



# The A10<sup>®</sup>

## Total Oxidizable Carbon Monitor

### A10 TOC Monitor Provides a Complete Picture of Water Purity

While resistivity is a sensitive and accurate way to measure and display the level of ionic concentration in ultrapure water, it gives no indication of the level of dissolved organic compounds that may be present. Ultrapure water with a resistivity of  $18.2 \text{ M}\Omega\text{-cm}$  @25 °C has a low inorganic salt\* level, but concentrations of organic substances still may remain high. Many laboratory experiments will be affected by even relatively low levels (50 ppb TOC) of organic contaminants. As a result, it is necessary to monitor these contaminants in order to give scientists a complete and accurate picture of the quality of high purity water used in the laboratory.

\*The theoretical resistivity of ultrapure water containing no other ions aside from the protons and hydroxyl resulting from the water molecule dissociation is equal to  $18.2 \text{ M}\Omega\text{-cm}$  @25 °C. The addition of only  $1 \mu\text{g/l}$  of NaCl makes the resistivity value drop to  $17.5 \text{ M}\Omega\text{-cm}$  @ 25 °C.

### TOC Reduction Improves Laboratory Results

For instance, a moderate TOC level in high purity water used for chromatography applications will degrade the baseline quality and reduce the sensitivity of an analysis. Additionally, the presence of TOC will shorten the lifetime of chromatography columns by fouling the chromatography column beads and subsequently preventing a good mass transfer between the beads and the mobile phase.

The variable presence of undetermined organic substances in ultrapure water used for the preparation of culture media or buffers will also affect experiments including cell culture or electrophoresis separations.

For all these reasons, it is important for laboratories to be able to regularly measure the TOC level of high purity water.

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## Millipore TOC Monitors

To meet this need, Millipore's Milli-Q® water purification systems are designed with a built-in TOC monitor to ensure regular, on-line measurement of the level of organic substances in ultrapure product water at the time of delivery.

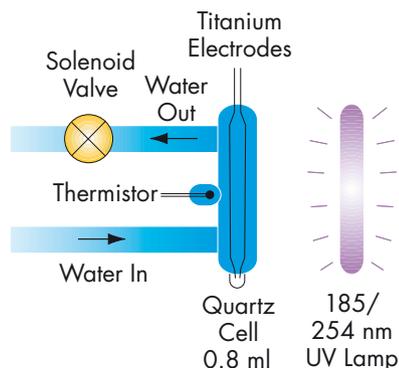
Millipore also offers an alternative solution to scientists who wish to measure the TOC level in high purity water delivered by systems without a built-in TOC monitor. The independent Millipore A10 TOC monitor can be connected to any high purity water laboratory system in order to provide a rapid measurement of the TOC level in the water produced.

## TOC Monitor Operation Principles

Both the independent Millipore TOC monitor and the built-in equipment operate according to the same principle.

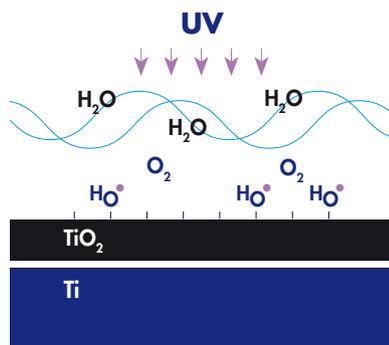
### How the Patented A10 Monitor Works

Figure 1: Instrument Design



Water flows for 3 minutes through the 0.8 ml quartz TOC analysis cell that contains 2 titanium electrodes. Then the solenoid valve closes and the conductivity of the high purity water is measured, compensated at 25 °C (baseline conductivity). The UV lamp is then powered "on", emitting light at 254 and 185 nm.

