chemtronic
Waltemode GmbH

Optical or Acoustic
Process measurement of liquids

- **Turbidity**
- **Colour**
- **Oil in Water**
- **Water in Oil**
- **Oil on Water**

Process UV- Photometry

Models UVS-1, MoniSpec-UV & MoniSpec-UVd

Model UVS-1 general information

The UV- photometer model UVS-1 / Messenger measures UV- absorbing compounds in liquid products. Optionally the probe may be upgraded to additionally detect the IR-absorbing compounds. This second IR- absorption signal is used to compensate for the turbidity caused by particles.

Principle of measurement

UV- Absorption:

The emitted light from a pulsed UV-LED (measuring wavelength typically 254nm or 280nm) passes the process stream when the resulting light is sensed by the measurement detector. Other wavelengths in a spectral range of 240nm to 880nm are available as an option. Please pay attention to the specification of your probe. The decrease in UV- energy is caused by the absorbance of the light by organic species, benzene and other substances with UV- absorption, e.g. turbidity, caused by particles.
A second, reference detector, controls the output of the UV-LED and thus corrects for any changes in the intensity of the UV output.

IR- Absorption: (optional)

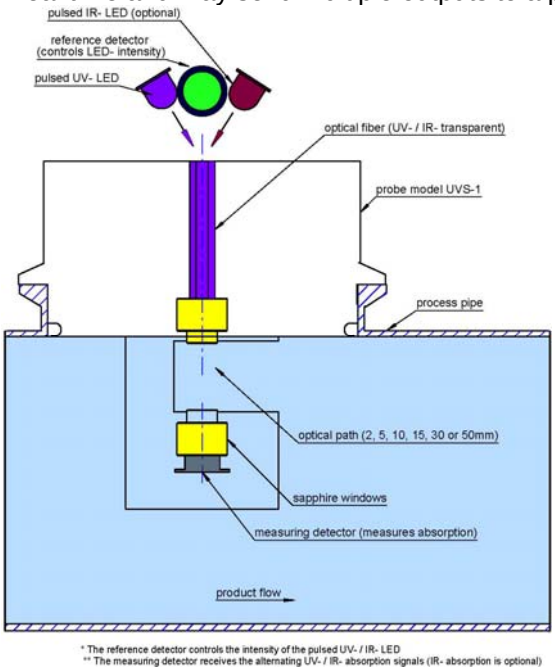
As with the UV- absorption the light from a pulsed IR-LED (alternates with the UV- LED) passes through the same path as described above. The decrease in IR- energy (typical wavelength 850nm) is caused by the IR-absorbance of particles (turbidity) only and will be displayed as a second measuring result. Now the reference detector corrects alternating eventual intensity changes of the IR- LED and the UV- LED.

Dual Beam / Dual Wavelength: (optional)

Alternating measurement of UV- and IR- absorption is used to compensate for turbidity caused by particles.
The absorption at measuring wavelength detects the UV- absorption caused by UV- absorbing compounds and total solids.
The absorption at reference wavelength detects primary the absorption caused by total solids.
The difference between the two signals gives the concentration of UV- absorbing substances only (e.g. organics, proteins, etc) this method compensates for the absorption of turbidity / particles and provides a measurement of the substances which absorb in the UV- spectrum only. If the probe is specified to measure the absorption in the visible spectrum (colour measurement) the result will be calculated as follow: ([colour absorption + turbidity absorption] - turbidity absorption) = colour absorption. The dual wavelength measurement compensates for turbidity and results UV- / colour- absorption only without being affected by turbidity.

Temperature:

The model UVS-1 is equipped with two built-in temperature sensors.
Sensor 1 is located in the measuring tip and provides the product temperature and may be displayed as an additional measuring signal. Sensor 2 measures the temperature of the UV- LED and is used to shut down the probe in case the upper temperature limit is reached or exceeded.
All probe signals are converted and processed by the Messenger transmitter. The Messenger transmitter provides the calculated measuring results in real time and may send multiple outputs to a process control system.



