

TresCon® – Systematic On-line Analysis

From sampling up to process control

Modules for

- Ammonia
- Nitrate
- Nitrite
- Phosphate
- Total Phosphorus
- Total Nitrogen

Simultaneous analysis
of up to three
parameters

Continuous on-line analysis
with self-contained
analyzer modules

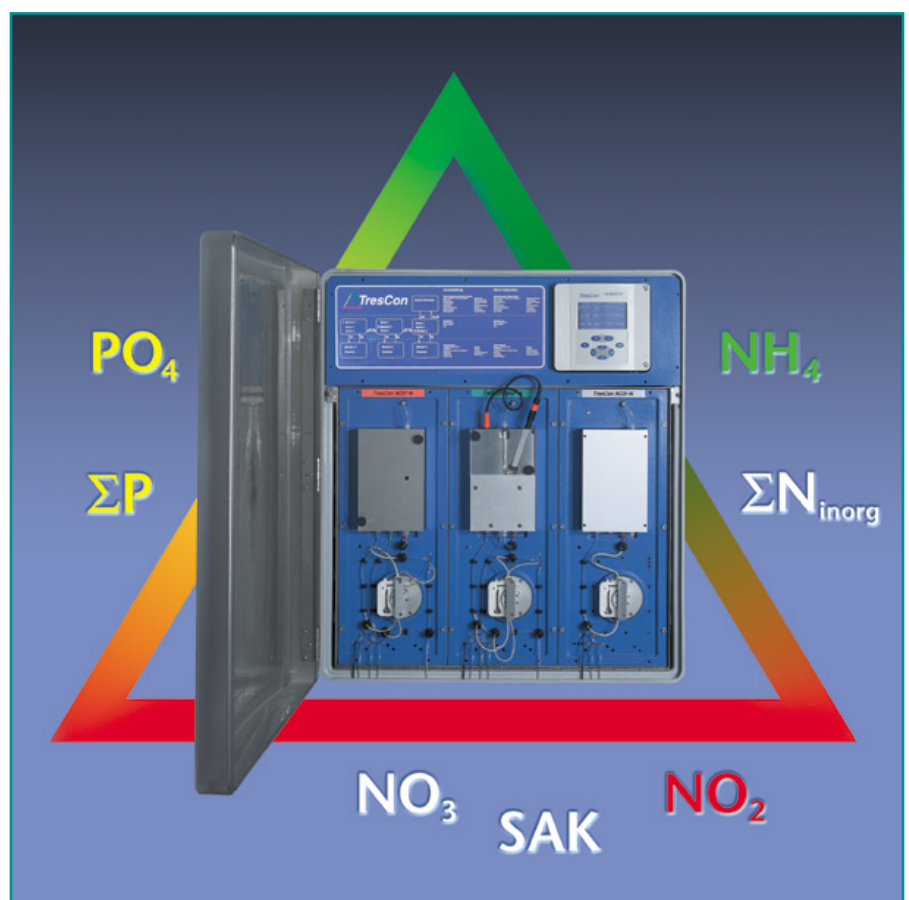
Flexible – free
selection of
analysis parameters

Adaptable – simple
retrofitting with
additional measuring
parameters

Ideal for control,
feedback control
and monitoring

High degree of operational
reliability

Uniform operation of all
analyzer modules



In the water and wastewater sectors ever higher quality requirements mean that the complexity of the plant technology is continuously increasing; this results in a higher degree of process automation. Efficient automation concepts, for example in the monitoring and optimization of biological sewage treatment plants,

require the use of powerful and practical on-line process analysis. Flexible and complete system solutions have a clear advantage here – from sampling to process control. These considerations have been logically realized by WTW with the development of the TresCon® multi-parameter analysis system.

An Innovative System Concept

TresCon® is a modular on-line analysis system which can be individually configured with up to three analyzer modules. In this way it is clearly conceptually different from conventional analytical instruments. Consisting of a control unit and up to three self-contained analytical modules, **TresCon®** forms a type of "analytical platform" which can be equipped with analysis parameters as required. This modular design means that the **TresCon®** system can be optimally adapted to solve the particular analytical problem.

TresCon® means "Three in One" – since up to three self-contained analyzer modules can be integrated in one system.

TresCon® allows individual configurations of the system with modules.

TresCon® automatically recognizes the hardware components – analyzer modules can be easily retrofitted or exchanged without any additional efforts or software update.

TresCon® features a common, clearly structured user interface.

TresCon® offers several new system functions, which enhance the overall functionality, flexibility and the operational reliability.

TresCon® presents measuring results and system information such as messages about preventative maintenance measures on a large graphical display in a clear and easily understandable form.

An economical solution

The modular design of **TresCon®** allows very cost-efficient system solutions. Even a **TresCon®** configuration with only two analyzer modules is clearly more favorably priced than two individual conventional instruments. A **TresCon®** system equipped with modules for measuring the common parameters ammonium, nitrate and phosphate can, for exam-

ple, be used in the aeration stage of a sewage treatment plant for controlling the oxygenation capacity (ammonium/nitrate) and at the same time carry out phosphate measurement for controlling the simultaneous precipitation. The same potential savings are obtained when monitoring the relevant discharge values of a treatment plant.

TresCon® is adaptable – if structural alterations to the treatment plant are made the analysis system can be adapted quickly, easily and at a favorable price.

TresCon® is future-oriented – the range of analyzer modules is continually being extended. This means that **TresCon®** is both a secure and economic investment for solving current and future problems.

PurCon® and TresCon® – the complete solution for modern on-line process analysis

In modern process analysis all the sample preparation elements together with the connected analyzer units are regarded as a single measuring setup. The **PurCon®** sample preparation system and the **TresCon®** analysis system form such a unit. They are optimally matched to each other and this ensures the maximum reliability of the complete system.

PurCon® is used for continuous sample preparation and has been developed specially for use with **TresCon®**. **PurCon®** provides **TresCon®** with an adequate supply of particle-free permeate and in this way creates the conditions for continuous on-line measuring operation. For further information about **PurCon®** please refer to page 325.

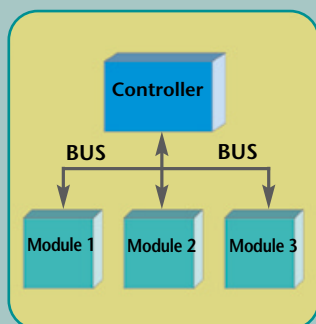


TresCon®

A Progressive Design



System Architecture



In the development of the **TresCon®** system WTW made use of a well-known principle in computer technology – structures with divided or decentral intelligence. This means that individual system components – in **TresCon®** the central control unit (controller) and the self-contained analyzer modules – have their own microprocessors with which they can process specific tasks independently.

The controller and the module communicate via an internal high speed bus. With this superior design concept, the analyzer is ideally suited to accomplish even difficult analysis and control tasks in real-time. As a result of the combination of absolute task separation with a clear structure this concept offers an unmatched flexibility with respect to custom-designed system solutions.

① System Controller Unit

Equipped with a fast microprocessor device, the controller comprises the electronic sub-components such as a graphical display unit, the control panel and all input/output interfaces. Along with the basic system routines including control of the internal communication bus, all application-oriented functions are performed at this level, i.e. system parametrization, processing and storage of acquired data, and, of course, visualization of the analysis results.

The basic software package already contains all the control routines and programs necessary for the operation of the system. If modules are added or exchanged at a later date the controller automatically recognizes the new components and automatically carries out an initialization. Neither a software update nor a new parametrization by the operator are necessary.

