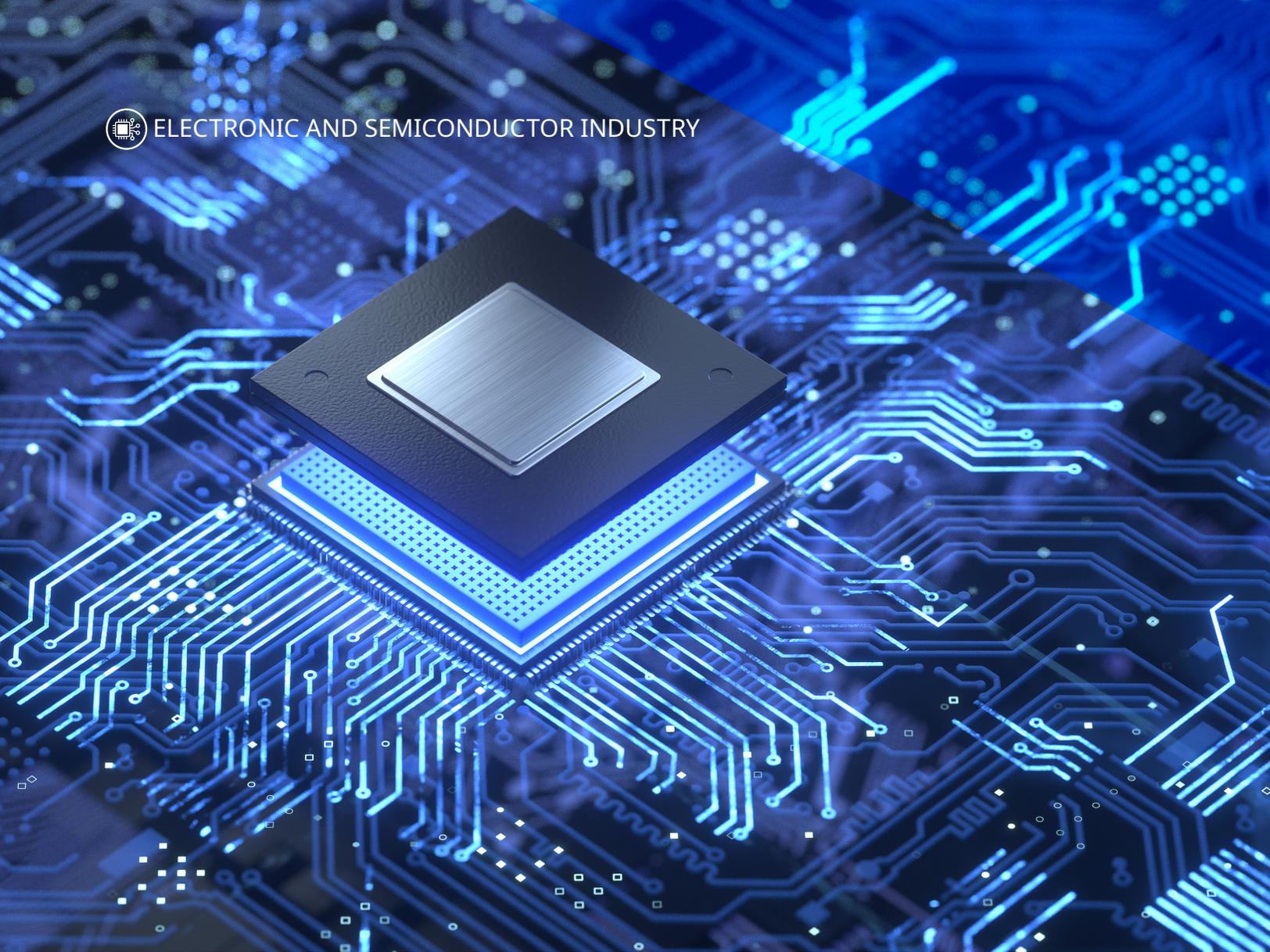




ELECTRONIC AND SEMICONDUCTOR INDUSTRY



# Hach's Semiconductor Quick Reference Guide



*Be Right™*



### “Be Right” when it comes to Ultrapure Water Quality Demand

The semiconductor industry uses Ultrapure Water (UPW) as an essential cleaning fluid, requiring the most extreme qualities to rinse “silicon wafers” after each elementary component and circuit installation operation.