Take notice: The figure shows the probe 90° turned in the process, this is just for better view.
The typical positioning of the probe makes sure that the process stream flows thru the optical path.

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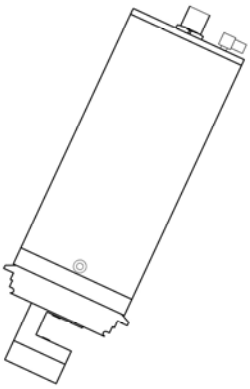
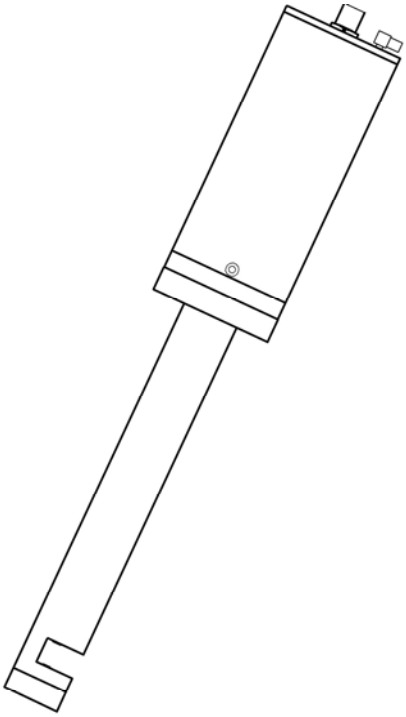
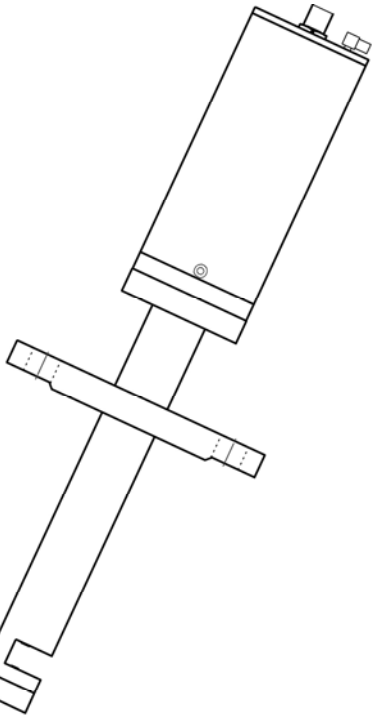
UVS-1 Probe Designs



TH- Variline version
Pipe installation in Variline flow cell



Insertion probe
Open channel or ball valve pipe installation



insertion probe with flange
instalation via several flange types

The UV- probe model UVS-1 is available in three different designs.

- Hygienic designed
  with TH- Varivent plate for installation in pipes with installed Variline flow cell.
- As 215mm probe for pipe mounting via a ball valve or for direct insertion in the liquid.
- As insertion probe with mounting flange.

Version with Varivent plate.

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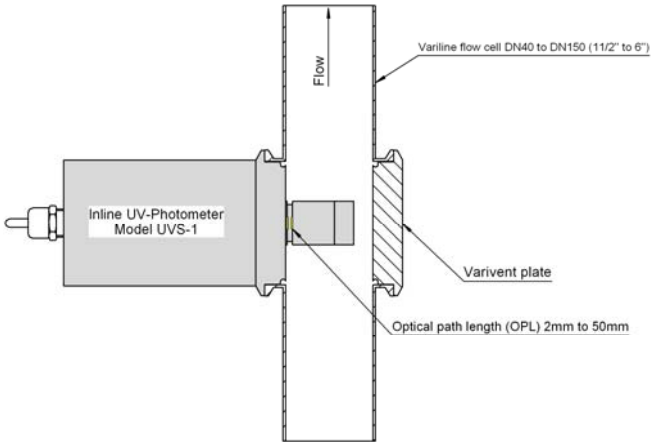
Model UVS-1