② Analyzer Modules

The analyzer modules are microprocessor-based, self-contained system components which will operate completely independent of each other. Up to three modules, in any combination of parameters, can be integrated into a single TresCon® system. The modules can be for the same parameter from different sample sites, or for any combination of the available parameters.

- NH_4 -Module (Ammonia-Nitrogen)
- NO_3 -Module (Nitrate-Nitrogen)
- NO_3 /SAC-Module (Nitrate-Nitrogen and SAC)
- NO_2 -Module (Nitrite-Nitrogen)
- PO_4 -Module (Orthophosphate)
- ΣP -Module (Total Phosphorus)
- Other analysis parameters will be available

Retrofitting or exchanging a module can be carried out in a few minutes. When the supply lines have been connected the new module is automatically recognized by the TresCon® controller and is immediately ready for use.



Ammonia-Nitrogen



Nitrate-Nitrogen/SAC



Nitrite-Nitrogen



Orthophosphate



Total Phosphorus

③ System Mounting

The stainless steel mounting column is an integral part of the TresCon® system. It is used for simple wall mounting and also contains the wide-range power supply for TresCon®.

④ Supplies Tray

A tray holds all bottles and containers for reagent, standard and cleaning solutions. The containers are color-coded so that parameters and connections can be allocated unambiguously.

User Interface

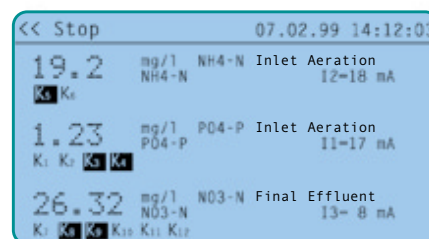
Simple Operation

- Uniform user interface for the complete system
- Uniform operation of all analysis parameters
- Clear and logically structured system program
- Rapid and safe input by 8 function and control keys
- Short instructions at instrument



Easy-to-read information and graphical presentation

- High-resolution backlit graphics display
- Up to 3 measuring parameters at a glance
- Clear presentation of measurement, units, individual text and assigned relays and current interfaces
- Daily or weekly trend curves for individual or several parameters in a single graph
- Status line for auxiliary information



System Functions of the Modules

AutoClean®	An innovative method for automatic self-cleaning whose high efficiency allows measurements in slightly polluted wastewater, e.g. in sewage treatment plant effluent, without sample preparation.
AutoCal	Automatic calibration and plausibility check at predefined time intervals – resulting in a higher degree of accuracy.
AutoKorr	A correction algorithm developed by WTW for compensating background color in the sample in photometric measuring methods.
AutoFlow	Function for continuously monitoring the container filling levels and the sample/reagent flow in the module and for producing useful maintenance messages.
AutoTherm	Automatic temperature control means that ambient temperature influences on the analytical results can be disregarded.
Interval	Software function for regular measurements at selectable intervals.
Interval-Program	Parametrizable measuring program – for a period of one week the measuring intervals within two-hour sections can be defined. This allows extremely reagent-saving operation in periods where experience has shown that only slight variations in the measurements are to be expected.
AutoAdapt	Measuring routine for automatically adapting the measuring intervals to the rate at which the measurements alter in order to minimize operating costs.

System Inputs & Outputs

TresCon® standard features include a number of analog and digital outputs, which provide enhanced data management and control capabilities of the system. All inputs and outputs can be assigned at will to the installed analyzer modules and freely configured.

Serial Interfaces

Two serial input/output interfaces which can be operated independently are standard equipment in the analyzer. While the RS 232, for example, is linked to a local device for data recording – such as a printer –, the RS 485 interface allows the analyzer to be easily interfaced with a supervisory control.

If a telephone connection is available then TresCon® can be addressed and controlled by a remote computer via the RS 232 interface and a modem. The RS 485 interface also allows TresCon® to be coupled to PROFIBUS-DP by using a gateway.

PID Control

As an alternative to outputting the measured values, the analog outputs of TresCon® can also be used as parametrizable PID controllers for control and feedback control purposes.

Proportional Control (PW/PF)

As well as being used for report or limit contacts, each relay can also be programmed as an impulse or frequency controller. Depending on the control function, in I/F control either the impulse length (I-control) or the impulse frequency (F-control) of the output signal is varied.

Features

- 12 relay contacts
- 3 analog outputs
- Serial input/output interfaces RS 232 and RS 485
- Comprehensive warning, alarm and control functions
- Free assignment of all inputs and outputs

TC/PU 1 Two-Channel Permeate Switcher

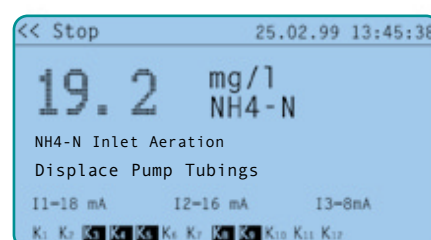
By means of the TC/PU 1 Two-Channel Permeate Switcher TresCon® can analyze samples from two different sampling locations in sequence. As the two analyzer samples, e.g. the permeate flows from two PurCon® systems, are directly in contact with the switching valve, any alteration in concentration of either of the permeate flows can be registered within minutes. Up to three TresCon® modules can be connected to the TC/PU 1 Two-Channel Permeate Switcher. It is available as an accessory and can be mounted on the side of the TresCon® stand in a space-saving manner. Control is via the TresCon® terminal. The mA outputs and relays can be parametrized accordingly so that no additional external reporting units are necessary.

Maintenance and Service

A high degree of availability combined with low maintenance requirements are expected from on-line analysis systems. TresCon® meets these demands to the highest degree as in the development phase great care was taken to obtain a service-friendly design and to include numerous useful system and monitoring functions. On the basis of these functions

the operator is given useful information about preventative maintenance and the status of the instruments, e.g. filling levels of the various containers.

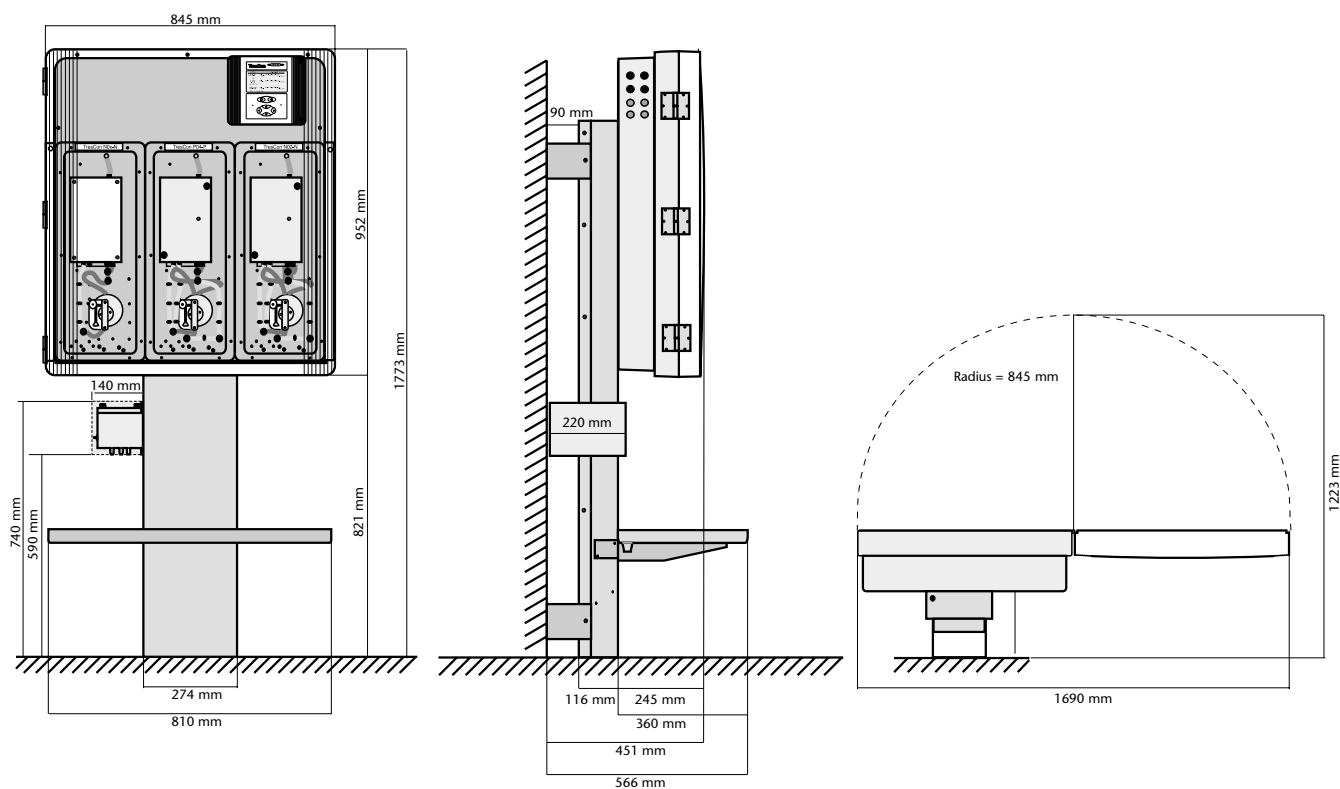
Thanks to its well-laid-out design all components are easily accessible for maintenance and servicing purposes.



