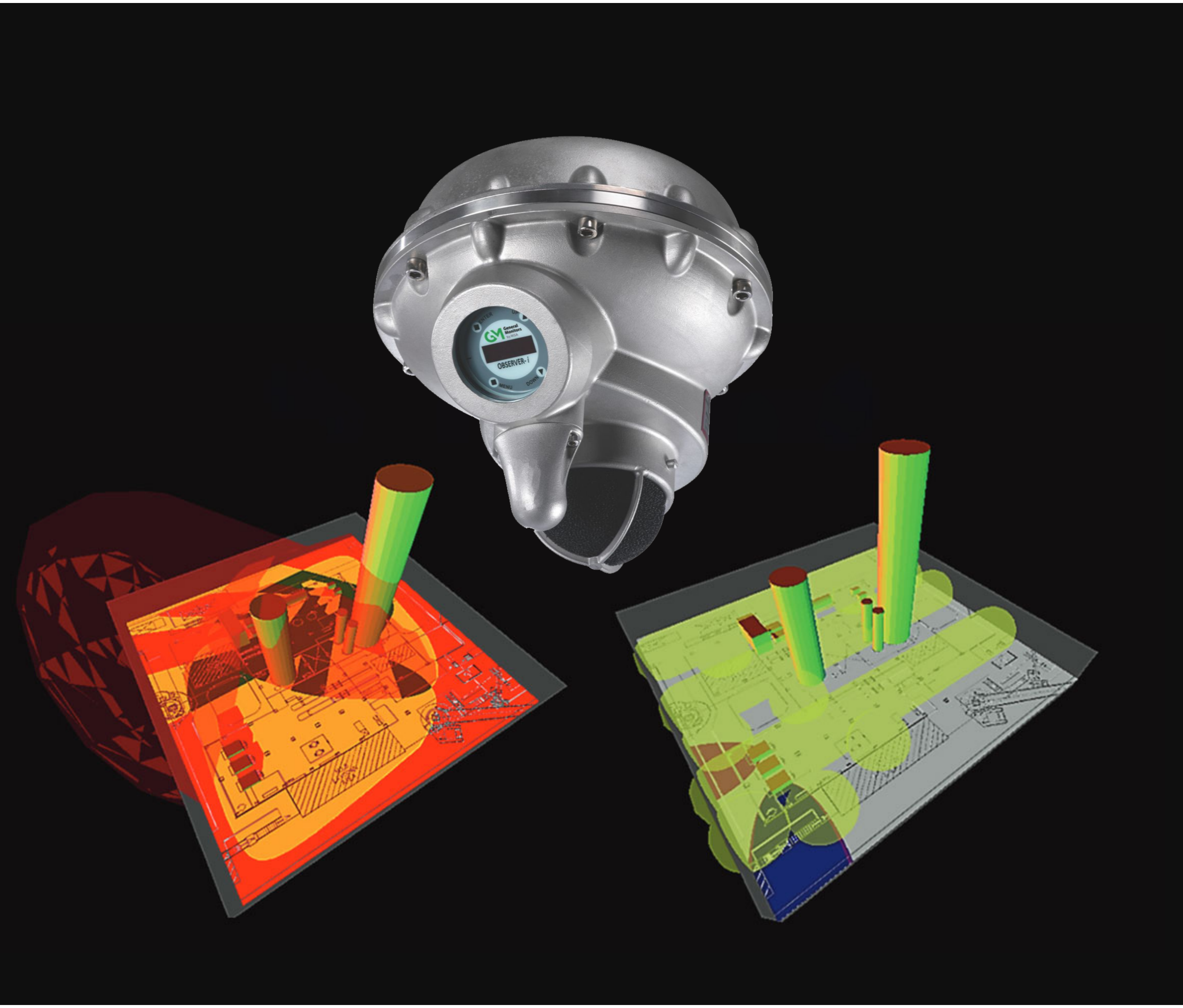
Fire & Gas Mapping Design Guide

Ultrasonic Gas Leak Detection

MSA
The Safety Company



How Fixed Gas and Flame Detectors can improve mapping design

WE KNOW WHAT'S AT STAKE.

How Fixed Gas and Flame Detectors can affect mapping design and the probability of detection

This document is intended for Fire and Gas Mapping design engineers and highlights how different detectors can improve detection probability and can potentially reduce the number of detectors required without reducing the detection coverage.

This design guide covers Ultrasonic Gas Leak Detectors.

The first Ultrasonic Gas Leak Detector (UGLD) was developed by Danish company Gassonic in the 1990's and detected gas leaks by listening for the acoustic noise signature of a high-pressure release. Since then, Gassonic became part of MSA and the technology has become more advanced. As the new technology, other companies developed their own UGLDs.

