Sensors, transmitters, compact devices and assemblies
Experts in Liquid Analysis
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Endress+Hauser – from a supplier of instruments to a complete provider

“What does Endress+Hauser have to offer?” There’s no simple answer to this question. After all, our expertise across products, solutions and services has continued to grow. That’s how we have evolved from a supplier of measuring technology to a complete provider, with the aim of accompanying our customers throughout the entire life cycle of their plants and enhancing their industrial productivity. This has prompted us to organize our business into four core processes: development, manufacturing and supply of quality products, solutions and trendsetting services. Wherever measuring technology is needed for level, pressure, flow, temperature, liquid analysis and recording, or wherever systems and components are in use, you’ll find that many businesses value the knowledge and expertise of Endress+Hauser. It is not least for this reason that we are a leading partner worldwide for measurement, control and automation solutions for production and logistics in the process industry.

We are a family-run business with a global headcount of over 9,500 and a total annual revenue of 1.5 billion euros in 2011. Thanks to our worldwide sales and service network, as well as a total of 19 production centers in Europe, Asia and the USA, we are always in close contact with our customers. This level of contact fosters one of Endress+Hauser’s primary goals - that of supporting the competitiveness of our customers on the long term with the highest levels of quality, safety and efficiency. By continuously optimizing our processes and using innovative, cutting-edge technology, we are able to push the application boundaries in instrumentation, control and automation engineering while finding safer and more efficient solutions to benefit you the user. In doing so, we ensure that our processes work in harmony with the environment to conserve energy and resources.

All this gives you the confidence that today, tomorrow and in the years ahead you can rely on us - the „People for Process Automation“. 

For more information visit: www.endress.com
Your partner for liquid analysis

Over 35 years’ experience in analytical measuring technology makes the globally present Endress+Hauser Group a strong partner. Endress+Hauser analytical measuring systems can be found anywhere customers require reliable measured values, high availability and long operating times.

**Technology know-how**

The quality of the electrodes and solutions is among the highest customers can actually use. Ongoing expansion of the research and development capacity in the past number of years has further improved the performance and high quality of the products, and the company has been able to offer new technologies to the user. Innovative products that give our customers an added advantage are central to the success of Endress+Hauser. In 2011, the company filed 225 new patents and invested a good 7% of its annual turnover in research and development. Endress+Hauser holds over 4,900 active patents and patent applications worldwide.

**Effective processes by standardization**

Our products are based on established standards and platforms and harness collective knowledge, resources synergy in all areas, be that in the enclosures, electronic modules, software, interfaces or displays. This helps us to boost the quality and speed of our processes and reduce complexity and costs for our customers. We also actively support standardization and open systems, thereby making life easier for our customers.
Added Values

W@M – hand in hand throughout the life cycle of your system

Fast, efficient, and at your side any time, anywhere – with Endress+Hauser as your partner, you benefit from an extensive service network and qualified customer service technicians around the world.

We offer the following services for your field devices:

- Commissioning and maintenance concepts
- Calibration and calibration strategies
- Factory repair and spare parts service
- Seminars and courses to train your in-house team of experts
- Helpdesks, which immediately answer any questions surrounding our instruments and systems

Enhancing competitiveness

Many companies outsource tasks that are not part of their core business activities. In terms of field devices and process automation, they are looking for partners who:

- Will take care of the maintenance, calibration, repair and replacement of instruments throughout the entire operating life of the system.
- Offer service agreements to minimize system downtime.
- Provide the right skills at a reasonable price.

Operation
- Up-to-date information 24 hours a day/365 days a year
- Efficient repair, maintenance and optimization of the installed base
- Risk minimization for your system

Commissioning
- Easy commissioning from the control room
- More process and staff safety

Installation
- Product documentation is available in several languages
- The latest software version is always available
- No long searches – the right documentation can always be retrieved in a matter of seconds

Planning
- Swift and reliable selection and planning of the right instrument for your application
- Project documentation and administration
- Start of life cycle monitoring in W@M – Life Cycle Management

Procurement
- Optimum support for your processes
- Your prices and delivery terms are always available on line
- High level of process quality
Experts in Liquid Analysis

Our automation solutions help you optimize your logistic, production and maintenance processes. They are reliable, long-lasting, scalable and cost-effective.

**Production**  Process control plays a key role in quality and efficient production. We offer control and visualization solutions on an instrument, system or area level. Our solutions are built on open standards, thereby ensuring cost-effective solution implementation.

**Asset Management**  Asset management is central to the smooth operation of your plant. We offer local and Web-based tools that support you in all phases of your system’s life cycle.

**Engineering**  Good planning and design ensures long-term investment protection. We are your experienced partner, guiding you along the way from conceptual design to commissioning.

**Digital communication**  To get the best from a fieldbus device, it must be perfectly integrated into your system. We offer a host of services that optimize the operation of your instruments.

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**Applicator**

The Applicator software is a convenient selection and design tool for your planning process. By entering application parameters, e.g. from the measuring point specification, the Applicator identifies a range of suitable products and solutions. With additional sizing functions and a project management module, it makes your day-to-day engineering tasks easier.

**Selection**  Applicator Selection is a product selection tool. You enter application parameters, such as ambient conditions, interface specifications or approvals, and Applicator suggests suitable products and components, and displays them with graphics and features on the screen. With the chosen application, Applicator Industry Applications uses graphics or tree structures to guide you to the right product selection.

**Administration**  With Applicator Project, it is possible to save data from the product selection and sizing process. Using the project module, you can manage projects which are hierarchically structured from the business level down to the tag number. The Spec Sheet Interface allows users to import electronic specification sheets and transfer the data to an Applicator module.

www.endress.com/applicator
Memosens technology

Liquid analysis makes great demands not only on the sensor element but also on the transmission of the measured value from the sensor to the transmitter. When measuring pH, low currents and very high sensor internal resistances additionally require a high-impedance connection to the transmitter. Moisture in the connection can change the measured value and may even result in measurement failure.

The Memosens technology revolutionizes the safety of data transfer by digitalizing the measured value in the sensor and transferring it to the transmitter without a contacting, and thus moisture-sensitive, connection.

The jump in technology to a new generation of sensors has additional advantages and eliminates general limitations of the technology in place to date.

Memosens makes the sensors digital with integrated data storage

Sensors with Memosens technology save the current calibration data and other information which can be used for look-ahead maintenance, such as hours of operation, maximum and minimum measured values and maximum and minimum temperature. When the sensor is mounted, the calibration data are automatically transferred to the transmitter and used to calculate the current value.

The result:
- Measuring point maintenance is no longer based on individual issues identified but rather all relevant sensor data are used.
- The current application of the sensors can be made to depend on the previous history.

An unestablished connection between the sensor and transmitter is actively displayed – the first really definite connection

Digital measured value transmission automatically results in an error message if the signal flow is interrupted. And this regardless of whether the sensor or measuring cable is no longer working properly.

The result:
- The availability of the measuring point is dramatically increased and ensured.
- Automatic sensor detection allows for unproblematic sensor replacement.

Benefits
- Non-contacting and digital signal transmission
- Lab calibration possible
- Cost saving – calculate yourself:
  www.apps.endress.com/memosens
Sensors with Memosens technology are the first sensors to allow calibration/adjustment away from the measuring point in the measuring lab.

The result:
- The availability of the measuring point is dramatically increased by the quick, easy replacement of calibrated sensors.
- Measuring point down-time is reduced to the time between detecting and replacing the sensor.
- The calibration/adjustment itself takes place under optimum external conditions in the measuring lab.

The first non-contact measured value transmission from the sensor to the transmitter
Sensors with integrated Memosens technology transmit the measured value contactlessly from the plug-in head of the sensor to the cable coupling.

The result:
- Always free from corrosion
- A coupling system that can even be connected under water
- Free from leaks and measured value distortion due to moisture

EMC safety through galvanic decoupling of medium from transmitter
Highly integrated electronics in the sensor convert the analog signal of the sensor to digital information which is then transferred via the cable coupling to the transmitter contactlessly and free from interference potential.

