



## 3-component-analysis

- Inline analytical technology for:
- gas scrubbers
  - etching baths
  - sulfuric acid / oleum
  - methanol / formaldehyde

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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 interruptions 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**

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# 1 Measuring method



## 1.1 Measuring principle

The measuring system LiquiSonic® 40 enables the concentration measurement in 3-component mixtures. A 3-component mixture usually means a liquid of two substances in a carrier fluid or solvent.

The measuring principle is based on the fact that the concentration changing of individual components of a liquid have different effects on certain physical values. For example, these physical values include sound velocity, density, pH, refractive index, or other known variables.

If in a carrier liquid, the concentration of two components changes, two physical values are necessary to determine the concentration.

If the relationship between changing in concentration and changing of physical values is unambiguous, the concentration of each single component can be determined from a known change of the physical value according to an analytical mathematical relation description.

Usually the relationship can be graphically illustrated. The graph below shows an example of sonic velocity and conductivity at different concentrations of each component and at a constant temperature:

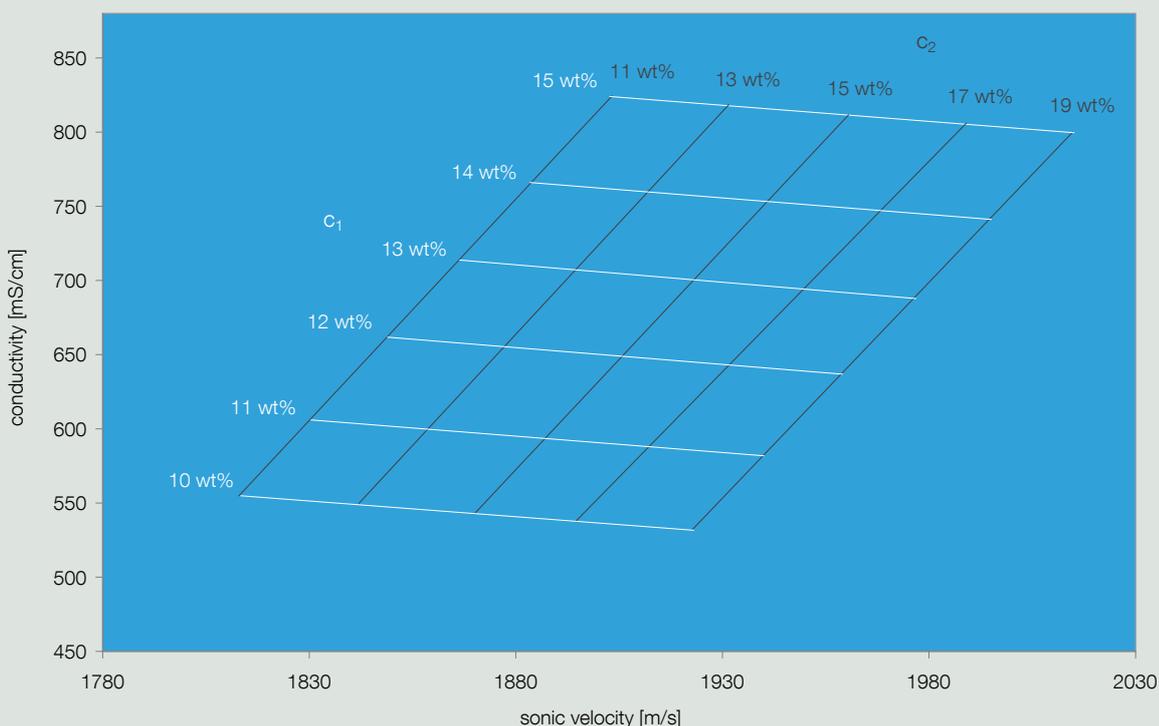
concentration 1:  $c_1 = 10\% \dots 15\%$

concentration 2:  $c_2 = 11\% \dots 19\%$

As a calculation model, these relationships are stored in the LiquiSonic® controller 40. So from the relevant physical value the controller calculates and displays the concentrations of the single components. Hence, due to the parallel analysis of two physical values, two concentrations simultaneously can be determined at a varying temperature.

