Teqwave H

Real-time, in-line concentration measurement for highest quality

Liquid analysis directly in the process

- **Economical** – just one sensor for a wide variety of concentrations
- **Hygienic** – meets the highest standards:
  - Easy-to-clean full-bore design
  - Can also be used in CIP applications
- **Reliable** – process transparency thanks to constant monitoring of product quality without sampling
- **Clever** – state-of-the-art algorithms for excellent measured values, even for complex concentration calculations
- **Maintenance-free** – no wear parts, no danger of drifting and no need for recalibration
- **Unique** – direct measurement and display of disturbance variables such as particles and gas bubbles

Endress+Hauser
People for Process Automation

Teqwave – The sensor that thinks right along with you

Liquid analysis for highest quality

Teqwave H enables reliable analysis in numerous applications in the food and beverage industry using ultrasound. Thanks to a single sensor that simultaneously measures concentrations, speed of sound, acoustic density and temperature in a wide variety of fluids, you always have your processes under control:

- Soft drinks and fruit juices (p. 3)
- Distilled beverages (p. 4)
- Cleaning agents and disinfectants (p. 5)

Four process variables using a single sensor			
Concentration	**Acoustic density**	**Speed of sound**	**Temperature**
Measuring range: 0 to 100% Accuracy: up to 0.01%	Measuring range: 0.7 to 1.5 g/cm³ Accuracy: ±0.01 g/cm³	Measuring range: 600 to 2000 m/s (1969 to 6562 ft/s) Accuracy: ±2 m/s (±6.6 ft/s) Repeatability: ±0.3 m/s (±1.0 ft/s)	Measuring range: 0 to 120 °C (32 to 248 °F) Accuracy: ±0.5 °C (±0.9 °F)

Plug-and-play thanks to preinstalled data sets

Teqwave H offers a wide variety of preinstalled product-specific data sets for concentration measurement, which allow the calibration usually repeated after batch change to be omitted. The users can adapt these data sets to their product as needed, e.g. by configuring product-specific recipes, to further increase the accuracy of concentration measurements. This means that users with a wide product range need just one measuring device for a great variety of applications. This is particularly helpful when one production line is being used to manufacture the entire product range in various batches.

Hygienic design for highest quality standards

Teqwave H is especially developed for hygienic applications in the food and beverage industry according to EHEDG. Its outstanding feature, in addition to the stainless-steel measuring tube, is its full-bore design. Thanks to the design without protruding parts, there are no places inside the measuring tube where material can accumulate. Another benefit is that there is no pressure loss, making it possible to save on energy costs.

Soft drinks and fruit juices

Measuring sugar concentration reliably – for assured product quality

Determining the sugar content (°Brix) and invert sugar content is a fundamental step in manufacturing soft drinks and fruit juices.
Teqwave H performs this task with a high degree of reliability in various sugar concentrations.
The device provides accurate measurement not only in syrup and fruit juice concentrates, classic juices and soft drinks, but even in diet beverages with low sugar concentrations (0 to 1.5 °Brix).

A device for every beverage

To make the device even more user-friendly, Teqwave H offers various preinstalled data sets for many types of beverages:

- Device software comes with integrated mapping of beverage-specific characteristics
- High field accuracy when calculating sugar concentration, even in demanding applications, thanks to the latest algorithms
- Time savings gained by omission of onsite calibration, manual conversion and time-consuming laboratory calibrations

Type of beverage	Analysis parameters	Meas. range [°Brix]
Fruit juice	Sugar concentration	0 to 25
	Invert sugar concentration	
Soft drinks	Sugar concentration	0 to 15
	Invert sugar concentration	

Furthermore, concentration data sets for diet beverages and syrup are also available. Also according to ICUMSA.

Highlights of Teqwave H

- **High flexibility** – can be used both for high and low sugar concentration
- **Optimal product safety** – outstanding hygienic design

Distilled beverages

Highly accurate alcohol measurement for consistent taste

One of the most challenging core processes in distilled beverage production is ensuring consistent alcohol content in the beverages and thus a consistent flavor.

A highly accurate alcohol measurement with Teqwave H directly in the process makes many work stages easier.