Technical Data

Sample preparation	TresCon® analyzer modules require continuous sample input with a low solids content; typical sample preparation with PurCon® (see Sample Preparation Section).
Sample delivery	Sample presented for analysis in overflow vessels supplied; up to three analyzer modules can be connected to one overflow vessel. Operation with up to three overflow vessels is also possible (parallel analysis of different samples).
Interfaces	3 freely configurable galvanically separated 0/4-20 mA outputs, 12 potential-free relays, freely configurable, RS 232, RS 485.
Electrical connections	230 VAC $\pm$ 10%, 50 Hz / 115 VAC $\pm$ 10%, 50 – 60 Hz
Ambient conditions	Storage temperature $-25 \dots 60$ °C, operating temperature $0 \dots 40$ °C, climate class 4, VDI/VDE 3540 Bl. 2
Test marks	GS, CE, DIN-GOST
Instrument protection	Safety class I according to IEC 1010-1/EN 61010-1
Weight	Empty housing: 27 kg; each module: 10 kg; mounting column: 25 kg
The technical data of the analyzer modules can be found on pages 304 to 317	

TresCon® dimensions



Ordering information

The TresCon® analysis systems can be individually assembled according to the following pattern. Each basic instrument (terminal) already has an analyzer module assigned to it. The second and third modules as well as the type of mounting are defined by completing the order

number. The substances necessary for operating each module have been assembled in favorably-priced reagent sets. Delivery without reagents, e.g. via air transport, is also possible. For these reason each module **can be supplied with a reagent set (RSet), or a con-**

tainer set (BSet) without reagents; the number of the required set must always be given separately in the order. Each module can also be ordered individually for retrofitting (for scope of supply please refer to ordering information on the following pages).

Ordering Information

One TresCon® basic instrument (without module) consisting of:

TresCon® terminal, mounting column, reagent tray, overflow vessels for max. three modules, terminal operating instructions (German)
If operating instructions in English are required these must be ordered separately.

TresCon® basic instrument (with first analyzer module)

			1st module	2nd module	3rd module
TresCon® Ammonia, A111	Basic instrument with OA 110 module for Ammonium-Nitrogen	8A-1	☐	☐	☐
TresCon® Nitrate, N211	Basic instrument with ON 210 module for Nitrate-Nitrogen	8A-2	☐	☐	☐
TresCon® Nitrite, N511	Basic instrument with ON 510 module for Nitrite-Nitrogen	8A-3	☐	☐	☐
TresCon® Orthophosphate, P211/MB 1	Basic instrument with OP 210/MB1 module for Orthophosphate (measuring range 1)	8A-4	☐	☐	☐
TresCon® Orthophosphate, P211/MB 2	Basic instrument with OP 210/MB2 module for Orthophosphate (measuring range 2)	8A-5	☐	☐	☐
TresCon® Orthophosphate, P211/MB 3	Basic instrument with OP 210/MB3 module for Orthophosphate (measuring range 3)	8A-6	☐	☐	☐
TresCon® Nitrate/SAC, S211	Basic instrument with OS 210 module for Nitrate-Nitrogen and SAC	8A-7	☐	☐	☐
TresCon® Total Phosphorus, P511	Basic instrument with OP 510 module for Total Phosphorus (requires two module places)	8A-8	☒	☐	☐

Ordering options for additional analyzer modules (2nd/3rd modules)

Without additional analyzer module
NH₄ analyzer module (Ammonia-Nitrogen), OA110
NO₃ analyzer module (Nitrate-Nitrogen), ON210
NO₂ analyzer module (Nitrite-Nitrogen), ON510
PO₄ analyzer module (Orthophosphate), OP 210/MB1
PO₄ analyzer module (Orthophosphate), OP 210/MB2
PO₄ analyzer module (Orthophosphate), OP 210/MB3
NO₃/SAC analyzer module (Nitrate-Nitrogen and SAC), OS 210

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7

Other ordering options

Without feet (wall mounting with mounting stand)
With feet (free-standing arrangement)

0
1

Please complete the ordering number by entering the required versions:

☐	☐	☐	☐	☐
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Ordering example:

TresCon® Ammonium A111 with additional nitrate module, for wall mounting with mounting stand

8A-1	☐	☐	☐	☐
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Ordering Information Accessories

Model	Description	Order No.
TC/ Fuß	Feet, for free-standing arrangement	821 001
TC/ ÜB 1	Overflow vessel for 1 parameter	821 004
TC/ ÜB V	Overflow vessel with valve	821 005
TC/ PU1	2-channel permeate switcher	821 008
BA/ TC/d	Terminal operating instructions, German	BA43108d
BA/ TC/e	Terminal operating instructions, English	BA43108e

TresCon® OA 110

Ammonia Analyzer Module

Features

- Wide measuring range of 0.1 ... 1000 mg/l NH₄-N
- Extreme long-term accuracy due to quartz-controlled pump
- Continuous measurements with automatic calibration
- Response time < 3 min
- No filtration required in effluents with low levels of suspended solids



On-line ammonium measurement

- Control of aeration for complete nitrification
- Continuous ammonium value monitoring in sewage plant effluent
- Analysis of the ammonium-nitrogen pollution in surface waters
- Monitoring water treatment plants

Measuring Principle

The continuous determination of ammonium in the OA 110 module is carried out according to the potentiometric measuring principle with a gas-sensitive NH₃ electrode. Sodium hydroxide is added to the thermostatted sample to convert the ammonium dissolved in the medium into undissociated ammonia gas. The gaseous ammonia alters the pH registered by the measuring electrode; the alteration is a direct measure of the ammonium concentration in the sample.

