

Microelectronics

Perspectives in Pure Water Analytics

7 News

THORNTON

Leading Pure Water Analytics

Powerful and Flexible The Future of Multi-parameter Analysis

Innovations have established our products as leading-edge in the demanding microelectronics industry, where measurement accuracy and reliability are critical to improvements in productivity. The M800 transmitter family is the most advanced universal transmitter for digital measurement technology.



Multi-parameter, multi-channel transmitter

The history of METTLER TOLEDO Thornton can be mapped by our product innovations; two of these being multi-parameter transmitters and Smart Sensing technology that allow fast and simple commissioning of measurement systems.

The next generation of Smart Sensing, Intelligent Sensor Management (ISM®), is embodied in the M800; a touch screen-enabled, multi-parameter process analytical transmitter.

ISM digital technology is integrated into a Plug and Measure platform that provides predictive maintenance features for applications in the microelectronics industry. Multi-parameter measurement is

ideally suited for microelectronics facilities where precise measurement of total organic carbon (TOC), dissolved oxygen (DO), resistivity, and temperature compensation of ultrapure water are critical.

Sensor diagnostics at a glance

The M800 transmitter with ISM digital sensors brings intelligence to Smart Sensing and incorporates a highly intuitive user interface, expanded measurement parameters and, most significantly, advanced sensor diagnostics tools.

iMonitor is an advanced sensor diagnostics utility. It anticipates maintenance intervals based on real-time sensor performance information rather than sensor failure alarms or imprecise estimates. iMonitor evaluates each sensor's condition



METTLER TOLEDO



and calculates remaining sensor (or integrated consumable) lifetime to predict when service or replacement will be necessary. The number of days until maintenance should be performed is displayed on the M800 with a red, yellow, or green indicator bar, providing at-a-glance information based on traffic light color coding.

Diagnostics tools include

- **Dynamic Lifetime Indicator:** A unique algorithm uses actual and historic measurements and calibration values to calculate the time until the sensor/consumable should be replaced.

- **Adaptive Calibration Timer:** Based on sensor behavior, the ACT predicts the time until the next calibration should be performed.
- **Time to Maintenance:** TTM indicates when maintenance will be required.

Multi-parameter flexibility lowers inventory costs

Multiple measurement parameters include conductivity/resistivity, TOC, pH, ORP, DO, dissolved ozone, and flow accessed from one universal transmitter – a Thornton innovation. Today, this approach is becoming common in process

instrumentation because the multi-parameter platform brings significant added value to users.

ISM multi-parameter transmitters communicate directly with ISM sensors via a firmware handshake. Upon successful recognition, information from the sensor is uploaded to the transmitter, which automatically configures itself to measure the particular parameter. This Plug and Measure functionality means, for example, that a four-channel transmitter can measure four of the same or different parameters depending on the sensors installed for the application. This is achieved automatically, without the need for time-consuming setup. Multi-parameter transmitters offer more flexibility, less system complexity, and simpler inventory. Now you need order only one model of transmitter for your process analytics needs.

Greater reliability and higher accuracy

ISM sensors bring advanced digital sensing advantages to the METTLER TOLEDO Thornton portfolio. Digital sensing means the measurement electronics are seamlessly integrated within the sensor itself,

eliminating vulnerable transmission of analog signals between sensor and transmitter.

With ISM technology, a robust digital signal is sent to the transmitter via standard communication cables, incurring no signal loss due to cable capacitance, insulation leakage, or interruption from potential electrical interference sources within a facility. This results in more reliable measurements with less possibility of signal interruption or data loss that could cause critical

ISM



Multi-parameter M800 Transmitter showing predictive diagnostics screen

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process alarms or unanticipated downtime. Furthermore, because all measurements and calibrations are contained within the sensor, higher measurement accuracy is achieved.

Complete control at a touch

The large, high-resolution, color touch screen simplifies all transmitter operations. The freely programmable display of up to eight measurement values plus sen-

sor diagnostics provides all vital information on one screen. Fully tailorable wizard set-up allows you to reach any menu function in only three touches. This revolutionary concept reduces training effort and configuration failures to an absolute minimum.

