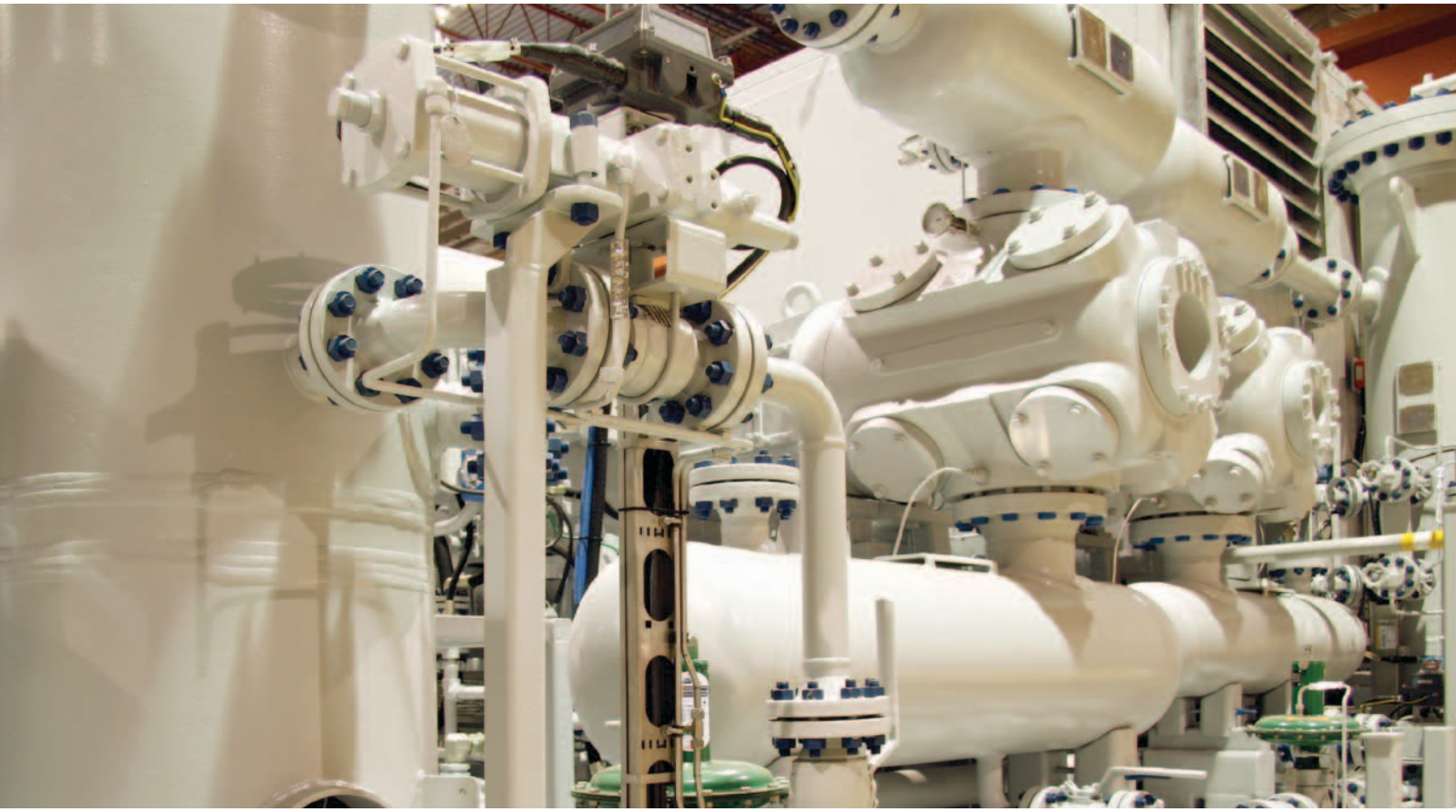
SensoTech



Oil in refrigerant

Inline analytical technology for:

- oil circulation ratio (OCR)
- polyester oil (POE)
- polyalkylene (PAG)
- polyalphaolefins (PAO)
- hydrofluorocarbons
- carbon dioxide
- ammonia
- propane

Increasing c

With high

Robust, ac

LiquiSonic®

quality, **saving resources: LiquiSonic®.**

-value, **innovative sensor technology.**

curate, **user-friendly.**

LiquiSonic® is an inline analytical system for determining the concentration in liquids directly in the production process. The analyzer is also used for phase separation and reaction monitoring. Sensor installation within the product stream means an extremely fast measurement that responds immediately to process changes.