Measuring Ranges		
	mg/l	μmol/l
NH ₄ -N	0.1 - 1000	0.01 - 71.0
NH ₄ ⁺	0.1 - 1280	0.01 - 71.0

Technical Data OA 110

Resolution (Display)	Range:	0.10 ... 10 mg/l:	0.01 mg/l
		10.0 ... 100 mg/l:	0.1 mg/l
		100 ... 1280 mg/l:	1 mg/l
Coefficient of variation for method	Range:	0.10 ... 10 mg/l:	3%
		10.0 ... 100 mg/l:	4%
		100 ... 1280 mg/l:	5%
	(values for calibration with suitable standard solutions)		
Response Time	< 3 min (after alteration in concentration at module input)		
Measuring interval	Continuous Mode and 10, 15, 20, 25, 30 min intervals selectable, AutoAdapt, Interval-Program		
Calibration	Automatic 2-point calibration (AutoCal) with two standard solutions		
Sample input	Approx. 0.3 l/h, solids content <50 mg/l		
Consumption	Reagent, 10 l:	14/30/50 days at measuring intervals cont./20/30 min	
	Standard solutions A/B, 1.5 l:	60 days with 24 h calibration interval	
	Cleaning solution, 1.5 l:	60 days with 24 h cleaning interval	
Maintenance interval	Every 6 months		

Ordering Information OA 110

		Order No.
OA 110	Separate TresCon® analyzer module for ammonium-nitrogen with: - Set of consumables for 1 year (Epack) - One Ammonium electrode - 3 membrane heads for ammonium electrode - Overflow vessel for one module - One 10 l canister (with screw cap and label) - Ammonium module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	820 008
Consumables		
RSet/ A111-1	Reagent set for ammonium analyzer module, for 120 days operation Standards (1, 10 mg/L) / reagents / cleaning agents	821 138
RSet/ A111-2	Reagent set for ammonium analyzer module, for 120 days operation Standards (5, 50 mg/L) / reagents / cleaning agents	821 140
BSet/ A111	Container set for ammonium analyzer module, 3 x 1,5 l bottles (with screw caps and labels)	821 055
Epack/ A111	Set of consumables for 1 year's operation of ammonium analyzer module	821 180
Accessories		
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
R/ A111	Pack of 400 g NaOH pellets and 390 g Na ₂ -EDTA powder, for 10 l	821 075
S/ AI - A111	Standard solution A-I (1 mg/l NH ₄ -N), 1.5 l	821 100
S/ AII - A111	Standard solution A-II (5 mg/l NH ₄ -N), 1.5 l	821 101
S/ BI - A111	Standard solution B-I (10 mg/l NH ₄ -N), 1.5 l	821 102
S/ BII - A111	Standard solution B-II (50 mg/l NH ₄ -N), 1.5 l	821 103
C/ A111	Cleaning solution for ammonium analyzer module, 10% citric acid, 1.5 l	821 160
NH500/TC	Ammonium electrode with 3 exchange membrane heads and electrolyte, for OA 110 module	821 210
ZBK/NH3/2	Accessories for ammonium electrode, 3 exchange membrane heads and electrolyte	180 100
BA/ A111/d	Operating instructions for ammonium module, German	BA43111d
BA/ A111/e	Operating instructions for ammonium module, English	BA43111e

Please also refer to the ordering information on page 303

TresCon® ON 210

Nitrate Analyzer Module

Features

- Reagent-free measuring method
- Very short response time
- Large measuring range of 0 bis 250 mg/l NO₃
- Insensitive to interfering substances
- Extreme long-term stability
- 4-beam measuring method for optimal background compensation
- Can be used in weakly polluted water without sample preparation



On-line nitrate measurement

- Determining the inflow pollution in sewage treatment plants
- Regulating nitrate degradation in denitrification
- Continuous monitoring of nitrate effluent values

Measuring Principle

In the ON 210 module the ability of nitrate ions to absorb UV light of certain frequencies is used for measuring the nitrate. The ultraviolet light from a pulsed photoflash lamp passes through a flow-thru measuring cuvette where it is partially absorbed by the nitrate ions present in the sample flow. The intensity of the attenuated light is measured at a measuring wavelength and at a reference wavelength and evaluated electronically. The 4-beam measuring method used ensures a high degree of long-term stability and absolute accuracy; interfering background influences are efficiently compensated.

Measuring Ranges

	mg/l	μmol/l
NO ₃ -N	0.1 - 60	0 - 4000
NO ₃	0.1 - 250	0 - 4000

Technical Data ON 210

Resolution (Display)	Range:	0.1 ... 100 mg/l :	0.1 mg/l
		100 ... 250 mg/l :	1 mg/l
Coefficient of variation for method	2%		
Response Time	30 s (after alteration in concentration at module input)		
Measuring interval	Continuous mode and 5, 10, 15, 20, 25, 30 min intervals selectable, AutoAdapt, Interval-Program		
Calibration	Automatic zero balance, works calibration		
Sample Flow Rate	0.5 L/hr approx., suspended solids content < 50 mg/L		
Consumption	Distilled water, 10 l: 130 days with 24 h interval for zero balance Cleaning solution, 1.5 l: 120 days with 24 h cleaning interval		
Maintenance Interval	Every 6 months		

Ordering Information ON 210

		Order No.
ON 210	Separate TresCon® analyzer module for nitrate-nitrogen with: - Set of consumables for 1 year (Epack) - Overflow vessel for one module - Nitrate module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	820 007
Consumables		
RSet/ N211	Reagent set for nitrate and nitrate/SAC analyzer modules, for 120 days operation Standard / cleaning agent	821 143
BSet/ N 211	Container set for nitrate and nitrate/SAC analyzer modules, 1 x 1.5 l bottle / 1 x 10 l canister (with screw caps and labels)	821 056
Epack/ N 211	Set of consumables for 1 year's operation of nitrate and nitrate/SAC analyzer modules	821 183
Accessories		
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
S/ AI - N211	Standard solution A-I (zero standard NO ₃ -N), 10 l	821 112
SSet/ N211	Set of standard solutions (NO ₃ -N), 4 x 1.5 l	821 113
C/ N211	Cleaning solution for nitrate analyzer module, 12% hydrochloric acid, 1.5 l	821 163
BA/ N211/d	Operating instructions for nitrate module, German	BA43110d
BA/ N211/e	Operating instructions for nitrate module, English	BA43110e

Please also refer to the ordering information on page 303

TresCon® OS 210

Nitrate/SAC Analyzer Module

Features

- Two on-line parameters in a single analyzer module
- On-line SAC determination according to DIN 38 404
- Reliable measurement with 4-beam reference method
- Efficient background compensation
- Reagent-free measuring methods
- Extremely short response time
- Wide measuring range
- Insensitive to interfering substances
- Can be used in weakly polluted water without sample preparation



On-line SAC measurement

- Simultaneous measurement of SAC (spectral absorption coefficient) and nitrate
- Continuous output of SAC value as mA signal
- Further processing of SAC signal possible via superordinate unit control, e.g. plant-specific correlation at the process leading control level as replacement parameter for dissolved wastewater pollution

SAC measuring principle

The SAC value is determined in accordance with DIN 38 404 by a pure absorption measurement on the aqueous sample in the UV range which is why the method requires no additional reagents. As undissolved substances interfere with the SAC determination, DIN 38 404 and EN ISO 7887:1994 require filtration of the sample through a 0.45 µm filter. The PurCon® continuous sample preparation unit supplies a permeate which fulfills these high quality requirements in an ideal manner.

Measuring Ranges		
	mg/l	µmol/l
NO ₃ -N	0.1 - 60	0 - 4000
NO ₃	0.1 - 250	0 - 4000
SAK	0.1 - 200 m ⁻¹	

Nitrate measuring principle

The ability of nitrate ions to absorb UV light of certain frequencies is used for measuring the nitrate. The ultraviolet light from a pulsed photoflash lamp passes through a flow-thru measuring

cuvette where it is partially absorbed by the nitrate ions present in the sample flow. The intensity of the attenuated light is measured at a measuring wavelength and a reference wavelength and

evaluated electronically. The 4-beam measuring method used ensures a high degree of long-term stability and absolute accuracy; interfering background influences are efficiently compensated.