Process UV/VIS/NIR- Absorption Photometer



- **Low Maintenance**
- **Typical calibration interval 12 Month**
- **Material measuring windows: Sapphire**
- **Typical measuring wavelength: 254nm or 280nm**
- **Other wavelength in UV/VIS- spectrum available on request**
- **Optional dual wavelength measurement**
- **Optional process temperature measurement**
- **Installation via TH- Varivent plate (TH- Variline flow cell)**
- **Variline flow cell sizes: DN40 to DN150 (1 1/2" to 6")**
- **Optional extended probe length (insertion length 215 mm)**
- **Optional flanges: DIN, ANSI, Tri clover, APV, TH, ...**
- **Optional Air purge**
- **Cleaning: CIP / SIP**

Description:

The sensor model UVS-1 is used to detect UV- absorbing substances in liquids at wavelength of 254nm or 280nm. Other wavelengths are available on request (240 – 880nm). The lifetime of the LED- light sources is between 2 and 5 years (depending by wave length and application).
The probe detects all UV- absorbing substances at the specified wavelength. This means the probe is sensitive against substances which absorb only UV- light (e.g. benzene) and substances which absorb in the whole UV/VIS/NIR spectrum (e.g. solids). Therefore the dual wavelength option offers a second reference measurement, typical in the NIR- spectrum at 850nm. The UV- absorption is affected by UV- absorbing substances and turbidity (solids).
The NIR- absorption is affected by particles (turbidity) only.
The difference of the both absorption signals ([UV- absorption + turbidity absorption] - turbidity absorption) allows to detect all substances which absorb in the specified UV- range only.
If the probe is specified to measure the absorption in the visible spectrum (colour measurement) the result will be calculated as follow: ([colour absorption + turbidity absorption] - turbidity absorption) = colour absorption. The dual wavelength measurement compensates for turbidity and results UV / colour absorption the influences of the turbidity will be compensated.

A temperature sensor provides a shut down of the probe in case of to high product temperature.
This temperature signal can be displayed as an additional option (accuracy approx. +/- 1°C).
The transmitter model Messenger is required to process the sensor signal of the UV- absorption, respectively the optional signals of dual wavelength absorption and temperature.
Calibration can be done in multiple ranges and measurement units by using up to 8 calibration samples. The UVS-1 covers a wide span measuring ranges, due to the availability of multiple optical path lengths (2mm up to 50mm).

Applications:

- UV254 (optional with reference wavelength 850nm)
- UV280 (optional with reference wavelength 850nm
- Spectral Absorption Coefficient (SAC)
- TOC / COD / PAC
- Toluene, Benzene, …
- Colour measurements in the visible spectrum

Operational areas :

- Potable water / Waste water treatment
- Produced water
- Food and drinking industry
- Bio technology
- Pharmaceutical
- …

Technical Data:

Line sizes:	DN40 – DN150 / 1½" to 6"
Process pressure:	PN25 at DN40 & DN50 PN16 at DN65 & DN80 PN10 at DN100 to DN150
Temperature range:	maximal 75° (110°C w. purge air) short time 140°C
Flow cell material:	1.4404 (316L)
Window material:	Sapphire
Gasket material:	EPDM (other on request)

Measuring range absorption:	typical: 0–4AU
Measuring range temp.:	typical 0-140°C (optional)
Optical path length:	2mm, 5mm, 10mm, 15mm, 30mm or 50mm
Reproducibility:	± 1 %
Measuring wavelength:	254nm or 280nm (other on request)
Reference wavelength:	850nm
Protection class:	IP65 / NEMA 4X
Cleaning:	CIP / SIP