The process temperature is also recorded and taken into the calculation model. Therefore, the concentration values of the components are always temperature compensated.

### Concentration $c_1$ and $c_2$ in a solution



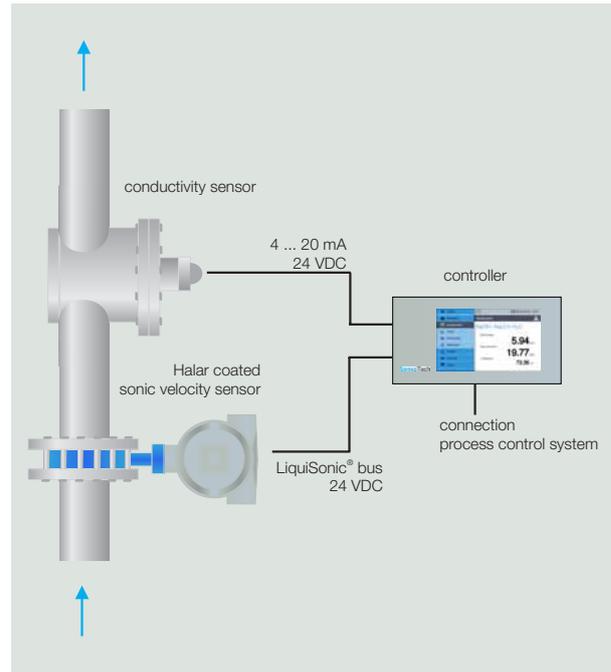
## 1.2 Combination of sonic velocity and conductivity

A common combination of physical values is the use of sonic velocity and conductivity:

1. The sensors are installed directly into the pipe. Thus, there is no need of bypass solutions.
2. The sensors are maintenance-free. By the robust design without moving parts there are no costs of adjustments or service.
3. Depending on the application the sensors are made of stainless steel or of special materials such as Halar, PFA or PEEK. Therefore, the sensors are resistant to corrosion, e.g. to strong acids such as hydrofluoric or hydrochloric acid.

The sonic velocity sensor is connected to the controller 40 via the standard available digital connection. The conductivity sensor is supplied with power via a two-conductor wiring to the controller, and simultaneously the conductivity value is transmitted to the controller using 4 ... 20 mA.

Within seconds the controller 40 calculates from the physical measuring values of sonic velocity and conductivity, the temperature compensated concentrations. The data can be passed to process control systems or PCs via several freely scalable analog or relay outputs, as well as various field bus interfaces.



LiquiSonic® in combination with conductivity



Installed sonic velocity and conductivity sensor

### 1.2.1 Gas scrubber

Concerning the process analysis in gas scrubbers there are different measuring points, where LiquiSonic® 40 systems have been used successfully. The analyzer makes it possible to determine inline and online the concentration of the washing solution and the salt separately. So the washing liquid can be re-dosed targeted and the liquid concentration is kept within the maximum absorption.

The costs for lower dosage, i.e. insufficient cleaning, as well as for overdose, i.e. excessive use of material, are avoided.

LiquiSonic® is successfully used in:

- chlorine gas scrubber (NaOH/NaCl (+NaOCl) in H<sub>2</sub>O)
- Phosgene scrubber (NaOH/NaCl (+Na<sub>2</sub>CO<sub>3</sub>) in H<sub>2</sub>O)
- NOX scrubber (NaOH/NaNO<sub>3</sub> (+NaNO<sub>2</sub>) in H<sub>2</sub>O)
- COX scrubber (NaOH/Na<sub>2</sub>CO<sub>3</sub> in H<sub>2</sub>O)
- SOX scrubber (NaOH/Na<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O)
- synthesis gas scrubber (K<sub>2</sub>CO<sub>3</sub>/KHCO<sub>3</sub> in H<sub>2</sub>O)