Technical Data OS 210

Resolution (Display)	Nitrate: Range: 0.1 ... 100 mg/l Range: 100 ... 250 mg/l SAC: Range: 0.1 ... 200 m ⁻¹	0.1 mg/l 1 mg/l 0.1 m ⁻¹
Coefficient of variation for method	2%	
Response Time	30 s (after alteration in concentration at module input)	
Measuring interval	Continuous measurement: 5, 10, 15, 20, 25 and 30 min can be set, AutoAdapt, Interval-Program	
Calibration	Automatic zero balance, fixed works calibration	
Sample input	Approx. 0.5 l/h, Nitrate measurement: no sample preparation if solids content < 50 mg/l SAC measurement: with sample preparation to DIN 38 404 (see PurCon®, page 325)	
Consumption	Distilled water, 10 l: 130 days with 24 h interval for zero balance Cleaning solution, 1.5 l: 120 days with 24 h cleaning interval	
Maintenance Interval	Every 6 months	

Ordering Informations OS 210

		Order No.
OS 210	Separate TresCon® analyzer module for nitrate-nitrogen and SAC with: - Set of consumables for 1 year (Epack) - Overflow vessel for one module - Nitrate/SAC module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	820 010
Consumables		
RSet/ N211	Reagent set for nitrate and nitrate/SAC analyzer modules, for 120 days operation Standard / cleaning agent	821 143
BSet/ N 211	Container set for nitrate and nitrate/SAC analyzer modules, 1 x 1.5 l bottle / 1 x 10 l canister (with screw caps and labels)	821 056
Epack/ N 211	Set of consumables for 1 year's operation of nitrate and nitrate/SAC analyzer modules	821 183
Accessories		
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
S/ AI - N211	Standard solution A-I (zero standard NO ₃ -N), 10 l	821 112
SSet/ N211	Set of standard solutions (NO ₃ -N), 4 x 1.5 l	821 113
C/ N211	Cleaning solution for nitrate analyzer module, 12% hydrochloric acid, 1.5 l	821 163
BA/ S211/d	Operating instructions for nitrate/SAC module, German	BA43120d
BA/ S211/e	Operating instructions for nitrate/SAC module, English	BA43120e

Please also refer to the ordering information on page 303

TresCon® ON 510 Nitrite Analyzer Module

Features

- Selectable measuring intervals: 5, 10, 15 or 20 min
- Reliable and very accurate thanks to 2-beam reference photometer
- Continuous background compensation
- Can be used in weakly polluted water without sample preparation



On-line nitrite measurement

- Observation of the nitrification process
- Monitoring nitrite effluent values
- Measurement checks in drinking water treatment
- Monitoring nitrite pollution in natural waters

Measuring Principle

The measuring principle of the NO₂ analyzer module is based on the azo dye method. A reagent reacts with nitrite to color the sample solution pink. The intensity of the pink color is proportional to the nitrite concentration in the sample and is measured by a double-beam reference photometer. An additional manual correction facility allows the system to be adapted to plant-specific characteristics so that a high degree of measuring accuracy can be achieved even with strongly colored samples.

Measuring Ranges		
	mg/l	µmol/l
NO ₂ -N	0.005 - 1.200	0.4 - 90.0
NO ₂	0.020 - 4.000	0.4 - 90.0

Technical Data ON 510

Resolution (Display)	Range:	0.005 ... 1.200 mg/l :	0.001 mg/l
		0.4 ... 90.0 µmol/l :	0.1 µmol/l
Coefficient of variation for method	1%		
Response Time	< 5 min to measured value (after alteration in concentration at module input)		
Measuring interval	5, 10, 15, and 20 min intervals selectable, AutoAdapt, Interval-Program		
Calibration	Automatic 2-point calibration, time and interval selectable		
Background Correction	Continuous background compensation based on new WTW algorithm		
Sample input	Approx. 0.06 l/h, solid content < 50 mg/l		
Consumption	Reagent, 1 l:	20/40/80 days with 5/10/20 min measuring interval	
	Standard B, 1 l:	80 days with 24 h calibration interval	
	Cleaning solution, 1.5 l:	45 days with 24 h cleaning interval	
Maintenance Interval	Every 6 months		

Ordering Information ON 510

		Order No.
ON 510	Separate TresCon® analyzer module for nitrite-nitrogen with: - Set of consumables for 1 year (Epack) - Overflow vessel for one module - Two 1,5 l bottle (with screw cap and label) - One 10 l canister (with screw cap and label) - Nitrite module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	820 009
Consumables		
RSet/ N511	Reagent set for nitrite analyzer module, for 60 days operation Standard / reagent / cleaning agent	821 146
BSet/ N 511	Container set for nitrite analyzer module, 2 x 1 l square bottles (with screw caps and labels)	821 057
Epack/ N 511	Set of consumables for 1 year's operation of nitrite analyzer module	821 186
Accessories		
BEH/ T 1	1 l bottle (with screw cap and label)	821 015
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
R/ A 111	Pack of 400 g NaOH pellets and 390 g Na ₂ -EDTA powder, for 10 l	821 075
R/ N 511	Reagent solution for nitrite analyzer module, 13% phosphoric acid, 1 l	821 085
S/ B - N511	Standard solution B (0.4 mg/l NO ₂ -N), 1.5 l	821 117
EL/ TC	Spare lamp for photometer block	821 175
BA/ N511/d	Operating instructions for nitrite module, German	BA43112d
BA/ N511/e	Operating instructions for nitrite module, English	BA43112e

Please also refer to the ordering information on page 303

TresCon®

OP 210

Phosphate Analyzer Module

Features

- Yellow method
- Continuous background compensation
- Continuous/Discontinuous operation selectable
- Can be used in weakly polluted water without sample preparation



On-line orthophosphate measurement

- Control or feedback control of chemical phosphate precipitation, e.g. precipitating agent addition with simultaneous precipitation
- Monitoring biological phosphate elimination
- Continuous determination of phosphate loading in sewage treatment plant inflows
- Measuring the phosphate pollution in natural waters
- Monitoring the phosphate concentration in the drinking water sector

Measuring Principle

The PO₄ module uses the vanadate/molybdate method (yellow method) for determining the orthophosphate content. A reagent reacts with phosphate in the sample to color the sample solution yellow. The intensity of this color is recorded photometrically and evaluated as a measure of the phosphate content. By carrying out a reference measurement at a second wavelength in combination with a correction algorithm, the double-beam reference photometer used permits the almost continuous compensation of possible interfering influences such as dirty cuvettes and the color of the sample itself.

