

Experts in UV254



Photonic Measurements are the experts in UV254. We can provide solutions for the measurement of UV254 in all applications within the drinking and waste water treatment, industrial effluent, receiving water and environmental testing, amongst others. Photonic Measurements range of UV254 products allow for the measurement of UV254 and its surrogates TOC, DOC, COD and BOD that fit your application needs.

UV254 Probe



Drinking water
& waste water
Treatment

Industrial
processes &
effluent

Environmental
testing

UV254 probe continuously measures water in real time online by taking a side stream to a flow cell, in-line with a T-piece fitting or in an open channel. For applications such as waste water the measurement optical component is kept clean via ultrasonic cleaning and the probe can be configured to be made from either stainless steel, aluminium or plastic.

UV254 Go! Portable



Portable
measurement water
treatment and
industrial process
and waste

Remote
measurements of
receiving waters and
environmental
testing

Measurement of
samples in
Laboratory
Environment

UV254 Go! Is a portable UV254 analyser that is as well suited to taken measurements at the river side as it is to measuring a sample back in the laboratory. Simply put your water sample into a cuvette, place the cuvette into the Go! Press measure and get your UV254 and surrogate measurements of TOC, DOC etc. Every measurement is stored for review and data export.

UV254 Dip Probe



Portable
measurement water
treatment and
industrial process
and waste

Remote
measurements of
receiving waters and
environmental
testing

Floating or fixed
Measurement of
open channel
water

The dip probe can be submerged by hand for portable measurements at different locations. It can also be fixed in an open channel for continuous measurement or a float for example on a river.

What is UV254 and why is it important?

UV254 is the measurement of the absorption of light in the UV part of the light spectrum at 254nm. The absorption of light at this wavelength is as an indicator of the organic species found in water and waste water. The measurement is sometimes referred to as Spectral Absorption Coefficient (SAC).

UV254 is more sensitive to species of organic material that can cause the most harm. These are the aromatic organics with their double ring carbon structure. This makes them and thus UV254 excellent at detecting potential of chlorination disinfection by products (DBPs) such as Trihalomethanes (THMs).

Organic water parameters such as TOC, DOC, BOD and COD (see 3 letter acronym reference at back of document) can be correlated to the absorption UV light at 254nm. This allows for fast real time and low-cost measurement of these surrogate parameters with UV254. It's important for regular calibration and verification of these parameters as the chemistry of the water may change overtime.

Environmental agencies such as the EPA (method 415.3) use specific UV absorbance (SUVA) as a measurement for determining the disinfection by-product (DBP). The measurement is the ratio of absorption of UV254 to the dissolved organic carbon (DOC) concentration. The larger the SUVA the more of the total organic material is made up of aromatic organics. Aromatic organics are highly reactive with disinfectants and thus level of aromatics will greatly increase the risk of DBPs.

By monitoring and reducing the level of UV254 and thus the level Of DOC the amount of organic food for harmful microorganisms is reduced in the treatment water; and thus, the ability for organisms to enter water distribution networks and effluent receiving waters.

Measuring the level of BOD via surrogate measurement is important in the optimisation of the oxygen levels in effluent water due to its effects on aquatic life. High levels of BOD can suffocate while low levels can stop metabolism of aquatic life.

Key Reasons for UV254

- Provides a measurement of Natural Organic Material (NOM)
- Surrogate measurements of TOC, BOD, COD among others. Allows for real time measurement without the need of expensive reagents
- Measurement allows water treatment sites to optimise and lower the cost of the treatment of organic material as well as the choice of coagulate
- Reduction of disinfection by-products such as Trihalomethanes (THM)
- UV254 is becoming a key parameter of measurement of water quality, along with the likes Hardness, Turbidity and pH

Measuring UVA and UVT

Absorbance is a measure of the amount of light that is absorbed by the sample a transmittance is a measure of the amount of light transmitted through the sample.

In order to get a comparative value, the transmission value is first measured with a reference sample - typically distilled water.