### 1.2.2 Etching and pickling baths

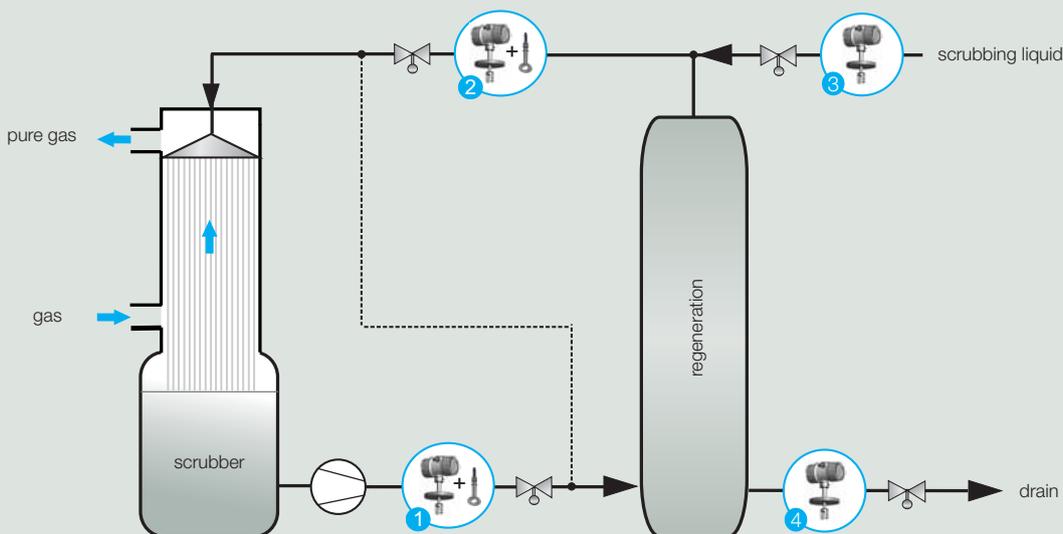
There are pickling solutions mainly consisting of mixtures of mineral acids. During the pickling process, the concentration of these acids decreases, while simultaneously the proportion of interfering components such as pollution and contamination increases.

By the LiquiSonic® online measurement of the pickling bath concentrations, fresh acid can be replenished targeted in order to keep an optimal pickling quality. Time delays caused by sampling and laboratory analyzes are eliminated.

LiquiSonic® is successfully used in:

- Sulfuric acid pickling (H<sub>2</sub>SO<sub>4</sub>)
- Phosphoric acid pickling (H<sub>3</sub>PO<sub>4</sub>)
- Hydrochloric acid pickling (HCl)
- Nitric acid pickling (HNO<sub>3</sub>)
- Hydrofluoric acid pickling (HF)

### Gas absorption process in a jet scrubber



Measuring point	Installation	Measuring task
1, 2	pipeline	monitoring of the concentration of the scrubbing liquid and salt
3	pipeline	monitoring of the concentration of fresh scrubbing liquid
4	pipeline	monitoring break-in during the treatment of salts

### 1.3 Combination of sonic velocity and density

The combination of sonic velocity and density measurement is usually applied, if the physical dependencies are better than those combining sonic velocity and conductivity.

In this case, density meters have proven working on the principle of an oscillating tube. Oscillating tubes are typically available to DN25 and therefore are often installed in a bypass.

