JUMO

# SENSORS + AUTOMATION

Issue 1/2023

## JUMO on the Path to the Future

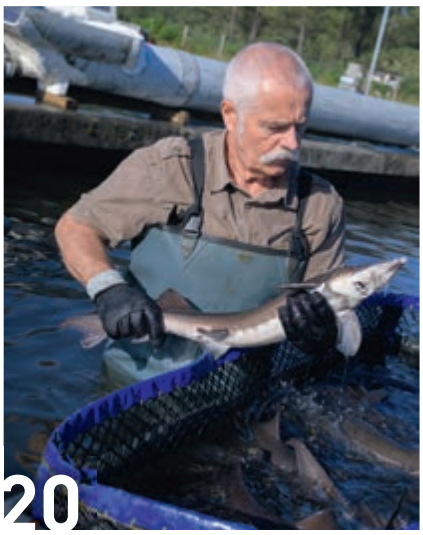
Industries, systems, solutions

75 1948 2023

People and technology on the move

TABLE OF CONTENTS




## TECHNOLOGY + PRODUCTS



## APPLICATIONS + KNOWLEDGE



## COMPANY + SERVICES




*To improve readability the masculine form is used for personal designations and personal nouns. These terms shall generally apply to all genders in order to be non-discriminatory. This abbreviated language is only used for editorial purposes and is not intended to suggest value judgment.*

# Dear Reader,

**2023** is a very special year for JUMO as it marks our 75th anniversary. This is a remarkable achievement, particularly when you consider that only 4 % of companies in Germany make it to 70 years old. The secret to JUMO's success is neatly summed up by the expression "roots to grow and wings to fly".

As a down-to-earth, regionally-rooted medium-sized company, the company owners – the Juchheim family – has attached great importance to sustainable corporate growth since the company was founded. We have always kept the future in mind and will continue to do so going forward. We take a systematic approach to opening up new markets and are developing advanced technologies "from the sensor to the cloud" for a wide range of industries across the globe, with a consistent focus on meeting our customers' particular needs.

In this anniversary year, we are proud to look back on where it all started in 1948 – a company with just 6 skilled workers – and see how we have grown into a global corporate group with around 2,500 employees. However, JUMO has also never rested on its laurels. Over the past few years, we have put in place the technology and organizational structures to ensure that JUMO can take its place among the 100-year-old companies in Germany – a select circle of just 2 % of all companies.

This issue of our customer magazine showcases the products, solutions, and systems that will help us to shape the future. We've also allowed ourselves our own birthday gift: a miniature brewing plant packed full of state-of-the-art JUMO technology. Keep reading for all the details.

We hope you enjoy reading this issue!

***Dimitrios Charisiadis***
*Chief Executive Officer*

***Dr. Steffen Hoßfeld***
*Chief Operating Officer*


The only co
in life is ch


# JUMO on the path to the future

## Industries, systems, solutions

75 years of JUMO means 75 years packed full of ideas that we have transformed into successful products. While we may have had the odd setback over the years, generally speaking the company has only ever moved in one direction – forward.

The secret to JUMO's success is best described by the quote from Greek philosopher Heraclitus shown on the left. Transformation, change, and a willingness to try out new things have always been intrinsic parts of JUMO's DNA, long before the world of management started using terms like "Change Management" or "transformation processes". →

## Change as a driving force for development

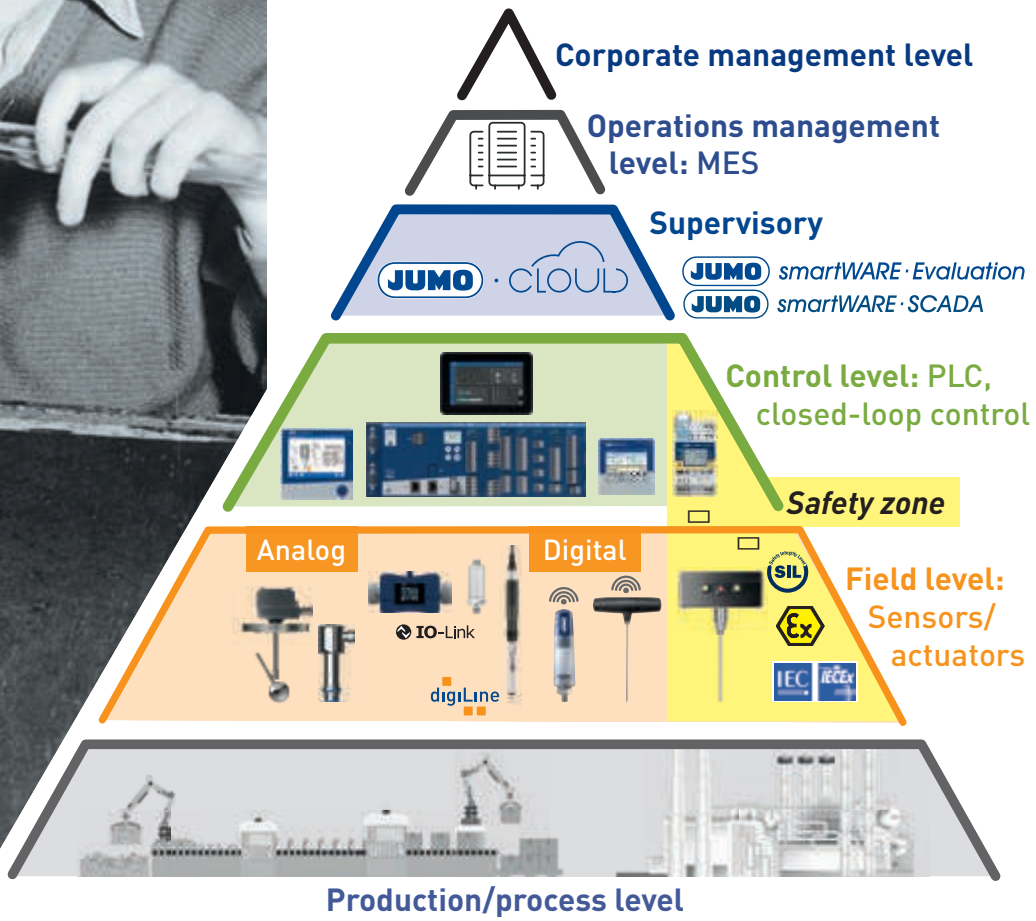
For example, in the 1960s glass thermometers for industrial applications were increasingly being replaced with dial thermometers. This meant that an important pillar of JUMO's business was at risk of being lost. It also meant that many glassblowers in the company were at risk of losing their jobs. Company founder Moritz Kurt Juchheim solved the problem by expanding JUMO's portfolio to include analytical measurement technology. In doing so he not only tapped into brand-new sales markets, he also secured the jobs of the glassblowers, who switched to producing casings for liquid sensors.

Today, the world seems to be turning ever faster and companies constantly need to reinvent themselves to remain competitive. However, there is also increasing pressure for companies to set themselves apart, as more and more businesses are producing the same products to a similar quality level.

So, how is JUMO responding to this need to transform ourselves? We are tackling the challenge head on, with the same passion for change that has run in our veins for the past 75 years. The key difference is that, nowadays, it's no longer about conquering markets with new measurands. Instead, what matters is ensuring customers remain loyal to JUMO for many years by offering them a blend of high-quality products, extraordinary services, and creative solutions.

## More than just sensors

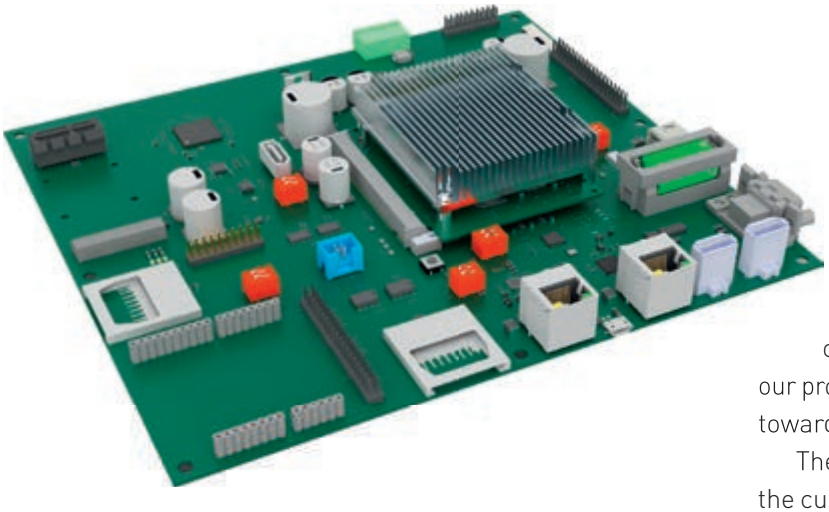
Our new slogan "from the sensor to the cloud" currently sets the scene for this strategy. It highlights our aim to provide holistic support to our customers, from production all the way through to the process control level. The introduction of a brand-new automation system as well



> *With its 3 pillars of products, systems, and solutions, JUMO is aiming to win new customers and markets in the coming years.*

as a cloud and SCADA solution "made by JUMO" were key milestones on this journey.

We are also placing a continued, systematic focus on our platform-based strategy. In 2019 we presented JUMO JUPITER, a modular, flexible, and above all sustainable hardware platform combined with a modern software architecture. In 2023 the PLUTO platform will be added, which will enable us to develop other JUMO products on a modular basis in the future. It will save both time and money as well as provide more flexibility.



