USER MANUAL

3S-TM
Total Organic Carbon Analyzer

Electrical equipment marked with this symbol can not be disposed of through home or public waste disposal systems after 12 August 2005. In accordance with local and national European regulations (EU Directive 2002/96 / EC), users must return the equipment which is unsuccessful or can no longer be used to the manufacturer, which have to provide free of charge disposal.
Note: To return devices at the end of their useful life, accessories supplied by the manufacturer and all auxiliary items for recycling, contact the manufacturer or the vendor of the device to arrange proper disposal.

CONTENTS

1 - SAFETY INFORMATION

Before installing and operating the analyser, read this manual thoroughly. Please pay particular attention to all the labels applied to the analyser and to all the hazard information indicators in this manual.

The manufacturer shall not be held responsible under any circumstances for improper use of the equipment.
The head of department and the machine operator must comply with the following rules and with the provisions of current legislation on the safety and health of workers.
The use, maintenance, and repair of the analyser are permitted only to persons authorised for such operations. These operators must be physically and mentally capable to perform such activities, which can not be performed under the influence of alcohol and drugs.
When the analyser is not being used it must be protected from voluntary or involuntary activation, after disconnecting the power supply.
Failure to follow the instructions given and/or failure to pay attention to the hazard indicators may cause serious risks of physical damage to operators and breaks or malfunctioning of the analyser.
All the components of the analyser are placed within a panel closed by a door with a special key, supplied only to maintenance operators.
The analyser must, then, be used under operating conditions with both right and left doors closed.

1.1 - List of warning labels and potential dangers

This symbol indicates the existence of a risk of electric shock and/or electrocution.
Only operators qualified for these activities can perform maintenance and control operations on the equipment bearing this label, always after unplugging it.

Parts involved:
- input terminal section in the upper right box
- UV lamp and its power wires in the upper part of the left box
-pump motors, air pumps, fans in the left and right boxes

This symbol indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury. The user must refer to this manual for proper use of the equipment. Only qualified operators, properly trained on the use and maintenance of the analyser can carry out service activities on the equipment.

This symbol is used to present an hazard of ultraviolet radiation. It is absolutely necessary to wear eyes protection to operate with the UV lamps labelled with this symbol.
Never look directly at a lighted UV lamp. UV radiation exposure can cause severe and permanent damage skin and eyes.
The UV lamp must not be removed from its housing while the device is operated.

Parts involved:
- UV lamps in the left box

This symbol indicates the risk of burns and physical damage caused by the presence of hazardous chemical compounds.
Only operators qualified for these activities can handle and perform service operations that may involve the risk of contact with such compounds. Before carrying out any type of service activities on the analyser, please read the safety data sheets of the different chemicals used and take all precautions specified therein.

Parts involved in the left box:
- reagent bottles/tanks
- reagent suction pumps and the tubings connected
- UV lamp connection tubings
- scrubber glass column connection tubings
- waste liquid from analyzer
Partinvolved in the right box:
-soda lime filter cylinder

This symbol is used to present an hazard of thermic shock and burns. Some parts of the analyzer may become hot during analyzer normal operations. Avoid skin contact with these surfaces and if necessary to service these parts be sure to lower their temperature sufficiently enough to avoid burn. Always disconnect input power to analyzer before servicing these parts.

Parts involved:
- UV lamps in the left box

1.2 - Vent exausted gas

Waste gases coming from analyzer oxidation process depend on the user's sample composition. They are labeled on the external side of the cabinet as VENT outlets. It is necessary to connect an extension tubing or to provide for safe venting to the atmosphere or to a classified safe area.

1.3 - Sample

Take appropriate precautions to avoid direct contact with sample stream. It is responsibility of the user to be aware of and take all precautions regarding physical, chemical, radiation and/or biological hazards and dangers coming from sample stream and/or sample vapors. It is also responsibility of the user to be aware of potential hazards regarding the chemical and physical compatibility of sample stream with the analyzer materials.

1.4 - UV Lamp disposal

Used or replaced UV lamps contain a small quantity of mercury and they must be disposed according with national or local environmental regulations regarding hazardous and poisonous materials.

1.5 - Electrical precautions and hazards

In all electrical devices that are 230 VAC (or 115 VAC opt.) powered present hazards of electrical shock or electrocution.

To protect all the personnel involved in analyzer use and maintenance, the doors of the two analyzer enclosures are equipped with a special key for opening.

If necessary to operate inside the electrical enclosure with the analyzer powered on, please consider that this operation must be made only by qualified personnel in accordance with national or local regulations. Qualified personnel means a person who has been fully trained and has professional experience to avoid electricity hazards and dangers.

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Service qualified personnel will receive the special key to open the electrical enclosure.

Before to service the analyzer or parts of that electrically powered, turn off all power to avoid risk of electrocution.

To turn off power from an electrical device is necessary to interrupt the power line using a circuit breaker or an isolating switch to be sure that there is no power in the area being serviced.
In case of loss of power the analyzer stops and will automatically restart as soon as power is restored.

GROUNDING
Electrical equipments of input power and grounding must comply the national or local regulations and laws.
Check that the source voltage to be used corrisponds with that requested by the analyzer.
Check periodically the power cord as well as the analyzer grounding.

UV LAMP power supply reaches an ignition voltage up to 3000 Volts; do not operate any service activity without removing the instrument power cord.

1.6 - Operating precautions and hazards

Mechanical hazards caused by moving parts of fans, pumps, motors and air compressors
To avoid risks the analyzer's moving parts have been designed, built and located in closed enclosure with a special opening key. When present inside the enclosures, these parts have protection covers to avoid any contact and physical injuries to users. Broken glass parts can represent a danger when servicing the analyzer .
Use protective gloves and glasses when opening the two doors.

Hazards of burns caused by hot parts of UV lamps, motors and air compressors
To avoid risks, the analyzer's parts that become very hot to the touch have been designed, built and located in closed enclosure with a special opening key. When present inside the

enclosures, these parts have protection covers and warning labels to avoid any contact and physical injuries to users.

Hazard of poisoning a caused by waste gas coming out from VENT line
Install the analyzer in location of adequate dimensions and well ventilated.

Hazards of UV radiation exposure caused by UV lamps
To avoid risks, the analyzer's parts that produce UV radiation emissions have been designed, built and located in closed enclosure with a special opening key. When present inside the enclosures, these parts have protection covers and warning labels to avoid any contact and/or exposure and/or physical injuries to users.

Hazard of electric shock and/or electrocution in the electrical enclosure
The analyzer's electric equipment complies with **EN 60204** requirements.
To avoid risks, the analyzer's parts that can cause hazard of electric shock and/or electrocution have been designed, built and located in closed enclosure with a special opening key. When present inside the enclosures, these parts have protection covers and warning labels to avoid any contact and serious injuries or death to users.

Hazard of burns and poisoning caused by contact with dangerous chemicals
To avoid risks, the analyzer's parts that can cause contact with chemicals have been designed, built and located in closed enclosure with a special opening key. Before to service the liquids enclosure, read the material safety data sheets supplied with each chemical to take all the necessary precautions when handling. Wear eye protections, gloves, mask and clothes if necessary.

1.7 - Physical hazards

The analyzer has been designed, built and equipped to avoid risks caused by phisical factors, like vibrations or noise.

2 - INTRODUCTION

This manual provides general informations regarding the principle of operation and for a proper installation and operation of the analyzer .

2.1 - Analyzer description

The analyzer measures Total Organic Carbon in liquid samples using the EPA approved method based on UV persulfate oxidation and detection of generated carbon dioxide using a Non Dispersive Infrared detector. This method meets also the the requirements of European ISO/CEN guidelines. The analyzer provides this measurements on liquid samples ranging from 0-2 mg/l to 0-20000 mg/l.
The analyzer conforms to EPA, DIN, CE, ASTM and NAMUR regulations.

2.2 - Applications

The 3S TOC Meter measures Total Organic Carbon (TOC) in water continuously.
It has been designed for the following applications:

- Industrial waste water
- Condensate and cooling water
- Drinking and river water
- Industrial water treatment plant inlet/outlet

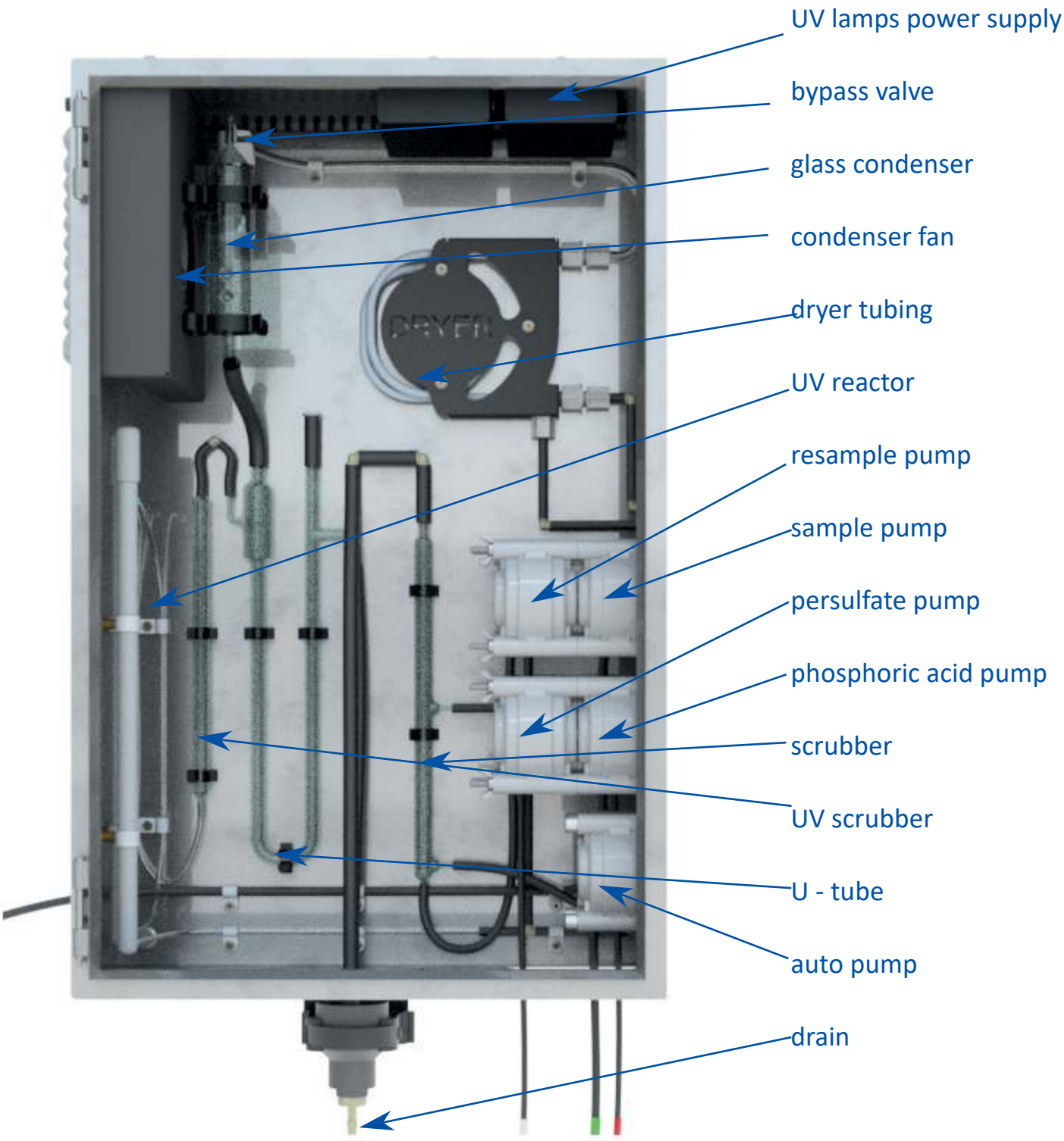
For different applications or different aqueous matrices it is recommended to contact your 3S Analyzers distributor to verify your application with our specialists.

2.3 - Components overview

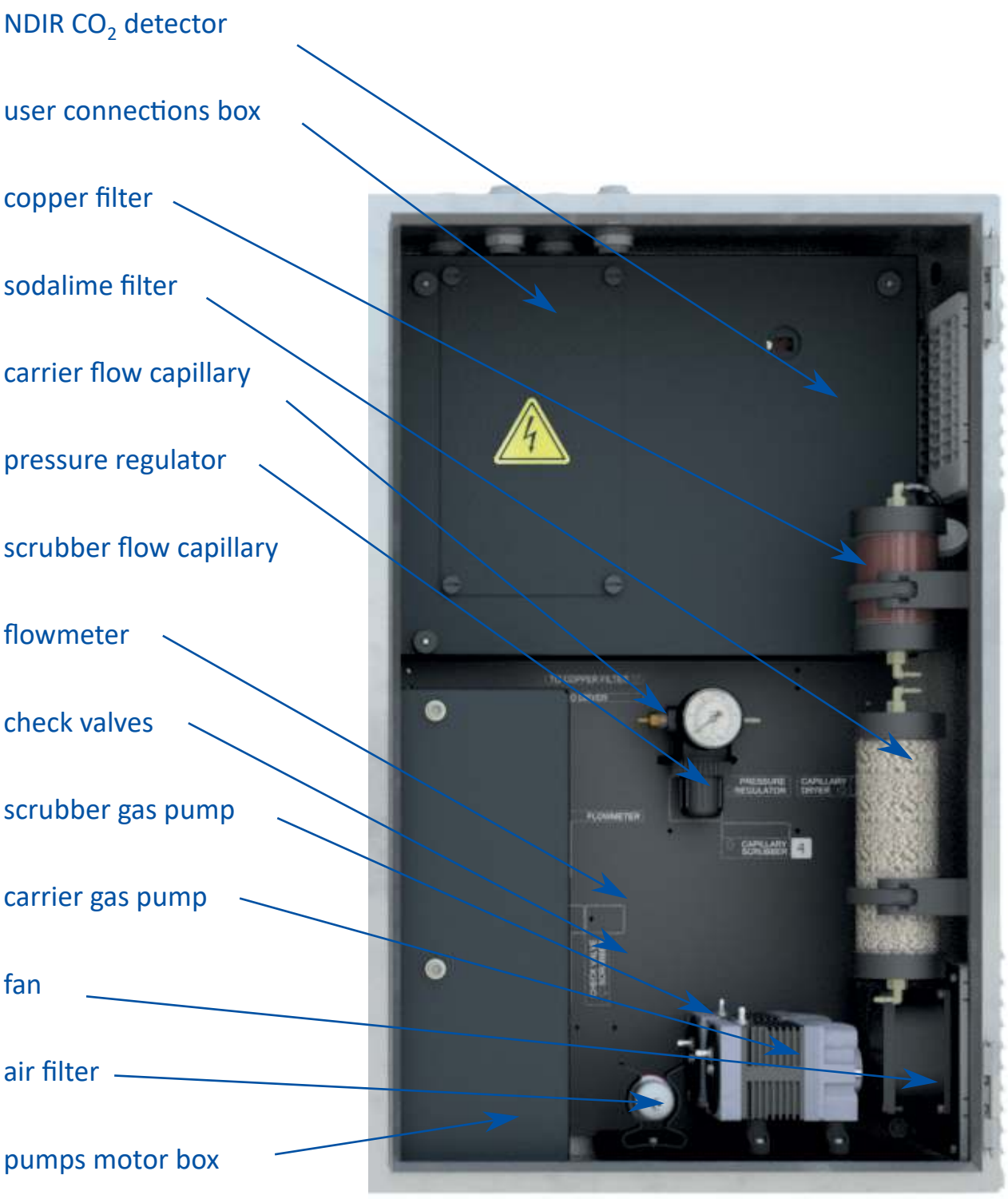
The analyzer is assembled in two separated enclosures. The first one, called **LIQUIDS enclosure**, includes all the components involved in sample and reagents flows as well as their mixing in sparging and oxidation stages. This enclosure is properly vented by a fan to allow good air refreshment inside the cabinet. The second one, called **ELECTRICAL enclosure**, includes the main power supply, the carrier gas generation and flow adjustment devices, the controller PCB assembly and the infrared detector.

2.4 - Left and right enclosures

The left enclosure contains all the parts wetted by liquids.