The transmittance value for a sample is $T = \left(\frac{L_T}{L_R}\right) \times 100$, where L_R is the reference light value and L_T is the transmitted light value. %Transmittance is simply the transmittance shown as a percentage value: %T = 100T.

The absorbance value $A = 2 - \log_{10}(T)$

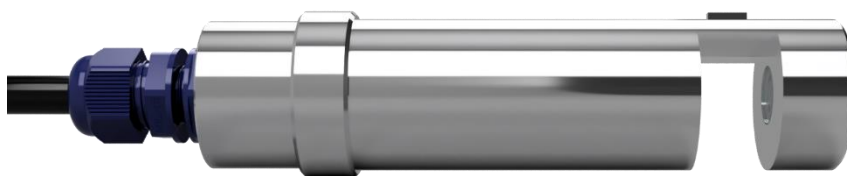
UVA and UVT are measurements of the absorbance and transmission of UV light at 254nm.

Pathlength and UVA/UVT

The absorbance of the water is not only proportional to the concentration of the material being absorbed but also the optical path length of the sample (beers law).

Thus, UVA and UVT measurements must be given for a certain path length. In general, the path length of 10mm/1cm is used and the absorption is reported abs/cm. This can be set to other values if necessary such as abs/m.

Photonic Measurements UV254 systems come in with different optical paths. The measurement of the absorption is converted to abs/cm no matter what size the optical path. Also, the larger the optical path the more sensitive the measurement will be, whereas smaller optical paths are better suited to measuring higher UV254 absorption such as found in waste water applications.



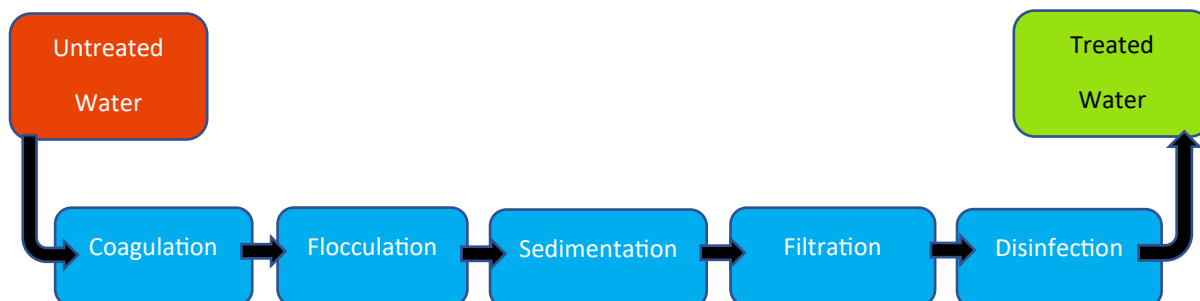
2-10mm optical path,
better for higher
absorption application
such as waste water



20-50mm optical path,
better for lower
absorption application
such as drinking water