Powerful by design

The combination of predictive diagnostics, multi-parameter measurement capability,

touch screen operation, and Plug and Measure functionality means the M800 is the most adaptable and user-friendly transmitter we have yet produced.

Discover more about the M800 at:

► www.mt.com/M800

Safeguarding Water Purity for Hard Disk Device Manufacturing

Ultrapure water is required throughout the production of hard disk storage devices. For one of the world's leading manufacturers, if out-of-spec water reached production lines it would result in "unimaginable consequences". On-line total organic carbon (TOC) sensors are ensuring that does not happen.

Hard disk specialists

One of the world's leading manufacturers in new technology operates a facility in South China where they specialize in the manufacture of cutting-edge hard disk storage devices. Their product range includes 1-inch, 2.5-inch, and 3.5-inch storage devices, as well as solutions catering to various other market requirements.

TOC monitoring is essential

The water supply capacity of the facility's ultrapure water system is 120 tons/hour and is used mainly to provide water for the cleaning of the entire factory's 1.7 million per year platter production line (the platter is the core component of hard disk storage devices).

During the platter manufacturing process, virtually every single procedure is followed by thorough cleaning. In the course of the cleaning process a large quantity of ultrapure water is used, the quality of which can directly influence the effect of the cleaning procedure and the quality of the products. Therefore, users set rigorous requirements for water quality. TOC concentrations should be 2–5 ppb and the resistivity should be around 18.1 M Ω -cm.

If the TOC concentration exceeded the specified amount, the consequences could be devastating as product quality and yield would be directly impacted. It would also cause organic substance pollution of the whole manufacturing line, leading to





significant economic losses and a lengthy delay in total output.

The company has installed two Thornton 5000TOC sensors in its ultrapure water system, to conduct TOC monitoring of its water purification equipment and its water distribution use location, respectively.

The 5000TOC sensor in the ultrapure water preparation system ensures that the quality of water produced by the equipment complies with concentration requirements in process water, so as to monitor whether the system is functioning normally. The 5000TOC at the water use location makes certain that users are informed promptly of any TOC pollution problem in the loop piping distribution system, in order to prevent organic substance pollution of ultrapure water during storage and distribution.

“Excellent industrial on-line TOC sensor”

In platter manufacturing, on-line TOC monitoring is required to stop unfit water from entering the production line. In this respect, the 5000TOC sensor has a distinct advantage compared with those from other manufacturers. Specifically, real-time, continuous monitoring provides a TOC measurement every two seconds, whereas other products usually need an interval of 6–10 minutes. Such a long analysis interval would mean that in the event of TOC exceeding limits, some 12–20 tons of out-of-spec water would be transmitted to different production lines with, as our customer puts it, “unimaginable consequences.”

In addition, the 5000TOC sensor and transmitter system features multiple electronic relays and an analog signal output function so that users can easily switch on/off, adjust, and alarm peripheral units such as the system’s transfer pump and control valves, making it very convenient to achieve automatic control and monitoring. The plant’s chief engineer says that the 5000TOC is, “unmatched in many respects compared with other similar instruments. Accurate, stable, and convenient it is indeed an excellent industrial on-line TOC sensor.”

High performance, low maintenance

Like the 5000TOC the 5000TOCi, our latest TOC instrument, conducts TOC analysis by the continuous derivative conductivity UV method. Unlike other TOC sensors, it contains virtually no moving



components, thus effectively avoiding the risk of TOC pollution of the sensor.

The only routine maintenance required for the 5000TOCi is the periodic replacement of the ultraviolet lamp, and it takes a skilled engineer only three minutes to complete the replacement procedure.

The compact and robust design of the sensor enables it to work easily in combination with ultrapure water purification systems, piping systems, and other purification equipment. The instrument can be installed on walls or pipes making it an ideal choice for industrial applications.

After-sales service whenever required

As one of the world's leading instrument manufacturers, our technical support experts supply our users with professional after-sales service support. According to our customer's chief engineer, "Thornton provides high-quality service with rapid response, and its technical support in relation to the operation of the TOC and other products is excellent."