24-7 efficiency

- Easy commissioning and use due to preinstalled data sets for determining alcohol content
- Product changes can be identified immediately thanks to continuous measurement in the process
- Simultaneous measurement of alcohol and sugar content
- Flexible use of a single device thanks to multiparameter measurement – even when batches differ or are being changed
- Manual titration or analysis of samples in the laboratory can be reduced or even omitted entirely, thus saving valuable time

Type of beverage	Analysis parameters	Meas. range
Liquor, low alcoholic strength	Alcohol concentration	10 to 26 % vol
	Sugar concentration, or invert sugar concentration	7 to 40 °Brix
Liquor, high alcoholic strength	Alcohol concentration	35 to 95 % vol
Flavored distilled beverages	Alcohol concentration	30 to 50 % vol
	Sugar concentration, or invert sugar concentration	0 to 35 °Brix

Highlights of Teqwave H

- **Wide range of applications** – can be used in low to very high alcohol concentrations
- **High flexibility** – comprehensive monitoring of alcohol concentration, sugar concentration and cleaning processes

Cleaning agents and disinfectants

The correct dosage for maximum hygiene at all times

In beverage production, increasing importance is being placed on hygiene and the obligation to provide proof of compliance with cleaning and disinfection processes. Teqwave H makes it possible to monitor production, cleaning and disinfection processes.

The device also has a large number of concentration data sets for commonly available cleaning agents on the market.

Reliable and clean processes

- Monitoring and documentation of cleaning and disinfection of plants and for cleaning bottles, barrels, etc.
- Easy to change cleaning agent, and problem-free measurement of their concentration without recalibrating the device
- No need for tedious trial and error to determine the correct dosage of the new cleaning agents
- Checking rinse water for cleaning agent residue

Cleaning agents*	Manufacturer	Meas. range [%mas]
Hydrogen peroxide	General	20 to 40
Nitric acid	General	0 to 3
Caustic potash	General	0 to 4.5
CIP-Cleaner CL Extra	Wigol	0 to 4.5
Mip SCA	Ecolab	0 to 7.5

*Partial listing of measurable cleaning agents (details in the Applicator)

Highlights of Teqwave H

- **Optimal process reliability** – direct output of the cleaning agent concentration without conversions
- **High flexibility** – easy change of cleaning agents thanks to stored data sets
- **Significant savings** – no subsequent recalibration thanks to device verification with water during operation

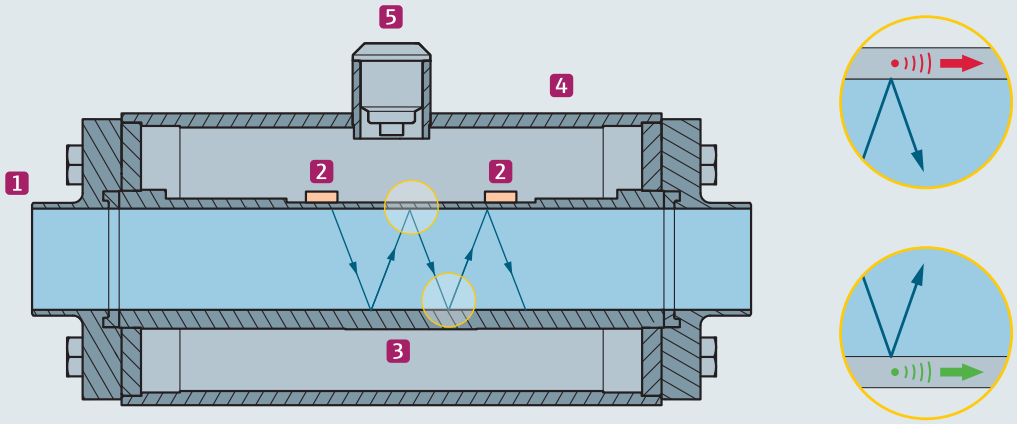
The measuring principle

Concentration measurement using ultrasound

The core of Teqwave is an acoustic waveguide that measures liquid concentrations extremely fast and accurately using ultrasound. The ultrasonic waves are created by a piezoelectric transducer and then propagate in the waveguide. A double arrangement of transmitter and receiver allows for a highly precise evaluation of the transmission times and amplitudes of the measured sound waves.