	Measuring Range 1		Measuring Range 2		Measuring Range 3	
	mg/l	µmol/l	mg/l	µmol/l	mg/l	µmol/l
PO ₄ -P	0.05 - 3.00	1.5 - 100	0.1 - 10.0	3 - 320	0.1 - 25.0	8 - 800
PO ₄	0.15 - 9.00	1.5 - 100	0.3 - 30.0	3 - 320	0.8 - 80.0	8 - 800

Technical Data OP 210

Resolution (Display)	Measuring range 1: 0.01 mg/l or 0.1 µmol/l Measuring range 2: 0.1 mg/l or 1 µmol/l Measuring range 3: 0.1 mg/l or 1 µmol/l
Coefficient of variation for method	2% (for all measuring ranges)
Response Time	< 3 min to measured value (after alteration in concentration at module input)
Measuring interval	Quasi-continuous measurement; 5, 10, 15, 20, 25 or 30 min settings, AutoAdapt, Interval-Program
Calibration	Automatic 2-point calibration (time and interval selectable)
Background Correction	Continuous background compensation based on new WTW algorithm
Sample input	Approx. 0.06 l/h, solid content < 50 mg/l (e.g. sewage treatment plant effluent)
Consumption	Reagent, 10 l: 60/155/310/465 days with cont./10/20/30 min measuring intervals Standard B, 1.5 l: 90 days with 24 h calibration interval Cleaning solution, 1.5 l: 45 days with 24 h cleaning interval
Maintenance Interval	Every 6 months

Ordering Information OP 210

		Order No.
OP 210/ MB 1	Separate TresCon® analyzer module for Orthophosphate, measuring range 1	820 004
OP 210/ MB 2	Separate TresCon® analyzer module for Orthophosphate, measuring range 2	820 005
OP 210/ MB 3	Separate TresCon® analyzer module for Orthophosphate, measuring range 3	820 006
	Module supplied with: - Set of consumables for 1 year (Epack) - Overflow vessel for one module - Two 1,5 l bottles (with screw cap and label) - One 10 l canister (with screw cap and label) - Orthophosphate module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	
Consumables		
RSet/ P211/ MB1	Reagent set for Orthophosphate analyzer module, measuring range 1, for 3 months operation: standard / reagent / cleaning agent	821 151
RSet/ P211/ MB2	Reagent set for Orthophosphate analyzer module, measuring range 2, for 3 months operation: standard / reagent / cleaning agent	821 152
RSet/ P211/ MB3	Reagent set for Orthophosphate analyzer module, measuring range 3, for 3 months operation: standard / reagent / cleaning agent	821 153
BSet/ P211	Container set for Orthophosphate analyzer module, 1 x 1.5 l bottle / 1 x 10 l canister (with screw caps and labels)	821 058
Epack/ P 211	Set of consumables for 1 year's operation of Orthophosphate analyzer module	821 189
Accessories		
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
R/ A 111	Pack of 400 g NaOH pellets and 390 g Na ₂ -EDTA powder, for 10 l	821 075
R/ P 211	Reagent solution for Orthophosphate analyzer module, 12% hydrochloric acid, 10 l	821 091
S/ BI - P211	Standard solution B-I (1.6 mg/l PO ₄ -P), 1.5 l	821 121
S/ B-II - P211	Standard solution B-II (8 mg/l PO ₄ -P), 1.5 l	821 122
S/ B-III - P211	Standard solution B-III (20 mg/l PO ₄ -P), 1.5 l	821 123
EL/ TC	Spare lamp for photometer block	821 175
BA/ P211/d	Operating instructions for Orthophosphate module, German	BA43109d
BA/ P211/e	Operating instructions for Orthophosphate module, English	BA43109e

Please also refer to the ordering information on page 303

TresCon® Total phosphorus analyzer module

NEW

Features

- On-line analysis of total phosphorus for sewage treatment plant effluent
- Molybdenum blue measuring method (DIN 38 405)
- Digestion to DIN EN 1189:1996
- Rapid analysis at 10 min intervals
- High degree of measuring accuracy thanks to 2-point calibration
- Fully automatic cleaning at regular intervals
- High degree of operating safety thanks to automatic monitoring



On-line P_{Total} measurement

- Monitoring the effluent from communal sewage treatment plant for P_{Total}
- Monitoring phosphorus pollution in natural waters

Measuring Principle

The P_{Total} module consists of two units: in the first unit (digestion unit) the sample undergoes a chemical-thermal digestion; in the second unit the total phosphorus content is determined. During the digestion all the phosphorus compounds contained in the sample are converted to orthophosphate; this can be determined photometrically. The phosphorus compounds are oxidized by peroxodisulfate under acidic conditions. This process is accelerated

by overpressure and an increased temperature so that very short digestion times are achieved. The subsequent analysis is by the molybdenum blue method. The sample is mixed with a molybdate reagent which reacts with phosphate via an intermediate chemical step to form a blue coloration. The intensity of this coloration is a measure of the original concentration of the phosphate ions. It is measured photometrically and evaluated.

Measuring Range*		
	mg/l	$\mu\text{mol/l}$
P_{Total}	0.05 ... 3.00/ 6.00*	1.5 ... 100/ 200*

* by continuous sample dilution in a 1:1 ratio

Technical Data

Resolution (Display)	Range: 0.05 ... 3.00 mg/l : 0.01 mg/l 1.5 ... 100 µmol/l : 0.1 µmol/l
Measuring principle	Photometric reference beam method after digestion
Measuring method	Molybdenum blue method
Coefficient of variation for method	1.5%
Measuring intervals	10, 15, 20, 25, 30 or 60 min can be set (DIN EN measurement with 30 min digestion at approx. 120 °C), Interval-Program
Calibration	Fully automatic 2-point calibration
Consumption	Reagents A, B, C, D: 10/15/20/30/60 days with 10/15/20/30/60 min measuring interval Standard, 1.5 l: 70 days with 24 h calibration interval Cleaning solution, 1.5 l: 60 days with 24 h cleaning interval
Maintenance interval	Every 6 months

Ordering Information Total Phosphorus

		Order No.
OP 510	Separate TresCon® analyzer module for total phosphorus (requires 2 TresCon® measuring places) with: - Set of consumables for 1 year (Epack) - Overflow vessel for one module - One 1,5 l bottle (with screw cap and label) - One 10 l canister (with screw cap and label) - Cool box for reagents - Total phosphorus module operating instructions in German (English version must be ordered separately) - Either one reagent set (RSet) or one container set (BSet), as chosen (the number of the required set must be given separately on the order)	820 011
Consumables		
RSet/ P511	Reagent set for total phosphorus analyzer module, for 60 days operation (at DIN EN measuring interval of 60 min)	821 154
BSet/ P511	Container set for total phosphorus analyzer module	821 059
Epack/ P 511	Set of consumables for 1 year's operation of orthophosphate analyzer module	821 192
Accessories		
BEH/ T 1,5	1.5 l wide neck bottle (with screw cap and label)	821 017
BEH/ T 10	10 l canister (with screw cap and label)	821 019
KB/P511	Cool box for total phosphorus reagents for P _{Total} analyzer module	821 068
R/ ADD/ TC	Pack of 390 g Na ₂ -EDTA powder as reagent additive for 10 l	821 071
R/ A 111	Pack of 400 g NaOH pellets and 390 g Na ₂ -EDTA powder, for 10 l	821 075
R/ P511	Reagents A, B, C, D for OP 510 module	821 095
S/ BI - P211	Standard solution B-I (1.6 mg/l PO ₄ -P), 1.5 l	821 121
EL/ TC	Spare lamp for photometer block	821 175
BA/ P511/d	Operating instructions for total phosphorus module, German	BA43121d
BA/ P511/e	Operating instructions for total phosphorus module, English	BA43121e