The original design and most of the UGLDs available today, require a sound mapping survey to establish the site conditions and noise levels of the process area under normal operating conditions. Once the sound mapping engineer has visited the site and the maximum noise level has been established, the UGLD alarm level can be set. The UGLD will then go into alarm whenever an acoustic sound is detected which is above the alarm threshold. The disadvantage of this technology when designing a new fire and gas system, is that it is not generally possible to know in advance the noise level of the site and therefore the required alarm threshold for the UGLD. As the alarm threshold affects the detection range, which affects the coverage area, it's only possible to estimate the number and location of the UGLDs. Therefore, some estimations are necessary, which can lead to additional UGLDs being required once the site is operational and an accurate sound mapping survey can be conducted. This can then result in additional work and expense, such as:

- An updated mapping design to determine how many additional UGLDs are required
- The location of both the existing UGLDs which may have to be moved and the additional UGLDs to be determined
- New cables may have to be installed and the control system may need expanding to accommodate the additional inputs

Another limitation with most UGLDs is that should site conditions change (e.g. new equipment is installed), which may affect the background noise levels, then a further site visit is required to conduct a new sound mapping survey. Until a new survey has been undertaken, the newly installed process equipment may cause false alarms and shut down production.

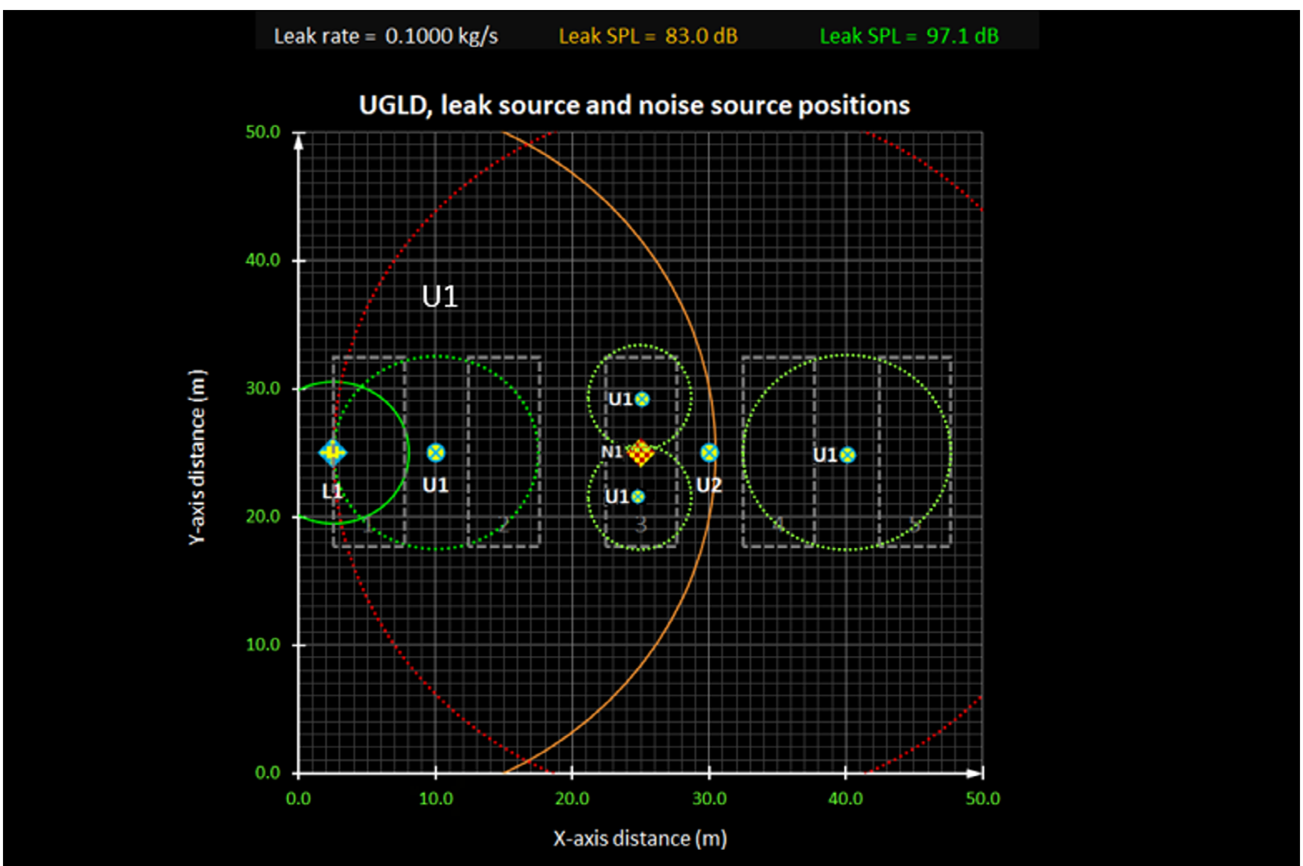
Since the original Gassonic design, the latest UGLD device from MSA has been through two major developments. The latest model is the Observer®-i and is the Third Generation of UGLD. The Observer-i has the following benefits:

- Artificial Neural Network (ANN) technology, which is the software that is built in to the UGLD, has a wide range of acoustic noise patterns from real pressurized gas leaks and background noise signatures found on industrial plants.
- When undertaking a new fire and gas mapping design utilizing the Observer-i, it is possible to accurately design the UGLD system without testing noise levels on-site. This is because the Observer-i detection range and coverage area is a known factor and because of its ANN technology, it will be unaffected by the background noise levels on site.
- The ANN technology also means that there is no requirement for sound mapping surveys after the initial installation or later on, should site conditions change.
- The Third Generation of UGLD is "plug-and-play", so as soon as it is powered up, it is ready for use and therefore no expensive sites visits are generally required for commissioning.
- The ANN technology of the Observer-i also extends the detection range over other traditional UGLDs, which means that there is the potential cost saving as less UGLDs would be required.

The below mapping diagram highlights the benefits of the Artificial Neural Network, which enables a longer detection range for the Observer-i in Enhanced mode (UGLD Type 2) over a traditional UGLD e.g. Observer-i in Classic mode (UGLD Type 1).

Key for below diagram:

- N1 = Machinery ultrasonic noise source
- L1 = Gas leak ultrasonic noise source
- U1 = UGLDs without ANN ultrasonic noise discrimination algorithm (e.g. Observer-i in Classic mode)
- U2 = Observer-i with ANN ultrasonic noise discrimination algorithm (e.g. Observer-i in Enhanced mode)
- Solid green line = 97.1 dB SPL limits of a 0.1kg/s gas leak rate (5.5m radius)
- Solid orange line = 83.0 dB SPL limits of a 0.1kg/s gas leak rate (28.0m radius)
- Dotted green line = 94.2 dB SPL reading limits of UGLD U1
- Dotted red line = 83.1 dB SPL reading limits of UGLD U2
- Grey dashed outlines numbered 1 to 5 = Process units with high pressure gas leak potential



UGLD	Detection mode	T.Level / S.Level (dB)	Leak SPL (dB)	Noise SPL (dB)
U1	Classic	99.0	94.2	96.4
U2	ANN	59.0	83.1	105.4

Conclusion on the Design and Benefits of Observer-i in Enhanced Mode:

1. U1 represents an Observer-i in classic mode (i.e. ANN ultrasonic noise discrimination feature inactive). U2 represents an Observer-i in enhanced mode (i.e. with ANN ultrasonic noise discrimination feature active.)
2. Given the scenario, a minimum of four units of the U1 UGLD would be required to provide adequate detection coverage over the five process areas. This quantity may be higher following the sound mapping survey of the operational site. On the other hand, only one unit of the U2 UGLD is needed to provide the same detection coverage.
3. U1 UGLD can be affected by background ultrasonic noise. Therefore, the presence of background ultrasonic noise sources such as N1 must be carefully evaluated during UGLD positioning/commissioning. The two U1 UGLD units that are closer to the N1 noise source, would have to be set at a high enough trigger level that prevents both units from giving false alarms triggered by the N1 ultrasonic noise emissions. Consequently, these two UGLD units would generally be positioned close enough to potential leak points in area three to ensure that dangerous gas leak noise from the area is louder than the set trigger level. This explains why these two units would have a relatively small radius of coverage, with each able to cover only half of a process area. The two U1 UGLD units that are further away from the N1 noise source, can have a lower trigger level since the interfering noise they would receive from N1 is lower. This explains why these two units would have relatively larger radius of coverage, with each able to cover two process areas.
4. Since U2 is unaffected by ultrasonic noise from N1, a significantly lower trigger level can be set with no risk of false alarms. In the example shown, the set trigger level produces a detection radius of 28m (more than 600m_2). This detection radius is large enough to cover all five process areas.
5. As well as requiring fewer UGLDs, site visits for sound mapping surveys would not generally be required if the Observer-i and Enhanced mode was selected for this application.

To learn more about MSA's mapping capabilities and how our products can help in optimising your design, please contact us by clicking here.

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