On-board intelligence

Equipped with powerful Intelligent Sensor Management (ISM®) technology, the 5000TOCi combined with the M800 multi-parameter transmitter provides a wide range of monitoring and control capabilities. The iMonitor, associated with our ISM technology, provides a fast, simple method for diagnosing system health. The 5000TOCi Sensor and M800 also offer advanced features such as automatic flow control, a highly intuitive user interface, and a system-guided semi-automated calibration method that significantly simplifies routine maintenance.

These innovative features transform the 5000TOCi measurement solution into a powerful process monitoring tool for protecting the normal operation of a water treatment system and subsequent production.

If you want to maximize production and reduce water wastage at your facility, go to:

► www.mt.com/TOC

5000TOCi

The latest version of the 5000TOC is now available. 5000TOCi improves the performance of the sensor still further with important new features and the inclusion of Intelligent Sensor Management (ISM) technology.

Main benefits of the 5000TOCi Sensor:

The 5000TOCi Total Organic Carbon Sensor with ISM delivers the power of an analyzer with the convenience of a sensor. This state-of-the-art ISM technology:

- Drastically reduces record keeping for the release of water through simplified data collection with innovative Peak and Average data compression
- Improves the quality and consistency of calibration with a semi-automated process which eliminates external interference
- Reduces maintenance record keeping: Easily monitor instrument performance trends through storage of up to four calibration reports
- Rapidly determines maintenance requirements through convenient ISM diagnostics and sensor status
- Improves the reliability of continuous, real-time TOC analysis by eliminating sensitivity to system pressure changes using Automated Flow Control



Greater Process Integrity with Digital Conductivity Measurement

Measurement of water conductivity/resistivity is crucial in many microelectronics processes to ensure ultrapure water quality, determine chemical concentration, in wastewater treatment, etc. Recent improvements in conductivity measurement technology have culminated in the development of digital UniCond® sensors that enable greater accuracy, sensitivity, ease of use, and reliability.

Choosing the right conductivity sensor

Selecting the correct model of conductivity sensor can not only provide a more accurate measurement, it can also reduce maintenance and simplify handling for operators, as well as increase process integrity.

In the cases of highly conductive fluids, four-electrode sensors are more suitable than two-electrode designs as four-electrode sensors are not subject to the polarization errors that can occur with two-electrode sensors. Additionally, in wastewaters, four-electrode sensors are also resistant to fouling from contaminants and therefore require less frequent cleaning.

Conventional analog conductivity measurement

Traditional conductivity measurement systems consist of the sensor mounted in the piping system at an appropriate location, with a cable running back to the display transmitter on a control panel. The transmitter contains the measuring circuit, which applies an AC voltage to the sensor to make the measurement. Although precautions are taken to minimize cable effects, the length and routing of the cable for each measurement point is different and will invariably have some influence on the measurement.

In addition, the transmitter installed at the fab is obviously not the same unit that was used for factory calibration of the sensor. Transmitters have some small tolerance in their calibrations, and the change from one transmitter to another adds another error to the installed measurement. These error sources can be cumulative and may adversely affect the accuracy of conductivity measurements.

Highly conductive samples require very low resistance measurements, and the leadwire and contact resistance in four-electrode sensors can contribute significant errors. With traditional separation of the sensor from the measuring circuit, leadwire and contact resistances are variable and difficult to control. This situation generally requires extensive calibration of the complete measurement system at installation and whenever a component is changed: a significant addition to time and logistics needed at start up.

Leading-edge digital conductivity solution

The advance of miniaturized electronics and very careful engineering of conductivity measurement circuits and sensor design have resulted in sensors capable of at least a 33% improvement in accuracy of conductivity measurement compared with analog systems.

METTLER TOLEDO Thornton's UniCond 4-E (four-electrode) conductivity sensors with Intelligent Sensor Management (ISM®) technology have the measuring circuit, calibration data, plus analog-to-digital conversion all built into the sensor itself.

Because the measuring circuit is part of the sensor and is inseparable from the sensing element, the two components are factory calibrated together as a system. This means that installed accuracy ex-



actly matches factory calibration accuracy. It also leads to a valuable feature of ISM, Plug and Measure: The operator does not have to enter any data, because the sensor already carries all its factory calibration and identifying information. This on-board memory also makes sensor set up more reliable as there is no chance of the operator forgetting to enter calibration data or of entering incorrect data. Once the sensor is connected, the system is ready to measure immediately.