User benefits include:

- optimal plant control through online and real-time information about process states
- maximized process efficiency
- increased product quality
- reduced lab costs
- immediate detection of process changes
- energy and material savings
- instant warning of irruptions in the process water or process liquid
- repeatable measuring results

LiquiSonic's® ‚state-of-the-art' digital signal processing technology guarantees highly accurate, fail-safe measuring of absolute sonic velocities and liquid concentrations.

Integrated temperature detection, sophisticated sensor design, and know-how from SensoTech's extensive measurement history in numerous applications promises users a highly reliable, long-lived system.

Advantages of the measuring method are:

- absolute sonic velocity as a well-defined and retraceable physical quantity
- independence from conductivity, color or optical transparency of the process liquid
- installation directly into pipes, tanks or vessels
- robust, all-metal, gasket-free sensor design with no moving parts
- corrosion-resistant by using special material
- maintenance-free
- use in temperatures up to 200 °C (390 °F)
- accurate, drift-free measurements
- stable measurements even amid gas bubbles
- controller connection capacity reaching up to four sensors
- data transmission via fieldbus (Profibus DP, Modbus), analog outputs, serial interface or Ethernet

Inline process analysis

Contents

1 Application

1.1 Introduction

In air conditioning processes, often compression chillers are used, in which refrigerants such as R134a circulate, that are ideal as a heat transfer medium due to their thermodynamic properties. In addition, refrigerating-machine oils are in the air conditioning processes to lubricate the compressor.

Depending on the design and application of the refrigerator, there are a variety of combinations of oil and refrigerant. A high percentage of oil is best for good lubrication, however, this reduces the efficiency of the refrigerator. Therefore, the objective is to have the perfect mixture of oil and refrigerant. To develop and ensure this optimum oil circulation ration, the LiquiSonic® analyzer is used. The analyzer continuously monitors the cooling process and detects the oil content in the refrigerant. This is necessary particularly in the development of air conditioning equipment or operation of large cooling plants.

1.2 Industries

Optimizing compression refrigeration machines, the LiquiSonic® analyzer is used by air-conditioning or compressor manufacturers as well as in research institutes and test bench engineering of various industries.

In the development and optimization of automotive air conditioning, the cooling circuits are continuously monitored to enhance the efficiency, system structure and parameters.

Similar goals are pursued in the development of large cooling plants, which are used for air conditioning in buildings and industrial processes.

In addition to the application in research institutes and test bench engineering, the LiquiSonic® technology is installed in cooling processes of final refrigeration systems to detect oil leakages and to monitor and ensure the oil circulation ratio and temperature in the process.