The result:
No more need to ask about “symetrically high-impedance” or “unsymmetrical” or an impedance converter for pH measurement.
Memosens tools

**Measure, calibrate and document with Memobase Plus**
Memobase Plus enables easy and accurate calibration of Memosens sensors and at the same time, documentation of the entire sensor life cycle. It can also be used as laboratory measuring device in combination with a standard PC. The customer benefits from:

- **Time saving** through plug & play with up to four sensors - simultaneously and independent from each other.
- **More flexibility**: Memosens sensors can be mixed and matched at will.
- **Increased product quality**: Comfortable calibration in the lab or on the workbench under optimum conditions increases calibration quality and thus measurement accuracy.
- **Improved quality management**: Documented, full traceability of sensors and reference solutions ensures compliance with audit guidelines - manual paperwork is a thing of the past. Today, working according to FDA 21CFR Part 11 is possible.
- **Better comparability**: Identical measuring technology in process and laboratory minimizes variability of measured values.

**Qualification and servicing of measuring points with Memosens technology**
Reliable measurements are a prerequisite for high process safety. With the Memocheck tools you can always be sure that measured value transmission is error-free, since these tools simulate measured values for qualification of digital data transmission.

- Comprehensive checks: from cable coupling to process control system
- Flexible application: for all transmitters with Memosens technology, available for hazardous or non-hazardous areas
- Always precise: Requalification with quality certificate possible

**Memocheck Sim** is the tool to check all parameters. It simulates freely configurable measured values, errors and calibration values and supports you during installation, commissioning or troubleshooting of various measuring points.

**Memocheck Plus** is the tool to qualify the complete analytical measuring chain. It consists of five plug-in heads that simulate one predefined sensor status each, and comprises a qualification certificate on option.

**Memocheck** supports service personnel during fast online-checks of a measuring point. The double plug-in head simulates two predefined sensor status.

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**Benefits**

- Reliable measurements guaranteed
- Full traceability
- Better comparability of process and laboratory
# Measuring parameter overview

<table>
<thead>
<tr>
<th>Description</th>
<th>Applications</th>
</tr>
</thead>
</table>
| **pH/ORP**  | - Process control in the chemical industry  
              - Municipal and industrial wastewater treatment plants  
              - Control in the food industry |
| **Conductivity** | - Monitoring of WFI water in the pharmaceutical industry  
                   - Monitoring of cleaning processes  
                   - Monitoring of boiler feedwater  
                   - Control of water treatment |
| **Turbidity** | - Drinking water measurement in the fine turbidity range  
                - Monitoring of residual water in the concrete industry  
                - Monitoring of the sewage treatment plant outlet |
| **Dissolved oxygen** | - Controlling in the aeration basin  
                        - Monitoring of boiler feedwater  
                        - Control of fermenters  
                        - Measurement in inertization and beverage bottling |
| **Disinfection** | - Flexible disinfection system in swimming pools  
                    - Process water and cooling circuits  
                    - Lasting disinfection in drinking water |

**Analysts**

- **Samplers**
  - For the automatic sampling, defined distribution and preservation of liquid samples  
    - CSF48 stationary samplers  
    - CSP44 portable samplers

- **Nutrients**
  - Online systems for measuring nutrient parameters  
    - Ammonium  
    - Nitrate and nitrite  
    - Phosphate and total phosphate

- **Carbons**

- **Industrial parameters**

- **Container**
<table>
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<th>Measuring principle</th>
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<tr>
<td>Potentiometric measuring principle</td>
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<tr>
<td>Based on a pH-sensitive glass membrane on which hydrogen ions accumulate, thereby causing electrical potential to build up.</td>
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<tr>
<td>Ion-selective measuring principle</td>
<td>Page 15</td>
</tr>
<tr>
<td>The ISFET is a simple transistor which is isolated from the gate by an isolator. Hydrogen ions can accumulate on this gate.</td>
<td></td>
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<tr>
<td>Conductive measuring principle</td>
<td>Page 21</td>
</tr>
<tr>
<td>An alternating voltage is applied to two electrodes located in the medium. The conductance value is calculated according to Ohm's law.</td>
<td></td>
</tr>
<tr>
<td>Inductive measuring principle</td>
<td>Page 22</td>
</tr>
<tr>
<td>Based on an alternating magnetic field that induces an electrical current in the medium which generates a magnetic field in the secondary coil.</td>
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</tr>
<tr>
<td>Optoelectronic measuring principle</td>
<td>Page 25</td>
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<tr>
<td>A beam of light is directed through the medium and scattered by elements with a greater optical density.</td>
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<tr>
<td>Ultrasonic measurement</td>
<td>Page 26</td>
</tr>
<tr>
<td>A piezoelectric crystal generates an ultrasonic signal that reaches solid particles and comes back to the receiver.</td>
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</tr>
<tr>
<td>Amperometric measuring principle</td>
<td>Page 29</td>
</tr>
<tr>
<td>Oxygen reaches the working electrode via a membrane and is converted to an electric current. A counter electrode keeps the system running.</td>
<td></td>
</tr>
<tr>
<td>Quenching</td>
<td>Page 30</td>
</tr>
<tr>
<td>Marker molecules are excited by a green light and respond with a red fluorescent light. Oxygen molecules adapt and reduce the fluorescent light.</td>
<td></td>
</tr>
<tr>
<td>Amperometric measuring principle</td>
<td>Page 33</td>
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<tr>
<td>Chlorine is reduced at the gold electrode. The electron acceptance is proportional to the concentration of chlorine.</td>
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<tr>
<td>Carbons</td>
<td>Page 41</td>
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<tr>
<td>Systems for determining organic load of water</td>
<td></td>
</tr>
<tr>
<td>SAC (spectral absorption coefficient)</td>
<td></td>
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<tr>
<td>BOD (biological oxygen demand)</td>
<td></td>
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<tr>
<td>COD (chemical oxygen demand)</td>
<td></td>
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<tr>
<td>TOC (total organic carbon)</td>
<td></td>
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<tr>
<td>Industrial parameters</td>
<td>Page 41</td>
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<tr>
<td>Different water quality requirements depending on the branch of industry</td>
<td></td>
</tr>
<tr>
<td>Softened for rinsing and washing water</td>
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<tr>
<td>Without calcium, Mg for industrial water</td>
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<tr>
<td>Without dyes, iron or manganese for paper</td>
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<tr>
<td>Containers</td>
<td>Page 41</td>
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<tr>
<td>Fully climate-controlled, individually sized containers with all necessary measuring devices</td>
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<tr>
<td>Support in project planning</td>
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<tr>
<td>Application advice</td>
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<tr>
<td>Commissioning</td>
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</tbody>
</table>
Experts in pH measuring technology

Experienced, skilled, reliable
Endress+Hauser pH measuring systems are in operation anywhere priority is given to reliable measured values, a high degree of availability and long operating times. With an annual production rate of over 300,000 process sensors, the company is an international market leader.

With its accredited calibration laboratory, Endress+Hauser sets another standard when it comes to ensuring correct measurement results. For our customers, this means they can rely completely on our pH quality buffers.

Research and development pay
Ranging from non-glass pH sensors to fully automated measuring points, R&D certainly pays off and means we can offer excellent price/performance ratios to our customers. Our sensors with their twin-chamber reference system or ion traps and gel compositions for tough, chemical applications offer maximum protection against contamination and a wider measuring range.

They boast a service life many times that of conventional pH/ORP sensors, which translates to a significant reduction in operating costs for pH measuring points. Sensors for fermenter applications with a pressurized reference system, or sensors for overhead installation are further examples of successful developments in sensor technology.

Benefits
- Outstanding price/performance ratio
- Long electrode operating times reduce operating costs
- Consistently high product quality
- Excellent vertical range of manufacture guarantees high product availability
The pH sensor portfolio covers the complete range of applications:

- Applications with fast-changing medium compositions or low conductivity in chemical or life sciences industries: Sensors with chemically highly resistant B-glass, liquid reference and ceramic diaphragm to guarantee fast responses also in these applications (CPS41D).
- Hygienic applications in the food and life sciences industries: Sensors with highly resistant B-glass and ion trap protecting from poisoning, autoclavable and suitable for CIP and SIP to 140 °C (CPS71D).
- Applications with high fiber or particle content in the pulp & paper or power & energy industries: Sensors with open aperture and durable B-glass that do not block easily (CPS91D).
- Applications that do not tolerate glass breakage, for example in the food industry or that imply high contents of organic solvents: Unbreakable ISFET sensors with a chip that is insensitive to organic solvents (CPS441D, 471D, 491D) or long-life, CIP- and SIP-suitable enamel sensors (CPS341D).
- Highly sensitive applications that require extremely accurate monitoring: Combined pH/ORP sensors with various reference systems (CPS16D, CPS76D, CPS96D).