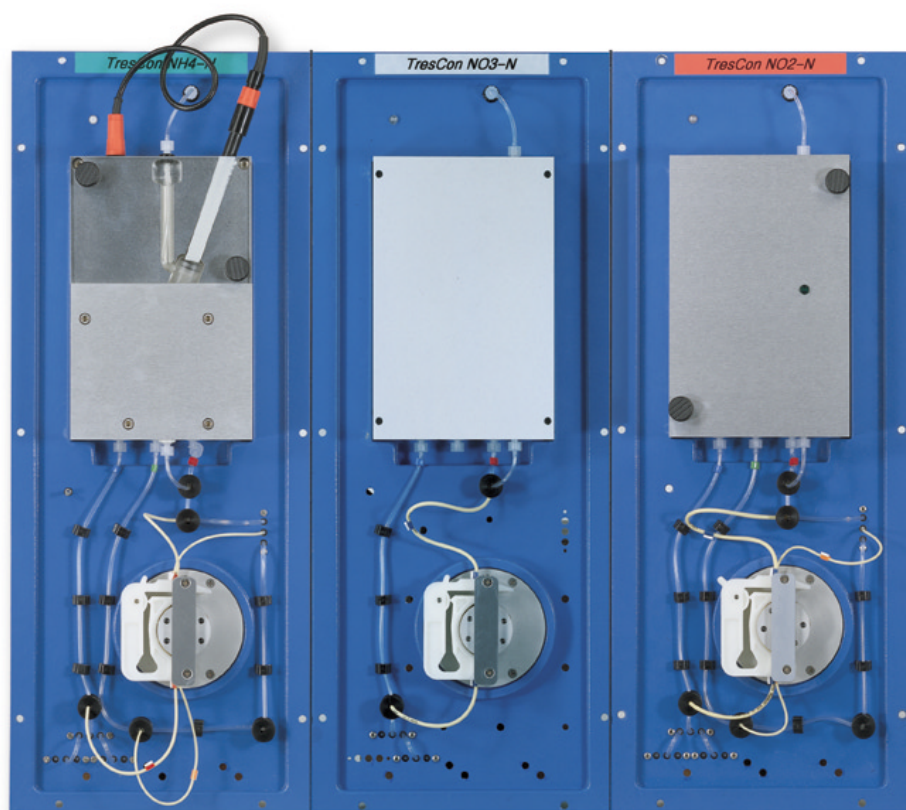
Please also refer to the ordering information on page 303

TresCon® Total Nitrogen

NEW

Features

- On-line nitrogen parameter balancing
- N_{Total} determination in sewage treatment plant effluent
- Nitrate determination completely without nitrite overlaying
- Use of ammonium and nitrate measurement, with nitrite measurement if necessary



$$N_{\text{Total}} = \underset{\text{ammonium-nitrogen}}{NH_4\text{-N}} + \underset{\text{nitrate-nitrogen}}{NO_3\text{-N}} + \underset{\text{nitrite-nitrogen}}{NO_2\text{-N}}$$

According to the German General Wastewater Management Regulations the definition of total nitrogen (N_{Total}) in the effluent of the biological stage of sewage treatment plants is "the sum of ammonium, nitrate and nitrite-nitrogen" [1].

Thanks to the modular design of the system, TresCon® is able to determine the N_{Total} parameter on-line.

This is done by determining the basic parameters ammonium-nitrogen (ISE), nitrate (UV) and nitrite (photometry) and then calculating the N_{Total} value. This means that TresCon® offers the possibility of continuously monitoring N_{Total} in sewage treatment plant effluent without a wet chemistry digestion.

Measuring Range	
	mg/l
N_{Total} (dissolved)	0.1 ... 1000
$NO_3\text{-N}$ (even with significant NO_2 content)	0.1 ... 60
NO_3 (even with significant NO_2 content)	0.1 ... 250

Determination of N_{Total}

In practice the measurement of the nitrate-nitrogen and ammonium-nitrogen is frequently sufficient for the determination of the total nitrogen N_{Total}. Only when the sample contains significant amounts of nitrite-nitrogen, typically when the nitrite-nitrogen content > 5 – 10% of the nitrate-nitrogen, is it also necessary to use the nitrite analyzer module to take the nitrite-nitrogen into account.

The TresCon® controller processes the N_{Total} analysis values in exactly the same way as if they were the data from an independent TresCon® analyzer module, i.e. they are stored and can, for example, be assigned as required to relay or mA outputs and also provided with limits.

Determination of nitrate-nitrogen in the presence of large amounts of nitrite-nitrogen

In sewage treatment plants it may be necessary to determine nitrate-nitrogen in a sample containing comparatively high amounts of nitrite-nitrogen. Conventional measuring methods based on UV self-absorption cannot be used in this case as they always record the overlaying of the two substances; this is usually known as the NO_x-N value. In such cases the separate nitrite-nitrogen determination (photometric azo dye method) means that TresCon® offers the possibility of calculating the “real” nitrate-nitrogen concentration from the NO_x-N value.

This software function is contained in the TresCon® controller as the nitrogen balance. The measuring data obtained for nitrate-nitrogen are processed if they were the data from an independent TresCon® analyzer module, i.e. they are stored and can, for example, be assigned as required to relay or mA outputs and also provided with limits.

Technical Data

Resolution N _{Total} (mg/l) (Display)	Range: 0.1 ... 100 mg/l : 0.1 mg/l 100 ... 1000 mg/l : 1 mg/l
Resolution nitrate (mg/l) (Display)	Range: 0.1 ... 100 mg/l : 0.1 mg/l 100 ... 250 mg/l : 1 mg/l
Response time	< 5 min to measured value (after alteration in concentration at all module inputs)
Measuring interval	5 ... 30 min, depending on individual module settings
Calibration	Automatically for each module
Sample input (3 modules)	Max. approx. 0.8 l/h
(Further information is given in the technical data for the individual modules)	

Ordering information:

Depending on the analytical problem, two or three analyzer modules for the determination of nitrite, nitrate and ammonium-nitrogen are required for the N_{Total} determination or NO₃ determination without the NO₂ fraction. The individual ordering information is given in the descriptions of the individual modules on the previous pages.

^[1] German General Wastewater Management Regulation on the minimum requirements for the discharge of wastewater into surface waters from 27 August 1991, Annex 1: Definition of the minimum requirements for communal sewage treatment plants

Analyzer

On-Line TOC Analyzer

PROTOC 200

Features

- Continuous measurement of TOC concentration
- UV persulfate method
- Measuring range 0 ... 10000 ppm TOC
- Illuminated graphics display
- Automatic cleaning
- Automatic 2-point calibration
- Calibration monitoring
- 2 contact for monitoring limits
- Quick and reliable analysis
- Low maintenance requirements



On-line TOC measurement

- For use in communal and industrial sewage treatment plants
- Monitoring the officially defined effluent values
- Checking the purification performance of sewage treatment plants
- Monitoring tasks in drinking water treatment

Total Organic Carbon (TOC) is a well established method for determining the quality of clean and polluted water. Giving accurate information about the quantity of organic carbon in water, this analysis technique therefore represents as a consent parameter the load of water and waste water with pollutants. The benefit of TOC as an on-line technique is, compared with BOD or COD-measurements, the speed of response allowing monitoring and actual process control rather than just past event analysis.

The PROTOC 200 is a precise and truly continuous analysis system for the determination of Total Organic Carbons (TOC). The system provides modern technology and features high performance and high reliability. It is easy to operate and requires low maintenance. PROTOC 200 can be delivered in varieing configurations that cover almost all applications in the water and waste water treatment.

Conceptual Design

Method of Analysis

The method of analysis performed by the PROTOC 200 analyzer is based on combined UV persulfate oxidation. In the first step a sample stream (particle size 100 µm or less) is supplied to a sample preparation, where inorganic carbons are removed (TOC-mode) from the sample by a steady stream of sparge gas. After that the remaining sample is transferred to a reaction vessel. There the dissolved organic carbon is oxidized by applying a sodium-persulfate reagent accelerated by a high intensity U.V. light source. The liberated carbon dioxide is captured by a second stream of carrier gas, transferred to a non dispersive infrared detector (NDIR) and continuously measured. The detector signal interpreted by a programmable processing unit correlates directly to the level of organic carbon and is reported as TOC concentration. Under normal conditions compressed air is used as a carrier gas, for the determination very low TOC-values nitrogen-gas is recommended.