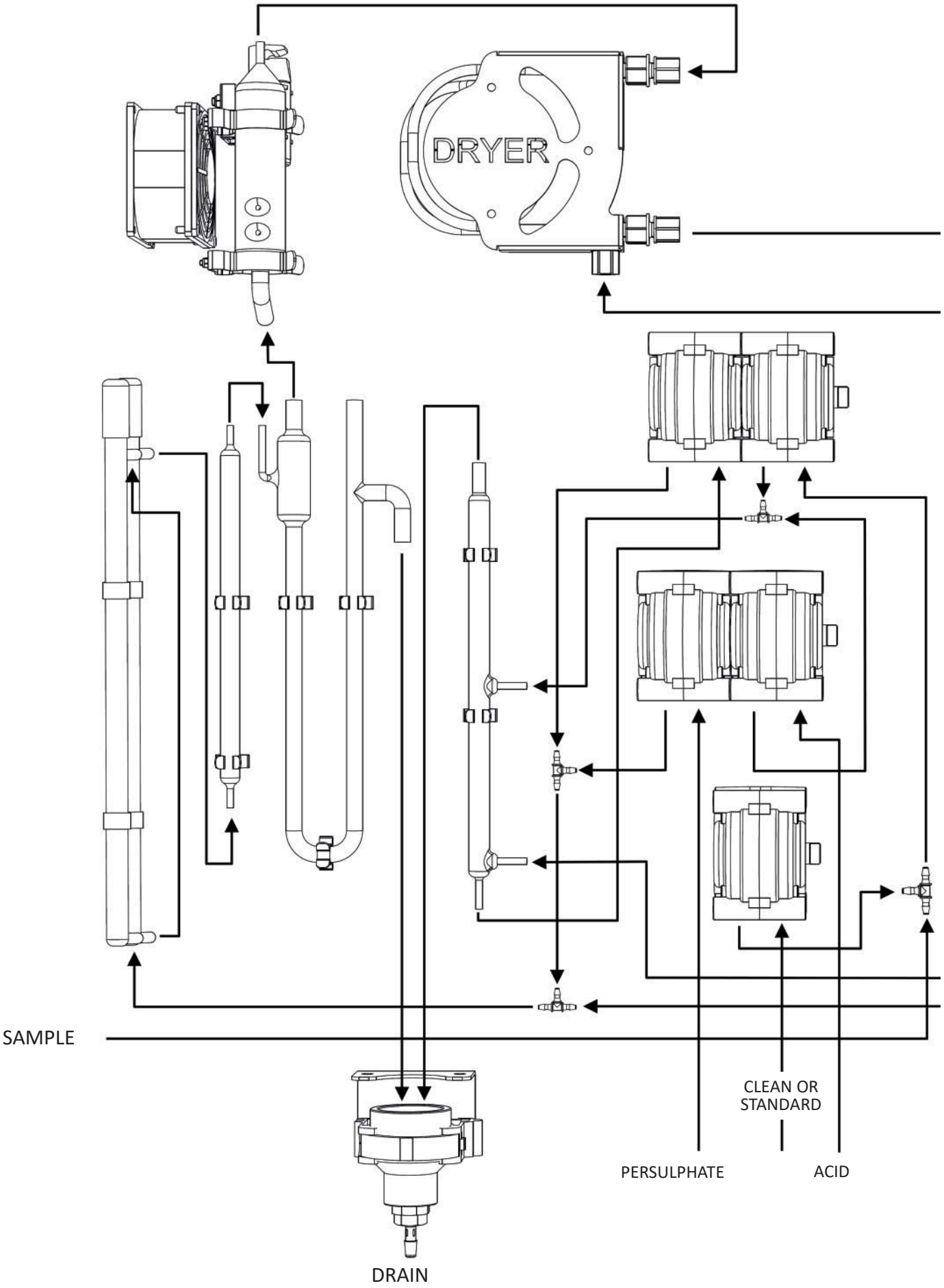
Inside the right enclosure there are all the electronic components, including the detector, and the gas generation section.



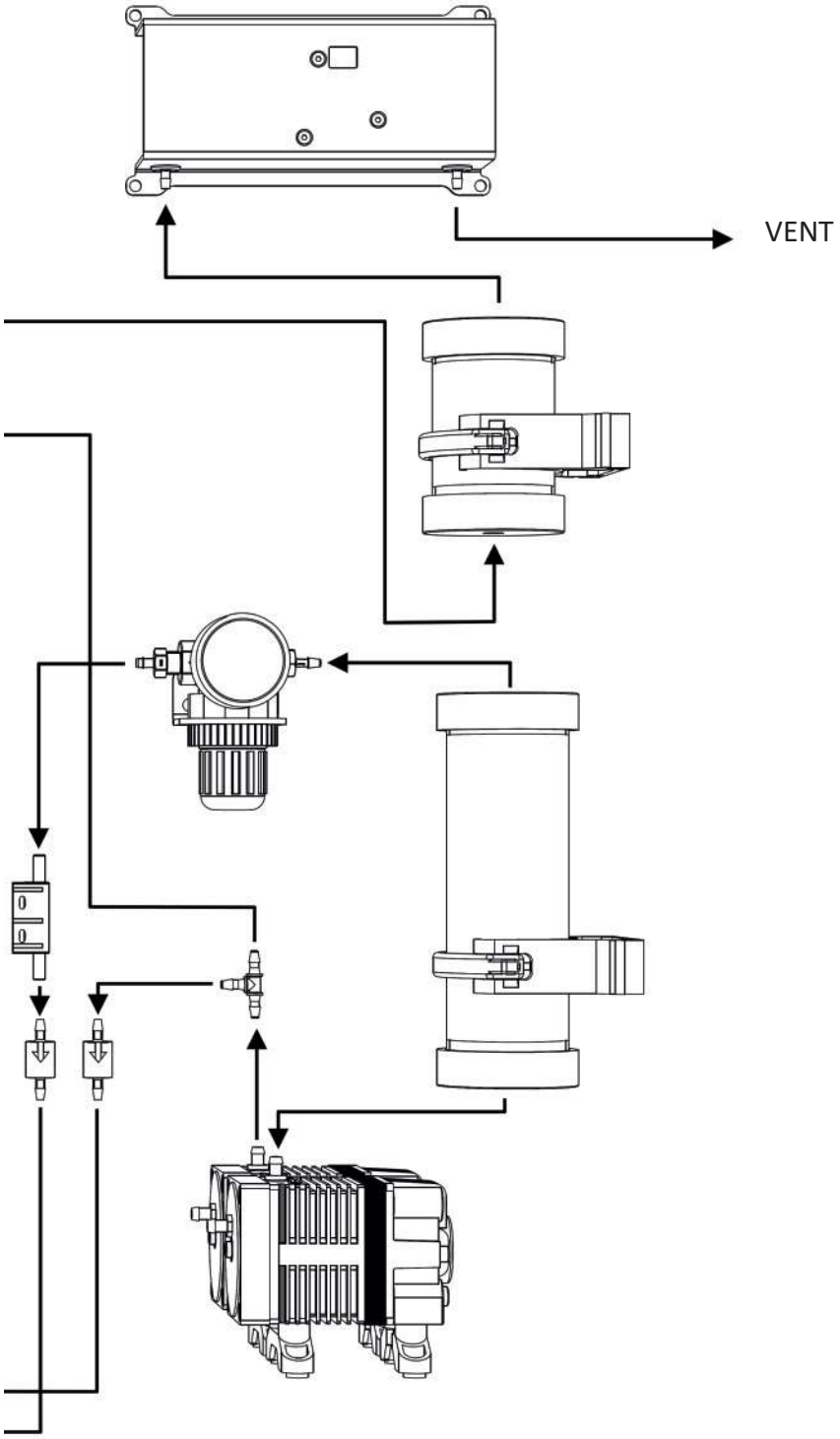
2.5 - Operating principle

Water (directly from the sampling point or through the optional filtration unit) is fed to a sampling device mounted on the external left side of the analyzer. This device drains the sample excess and is equipped with a level sensor to check the sample presence. This device allows a good sample refreshment and will put the analyzer in standby condition in case of loss of sample. The analyzer will automaticially restart when sample flow resumes. The sample is pumped by a peristaltic pump to the inorganic scrubber after mixing with acid (usually phosphoric acid) pumped by a second peristaltic pump. The inorganic removal is performed using ambient air provided by an internal air compressor. This first process lowers the pH of the sample and convert the carbon carbonates to carbon dioxide. The carbon dioxide dissolved in water is then driven out by the sample to the vent using compressed air.
The acidified and sparged sample is then pumped from the scrubber bottom to the UV reactor by the resample pump, after mixing with a strong oxidizing agent (sodium persulfate) pumped by a dedicated peristaltic pump. The presence of a strong oxidizing agent combined with high level UV radiation causes the oxidation of organic compounds. The produced carbon dioxide is driven to the gas liquid separator. The liquid sample is drained off while the air containing carbon dioxide goes to the infrared detector, passing in sequence through a glass condenser, gas drier tubing and a halogens filter. These devices are present to prevent condensation and corrosion inside the stainless cell of the IR. The carrier gas used for the oxidation and detection stages is generated by a second internal air compressor and is passed through a soda lime filter. The carbon dioxide free gas passes through a pressure regulator, a capillary tubing and a digital flow meter to reach finally the UV reactor. All these devices are necessary to guarantee high precision and stability of carrier gas flow as well as to control and display the flow.

2.5.1 - Flow diagram left enclosure



2.5.2 - Flow diagram right enclosure



3 - COMPONENTS

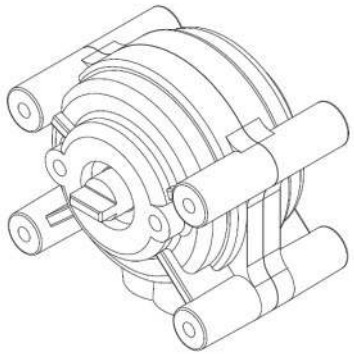
Let's see one by one the most important components of the analyzer.
Please, take a look at the analyzer an localize each part in order to understand how it works

3.1 - Peristaltic pump

In normal on-line conditions the analyser uses two pump motors with two pump heads driven by each motor. An extra pump head driven by a specific motor is used just in autocalibration, autovalidation or autocleaning cycles.

The **sample pump** head shown in flow diagram as is driven by the M1 (see section 3.11) motor and is located in the upper position, closest to the motor. It pumps the sample from the external reservoir to the T fitting connected on the other side to the phosphoric acid pump head. Optimizing the sample pump flowrate is important to have a representative sample and to reduce the analyser response time.

PUMP CODE	FLOW ml/rev
14	0.21
16	0.8
15	1.7
24	2.8



The **phosphoric acid pump** head is driven by the M2 (see section 3.11) motor and is located in the middle position,closest to the motor. It pumps phosphoric acid from the phosphoric acid container to the T fitting connected to sample pump head.

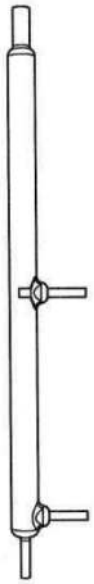
The acid addition to the sample is necessary to lower the sample pH and to remove the inorganic carbon (IC) by gas sparging.

The **resample pump** head is driven by the M1 motor and is located in the upper position, UV lamps side. It pumps the acidified and sparged sample from the bottom of the scrubber to the T connection where it mixes with the carrier gas coming from the air compressor (right enclosure) and directed to UV reactor.

The **persulfate pump** head is driver by the M2 motor and is located in the middle position, UV lamps side. It pumps sodium persulfate from the persulfate container to the UV reactor, adding it to the mixture of sample and carrier gas coming from the resample pump and after is directed to UV reactor.

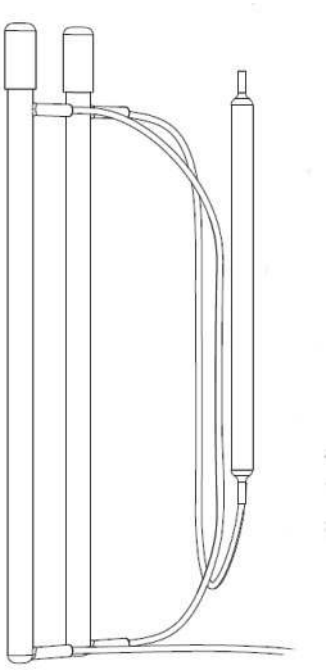
The **Auto pump** head shown in flow diagram as is driven by the M3 motor. It pumps the calibration/validation standard solution or the cleaning solution from its container to the analysis circuit when requested by the user or when programmed as autocal/val/clean cycle. The auto pump flowrate is higher than sample pump flowrate. This means that in case of an autocleaning cycle a portion of the cleaning solution will be driven towards the sample inlet, cleaning the sampling point.

3.2 - Scrubber tube



This device is a glass cylinder with the acidified sample inlet in upper right position. The acidified sample passes down by gravity through the scrubber and it's sparged by the carrier gas coming from air compressor, connected in the lower right position. The carbon dioxide coming from the inorganic carbon present in the sample is sparged by the carrier gas flow and removed from the sample through the vent/drain tubing connected to the straight upper position of the scrubber. As a result, the sample at the scrubber bottom is IC free and it can be pumped by resample pump to the oxidation stage.

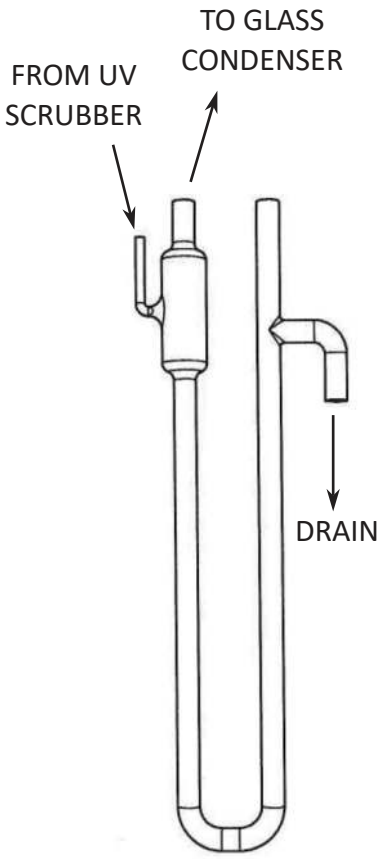
3.3 - UV reactor + UV scrubber



The UV reactor consists of two high energy UV lamps. The reaction of oxidation is catalyzed by UV radiation with decomposition of sodium persulfate and creation of strongly oxidizing radicals. These conditions ensure the best recovery of organic substances present in the sample. The second UV lamp is connected to UV scrubber. The oxidized sample at the UV lamps is sparged inside this device.

3.4 - U-tube

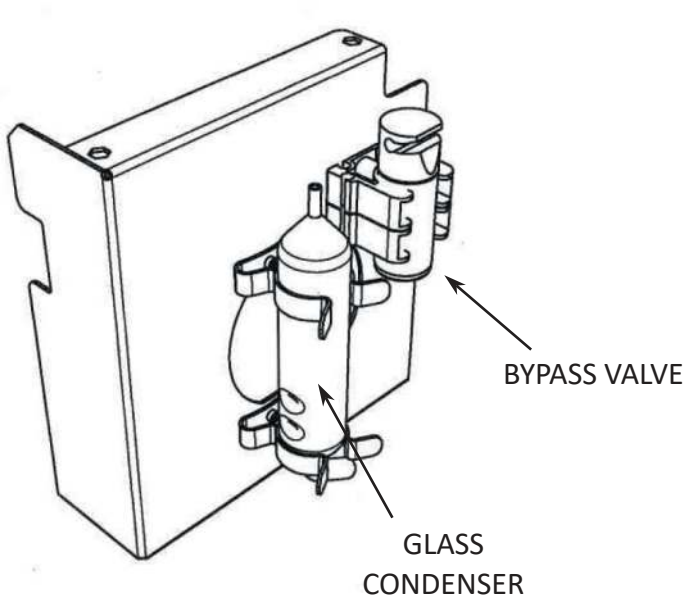
This device is a U shaped glass device, with two inlet and two outlet points. It separates the analyzed liquid part of the sample coming from UV reactor from the gaseous stream directed to the infrared analyzer. It also drains the exhausted sample and vents the sparging gas coming from the top of the scrubber. The gas mixture coming from the oxidation stage is driven by the carrier gas to the drying devices through the upper right outlet of the gas liquid separator, towards to the glass condenser.



3.5 - Glass condenser and bypass valve

The glass condenser uses the temperature difference between its glass body, cooled by a fan, and the hot treated sample coming from UV reactor.

This fan cools the condensor which removes the majority of water vapour from the carrier gas.

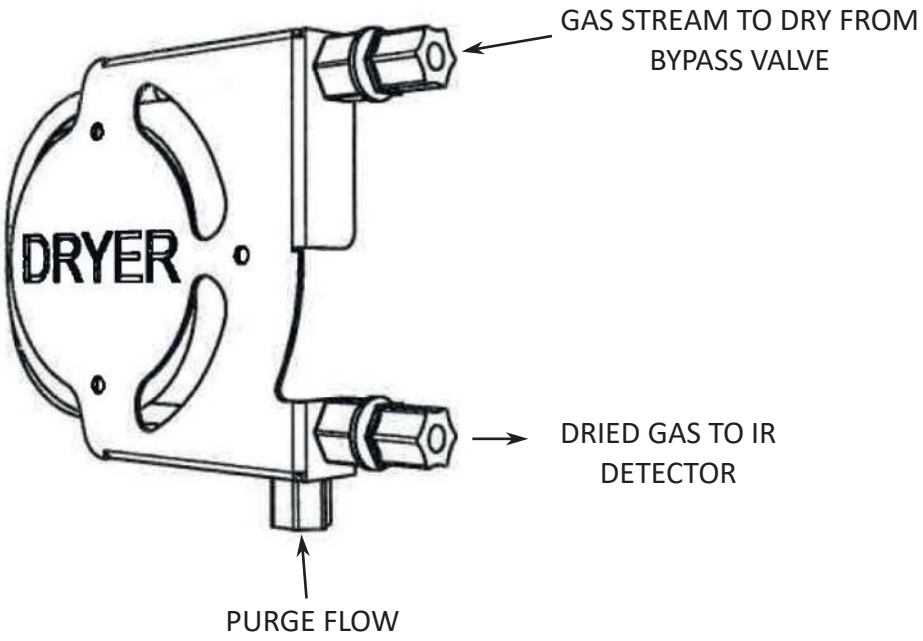


The bypass valve blocks the gas stream avoiding it to flow through the IR cell when not strictly necessary.

3.6 - Dryer

This device consists of a coil of two concentric tubes. In the internal tubing flows the gas stream to dry. This tubing is water vapor permeable so that the humidity passes to the external tubing. In the external tubing there is a countercurrent purge gas flow that removes the water vapor. The dryer prevents water condensation inside the IR cell

CAUTION: do not overtighten or twist gas dryer ends when installing or servicing, as this will restrict the gas flow.

