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On-Line TOC Analyzers for Pure Water TOC-1000e S

Application News

Online TOC Measurement for Ultra-pure Water in Semiconductor Industries

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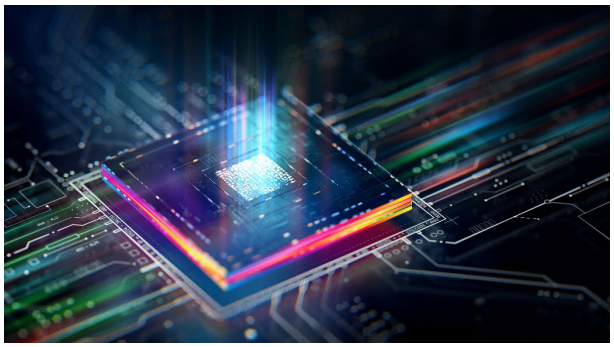
User Benefits

- Enables stable measurement of ultra-pure water with TOC concentrations below 1 µg/L.
- The large color touch panel and compact body make operation easy.
- The Active-Path™ structure, which integrates the lamp and sample flow path, enables high oxidation performance.

■ Introduction

The semiconductor manufacturing process involves various stages such as wafer production, film formation, photolithography, etching, and resist stripping, each of which involves cleaning steps. Even minimal contamination on the semiconductor surface can impact product quality and yield, making it crucial to effectively remove dirt and impurities during cleaning. For this reason, the purity of the cleaning water used in these cleaning processes is extremely important. The recent trend towards ever-smaller, higher-capacity semiconductors means that ultra-pure cleaning water, thoroughly free of organic and other impurities, has become essential.



Typically, ultra-pure water is produced by first purifying tap or groundwater to produce pure water, and then further refining it into ultra-pure water. Impurities in water include organic and inorganic substances, particles, as well as microorganisms. Various methods, such as activated carbon filters, reverse osmosis (RO) membranes, ultraviolet lamps, and ion exchange resins, are used in combination to purify water into ultra-pure water.

Maintaining the quality of ultra-pure water used for semiconductor cleaning is critical. The online TOC analyzer for ultra-pure water, TOC-1000e S (Fig. 1), enables highly sensitive TOC measurement with a detection limit of 0.02 µg/L using UV oxidation and conductivity measurement methods. This application presents the features and functions of the TOC-1000e S, along with examples of online measurements of ultra-pure water.

Fig. 1 TOC-1000e S

■ Features of TOC-1000e S

The TOC-1000e S is an ultra-compact device that can be installed on a tabletop, wall, or pole mount. The front panel features a large color touch panel that is highly visible even in dark environments, enabling easy operation. An excimer lamp (mercury-free) that emits high-energy ultraviolet light with a wavelength of 172 nm is used as the light source for the oxidation section. To ensure the oxidation of organic compounds, TOC-1000e S uses a unique structure called Active-Path, which integrates the excimer lamp and the sample flow channel. In a typical ultraviolet irradiation section, an air gap between the lamp and the sample flow channel results in inefficient ultraviolet light transmission and the generation of ozone within the device. However, in Active-Path, a sample flow path within the light-emitting part enables efficient irradiation of the sample with ultraviolet light while preventing ozone generation (Fig. 2).

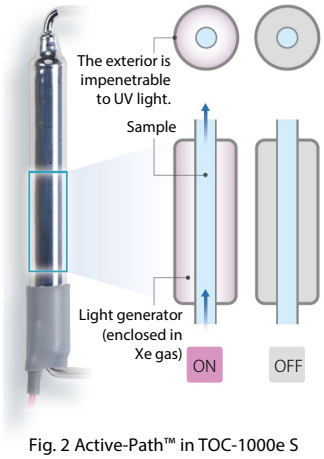


Fig. 2 Active-Path™ in TOC-1000e S

■ Usability of TOC-1000e S

TOC-1000e S displays the latest measurement results and trends simultaneously on the same screen during measurement, enabling users to check the measurement status (Fig. 3) easily. It also supports user authentication via ID/password and operation history recording.

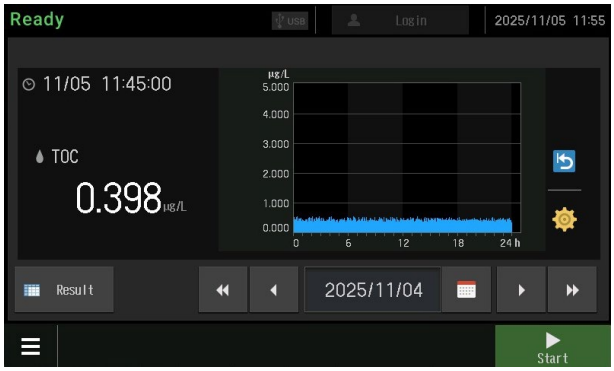


Fig. 3 Touch Panel Screen for the Latest Result and Trends

Maintenance involves only replacing the excimer lamp and the pump head once a year. This task can be performed easily on-site without tools. After maintenance or relocation, the equipment's stability can be confirmed using the "stability remark function" before resuming online measurement.