In terms of technology there is, of course, an increasing focus on the trends of digital transformation and the smart networking capabilities that this requires. Products with IO-Link have been standard at JUMO for years. Single Pair Ethernet has recently been added. It enables sensors to communicate directly with a cloud for the first time without the need to go through a PLC system first.

## Systems and solutions

All these products and technologies are combined with decades of application expertise to produce holistic systems for a wide range of industries. JUMO considers a "system" to be a collection of products that can be used by default for a particular application. For example, this could be a complete JUMO digiLine package comprising smart sensors and suitable measurement technology for the water industry, or a complete measuring chain for SIL applications from the JUMO Safety Performance range.

Should these end-to-end systems not meet the particular requirements of a customer's application, tailor-made solutions can be developed in collaboration with JUMO Engineering.

## A focus on industries

This concept forms part of our clear focus on industries. JUMO has identified key industries that either offer major scope for growth (e.g. water and wastewater engineering) or are fields in which the company has particularly in-depth expertise (e.g. industrial furnace construction or safety applications). In the future, our product development work will be geared more heavily toward these key industries than is currently the case.

The miniature brewing plant presented in this issue of the customer magazine is a great example of how we are putting this new strategy into practice on the ground. It has long been the case that different JUMO products can be combined to create a complete system for controlling brewing plants. In cooperation with an external partner, a complete solution was developed from the system in the form of its own small brewing plant to celebrate our anniversary. ■

### Good to know

**Even after 75 years, JUMO's openness to change is what continues to drive the family-run company forward on its path to its global future.**

# JUMO innovations

## 5 products that make users happy




### JUMO miroTRON + JUMO miroVIEW

JUMO offers a high-quality alternative to mechanical thermostats and dial thermometers with the electronic JUMO miroTRON thermostat and the JUMO miroVIEW digital indicator. The 2 devices are available in a modern design in both rectangular and round formats.

Different measurement inputs for RTD temperature probes, thermocouples, and standard signals as well as a digital input make them suitable for use within a wide range of applications.

JUMO miroTRON has up to 4 relay outputs. As an option to the thermostatic function, it can also be used for more demanding control processes. When using the PID two-state controller with autotuning version it delivers a significantly higher control quality. JUMO miroVIEW digital indicators are ideal for displaying important process values on-site. They also support additional functions such as min./max. display, hold signal, and tare signal for a scale application.



## JUMO variTRON 500 touch

JUMO variTRON 500 touch provides users with a smart solution for demanding automation applications. The system can be used in a wide range of industries. These include plant engineering, mechanical engineering, industrial furnace construction, food, pharmaceutical/medical/biotechnology, energy and water supply, as well as water and environmental engineering.
It is the first JUMO automation system with a capacitive touchscreen. The central processing unit and the display are built into one device. The product is available in 7" and 10.1" as well as with the IP65 and IP69K (excellent robustness) protection types.
JUMO variTRON 500 touch is based on a powerful CPU with an 800 MHz quad-core processor. The software has a modular structure based on a Linux platform and uses the CODESYS V3.5 programming environment SP17 to create PLC programs. Another special feature is a customer-specific configuration and process data editor. In addition, individual applications can be created using the modern programming environment Node-RED.

## JUMO digiLine O-DO H10/H20

JUMO digiLine O-DO H10/H20 is ideal for reliably measuring dissolved oxygen in both high concentrations as well as very low trace concentrations. Its high-quality sensors enable it to be used in hygienic and demanding applications. The sensor's application areas include the pharmaceutical industry, biotechnology, and the food and beverage industries.
Thanks to state-of-the-art optical technology, the trace and saturation concentration measurement function quickly provides the customer with the results they need. What's more, JUMO digiLine provides a reliable digital means of monitoring the process. The sensor is made from high-quality stainless steel. In the standard measuring range the measuring range is 0 to 22 ppm (mg/l) and up to 45 ppm (mg/l) if required; in the trace measuring range it is 0 to 2000 ppb (µg l).
The analog and digital interface allows it to be connected to field devices and process control systems. The connection to the intelligent, bus-compatible JUMO digiLine system involves simple Plug and Play. The sensor is calibrated in the factory and can therefore be used immediately. Recalibrations can be performed at any time on the JUMO AQUIS touch S/P or conveniently on a PC using the JUMO DSM software. ➜

## JUMO flowTRANS MAG H20

The electromagnetic flowmeter JUMO flowTRANS MAG H20 measures conductive media with high precision – even drop-by-drop. It can be used with flexibility in a wide range of processes. A modern HMI allows configuration via Bluetooth and the JUMO smartCONNECT app. The SPE interface with PoDL (Modbus TCP, JUMO Cloud gateway) makes it simple to connect to the JUMO Cloud.

Its accuracy is ± 0.5 % of the measured value. An additional temperature sensor is already integrated. Due to such factors as its metal case and a Tri-Clamp process connection in nominal widths from DN 06 to DN 25, the JUMO flowTRANS MAG H20 is ideal for use in food-related areas along with other industries for which a G external thread is available. The nominal pressures can be up to PN 16 and the medium temperature can reach up to 90 °C, so that CIP cleaning is possible. Its IP65/IP67 protection type makes the device a flexible partner for a wide variety of processes.

The HMI of the JUMO flowTRANS MAG H20 consists of a TFT display on which 2 process values including the status and info messages are displayed. This device is configured locally via the Bluetooth interface and the JUMO smartCONNECT app. The SPE with PoDL interface uses the Modbus TCP protocol, which enables continuous IP communication from the sensor to the automation system. An integrated JUMO Cloud gateway simplifies the connection to the JUMO Cloud. Another variant is available with an IO-Link interface. On the JUMO flowTRANS MAG H20, it also allows other inputs and outputs such as 4 to 20 mA, pulse output, and status output.



JUMO smartCONNECT

IO-Link

## JUMO exTHERM S200

The JUMO exTHERM S200 surface-mounted thermostat has SIL 2 approval according to DIN EN 61508 and complements the extensive JUMO portfolio in the field of safety technology. It is available as a temperature monitor, safety temperature monitor, and safety temperature limiter. The [Ex i] version can be used directly in zone 1/21. Additional thermowells allow use in zone 0.

JUMO exTHERM S200 is available as a single or double thermostat with capillary or rigid thermowell. A microswitch is used as the electrical switching element. The device operates according to the liquid expansion principle. The control ranges are between -20 and +500 °C; 10 kΩ and 1 kΩ are pre-installed.

Its standard industrial housing and the use of PUSH IN terminal blocks allow JUMO exTHERM S200 to be easily mounted and connected safely. Due to the robust design, use at ambient temperatures from -40 to +75 °C is possible. Separate weather protection or similar protective measures are usually not necessary. The surface-mounted thermostat has IP54 protection while IP65 is also available as an option.

# A modular system and proprietary company software

## Absolute process reliability in the test lab

*Alexander Kamke (right, Division Manager R&D, Reiss GmbH, Weinheim) and Marvin Karbowiak (Sales Manager North Baden-Württemberg, JUMO Fulda) are delighted about the success of the partnership*

*The new solution has significantly increased process reliability.*

**Nowadays, test benches in chemical labs don't just need to provide exact test results across the board, technicians also need to be able to convert them quickly in line with the customer's specific requirements. However, it is crucial that the quality of the test parameters and data remains unaffected. Reiss, based in Weinheim, Germany, is a specialist in solutions for laboratories and partnered up with JUMO to develop a customized solution. The benefits: absolute process reliability is guaranteed and Reiss can reprogram the company's own user-friendly hardware to test the required variety of sensors.**

## Sensor output signals designed to meet the customer's needs

The Reiss test bench is designed to test electrochemical sensors for aqueous media. It can be used during both the development and quality assurance phases of these sensors. The sensors being tested can acquire a range of disinfectants and disinfection by-products in concentrations from 0.05 ppm and 20 % in the measured water. These include chlorine, chlorine dioxide, ozone, peracetic acid, hydrogen peroxide, bromine, and chlorite.

The sensor output signals are designed to meet the customer's needs and are therefore available in different forms: 4 to 20 mA, 0 to 2 V, and Modbus. In addition, the technicians had to be able to select the exact test parameters they require.

**Concentration/disinfectant:**
0.05 ppm to 20 %
**Pressure:**
0.1 to 11 bar
**Temperature:**
Up to 75 °C
**pH value:**
2 to 12
**Conductivity:**
10 µS/cm to 50 mS/cm

digiLine

The previous test benches were made up of a number of independent JUMO controllers and a JUMO paperless recorder. As a result, it used to be quite difficult to make changes to a test bench quickly. For example, a new test setup also required new cabling, which usually meant the services of a professional electrician. It was not possible to expand the test bench based on a modular principle or provide complex monitoring functions. Moreover, the only way to control the test bench and set its parameters was to do so on-site.

## JUMO variTRON system adds real value

Reiss and JUMO focused their discussions on the respective customer needs and looked for a customized solution. This is where the JUMO variTRON automation system came into play, as it offered several advantages at once. For example, sensors for liquid analysis can be connected easily in just a few steps without having to install any fixed modules.