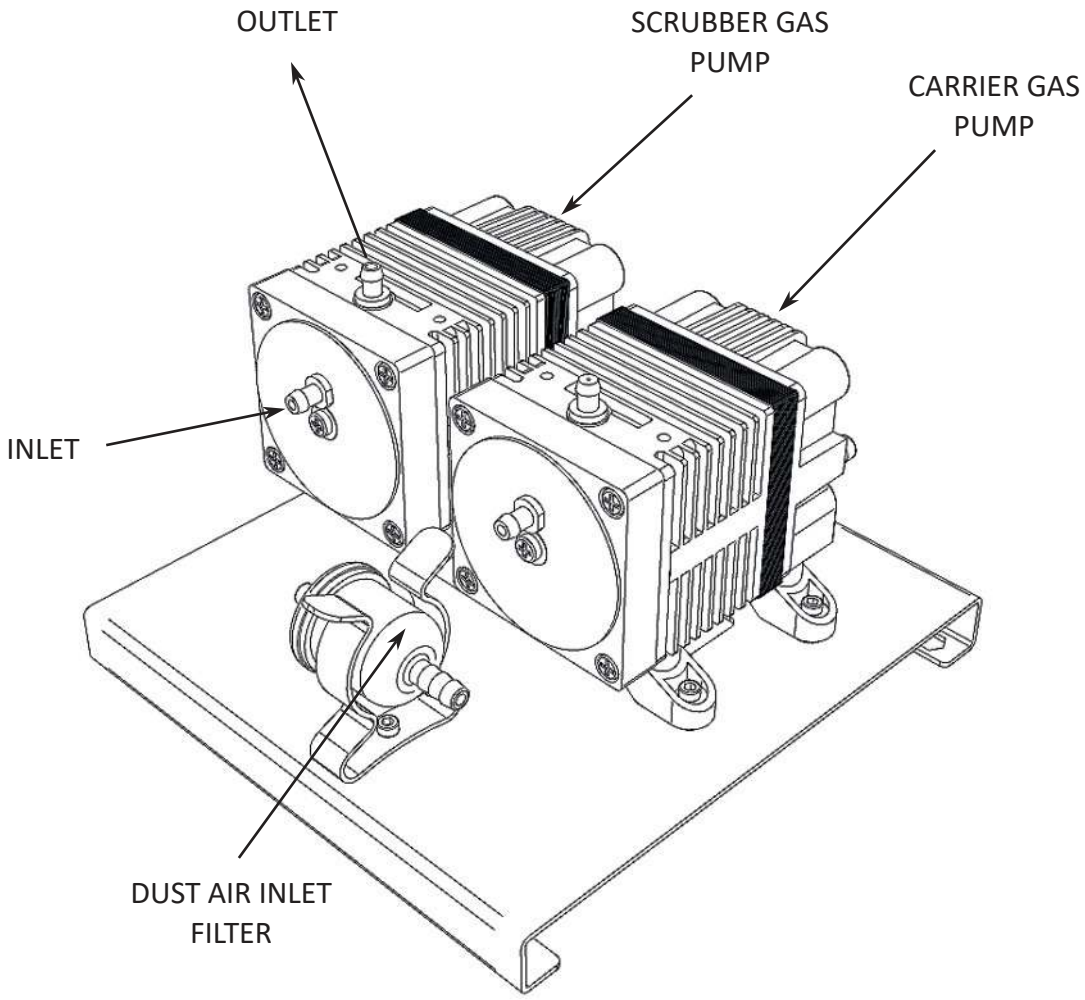


3.7 - Copper filter

The copper filter is located in the electrical enclosure immediately before the IR detector inlet. It is a plastic container filled with copper wool. The gas leaving the dryer tubing is forced to go through this device to prevent corrosive effects due to gases like chlorine or chlorine dioxide that could be generated in the oxidation stage.

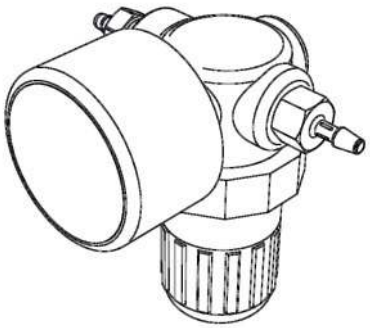
3.8 - Gas pumps

The air pumps are located on the lower side of the electrical enclosure. The scrubber air pump provides the sparging gas used in the scrubber and the counterflow gas in the dryer.
The second carrier pump provides the carrier gas for oxidation and detection stages. They eliminate the need for an external air treatment system and for compressed air as a requested utility, this saving cost.



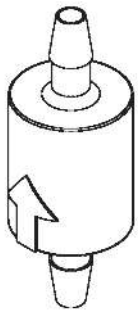
As pumps accessories there is a dust inlet paper filter and an electrical fan blows on the air pumps surface to cool them.

3.9 - Pressure regulator, capillaries,flowmeter and check valves

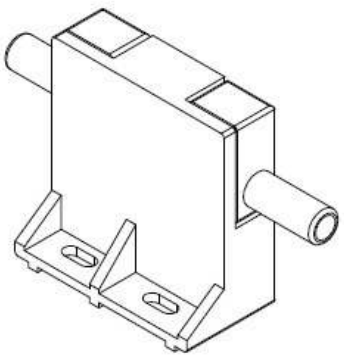


These devices are located in the central part of the electrical enclosure with a pressure gauge on the front and are used to supply a precise and reliable adjustment for the carrier gas flow.
The carrier gas capillary is directly mounted on the pressure regulator outlet port.

The Scrubber sparging gas and the Dryer purge gas capillaries are in-line connected on their tubing.
A label on the back plate refers to the flow code



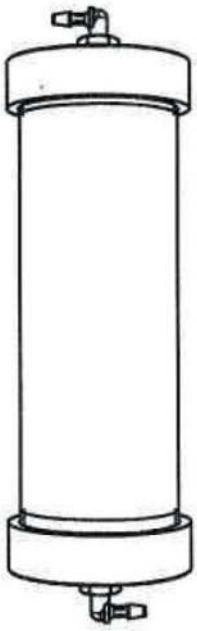
To prevent liquid back flow from the Liquid left compartment, a couple of Check valves are mounted on the two gas lines.
An arrow indicates the right flow direction.



A mass termal flowmeter provide the value of the carrier gas flow.
Normal value, depending on the range of the analyzer, is within 80-120 mL/min

3.10 - Sodalime filter

The sodalime filter is located on the left side of electrical enclosure. It's a plastic container full of sodalime pellets and it absorbs the carbon dioxide from atmospheric air providing the analyzer with CO_2 free air for its processes.
Sodalime has a color indicator that turns light violet when exausted.

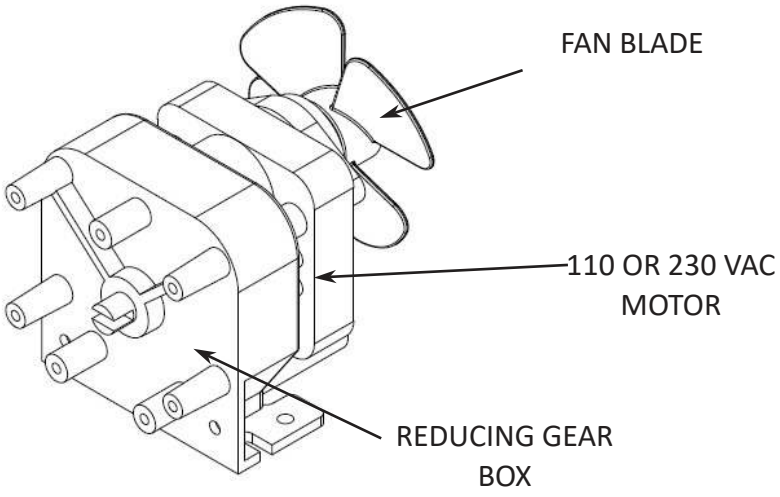


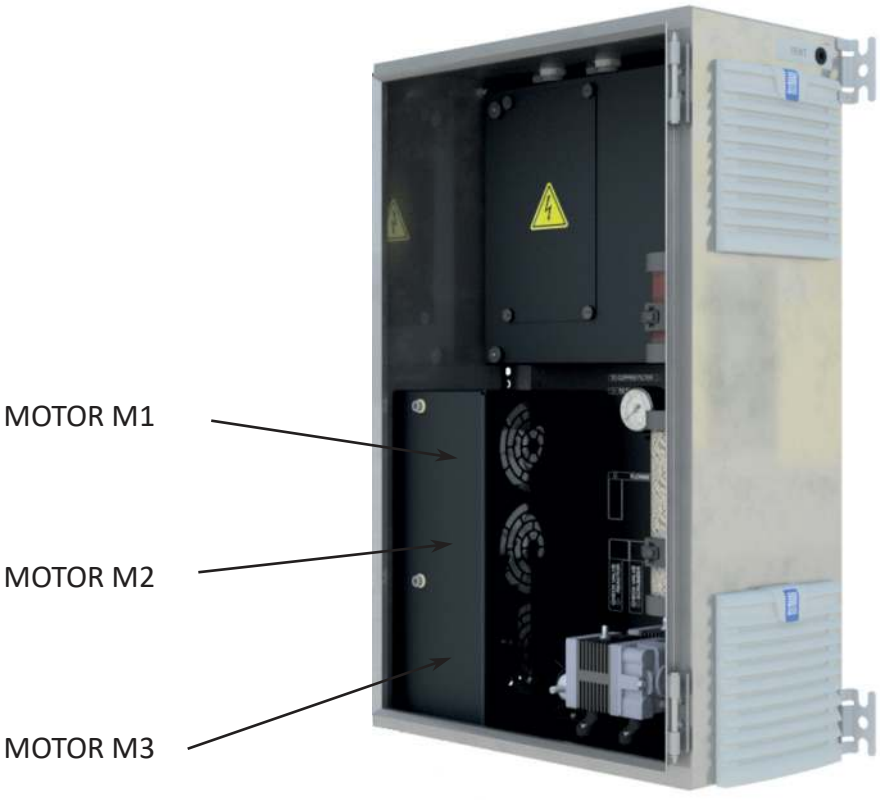
3.11 - Pump motors

The three pump motors are positioned in the electrical enclosure, on the left side.
They drive multiple pump heads that move the sample and reagents through the different analyzer treatment stages.
Depending on the configurations there will be from three to six pump heads connected to the 3 motor shafts.
To access the motors a metal protection cover must be removed.

M1 and M2, that continuosly run, have a fan blade to prevent the motor from overheating, while M3 that only runs during Auto operation (clean, calibration or validation) does not need it.

Pump motor





Pump motors position

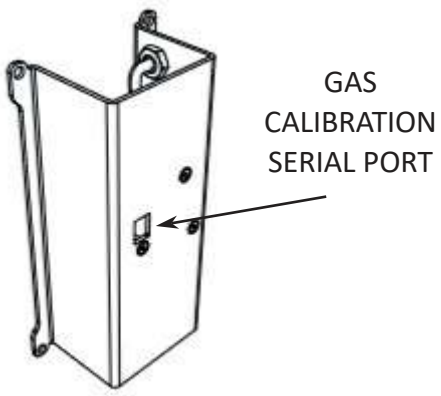
MOTOR	SPEED	POSITION	PUMPS
M1	5 - 6 rpm	upper	sample resample
M2	1 rpm	middle	acid persulfate optional reducing agent
M3	10 - 12 rpm	lower	calibration validation cleaning

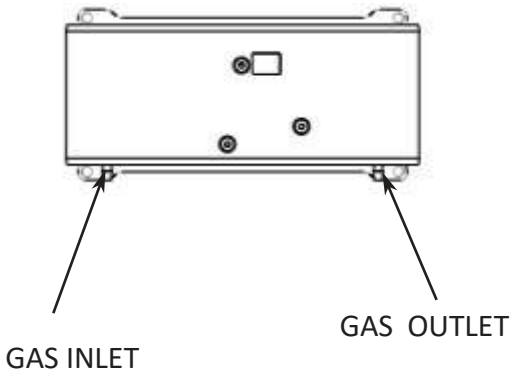
3.12 - NDIR detector

The infrared analyser is located in the higher part of the electrical enclosure, on the right side. It consists in a PCB board fitted with a stainless steel cylinder (the IR cell). It's a Non-Dispensive Infrared analyser (NDIR) with high stability and reliability.

The measuring scale of IR is related to the range of analyzer.

There are three ranges available 1000, 5000 and 10000 ppm of CO_2.





4 - UNPACKING AND INSPECTING

The 3S-TM analyzer is assembled and fully tested for proper performances directly in our facilities and it's delivered inside a wooden box. Before to proceed with analyser installation, it is recommended to check carefully that box and analyzer have not been damaged during transportation. Take extreme care during analyzer unpacking and moving.

4.1 - Analyzers moving

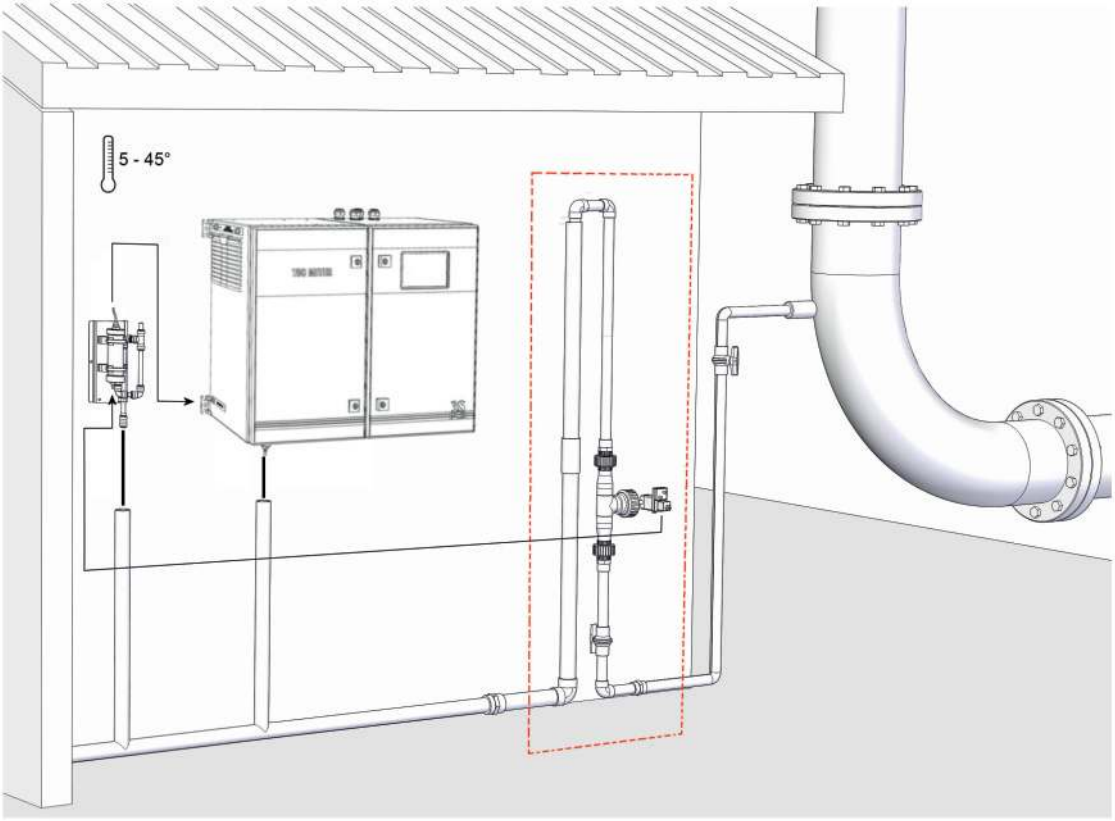
Take extreme care when lifting or moving the analyzer, its weight is about 37 kg. Before to move the analyzer it is recommended to empty manually the glass parts of liquids enclosure using an appropriate plastic syringe and tubing.

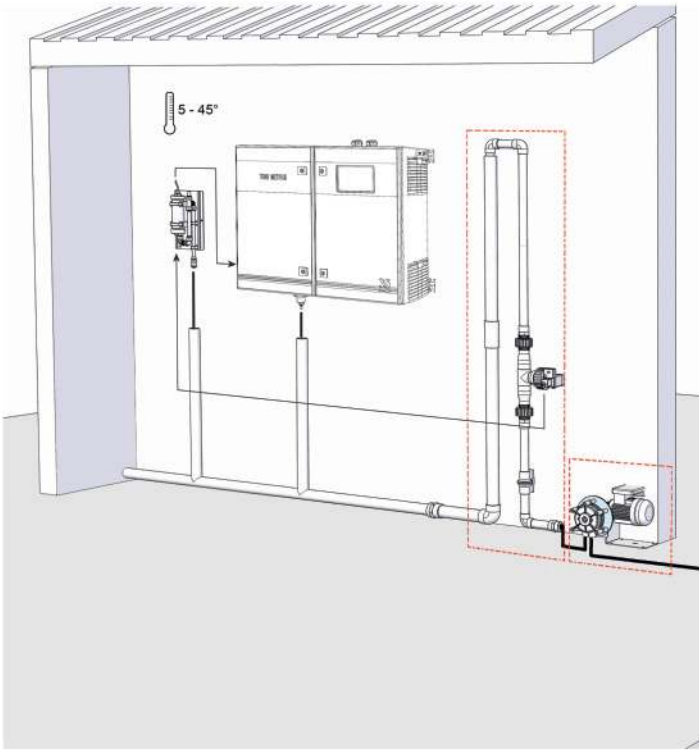
4.2 - Location and mounting instruction

It is recommended to install the analyzer in a suitable position. The location must be clean, covered and properly enclosed to provide the analyser with good ventilation and low dust concentration. Operating environmental conditions are: temperature between 5 and 40°C at max 80% relative humidity.
Due of chemicals and waste gases it is absolutely necessary to choose a well ventilated location for the analyzer.

The 3S-TM analyzer is supplied with four mounting brackets for wall or stainless steel support rack installation. Use four M8 screws to hang the analyzer.
The analyser should be mounted with the display at eye level for easier operation and access.

Example of TOC analyzer installation where the sample is taken from a pressurized pipe, with the optional filtration unit SF-100





Example of a TOC analyzer installation where the sample is taken from an open tank or shallow water, with the optional filtration unit SF-100 and a sample intake pump

4.3 - Precommissioning

Listed below are key points that must be followed in order to setup a good installation:

- the installation site should be as near to the sampling point as possible to reduce delay in response time.