Modern plants produce smaller electronic elements requiring water quality analysis at extremely low levels. Table 1 illustrates changes to rinse water specifications in DRAM documentation. Silicon etching has become so fine that no trace of particulate deposits, bacteria, or salts can be present after rinsing. As the race toward miniaturization requires more and more exacting margins, water quality analysis demands more reliability. Silicon quality defects due to rinse fouling, cause costly rejections, and even line-down situations.

With such a high standard of requirements you need a trusted partner with longstanding expertise

in Ultrapure Water. Hach®’s fully integrated monitoring solutions, complete suite of field and lab instruments, along with our process control solutions, will help you navigate day-to-day semiconductor plant needs, boost operational efficiency, and be confident in maintaining process and regulatory compliance.

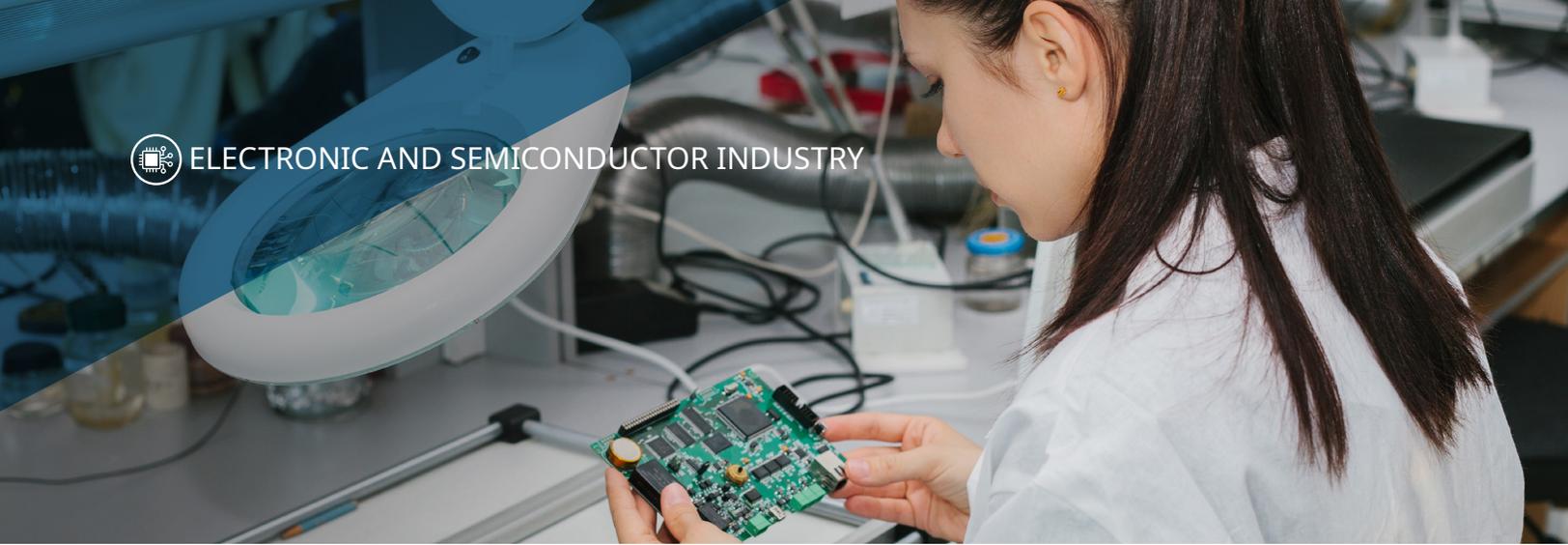
The semiconductor industry relies on our water quality experts to innovate analysis performance solutions meeting their specific needs. With nearly a century of water analysis experience, Hach’s portfolio and scientific thought leadership provides best-in-class partnership with semiconductor professionals across the globe. As a Danaher operating company, Hach is also positioned to leverage cross-corporation collaboration with adjacent expertise to deliver solutions for this highly specialized industry.

Etching fineness		0.9 µm	0.7 µm	0.5 µm	0.35 µm	0.25 µm	0.13 µm
DRAM	octets	1 M	4 M	16 M	64 M	256 M	1 G
Resistivity (25°C)	M Ohm - cm	17.8	18.1	18.2	18.2	18.2	18.2
Bacteria	CFU - L <sup>-1</sup>	100	50	50	30	20	10
TOC	ppb	50	10	5	3	2	1
SiO <sub>2</sub>	ppb	10	5	5	3	3	1
Cations	ppt	1,000	500	50	5	2	
Anions	ppt	100	100	75	50	20	20
Oxygen	ppb	25	25	25	10	10	3
Particles> 0.5 µm	nb - L <sup>-1</sup>	200	200	200	50	50	5
Particles> 0.2 µm	nb - L <sup>-1</sup>	500	500	500	100	100	10
Particls> 0.1 µm	nb - L <sup>-1</sup>	1,000	1,000	1,000	350	350	100
Particles> 0.05 µm	nb - L <sup>-1</sup>			1,000	1,000	200	