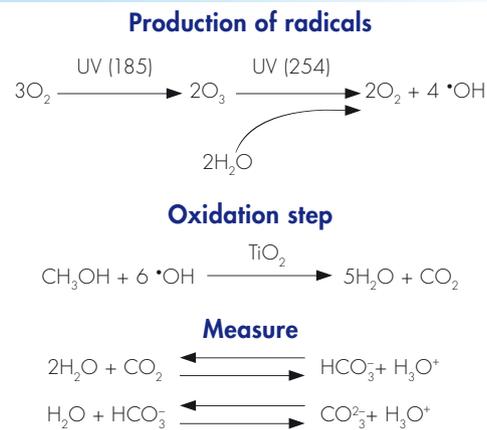
Figure 2: From UV to hydroxyl radicals



The energy of the 185 nm light generates ozone that produces hydroxyl ( $\bullet\text{OH}$ ) radicals from the oxygen dissolved in water. This process is catalyzed by the titanium dioxide coating formed on the electrodes. The  $\bullet\text{OH}$  radicals are powerful oxidizing agents that will react with the organic substances dissolved in water.

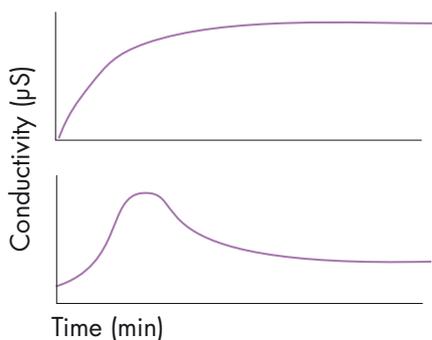


Figure 3: Oxidation and Measure



The end product of organic molecule oxidation is carbon dioxide, which dissolves and reacts with water to produce charged ions that increase the conductivity. The A10 monitor will measure conductivity compensated at 25 °C and perform the oxidation until all organic molecules are oxidized and the conductivity value becomes stable. The test can therefore last 3 or 6 minutes depending on the nature and concentration of organic molecules in water. A complex set of algorithms confirms complete oxidation, calculates TOC value from the difference between baseline and final conductivity, and displays result.

Figure 4: Conductivity Patterns



Different profiles of conductivity curves are possible depending on type and concentration of organics present. During oxidation, some organic molecules can produce intermediate products that generate a higher conductivity than  $\text{CO}_2$ . Therefore, accurate results can only be obtained in unknown samples when the difference between baseline and final conductivity is determined after complete oxidation.

## Quality Assurance

Millipore A10 TOC monitors are calibrated in accordance with Millipore's Quality Assurance System standard procedures and specifications. Traceability of measurement equipment is performed according to the Millipore Calibration System.

Millipore A10 TOC monitors are delivered with a Certificate of Calibration. They can be recalibrated at user request and have been designed to take into account the suitability test requirements as specified in USP <643>.

## Specifications

Parameter	Value
<b>Performance</b>	
Operating range	1 - 999 ppb TOC
Display resolution	single ppb increment
Repeatability	+/- 5 %
Accuracy	+/- 15 % or +/- 1 ppb (whichever is greater)
<b>Water Sample</b>	
Inlet pressure	4.8 bar (70 psi) max
Temperature	5 to 35 °C (41 to 95 °F)
Resistivity	> 15 MΩ·cm @25 °C**
**The Millipore A10 TOC monitor also may be used with a water sample whose resistivity is between 5 and 15 MΩ·cm @ 25 °C, but repeatability and accuracy levels will be lower.	
<b>Physical Characteristics</b>	
Operating temperature	15 to 30 °C
Operating weight	1.9 kg (4.2 lb)
Size, mm (in) (H x W x D)	237 x 155 x 150 mm (9.3 x 6.1 x 5.9 in)
Power supply	100 - 230 V +/- 10 % / 50 - 60 Hz

## Ordering Information

Description	Catalogue No.
Millipore A10 TOC Monitor	<b>ZFA100001</b>
Millipore A10 UV Lamp replacement	<b>ZFA10UVM1</b>
Set of Inlet/Outlet tubing replacement 2 x 5' tubes (4.7 mm O.D./3.17 mm I.D.) with Luer fittings	<b>FTPF04945</b>
Tubing – 25' roll	<b>FTPF04949</b>
Luer fittings (5/pk)	<b>FTPF04950</b>

## To place an order or for technical assistance

On the Internet go to: [www.millipore.com](http://www.millipore.com)  
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