This enables Teqwave to simultaneously measure the speed of sound, density (using acoustic core impedance) and temperature within nanoseconds. The combination of all these characteristic values makes it possible to determine the composition and the substance concentrations within a mixture of liquids reliably and exactly.

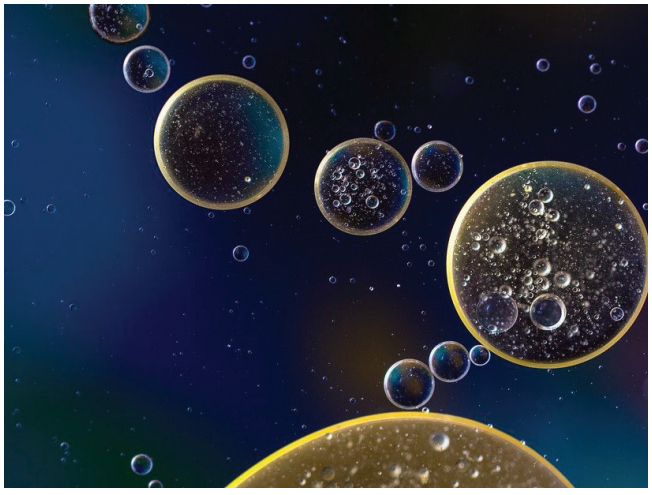
Propagation of sound waves in the measuring tube and in the liquid to be measured



1 Process connection 2 Transducer 3 Pipe wall 4 Housing 5 Cable connection

Stable processes despite contamination

Unique function for gas bubble and particle detection



In many processes, dispersion typically occurs in the form of gas bubbles or particles that can interfere with the measuring signals. To support stable process control, Teqwave enables users to detect such disturbance variables, evaluate their severity and compensate for them to achieve continuous accurate measurement. This provides users with even greater transparency in their processes.

- Continuous monitoring of disturbance variables directly in the process
- Immediate notice message if the disturbance variables affect measuring accuracy
- Reliable dispersion measurement; reacts exclusively to gas bubbles, particles, or two-phase mixtures (e.g. with emulsion formation)
- Targeted reaction to error signals in the production process, such as for contamination or leaks

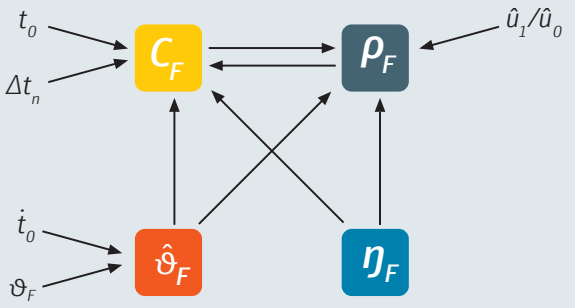
Smart concentration calculation

Identifying product changes immediately thanks to highest measuring accuracy

Clever concentration calculation due to state-of-the-art algorithms

Teqwave uses state-of-the-art algorithms. These are capable of calculating even complex concentration measurements mathematically with high accuracy. The measuring accuracy depends both on the sensor and on the mathematical models that can be used to register changes in the concentration.
With Teqwave, in addition to the measured characteristic values – i.e. speed of sound, acoustic density, dispersion and temperature –, numerous other fluid properties enter into the calculation to keep the mathematical approximation error as low as possible. In practice, this means reliable measured values and optimal control of your processes.

Measured variables calculated by Teqwave



C_F Speed of sound
t_0 Transit time
Δt_n Differential transit time

ρ_F Acoustic density
$\hat{u}_1/\hat{u}_0$ Amplitude ratio

$\hat{\vartheta}_F$ Temperature
$\dot{t}_0$ Measurement of temperature using speed of sound
ϑ_F Temperature (sensor)