Applications of UV254

Applications in Water Treatment Process

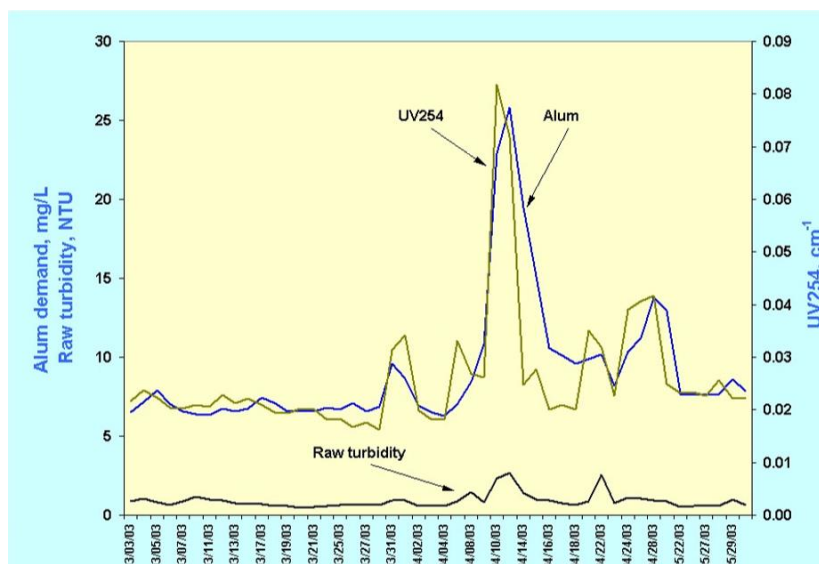


Coagulation Optimisation

In coagulation polymers are used to clump small particulate matter together so that they can be easily separated from the water. The coagulation process also helps with the reduction of organic material that can cause disinfection by-products. Organics in water can absorb the polymers reducing overall effectiveness of the process.

Monitoring the level of organics using UV254 absorption allows for the optimisation of the coagulation process. This reduces the chemical polymer waste, sludge production and lowers potential disinfection by-products such as THM.

Required dosing level of the coagulate Alum can be seen in the figure following to trend well with UV254 in comparison to the more commonly measured Turbidity. Thus, UV254 provides an excellent tool in setting coagulate dosing levels.



Lake Michigan Filtration Plant, Grand Rapids, MI – Reference – Systemic Approach to Water Treatment Plant Process Optimization and Why Should Surface Water Treatment Plants Monitor UV254 in Source Water? Alex Yavich, Ph.D.,P.E. Optimization Solutions Environmental,LLC

Flocculation, Sedimentation and Filtration

Previously for these steps the amount of organic material was not being measured. The performance at these steps is measured via other indicators such as turbidity and/or pH. There is a trend to measure the UV254 throughout the process as this gives a better information about the water quality than say turbidity.

For flocculation the UV254 level drops with the optimisation of charge neutralisation and thus gives an indication of the flocculation performance. For sedimentation and filtration, the measurement is used to monitor the removal of organic material.

Chlorine Disinfection

Disinfection is an important part of the treatment of water in order to protect against waterborne infections and parasitic diseases. However, disinfection can produce harmful by-products such as carcinogens like trihalomethanes (THM). The by-products arise from generally harmless natural organic materials combining with chlorine.

Measurements before and after the disinfection process allow for real time data on the performance, optimisation and reduction of disinfection by-products.

UV Disinfection

UV disinfection works by rendering viruses and bacterial ability to reproduce and infect. For this to happen the UV light needs to be above a certain intensity in order to reduce the photo repair of these organisms.

If the water has a high UV absorbance the effectiveness of the disinfection may be limited unless the intensity of the UV light is increased or a secondary process is applied. As the main cost of the UV disinfection is the cost of lamps it's important to monitor the UV absorption. This can be done with UV254 measurement. The UV254 measurement can be used to trigger a secondary process such as chlorination or increase the intensity of the treatment light when the absorption levels are high and thus the effectiveness of the disinfection is low.

Other applications include:

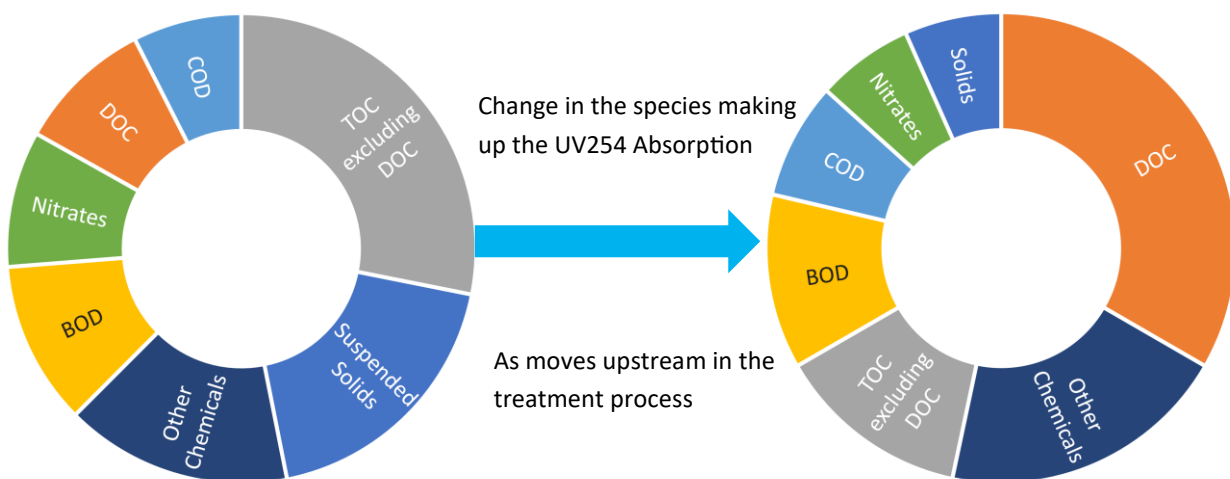
- Ultra-pure water for industrial processes- such as silicon wafer production
- Power Plants – water with high organic content causes fouling and degradation of equipment
- Effluent Water – Final check of the water quality of in industrial processes before water is placed back into the environment
- Measurements of Disinfection By-Products and Organics in Rivers