All Endress+Hauser sensors are approved for hazardous areas according to ATEX/FM/CSA, NEPSI and TIIS.

**Benefits**

- Complete portfolio for all kinds of applications
- All relevant approvals
- Accredited calibration laboratory

**Memosens - a strong partner in pH measuring technology**

The advantages of the Memosens technology are particularly evident in pH measuring technology. Problems with moisture are a thing of the past. In addition to excellent transmission reliability, for the first time ever a system is available that can detect a cable break or other interruptions in the measuring signal. This, in turn, significantly reduces process downtime.

**Modularity as a prerequisite for flexible measuring point concepts**

The ambitious implementation of a modular concept across all modules of a pH measuring point - i.e. from the sensor and the assembly to the transmitter - makes it possible for Endress+Hauser to develop instruments catering for the simplest standard right up to high tech applications. If it’s a case of upgrading a manual measuring point to a fully automated pH solution, you will find the ideal solution for all your needs. There is a great range of assemblies and retractable assemblies to choose from with so many different process connections for every installation position and a wide range of materials ranging from PVC to stainless steel and Hastelloy. All sensor types fit into the same assemblies. As a result, it is easy to convert to another sensor type even in difficult applications.

**Safe transmission of measured values**

To ensure safe transmission of measured values from contacting plug-in systems, double-shielded measuring cables are required to prevent electromagnetic interference impulses. With Memosens technology, values and data are digitized directly in the sensor and transmitted with a standard bus cable of low impedance.
The method of pH measurement using glass electrodes is a potentiometric measurement method. Since glass is an electric insulator, transmitters for analog pH measurement must have an extremely high input impedance. In the case of Memosens electrodes, signals are transmitted digitally without interference. The measuring effect is based on a pH-sensitive glass membrane whose surface reacts to the acid content of the solution with a specific voltage. This voltage is then measured relative to a reference element made of silver/silver chloride (Ag/AgCl).

Nowadays, the most modern pH glasses display high selectivity (low cross-sensitivity to ions other than H+) over a wide temperature range. A pH sensor achieves the outstanding performance of the linear measurement of a material component over a concentration range of 14 (!) exponents. pH glass electrodes have become a standard worldwide.

Glass has the advantage of being very chemically inert and very stable when working with hot acids and alkalis. This means that pH glass electrodes can be used universally in a multitude of applications.

Combined pH/ORP sensors enable simultaneous measurement of pH value and ORP potential. Those values can be used to calculate the rH value which is a measure for the oxidizing or reducing effect of a medium.

**Benefits**
- Universal use (pH 0-14)
- High chemical resistance
- Lead-free shaft glass
- Temperatures up to 140 °C

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- Universal use (pH 0-14)
- High chemical resistance
- Lead-free shaft glass
- Temperatures up to 140 °C

**Potential buildup during pH measurement with glass electrodes**
The ORP value is an indicator of the oxidizing or reducing properties of a process medium and is measured in mV. In aqueous media, the measuring range is between -1 500 mV and +1 500 mV. A precious metal electrode (silver, gold or platinum) acts as the measuring electrode. As is the case with pH measurement, the electrochemical potential is measured against a silver/silver chloride reference (Ag/AgCl) and indicated in mV.

All ORP pairs in a process make up the oxidation reduction potential. As such, in contrast to pH measurement, the ORP value is a sum parameter that cannot be assigned quantitatively to the individual ORP pairs.

Even though only one sum parameter is measured, ORP measurement is an effective and low-cost method which can be used for chromate detoxification, cyanide detoxification or to measure the metering of oxidants for disinfection purposes.

The ORP value can also be indicated as a percentage. Here, two characteristic mV values are assigned to a 20 % and an 80 % value, making it possible to detect activities pertaining to chemical reactions and also of reaction endpoints.

Benefits
- Cost-effective measurement method
- Universal use
- Gold electrodes for oxidizing media
- Platinum electrodes for reducing media

Gold pin or platinum cap as measuring electrode

ORP electrodes using the potentiometric method
Non-glass pH electrodes using the ion-selective method

The pH value can also be measured with an ion-selective field effect transistor (ISFET). It is, in effect, a simple transistor with a source and drain that are separated from the base by a semiconductor. Hydrogen ions from the medium may accumulate here. The resulting positive charge on the outside is „mirrored” on the inside of the base where a negative charge occurs. This makes the semiconductor channel conductive. The lower the pH value of the liquid, the more H+ ions accumulate on the base and the more current can measurably flow between the source and drain.

The accumulation of protons is a purely electrostatic effect. As a result, the sensor material does not change and the need for recalibration is by no means as frequent as with glass electrodes. Since there is no gel-like layer, ISFET electrodes are also suitable for pH measurement in media with a low proportion of water.

Modern gate materials are highly selective and follow the Nernst law in close tolerance limits. The particularly robust nature of the sensors is a result of the ISFET chip being embedded in a stable and unbreakable PEEK body (polyetheretherketone; polymer thermoplastic with excellent mechanical and chemical resistance properties that are retained at high temperatures). ISFET-based pH electrodes are primarily used in applications where unbreakability is required, as is the case in the food and pharmaceutical industry, since fragile glass electrodes could cause problems if broken.

**Benefits**
- Non-glass, break-proof electrode
- For low water content
- Fast response
- For low temperatures

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1. **High-performance sensor Tophit CPS441D/441**
   - FDA-certified, EPDM chip seal, 3A;
   - perfluoroelastomer seal for process applications; ceramic diaphragm, liquid reference; overhead installation possible

2. **Hygienic sensor Tophit CPS471D/471**
   - Sterilizable, autoclavable, FDA-certified; rapid response in applications with low temperature and low water content; ceramic diaphragm, twin-chamber reference system, polycrylamide-free gel

3. **Sensor for suspensions Tophit CPS491D/491**
   - For process applications; for low temperatures and high particle content; open aperture diaphragm, extremely stable twin-chamber reference system with gel

4. **Sensor with pH-sensitive enamel Ceramax CPS341D**
   - Pharmaceutical industry, food & beverages, CIP/SIP capabilities; no aging, extremely corrosion resistant
Accredited pH laboratory

**Correct results you can rely on**

Our permanent calibration laboratory for pH quality buffers meets highest customer requirements. Endress+Hauser has successfully passed the tough accreditation process of the German Calibration Service (DKD) in accordance with the specifications of DIN EN ISO/IEC 17025:2005. This accreditation guarantees our customers even greater reliability when it comes to pH measurement.

The accuracy of a pH measuring point is rooted in achieving the right calibration with pH buffer solutions. Endress+Hauser produce pH buffer solutions for the most stringent requirements, which are specified with the actual value and an accuracy rating of ±0.02 pH. On May 5 2009, the accreditation body granted a calibration license with the DAR registration number DKD-K-52701 to the permanent laboratory in Waldheim. This accreditation confirms that the actual values and deviations of the buffer solutions produced are determined correctly.

Furthermore, the quality buffers meet the strict requirements of the pharmaceutical industry and contain only FDA-listed preservative agents. Users in the chemical, food and water/wastewater industries also benefit from the reliability of the calibration solutions.

**Benefits**

- In-house DKD calibration laboratory
- Maximum measured error ±0.02 pH
- Traceable calibration values
Fully automated measurement, cleaning, calibration and sterilization

Continuous maintenance of the sensor guarantees a high degree of accuracy and the highest degree of availability of a pH measuring point. However, this causes a hike in operating and maintenance costs, particularly in applications with strict requirements, such as in the chemical, food and pharmaceutical industry or with measuring points with aggressive process conditions. Endress+Hauser offers automatic pH measuring points to keep these costs to a minimum. Thanks to the various degrees of automation, a suitable automatic measuring system can be found for each process: from the simple application in the area of wastewater to processes in the chemical industry right up to very demanding applications with regard to accuracy and measuring safety and certainty in the pharmaceutical industry. With Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT), we make sure that the systems meet your requirements.

**Topcal**
The fully automated Topcal system for very demanding applications provides reliable measurement results particularly in aggressive and highly contaminated media as often occur in chemical processes. With Topcal, you can clean and calibrate fully automatically outside the process. Maintenance work is limited to changing the electrodes, buffers and cleaning solution. The Parawin software allows you to do a complete configuration of the system at the PC. To transfer the data to the Topcal, you can use the DAT module.