η_F Viscosity

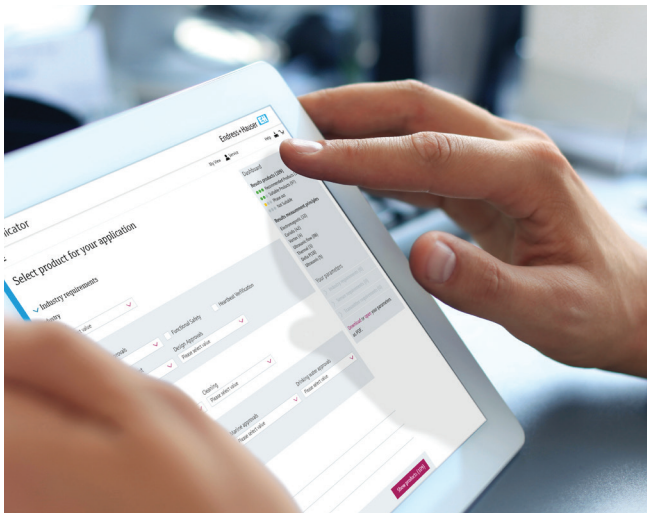
Optimization by integrating additional parameters

Used as a standalone device, Teqwave H is able to identify changes in liquids quickly and precisely thanks to its measurement method using speed of sound and parameters derived from it. By taking additional process parameters into account, the concentration measurement can be further optimized.

The unique algorithms permit highly flexible calculation of measured values when determining the concentration. For this reason, Teqwave can read in additional process parameters, such as reference density, acidity, pressure, mineralization (conductivity) or CO_2 content of the fluid as a measured value to compensate for their fluctuations in real time. Furthermore, the user can also enter fixed characteristic values for compensation. Endress+Hauser has a wide product range that can be used to measure these parameters, including Liquiphant and Promass Q for measuring a reference density.

Integrating further measured values is useful for liquids with extremely fluctuating acid content and/or pressure fluctuations of multiple bars.

The ability to integrate additional values into the calculation enables Teqwave to detect and determine product changes with even greater precision whenever necessary.



Applicator

All applications that Teqwave is able to solve can be found in the Endress+Hauser Applicator.

Applicator also shows how the concentration measurement can be improved even further by reading in further measured values.

Find out more at:
https://eh.digital/2KrFauw

Technical data

Transmitter	
Display	Touch screen or LED status indication
Operation	Via local display, RJ45 interface with operation software, or digital communication protocol (Modbus TCP)
Material (housing)	Aluminum anodized (Option: protective housing in stainless steel)
Power supply	DC 24 V (18 to 36 V)
Ambient temperature	0 to 60 °C (32 to 140 °F)
Degree of protection	Transmitter (aluminum housing): Standard: IP40 Option: IP67 (protective housing stainless steel only combined with touch screen)
Outputs/communication	4 to 20 mA, current output (0 to 10 V), switch output (relay), Modbus TCP

Sensor	
Nominal diameter	DN 25 (DIN); 1" (ANSI)
Process connections	Welding socket (ASME BPE, EN 10357), Clamp (DIN 32676, ISO 2852), Tri-Clamp, Flange (DIN 11864), SMS 1145
Max. flow rate	0 to 10 m/s (0 to 33 ft/s)
Process pressure	Max. 16 bar (232 psi)
Process temperature	0 to 120 °C (32 to 248 °F)
Degree of protection	IP67
Max. measured error	▪ Concentration: up to ±0.01% ▪ Speed of sound: ±2 m/s (±6.6 ft/s) ▪ Acoustic density: ±0.01 g/cm³ ▪ Temperature: ±0.5 °C (±0.9 °F)
Materials (wetted parts)	1.4404 (316L) Seals: EPDM, FKM, VMQ (silicone)
Pressure loss	No pressure loss thanks to full-bore design without protruding parts
Approvals	Regulation (EC) No 1935/2004, EHEDG

Subject to modification

The Teqwave measuring system fulfills the EMC requirements according to IEC/EN 61326. It also conforms to the requirements of the EU directives and thus carries the CE mark. In addition, the sensor is designed and manufactured in accordance with directive 2014/68/EU (PED) in line with current good engineering practice.

www.addresses.endress.com

Eco-friendly produced and printed
on paper from sustainable forestry.

IN01171D/06/EN/01.20

Endress+Hauser

People for Process Automation