The new test bench already contains all the necessary hardware to test the described variety of sensors. For Reiss, the concrete added value is based on several significant improvements that save time and money. Consequently, changes can be implemented quickly via the development environment (CODESYS). ➜

JUMO digiLine, a smart sensor solution based on the Modbus protocol, provides a number of different analysis measurands, but Reiss mainly uses conductivity and pH value.

Complex monitoring functions can also be provided for such purposes as to ensure the pressure does not exceed a specific value. The new solution has significantly increased process reliability.

Another advantage of the JUMO solution is the consistency in the process. Some providers of test lab equipment do not offer any automation components alongside the analytical measurement technology. This means that an additional external device needs to be used, which makes for a more complex setup.

The JUMO variTRON 500 automation system is now available with an integrated touch-display (see page 9). The system is able to control, regulate, monitor, and record processes.

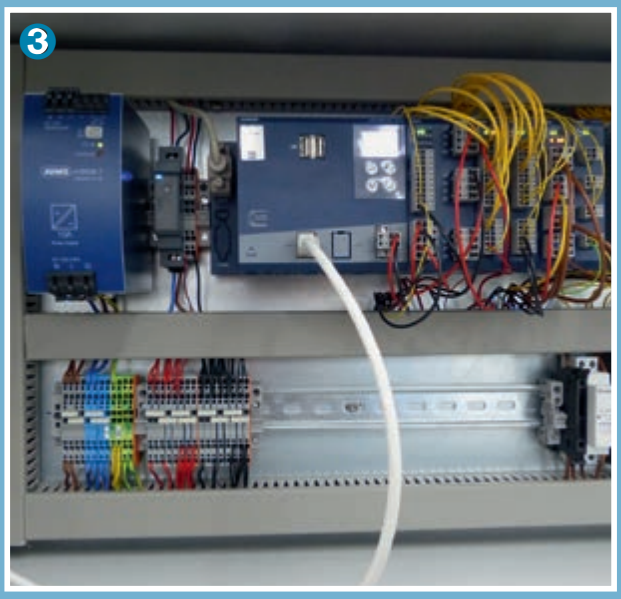
The test bench parameters can also be set via the web browser. In the previous setup, these 2 important activities could only be performed on-site. Now, the test bench can be controlled from the technician's desk or sofa at home. As a result, the solution makes everything much more efficient and is a game changer when it comes to providing as much flexibility as possible for the processes – particularly in this era of Industry 4.0. In addition to the Modbus protocol, the JUMO variTRON also speaks other industry languages such as PROFINET, EtherCAT, BACnet, MQTT, and OPC UA.

Looking to the future, Reiss has a wealth of possibilities for building on the JUMO variTRON system. For example, it could connect to a SCADA or cloud to provide access to the data both locally and globally.




## Good to know

**The JUMO variTRON 500 met all of Reiss' needs and wishes in full. Both companies are now looking forward to collaborating on other projects.**



❶ *An important step toward the digital transformation:*
*Older, tried-and-tested equipment is replaced with state-of-the-art technology*

❷ *All information at a glance:*
*The web panel provides the user with a complete picture of the plant status*

❸ *"Sensors and automation made in Germany":*
*Test bench for electrochemical sensors from Reiss GmbH and the JUMO Group*

# Sensors to measure axle temperature

## JUMO is writing the next chapter of the TGV's success story

*The TGV 2020 project is a prestige project by the French government.*

**If overheating axle boxes on railway vehicles are not detected in good time, they could cause major damage or even a catastrophe where people are injured or worse. Over the past few years, railroad experts and engineers have placed a renewed focus on this problem and continuously worked to improve the solutions available. For example, special, highly precise JUMO temperature sensors measure the axle temperature in the new generation of TGV trains.**

The French JUMO subsidiary, based in Metz, supplies temperature sensors for the axle boxes on the bogies of the new Alstom Avelia Horizon high-speed trains. The French state railroad company SNCF has ordered 100 of these trains, which will be used as of 2023 as part of the TGV fleet, the equivalent of the German ICE series.

The Avelia Horizon is one of the trains with the lowest carbon footprint on the market, with 97 % of the train set recyclable. This makes the new generation 20 % more economical and significantly less energy-intensive. Called TGV™-M, the trains can accommodate up to 740 passengers, which is 140 more than in previous trains. ➜

Alstom chose JUMO France as its partner for the supply of the HABD (Hot Axle Box Detection) temperature sensors, not least because of its many years of successful cooperation. These sensors are mounted on the bogies of the high-speed trains. They are part of the BMS (Bogie Monitoring System) and play a crucial role as they are directly connected to an alarm system that can cause a total stop of the train if the axle boxes overheat.

The sensors are customer-specific special designs that are exposed to extreme conditions such as high temperatures, vibrations, and high levels of moisture. As a result, they must meet particularly demanding specifications to comply with the required standards.

## An alarm is triggered if the operating temperature is exceeded

Maintenance work alone is not sufficient to ensure that railroad traffic runs safely. While the train is in motion, damage repeatedly occurs on the axle box bearings, which can lead to broken shaft journals and thus major accidents. This is caused by the bearings heating up excessively, which means the lubricating grease stops working and the bearing is destroyed. The resulting uneven axle pressures can cause derailments. To guarantee a high level of operational safety, sensor systems were developed that can detect damaged bearings which are heating up.

These systems continuously acquire and process the temperature inside the bearing. An alarm with 2 thresholds is triggered if the operating temperature is exceeded.

An overheating axle box is classified as damage that endangers safe operation, which means that the vehicle must be taken out of service immediately if it occurs. In order to meet Alstom's stringent requirements, JUMO's axle box probe, which has been tried and tested over many years, was completely redesigned again. The result was a new stainless steel temperature probe based on Pt1000. Available in 2 different versions, it meets all current railroad standards in terms of fire protection, vibrations, etc.

JUMO's many years of experience in the demanding railroad industry make it possible to meet Alstom's high expectations. The current order includes the delivery of several thousand temperature sensors for the first 50 trains. Production started at the end of 2020 and JUMO's deliveries will run until 2025.

## The TGV 2020 project is a prestige project

The TGV 2020 project is a prestige project by the French government. The first trains are set to be delivered by the end of 2023 as Paris will host the 2024 Summer Olympics – meaning all eyes will be on the French metropolis. 50 trains are scheduled to enter service by March 2027, and 50 more trains by October 2031. The second tender provides an opportunity for JUMO to participate in the project again with its tried-and-tested technology.

TGVs are as much a symbol of France as French wine, the hundreds of varieties of French cheese, or the Tour de France. The very first "train à grande vitesse" (TGV) departed Paris toward Lyon around 42 years ago. In September 1981 it was not possible to travel from Paris to Lyon (located almost 400 kilometers to the southeast) in 2 hours because the new high-speed line had not been fully built yet.

Today, the TGV trains speed through the country at just under 320 km/h, connecting Paris to Lyon in just 2 hours.

## JUMO summary

- **The temperature inside the bearing is continuously acquired and processed. An alarm with 2 thresholds is triggered if the operating temperature is exceeded.**
- **The tried-and-tested JUMO axle box probe was completely redesigned again. The result was a new stainless steel temperature probe based on Pt1000, in 2 different versions.**
- **The TGV covers the 765 kilometers between the French capital Paris and the port city of Marseille in just 3 hours and 11 minutes.**

# Like a fish to water

## Recirculating aquaculture systems protect the environment

*There are 2 pioneering RAS systems with state-of-the-art JUMO technology.*

**An ecological revolution is currently under way in the world of fish breeding, and JUMO is supplying the relevant sensor and automation technology. Aquacultures are the fastest-growing sector of the food production industry. The rich diversity found in our oceans across the globe is declining, meaning more than half of all fish and seafood consumed today comes from fish farms – and this percentage will only increase further. To prevent environmental damage and water pollution as well as safeguard the welfare of the fish being farmed it is crucial to take a responsible approach to the production facilities.**

In this context, closed recirculation plants (so-called recirculating aquaculture systems or RAS for short) play a major role in protecting the environment. In these systems, the water required to breed the fish remains in the facility where it is filtered and treated for reuse, thereby conserving resources and preventing environmental contamination. Thanks to the permanent monitoring, automation, and optimization of the breeding tanks, the fish themselves remain unstressed and grow without the need for additional antibiotics.

## ANFACO: Modern fish breeding technology in Spain


ANFACO, a Spanish research and development institute from the processing and aquaculture sector, required a professional RAS system. Apart from the continuous monitoring and optimization of temperature, salt and oxygen content, pH value, alkalinity, and chemical composition, solids have to be filtered out and the wastewater treated with a biofilter. Furthermore, salt has to be added to the water in the breeding tanks to simulate seawater because the company is located far from the coast. The RAS process and the aquaculture room were to be located on 2 different floors and the process data had to be accessible at any time by smartphone or tablet via the JUMO Device App. Text message alerts were requested for deviations from setpoint values.

## Complete solution to automate the entire plant

All requirements were met with an intelligent complete solution from JUMO under the leadership of JUMO Spain. Here, the JUMO mTRON T central processing unit is responsible for the control, automation, and visualization of the RAS system. The JUMO AQUIS touch S multichannel measuring device together with the JUMO CTI-500 take over monitoring of the parameters for water analysis and inductive conductivity measurement. A total of 6 measurements are carried out simultaneously in the device – some of them are also controlled. This way, measurands such as water temperature, salt content, and other critical values can be set and monitored. ➜

The logging data is sent to the customer's data center for analysis and visualized on the screen of a tablet or PC in the aquaculture room. Remote access is possible via the JUMO Device App.

