PRODUCT SHEET

KONGSBERG

K-GAUGE GAS

TANK MONITORING SYSTEM FOR LPG CARRIERS

K-Gauge GAS is a modern and flexible tank monitoring system suitable for use in all type of LPG tank designs. The radar tank gauges, temperature sensors and pressure transmitters are designed to provide continuous and reliable accuracy in the challenging demands of transporting LPG (Butane and Propane), LEG (Ethane and Ethylene), liquefied VCM and liquefied Ammonia (NH_3) on board ships.

Functional description
K-Gauge GAS offers a cost effective solution that can be tailored to individual operational needs. Modular design allows flexibility in configuring the system to meet every vessels requirement, covering the whole range from small pressurized carriers to very large fully refrigerated gas carriers.

The field instrumentation are designed for marine applications and fulfills the requirements set in relevant ISO standards for instrumentation used for liquefied petroleum and chemical gases on board marine carriers and floating storage.

KONGSBERG system technology consists of a library of software- and hardware modules, communicating through dual (redundant) process buses and networks. The heart of the system is a specially designed Radar Tank Gauge with the unique online verification method - AutroCAL®.
A family of Distributed Processing Units (DPU's) handle the monitoring functions locally, while the multifunctional Operator Stations facilitates for user interaction.

The system automatically logs all tank data and presents instant status on the Operator Station through dedicated mimics. Alarm settings are available for all parameters in order to maintain safe operation.

K-Gauge GAS can be extended with optional software modules to provide accurate volume calculations and a flexible Gas Report function, where quantity of gas transferred are reported by type of gas, densities, volume and weight for both liquid state and vapour state.

All components in the K-Gauge GAS tank monitoring system are designed for marine use and type approved by the major classification societies. The intrinsically safe apparatus are certified Ex ia according to ATEX and IECEx.

BUILDING BLOCKS

Radar Tank Gauge (RTG)
The KONGSBERG Radar Tank Gauge (RTG), GLA-310/5, is designed to measure level in tanks containing liquefied gases. Accurate measurement is possible regardless of the tank atmospheric conditions.

The RTG consists of an antenna unit and a microwave unit. The microwave unit includes a sophisticated signal detection method that ensures optimum performance, which combined with its superb signal-to-noise ratio, offers the highest measurement reliability and accuracy.

The horn antenna is designed to emit a frequency sweeping microwave signal through a 50 mm standpipe. The standpipe is considered as an integral part of the level gauge, and comes in sections adapted to match the total tank height.
The RTG is specially designed to withstand the severe mechanical and physical conditions in a maritime outdoor environment. Only AISI 316L acid-resistant steel and PTFE/ PEEK materials are used.

Ammonia (NH_3)
Ammonia represents a challenge for microwave radar measurement. Due to the molecule structure, the ammonia vapour induces an excessive loss of the radar signal. This phenomenom is increasingly challenging at higher pressures. Kongsberg RTG, with its high signal-to-noise ratio and unique detection method has overcome this challenge and offers measuring ranges that is applicable for any type of LPG carrier with ammonia on the cargo list.

Signal Processing Unit (SPU)
Each RTG is connected to a dedicated processing unit.
The GLK-300/LPG Signal Processing Unit (SPU) is located in a safe area and provides necessary communication and intrinsically safe power barriers to the instrumentation located in hazardous area. The SPU employs powerful processing of the data from the Radar Tank Gauge, Cargo Temperature Unit and vapour pressure transmitter.
Communication with the Segment Controller Unit (SCU) is done by dual high speed Ethernet. The SPU is equipped with LEDs in the front for easy condition monitoring by crew.

AutroCAL®
AutroCAL® is a unique calibration and verification function in the KONGSBERG system. Gas vapour density and mixture of gases influence the propagation speed of the radar signal, thus the accuracy of the measurement. By using pipe joint reference markers, AutroCAL® continuously compensates for the changes caused by the differences in the propagation speed.

Each pipe section is supplied with flanges prepared with reference markers. The liquid level and the markers are measured simultaneously, hence the system automatically verifies itself at every measurement. By careful calibration of the pipe section lengths before installation, the position of the markers are recorded and stored in the system. By comparing the liquid echo with the reference marker echo, a continuous auto-calibration of the measurement is done.