To counteract possible cable effects, UniCond 4-E sensors send a robust digital signal to the transmitter. Being digital, the signal does not degrade, regardless of cable length, resistance, or capacitance.

Many processes, one sensor

In addition to greater accuracy, the very close proximity of the measuring circuit to the sensor element within UniCond 4-E sensors has enabled a highly optimized measuring technique that can work across

an exceptionally wide range. These same UniCond 4-E sensors can be utilized from treatment of raw water to monitoring industrial process fluids, simplifying spare parts and maintenance.

UniCond 4-E sensors are used with transmitters that can provide direct readout in conductivity or chemical concentration units for several acids, salt, and caustic (sodium hydroxide).

Simple installation

A further advantage of these sensors is their small process connection. UniCond 4-E sensors have 1" NPT process connections for insertion or submersion mounting. They are available with PEEK or CPVC polymer bodies and 316 L stainless steel or Hastelloy C22 electrodes. The wetted electrode surface area is less than 1 cm², so there is little exposure of metal to the process fluid.

To find out more about UniCond conductivity sensors, visit:

► www.mt.com/UniCond

Best Practice

On-line measurement means optimized production and lower operating costs

The continuous stream of data that on-line measurement provides lets you know that your processes are working as they should and informs you the instant that they are not, helping you to maximize production and reduce operating costs.

Discover more at:

► www.mt.com/pro-micro

ISM



UniCond 4-E conductivity sensor

More Reliable, Less Maintenance Advanced Ozone Measurement

The increasing popularity of ozone as a disinfecting agent for ultrapure water is testament to its efficacy and economy. Efficient ozonation systems require the use of sensors to ensure proper dosage and confirm the absence of ozone after destruction by UV. METTLER TOLEDO offers a proven dissolved ozone sensor designed for high performance and low cost of ownership.

Controlling bacteria with ozone

The use of dissolved ozone in the production of ultrapure water is commonplace in microelectronics facilities around the world. It is an economical and practical approach to controlling bacteria levels in final treatment processes of ultrapure water. As many plants operate around the clock, all year, it is obvious that the instrumentation used to monitor ozone must be reliable, robust, and require little maintenance.



Polarographic dissolved ozone sensor

Optimized ozone sensor

Dissolved ozone measurement has typically been accomplished using instrumentation that ranges from sophisticated, high-cost, maintenance-intensive equipment that gives good performance, to low-cost, less reliable equipment with flow-sensitive readings. We offer a proven polarographic dissolved ozone sensor optimized for a wide range of measurement, which provides low maintenance operation and is designed to operate on our M800, M300 ISM®, and M300 multi-parameter transmitters.

The M800 and M300 ISM transmitters offer Intelligent Sensor Management, providing sensor identification, Plug and Measure, and calibration history retention. In addition, the M800 features the full suite of ISM sensor diagnostic tools including Adaptive Calibration Timer (ACT), Time to Maintenance (TTM), Dynamic Lifetime Indicator (DLI), and a sanitization counter.

Convenient, flexible transmitters

In most ultrapure water systems using dissolved ozone, multiple measurement points are needed to ensure proper dosage and also to confirm the removal of residual ozone after ozone-destroy by exposure to ultraviolet light. The multi-parameter and multi-channel capabilities of our transmitters provide the convenience of having only one transmitter model to operate for multiple measurements.

Straightforward, rapid sensor maintenance

Sensor reliability is often a function of durability designed into a device. Our ozone sensor contains materials of construction calculated to provide long-lasting performance.

The sensor body is made of stainless steel, offering high corrosion resistance. The reinforced silicone membrane maintains performance while offering the durability required for applications where maintenance downtime can be extremely costly. However, all dissolved ozone sensors require periodic maintenance. This is where Thornton's ozone sensor clearly separates itself from other sensors.