## SEAWATER Cubes GmbH: When a startup makes history

Many years of research at the University of Applied Sciences in Saarland, Germany, were required to get the fish breeding farm up and running. According to the founders Carolin, Christian, and Kai, it aims to "break down established structures in the fishing industry and revolutionize how we produce and consume fish". The innovative aquaculture system is built from scrapped shipping containers, which are comprehensively reconditioned before being used to breed sea fish. This means that the sea bass and sea bream that are bred on the farm can be marketed regionally without the need for long, environmentally harmful transport routes.

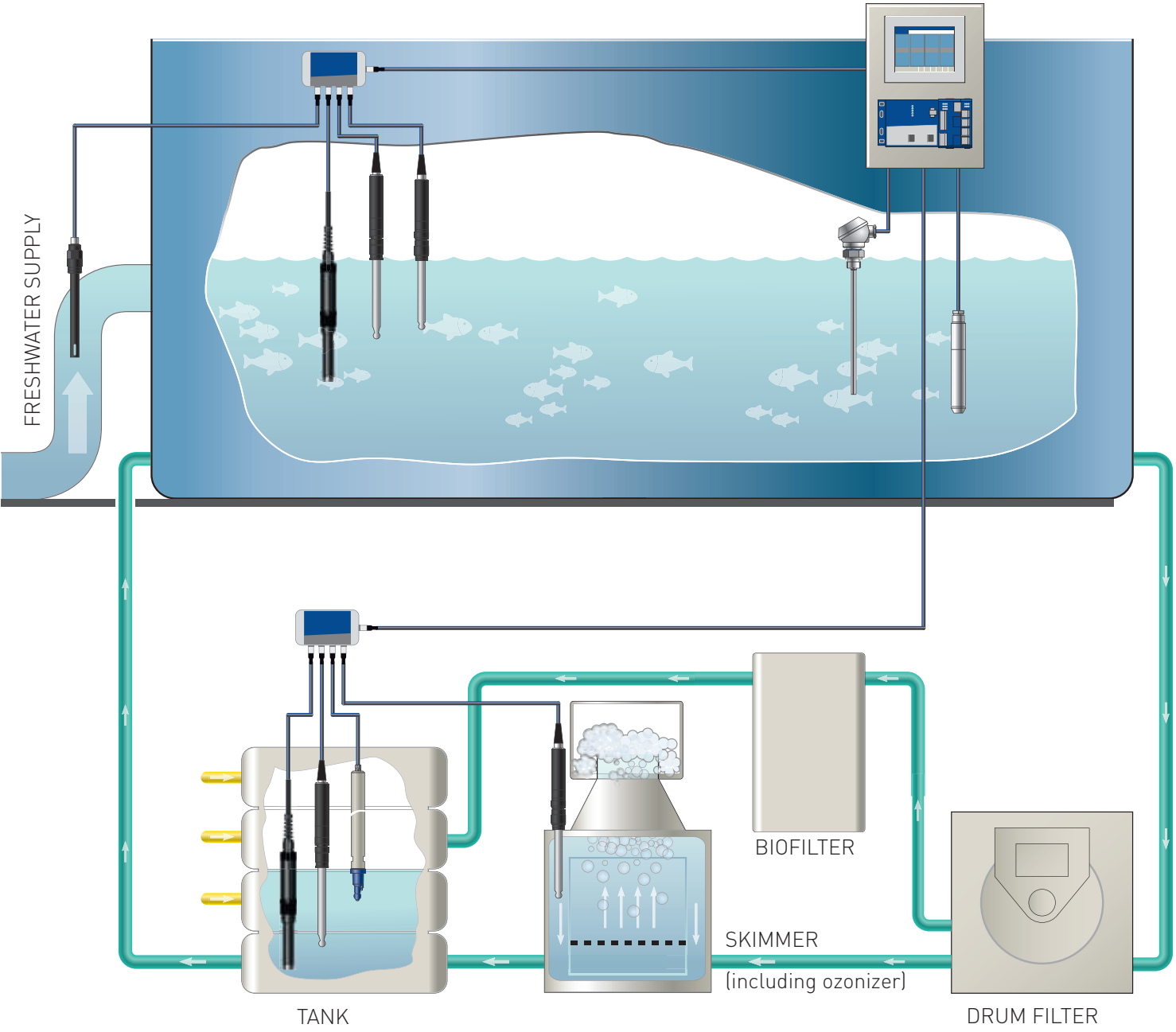

## JUMO: Advanced technology ensures efficiency and saves time

The relevant water quality parameters are continuously monitored and optimized here. For inspection purposes, the company uses the modular JUMO AQUIS touch multichannel measuring device as well as JUMO digiLine sensors for measuring conductivity, temperature, and oxygen content. All sensors are networked with one another via a signal line and can easily be parameterized and calibrated on a PC/laptop in the lab using the system's own DSM software.

The calibration data and the evaluation of the sensor status are stored directly in the sensor and enable seamless documentation over the entire lifecycle. Precalibrated sensors can be installed quickly thanks to the Plug and Play design. Furthermore, JUMO tecLine sensors are used to measure the chlorine dioxide and ozone level.

The high level of automation means the plant runs almost by itself without any supervision, saving around 1.5 hours of work each day.

*From Spain to Germany: Aquacultures are international.*




*Intelligent systems for controlled breeding on land*

## Cloud solution

**The data collected is analyzed and visualized quickly in a cloud solution so that it is conveniently accessible from all common browsers.**

# Clean energy in China

## Using hydropower to generate electricity protects the environment

*Aerial shot of the Wudongde hydropower plant*

*The leading countries in terms of hydropower are China, Brazil, Canada, the USA, and Russia.*

**The People's Republic of China has 5 of the world's 10 biggest hydroelectric power plants. Innovative JUMO technology plays a key role in these structures.**

**People have been using the power of water for thousands of years, be it through scoop wheels, Archimedes' screws, or water turbines. The first major hydroelectric power plant started running at Niagara Falls in 1895 and the power of water has been in full flow ever since to generate renewable energy.**

According to the statistics portal Statista, a nominal power output of 1,360 gigawatts was generated around the world by hydropower in 2021, equivalent to around 16 % of global electricity demand.

## Wudongde – the hydroelectric power plant with the largest global single unit capacity

The Wudongde hydropower plant (WDD), located on the lower stretch of the Jinsha river, was built in only a few years and is the 7th largest hydroelectric dam in the world. It started running in 2020. As such, this massive structure is the youngest and most innovative of all the major hydroelectric power plants.

Forming part of the Chinese "West-East Power Transmission Project", Wudongde has opened up the energy resources of China's west to the undersupplied east. This is expected to save around 12.2 million metric tons of coal per year and to drastically reduce emissions of carbon dioxide and sulfur dioxide. A single unit is able to power around 1.8 million Chinese households – an impressive feat when it comes to climate protection. ➜

## Powerful measurement and automation technology for the energy transition

This exciting project was implemented by JUMO's Chinese subsidiary and a global manufacturer of power converter systems. The measurement and control technology used for the project successfully handled all the technical challenges, even the complex ones. The sensors used in the generators and turbines to monitor the temperature of the oil hydraulics must be suitable for pipes with oversized diameters, respond quickly to high-speed flows, and measure data in a stable as well as reliable manner even when large vibrations occur. Just as important are excellent sealing properties and low maintenance requirements.

In addition, the air humidity and air temperature in the generator rooms must be monitored and corrected if necessary to prevent corrosion, electrical flashovers, and damage to electrical installations.

When the company was founded back in 1948, Moritz Kurt Juchheim's vision was to provide high-quality products, effective industrial processes, and the best possible customer service. JUMO has remained true to these principles ever since in all its projects, at its headquarters, in its subsidiaries, and in all branch offices. These principles therefore also underpinned the company's approach to the Wudongde project.

> *Technical challenges are there to be solved efficiently.*

### Conclusion

**The energy transition is more important than ever, but it also presents major challenges for the technical infrastructure in the planning phase. The Wudongde project demonstrates that protecting the climate pays off and that you can overcome all difficulties with a reliable partner by your side.**

## Tailored solutions for all requirements

Fail-safe hygro transducers and hygrothermal transducers in the duct version measure the relative humidity and temperature at the turbine installation points. The humidity is acquired by a capacitive humidity element and converted into current (4 to 20 mA) or into voltage signals (DC 0 to 10 V). A platinum temperature sensor

according to DIN EN 60751, whose signal is also converted, is used to determine the temperature. The temperature of the turbine cooling water is acquired by screw-in RTD temperature probes, which have reliable leak tightness even when underpressure or overpressure occur.

Push-in RTD temperature probes with SIL approval and metrological registration are used to monitor the temperature of an air cooler's intake air and exhaust air in the generators and generator rooms. These are available in several versions and with interchangeable measuring inserts. This way, any malfunctions that occur can be detected at an early stage so that adequate countermeasures can be taken. These include shutting down parts of the plant or alerting technical personnel.