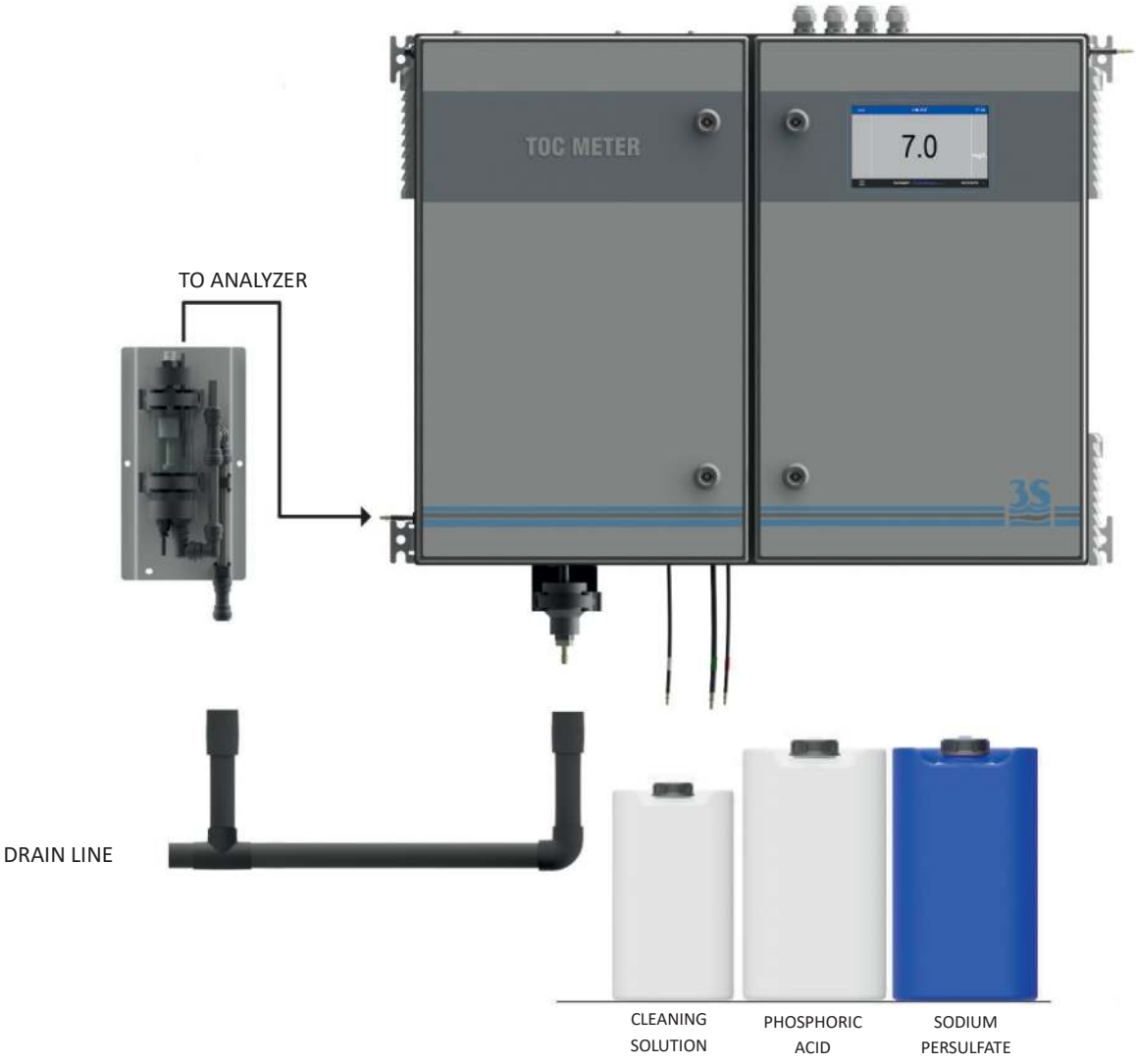
- the drain line should be properly dimensioned and positioned with downward slope to allow the draining of analysed sample and the overflow coming from the external fast-loop reservoir (see page 97). If the optional filtration unit is present, the drain pipe should be dimensioned to drain also the sample coming out from filtration system fast-loop.

- Clearance requirements for the analyzer should be 20 cm on either side and 100 cm on the front (see next page).

- Sufficient space for two 10 liter containers and one 5 liter container should be provided beneath the analyzer; if necessary, the reagents containers should be positioned in a suitable receptacle to prevent spills.

- Installed the instrument in a well ventiled area of adequate dimensions or provide a dedicated waste gas line for safe venting to the atmosphere.

<u>WARNING</u>: depending on the sample chemical composition, its oxidation may generate hazardous gases. In these cases it's strictly necessary to provide a safety system to allow waste gases vent to the atmosphere



Please note that the sample drain of the analyzer must be at ambient pressure with no restriction or counterpressure. Please verify that this condition has been strictly respected during installation.

4.4 - Electrical connections

All electrical connections should be made by qualified personnel in accordance with national or local codes and regulations.

Qualified Personnel means a person who has been fully trained and has professional experience to avoid electrical hazards and dangers.

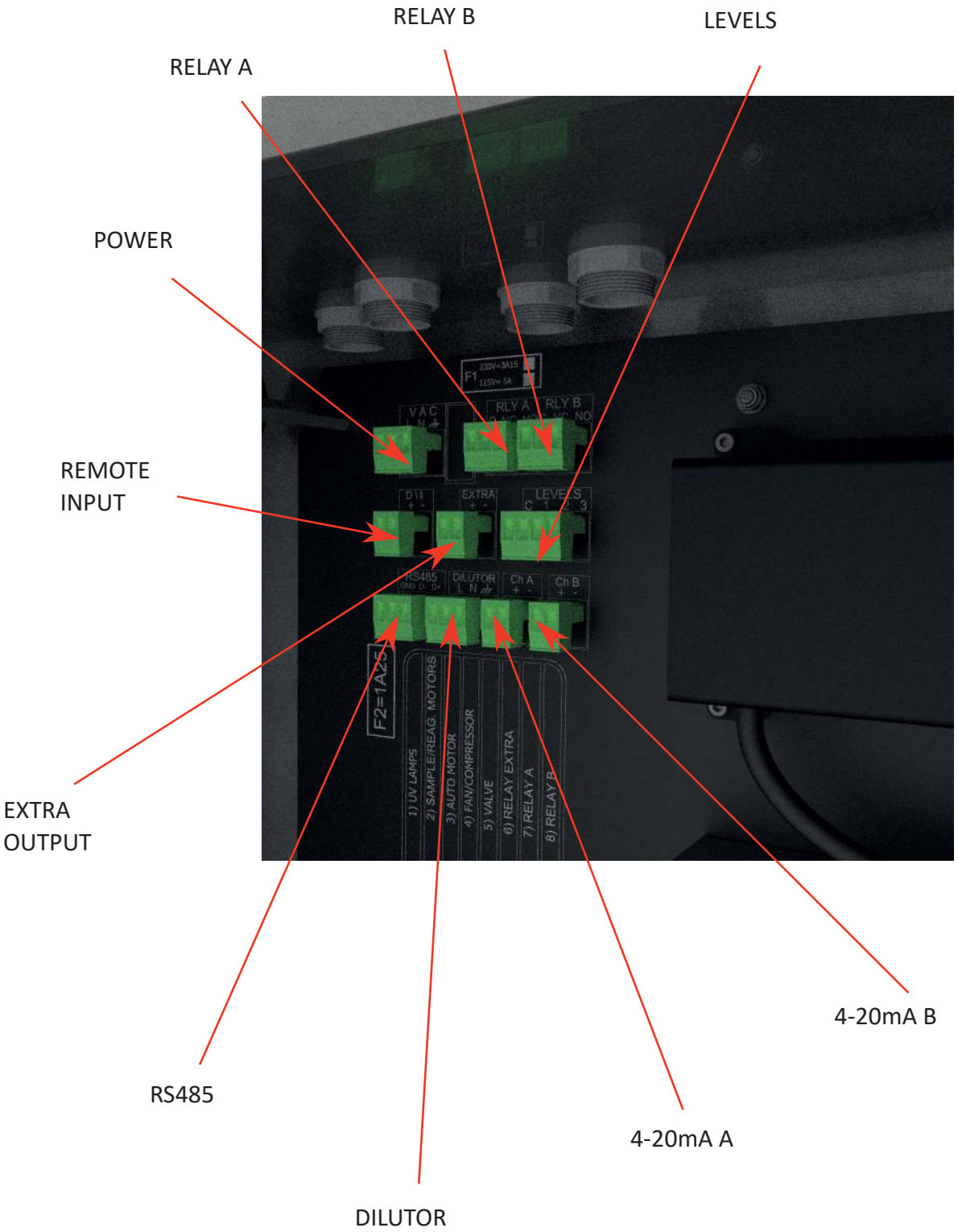
Service qualified personnel will receive the special key to open the electrical enclosure.

A circuit breaker must be installed near the analyzer to allow easy isolation of power in case of electrical problems and every time it is necessary to service the analyzer.

It will be user's task to check and guarantee periodically the perfect functionality of the analyzer's grounding.

To avoid potential fatal electrical shock and/or analyzer damage always disconnect input power to analyzer before servicing (disconnecting the 115 VAC - 230 VAC plug).

ALWAYS ISOLATE POWER BEFORE SERVICING


RELAY B
LEVELS
RELAY A
POWER
REMOTE
INPUT
EXTRA
OUTPUT
4-20mA B
RS485
4-20mA A
DILUTOR

4.5 - AC Power connection

The 3S-TM analyser is designed for operation with 230VAC, 50/60 Hz power. It is provided with 2 meter long power cord and European Schuko plug (ref. CEE 7/ VII regulation). Optional configuration with 115 VAC power supply and US plug. The analyzer is delivered with the power cord wires already connected to the AC terminals of *USER CONNECTIONS*.

AC power enters on the top side of the electrical compartments through the supplied power cord.

All the connections must be made in accordance with national or local regulations. It is recommended that the analyzer has its own dedicated circuit with a circuit breaker or an isolating switch installed near the unit.

4.6 - Analog output connection

The 3S-TM analyzer provides 2 x 4-20 mA analog outputs for the analysis value. Wiring connections use a twisted-pair signal cable with shield connected to the A/01 or A/02 located right on top of electrical enclosure.

4.7 - Relays A and B

RELAY A function is programmable in the CONFIGURATION / RELAY page.

Here below the list of the possible functions:

online (relay activated when analyzer is online)
offline (relay activated when analyzer is offline)
loss of sample (relay activated in case of loss of sample alarm)
result alarm (relay activated when the result is higher than the preset value)
validation alarm (relay activated in case of validation alarm)
reagent alarm (relay activated in case of reagent's alarm)
calibration alarm (relay activated in case of calibration alarm)

RELAY B is activated in case of fault alarm.

Fault alarms occur if certain conditions arise that risk the analyzer giving incorrect results.

They are as follows:

carrier gas flow too low

reagent levels too low

zero gas too high

emergency stop activated

4.8 - RS485 Serial com

The analyzer can communicate on the RS 485 serial port by using the ModBus RTU Protocol .

See below the detail of the protocol parameters and the addresses.

Baudrate	9600
Data bits	8
Parity	E
Stop bit	1

Slave I.D.	1

Address	Format	Alias
150	32 bit float (CD-AB)	Result CH1
152	32 bit float (CD-AB)	Result CH2
154	16 bit unsigned	Analyzer status

Analyzer status	Value
Standby	0
Conditioning (to drain)	3
Conditioning (purge detector)	4
Online	5
Zerogas	6
Zerogas	7
Autofunction	1
Stopped	8

4.9 - Digital Input / Extra relay

Digital input is a remote function available for a remote Start / Stop, that will result in switching ONLINE the analyzer when the contact is closed and on STAND BY when released. Manual command (ONLINE and STAND BY) prevail on remote input.

Extra Relay is used for external operations (24V DC available) powering external devices. It can be used to switch the external dilution (Dual Range option) or the external solenoid valve (Dual Stream option)

4.10 - Levels

Level switch terminals - level 1 and level 2 works with same logic as level switches left side connectors. Additional level 3 can be configured with jumpers in order to be associated to 1, 2 or 1 + 2. C is the common terminal.

4.11 - External dilutor power supply

230/115 Vac for supplying power to the external dilutor. Functions when the analyzer is in Conditioning and online mode.

4.12 - Fuses

The analyzer is equipped with 2 fuses.

Fuse	Function	Rating
F1	Power supply fuse	3.15 A @ 230 V or 4 A @ 115 V
F2	Detector/digital flowmeter fuse	1.25 A

4.13 - Start up the TOC analyzer

Before proceeding with analyzer start-up it is absolutely necessary to check that all the operations for a proper installation and reagents preparation has been made with accuracy.
Please verify that all the suggestions and recommendations have been respected.

After this double check, please proceed as follows:

A - Connect the sample line inlet tubing (or filtered sample outlet coming from optional filtration system) to the fast-loop reservoir (R) installed on the left side of the TOC analyzer

B - Connect the drain fitting of the fast-loop reservoir to the waste line

C - Put the acid inlet tubing (red labelled) in the phosphoric acid container beneath the analyzer and check that it is in correct position at the bottom

D - Put the persulfate inlet tubing white labelled) in the sodium persulfate container beneath the analyzer and check that it is in correct position at the bottom

E - Put the cleaning (or calibration or validation) solution inlet tubing (green labelled) to the cleaning (or calibration or validation) solution container placed beneath the analyzer and check that it is in correct position beneath the analyzer

F - Connect the funnel beneath the analyzer to waste DRAIN line

G - Check sample presence in fast-loop reservoir and adjust the sample flowrate (suggested 100 - 500 ml/min)

H - Power the analyzer. External fans, microprocessor and infrared analyzer will start.

Now the analyzer can proceed as follows:

If the analyzer has been previously shut off in ONLINE status, it will start immediately with a conditioning cycle. The analyzer is totally in operation but measurement and output signal are not valid until the conditioning delay will be over.

If the analyzer has been previously shut off in STAND BY status, it will stay in STAND BY conditions; to start the analyzer it is necessary to press ONLINE button in the command menu. This forces the analyzer to start immediately with a conditioning cycle. The analyzer is totally in operation but measurement and output signal are not still valid until the conditioning delay will be expired.

In the next few following minutes it is necessary to check:

- sample presence in the scrubber, sample presence in the gas-liquid separator

- free drain with no restriction of gas-liquid separator drain outlet. The drain tube must not be submerged and the exhausted sample must be carried out by gravity.

4.14 - Analyzer's status

After switched on the analyzer the user can find it in many different status, depending on the current operation.

Here a list of the possible status:

STANDBY	Waiting for a command, the analyzer in not running in STANDBY status, air pumps, liquid pumps and UV lamp are OFF. The detector NDIR is ON but no gas passes trought his cell. This condition could be used for maintenance.
ONLINE	This is the normal working status, when the oxydation of the sample and the detection is ON. The screen shows the result and the analog output is active. All other status but this are considered OFFLINE.
CONDITIONING	This is the status that is needed everytime passing from an OFFLINE status to the ONLINE condition. This because the new sample entering the analyzer takes time before to replace the pre-existing liquid (standard or cleaning solution) and give the correct result, as the tubings, the lamps and the sample gas line needs to be conditioned. Furthermore coming from the STANDBY or from a ZEROGAS, the UV reactors need time to warm them up and start the oxydation. During CONDITIONING the airpumps, the liquid pumps and UV lamps are ON but the result shown in the display is the last old value, kept frozen during OFFLINE status. The same happens to the analog output, frozen value during OFFLINE conditions (CONDITIONING included) and analytical value during ONLINE.

ZEROGAS	During a ZEROGAS cycle the pumps and UV lamps are switched off. In these conditions the carrier gas goes through all the fluidics to reach the NDIR. The CO_2 concentration value expressed in ppm detected by the infrared analyzer decreases so that after the programmed delay time it will be stable and equal to the CO_2 generated by carrier gas only. This value is stored and shown as ZEROGAS. Typically is lower than 200 ppm . Refreshing frequently this value is important because the sodalime loses its capacity to adsorb CO_2 from ambient air. If the ZEROGAS exceeds a certain preset limit, the alarm “Zero too high” will be activated and the analyzer will display this alarm message. The ZEROGAS cycle usually lasts 10 minutes, since the residual CO_2 takes time to be cleaned up. The analog output are frozen during all the ZEROGAS cycle, and at the end of it a CONDITIONING period is needed before to come back to the normal ONLINE status.
CLEAN	While the analyzer is in CLEAN status, the AUTO pump is ON and a cleaning solution is taken instead of the sample. In addition the GAS BYPASS valve closes to avoid corrosive gas from the cleaning solution can reduce drastically the efficiency of the halogen filter. Since CLEAN is an OFFLINE operation, then the analog output is frozen and a CONDITIONING period will be carried out before the analyzer to come back to ONLINE. It usually lasts 3-5 minutes, depending on the sample.