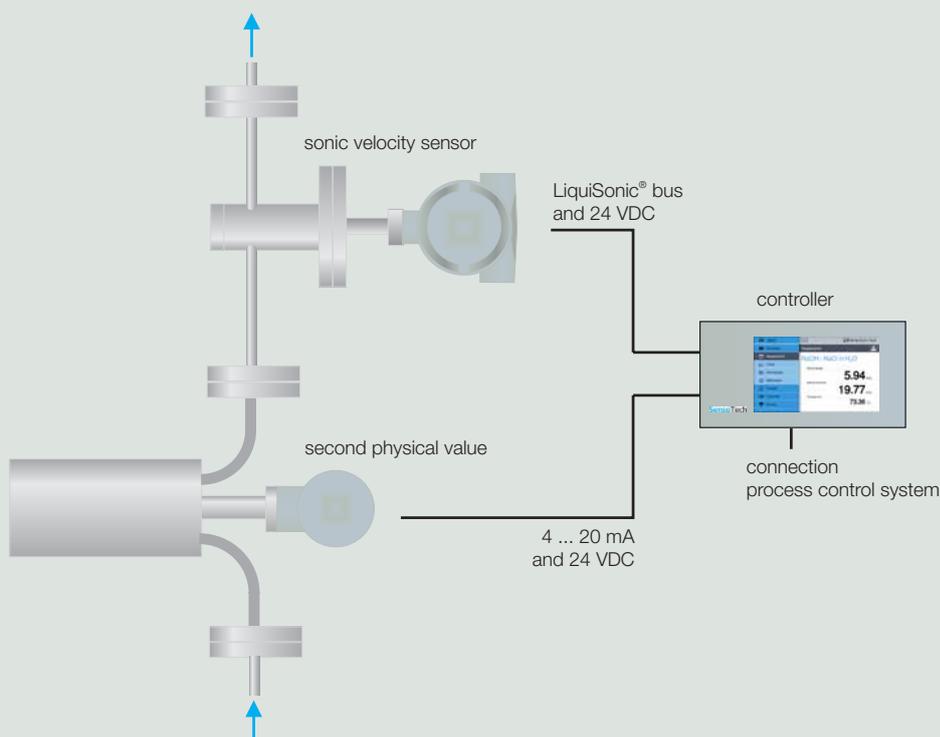
Alternatively, in few cases the density measurement using Coriolis mass flowmeter can be used. Since with this method the density value is only a „by-product“, the measuring accuracies are significantly lower than with the use of oscillating tubes.

The sonic velocity sensor is connected to the controller 40 via the standard available digital connection. The density meter is supplied with power via a two-conductor wiring to the controller, and simultaneously the density value is transmitted to the controller via 4 ... 20 mA.

To facilitate the installation of the ultrasonic sensor into the bypass, an appropriate T-adapter can be provided.

Within seconds the controller 40 calculates from the physical measuring values of sonic velocity and density, the temperature compensated concentrations. The data can be passed to process control systems or PCs via several freely scalable analog or relay outputs, as well as various field bus interfaces.

#### LiquiSonic® in combination with density



### 1.3.1 Oleum and sulfuric acid

By mixing sulfuric acid with oleum, any concentrations of highly concentrated sulfuric acid can be set. The setting requires the continuous inline monitoring of the concentration. Furthermore, oleum poses a hazard potential and must not be produced under certain absorption processes. The warning limits integrated in the LiquiSonic® analyzer signal this prematurely and send a warning to the process control system via the peripheral.

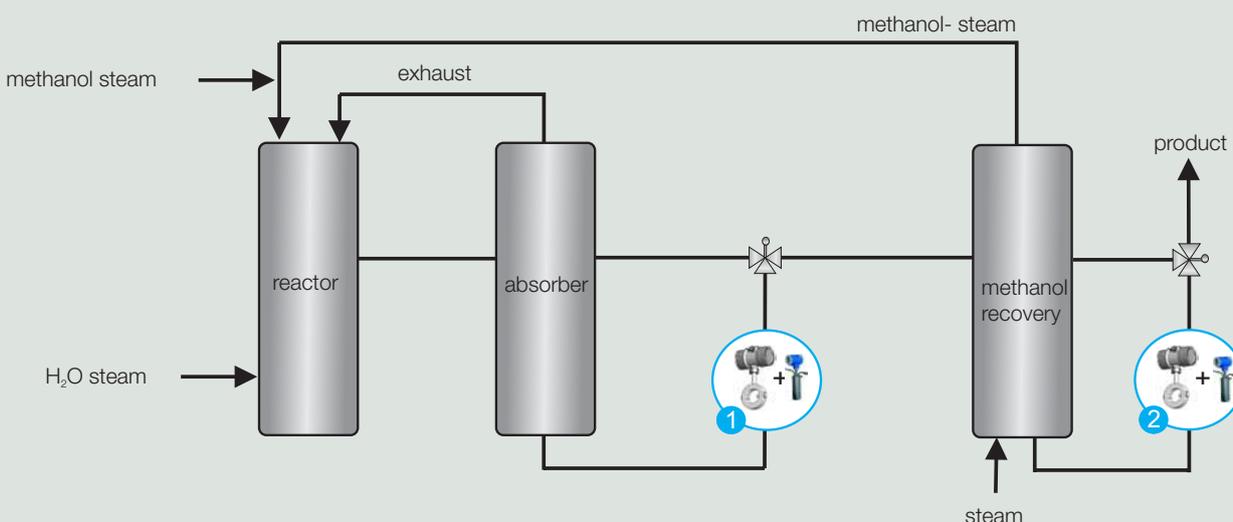
The curve of sonic velocity has at 100 %wt a inflection point, so that with only one ultrasonic sensor no clear measurement is possible in the process liquid sulfuric acid / oleum. Therefore, LiquiSonic® 40 analyzer includes a density sensor, which allows, together with sonic velocity, effective measurements in sulfuric acid and in oleum as well. Thus, a reliable and accurate concentration measurement is ensured.