1.3 Process

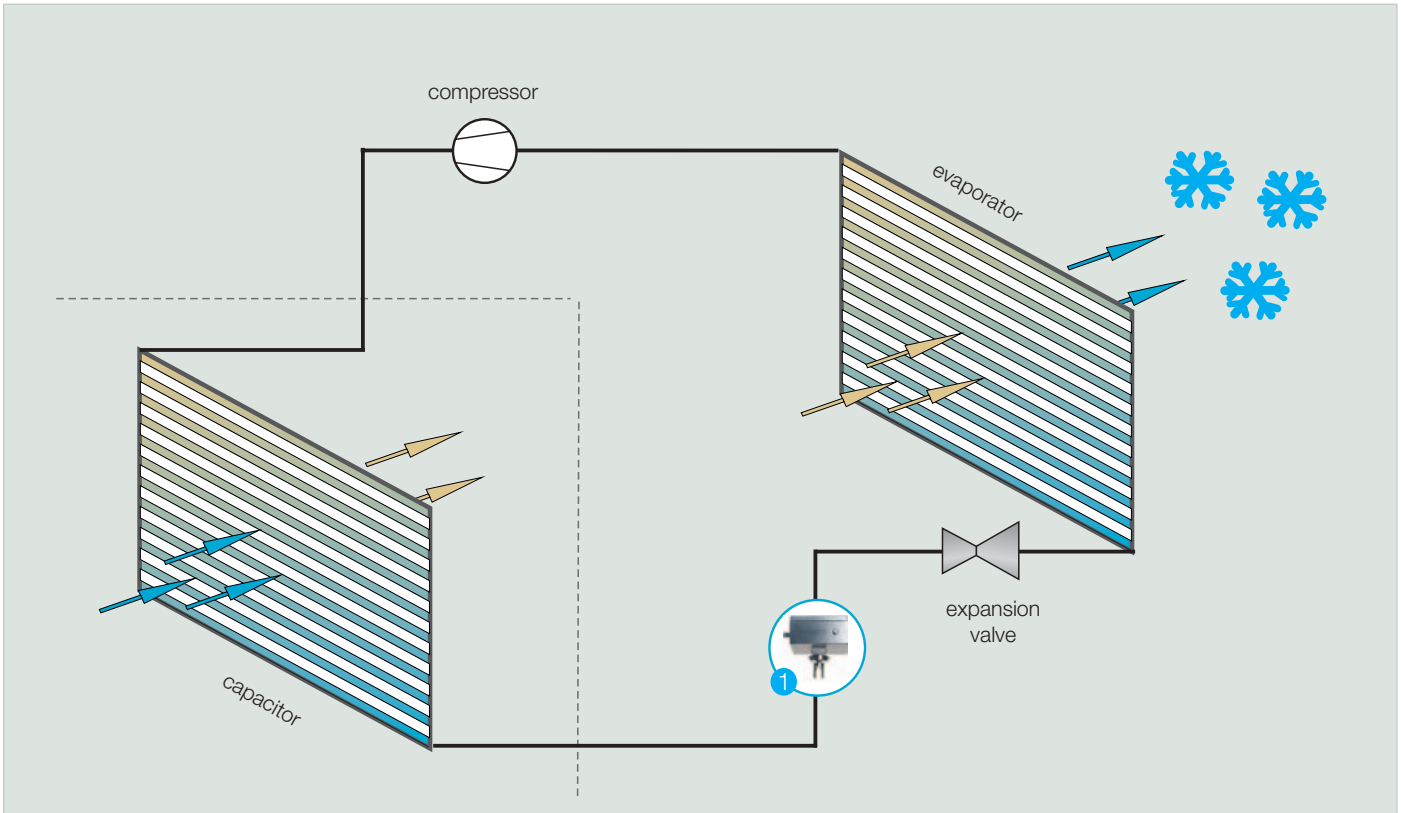
The principle of compression chillers is based on a cyclical process in which the refrigerant gasifies on one side and emits cold. On the other side it liquefies and releases heat. The chiller consists of four main components:

- expansion valve
- vaporizer
- compressor
- capacitor

The expansion valve lowers the high pressure the liquid circulates under. With the pressure reduction, the refrigerant evaporates completely in the evaporator and emits the cold to the environment and the evaporator absorbs heat from the environment. In the evaporator, the refrigerant is always gaseous, as by the suction of the compressor there is always a smaller pressure than the evaporation pressure.

Condensation or low evaporation reduce the effectiveness of the air conditioning and lead to higher power consumption of the compressor.