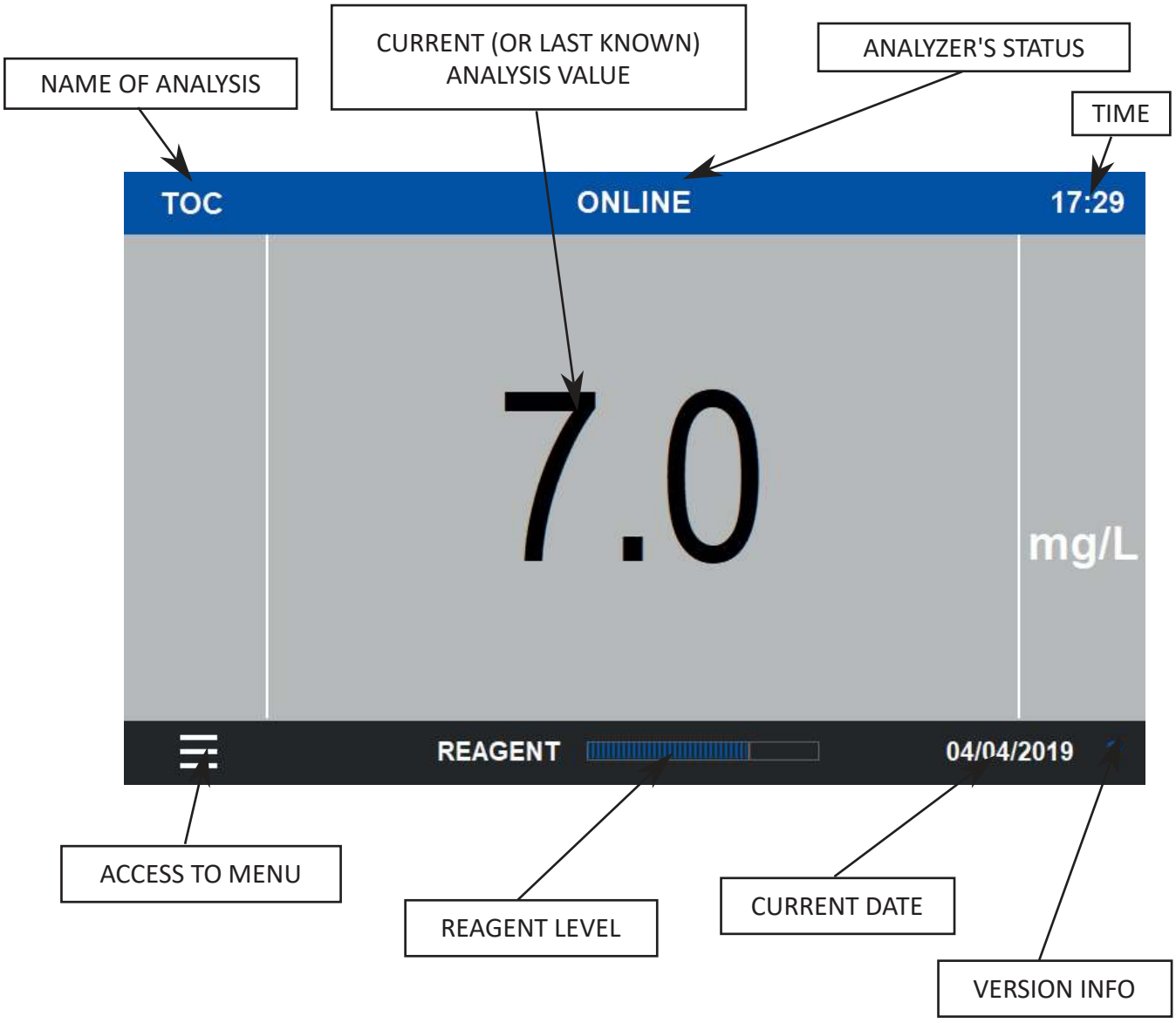
AUTOCAL	An AUTO-CAL cycle starts automatically at the time and days programmed in CONFIGURATION/AUTO FUNCTION menu if AUTOCAL is selected as AUTO FUNCTION. In this case, at the programmed time and days the calibration pump is switched on. The standard solution is pumped from a container placed beneath the analyzer through all the fluidics for the number of minutes programmed AUTO FUNCTION configuration page as EVENT DELAY. The CO_2 concentration value, expressed in ppm detected by the infrared analyzer, will increases until the end of the programmed delay time.At this moment the CO_2 value will be stable and its amount correspondant to the applied standard solution. After subtracting the last stored baseline value, it will memorized as ppm span gas. The trend of result values is displayed during autocalibration cycle together with the ppm of CO_2 measured by NDIR detector, the last calibration stored and the carrier flow.
AUTOVAL	An AUTO-VAL cycle starts automatically at the time and days programmed in CONFIGURATION/AUTO FUNCTION menu if AUTOVAL is selected as AUTO FUNCTION In this case, at the programmed time and days the calibration pump is switched on. The standard solution is pumped from a container placed beneath the analyzer through all the fluidics exactly as it happens for the autocalibration, but at the end of the delay time, the result will be compared with the last calibration value and the percentage deviation stored.

5 - INTERFACE INSTRUCTIONS

The user's interface consists of the touchscreen located on the front panel of the analyzer enclosure. All the output/input data, informations, alarms and fault conditions are shown on the display while all the commands and settings may be transferred to the analyzer simply pressing the touchscreen buttons.

5.1 - Main page

The main page screen displays :



Please note that after hours of inactivity the touchscreen backlight moves to sleep mode.

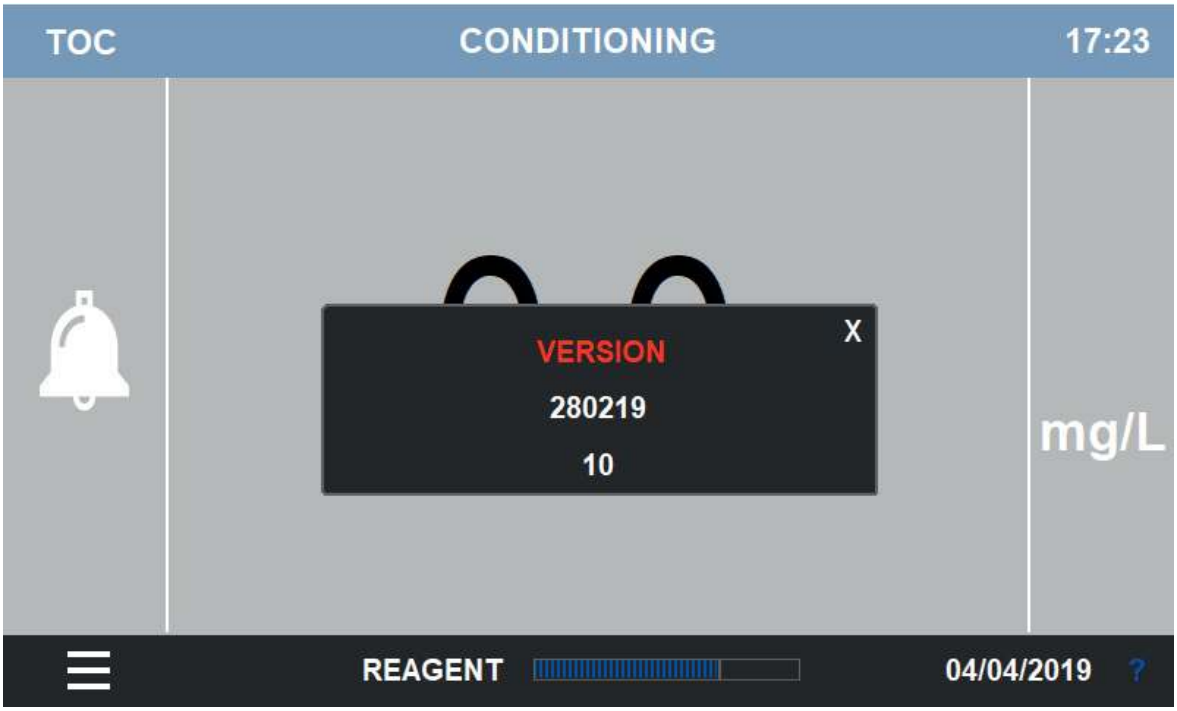
Touch the screen to reactivate it.

In the case of an alarm occurred it switches on automatically.

5.2 - Version

From the main page the user may check the current program version by pressing the **?** key at the right bottom of the screen.

Here is what appears:

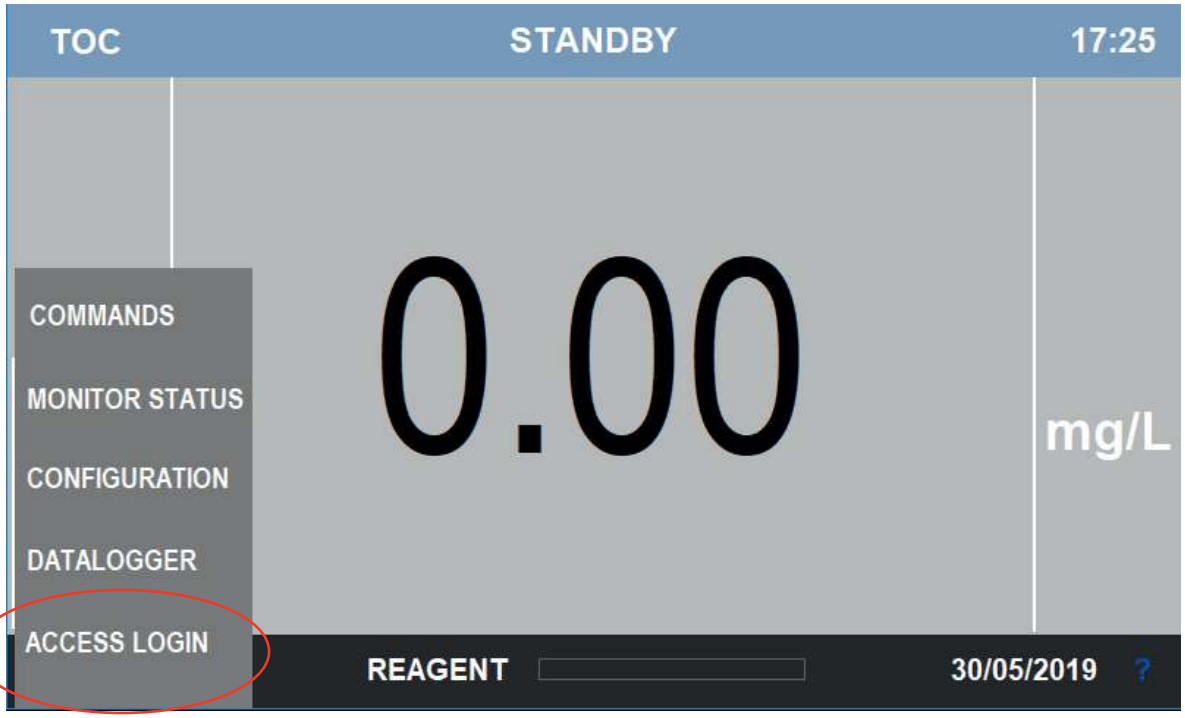


5.3 - Main menus

All commands and settings are divided in 5 sub-menus

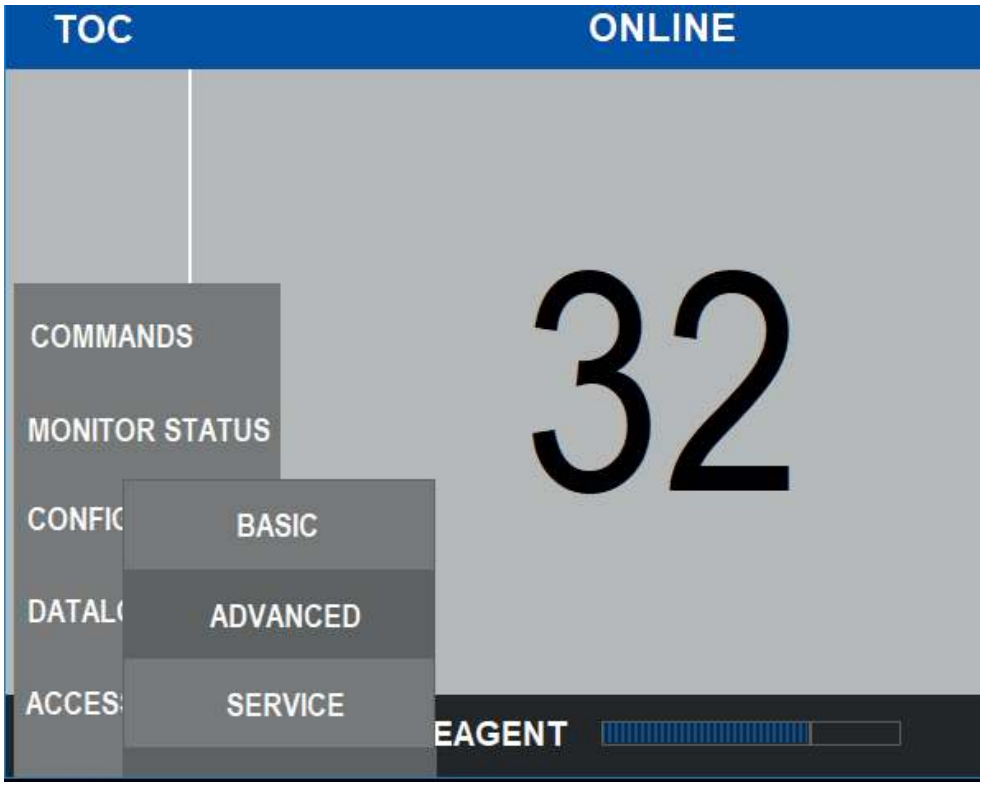
COMMANDS	Under this menu all the commands that can be given to the analyzer are grouped
MONITOR STATUS	Here the status of the analyzer can be monitored, showing all the analog and digital input/output
CONFIGURATION	This menu allows the user to modify all the settings
DATALOGGER	Results and Alarms are stored in dataloggers This menu allows the operator to access to them.
ACCESS LOGIN	This is the password inputing procedure

5.4 - Access Login



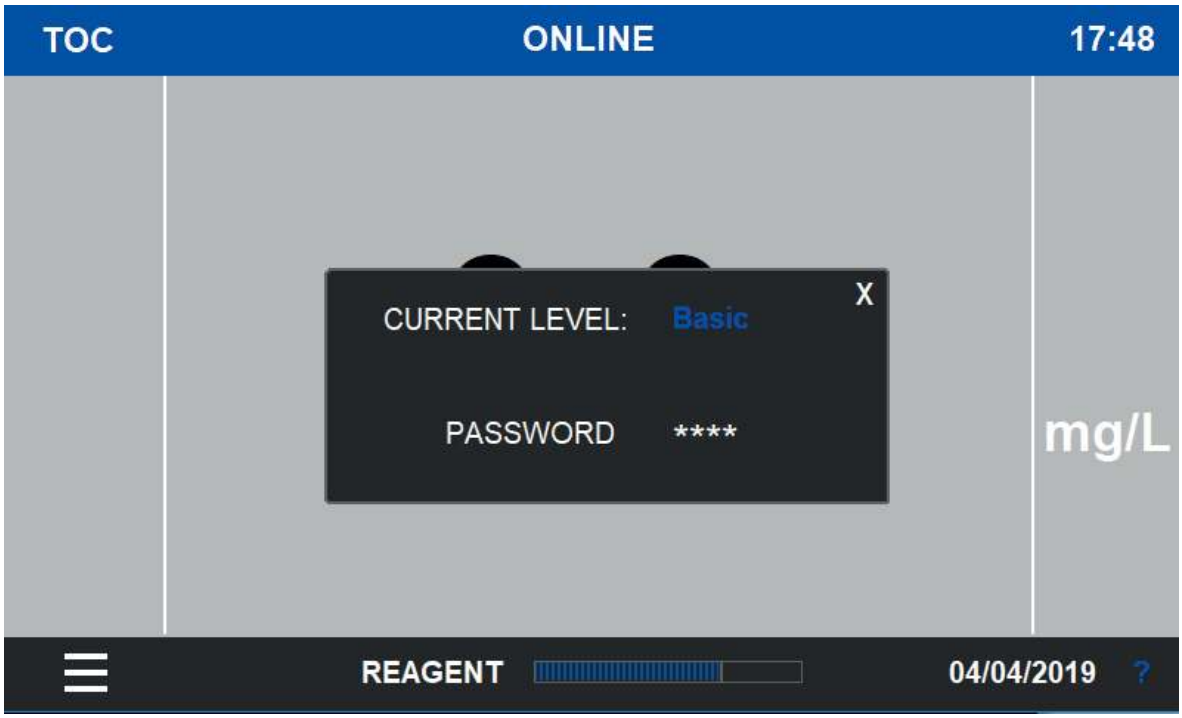
In order to achieve the access to commands and settings, fhe user first have to proceed with the Login

PRESS THE ACCESS LOGIN KEY



BASIC is the user level without any rights to launch calibrations and modify configurations. It allows anyhow to give basic commands and view datalogged and current results.
ADVANCED is the user level allowed to perform calibrations.
SERVICE is the user level allowed to modify all the configurations

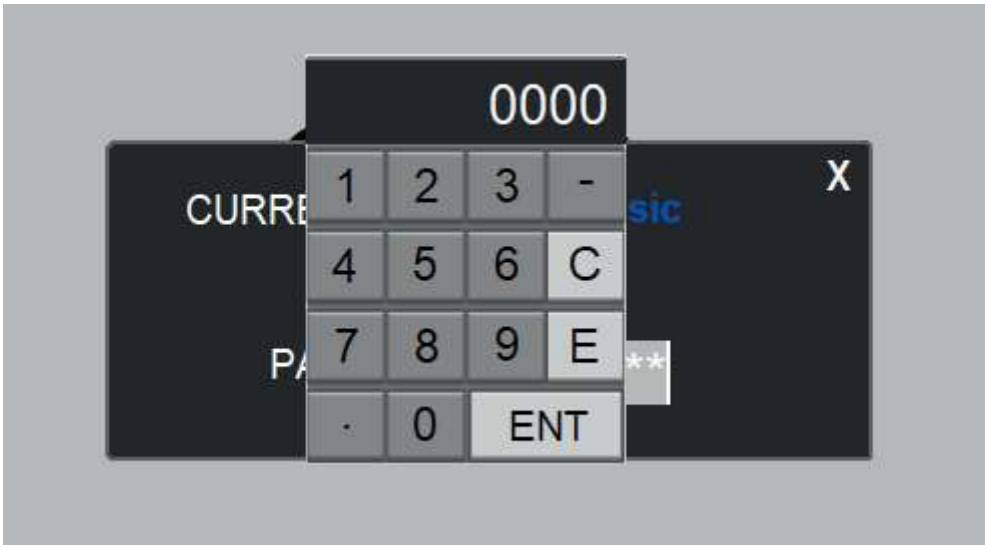
Once the user has been selected, this window opens.