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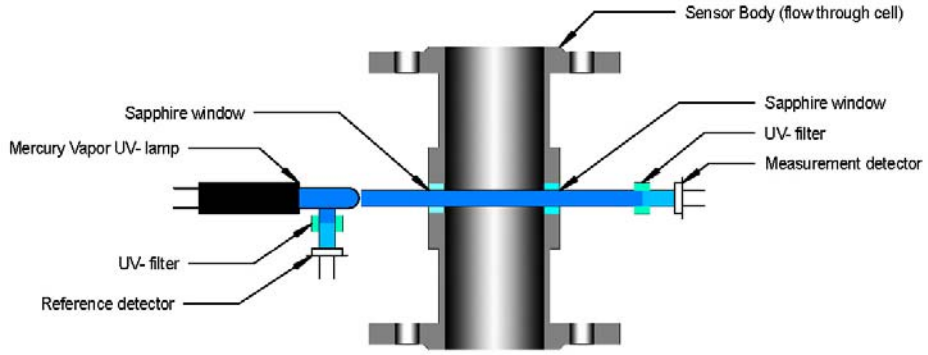
Principle of single Wavelength UV- Absorbance Measurement



UV- light from a Mercury Vapor UV- Lamp passes through sapphire windows and process stream. The narrow band pass UV- filter blocks all transmitted light except the specified UV- wavelengths. These UV- light can pass the filter and the measurement detector registers the specified UV- wavelengths only.
The UV- light also passes directly through an UV- filter with equal specification located next to the lamp. The reference detector behind that filter measures the current UV- intensity. This reference detector signal is used to compensate any intensity fluctuations of the UV- source caused by lamp aging, extreme temperature changes, etc.

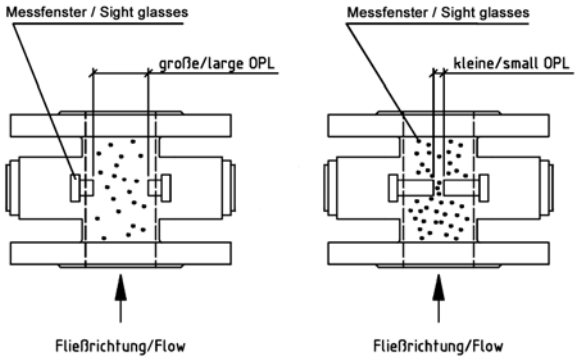
The application is the measurement of UV- decrease caused by particles, organic components, or solvents within the process liquid. The resulting photocurrents of measurement and reference detector will be amplified, converted and processed by the Messenger transmitter. The Messenger transmitter provides the calculated measurement results in real time and can send multiple outputs to a process control system.

The sensitivity of an UV- measurement system is mainly dependent on two parameters.

1. **The intensity of the UV- source.**
2. **The optical path length (OPL[1]).**

The Intensity of the UV- source is measured by using a reference detector. The reference detector compensates changes of the UV- intensity caused by lamp aging.

The **optical path length** is variable and can be changed to meet the requirements of specific applications. A large OPL is required for low concentration measurement. Otherwise there is not enough change in UV- intensity to get valid measurement results. A small OPL is required for high concentration measurements. Otherwise there is not enough UV- energy to pass the product.



Large OPL = Low concentrations / high sensitivity
Small OPL = High concentrations / low sensitivity

[1]OPL [= optical path length] specifies the product slot between light source and detector

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Model MoniSpec-UV (MSUV)

- **Low maintenance**
- **Extended calibration interval: Typical 12 month**
- **Sight glass material: Sapphire, alternative Quartz**
- **Typical measurement wavelengths: 254 or 280nm**
- **Sight glass cleaning: Via cleaning jets**
- **Cleaning in place (CIP)**
- **Process connection: DIN, ANSI, SMS, NPT, APV, TH, …**
- **Optional air purge connection: 4mm**

Description:

The sensor model MoniSpec-UV uses the principle of single wavelength absorption to detect UV- absorbing substances in liquids. Typical measurement wavelengths are 254 or 280nm. The transmitter model Messenger is required to use this sensor. Each sensor provides two detectors. The reference detector detects the UV- intensity directly next to the lamp. The measurement detector registers the UV- absorption caused by the product stream. Both of the detector signals are used to calculate the measurement values. The technology compensates for any changes of the UV- intensity caused by lamp aging or other factors. The sensor can be installed into almost any type of pipe and has been designed for continuous operation with long life time and low maintenance. Process connection, gasket material, etc. can be selected according to the specific application. Optional cleaning jets will allow a cleaning of the measurement windows in user determined intervals. The availability of multiple optical path lengths allows a wide span of measurement ranges.