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 8 programs to choose from for cleaning, calibration and sterilization</td>
</tr>
<tr>
<td>• Optionally available with ATEX approval</td>
</tr>
<tr>
<td>• Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT)</td>
</tr>
<tr>
<td>• Wide range of retractable assemblies</td>
</tr>
</tbody>
</table>

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[Image: Fully automated measurement, cleaning, calibration and sterilization]
pH solutions from Endress+Hauser benefit all sectors of industry

1. Wastewater industry:
pH measurement is an important parameter in municipal and industrial wastewater treatment plants. Measuring points are typically located in the inlet, sludge activation basin, and the outlet.

Solution:
pH electrodes Orbipac CPF1D/81, also available with a flat membrane for fibrous processes, and Orbisint CPS11D/11 with contamination-resistant Teflon diaphragms. The Flexdip CYA112 assembly ensures optimum installation.

Benefits:
- No penetration of acids or alkalis into the wastewater treatment plant
- Optimum decomposition behavior of microorganisms
- Legal compliance with limit values

2. Chemical industry:
pH measurement must be permanently available. It acts as a measured variable for process control, as a control and actuating variable and for controlling the quality of batching and continuous processes.

Solution:
- Topcal with automatic cleaning and calibration for particularly demanding processes.
- Orbisint CPS11D/11 with ion trap for processes contaminating the reference system, CPS41D/41, CPS91D/91, CPS441D/441
- Pneumatic retractable assemblies e.g. Cleanfit CPA472D and CPA473

Benefits:
- Precise measurements, long pH electrode operating life
- Topcal enables on-the-fly cleaning and calibration
- Laboratory calibration concept with Memobase Plus

3. Food industry:
pH measurement controls and regulates production and meets strict hygiene, cleaning and sterilization requirements.

Solution:
- CPS471D/471 based on ISFET
- CPS711D/71 glass sensor
- Topcal with hygienic CPA475 retractable assembly

Benefits:
- Non-glass electrodes avoid glass splinters in the product
- ISFET meets 3A standard and EHEDG test criteria
- Topcal enables on-the-fly cleaning and calibration
Experts in conductivity measurement

Experienced, skilled, reliable
Over 35 years ago, Endress+Hauser began using the measurement of electrolytic conductivity not only to monitor water treatment, but also to control cleaning processes in the food industry (CIP = Cleaning in Place). We are a leader in this field today. Since then, the range of applications for conductivity measurement has been constantly expanded, with new products introduced for the chemical and pharmaceutical industries, making Endress+Hauser a supplier for all sectors of industry today.

High-tech production
Cutting-edge plastic injection molding and connection techniques are key processes in the production of sensors. Before being packed for distribution, each individual sensor is inspected and its cell constant measured. The electronic components are produced on state-of-the-art pick-and-place machines and assembly stands. Each assembly is tested individually. The production subsystems are centrally controlled and allow a high degree of flexibility teamed with excellent production safety. This ensures the consistent high quality of our products.

Developing solutions for customers
In addition to the clear segmentation of the product portfolio for individual industries, Endress+Hauser also provides support in planning and implementing customized solutions. Qualified experts are at hand to provide our customers with professional application advice. Furthermore, Endress+Hauser also offers services to ensure the long-term reliability and availability of the measuring systems.

Benefits
- EHEDG-certified sensors for ultrapure water
- Injection molding technology for particularly smooth surfaces
- Consistently high product quality
- Excellent vertical range of manufacture guarantees high product availability
Conductivity sensors using the conductive method

The electrical conductivity of liquids is determined using a measuring arrangement incorporating two electrodes located opposite from one another - as is the case in a capacitor.

The electrical resistance R, or its reciprocal value - the conductance value G - are measured following Ohm’s law. From this, the specific conductivity (Greek; kappa) is calculated using the cell constant k, which describes the geometry of the individual electrode arrangement:

\[ \kappa = k \cdot G = k / R \]

The cell constant k usually has the unit cm⁻¹ and is specified by the manufacturer for each sensor. With an ideal plate capacitor, the cell constant is:

\[ k = \text{electrode spacing} / \text{electrode surface} \]

The choice of sensor with a specific cell constant depends on the desired measuring range: the lower the conductivity, the smaller the cell constant selected. The size of the cell constant affects the optimum arrangement of the electrodes. For example, for ultrapure water the preference is for a concentric arrangement of cylindrical electrodes.

**Benefits**
- High sensitivity
- Can be used over a wide range
- Simple design

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1. **High-temperature sensor Condumax CLS12/13**
   Industrial and power plant applications (boiler feedwater); measurement of low conductivity values at high pressures (up to 40 bar) and high temperatures; Ex approval

2. **Pure and ultrapure water sensor Condumax CLS15D/CLS15**
   Monitoring of ion exchangers, reverse osmosis, distillation and chip cleaning; electropolished electrode surfaces; Ex approval

3. **Hygienic sensor Condumax CLS16D/16**
   Pharmaceutical industry, WFI (Water for Injection); monitoring of ion exchangers, reverse osmosis, distillation, FDA, EHEDG and 3A certificates; Ex approval

4. **Low-cost sensor Condumax CLS19**
   Pure and ultrapure water; compact design

5. **Drinking water and wastewater sensor Condumax CLS21D/21**
   Medium separation; potable water treatment, wastewater treatment; measuring range up to 20 mS/cm; Ex approval
Conductivity sensors using the inductive method

In the case of inductive conductivity measurement, a transmitter coil generates a magnetic alternating field that induces an electrical voltage in the medium. This sets the positively or negatively charged ions in the liquid in motion and an electrical alternating current flows through the liquid. This current produces a magnetic alternating field in the receiver coil. The induction current produced in the coil in this way is evaluated by the electronics system and used to calculate the conductivity.

A magnetic alternating field induces an electrical voltage in the medium

**Benefits**

- No restrictions in the case of high conductivity values due to polarization effects
- No galvanic contact with the medium
- Not sensitive to contamination

1 Robust sensor Indumax CL550D/CLS50
Concentration measurements for acids, bases and salts, product monitoring, wastewater treatment; excellent chemical resistance properties thanks to PEEK or PFA; up to 125 or 180°C; Ex approval

2 Hygienic sensor Indumax CL554D/CLS54
Pharmaceutical industry; certified, hygienic design: FDA, EHEDG, 3-A, USP <87> and <88> class VI; part of the Smartec CLD134 measuring system
Conductivity solutions from Endress+Hauser benefit all sectors of industry

1. Pharmaceutical industry:
In the pharmaceutical industry, the requirements for hygiene and cleanliness in all systems are particularly high. The most important raw material is ultrapure water. Conductivity is an important variable in monitoring pharmaceutical water.

Solution:
- Conductivity sensor Condumax CLS16D, sterilizable in accordance with EHEDG up to 150 °C
- Liquiline CM42, stainless steel version

Benefits:
- Meets all hygienic requirements
- Minimum product loss thanks to early warning that indicates that the system has to be regenerated

2. Food and beverage industry:
Conductivity measurement is required in particular for the cleaning procedure used in the systems (CIP = Cleaning in Place). It monitors the concentration of the solutions in the return line and measures the temperature with integrated temperature sensors.

Solution:
- Smartec CLD134 in stainless steel housing with hygienic sensor CLS54 as a compact or separate unit.

Benefits:
- Certified design meets hygienic requirements
- Process safety and cost savings thanks to optimized CIP cycles

3. Power plants:
Conductivity measurement makes it possible to monitor the quality of the boiler feedwater.

Solution:
- Conductivity panel with
  - 2 conductive conductivity sensors Condumax CLS15D
  - 1 multichannel transmitter Liquiline CM44

Benefits:
- High degree of safety thanks to necessary temperature compensation for ultrapure water
- pH calculation based on differential conductivity (in accordance with VGB-R 450L guidelines for operators of large power plants)
Experts in turbidity and sludge level measurement

Focus on water and wastewater
In the area of turbidity and sludge level measurement, the focus is on providing solutions for the water and wastewater industries. Regardless of whether you’re measuring turbidity downstream of a sand filter in waterworks in the limit range of optical metrology, or the solid contents of sewage sludge so concentrated it can barely be pumped – Endress+Hauser’s sensors cover a wide range of applications. With the 90-degree scattered light measurement system that complies with DIN/ISO specifications, we provide a universal sensor system that can be used for most common applications. Our product portfolio is complemented by sensors that are based on the 4-beam alternating light method and, depending on the particular measuring range, use scattered light, forward scattered light or backscattered light. These optical sensors are also used in sludge level measurement. Ultrasonics provides an alternative method of determining the level of sediment in a basin or container by measuring the “time-of-flight” of the acoustic signal.