AutroCAL® ensures high accuracy over the whole measurement range, independent of the gas mixture, pressure and temperature.

Cargo Temperature Unit (CTU)
Temperature measurement is a crucial parameter for correct volume calculation of the liquefied gas. High quality sensors with reliable accuracy are an important factor when monitoring cryogenic cargoes.

Figure 1: Radar Tank Gauge GLA-310/5

Figure 2: Signal Processing Unit GLK-300/LPG

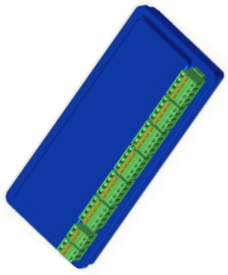
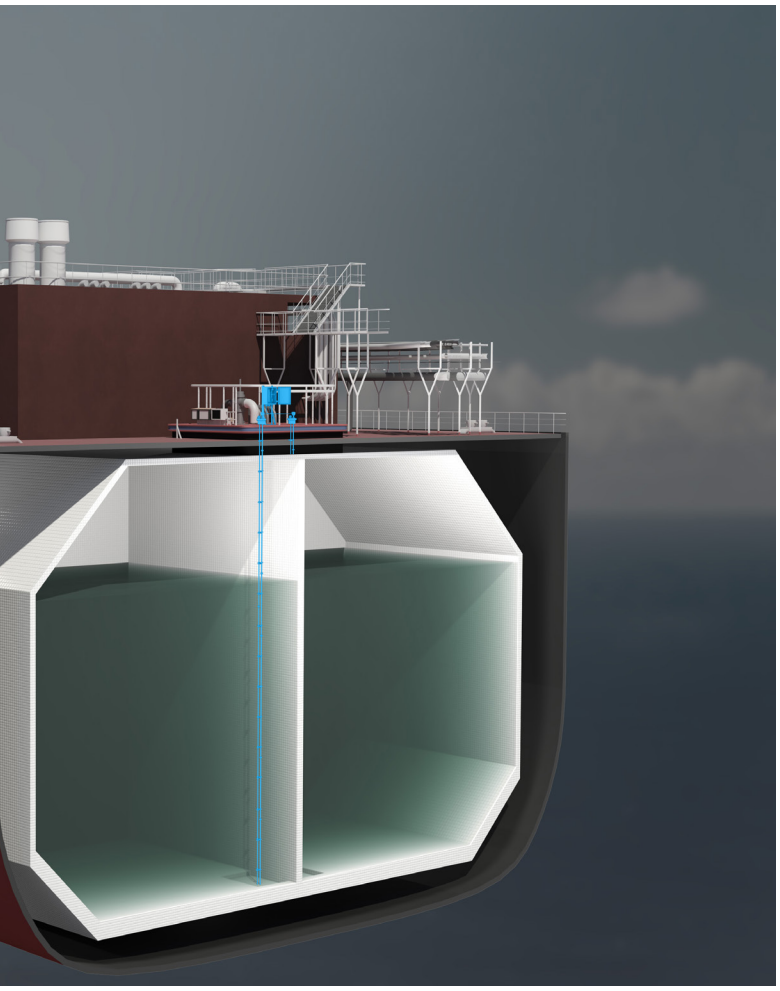


Figure 3: Cargo Temperature Unit GC-306

Figure 4: Cargo temperature sensor



Cargo temperature sensors
KONGSBERG temperature sensors are marine approved temperature sensors, designed for accurate measurements of temperature in liquefied gas tanks. The sensors are delivered with serial numbers and calibration certificates.

Vapour pressure
KONGSBERG pressure transmitters are marine approved pressure transmitters, designed for accurate measurements of tank pressure. The sensors are available with local display as an option.
The pressure transmitter comes with a control valve with test flange and closing ball valve.