Surrogate Measurements

The measurement of NOMs' can be correlated against the UV254 response in order to form surrogate measurements.

The advantage in the correlation depends on the species that is being measured; for example, this could be: fast real-time measurement, lower cost instrumentation, lower operational cost (no need for chemical reagents or consumables) and the ability to measure a number of parameters at the same time.

Importantly though, as the chemical make-up of the water changes so does the percentage of species that make up the complete UV254 response. For instance, the percentage of dissolved organic carbon (DOC) making up the overall UV254 response should increase through-out the treatment processed as suspended organic material is removed. Thus, the correlation at one point of the treatment process will be different at another.



The above figure is for illustration purposes, as such illustrating how the components that make up the overall UV254 signal may change as one moves upstream in the treatment process.

TOC- Total Organic Carbon

TOC in water comes from a number of sources such as decaying Natural Organic Material (NOM) and synthetic sources such as detergents, pesticides and other industrial chemicals. Knowing the level of TOC is important in estimating the amount of NOMs, as NOMs react with the chloride during the disinfection process to produce harmful by-products.

Examples of Instruments/Methods of measuring TOC between 1-10,000mg/L (Require range of drinking and waste water) other than UV254

Online

Method: Infrared measurement of CO₂ after Oxidation.

Measurement time is around 3-6mins for the application and the range is generally limited to 0-25mg/L and requires are feed and reagents.

Instrumentation examples:

Hach – BioTector

Metrohm - 7010 TOC

Laboratory

Method: Infrared measurement of CO₂ after Oxidation

A number of suppliers such as GE and S

Method: Reagent test

Hach and other reagent manufactures provide a reagent test. Although low cost, the test requires a number of steps, with an overall time to measurement being a time being 2hours.

UV254 advantage

The main advantage the UV254 surrogate measurement has over the above is speed of measurement and operational cost. The Photonic Measurements online UV254 can take an input from the slower TOC analysers to update the UV254 surrogate measurement of TOC and thus, allow for the end user to combine both methods for fast real-time calibrate TOC measurements. This makes the overall system less likely to miss TOC upsets.

DOC – Dissolved Organic Carbon

Dissolved organic carbon is part of the TOC found in the water and is the part that is smaller than 0.45µm.

DOC is the part of the TOC that combine with chlorine causes harmful disinfection by-products.

DOC acts as food source for bacterial and other microorganisms. Thus, levels need to be kept at a minimum in order to produce biologically stable water at the treatment effluent entering distribution system and water networks (such as rivers).

Other methods of measurement of DOC other than UV254.

Infrared measurement of CO₂ after Oxidation same as that used in TOC but the suspended organic carbon is removed first using a 0.45 µm filter. For online/inline measurements the filters can be placed at the inlet to the device.

For the laboratory

The reagent test require that the water sample is pass through a 0.45 filter and measurement procedure takes 2hours.