The membrane cartridge design reduces time for periodic maintenance to a few minutes. Cartridge exchange is achieved by simply unscrewing the end of the sensor body, removing the existing cartridge, filling a new cartridge with electrolyte, installing the new cartridge into the end cap, and screwing it back onto the sensor body. This is a significant improvement in convenience and time savings over other dissolved ozone sensor designs.

Find out more at:

► www.mt.com/Thornton-ozone

Keep Up to Date Microelectronics Competence Center

METTLER TOLEDO Thornton is dedicated to continuous improvement in producing instruments for the detection of impurities in microelectronics facility water systems. An online resource keeps you informed as to our latest developments in monitoring and measuring pure water.

Essential monitoring of high purity water

The microelectronics industry requires large quantities of ultrapure water in production processes. Cleaning, rinsing, and etching of wafers and substrates consumes thousands of cubic meters of UPW per day in a typical facility. Process analytical measurements are vital to optimize water usage and maximize recovery and reuse.

We offer an extensive range of analytical instrumentation specially designed for use in the most demanding microelectronics processing applications. Thornton provides superior solutions for monitoring resistivity/conductivity, TOC, pH, ORP, dissolved oxygen, dissolved ozone, silica, and sodium to increase the volume of water recovered, limit discharge and reduce processing costs.

The latest information

We recently launched an online resource for ultrapure water used to manufacture microelectronics. Learn more about in-line measurement solutions featuring the unique Intelligent Sensor Management (ISM) concept for Plug and Measure convenience in analytical measurement.

Resources in this competence center include information on instruments for



monitoring and measuring ultrapure water used to manufacture semiconductor wafers, photovoltaic cells and flat panel displays.

- Semiconductors – Thornton has in-depth knowledge of the critical measurements needed for semiconductor processing and ultrapure water production. Our instruments for resistivity/conductivity, TOC, pH, ORP, dissolved oxygen, and dissolved ozone are specified to monitor and control UPW systems in the majority of semiconductor manufacturing facilities worldwide.

► www.mt.com/pro-semi

- Photovoltaic cells – Thornton enables photovoltaic manufacturers to improve product quality and maximize yields by providing innovative measurement and monitoring solutions for critical etching/texturing, cleaning, and rinsing operations. Our in-line measurement solutions for UPW in a modern PV cell production facility include resistivity/conductivity, TOC, pH, ORP, dissolved ozone, and dissolved oxygen.

► www.mt.com/pro-pv

- Flat panel displays – We offer the flat panel production facility accurate and continuous real-time measurement solutions for resistivity/conductivity, TOC, pH/ORP, dissolved oxygen, and dissolved ozone in order to increase yield from make-up and ultrapure water to water reuse, recycle, and reclaim.

► www.mt.com/pro-fpd

Visit the microelectronics competence center “In-line Measurement Solutions for UPW in Microelectronics” at:

► www.mt.com/pro-micro

Increased Dependability of Silica Measurements

The **2800Si Analyzer** provides reliable, repeatable, and accurate measurements of silica in ultrapure water. Advanced features, including unattended calibration and automatic zeroing, allow users to prevent UPW-related issues such as spot formation on wafers.

Water spots on wafers lead to a number of quality issues, including reduced film adhesion and contact resistance.

To minimize these, the silica level in ultrapure water has to be continu-

ously monitored and controlled at sub-ppb levels. According to the ITRS Roadmap, total silica in ultrapure water should be <0.3 ppb.

By integrating technological advances and satisfying user needs, the 2800Si Analyzer provides reli-

able measurements of silica while having one of the lowest costs of ownership among all silica analyzers.

Find out more at:

► www.mt.com/Thornton-silica

Your benefits



Extremely reliable measurements

Features including automatic zeroing and temperature monitoring ensure highly accurate silica determination.