Table 1: Ultrapure Water for the electronics industry—example of changing specifications



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Below are examples of some of the solutions Hach can provide:

### Water classification according to ASTM D5127 norm

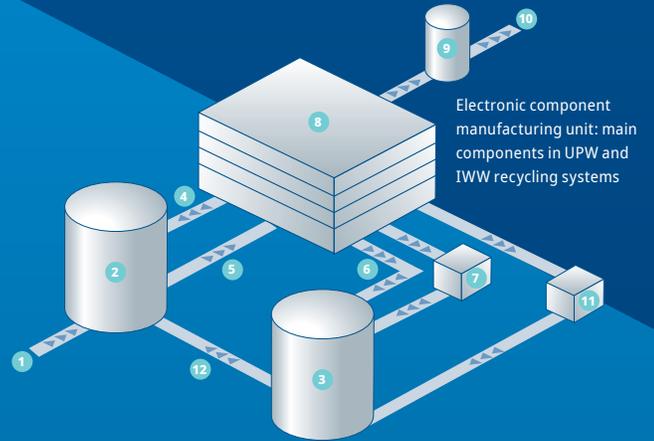
- **Type E-1**—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.5 and 1.0  $\mu\text{m}$ .
- **Type E-1.1**—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.25 and 0.35  $\mu\text{m}$ .
- **Type E-1.2**—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.09 and 0.18  $\mu\text{m}$ .
- **Type E-1.3**—This water is classified as microelectronic water to be used in production of devices having line widths between 0.065 and 0.032  $\mu\text{m}$ . This type is the water of ultimate practical purity produced in large volumes and is intended for the most critical microelectronic uses. ASTM Type E-1.3 is also identical to the SEMI (Semiconductor Equipment and Materials International) Guide for Ultrapure Water Used in Semiconductor Processing (F063), 2010 version.
- **Type E-2**—This water is classified as microelectronic water to be used in the production of devices that have dimensions between 1 and 5  $\mu\text{m}$ .
- **Type E-3**—This grade of water is classified as macroelectronic water to be used in the production of devices having dimensions larger than 5  $\mu\text{m}$ . This grade may be used to produce larger components and some small components not affected by trace amounts of impurities.
- **Type E-4**—This grade may be classified as water used in preparation of plating solutions and for other applications where the water being used can be of lesser quality.



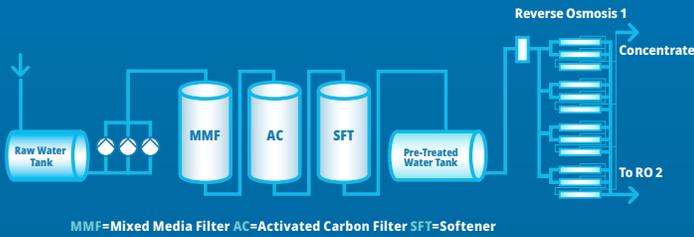
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# Semiconductor Manufacturing Process

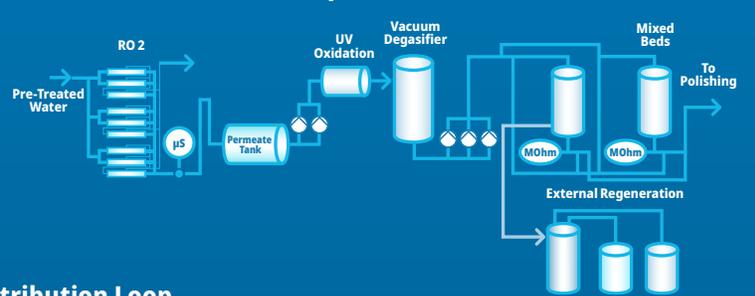
- 1. Mains Water
- 2. Ultrapure Water Production
- 3. Recycling System
- 4. Ultrapure Water Loop
- 5. Ultrapure Water Loop
- 6. Rinsing Water
- 7. CMP
- 8. FAB
- 9. Wastewater Treatment
- 10. Discharge
- 11. Organic Industrial Wastewater
- 12. Pre-treated Recycled Water