The simple CUE21/CUE22 cell flow system is perfect for measuring drinking water. It enables the measurement of lowest turbidity levels in accordance with EN ISO 7027 and US EPA 180.1. The measuring device is calibrated with reusable, traceable turbidity standards.

Flexible installation
Turbidity sensors from Endress+Hauser are designed to be equally suitable for installation in pipes or containers and for immersion applications in basins or channels. A wide range of assemblies safely positions the sensor in the process, including the CYA112 immersion assembly, the CUA250 flow assembly, and the CUA451 ball valve retractable assembly.

Benefits
- Cost-saving solutions for control, monitoring and quality assurance
- Compact devices and sensors
- Factory calibration offering long-term stability
- Versatile applications
Turbidity sensors using established scattered light methods
90-degree, 135-degree and 4-beam alternating light method

Scattered light methods
The 90-degree scattered light method in accordance with ISO 7027 / EN 27027 measures turbidity values under standardized, comparable conditions mainly in the low turbidity range. The 135-degree scattered light method is optimized for the measurement of high turbidities. With both methods, the solid particles in the medium cause the incident light to scatter. The scattered light thus generated is measured using scattered light receivers. The turbidity of the medium is calculated from the amount of scattered light. A temperature signal is recorded and transmitted in addition to the turbidity signal. Digital filter functions with interference signal suppression and automatic sensor monitoring make measurements even more reliable.

4-beam alternating light method
The method is based on two lights and four detectors. Long-life light emitting diodes are employed as monochromatic light sources. These light emitting diodes are pulsed at a frequency of several kHz so as to eliminate any effects of extraneous light. With each light signal, two measuring signals are detected at the four detectors. Eight measuring signals in total are processed in the sensor and converted to solid concentrations. The 4-beam alternating light method allows users to compensate for any fouling and aging of optical components.

Benefits
- Standardized measurement method
- Reliable measurements
- Excellent long-term stability
- Portfolio suits all applications

Scattered light methods: The scattered light generated by solid particles is measured at 90° and 135°

The 4-beam alternating light method compensates fouling and aging

1 Online turbidimeter
   Turbimax CUE21
   Drinking water and treated process water; with infrared light measurement in accordance with EN ISO 7027 / DIN 27027; measuring range: 0-1000 NTU/FNU; ultrasonic cleaning, simple calibration.

2 Online turbidimeter
   Turbimax CUE22
   Drinking water and treated process water; with white light measurement in accordance with US EPA 180.1, measuring range: 0-1000 NTU/FNU, ultrasonic cleaning, simple calibration.

3 Potable water sensor Turbimax
   CUS31
   Fine turbidity range with a resolution of 0.001 FNU; scattered light measurement in accordance with EN ISO 7027 / DIN 7027; long-term stable and write-protected factory calibration.

4 Wastewater sensor Turbimax
   CUS51D
   All wastewater applications; 4-beam alternating light methods; excellent long-term stability; cleaning only - no maintenance; automatic air cleaning, if required.

3 Potable water sensor Turbimax CUS31
4 Wastewater sensor Turbimax CUS51D

⚠️ Benefits
- Standardized measurement method
- Reliable measurements
- Excellent long-term stability
- Portfolio suits all applications
Sludge level measurement using the optoelectronic or ultrasonic method

**Optoelectronic method**
The optoelectronic system also uses the 4-beam alternating light method, which compensates for aging and fouling of optical components.

**Ultrasonic method**
In the ultrasonic method, a piezoelectric crystal is encased in a flat cylindrical plastic body. When the crystal is excited with voltage it generates a sonar signal. In the process, ultrasonic waves are emitted to scan the separation zones. The measured variable is the time the emitted ultrasonic signal needs to reach the solid particles in the separation zone and return again to the receiver.

- **Benefits**
  - Easy configuration
  - Simple calibration
  - Quick and easy installation

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1. **Optoelectronic system CUC101**
   Water, wastewater, mining, chemical industry; in secondary clarification and flotation plants, direct continuous measurement performed by probe in delay mode

2. **Ultrasonic system CUS71D/CM44**
   Water, wastewater, mining, chemical industry; in preclarification, secondary clarification and thickeners; multichannel design for parallel measuring, no moving parts, quick and easy to install
1. Drinking water:
In drinking water, the turbidity value is an important measure of quality. Practically every country in the world has a legal limit value for drinking water turbidity. Turbidity measurement can be used to monitor and control all of the steps involved in drinking water treatment.

**Solution:**
Online turbidimeter Turbimax CUE21

**Benefits:**
- Continuous turbidity measurement
- Very fast response times thanks to the low flow cell volume
- No interfering air bubbles and little cleaning required thanks to automatic ultrasonic cleaning

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2. Wastewater:
In the area of wastewater treatment, turbidity and solids measurement is used in different applications. From the inlet and sludge treatment, to sludge dewatering, the aeration basin and the outlet, it helps monitor and control the processes.

**Solution:**
- Wastewater sensor Turbimax CUS51D
- Multichannel controller Liquiline CM44

**Benefits:**
- Excellent long-term stability
- Only cleaning required - no maintenance - thanks to extremely even surfaces
- Quick and easy to install as protecting tubes are not necessary

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3. Process engineering:
In process engineering, sedimentation is used to separate suspensions in many processes. Sludge level measurement helps prevent water from entering the thickener, for example.

**Solution:**
- Optoelectronic measuring system for sludge levels and sludge concentration CUC101

**Benefits:**
- Direct, continuous concentration measurement performed by immersion sensor in delay mode
- Simple sludge profile analysis thanks to simultaneous concentration measurement and level determination
Experts in dissolved oxygen measurement

A solution for every industry
The range of dissolved oxygen measurement from Endress+Hauser spans from controlling the aeration of activated sludge basins in wastewater treatment and residual oxygen measurement in power station boiler feedwater, to controlling fermentation in food processing and assessing color and taste in the production of red wine.

Established and new sensor technologies
Two types of technology are deployed in sensory measuring technology: the well-known and tried-and-tested amperometry - here oxygen concentrations are converted to electric currents - and the optical method of fluorescence quenching. Here, the fluorescing light of an oxygen-sensitive molecule is used to determine the concentration. In the transmitter, the signals are processed further for the desired reading.

Flexible measuring point concept
Channels, pipes, tanks – not a problem. With the flexible measuring point concept, every task is mastered. Oxygen sensors from Endress+Hauser are designed both for use in channels and basins as well as for installation in pipes and tanks. The wide range of assemblies on offer safely positions this sensor at the place of application - these assemblies include the CYA112 immersion assembly, the COA250 flow assembly or the COA451 retractable assembly. This strategy of flexibility is completed by the Liquiline platform whose transparent operating concept impresses every user.

Superb product quality
Sensor production is highly automated. Testing is also performed in a fully automated test stand. Here, the zero point, slope and constancy of the sensors are checked, and the results are documented. This guarantees the consistent high quality of our products.

Benefits
- A wide range for all applications
- Technologies for different measuring requirements
- Flexible installation
- High-quality products guaranteed
Oxygen sensors using the amperometric principle

When performing measurements according to the amperometric principle, the sensor comprises a working electrode and a counterelectrode in the simplest version of the two-electrode system. Both are surrounded by an electrolytic liquid in a common chamber. A membrane provides the link to the medium or process: oxygen permeates from the medium into the electrolyte through the membrane and is converted to a current at the working electrode. The counterelectrode keeps the system running by means of a chemical equivalence reaction. The resulting current response is in direct proportion to the oxygen partial pressure. The current is converted in the downstream transmitter and displayed to the user in the familiar units of oxygen saturation, concentration (in mg/l or ppm) and oxygen partial pressure.

In more complex three-electrode systems, an extra electrode is used (the reference electrode) to accurately control and regulate the internal condition of the sensor. This sensor demonstrates a high level of long-term stability.