The compressor increases the low pressure the gaseous refrigerant circulates under, so with higher pressure the refrigerant liquefies again. In addition, this pressure effect realizes the circulation of the refrigerant in the air conditioning cycle. The liquefied refrigerant gets very warm by the compression process. In the capacitor, this heat releases to the environment and the capacitor takes cold on. Thus both the capacitor and the evaporator are heat exchangers. In automotive air conditioning, the evaporator inside the car serves for cooling and the capacitor discharges the heat to the outside. The liquid refrigerant leaves refreshed the capacitor, flows to the expansion valve and the refrigeration cycle begins again.



Measuring point	Installion	Measuring task
1	pipeline	Monitoring of the oil concentration in the refrigertant

Air conditioning circuit with LiquiSonic® analyzer

1.4 Refrigerants

The main task of the refrigerant is the transport of heat in the air conditioning circuit. Earlier, refrigerants such as chlorofluorocarbons (CFCs, R12) were used. Since these involve a very high ozone depletion potential (ODP) and destroy the ozone layer, they were banned. Nowadays, a common refrigerant is R134a, which is used particularly in mobile refrigeration systems like in cars. Since R134a has a high global warming potential (GWP), it should be gradually abolished until 2017 and replaced by climate-friendly refrigerants such as CO_2 or 1234yf in accordance with the EU regulation of 2011. In large stationary cooling plants, often ammonia (R717) is used, which has proved itself since the start of refrigeration technology.

Refrigerants should include the following properties:

- low evaporation and condensing pressure to avoid an overload of the mechanical components
- high thermal conductivity for optimum heat transfer high enthalpy of vaporization for maximum cooling capacity
- low ozone depletion and global warming potential
- no danger to humans and the environment

The following refrigerants have been measured by SensoTech in the in-house laboratory: R22, R32, R125, R134a, R143a, R290, R407C, R410A, R717, R744, R1233zd (E), R1234yf, CO_2, propane

1.5 Refrigerating-machine oils

The oils serve primarily for lubrication, sealing and cooling of the compressor. Different oil types are used:

- Polyester oil (POE)
- Polyalkylene (PAG)
- Polyalphaolefins (PAO)

The oil is located directly in the compressor and circulates inside. It should be separated from the refrigeration circuit through several seals (ring).

Due to small leakages, it always comes to an oil entry in the refrigerant. Since in the air-conditioning circuit is a higher pressure, the oil is also partially pushed back into the compressor. This back and forth flow of oil improves the sealing and lubrication of the compressor. Therefore, a small amount of oil is already added within the refilling with refrigerant.

However, the oil in the refrigerant decreases the efficiency of the air conditioning process due to:

- poor heat transfer in the evaporator and the condenser
- reduction of the enthalpy of vaporization of the refrigerant
- unwanted increase in temperature at the compressor by increasing the viscosity

1.6 Oil concentration measurement

Continuous monitoring of the oil content in the refrigerant places high demands on the analysis. On the one hand, there are high pressures, which may be up to 150 bar in case of CO_2. On the other hand, the refrigerant is a gas at ambient pressure, which makes manual sampling and offline analysis almost impossible.

The LiquiSonic® sensors belong to the field of online analytics, measuring continuously and directly in the running process the temperature and pressure compensated oil concentration with an ultra-fast refresh rate. The sensors are installed directly in the main line.