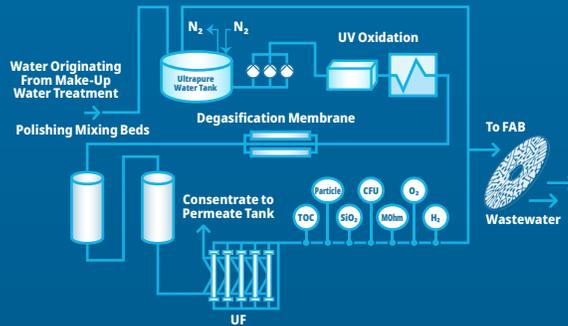
## Pretreatment



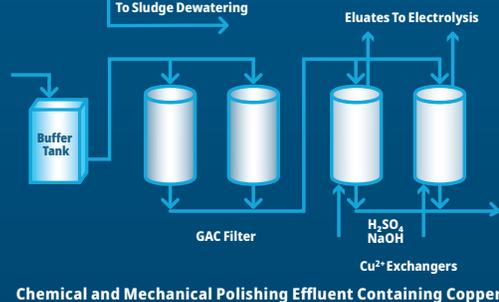
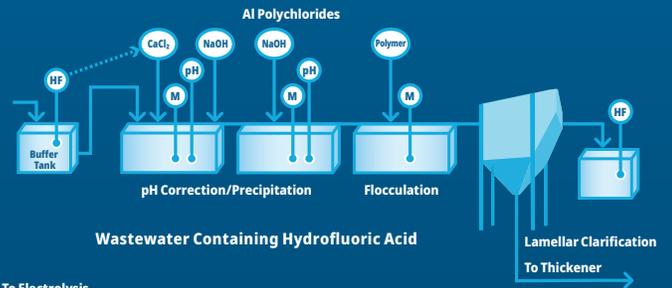
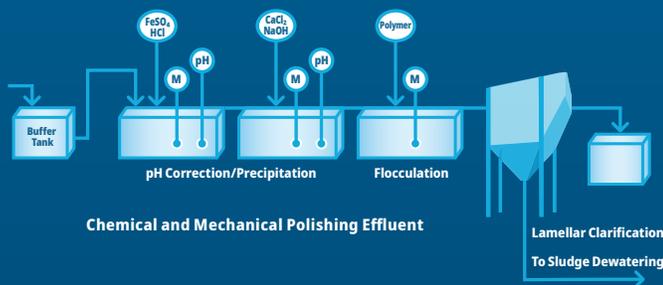
## Make-Up Water Treatment



## Polishing and Distribution Loop



## Three Examples of Wastewater Installations





## Monitor and Optimize your Dechlorination process

### Mitigate issues-Optimize your process

Hach Ultra Low Range CL17sc has the lowest limit of detection at less than 8 ppb, and uses colorimetric DPD Standard Method 4500-Cl G.

### Protect your assets

Understand the true impact of chlorine exposure. The Ultra Low Range CL17sc allows for process control across your water cycle, including visibility into GAC exhaustion or channeling and dechlorinating agent dosage. It is the only instrument with a cumulative chlorine counter, which helps you forecast your RO membrane efficiency and its useful life.



Ultra-Low Range CL17sc



3444B8 Conductivity Sensor

## Conductivity Sensors

- Each sensor has a unique four-digit cell constant determined according to ISO 7888 and ASTM D 1125 standards.
- Quickly and easily transfer user settings between conductivity loops.

- Reduce training complexity
- A single platform minimizes time required to teach and learn product operations, getting new systems in use faster.
- Simplify maintenance and operation
- Common menu guides reduce variability and provide step-by-step procedures for maintenance and calibration.
- Robust construction with 316 Stainless Steel and a sturdy industrial design ensures the product can withstand even the most demanding conditions.
- Hach's contacting conductivity sensors measure a broad range (pure water 0.057  $\mu\text{S}/\text{cm}$  up to 20,000  $\mu\text{S}/\text{cm}$ ) with high accuracy.



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**5500sc SiO<sub>2</sub>**

### Lower Maintenance, Less Downtime

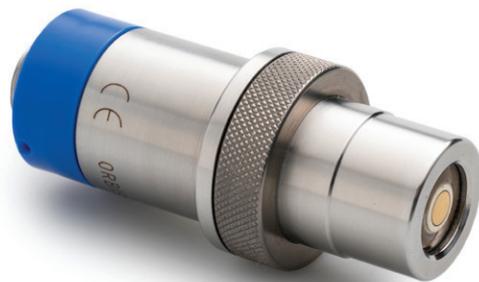
The 5500sc silica analyzer needs only two liters of reagent to perform unattended for up to 90 days. The industry's only pressurized reagent delivery system eliminates the frequent maintenance associated with pumps.