Benefits
- Proven technology
- Highly accurate
- Excellent long-term stability
- With a three-electrode system

Oxygen permeates into the electrolyte through the membrane and is converted to a current.

1 Hygienic sensor
Oxymax COS22D
Digital sensor for food, pharmaceuticals, energy, chemicals, inertization; very wide measuring range: 0.001-10mg/l trace sensor; 0.01-60mg/l standard; 12mm stainless steel design, CIP and SIP compatible

2 Water sensor
Oxymax COS41
Analog sensor for water treatment; tried-and-tested 40mm design; two-electrode system; measuring range: 0.0-20mg/l

3 All-round sensor
Oxymax COS51D
Digital sensor for water and wastewater; very wide measuring range: 0.05-100mg/l; 40mm design, 3-electrode system; long-term stability
Oxygen measurement using the principle of fluorescence quenching

With the fluorescence quenching method, a layer that is permeable to oxygen also forms the junction with the process. This layer contains just as many oxygen molecules as the medium (the partial pressure of the oxygen is just as high in the medium as in the layer). It is separated from the optics at the sensor by means of a substrate that is permeable to light. The layer contains marker molecules that are optically excited with a green light and respond with a red fluorescence light.

Oxygen molecules adapt to these marker molecules and decrease (quench) the fluorescence light emitted. The reduction in fluorescence light is connected to the oxygen partial pressure, both in terms of the amplitude and the duration. The light signal is converted in the downstream transmitter and made available to the user in the familiar units of oxygen saturation, concentration (in mg/l or ppm) and oxygen partial pressure, just as with the amperometric sensor.

Benefits

- Purely optical system
- Short response times
- Low maintenance
- Excellent availability

1 Optical sensor
Oxymax COS61
Water, wastewater, fish farming; digital signal processing in the sensor; measuring range: 0.05-20 mg/l; long-term measurement stability; long maintenance intervals; intelligent self-monitoring

2 Memosens sensor
Oxymax COS61D
Water, wastewater, fish farming; digital signal processing in the sensor; measuring range: 0.05-20 mg/l; long-term measurement stability; long service intervals; intelligent self-monitoring
Oxygen solutions from Endress+Hauser benefit the water treatment sector, power stations, and the food and pharmaceutical industries.

1. Water and wastewater:
Oxygen measurement is an important parameter to control nitrogen degradation in the aeration basin. Insufficient oxygen means too little degradation, while too much oxygen means high energy costs.

Solution:
- Amperometric measurement with Oxymax COS51D; optical measurement with Oxymax COS61D
- Liquiline CM44

Benefits:
- A high level of availability while ensuring reliable measured values
- Lower energy costs thanks to optimized system operation
- Long maintenance intervals

2. Power stations and industrial process water:
Hot boiler feedwater in conjunction with dissolved residual oxygen will lead to corrosion on the system units. High pressure and high temperature demand a trace sensor suitable for daily use, with reliable sample conditioning, to reliably display the residual oxygen contents.

Solution:
- Trace oxygen measurement with Oxymax COS22D and sample conditioning
- Liquiline CM42

Benefits:
- Oxygen-free water that does not cause corrosion
- Optimum system operation
- Increased system safety

3. Food and pharmaceutical industry:
Oxygen is unwanted in the area of inertization applications and beverage bottling. This is where trace measurement is important. In fermentation plants, measurements help to check and regulate the fermentation process.

Solution:
- Autoclavable and sterilizable sensor Oxymax COS22D, stainless steel design
- Liquiline CM42, stainless steel version

Benefits:
- Optimum oxygen supply in fermenters
- High product quality thanks to the absence of oxygen
- Prevents bacterial fouling
Experts in Liquid Analysis

Disinfection solutions for all applications
Disinfection solutions play a particularly important role in applications such as drinking water, industrial water treatment and swimming pools. In these applications, the focus is on safe and cost-effective water treatment and disinfection as a means of protecting people and systems. An appropriate disinfectant is added to the process in a waterworks, swimming pool, cooling tower or bottle cleaning facility. Due to their powerful disinfectant properties, chlorine and chlorine dioxide have established themselves as the best solution currently available worldwide.

Complete measuring points
The sensory mechanism uses the amperometric principle, i.e. the chlorine concentrations are converted to electric currents in the sensor, which are then processed in the transmitter to provide the required reading. To do this, the medium (mostly water) is supplied to the sensor via a flow assembly. The discharged medium is either returned under pressure or directed into the drain. This is referred to as a lost sample, a method commonly used in the field of drinking water for the prevention of all possible contamination. The measuring points are often fully mounted on a panel; once the water supply and operating voltage have been connected, measurement can begin without delay.

Wide range of high-quality products
Endress+Hauser offers a wide range of sensors. Besides the sensor for free available chlorine, sensors for chlorine dioxide and total chlorine are also available. The highly automated production process guarantees consistently high quality.

Testing is also performed on a fully automated testbed, where the sensors are tested for zero point, slope and constancy and the results are documented.

**Benefits**
- Sensors for all forms of chlorine: free available chlorine, chlorine dioxide and total chlorine
- Easy installation thanks to complete measuring panels with flow assembly
- Simultaneous measurement of pH and ORP values possible
- High-quality products guaranteed
Sensors for disinfection using the amperometric principle

The sensors work in accordance with the amperometric principle in a membrane-covered cell. How they work can be described using the example of chlorine dioxide measurement:

The sensor features a metallic cathode, which is separated from the medium by a thin membrane. Chlorine dioxide coming from the medium diffuses through this membrane and is reduced at the gold cathode. The circuit is completed by means of the silver anode and the electrolyte. The electron reduction at the cathode is proportional to the concentration of chlorine dioxide in the medium. The transmitter converts this current to the appropriate display value.

With chlorine dioxide, this process works in a wide pH and temperature range. The situation with free available chlorine is somewhat different. Here, hypochlorous acid diffuses through the membrane and produces a reaction. The presence of hypochlorous acid in the medium depends on the pH value. This dependency is compensated by means of pH measurement in the flow assembly and balancing in the transmitter. Total chlorine measurement is more complicated. In addition to hypochlorous acid, chloramines also play a part in a complex system of reactions.

**Benefits**
- Membrane-covered
- No zero point calibration
- Virtually independent of flow
- Low maintenance

1 Sensors for free available chlorine CCS140/CCS141
   CCS140: Recreational water and industrial water; measuring range: 0.05 to 20 mg Cl₂/l; CCS141: drinking water; measuring range: 0.01 to 5 mg Cl₂/l; independent of flow over 30 l/h

2 Sensors for chlorine dioxide CCS240/CCS241
   CCS240: Recreational water and industrial water; measuring range: 0.05 to 20 mg ClO₂/l; CCS241: drinking water; measuring range: 0.01 to 5 mg ClO₂/l; independent of flow over 30 l/h

3 Sensor for total chlorine CCS120
   Drinking water, recreational water, industrial water and wastewater; measuring range: 0.1 to 10 mg/l including chloramines; wide pH range 5.5 to 9.5; for flow and immersion operation

4 Digital Memosens sensor for free available chlorine CCS142D
   Drinking water, process water, industrial water and wastewater; measuring range: 0.01 to 20 mg Cl₂/l depending on version; digital signal processing; storage of sensor and process data

Chlorine dioxide diffuses through the membrane and is reduced at the gold cathode.
Measuring panels for disinfection - practical complete solutions

A complete measuring point including all medium-conducting components and connections, complete and ready to operate on a single panel. Set it up and off you go! CCE stations are fully mounted and tested. All the customer has to do is connect them to the water supply. The water circuit already includes a filter, check valve and sampling tap. This facilitates easy sampling for DPD comparison measurements used for calibration.

**Benefits**

- System is ready to connect
- Easy to access from the front
- Easy to calibrate
- Easy to maintain

**Universal measuring panel CCE10**

Drinking water, industrial water, swimming pools; chlorine dosage for water treatment; based on Liquisys CCM253; for free available chlorine, chlorine dioxide or total chlorine as well as pH and temperature.
1. Swimming pools

The best known application for disinfection solutions is the swimming pool. Not only must the disinfection process in a pool be just right, so too must the pH value. And allowances must be made for widely fluctuating visitor numbers and therefore dynamic changes in contamination levels.