Measurement data can be output to USB memory drives in CSV or PDF format. Additionally, the device can connect to a LAN, allowing measurement data to be viewed and obtained using a web browser on a PC or tablet. The TOC-1000e S includes external input/output functions as standard. Measurement data can be output via analog output, and alarms and events via contact output.

By using optional pre-prepared standard solutions and a vial sampler, calibration and validation can be carried out. Calibration procedures are displayed on the touch panel for easy on-site execution (Fig. 4).

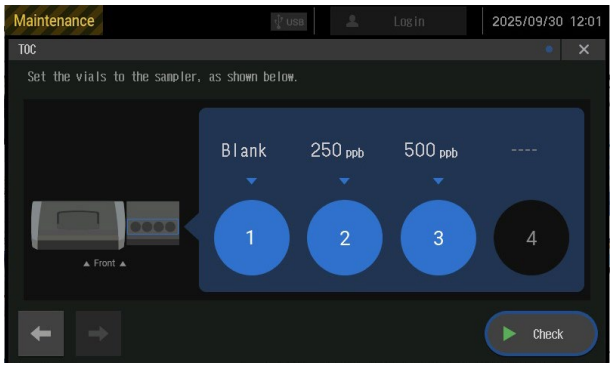


Fig. 4 Touch Panel Screen for Calibration

■ Measurement of Ultra-Pure Water

The TOC-1000e S was connected to ultra-pure water purification equipment and performed online measurements at five-minute intervals. The measurement conditions are shown in Table 1. Fig. 5 shows the trend graph of TOC values measured over approximately one week under the conditions specified in Table 1. It can be seen that stable measurements of ultra-pure water with TOC concentrations below 0.2 µg/L are achieved.

Table 1 Measurement Conditions

Analyzer	:	Shimadzu TOC-1000e S online total organic carbon analyzer
Range	:	500 µg/L
Calibration Curve	:	0 – 250 – 500 µg/L Sucrose standard solution
Measurement Interval	:	5 minutes

■ Conclusion

TOC-1000e S enables the monitoring of TOC of ultra-pure water used in semiconductor manufacturing. The compact body and user-friendly interface assist users in their routine operations.

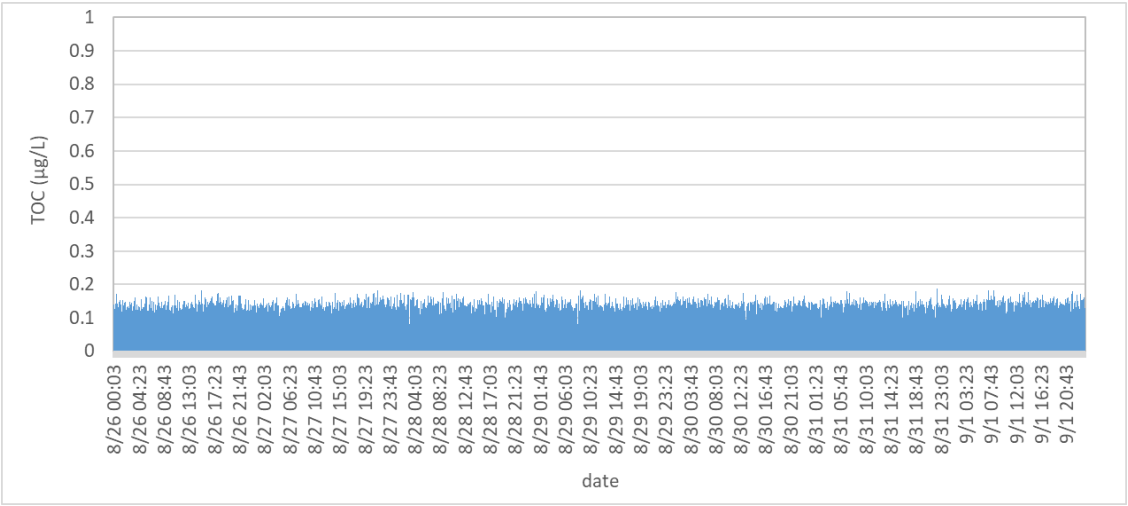


Fig. 5 Trend Graph of Measured TOC Values

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On-Line TOC Analyzer for Ultrapure Water

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