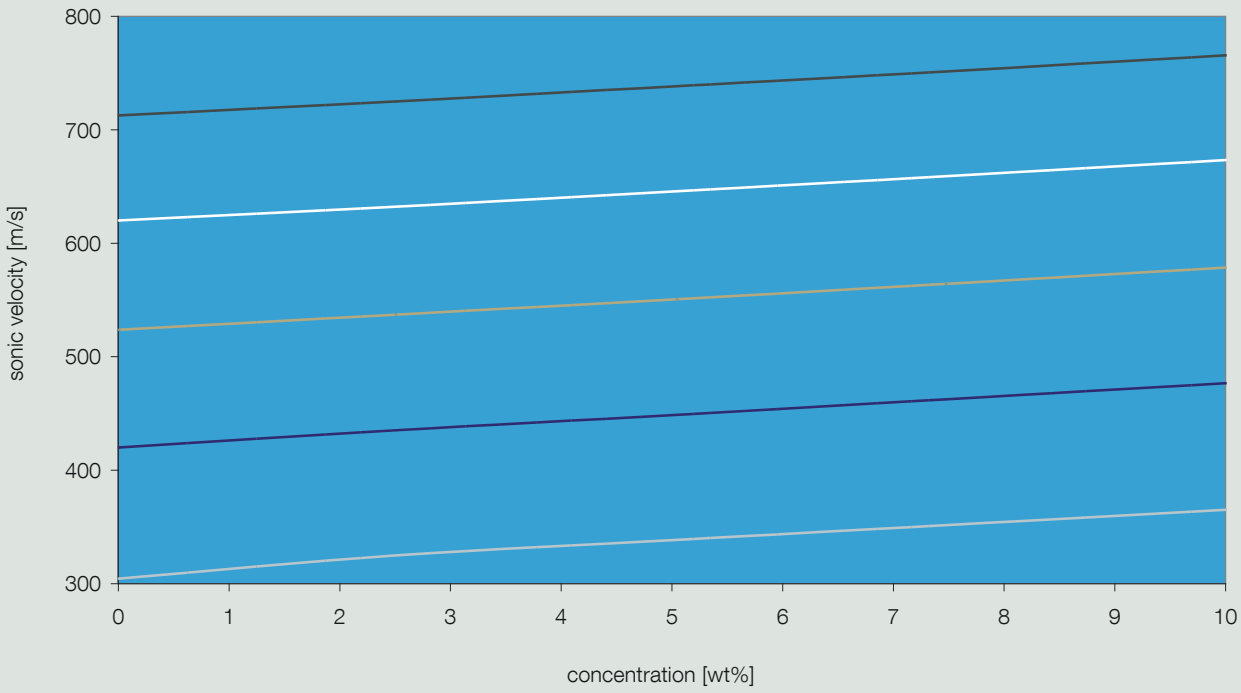
The measuring principle is based on the sonic velocity measurement, which is recognized as clear and traceable physical value. To determine the sonic velocity, a ultrasonic pulse is sent through the liquid and the time is measured until the pulse reaches the receiver. Since the distance between the ultrasonic transmitter and receiver is constant due to the design, the sonic velocity can be calculated.

In addition, two high-precision platinum temperature probes measure the liquid‘s temperature and a pressure transmitter provides the pressure signal via 4 ... 20 mA.