Automatic calibration

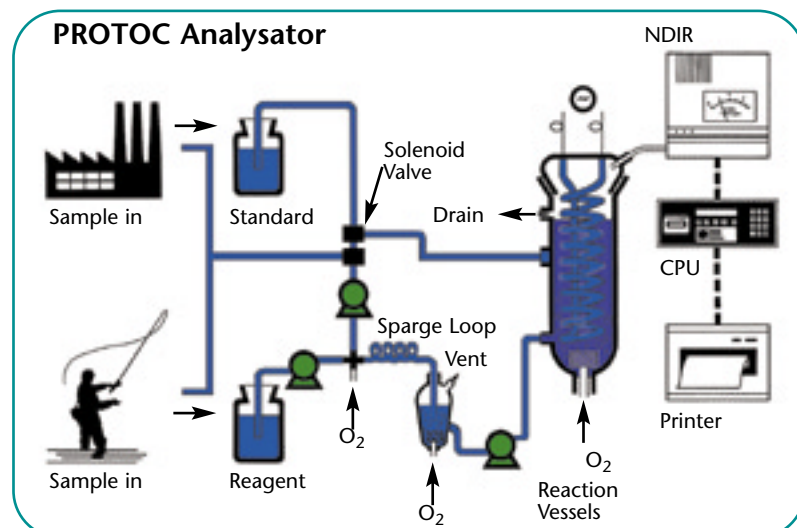
The calibration of PROTOC 200 is performed automatically, typically every 24 hours. Within a calibration the zero setpoint is internally adjusted at first, without an extra zero-standard. After that a reference-measurement with a stable standard-solution is done and the calibration is finished. The results of the calibration are compared automatically with former data, if certain limits are exceeded, a system warning is activated. In such a case PROTOC 200 continuous operation with the former data.

Environmental conditions

As known from every analysis system also for TOC in some respects sample conditioning may become an important stage of a TOC measurement. The feed pump must be selected properly according to the specific operating and site and supply a steady and sufficient stream of representative sample.

The Sample should not contain solids greater than 100 µm, fats and grease. To avoid a possible clogging during the continuous operation the sample can pass, for example, a selfcleaning filter system. The sample pump, filter system and connecting pipework need to be considered as well matched components of a whole system installation. WTW provides the adequate accessories.

System Flow Diagram



IC removal

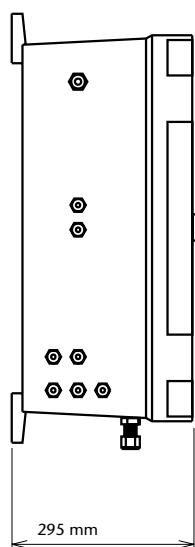
In order to measure TOC, the inorganic carbon (IC) has to be removed. Thus, a small amount of acid is added automatically to the sample to reduce the pH value below pH 3. The sample is then sparged with a strip gas. Passing through a liquid/gas separator, the inorganic carbon is now released as CO₂ gas.

System description

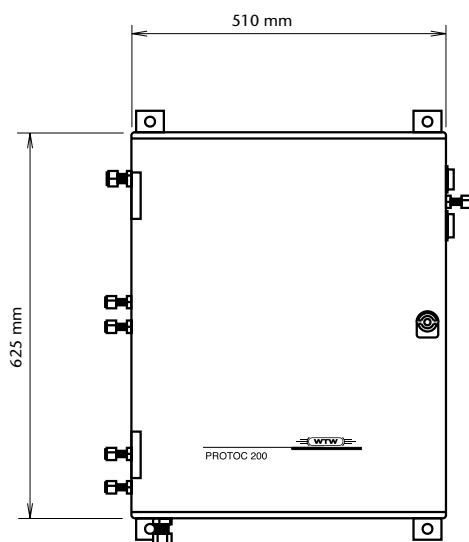
The PROTOC 200 system consists of an analysis-unit which is connected to a separated controller. While analysis is continuously performed in the analyzing unit, the measurement values are interpreted, displayed and stored by the controller. In order to minimize consumption of reagent, cleaning solution and standard the analyzing unit is configured individually by special tubing sets. The system is operated via softkeys.

For data transmission, e.g. to the upper control system of a plant, the controller features an analog-output that can be used as 4 – 20 mA or 0 – 10 V-output, as well as 2 relais contacts.

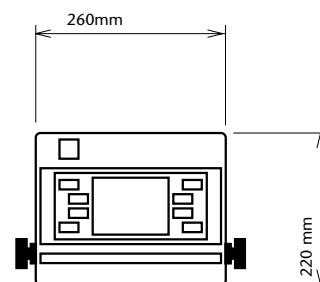
Side view:



Front view:



Analyzer



Controller

Technical Data PROTOC 200

Controller

Display	Illuminated graphics display
Operation	Menu guidance via 8 softkeys
Measuring data presentation	Measurement or curve (8 or 24 h selectable)
Language	English
Output	One analog output, switchable between 4 – 20 mA and 0 – 10 V
Safety	3-place access code
Relay outputs	2 programmable switching contacts for upper/lower limits
Power supply	230 V / 115 V $\pm$ 10%
Power consumption	230 VA
Installation	Wall mounting
Protection code	IP 55
Weight	Approx. 3 kg

Analyzer unit

Analysis parameter	Determination of TOC
Typical measuring ranges	0 – 10 ppm (carrier gas nitrogen) 0 – 100 ppm (carrier gas compressed air) 0 – 1000 ppm (carrier gas compressed air) 0 – 10000 ppm (carrier gas compressed air) (defined upon ordering; alteration may require component exchange)
Detection limit	< 1% of ultimate measuring range value
Reproducibility	< $\pm$ 2% of ultimate measuring range value
Response time	Typically 2 – 5 minutes, depending on measuring range
Cleaning	Fully automatic self-cleaning, up to 4 times per day
Calibration	Automatic 2-point calibration
Carrier gas	Compressed air, 2.2 bar overpressure, typically approx. 400 ml/min
Consumption	Reagent: sodium peroxodisulfate solution, approx. 20 l in 14 days Standard: potassium hydrogen phthalate solution, typically 1 l per week Sample: Typically 1.2 l/h
Maintenance	Typically 30 min per week
Wear and tear components	Change of pump tubing very 6 months
Ambient conditions	5 ... 50 °C, max. 90% rel. humidity
Power supply	230 V / 115 V $\pm$ 10%
Power consumption	230 VA
Installation	Wall mounting
Protection code	IP 65
Weight	32 kg

Ordering Information PROTOC 200

Model	Description	Order No.
PROTOC/ 200	Continuously operating TOC analyzer system, consisting of an analysis unit with automatic self-cleaning system, auto-calibration, auto-balancing and separate control with graphics display	890 002
Accessories		
CMP/PT	Free-standing air compressor to supply PROTOC 200 with carrier gas (compressed air)	890 016
CFF/PT	Self-cleaning cross-flow filter for in-line operation with quick-coupling for easy maintenance, sample supply 5 to 10 l/min and separating limit approx. 75 μ m (no grease or oil)	890 017
FE/PT	Spare filter element for cross-flow filter CFF/PT (no. 890 017)	890 018

PROTOC 200 is available in various configurations (measuring range, carrier gas, ...). The exact specifications of the system will be defined by a check list accompanying the offer/order and set manually during manufacture.