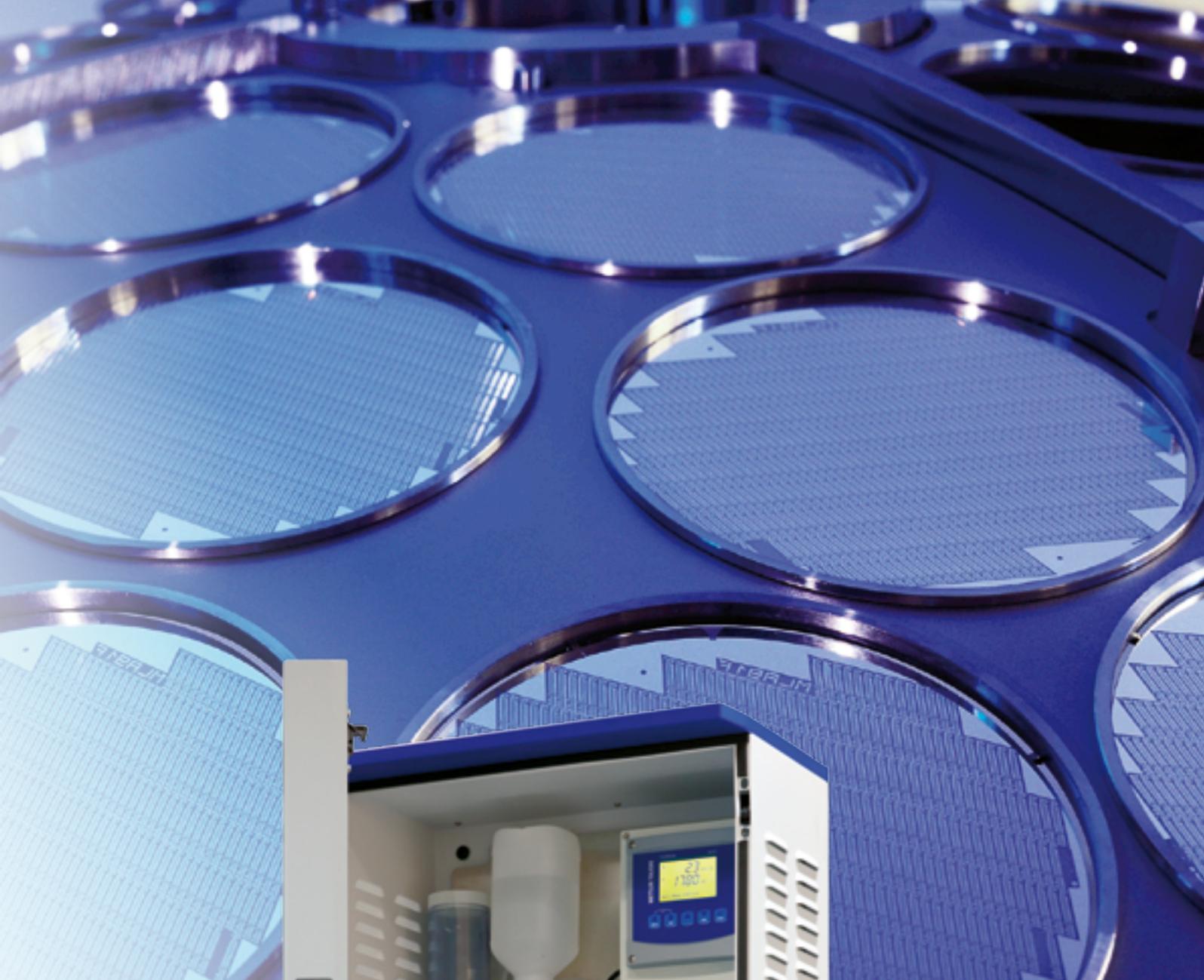
Automatic calibration

Fully automatic, unattended calibration provides repeatability and saves operator time.



Long service intervals

Large reagent containers allow longer service intervals and reduce analyzer downtime.



2800Si Silica Analyzer

Get in-line with METTLER TOLEDO



Water Calculator App for Mobile Devices

A water calculator application for smart phones and mobile devices enables water specialists to perform water calculations and unit conversions using an iPhone®, iPod touch®, iPad®, or Android™-compatible smart phone or mobile device.

This FREE application calculates:

- Conductivity, resistivity, and total dissolved solids (TDS) conversions
- Flow rate and flow velocities for various pipe sizes
- Temperature versus resistivity and conductivity of ultrapure water
- Sample and process flow rate unit conversions
- Temperature conversion between °C and °F

For more information, visit:

► www.mt.com/pro-watercalc

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