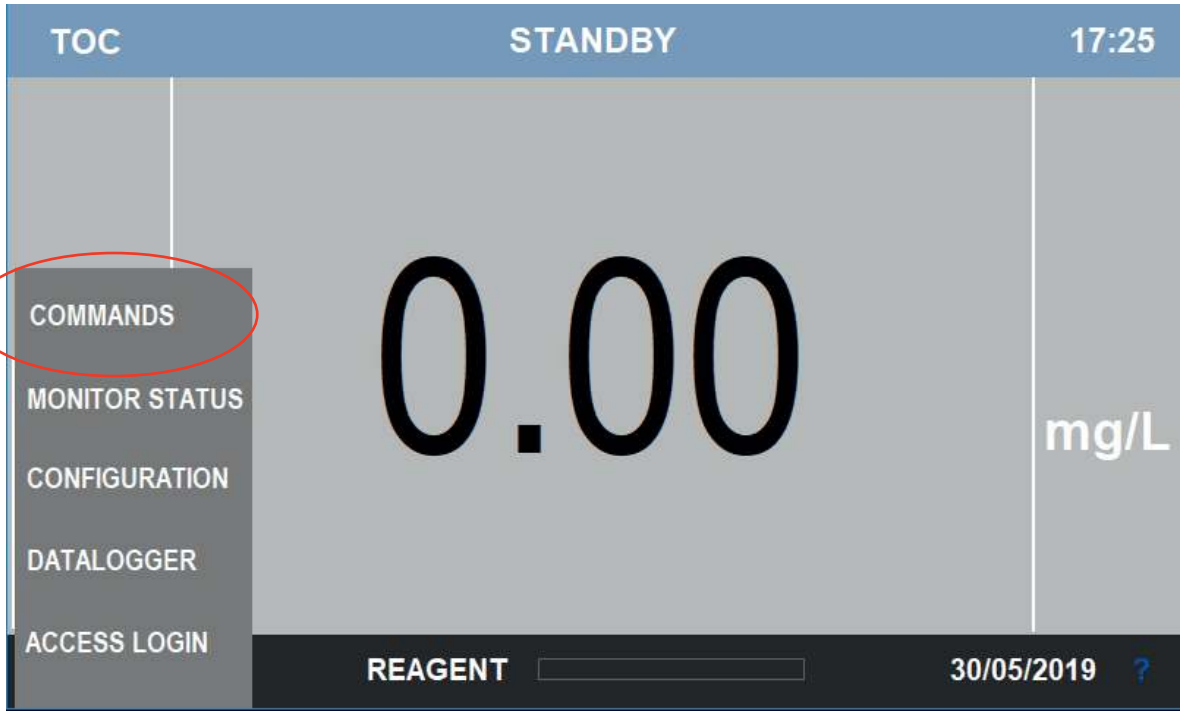
The password consists of 4 numeric digits (0000-9999).
ADVANCED PASSWORD = 1111

SERVICE PASSWORD = ...
(please ask for it during commissioning or contact the 3S Analyzers technical service)

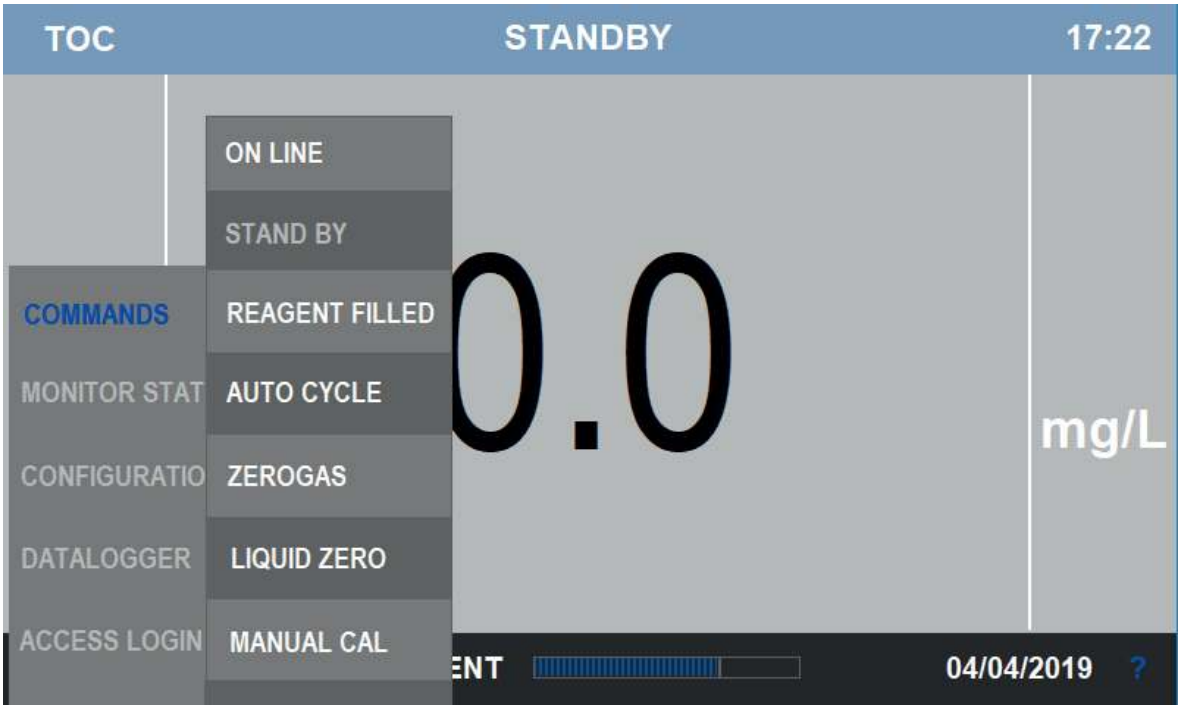
After pressing the **** area a numeric keybord will appear and the password can be input and confirmed by the ENT key.



5.5 - Commands menu



The menu COMMANDS allows the user to move between the analyzer's status.



5.5.1 - ONLINE key

After pressed the ONLINE key the analyzer starts the procedure to move to ONLINE condition passing through a CONDITIONING period.

Refer to 3.6 ANALYZER'S STATUS

5.5.2 - STAND BY key

After pressed the STAND BY key the analyzer stops any operations and other status to move to STAND BY

Refer to 3.6 ANALYZER'S STATUS

5.5.3 - REAGENT FILLED command key

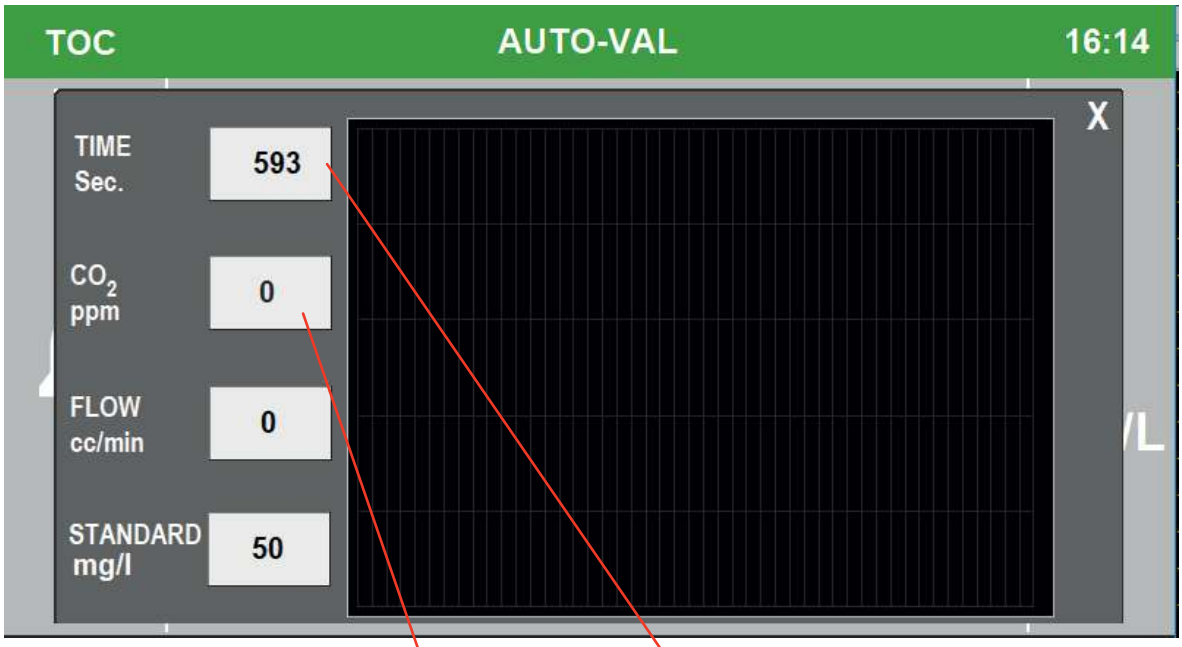
This key allows to reset the counter to 100%. This operation should be done everytime the reagent container is refilled.

An internal cumulative timer will take into account of the reagent consumption whenever the reagent pump will activate and will raise an alarm when the calculated remaining volume is below the low limit (see CONFIGURATION/REAGENT)

5.5.4 - AUTO CYCLE start key

Here the user can manually start an Auto Cycle at any moment, other than the programmed timed events .

When pressed for 2 seconds a CLEAN, AUTOCAL or AUTOVAL, whatever is selected, will start and the corresponding display page will be displayed.



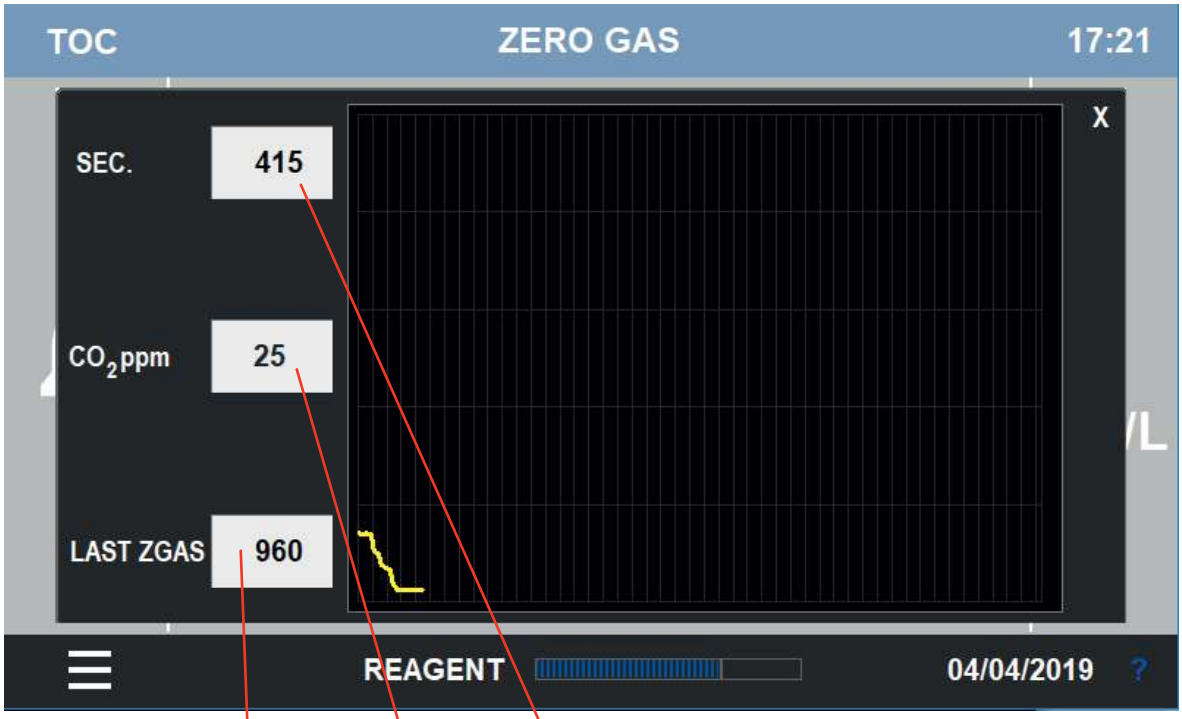
CO_2 ppm current value

elapsing time, in second, to the end of the procedure

5.5.5 - ZEROGAS start key

Here the user can manually start a Zerogas cycle at any moment, other than the programmed time (see CONFIGURATION/ZEROGAS) .

When pressed for 2 seconds a ZEROGAS calibration will start and the Zerogas trend page will be displayed (see 3.6 for ZEROGAS status and meaning)



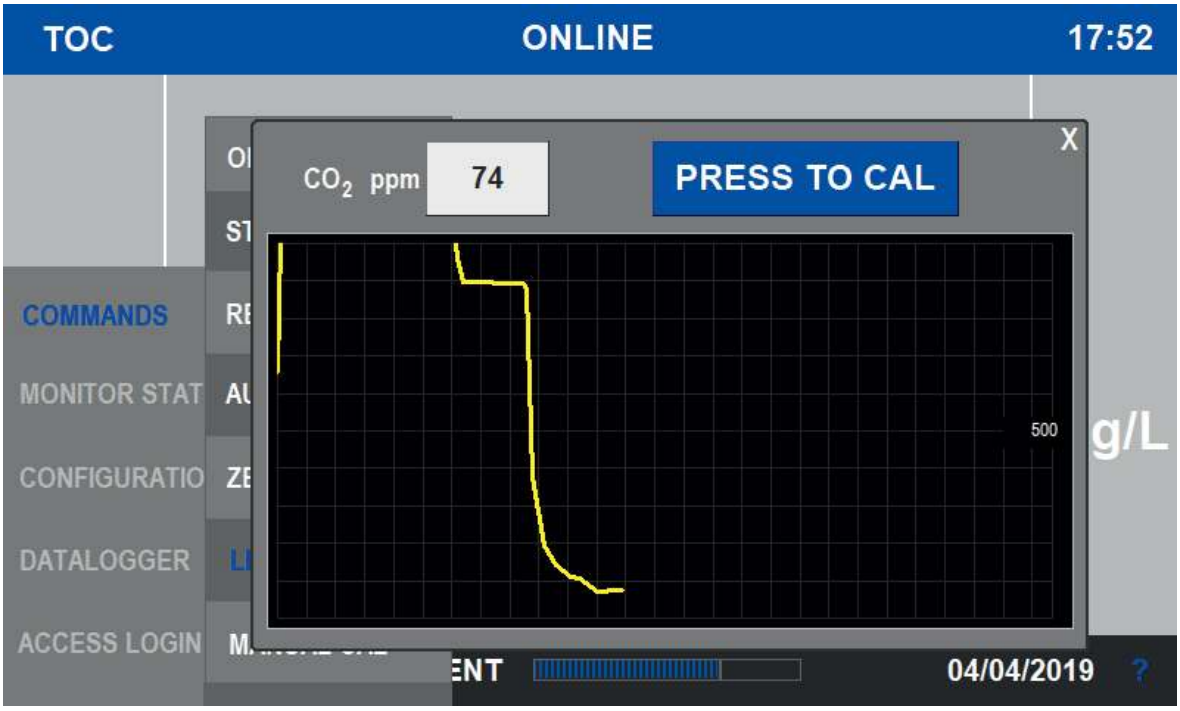
elapsing time, in second, to the end of the procedure

CO_2 ppm current value

CO_2 value of the last Zerogas performed

5.5.6 - LIQUID ZERO key

After pressing LIQUID ZERO key the analyzer will display the liquid zero trend window.
The LIQUID ZERO manual procedure means waiting untill the lowest reachable value is obtained from a zero TOC water.