UV254 advantage

The main advantage the UV254 surrogate measurement has over the above is speed of measurement and operational cost.

The Photonic Measurements online UV254 can be purchased with a filter before the flow cell to remove the suspended organic material, and allow for better surrogate measurements of DOC.

BOD – Biochemical Oxygen Demand

Biochemical oxygen demand is a measurement of the amount of dissolved oxygen that is need for aerobic biological organisms in a volume of water to break down an amount of organic material at a given temperature over a certain time period. The measurement is commonly expressed at mg/L of oxygen consumed in a 5-day period at 20°C.

The measurement of BOD is not a precise measurement but is widely used for the indication of the quality of water.

For water going back into the environment, the level of BOD is important for aquatic life. Too low and there isn't enough oxygen for these organisms to carry out metabolic processes. Too high and the organism become stress and suffocate.

Other methods of measurement of BOD other than UV254.

By measuring the dissolved oxygen via optical luminescent the BOD value can be calculated the follow instruments perform such measurement:

Online

- Hach - IntelliCAL™ LDO101 - 30 mins

Laboratory

- Hach LBOD101- range 0.05-20.mg/L, measurement time 10.5minutes
- Xylem-YSI-MultiLab IDS ProOBOD – 0-50mg/L, measurement time 1 minute

Other methods

Online

- LAR – BioMonitor – using a multistage measurement cascade in which the residual oxygen is measured. Measurement time 4 mins

UV254 advantage

The main advantage the UV254 surrogate measurement has over the above is speed of measurement.

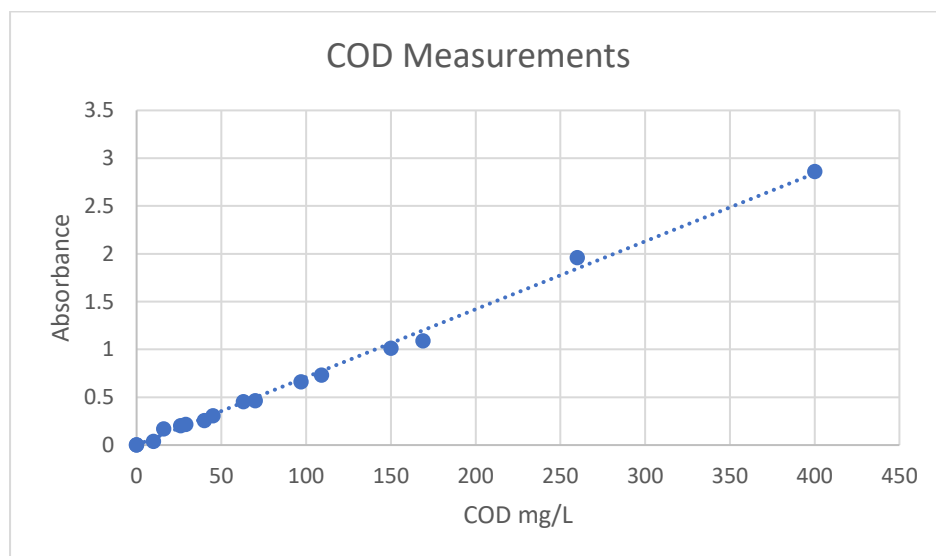
The Photonic Measurements online UV254 can take an input from these analyser, allowing the combine system to provide real time calibrated measurements.

COD – Chemical Oxygen Demand

Similar to BOD, chemical oxygen demand is the amount of oxygen consumed over a given volume given in mg/L. Where they differ is that COD is the organic compounds that can be chemically oxidised.

The measurement of COD is important for the aeration of water during the treatment process. This is to optimise the levels of oxygen needed to treat and reduce negative effects on effluent. If the COD is too high then the receiving waters can be stripped of their oxygen levels and damage aquatic life.

The figure below shows the correlation of UV254 absorption and COD as measured with the Photonic Measurements UV254 probe.



Other than UV254, the measurement of COD for online applications is performed by combustion process and measuring the oxygen using an IR sensor. This type of measure can take several minutes

For laboratory measurements there are a number of reagent-based measurements that in general require a slow incubation period for the detection chemistry to complete.