Applications:

- UV_{254}
- UV_{280}
- Spectral absorption coefficient (SAC)
- TOC

Operational areas:

- Chemical industry
- Petrochemical industry
- Water & Wastewater
- Bio technology

Technical Data:

Line size:	DN 25 – DN 125 / ½“ - 4“	Measurement range:	typical 0–2 AU ±
Process pressure:	PN16 / ANSI class 150	Reproducibility:	1 %
Process temperature:	maximum 90° (140°C short time)	Detector:	Silica diodes
Sensor material:	1.4404 / 316L	Measurement wavelength:	254nm or 280nm (other on request)
Sight glass material:	Sapphire	Cleaning:	optional cleaning jets
Gasket material:	application specific		CIP (cleaning in place)
Protection class:	IP65 / NEMA 4X	Optional hazardous area:	on request

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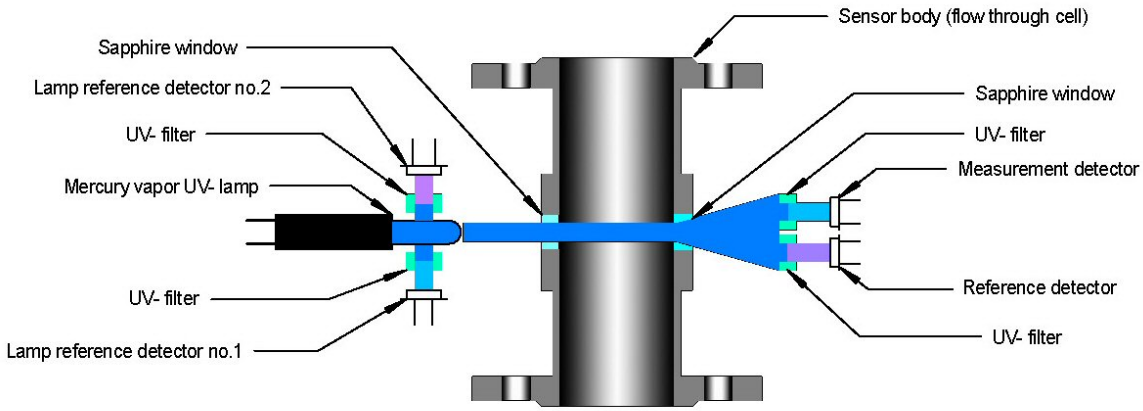
Principle of dual wavelength single beam UV- absorption



The light from the Mercury Vapour UV- lamp passes through sapphire windows and process stream. The resulting light passes through two different filters. The narrow band pass UV- filter in front of the measurement detector blocks all wavelengths except the specified measurement wavelengths.
The second narrow band pass filter in front of the reference detector blocks all wavelengths except the specified reference wavelengths. The reference filter can be specified for UV-, Vis-, or IR- light, depending on application. The application is the measurement of UV- decrease. This absorption is typically caused by organic components or other substances with UV- absorption at the specified measurement wavelength.
The reference detector is used to compensate absorption caused by particles, window coatings, etc.

Light from the Mercury Vapour UV- lamp also passes through two other narrow band pass filters located next to the lamp. These filters have the same specification as the measurement and reference filters. The signals of the both lamp reference detectors are used to compensate any intensity fluctuations of the UV- source caused by lamp aging, extreme temperature changes, etc.