- Prognosys allows you to be proactive in your maintenance.
- Warning LEDs, and high-visibility notification screens let you avoid unplanned downtime.
- Grab Sample In and Grab Sample Out features allow quick analysis of a grab sample poured into the analyzer and facilitate taking a sample out of the online silica analyzer to verify in a lab test.

### Highly accurate and customizable oxygen measurement for all environments

The Orbisphere GA2400/GA2800 EX oxygen (O<sub>2</sub>) Electrochemical (EC) sensors are designed for process monitoring as well as laboratory analysis in the liquid or gas phases across.

- The Orbisphere GA2400 O<sub>2</sub> EC-sensor can be used for a wide range of applications like rinsing of semiconductor waters in chip-manufacturing plants.
- A small residual signal with unrivalled accuracy ( $\pm 0.1$  ppb) is made possible by the exclusive sensor design.
- Different pre-mounted membrane kits are available to fulfill any particular process requirements and O<sub>2</sub> measurement ranges required



**GA2400/GA2800 EX Orbisphere Sensor**



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### Ultra-High Precision Low Range Laser Turbidimeter

The next standard in the evolution of turbidity. Compliant with EPA approved Hach Method 10258 and great for conventional filtration and other low range turbidity measurements, the TU5300sc employs a patented optical design that sees more of your sample than any other turbidimeter, delivering the best low-level precision and sensitivity while reducing variability between measurements. For the first time you will be able to remove uncertainty of which measurement to trust between your lab and online instruments, thanks to identical 360° x 90° Detection Technology in any TU5 Series turbidimeter.

- Ability to measure to 0.002 NTU, gives you the next standard in the evolution of turbidity.
- Groundbreaking 360° x 90° Detection Technology
- Matching lab and online results
- Everything about turbidity – faster
- No surprises



**TU5400 sc**

### A customized solution for water quality testing that takes the guesswork out of your measurements



**HQD Meters with IntelliCAL probes**

### Easy to Use in the Field.

Information is clearly displayed on one screen with back light for low light conditions. Display results can be enlarged for easier reading.

### Probes for Every Application

All IntelliCAL probes are automatically recognized by HQD meters and retain calibration history and method settings to minimize errors and setup time. Offering a complete portfolio of water testing parameters and a simple bench top setup, this meter provides the ultimate in lab analysis. The intuitive user interface with guided calibration accurate results, and with a new, large, backlit LCD screen, the meter is simple to read even when measuring two parameters simultaneously.



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**Titration**



**Chemiluminescence Analyzer**



**Colorimetric Analyzer**



**ISE Analyzer**

## **EZ Series Online Analyzers Your Complete Solution**

### **One Platform – Multiple Technologies**

Thanks to the versatile instrument platform, in many cases it will be possible to match the online analysis to your established laboratory method.

- Colorimetry
- Ion-selective electrode (ISE)
- Single and multi-parameter titration
- Voltammetry
- Chemiluminescence or respirometry

All EZ Series analyzers come in the same rugged mainframe with a compact footprint. Their common user interface on industrial panel PCs is easy to use and keeps training efforts low.