1 *The dam wall of the Wudongde hydropower plant on the lower stretch of the Jinsha river*

2 *The pipes in the Wudongde hydropower plant*

3 *Close-up of a JUMO screw-in RTD temperature probe in use*

# Bottoms up:

## A refreshing pilsner to celebrate JUMO's anniversary

**As an innovative technology leader, JUMO has been supplying high-quality measurement and automation technology for the food industry for decades. So it was an obvious step to have our own anniversary beer created for the 75th anniversary in 2023. In the brewing process, all relevant JUMO products that are supplied to the brewing industry were to be combined in one application. The choice therefore fell on an in-house, modern, and highly efficient brewing plant.**

In search of engineering expertise and a regional brewery capable of building such a plant and brewing such a beer, JUMO quickly came across Burkard und Gärtner (B+G), a specialist in plant design and plant engineering – as well as the company "Hunfelt Braeu". This young brewery on the outskirts of Fulda was founded in 2017 as a hobby in a garage. It has grown steadily since then and now produces 10 different specialties. The idea of a "mini brewing plant" came about because Sebastian Gärtner, who is 1 of the 3 brewers, is also one of the owners of B+G on a full-time basis.

## Brewing plant is a classic 3-unit brewhouse

The planning of the plant on the basis of an intelligent 3D CAD model (using the latest CAD/CAE software) and manufacturing methods (such as orbital welding technology) meant that the project was completed in just a few months by B+G, JUMO Market Segment Management, and JUMO Engineering.

This has resulted in a fully automated brewing plant in compact skid design which is completely made of stainless steel, has an output of 100 liters of cold wort, and which features an automated CIP function (Cleaning in Place). The brewing plant is a classic 3-unit brewhouse with lauter tun.

In addition to the mash tun, lauter tun, and wort kettle, the plant was also equipped with a hot water tank. Apart from the lauter tun, all containers are electrically heated via the inner wall of the vessel. JUMO TYA 202 power controllers are used to control the heating elements.

Furthermore, the plant has a pump for water and the CIP function as well as another frequency-controlled pump for the mash or wort. In both pumps the JUMO ZELOS C01 LS level switch is used as dry-run protection.


When measuring the level of the hot water tank, mash tun, and wort kettle, the new JUMO DELOS S02 pressure transmitter with Single-Pair Ethernet (SPE) is used. ➜

The differential pressure measurement in the lauter tun was implemented with the **JUMO TAROS S46 H**.

**JUMO flowTRANS W02** is used for quantity measurement of the main pour and the post pours.


After the wort cooler, the new **JUMO flowTRANS MAG H20** (also with SPE) measures both the totalized flow rate and the temperature.


Temperature in the respective containers is determined with the **JUMO dTRANS T1000**.

The sensors were installed in the plant with the process connections G ½ (hygienic), **JUMO PEKA** (EHEDG certified), and clamp. They were integrated via SPE, IO-Link, or with a 4 to 20 mA signal.

## JUMO digiLine Ci HT10 determines concentration of the cleaning media

Automatic cleaning of the equipment is also an option. The CIP function is made possible by such factors as concentration measurement of the cleaning media. **JUMO digiLine Ci HT10** determines the concentration of the different cleaning media via the temperature-compensated conductance in the hot water container.

*There's now another enticing reason to visit a JUMO booth or the company's headquarters in Fulda soon.*

## Control and visualization

The plant is operated via the **JUMO variTRON 500 touch** controller and the **JUMO smartWARE SCADA** software for process monitoring and control.

The recipes for the individual beer types and the individual CIP functions can be configured intuitively without programming skills using the browser-based software solution **JUMO smartWARE Program**.
**JUMO smartWARE Evaluation** enables additional recording of all process parameters. ■

JUMO smartWARE · SCADA

JUMO smartWARE · Program

JUMO smartWARE · Evaluation

*View of the brewing plant application*

# Well looked after with JUMO Care+

## Taking service to a whole new level

Further information **http://thermoprocess.jumo.info**

**On September 14, 2023 there is another event to which to look forward: The annual industry day for thermoprocess technology will be streamed live from the octagon on the Zollverein industrial complex in Essen.**

# care+ Solutions made easy.

**As a hybrid company, JUMO supports its customers throughout the entire product lifecycle from development right through to discontinuation. Given that the sensor and automation solutions are very durable, this support can last 15 years or more. To ensure that its solutions and products work reliably over the entire period, JUMO offers a number of different services such as calibration, support, repairs, and maintenance. In the future, these services will be bundled under the new brand JUMO Care+.**

Customers are now able to sign up to a subscription and choose individual service packages from a catalog to suit their particular needs. Safety, speed, and convenience are the main focus here. The aim is to put together a tailored, comprehensive carefree package for every customer.

## The JUMO Care+ package

For example, the JUMO Care+ package for a controller could include the configuration of the device using Plug and Play, advanced telephone support for the startup work, and additional support during the first 12 months.

## Complete service packages

A complete test kit for up to 5 calibrations is available to calibrate pH sensors. It contains all the necessary solutions as well as cleaning agents and gloves.

As such, customers can start their calibration work directly "out of the box". In the future, the calibration services that JUMO offers either on-site at the customer's premises or in its own DAkkS lab will also be available as complete service packages.

## The aim of JUMO Care+

**To offer every customer a tailored service solution that ensures all of the product's functions and features for the longest possible period of time.**
**More info:**
**care.jumo.info**

# News from the JUMO labs

## Accreditation for pressure as a measurand and the TestLab

*Specialist expertise, reliability, and integrity are independently tested and confirmed.*

**JUMO supports its customers throughout the entire product lifecycle, which is why an accredited calibration laboratory has been running in Fulda since 1992. It enables the company to guarantee that products are always calibrated in compliance with the relevant legal requirements and standards in a way that is internationally comparable. Along with temperature and humidity, we received accreditation for pressure as a measurand in the permanent calibration laboratory at the end of 2022. The JUMO TestLab has now also been accredited.**

It is advisable to calibrate pressure measuring devices once a year to ensure that they operate at optimum performance. Negative and positive overpressure can be calibrated in a measuring range of -1 to +600 bar, and absolute pressure can be calibrated in a measuring range of 0 to 601 bar. The smallest measurement uncertainty, for example, is 0.4 mbar in a measuring range of -0.4 bar to +0.4 bar.

## Other services

The calibration process adheres to DKD-R 6-1:2014. The services include issuing a calibration certificate, applying a calibration mark on the calibration object, adjustments, and disclosure of the measured values before making adjustments. In the future, complete service packages will also be available for calibration services that JUMO performs on-site at the customer's premises or in its own DAkkS lab.

## JUMO TestLab

In addition to pressure as a measurand, the JUMO TestLab has now been accredited for the first time as a test lab according to DIN EN ISO/IEC 17025:2018 by Deutsche Akkreditierungsstelle (DAkkS). As part of this accreditation process, the working methods and technical expertise of the TestLab employees in the fields of EMC, product safety, and environmental testing were independently checked and confirmed according to international standards.

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle

Anlage zur Akkreditierungsurkunde D-K-15129-01-00
nach DIN EN ISO/IEC 17025:2018

Gültig ab: 14.12.2022
Ausstellungsdatum: 14.12.2022

Inhaber der Akkreditierungsurkunde:
JUMO GmbH & Co. KG
Hermann-Muth-Straße 2, 36039 Fulda

Das Kalibrierlaboratorium erfüllt die Mindestanforderungen gemäß DIN EN ISO/IEC 17025:2018 und gegebenenfalls zusätzliche gesetzliche und normative Anforderungen, einschließlich solcher in relevanten sektoralen Programmen, um die nachfolgend aufgeführten Konformitätsbewertungstätigkeiten durchzuführen.

Die Anforderungen an das Managementsystem in der DIN EN ISO/IEC 17025 sind in einer für Kalibrierlaboratorien relevanten Sprache verfasst und stehen insgesamt in Übereinstimmung mit den Prinzipien der DIN EN ISO 9001.

Kalibrierungen in den Bereichen:

**Thermodynamische Messgrößen**

**Temperaturmessgrößen**
- Widerstandsthermometer a)
- Direktanzeigende Thermometer a)
- Temperatur-Transmitter, Datenlogger a)
- Thermopaare, Thermoelemente a)
- Temperatur-Blockkalibratoren
- Mechanische Thermometer a)
- Temperaturanzeigegeräte und -simulatoren a)
- Klimaschränke (Temperatur) a)

**Feuchtemessgrößen**
- Messgeräte für relative Feuchte
- Klimaschränke (Feuchte) a)

**Mechanische Messgrößen**
- Druck a)

a) auch Vor-Ort-Kalibrierungen

Diese Urkundenanlage gilt nur zusammen mit der schriftlich erteilten Urkunde und gibt den Stand zum Zeitpunkt des Ausstellungsdatums wieder. Der jeweils aktuelle Stand der gültigen und überwachten Akkreditierung ist der Datenbank akkreditierter Stellen der Deutschen Akkreditierungsstelle zu entnehmen (www.dakks.de)

Verwendete Abkürzungen: siehe letzte Seite

Seite 1 von 11

## Good to know

**The calibration certificates issued by the accredited calibration laboratory therefore comply with the stringent requirements of DIN EN ISO/IEC 17025 and are internationally recognized.**

# Practical applications of PID controllers

## Manual optimization for a relatively fast control process


*JUMO has been holding training courses on its product range for around 30 years.*

It all started with seminars on control technology, and to this day these are still the most requested of all the courses on offer. Control technology is often conveyed in a very theoretical manner, which is probably why the subject has a certain deterring effect. When applied, however, little theory is required and calculations are only rarely needed. This article explains how to manually optimize a PID controller for a relatively fast control process

*"To get people interested in the topic, this article looks at the PID controller. It explains the manual optimization steps required for a relatively fast control process."*

Manfred Schleicher
*Trainer*
*Sensor and Automation Technology*
manfred.schleicher@jumo.net

## The P component

When using JUMO controllers, you have the option to only work with the P component. This component is optimized first even if the aim is a PID controller.