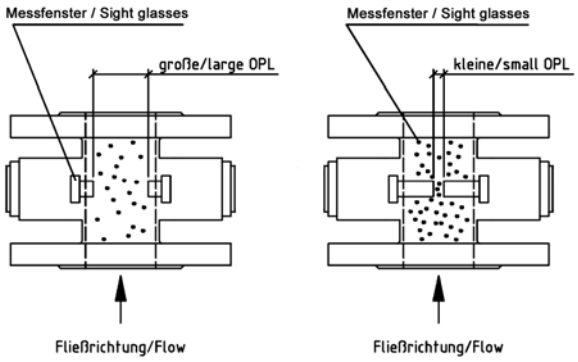
The resulting photocurrents of all detectors will be amplified, converted and processed by the Messenger transmitter. The Messenger transmitter provides the calculated measurement results in real time and can send multiple outputs to a process control system.

The sensitivity of an UV- measurement system is mainly dependent on two parameters.

3. **The intensity of the UV- source.**
4. **The optical path length (OPL[1]).**

The Intensity of the UV- source is measured by using a reference detector. The reference detector compensates changes of the UV- intensity caused by lamp aging.

The **optical path length** is variable and can be changed to meet the requirements of specific applications. A large OPL is required for low concentration measurement. Otherwise there is not enough change in UV- intensity to get valid measurement results. A small OPL is required for high concentration measurements. Otherwise there is not enough UV- energy to pass the product.



Large OPL = Low concentrations / high sensitivity
Small OPL = High concentrations / low sensitivity

[1]OPL [= optical path length] specifies the product slot between light source and detector

Model MoniSpec-UVd (MSUVd)

- **Low maintenance**
- **Extended calibration interval: Typical 12 month**
- **Sight glass material: Sapphire, alternative Quartz**
- **Typical measurement wavelength 254nm or 280nm**
- **Typical reference wavelength 545nm**
- **Sight glass cleaning: Via cleaning jets**
- **Cleaning in place (CIP)**
- **Process connection: DIN, ANSI, SMS, NPT, APV, TH, …**
- **Optional air purge connection: 4mm**

Description:

The sensor model MoniSpec-UVd uses the principle of dual channel absorption to detect UV- Absorption in liquids. The measurement detector registers the UV- absorption caused by UV- absorbing substances and particles inside the product stream. The reference detector registers the absorption caused by particles within the product stream. Both of the signals are used to compensate the measurement results against effects caused by particle turbidity and coatings of the flow cell windows. Typical measurement wavelengths are 254 or 280nm. A typical wavelength for the reference channel is 545nm.

Two additional detectors are located next to the UV- lamp. These detectors register directly the lamp intensity at measurement and reference wavelength. Changes in lamp intensity caused by lamp aging or other factors are compensated by using these two additional detector signals. The micro controller of the Messenger transmitter uses the four detector signals to calculate highly stable measurement results. Calibration can be done in multiple ranges and measurement units.
The sensor is designed for continuous operation with long life time and low maintenance. Optional cleaning jets will allow a cleaning of the measurement windows in user determined intervals. The availability of multiple optical path lengths allows a wide span of ranges.

Applications:

- UV_{254}
- UV_{280}
- Spectral absorption coefficient
- TOC

Operational areas:

- Chemical industry
- Petrochemical industry
- Water & Wastewater
- Bio technology

Technical Data:

Line size:	DN 25 – DN 125 / ½“ - 4“	Measurement range:	typical 0–2 AU
Process pressure:	PN16 / ANSI class 150	Reproducibility:	± 1 %
Process temperature:	maximum 90° (140°C short time)	Detector:	Silica diodes
Sensor material:	1.4404 / 316L	Measurement wavelength:	254nm or 280nm (other on request)
Sight glass material:	Sapphire	Reference wavelength:	545nm (other on request)
Gasket material:	application specific	Cleaning:	CIP (cleaning in place)
Protection class:	IP65 / NEMA 4X		Cleaning jets
		Optional hazardous area:	on request

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Model Monitek Messenger

Universal Transmitter, Monitek Product Line of Galvanic Applied Sciences Inc.