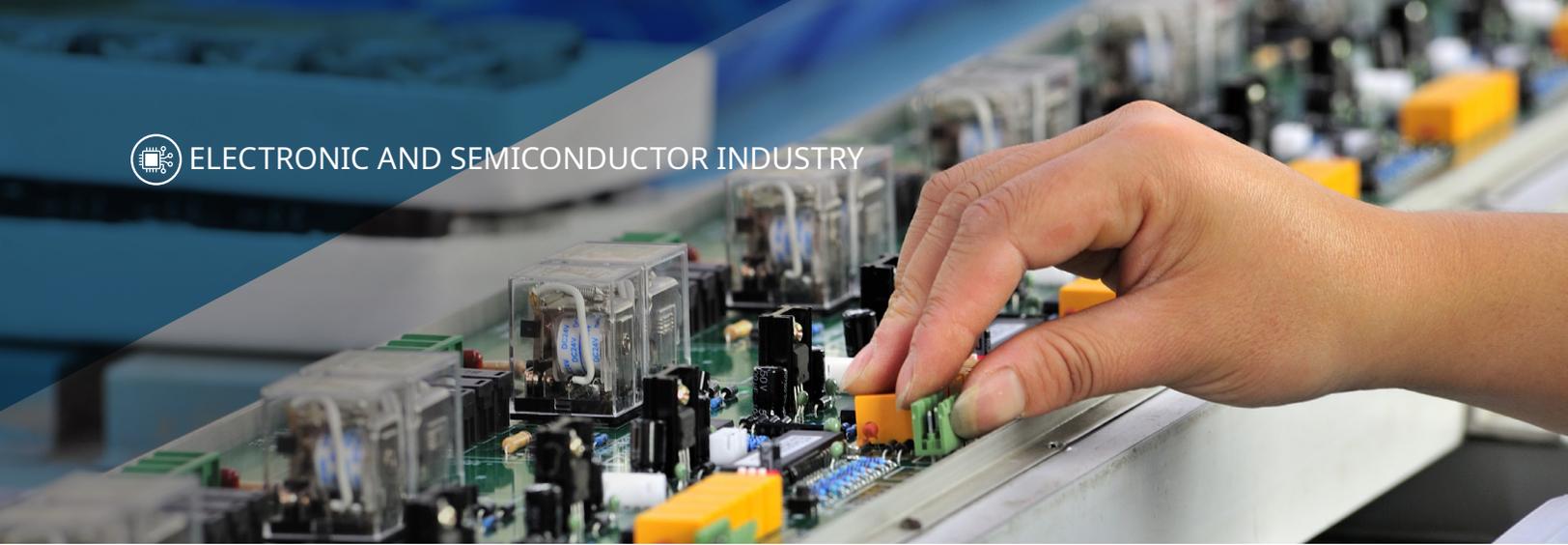
### **Applications**

EZ Series parameters cover the complete water cycle from water intake to wastewater effluent. Learn more by downloading application notes and parameter specific documents from the Hach Support Page. Some examples:

- Aluminium in drinking water
- Iron and Manganese in raw water
- Microbial Activity / ATP in industrial and environmental applications
- Volatile Fatty Acids and Alkalinity in anaerobic digesters
- Alkalinity and Hardness in cooling cycles



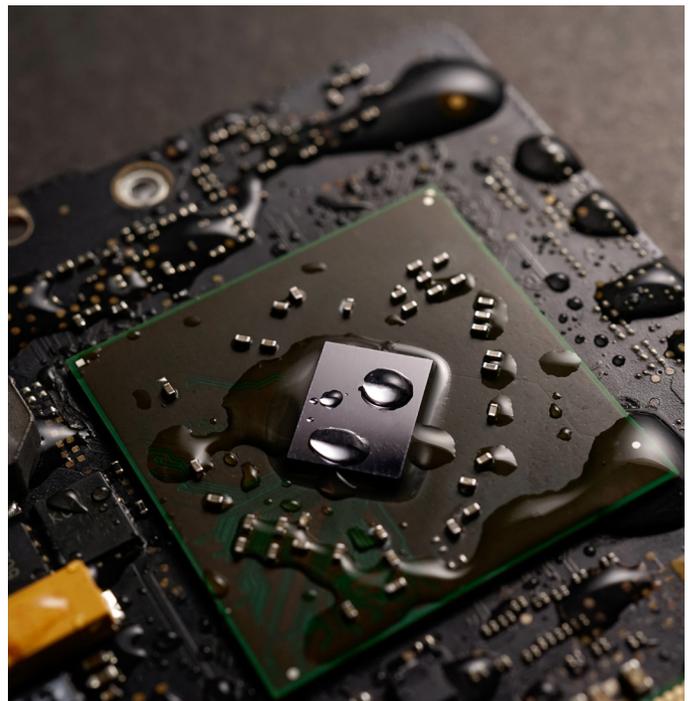
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## Conclusion

Whether rinsing or positioning the individual components on a wafer, the key factor in each stage of production is purity. All processes need to be performed without any impurities present including monitoring airborne particles in clean rooms and maintaining purity with rinsing agents. Simply de-ionizing the water is not enough. Targeting the quality of the Ultrapure Water requires the use of highly accurate water analyses. Even particles just micrometers in size can seriously impair the process.

As a world leader in water analytics, we have fully integrated monitoring solutions to address your water needs related to production performance, cost efficiency and sustainable development. From source water to wastewater monitoring and analysis, to Ultrapure Water, you can depend on Hach.



To learn more, visit [hach.com/industries/semiconductors-electronics](https://hach.com/industries/semiconductors-electronics), or reach out to a Hach representative today.

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