Independent level switch
KONGSBERG capacitive level switch is designed for high level and overfill alarm detection in cargo tanks. With continuous monitoring and no moving parts, the robust sensor meets the IMO requirements concerning “Cargo Tank Overfill Protection Systems”

Figure 5: Pressure transmitter GT405

Figure 6: Level alarm switch GL-7B/2

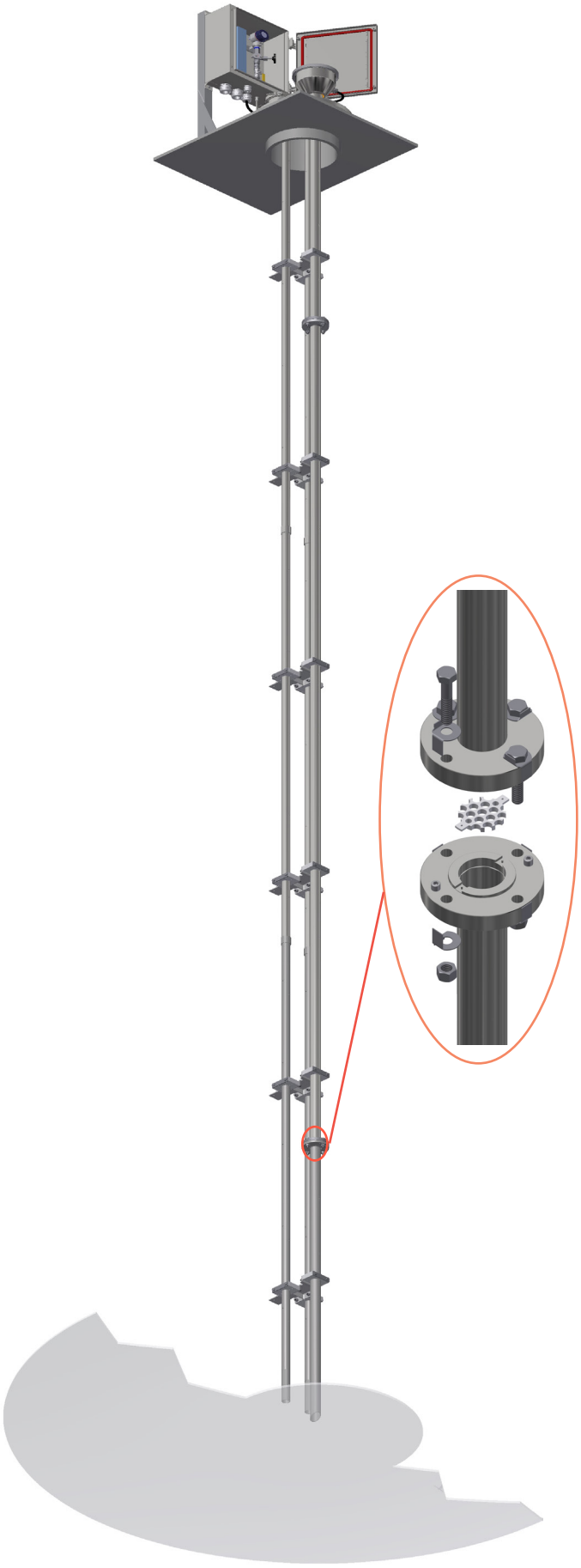


Figure 7: Standpipe installation with marker for auto-calibration by AutroCAL® (example)

Operator Station
A number of computers can be connected in a network to provide redundancy and the possibility to arrange control stations at several locations onboard. The Operator Stations consist of marine approved HP computers running Windows 7, a choice of 22”, 24” or 27” wide screen monitors and a set of user friendly mimics for presentation of:

- Liquid levels.
- Liquid volumes (total, individual and group).
- Cargo temperatures (average liquid, average vapour, individual).
- Tank vapour pressures.
- Trim and List readings.
- Level alarms (HiHi, Hi, Lo, LoLo).

Figure 8: Tank monitoring system mimics (split screen example)

Gas Report (option)
A cargo transfer report can be included in the system. The flexible report generator offers an easy way to adapt the printed reports to the changing cargoes transported. The report calculates quantity of gas transferred listed by type of gas, densities, volume and weight for both liquid state and vapour state.

Filtering function (option)
The level filter function will ensure accurate reading of the cargo level when operating in a rolling condition. The function utilizes the following features in the system:

- Mechanical filtering by the standpipe and theAutroCAL® reference markers.
- Dual sweep FMCW technology that eliminates the Doppler effect caused by cargo movement.
- Simultaneous filtering of Trim/List values for level corrections.