The P component proportionally amplifies the control deviation and the intensity is changed by what is known as the proportional band ($P_b$).

Fig. 1 shows the setpoint value, actual value, and output level for a **P controller** in a control process. The setpoint specification is 120 °C and a favorable proportional band of 50 K has been set:

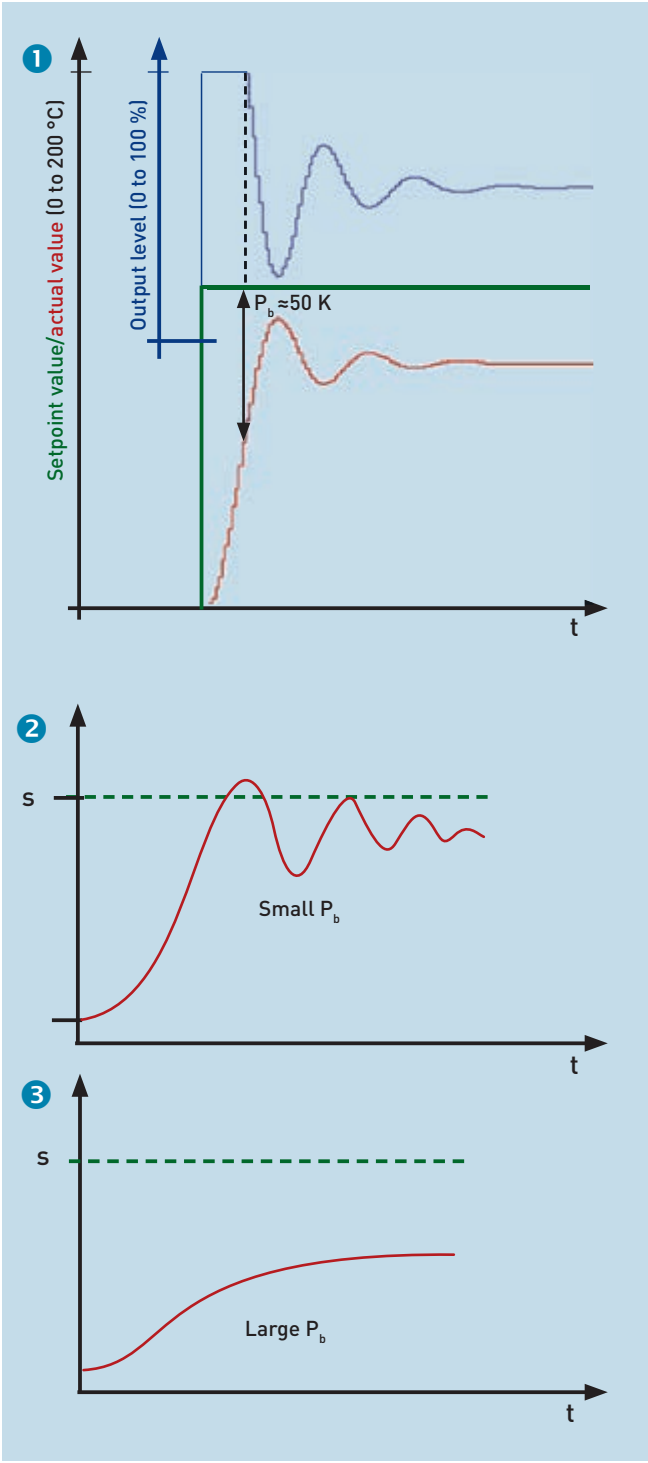
*As long as the actual value is below the proportional band (< 70 °C), the controller's output level will be 100 %. If the actual value enters the proportional band, the output level will be reduced in proportion to the control deviation. If the actual value reaches the setpoint value (or exceeds it), the output level will be 0 %. In this example, a favorable $P_b$ has been set, meaning there is a stable actual value in the proportional band.*

*The P controller only outputs an output level as long as the control deviation is greater than 0 K. This explains the steady-state control deviation of around 30 K.* 1

*If a smaller $P_b$ is set, the controller's amplification will increase, and the necessary output level will already be reached with a smaller control deviation. On the other hand, major changes to the output level already occur in the proportional band if the actual value moves only slightly, and the control loop tends to oscillate.* 2

*If $P_b$ is too large, the output level will already be reduced with large control deviations. The control response is very stable, but on the other hand the actual value only increases very slowly and the steady-state control deviation is very large.* 3

The response for a P controller is usually favorable, as shown in Fig. 1: $P_b$ was set small enough that the actual value stabilizes after 2 to 3 full oscillations. →



The next step is to add the **D component** to the controller structure. It can usually suppress or even entirely eliminate the tendency to oscillate:

## The D component

The **D component** in JUMO controllers is always activated when the actual value changes. Among other things, it therefore ensures that the total output level reduces as the actual value increases – the actual value is approached in attenuated form. On the other hand, the total output level increases as the actual value decreases and the drop in the actual value is intercepted. The intensity of the D component is influenced by the derivative time $d_t$:

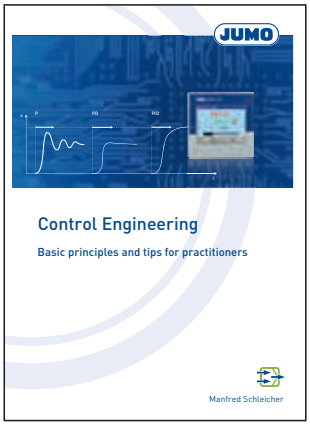
$d_t$ large ≙ strong attenuation,

$d_t$ small ≙ weak attenuation.

For PD controllers, the $P_b$ shown in Fig. 1 is retained and the derivative time is gradually increased:

*The control response shown in Fig. 4 on the left arises when the $d_t$ – and therefore the attenuation – is still slightly too small. The **D component** does not counteract the movement of the actual value strongly enough yet and there is still a clear tendency to oscillate. As can be seen in the right-hand figure, the control loop may become unstable if there is too much attenuation – the **D component** counteracts the movement of the actual value too strongly.*

*In Fig. 4 in the middle, a favorable $d_t$ has been set – there is barely any tendency to oscillate. Despite this, the control response still has a major weakness: The controller does not adjust the value to the configured setpoint value and there is a steady-state control deviation. Therefore, the final step is to switch over the controller structure to PID, and the **I component** eliminates the steady-state control deviation:*

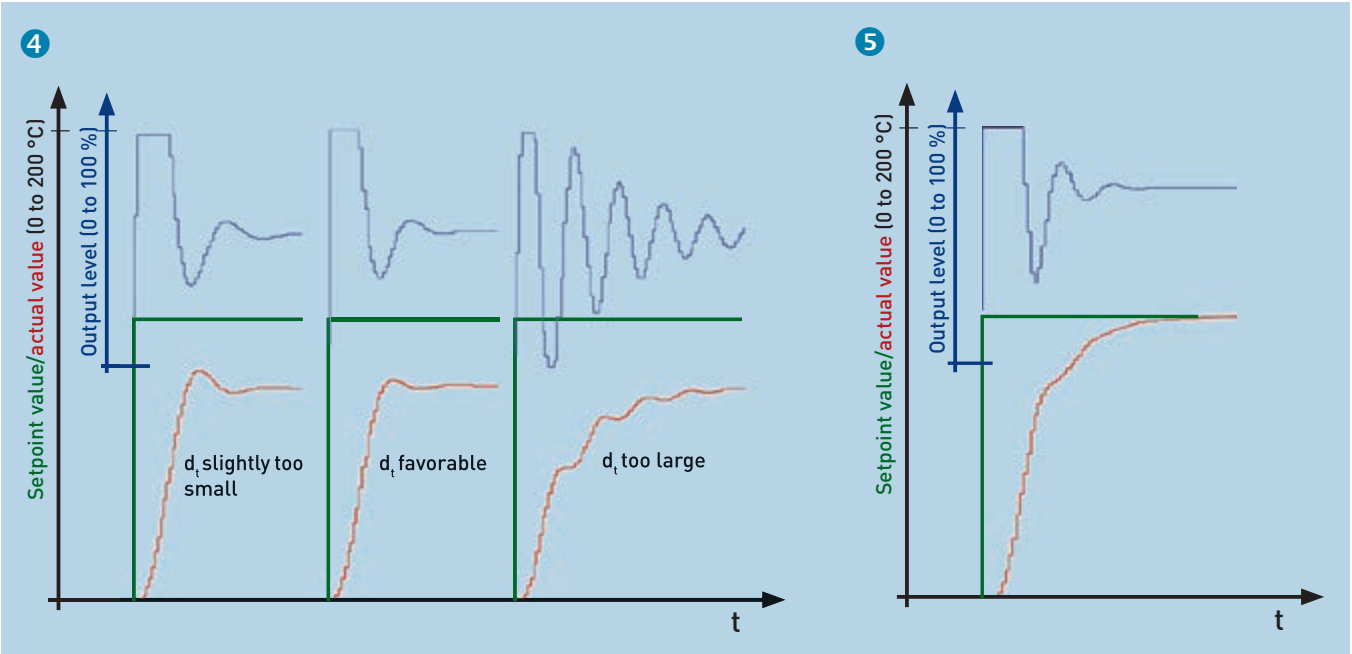



*Technical literature: Control Engineering – Basic principles and tips for practitioners*