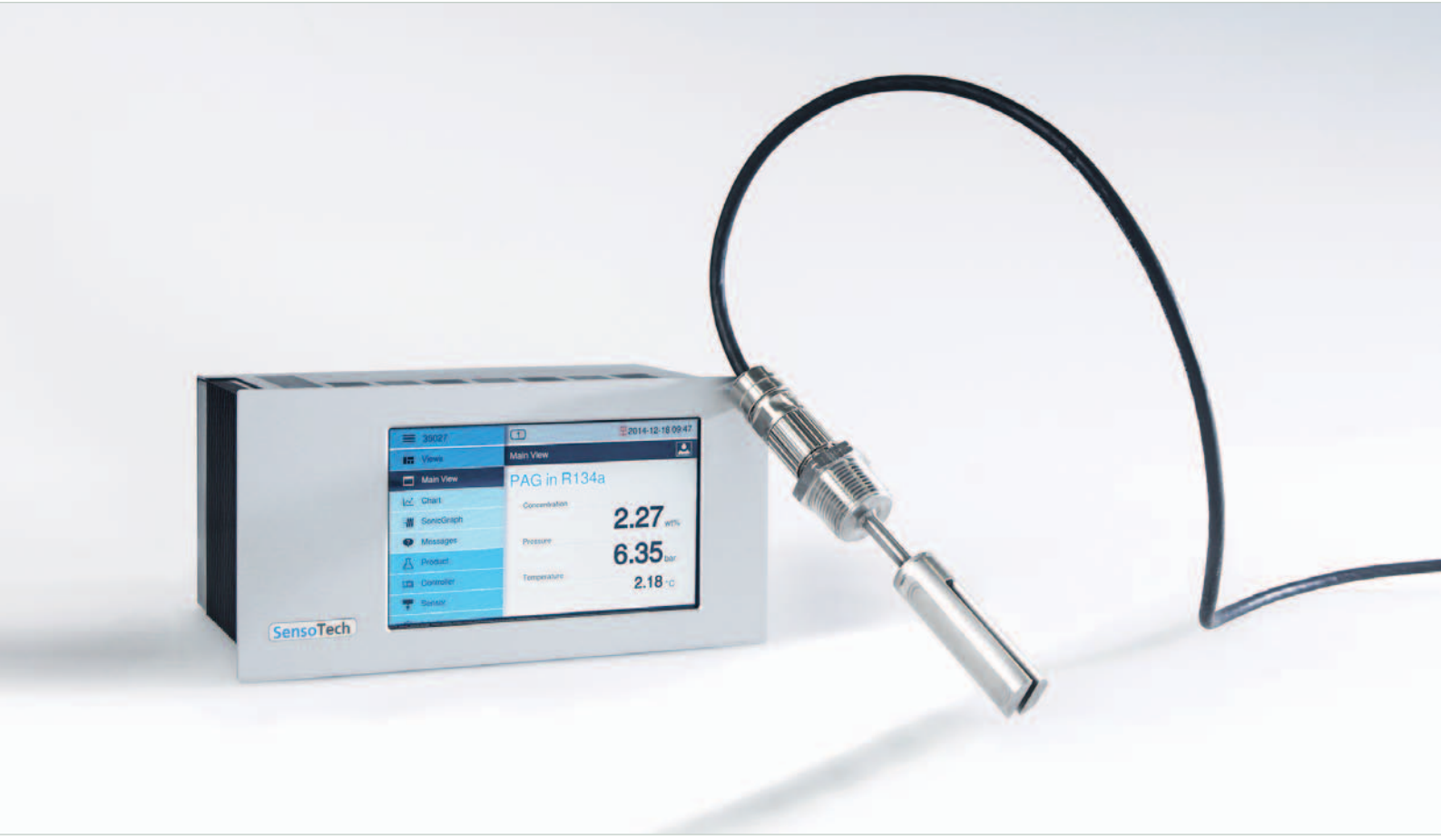
The relationship between sonic velocity, temperature and concentration differs depending on the refrigerant. For a multitude of refrigerants, the relationship is fully described mathematically. The resulting „product data sets“ are stored in the LiquiSonic® controller.

As refrigerant applications often include severe pressure fluctuations, which have an impact on the sonic velocity, high-end measurement technology is required. In addition, refrigerants have a very low sonic velocity in comparison to other process liquids, which may be just 300 m/s. This places special demands on the measurement technology, which are fulfilled by the outstanding high-power technology and the sophisticated design of the LiquiSonic® sensors.

Oil (ND11) in refrigerant R134a



2 LiquiSonic® system



The LiquiSonic® system consists of one or more sensors and one controller. The controller can handle up to four sensors. Each sensor works autonomous and can be used in different applications.

LiquiSonic® is delivered as a complete plug&play system and displays immediately the correct liquid concentration after installation. A field calibration or other commissioning measures are not necessary. For use in refrigerant applications, the measuring system comprises a controller, an ultrasonic sensor, a pressure transmitter and a flow adapter.

LiquiSonic® controller 30

2.1 Controller

2.1.1 Controller 30

The controller 30 processes and displays the measuring results. The operation via the high resolution touch screen is easy and intuitive. Secure network integration including web server allow operating the controller alternatively via browser with a PC or tablet.