### 1.3.2 Formaldehyde and methanol

The formaldehyde is produced from methanol in the so-called silver process. It means, methanol gas is mixed with air and passed through silver electrodes which act catalytically. The result is a formaldehyde gas, which precipitate with water and then becomes liquid. The excess methanol is recovered and fed back into the process, leaving a residual of about 0.8 wt% in the formaldehyde to stabilize.

Die LiquiSonic® 40 analyzer is used to expel the semi-finished product and to ensure the quality of the finished product. Extensive laboratory measurements, providing analytical results with time delay, are omitted.

## Production process of formaldehyde



Measuring point	Installation	Measuring task
1	pipeline	discharging of the semi-finished product
2	pipeline	assuring the quality of the finished product

## 2 LiquiSonic<sup>®</sup> system



## 2.1 LiquiSonic® 40

The LiquiSonic® 40 system consists of one sensor and one controller. The maximum distance between sensor and controller is 1,000 m.

The ultrasonic sensor includes the ultrasonic measuring path and the highly precise temperature detection. The liquid-wetted parts of the sensor are made of stainless steel DIN 1.4571 as standard. In chemical aggressive liquids the sensor is made of special non-corrosive material such as Hastelloy, Titan-Palladium, PFA or Tantal.

The rugged and completely enclosed design does not need any gaskets or “windows” to the process and is thus completely maintenance-free.

Different additional functions integrated in the sensor like flow stop monitoring and full/empty liquid monitoring in pipes increase the customer's benefit significantly. The special LiquiSonic® high power technology ensures stable measurement results, even at high portions of gas bubbles and strong signal attenuation by process liquid.

For use in hazardous areas, the immersion sensor Ex 40-40 is approved by ATEX and IECEx certification (Ex d IIC T1 to T6 Ga/Gb, zone 0 / zone 1) and FM certification (Class I, Division 1, Groups A, B, C, DT1-T6).

The flange sensor has an ATEX and IECEx approval (II 1/2 G / Ex d IIB T1 to T6 Ga/Gb).



LiquiSonic® immersion sensor 40-40 Ex

The controller 40 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.



Simple and intuitive controller operation

## 2.2 Accessories

### 2.2.1 Controller and field housing

The controllers are designed for rack-mounted systems. It is alternatively available with a 19" housing 4RU.

In order to be able to mount controllers into the field, two variants of field housings made of plastic or stainless steel can be delivered, which meet on-site conditions in an optimal way.

#### 19" housing 3RU

material: anodized aluminum

dimensions: 482.9 (19") x 177 (4RU) mm

application: rack-mounted system



#### Wall mount housing (stainless steel)

material: stainless steel DIN 1.4301 (AISI-304)

protection degree: IP66 (NEMA 4X)

dimensions: 430 x 300 x 230 mm

window: VSG with 6 mm thickness

application: in areas with highly hygienic requirements like pharmaceutical and food industry, e.g. breweries