With the filtering function enabled, the same accuracy is achieved as for steady conditions at port.

TOPOLOGY DRAWING

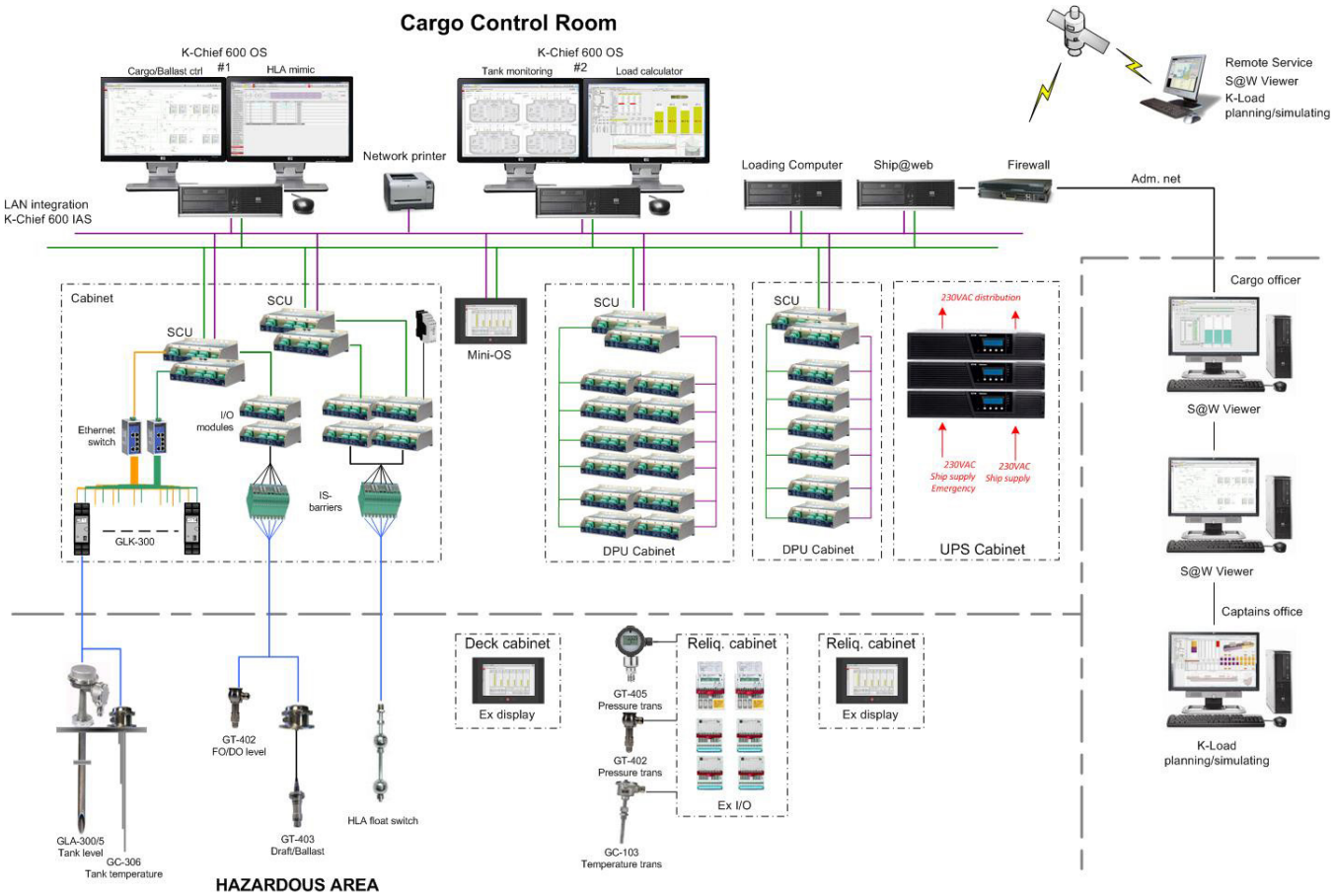


Figure 9: KM integrated LPG tank management topology

Specifications subject to change without any further notice.

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