## The I component

*As long as there is a positive control deviation, the **I component** will increase its output level and thus adjust the actual value to the setpoint value. Accordingly, it will decrease the output level if the actual value is above the setpoint value. The larger the amount of the control deviation, the faster the change in output level. Additionally, the controller will change its output level faster when a smaller reset time $r_t$ is set.*

**When determining the reset time for the PID controller, one crucial aspect must now be considered:** If a favorable $d_t$ has been determined for a process, the $r_t$ can generally be set to 4 times the value of dt, producing a favorable I response. Returning to our example, if the structure of the PD controller from **Fig. 4 in the middle** is set to PID and $r_t$ is set to 4 times the value of $d_t$, this produces the control response in **Fig. 5**:



# Virtual beverage technology day

## Beverage technology live from the HUNFELT BRAEU brewery

**Participants will enjoy a live demonstration of JUMO's system solutions for the entire brewing process from a real-life brewing plant. They will also gain a whole host of valuable practical tips.**

**Thursday, July 6, 2023,**
**9 AM to approx. 2 PM –**
JUMO would be delighted to meet you at the virtual beverage technology day.

The event will be held online so that attendees can take part easily on the award-winning JUMO Xperience platform without needing to travel anywhere.

Register for free and find out more here:
**http://brewery.jumo.info**

The event will be professionally livestreamed directly from a brewery in Hünfeld that brews beer for the young craft beer brand "HUNFELT BRAEU." Alongside fascinating presentations relating to real-world applications, participants can look forward to engaging live demos on a brewing plant. The entire brewing process will be highlighted throughout the day: from water well monitoring to the design of an operational plant with mapping of the measurands pressure, level, flow, and conductivity as well as their interaction with an intuitive automation solution. A look at CIP (Cleaning in Place) and digital sensor technology will round off the day's proceedings.

The experts and trainers will be available on the JUMO Xperience platform throughout the event to answer any questions. Participants can also exchange ideas and experience with other visitors at the virtual networking bar.

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www.jumo.net

JUMO


## JUMO on the move

JUMO, a leading system provider of industrial sensor and automation solutions, is celebrating its anniversary.
It is doing so together with 25 subsidiaries, more than 60 agencies, and over 2,500 employees around the world.

**www.75-jumo.net/en**

# Interview: CEO/COO and General Partners

*Michael Juchheim*
*GENERAL PARTNER*

*Dr. Steffen Hoßfeld*
*COO*

*Bernhard Juchheim, when you were born in 1949, JUMO (or rather M. K. JUCHHEIM as it was known back then) was just under 2 years old. In spring 2022 you stepped back from your operational management duties to devote your full attention to your role as general partner. You could say that the company has always been part of your life. How do you look back on the years gone by?*

*Bernhard Juchheim*

"In a nutshell, I look back with pride and joy. Even when I was a child, I saw first-hand how passionate and committed my father was about building up JUMO, and how much his employees always meant to him. But he also had an unwavering commitment to seeking out new markets and technologies so that the company could stay at the cutting edge. When I started my management duties as Chief Executive Officer in 1985, we had a lot of work to do in markets outside Germany. Apart from one subsidiary that was already generating good profits back then, we had to work hard to make a name for ourselves in non-German markets. That was hard graft. But thanks to the export team, we managed to continue growing successfully."

*The third generation has written the next chapter of the family's success story. Michael Juchheim, you joined the corporate group in 1999 and became Chief Executive Officer in 2003. What do you believe sets JUMO apart?*

*Michael Juchheim*

"I think it's our ability to constantly reinvent ourselves. Many big German companies no longer exist because they relied on existing successful products for too long. Over the course of its 75-year history, JUMO has constantly demonstrated its strengths in adapting its portfolio. That's why we are now well prepared to overcome crises, with a wide range of products covering various different industries. When you combine this with the fact that we are very open to technological developments and our high level of production depth, we are able to respond quickly and flexibly to changing market requirements. This has been an invaluable advantage, particularly in the last few years."

*Together with your father, you stepped back from your operational management duties last year to focus on your role as general partner. Does this mean that JUMO is no longer a family company?*

*Michael Juchheim*

"JUMO is and will remain a family company as the Juchheim family owns all the shares in the company. My father and I can now concentrate more heavily on the topics that will shape our future, and can take a holistic view of the corporate group as a whole. Chief Executive Officer Dimitrios Charisiadis and Chief Operating Officer Dr. Steffen Hoßfeld are taking care of the operational side of things. We trust them completely and work closely with them."

*Dimitrios Charisiadis, in 2020 you became the first person outside of the family to join the JUMO management team. Was that a special challenge?*

*Dimitrios Charisiadis*

"I've been at JUMO since 2017 and also worked in a family company for many years prior to that, so I was familiar with the special "spirit" in family companies. I also quickly realized that the JUMO corporate group has enormous potential to make a success of our digital future. I established a collaboration based on trust with Bernhard and Michael Juchheim right from

*Bernhard Juchheim*
*GENERAL PARTNER*

*Dimitrios Charisiadis*
*CEO*

the very outset. I value the culture and values at JUMO and am delighted to be able to continue fostering and developing them together with the owners."

*What do you believe is so special about JUMO?*

*Dimitrios Charisiadis*

"Our company policy is based on long-term, sustainable business practices. We consider evolution to be more important than revolution. We don't simply run after every trend right away, rather we assess the impact on the market and our company in a measured way. We also foster and promote a culture of respect with all employees across all levels in the company.
Our claim "More than sensors and automation" has been reinforced internally by the vision we have for the company. One element of this vision is "We shape the future." It is what spurs us on to continue developing and offering sustainable, high-quality products and increasingly also systems and solutions, so that we can inspire our customers and make them even more successful."

*Dr. Steffen Hoßfeld, you have been leading the JUMO corporate group together with Dimitrios Charisiadis since 2022 as Chief Operating Officer. How would you sum up your collaboration as a duo?*

*Dr. Steffen Hoßfeld*

"While our areas of responsibility are clearly defined, we also don't work in silos, and coordinate matters with one another whenever necessary. As Chief Operating Officer, I'm responsible for steering and organizing all of the company's operational processes. Dimitrios Charisiadis is Chief Executive Officer and therefore manages market-oriented areas such as Development and Sales. Together, we share responsibility for the strategic management of the corporate group."

*What do you believe are the biggest challenges facing JUMO in the coming years?*

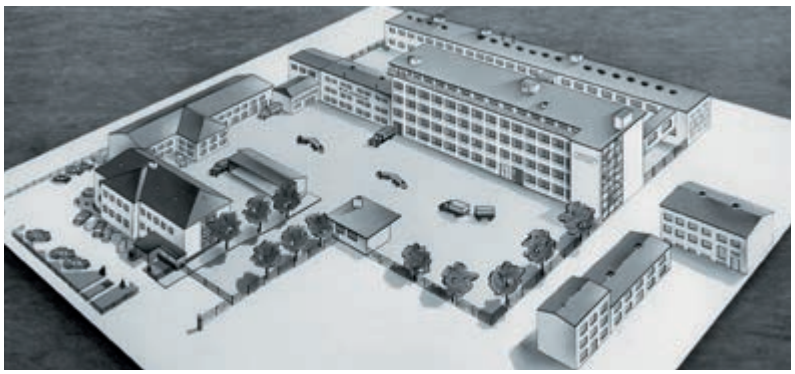
*Dr. Steffen Hoßfeld*

"We need to continue evolving internally in order to master our increasingly complex and unpredictable world. The construction of our new production facility in Fulda – an investment worth almost 50 million euro – is of course a key part of our strategy in this respect. We are building a sustainable and smart factory of the future that will make us much more competitive. It's also a clear commitment to Germany as a place to do business. In terms of our operations, one major issue for us at the moment is the lack of skilled workers, and I expect this will remain the case in the next few years. It means we cannot just think about technologies and products, we also have to consider what makes us attractive as an employer."