The user has to provide a pure water (demineralized, distilled or bidistilled water) and connect to the sample inlet tubing.
After reaching a good low and stable value,It usually takes at least 30 min, the PRESS TO CAL button can be pressed.
The analyzer will calculate the Liquid zero value:

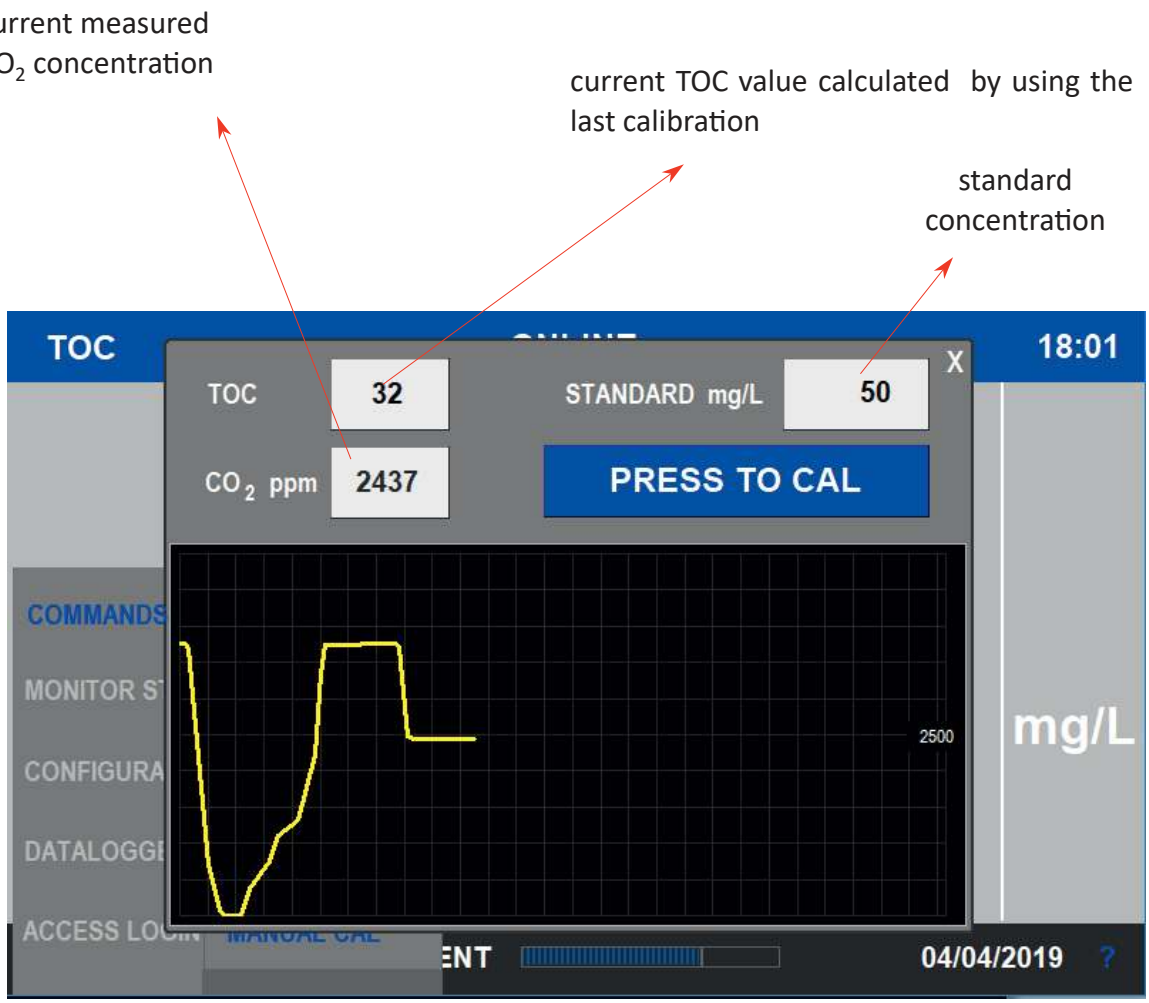
Liquid Zero = detected CO_2 value (when the key is pressed) - Zero Gas Value

The detected CO_2 value (after flushing the pure water)will also represent the baseline, as the sum of Zero Gas (the residual CO_2 after the sodalime filter) and the Liquid Zero (the organic impurity of the reagents)
Measured CO_2 above the Baseline value will be calculated as TOC, according to the calibration.

5.5.7 - MANUAL CAL key

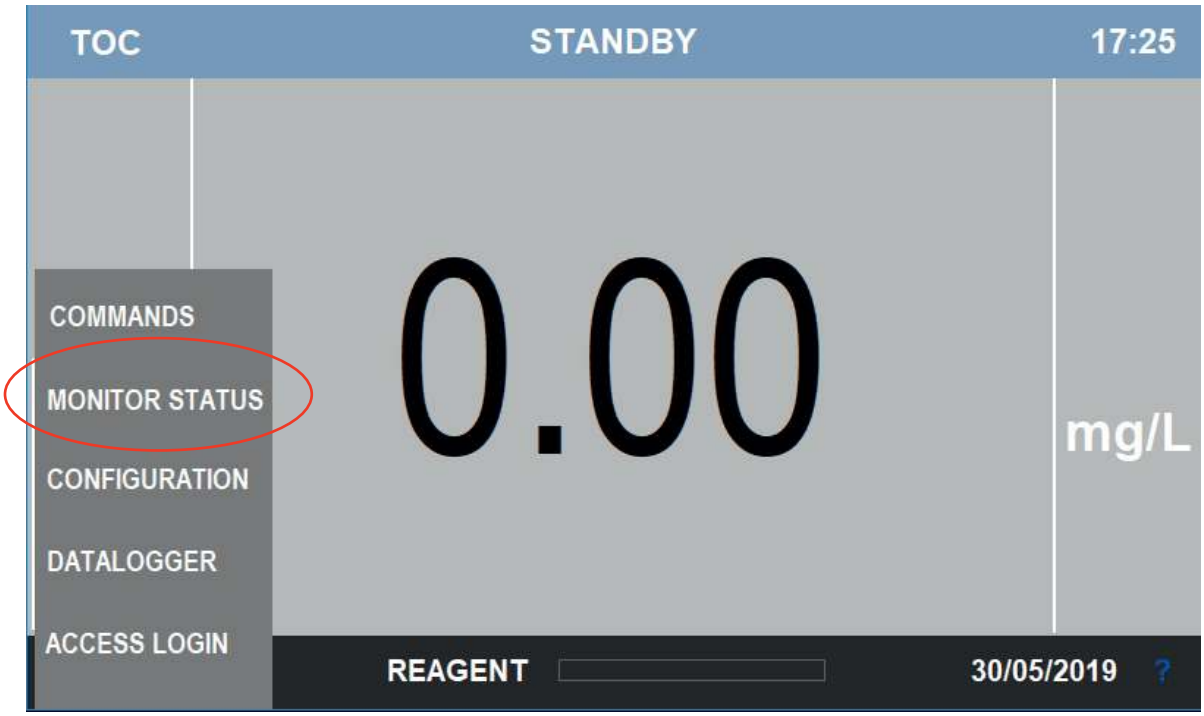
After pressing MANUAL CAL key the analyzer will display the manual cal trend window.

The manual calibration procedure can be performed as follow.

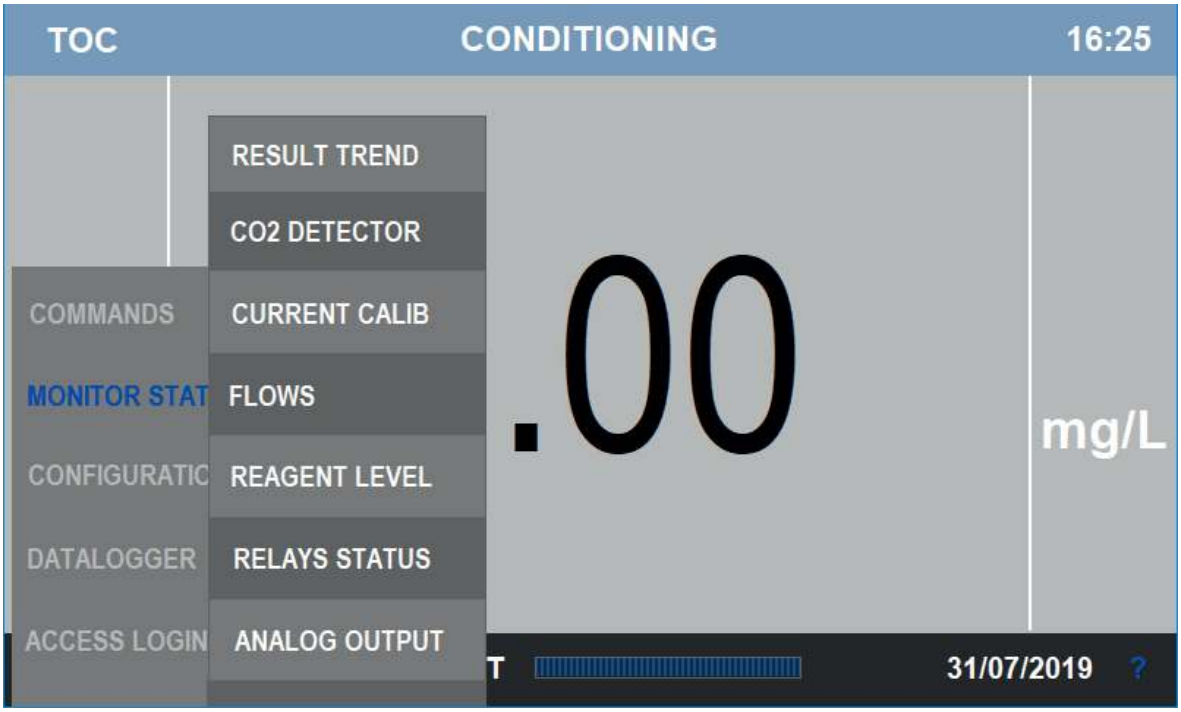


- Apply the standard solution to the sample port tubing and wait 20-30 minutes of conditioning and stabilization time.
- Input the standard concentration value
- Press the key PRESS TO CAL untill the page closes.

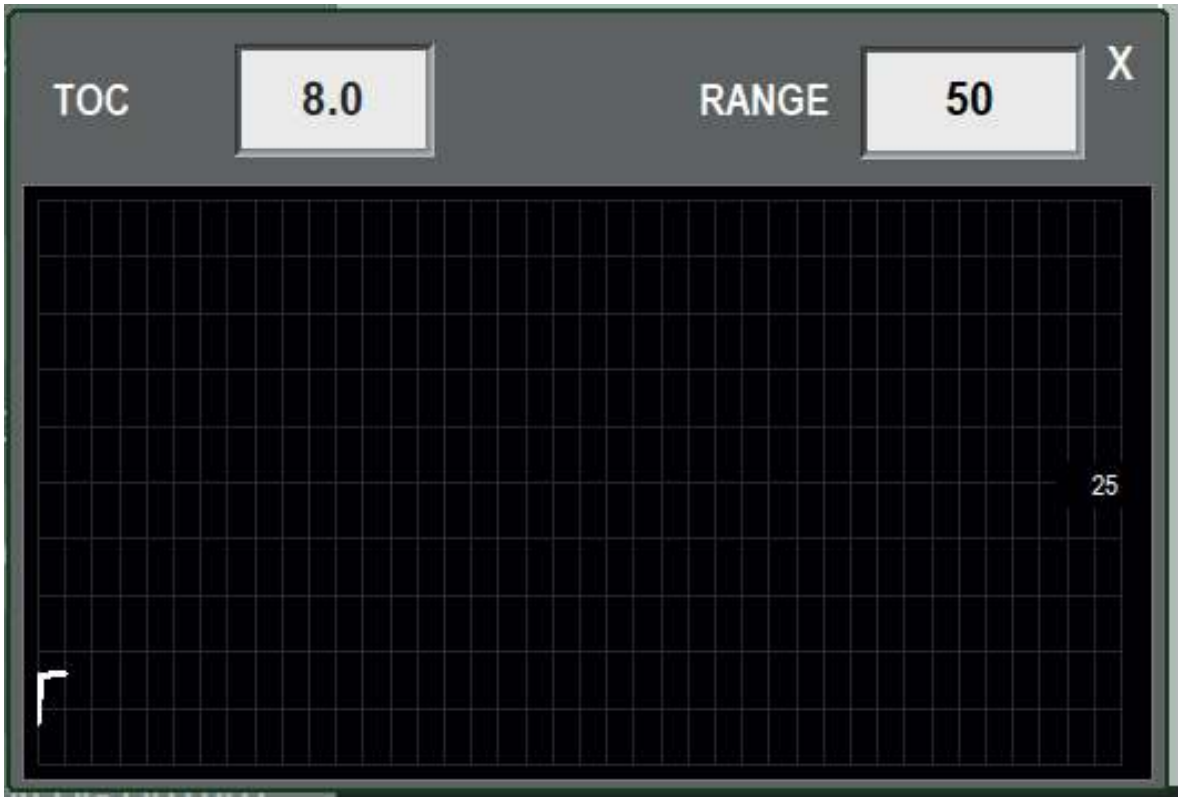
5.6 - Monitor Status menu



Users can access to the Monitor Status by selecting it from the Main menu list



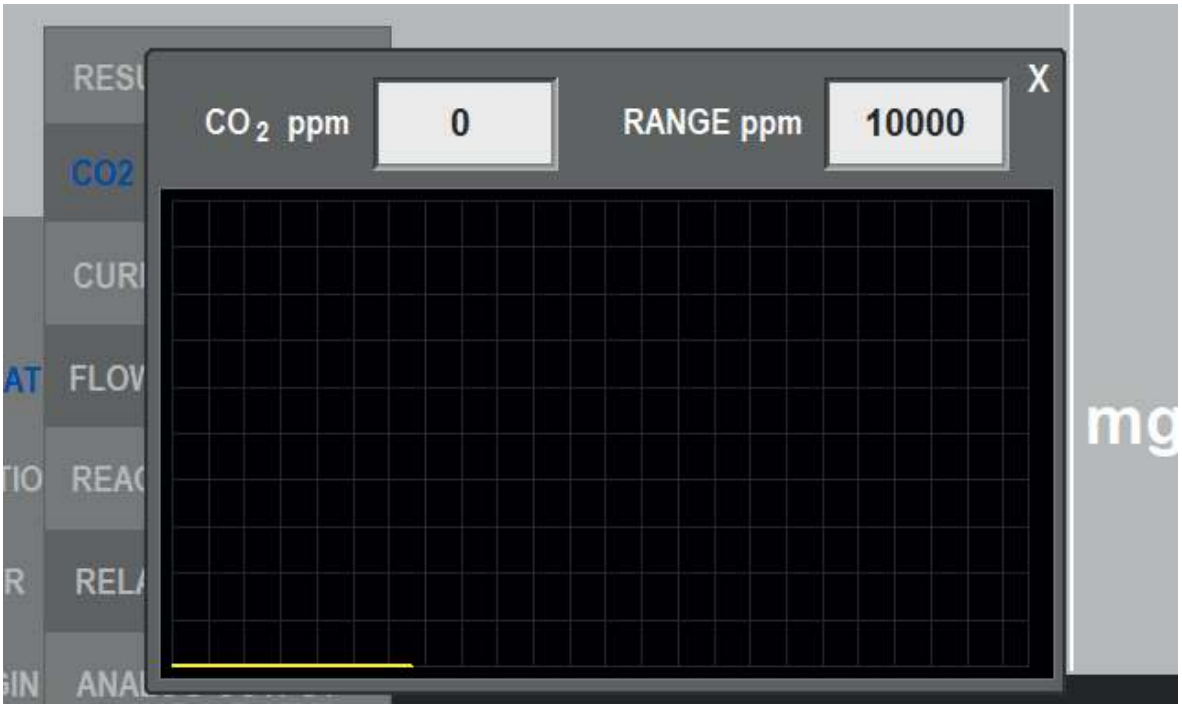
5.6.1 - Result trend



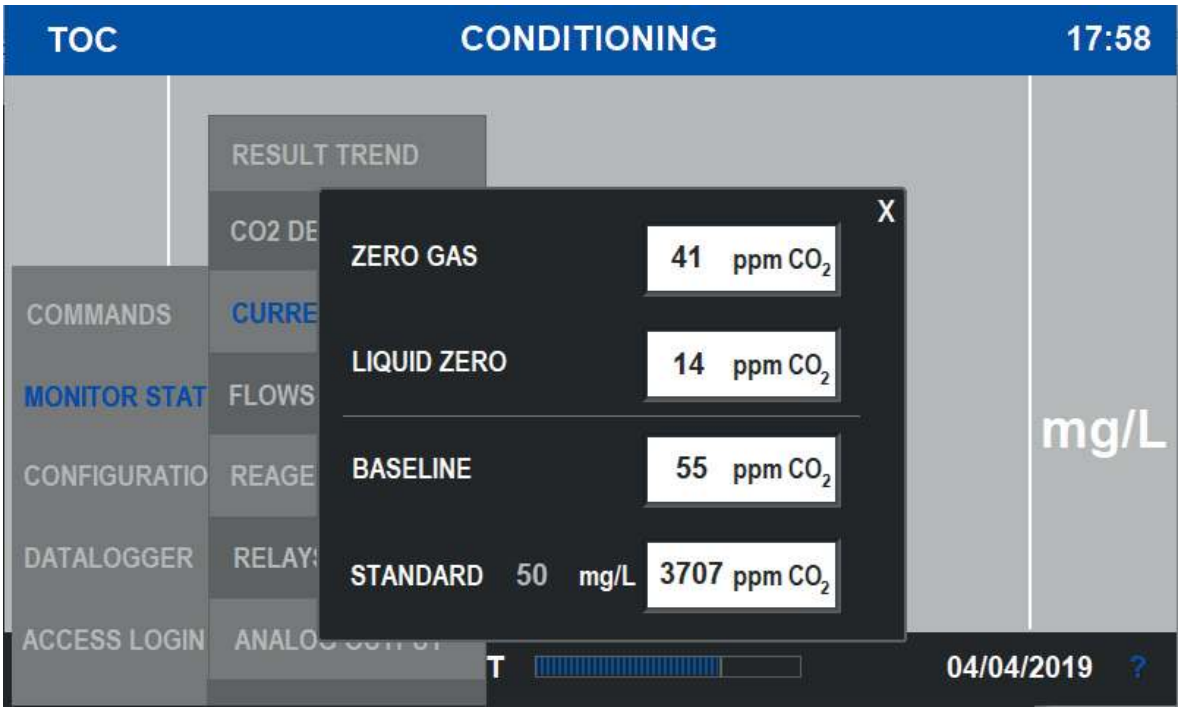
This is what appears after the RESULT TREND key has been pressed.

The trend table is vertically a 10% of the fullscale division grid, and horizontally a 5 minutes division grid.