UV-254 Probe



Stainless Steel Probe with 50mm pathlength



Plastic Probe with 20mm pathlength

With Photonic Measurements UV254 probe take control of Natural Organic Materials (NOMs) in your process water with real time surrogate measurements of TOC, BOD and COD without the need of expensive reagents. Measuring UVA, UVT and SUVA for responsive detection of aromatic organic material allows you to act on disinfection by-products such as Trihalomethanes (THM).

Long life UV LED and high sensitive optical system reduces the need to replace the illumination source which has an expected life of greater than 10 years.

The 39mm diameter small footprint probe with a selection of optical path lengths to match the sensitivity requirements of your application. The probe can measure in side stream using a flow-cell, in-line via a T-Piece or in open water using a light shield system.

The probe can be combined with a second measurement such as colour by request.

Water or Waste Water?

Choose a probe material: plastic, aluminium or stainless steel, depending on your application. For waste water add Ultrasonic Cleaning to insure continuous operation of the probe by removing fouling of optics.

Connect to Photonic Measurements Control Unit for real time data and alarming. With all data being stored to SD card for easy export of results. 4-20mA output to relay back to SCADA system.

For remote deployment. Low power consumption with the probe enables it to run on battery without needing to be connected to a control unit and can store data internally for retrieval at a later date.

Flow Cells



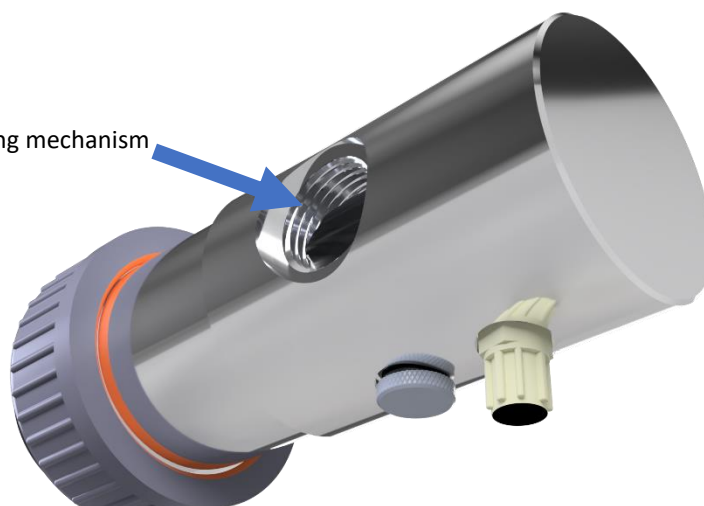
Plastic flow cell with a 20mm and 50mm optical path outlets

Stainless steel/aluminium flow cell for waste water applications

The flow cell allows for a stream of water to be taken from the source and brought to the flow cell. The UV254 probe is placed inside flow cell and measure water as it moves through the flow cell.

The flow cell can be configured to be made of plastic/aluminium/stainless steel depending on the application needs. In the measurement of drinking water, the plastic flow cell will provide best price to performance. Whereas in waste water, stainless steel with a port hole for the ultrasonic cleaning will allow for low service intervals due to the need for automatic cleaning process.

Porthole option for cleaning mechanism



UV-254 Probe Display Monitor



The Photonic Measurements UV254 Display Monitor allows real time measurements of UV254 and surrogate measurements to be displayed and trended over time. The daylight readable touchscreen makes navigation of menus intuitive.

Display a number of Surrogate measurements such as TOC, COD and DOD as well UVT and UVA. Calibrated and verify surrogate measurements with a simple guided screen process.

Sent up to four values back to control room/SCADA system via 4-20mA including surrogate measurements. All measurement data is stored to an SD card that is accessible inside the enclosure. Connect to optional ultrasonic cleaning for controlling the cleaning routine.

Take a 4-20mA input from a dedicate TOC, DOC, BOD, COD or THM analyser to provide real time output from these otherwise slow measurements.