*Dimitrios Charisiadis*

"In general, I think it will become increasingly important for companies to clearly define their role and purpose in our society. The crises we have gone through in the past few years have demonstrated clearly that it is no longer enough simply to establish successful products on the market and create jobs – many companies can do that now. We need to be prepared for the fact that in the future the public will increasingly ask us about our carbon footprint or our approach to the trouble spots in our world. If we can provide sound answers to these questions and make systematic progress on our journey to becoming a provider of systems and solutions, then we will have the power to write the next chapter of JUMO's success story." ■

# **Timeline:** JUMO's history



## 1948

In Fulda, Moritz Kurt Juchheim establishes a company known as M. K. JUCHHEIM, now JUMO GmbH & Co. KG, and employs 6 staff to produce glass and glass contact thermometers in a manufacturing area measuring 350 m²

## 1950 bis 1959

Establishment of a national sales network
1951
First patent for the development of a glass contact thermometer
1952
For the first time, JUMO has more than 100 employees

## 1960 bis 1969

Establishment of first branch offices in Germany
1960
750 JUMO employees work in a manufacturing area measuring some 12,000 square meters
1965
Peter Juchheim, son of the company founder, becomes joint Chief Executive Officer of the company

## 1970 bis 1979

Continuous expansion by developing new and enhancing existing electronic temperature controllers, recording and programming devices, and transmitters
1970
JUMO's Fulda site employs almost 1,000 employees
1978
By including microprocessor technology in JUMO devices and developing the necessary software, JUMO becomes one of the first companies in the world to use processors in control technology

2011
For the first time, Group turnover is more than 200 million euro
2012
The JUMO corporate group has more than 2,000 employees
2017
JUMO receives the "Grand Prize for Medium-Sized Businesses"
2019
In April, JUMO is recognized at the 2019 HANNOVER MESSE trade fair for attending 70 times over the years
2020
JUMO Managing Partners Bernhard Juchheim and Michael Juchheim appoint Dimitrios Charisiadis as the third executive in his role as Chief Executive Officer on January 1, 2020
2021
To reach its customers and interested parties during the pandemic, JUMO holds its first virtual in-house trade fair at the start of 2021: the "JUMO Xperience Days"; the event scoops the Stevie Award for "Best Brand Engagement Event of the Year"
2022
Bernhard Juchheim and Michael Juchheim focus on their role as general partners in the family company; Dimitrios Charisiadis is joined by Dr. Steffen Hoßfeld as the new Chief Operating Officer
2023
Construction of a new, state-of-the-art site for 2 production departments starts in Fulda; JUMO celebrates its 75th anniversary

1992
Opening of a certified DKD lab (German calibration service) at JUMO
1996
On November 2, 1996, the company founder Moritz Kurt Juchheim passes away in Fulda; he played an active role in the management team right up until his death

## 1980 bis 1989

**The company's global expansion continues with the establishment of further subsidiaries**
1980
JUMO offers extensive services relating to metalworking and electronic modules to external customers for the first time
1982
The company builds up its analytical measurement technology department
1985
Following the death of his oldest brother Peter Juchheim, Dipl.-Ing. Bernhard Juchheim takes over the management of M. K. JUCHHEIM GmbH & Co. KG
1989
For the first time, JUMO uses robots in temperature probe manufacturing, making it a pioneer on the market

## 1990 bis 1999

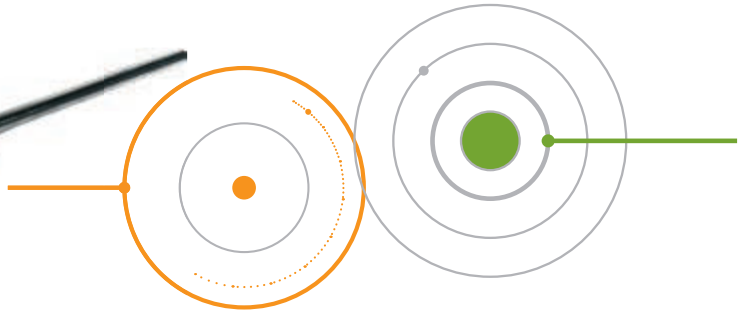
## 2000 bis 2009

2000
JUMO achieves a turnover of over 100 million euro for the first time
2003
M. K. JUCHHEIM GmbH & Co. KG is renamed JUMO GmbH & Co. KG to align it with the international company name; Dipl.-Kfm. Michael Juchheim – alongside his father Bernhard – becomes Chief Executive Officer with sole power of representation
2007
For the first time, JUMO launches devices with wireless data transmission on the market, opening up brand-new application areas to customers

## 2010 bis 2023

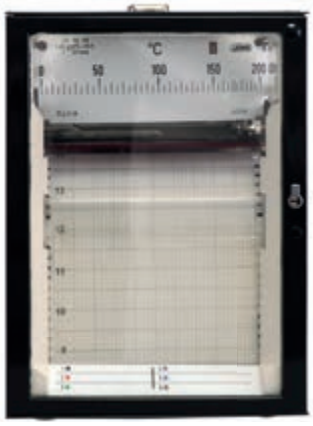
# **Products:** Then and now

Rod thermostat
**1950s**



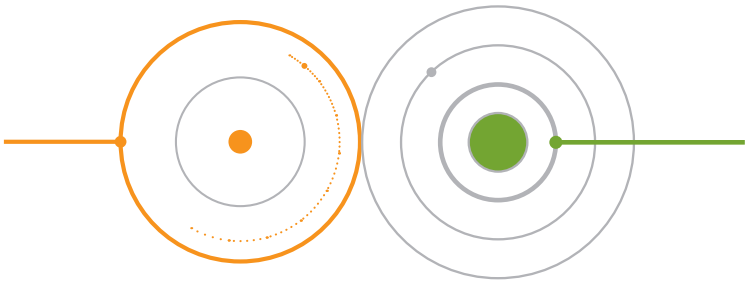
Rod thermostat
**Today**

Galvanometric recorder
**1960s**



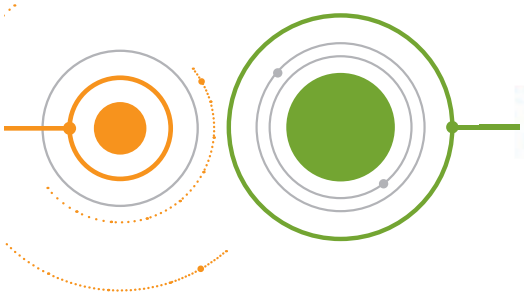
Paperless recorder
**Today**


Platinum-glass temperature sensor
**1960s**



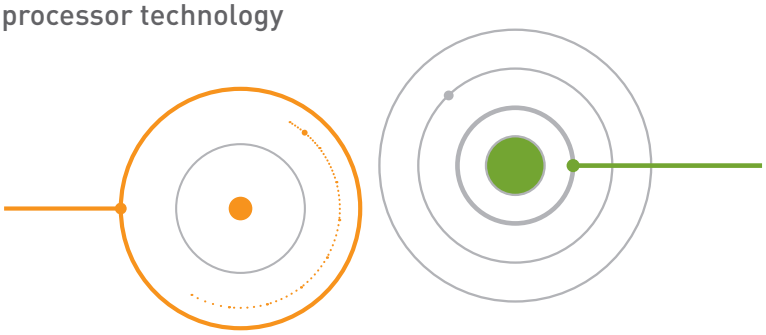
Platinum temperature sensor
**Today**

Thin film temperature sensor
**1970s**



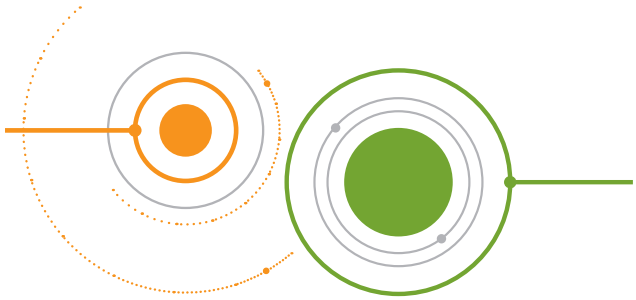
Thin film temperature sensor
**Today**

Controller with microprocessor technology
**1970s**



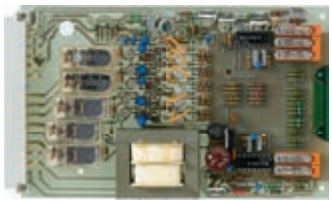
Controller
**Today**

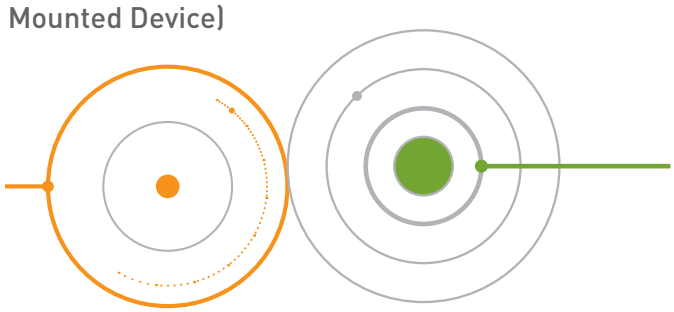

Humidity sensor
**1980s**



Humidity and temperature transmitter
**Today**

SMD technology (Surface Mounted Device)
**1980s**





Electronic module
**Today**

## **Global:** The JUMO subsidiaries (red dots)

| Country of the subsidiary | Founding year |
|---|---|
| Belgium, Austria, Switzerland | 1971 |
| Italy | 1975 |
| Netherlands | 1976 |
| France | 1977 |
| England | 1979 |
| Denmark | 1982 |
| USA | 1984 |
| Sweden | 1986 |
| Spain | 1987 |
| Russia | 1993 |
| China | 1997 |
| Poland | 1999 |
| Czech republic | 2000 |
| Romania | 2001 |
| Norway | 2002 |
| Slovak republic | 2002 |
| Hungary | 2005 |
| Bulgaria | 2007 |
| India, Turkey | 2008 |
| Bosnia and Herzegovina | 2010 |
| Canada | 2012 |