#### Wall mount housing (plastic)

material: plastic

protection degree: IP56 (Nema 12)

dimensions: 500 x 500 x 300 mm

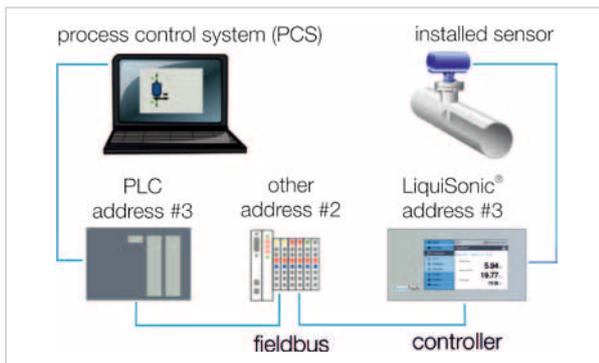
window: acrylic glass

application: outdoor or under rough process conditions like gas scrubbers or pickling baths



## 2.2.2 Fieldbus

The fieldbus option provides the possibility to integrate the controller in a PCS or to automate the process flow via PLC. Beside the transfer of measuring values like concentration and temperature it is also possible to exchange parameters and control data (for example product switch).



Connection points

The controller supports different fieldbus systems and follows the standards recommended by the respective standards organizations. Common variants are Modbus and Profibus DP.

## 2.2.3 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.

Integrating the controller into the network enables remote control, view of status information, transfer of product data sets or calibration of products.

The Network integration includes

- web server (HTTP),
- command line (TELNET),
- file transfer (FTP),
- time synchronisation (NTP),
- e-mail notification (SMTP).

## 2.2.4 UMTS router

With a UMTS router it is possible to operate remotely the LiquiSonic® controller. For this purpose, the controller is connected to the UMTS router and appropriate IP address must be entered in the browser on the PC.

The remote connection includes the following features:

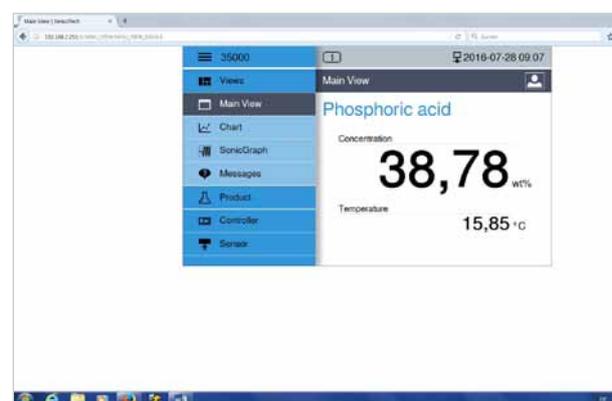
- uploading new product data sets on the controller
- reading out the controller data storage, e.g. to record product data for unknown liquids
- monitoring and configuration of the controller and sensors
- worldwide and fast customer support by SensoTech service

## 2.2.5 Web server

Via web server, a safe remote access to the LiquiSonic® controller within a network is possible without installing special application software.

The web server enables the direct access to the controller with standard web browsers (e.g. Firefox, Internet Explorer or Edge).

The feature “web server“ requires the activation of the option “Network integration“. If no network integration is activated, the remote control of the controller can be done in the web browser via UMTS router connection.



Controller operation via web browser

## 4 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.



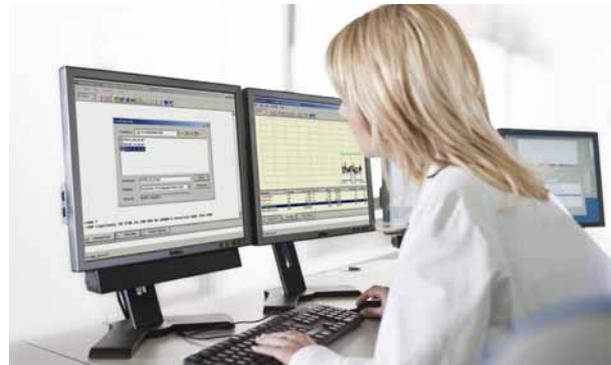
Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

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.

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**SensoTech**

SensoTech



standards **for process analysis.**  
n, that **creates new solutions.**  
bsolute **spirit of development.**

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 and density 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.



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In liquids, we set the measure.