The process data is updated every second. The displayed value can be adjusted to internal reference values. If the measuring values exceed or fall below the threshold, the display shows an alarm message and a signal will be sent immediately.

The data can be transmitted in several defined analog or digital forms or through different fieldbus interfaces to communicate with process control systems or computers.

The controller features an integrated data logger which can store up to 2 GB of process information with up to 32 (optional 99) data sets for different process liquids. For processing on the PC, the data can be transferred via network or USB port. In addition, the controller enables creating easily process reports for documentation purposes.

The event log records states and configurations such as manual product switches, alarm messages or system states.

The controller power supply is 100 - 240 V AC, 50 - 60 Hz. Optionally, 24 V DC (10 - 32 V DC) are available, which have proved particularly for mobile use of the device.

2.1.2 Controller 5

The controller 5 manages the measuring data of the sensor like the controller 30, however, it includes no display and the technical features are reduced. Only one sensor can be connected and the operation is only possible via web browser.

By the space-saving construction with rail mounting, the controller 5 is designedv as OEM device for the equipment of vehicles and the integration in test benches. In addition to the usual interfaces, the controller 5 includes an integration via CAN bus. The power supply is 24 V DC (± 15 %). Optionally, a large power supply with 10 - 32 V DC is available.

LiquiSonic® controller 5 for OEM refrigerant applications

2.2 Sensor

The LiquiSonic® sensor continuously senses both concentration and temperature. The liquid-wetted parts of the sensor are made of stainless steel and the rugged, completely enclosed design requires no gaskets or “window” to the process, making it totally maintenance-free.

Additional sensor features such as flow / stop or full / empty pipe monitoring greatly advance process control. The LiquiSonic® high-power technology stabilizes measuring results, even when facing gas-bubble accumulations or large-scale signal attenuation through the process flow.

The special sensor electronics are located in a stainless steel housing, separated from the sensor and with a protection degree of IP68.

LiquiSonic® immersion sensor for oil/refrigerant mixtures

LiquiSonic® system structure - ultrasonic sensor and pressure transmitter integrated in the flow adapter

2.3 Flow adapter

For an easy integration of the sensor into the process, the flow adapter is ideal and available in various designs. The inlet and outlet are a standard tube with 12 mm diameter (OD), which can be assembled with suitable fittings. In addition, the adapter provides the integration of a pressure sensor.

Flow adapter for refrigerant applications

2.4 Pressure transmitter

To determine the pressure compensated concentration, the LiquiSonic® analyzer includes a pressure sensor. The pressure is fed and set off by an analog signal of 4 ... 20 mA in the controller.

Pressure transmitter for refrigerant applications

2.5 Accessories

There are several possibilities to support the installation of the LiquiSonic® analyzer and to facilitate the integration into the process control system. The following products have proved to be useful.

2.5.1 Calibration certificate

To ensure the specified measuring accuracy, the ultrasonic sensors are calibrated and adjusted. As proof, the user gets the calibration certificate, that states all relevant data.

2.5.2 Certificate of measuring ability

If there is no offline reference measuring technology available on-site, a certificate of measuring ability can be requested. This confirms that the measuring accuracy of the LiquiSonic® analyzer meets the customer‘s requirements. Firstly, the evidence includes the functional test over the customer‘s working range. Secondly, the evidence documents that all values are within the specified tolerance range.

2.5.3 Network integration

The LiquiSonic® controller has an Ethernet interface, that makes the integration into the corporate network possible. After entering the user name and password, the access to the stored logs is possible. Furthermore, the Telnet protocol can be activated.

Functions in the network include, for example,

- remote control,
- display of status information,
- transfer of product data sets,
- product calibrations,
- e-mail notification.

3 Quality and support

Enthusiasm for technical progress is the driving force behind our company as we seek to shape the market of tomorrow. As our customer you are at the centre of all our efforts and we are committed to serving you with maximum efficiency.

We work closely with you to develop innovative solutions for your measurement challenges and individual system requirements. The growing complexity of application-specific requirements means it is essential to have an understanding of the relationships and interactions involved.

Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

Our SensoTech quality management also only accepts the best production performance. We have been certified according to ISO 9001 since 1995. All device components pass various tests in different stages of production. The systems have all gone through an internal burn-in procedure. Our maxim: maximum functionality, resilience and safety.

This is only possible due to our employee`s efforts and quality awareness. Their expert knowledge and motivation form the basis of our success. Together we strive to reach a level of excellence that is second to none, with a passion and conviction in our work.

Customer care is very important to us and is based on partnerships and trust built up over time. As our systems are maintenance free, we can concentrate on providing a good service to you and support you with professional advice, in-house installation and customer training.

Within the concept stage we analyse the conditions of your situation on site and carry out test measurements where required. Our measuring systems are able to achieve high levels of precision and reliability even under the most difficult conditions. We remain at your service even after installation and can quickly respond to any queries thanks to remote access options adapted to your needs.

In the course of our international collaboration we have built up a globally networked team for our customers in order to provide advice and support in different countries. We value effective knowledge and qualification management. Our numerous international representatives in the important geographical markets of the world are able to refer to the expert knowledge within the company and constantly update their own knowledge by taking part in application and practice-oriented advanced training programs.

Customer proximity around the globe: an important element of our success worldwide, along with our broad industry experience.


In
With inno
Tough, acc
SensoTech
35027
Views
Main View
Chart
SonicGraph
Messages
Product
Controller
Sensor
Main View
2016-09-20 13:47
System test H_2O
Concentration
-0,01
Temperature
SensoTech

liquids, **we set the measure.**

ovative **sensor technology.**

curate, **user-friendly.**

SensoTech is a provider of systems for the analysis and optimization of process liquids. Since our establishment in 1990, we have developed into a leading supplier of process analyzers for the inline measurement of liquid concentration and density. Our analytical systems set benchmarks that are used globally.

Manufactured in Germany, the main principle of our innovative systems is to measure ultrasonic velocity in continuous processes.
We have perfected this method into an extremely precise and remarkably user-friendly sensor technology. Beyond the measurement of concentration and density, typical applications include phase interface detection or the monitoring of complex reactions such as polymerization and crystallization.

Our LiquiSonic® measuring and analysis systems ensure optimal product quality and maximum plant safety. Thanks to their enhancing of efficient use of resources they also help to reduce costs and are deployed in a wide variety of industries such as chemical and pharmaceutical, steel, food technology, machinery and plant engineering, car manufacturing and more.

It is our goal to ensure that you maximize the potential of your manufacturing facilities at all times. SensoTech systems provide highly accurate and repeatable measuring results even under difficult process conditions. Inline analysis eliminates safety-critical manual sampling, offering real-time input to your automated system. Multi-parameter adjustment with high-performance configuration tools helps you react quickly and easily to process fluctuations.

We provide excellent and proven technology to help improve your production processes, and we take a sophisticated and often novel approach to finding solutions. In your industry, for your applications – no matter how specific the requirements are. When it comes to process analysis, we set the standards.

SensoTech GmbH
Steinfeldstr. 1
39179 Magdeburg-Barleben
Germany

T +49 39203 514 100
F +49 39203 514 109
info@sensotech.com
www.sensotech.com

SensoTech Inc.
1341 Hamburg Tpk.
Wayne, NJ 07470
USA

T +1 973 832 4575
F +1 973 832 4576
sales-usa@sensotech.com
www.sensotech.com

SensoTech (Shanghai) Co., Ltd.
申铄科技(上海)有限公司
No. 35, Rijing Road, Pudong New District
上海市浦东新区外高桥自由贸易区日京路35号1241室
200131 Shanghai 上海
China 中國

电话 +86 21 6485 5861
传真 +86 21 6495 3880
sales-china@sensotech.com
www.sensotechchina.com

LSM214_01_04_R 10/2018

In liquids, we set the measure.