UV-254 Go Portable UV254



With Photonic Measurements UV254 GO measure UV254 transmission and absorption on small handheld device that as easy suited to the lab as it is to the field.

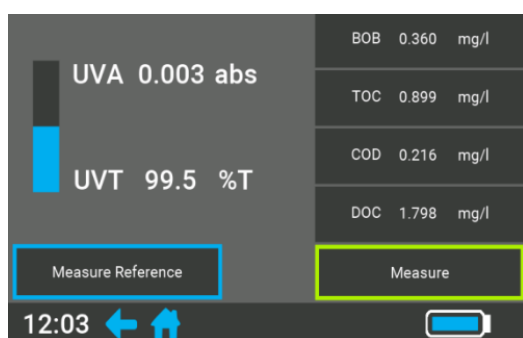
The GO allows the measurement of Natural Organic Materials (NOMs) in your water with surrogate measurements of TOC, BOD and COD without the need of expensive reagents.

Measure a number of parameters at the same time. Such as surrogate measurements of TOC, BOD and COD etc. Configuration of parameters is easy via the simple calibration wizard.

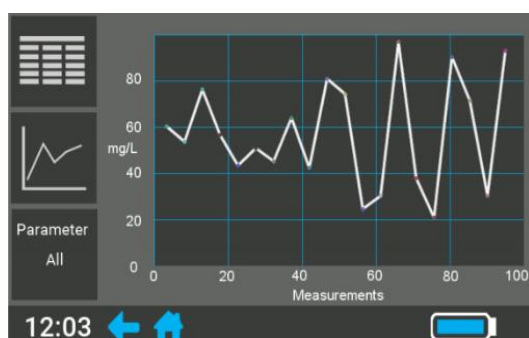
Create calibration profile for different water sampling areas. For example, after the disinfection process or before coagulation were water chemistry may vary requiring different calibration profiles

Full colour touch screen display with simple icon driven menu system. Allows for measurements to be taking quickly, while every measurement is stored on the analyser.

Stored measurements can be viewed on the data review screen, with trending graphs display how the results for each parameter changes overtime. Results can be exported by connecting the Go to a PC and copy across .csv data files. Results can then be view in excel.



Date	Time	Parameter	Value	Units
15 Feb 18	09:30	UVA	0.126	ABS
15 Feb 18	09:32	UVA	0.051	ABS
15 Feb 18	10:11	UVA	0.075	ABS
15 Feb 18	10:16	UVA	0.056	ABS
15 Feb 18	10:18	UVA	0.053	ABS
15 Feb 18	10:32	UVA	0.092	ABS
15 Feb 18	10:35	UVA	0.079	ABS
15 Feb 18	10:37	UVA	0.082	ABS
15 Feb 18	10:38	UVA	0.076	ABS



Top left: Measurement Screen

Top Right: Data Review Screen

Bottom Left: Trending Review Screen

UV-254 Dip Probe



Measure natural organic materials (NOMs) in open water the Photonic Measurements UV254 dip probe.

The dip probe can be submerged by hand for portable measurements at different location. Left fixed in an open channel for continuous measurement or a float for example on a river.

For hand held application the dip probe is connected to the Photonic Measurements portable display unit. Which has all the same application software as the UV254 Go. For fixed operation the dip probe using the probe display unit. In both configurations the all data is logged and surrogate measurements (for example TOC, BOB and COD) as well as UVT and UVA.

Dip probe comes with a light shield to remove negative effects of ambient light on the measurement. The probe can be configured on order to have either a 20 or 50mm path length to suit your application needs.

The dip probe can be requested in different materials for example aluminium.

Typical Probe Configurations

Drinking Water



Waste Water



UV254	Ultraviolet light at a wavelength of 254nm
SAC	Spectral Absorption Coefficient
UVA	Ultraviolet absorption
UVT	Ultraviolet transmission
SUVA	Specific Ultraviolet Absorption
TOC	Total Organic Carbon
DOC	Dissolved Organic Carbon
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
THM	Trihalomethanes
DBP	Disinfection by products

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