Solution:
- DI sensor CCS140 with pH/ORP sensors CPS31/32
- Flowfit CCA250
- Liquisys CCM253

Benefits:
- Accurate measured values for controlling chlorine dosage
- Reliable disinfection
- Prevention of excessive chlorine concentrations and therefore corrosion and taste impairment
- Compliance with pH limits

2. Process water and cooling circuits

Chlorine measurement is used in the process to control the disinfection of any water used for industrial purposes. In cooling circuits, it is used in the decomposition and long-term prevention of biofilms within cooling systems and related equipment.

Solution:
- DI sensors CCS140 or CCS240 with pH/ORP sensors CPS31/32
- Flow assembly CCA250
- Transmitter Liquisys CCM253

Benefits:
- Prevention of film formation in cooling systems
- Cost-effective reuse of treated water

3. Drinking water

In the case of drinking water, effective and long-lasting disinfection of the water is required. The depot effect of chlorine, in addition to its instant germ-killing properties, plays an important role here. Unconverted chlorine remains active and guarantees that water remains germ-free in the long-run.

Solution:
- Trace sensor CCS142D with pH sensor
- Flow assembly CCA250
- Transmitter Liquiline CM44, or
- Trace sensors CCS141/CCS142 with Liquisys CCM253

Benefits:
- Reliable control of chlorine dosage
- Monitoring of active chlorine in the distribution network
- Germ-free water from the distribution network right to the end customer’s water tap
Assemblies open a window onto the process

No assembly, no measurement!
For almost every measurement, whether in the food or chemical industries or in environmental applications, an assembly is required which must be optimally designed to suit the sensor and the application. In the chemical industry in particular, monitoring, accuracy and plausibility (for example of the pH value), guarantee optimum productivity and the highest quality. The accuracy of the measured value depends on how the sensor is looked after and also depends on cleaning and calibration. Endress+Hauser offers a range of retractable, flow and installation assemblies, which are used to move the sensor in the process boiler, pipe or fermenter to the desired position in the medium and to remove it while the process is running. After all, no assembly means no measurement!

Our expertise, which is based on our continuously expanding experience and progress, guarantees you an optimized and reliable measuring unit from one source! What is unique is the range of choice available with a large variety of process connections to ensure that the right assembly solution is available for all possible installation positions and applications.

For example, our heavy-duty assemblies CPA472D also operate reliably at very high temperatures and pressures up to 10 bar. The modular design makes it possible to switch between corrosion-proof stainless steels and special materials such as Alloy, PEEK or PVDF. Many modifications are available on request.

Benefits

- Process-compliant assembly family
- High degree of modularity for individual adaption
- Flexible range of materials, from plastic to Alloy for any kind of application
- Internal research and development and high-tech manufacturing
Assemblies | Advantages and benefits
--- | ---
Retractable assemblies | • Safety for people and processes thanks to patented sealing concept or the use of a ball valve as a process seal
• Easy to operate with safety functions
• High level of sensor availability for 120/225 mm sensors
• Sensors can be replaced and checked while process is running
• Integrated rinse chamber means that work, including calibration, can be carried out in a contamination-free environment
Cleanfit | Only a retractable assembly allows you to achieve continuous availability of the sensor. When the tank is full and in the event of process pressure, you can remove the sensor and replace it, or clean it and calibrate it.

Installation assemblies | • Easy fixed mounting. EHEDG-certified design
• Integrated basket protector protects against electrode breakage
• Versatile PVDF or stainless steel 1.4435 for the food and pharmaceutical industries
• Low-cost pipe and boiler mounting
• Cost-effective solution
Unifit CPA442/CPA640 | Simple and cost-effective assemblies may be used if the sensor does not require replacement or cleaning online/under pressure and the application permits it!

Immersion assemblies | • Installation in open basins, tall containers and rubberized boilers
• Sensor holder with bayonet lock facilitates dismantling and prevents twisting of the cable
• Sensor removal following removal of complete assembly
• Range of materials facilitates wide range of uses
• Installation of up to three electrodes possible
Dipfit | These assemblies are used mainly in wastewater treatment plants or in the chemical industry. They are also a good choice for top-mounting in tanks or containers.

Flow assemblies | • Cost effective
• High level of sensor availability due to bypass installation
• For 12- and 14-mm sensors
• Resistant plastic housing
• Spray cleaning possible
• Integrated flow display and adjustment for CCA250
Flowfit | Flow assemblies are often found in waterworks, in the food and chemical industries and on analysis panels in power stations.

Holder and assembly for immersion operation | • For open basins, channels and tanks
• Easy, cost-effective and flexible
• Existing structures can be used
• Easy to install and service, with rapid fastening for quick installation and sensor replacement
• Assembly version in stainless steel V4A or PVC with a wide range of connection threads for all applications
• Floating versions for varying levels
Flexdip CYH112/CYA112 | Flexdip holder and assemblies for immersion applications allow for modular and flexible insertion of sensors in the medium.
Transmitters make the measuring point complete!

They process the measured value of the sensor and display it or make it available for further processing. They also make it possible to adapt the measuring point exactly to the operating and process conditions and to take over control tasks.

The transmitter concept of Endress+Hauser comprises the Liquisys and Mycom transmitters and the Liquiline platform. The latter ranges from the cost-efficient one-parameter device Liquiline CM14 over the high-performance Liquiline CM42 with two-wire technology to the multiparameter and multichannel controller Liquiline CM44. Up to 8 sensors with Memosens protocol can be connected to the controller simultaneously in any desired parameter combination.

The outstanding feature of the devices is their easy and uniform operator guidance.

The Liquiline product line, in particular, offers one-of-a-kind convenience with the Navigator. In addition, its modular design makes it very simple to expand the functionality and also saves you storage costs. Software updates and transferring the configuration to other transmitters are also simple. A DAT module is available for the Mycom S and Liquiline CM42 for this purpose. The Liquiline CM44 is even more up-to-date, using an SD card.

Liquiline CM44 is the heart of the Endress+Hauser platform for liquid analysis. Its hardware and software are also integrated into the samplers Liquistation CSF48 and Liquiport 2010 CSP44. Our objective is to make your everyday work easier – with maximum uniformity to provide you with the utmost reliability at low costs.

Benefits

- Transmitters for every application
- Reliable thanks to easy operation
- Modular design saves time and costs
- Flexible due to standardization
<table>
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<tr>
<th>Transmitters</th>
<th>Advantages and benefits</th>
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| **Liquiline CM44** | - Easy operation with uniform and easy-to-understand menu guidance for all parameters and each sensor combination  
                    - Simple commissioning and integration into process control systems due to HART, PROFIBUS DP and Modbus communication  
                    - Comfortable configuration and check of the device with any browser  
                    - Saves time thanks to preconfigured software and easy sensor replacement with precalibrated Memosens sensors  
                    - Modular and standardized components reduce maintenance and storage costs                                                                 |
| **Liquiline CM42** | - Version for pH/ORP, conductivity, dissolved oxygen – easy switch of parameters via sensor modules  
                    - Intuitive operation with plain-text display and online help  
                    - Easy integration into process control systems due to HART, PROFIBUS PA and FOUNDATION Fieldbus  
                    - Predictive maintenance possible with Memosens sensors  
                    - Available as TÜV-approved SIL2 version                                                                                                                   |
| **Liquiline CM14** | - Low-priced, reliable one-channel controller for one of the parameters pH/ORP, oxygen or conductivity  
                    - Very easy operation and handling  
                    - Time saving and comfortable: Plug&play due to pre-calibrated sensors with Memosens protocol  
                    - Safe and resistant to interferences due to digital signal transmission  
                    - Especially attractive for skid builders: Compact housing fits into standard panels                                                                 |
| **Liquisys**      | - Version for pH/ORP, conductivity, dissolved oxygen, turbidity and chlorine  
                    - Easy-to-understand menu structure makes configuration easier  
                    - Large two-line display enables simultaneous display of measured value and temperature  
                    - 4 to 20 mA, HART or PROFIBUS PA/DP outputs for connection to the process control system available  
                    - Optional relay functions, e.g. for neutralization processes  
                    - Extended diagnostic functions                                                                                                                                  |
| **Mycom CPM153**  | - Version for pH/ORP and conductivity  
                    - For one or two sensor circuits  
                    - Logbooks for operation, calibration and error messages  
                    - Extended relay functions for control and cleaning  
                    - Extended diagnostic functions  
                    - Various outputs available: 4 to 20 mA, HART, PROFIBUS PA/DP                                                                                             |

**Transmitters**

- Liquiline CM44
  - The multiparameter and multichannel controller is suitable for all Memosens sensors and digital sensors with Memosens protocol.