- **Configuration via PC, Laptop or Netbook**
- **Optional with implemented Panel PC**
- **Menu - based, intuitive User Interface**
- **Instruction Manual available via Help Function**
- **Serial Interface RS 232C / RS 485 (Modbus RTU Protocol)**
- **Simultaneous Use of up to 4 Sensors**
- **Sensors for Turbidity, Colour or Absorption measurement**
- **Fully Programmable Units (ppm, EBC, FTU, g/l, % TS...)**
- **Two Independent, fully programmable Cleaning Cycles**
- **Linearization of Measurement Values**
- **Integrated Data Logger for up to 8000 measurement Values**
- **Recovery via Back-up File**

Description:

The universal transmitter model Messenger can be used with all optical sensors of the Monitek series. The Messenger allows the simultaneous use of multiple sensors. Hereby you can use up to four single channel sensors. Even different sensors can be used with one transmitter. The measurement results can be linked together using almost any mathematical equation. This ensures an easy setup of e.g. dosage systems. The programming / calibration of the system will be done via a PC, Netbook or Laptop using the menu-based software. Only one PC or Panel- PC is required to configure an instrument in a network of up to 255 Messengers. Using the Messenger with an integrated Panel- PC allows the paperless recording or displaying of the measurement results as bar- or line graph's.

Applications:

- Scatter light turbidity measurement
- Absorption turbidity measurement
- Single channel colour measurement
- Dual channel colour measurement

Operational areas:

- Chemical industry
- Petrochemical industry
- Pulp & Paper
- Beer and beverages

Technical Data:

Supply voltage:	90-260 VAC, 50-60 Hz optional: 24 V AC/ DC	optional digital inputs:	4x 5V High
Power consumption:	maximum 50 VA	Reproducibility:	± 1 %
Relay capacity:	4 Relays fully programmable (48V / 2A)	Temperature:	-10°C to 50°C
Analogue output:	Up to 4x 0/4 - 20mA (isolated)	Enclosure / Protection:	1.4301 / IP65 (NEMA 4X)
Interfaces:	RS 232C / RS 485 Modbus RTU	optional hazardous area:	ATEX Zone I / Zone II

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UV- Photometry in Water Treatment Applications

UV PHOTOMETER

MONITORING OF DISSOLVED ORGANICS IN WATER

The amount and character of dissolved organic carbon is a very important factor in the majority of the water treatment processes. This parameter is relevant for cost, effectiveness and quality of water treatment.
Our advanced inline UV-Colour photometer allow for reliable and accurate in-line detection of the dissolved organics and coloured species. The instruments contribute to determine the chlorine demand and the disinfection requirement to prevent by-product formation. The real time monitoring of dissolved organics will reduce costs through improved coagulation control, disinfection by chlorination or UV irradiation.

THE UV- PHOTOMERTER ARE USED IN AREAS OF:

- Wastewater
- Drinking water
- Surface water
- Chemical/industrial process water
- BioTec & Fermentation processes

Dissolved organic substances in water are normally derived from biological substances and processes. These organic substances can reduce the efficiency of water treatment processes and lead to new toxic substances. A high load of these organic substances:

- Require removal with coagulation, flocculation and sedimentation
- Contribute to colour and taste issues
- Reduce the effectiveness of UV disinfection processes
- Form chlorinated disinfection by-products such as THMs (trihalomethanes) or haloacetic acids

IMPROVED MONITORING OF DISSOLVED ORGANICS

- Our instrument design incorporates the following features:
- Real time monitoring of the sample with or without compensation for turbidity
- Low maintenance, high long-term reproducibility and stability.
- Extreme long life time of the Hg- UV- lamp
- Automated cleaning of the flowcell (optional)
- Dual wavelength option

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254nm MONITORING OF ORGANICS AN ALTERNATIVE FOR TOC DETERMINATION

In response to the increasing use of UV measurement for dissolved organic substances in water and wastewater, The Standard Methods Organization, authors of Standard Methods for the Examination of Water and Wastewater, adopted Method 5910 in 2000. This method describes the measurement of dissolved organics using absorbance of UV light at 254 nm. 4 von 5