- Liquiline CM42
  - The high-performance 2-wire transmitter can be used in hazardous and non-hazardous locations.

- Liquiline CM14
  - The compact 4-wire transmitter is suitable for sensors with Memosens protocol.

- Liquisys
  - The 4-wire transmitter is available with a field or panel-mounted housing.

- Mycom CPM153
  - The 4-wire transmitter is suitable for both hazardous and non-hazardous locations and comes with a variety of functions.
Experts in analyzers, sample conditioning, containers, solutions

Today, most process conditions demand far more than just an accurate analyzer. Many applications require sample conditioning for reliable and accurate results. Other cases call for an interface for integration into cost-saving automated systems. In addition, special housings are needed to protect your devices that are installed outdoors or in aggressive environments. Frequently, correct sampling and sample conditioning are critical for successful analytics. Endress+Hauser sample conditioning units are optimally matched to your process conditions. They are reliable in everyday operation and easy to install and maintain. Intelligent solutions such as the in-situ sampling systems relieve the customer of the additional installation of a sample pump.

Analytics do not have to be complicated!
Customers in all sectors benefit from our many years of experience in wastewater treatment. Whether you need an analyzer for certain parameters or for complex mixtures - Endress+Hauser helps you select the suitable device and any peripherals you may need. Our analyzers need few or no consumables and are so simple that they can be easily operated by operating personnel. The modular design of all analyzers also simplifies inventory management and provides a previously unknown level of flexibility that makes your investment future-proof. In many cases, adaptations are possible even for already installed devices. The analyzer product line has been consistently further developed to make us a complete supplier in environmental technology.

Benefits
- Wide variety of measuring principles
- In-situ and cabinet devices
- For all industries
- Robust
### Parameter

#### Samplers
The new samplers from Endress+Hauser can be easily equipped with sensors for online measurement of various parameters and integrated into the control system.

**Advantages and benefits**
- Liquistation CSF48
  - Stationary sampler for automatic sampling, defined distribution and preservation of liquid samples taken using the vacuum or peristaltic system or the CSA420 assembly.
- Liquistation 2010 CSP44
  - Portable sampler for automatic sampling and defined distribution of liquid samples using a peristaltic pump, easy and user-friendly, compact design with integrated grips.

#### Nutrients
In addition to decomposing carbon, today's wastewater treatment plants also reduce nitrogen and phosphate. For this purpose, online measurement of nutrient parameters plays an important role.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrate</strong></td>
<td>Viomax CAS51D*</td>
</tr>
<tr>
<td></td>
<td>iSEmax CAS40D*</td>
</tr>
<tr>
<td></td>
<td>STIP-scan CAS74/CAM74</td>
</tr>
<tr>
<td><strong>Nitrite</strong></td>
<td>Stamolys CA71NO</td>
</tr>
</tbody>
</table>

* in combination with multichannel controller Liquiline

#### Carbons
To evaluate the organic load of water and wastewater, the primary parameters measured are TOC, SAC, BOD and COD. Endress+Hauser offers various measurement methods for these parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOC</strong></td>
<td>TOCII CA72TOC</td>
</tr>
<tr>
<td></td>
<td>STIP-scan CAS74/CAM74</td>
</tr>
<tr>
<td><strong>SAC</strong></td>
<td>Viomax CAS51D (SAK)*</td>
</tr>
<tr>
<td></td>
<td>STIP-scan CAS74/CAM74</td>
</tr>
</tbody>
</table>

* in combination with multichannel controller Liquiline

#### Industrial parameters
The requirements differ depending on the branch of industry. However, most process water is softened and virtually all manufacturing processes require corrosion-free water that is likewise free of turbidity, color, iron and manganese.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stamolys CA71AL</strong></td>
<td>Aluminum</td>
</tr>
<tr>
<td><strong>Stamolys CA71CL</strong></td>
<td>Chlorine</td>
</tr>
<tr>
<td><strong>Stamolys CA71CR</strong></td>
<td>Chromate</td>
</tr>
<tr>
<td><strong>Stamolys CA71FE</strong></td>
<td>Iron</td>
</tr>
<tr>
<td><strong>Stamolys CA71MN</strong></td>
<td>Manganese</td>
</tr>
<tr>
<td><strong>Stamolys CA71HA</strong></td>
<td>Hardness</td>
</tr>
<tr>
<td><strong>Stamolys CA71HY</strong></td>
<td>Hydrazine</td>
</tr>
<tr>
<td><strong>Stamolys CA71SI</strong></td>
<td>Silicic acid</td>
</tr>
<tr>
<td><strong>Stamolys CA71CU</strong></td>
<td>Copper</td>
</tr>
</tbody>
</table>

#### Container measuring stations
In industrial parks, the various types of wastewater are monitored before being fed to a wastewater treatment plant in order to prevent incidents. Endress+Hauser offers complete solutions for this environmental monitoring.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samplers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measuring containers</strong></td>
<td>Fully climate-controlled, individually sized containers with necessary accessories for a laboratory, online analytical measuring devices, samplers and flowmeters</td>
</tr>
<tr>
<td></td>
<td>Application advice and basic engineering</td>
</tr>
<tr>
<td></td>
<td>Construction and software integration</td>
</tr>
<tr>
<td></td>
<td>Commissioning and maintenance</td>
</tr>
</tbody>
</table>
Experts in services

As a manufacturer of measuring equipment for plant engineering, Endress+Hauser has been active in the market for over sixty years now. We work together constantly with our customers, providing support in every situation. Whether you need troubleshooting, fast delivery of spare parts, calibration or on-target advice - our entire business structure is oriented towards helping you achieve your business goals at all times. Your job is to manufacture optimum product quality safely, reliably and profitably - our job is to support you with the right balance of services so that you can reach this goal with maximum plant safety and optimum effort.

Benefits

- Services for the entire life cycle
- Worldwide service network
- Cooperation as partners

Our contribution to your return on investment

Our entire organization is oriented towards helping you in your tasks in the procurement, installation, commissioning and operation phases. This starts with continuously optimizing our measuring equipment for plant engineering to your branch of industry, in conjunction with developing special solutions for your specific needs, and continues with our range of innovative tools and services. Whether your facility just recently came online or has been running for twenty years - our customer service consultants can help you optimize maintenance schedules, improve your return on capital and avoid costs incurred by unnecessary downtime.

Comprehensive service offering

Endress+Hauser offers a wide range of services focused on industrial measurement and process automation. These range from application advice to commissioning and calibration and even complete maintenance packages. With our service support, we offer you everything you need over the life cycle of your facility.
Calibration
Accurate liquid analysis is of great importance in many manufacturing processes. We calibrate your conductivity measuring point onsite according to USP recommendations and ASTM standards. We offer the same service for pH measuring points calibrated with our DKD (German Calibration Service) accredited buffer solutions. If a turbidity, DI, oxygen or nitrate sensor should ever leave its ideal line, we restore its accuracy with a factory calibration.

Application advice and commissioning
The demands on your employees are increasing continuously. They have to maintain the existing facilities while simultaneously planning and commissioning new ones with state-of-the-art technology. Endress+Hauser can help you with these tasks. Our contact persons provide comprehensive application advice, draft concepts and work with you to develop the ideal solution. If you like, we can study your wastewater as a snapshot. We analyze your sample using recognized reference methods and according to the measuring point requirements and recommend how to proceed. We commission the measuring points along with you, provide support for the integration into the facility-wide process control and asset management system and run a series of tests to ensure that your measuring point works correctly.

Maintenance concepts
Our maintenance concepts provide the right safeguard for quality and safety-related measuring points. We work closely together with our customers and, in consultation with you, determine the amount of maintenance required for your devices. From Service Level 1, in which we carry out all required maintenance tasks and generate documented reports about compliance with quality procedures, to Service Level 4, with which you can select the service components you need individually, we offer professional support, both for Endress+Hauser devices and those from other manufacturers.

Benefits
- Calibration to international standards
- Expert application advice
- Flexible maintenance concepts for every need