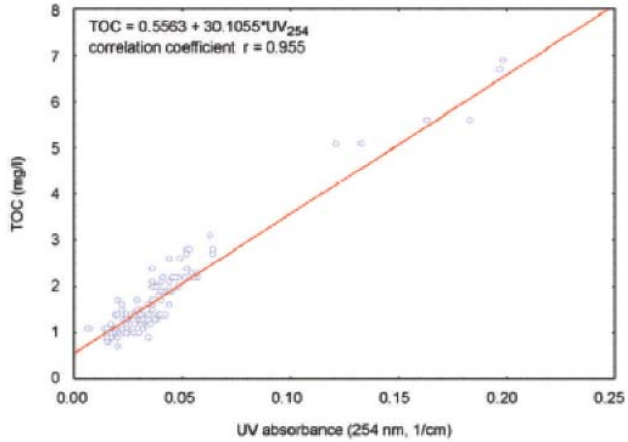

Figure 1. Correlation between TOC and UV absorbance.

There have been numerous studies that have characterized the relationship between total organic carbon or dissolved organic carbon and UV absorbance at 254 nm. TOC and $_{UV254}$ are complete different methods but fortunately there is a general correlation between the two measurements.
Figure 1 shows the correlation between TOC and UV absorbance for water from the Alberta river system.

APPLICATIONS

UV- photometer can be used on the clean water side to improve control of UV irradiation or to predict THM formation due to chlorine addition. The monitoring of the raw water provides information about dissolved organics in the water. The degree that the dissolved organics are removed during the water treatment process depends on the nature of these organics and the treatment process itself. Treatments such as enhanced coagulation and the addition of activated carbon may be required for some surface waters.

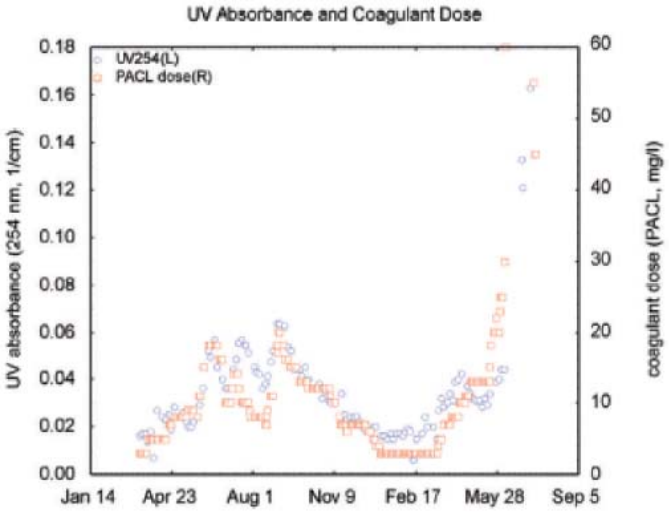

Figure 1. Correlation between UV absorbance and cagulant dosage

The coagulation levels are typically controlled to achieve certain settled and filterable turbidity levels. Turbidimeters do not show a good correlation between chemical addition and turbidity. The correlation of the UV- absorbing organics compared to the required coagulant dose is shown in Figure 2. In this figure it is clear that the coagulant dose trends very closely to the UV absorbance. The correlation between UV-Absorption and coagulant dose is much better than the correlation between the raw turbidity values and coagulant dose.

Numerous studies have shown that UV absorbing species are more reactive to chemicals used for adsorption, coagulation, and disinfection. Normally dissolved UV absorbing substances may dominate the water purification chemistry even though these substances are not the target substances. For these reasons UV absorbance is excellent for measurement of dissolved organics in control or addition of the following water treatment chemicals:

- **Activated carbon**
- **Coagulants (alum, PACl, ferric chloride)**
- **Disinfectants (chlorine, chloroamines)**
- **etc.**

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