5.6.2 - CO_2 detector signal

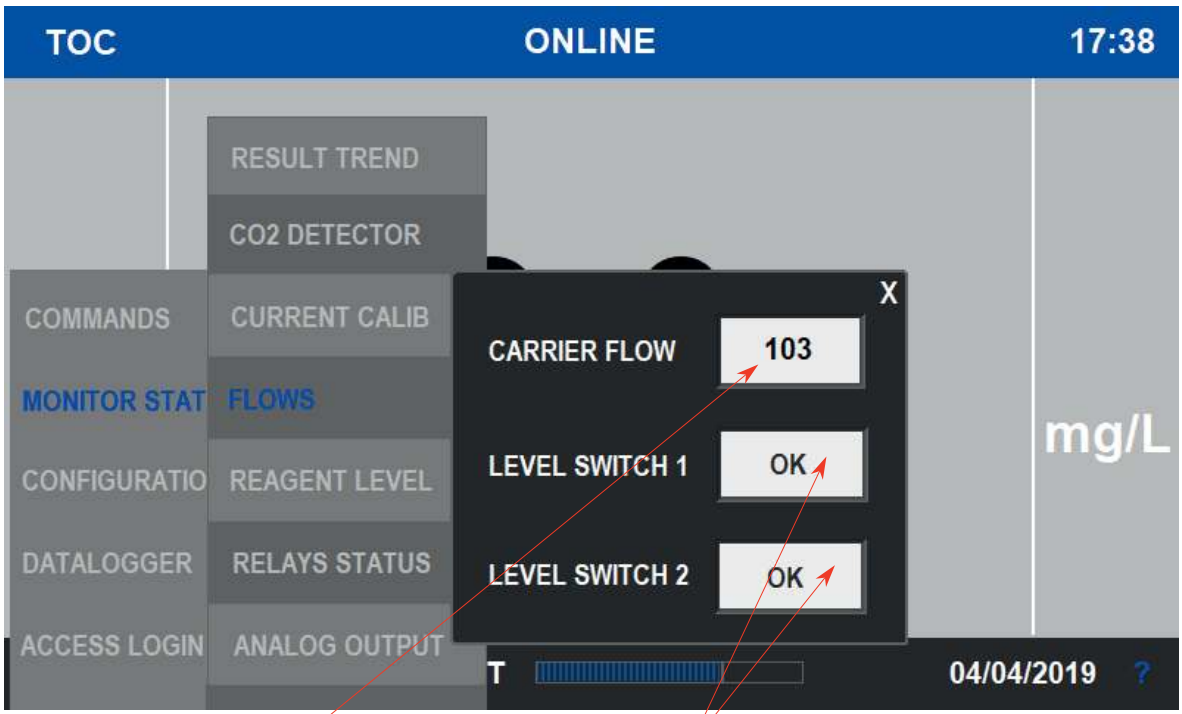


5.6.3 - Current calibrations display



Current calibrations can be displayed selecting the CURRENT CALIB key in the Monitor Status menu.

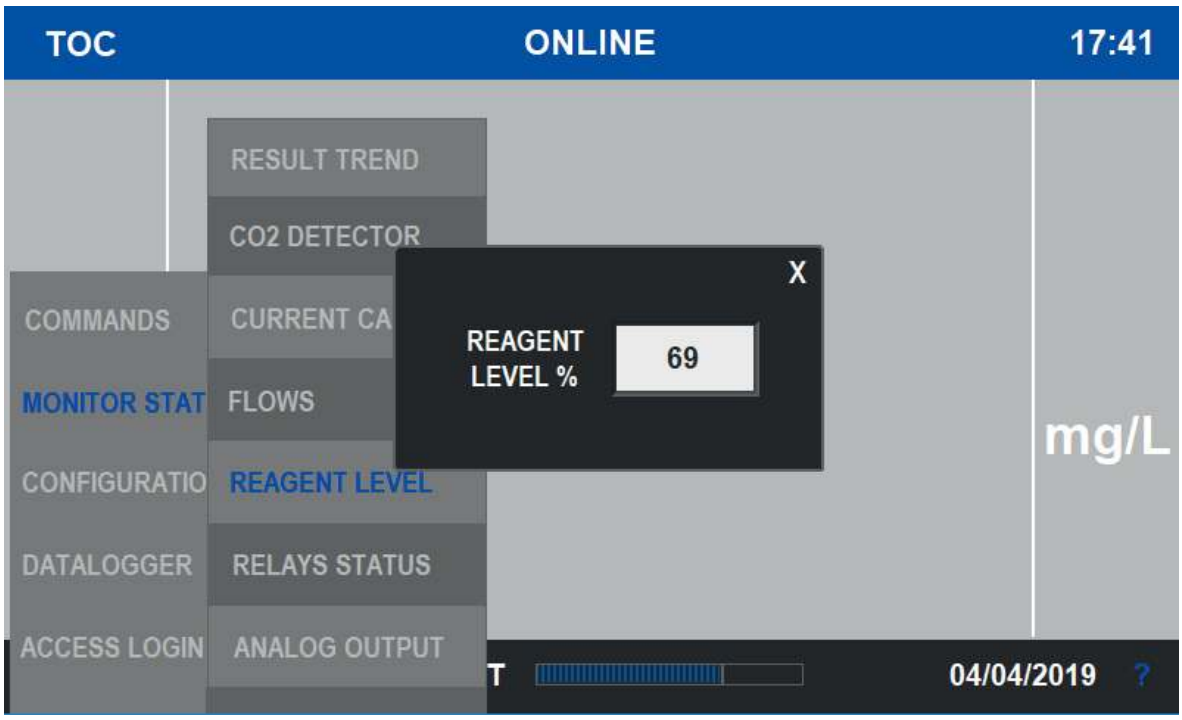
5.6.4 - Flows display



Reactor carrier gas flow espressed in cc/min

External sample level switches (one if single stream or two if dual stream)

5.6.5 - Reagent level display

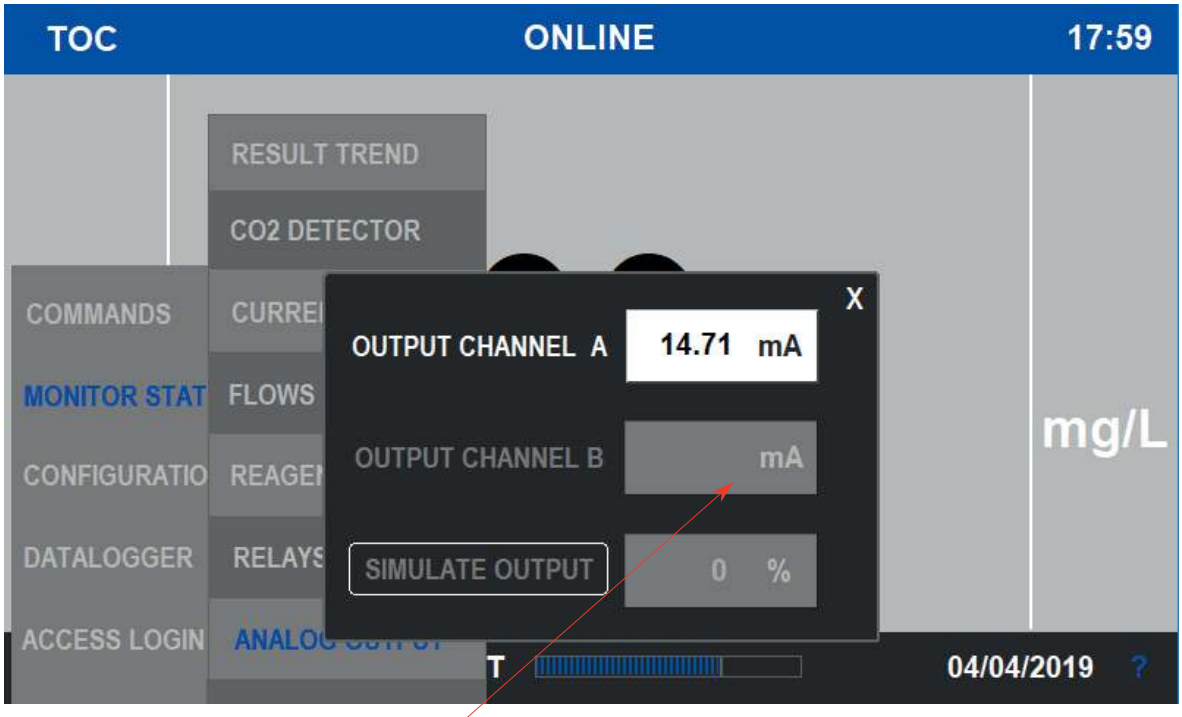


The current reagent level can be displayed choosing the REAGENT LEVEL selection in the Monitor Status menu.

5.6.6 - Relays status display

RELAY A	Programmable WARNINGS, see 5.7.6
RELAY B	FAULT ALARMS (Analyzer stopped)
EXTRA RELAY	External option (Dual stream valve, dilutor)

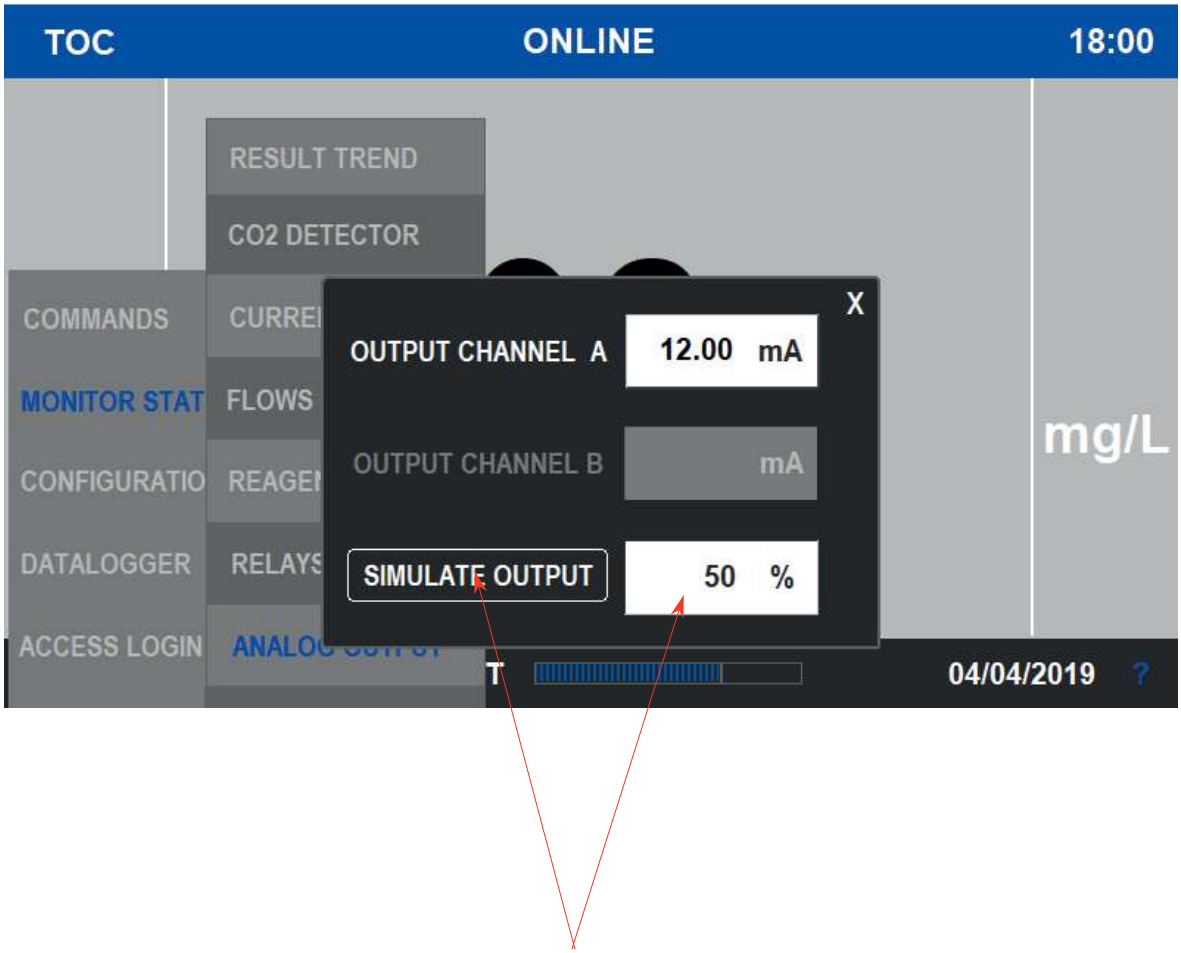
5.6.7 - Analog outputs display and simulation



The second analog output is displayed in the Dual Stream configuration only

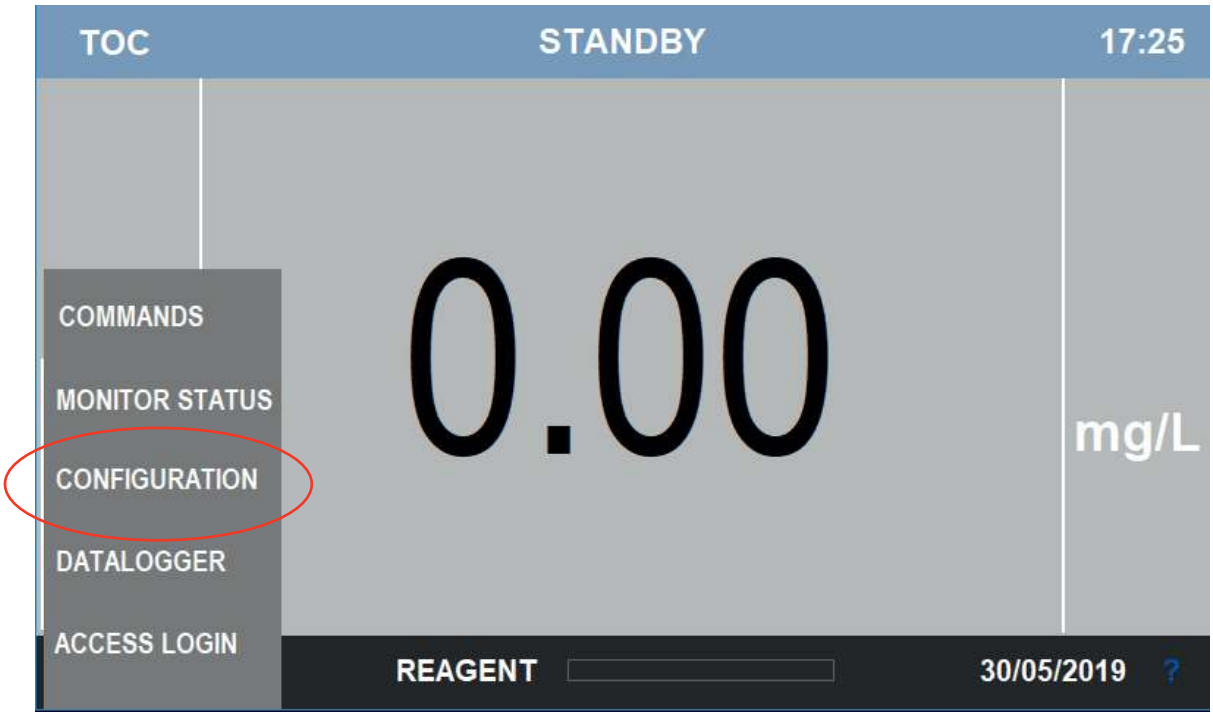
Apart from the analog output display espressed as mA value, from the same page the user can simulate the output for maintenance purposes.
This can be done by pressing the SIMULATE OUTPUT button and setting the desired output % value.

Be aware that SERVICE LOGIN is needed

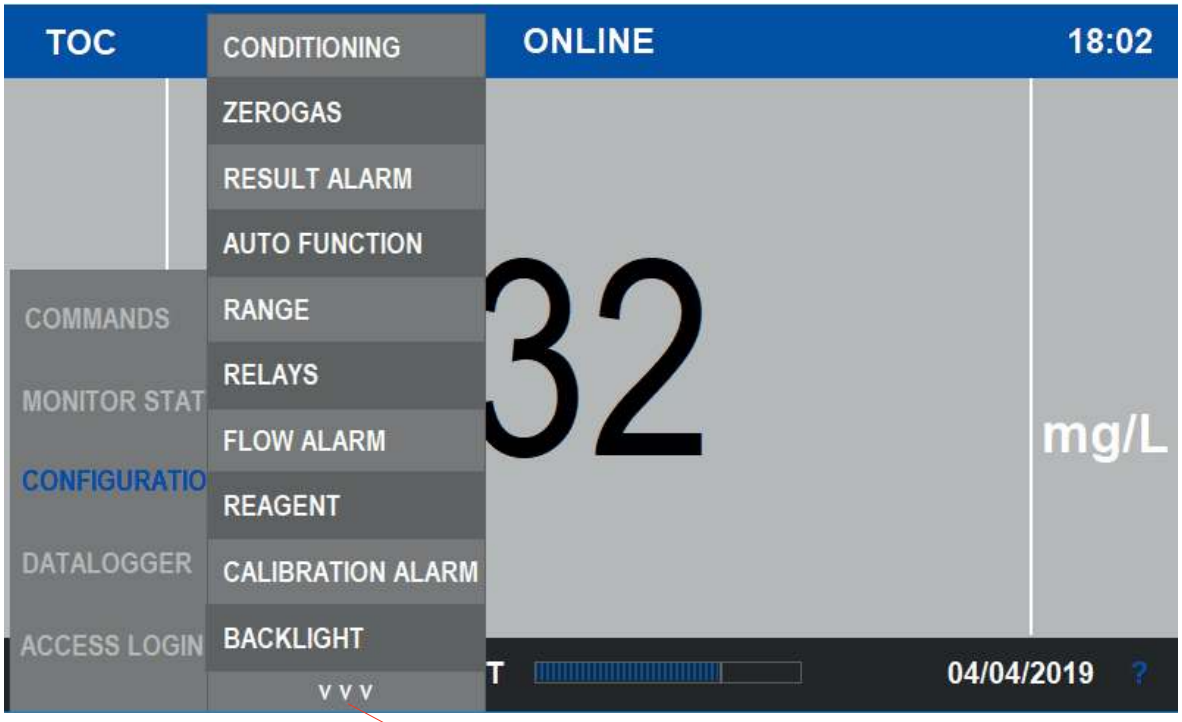


Once pressed SIMULATE OUTPUT, the simulation % field lights up .
After completing the test or maintenance, do not forget to switch the simulation off.

5.7 - Configuration menu



Users can access to the Configuration menu by selecting it from the main menu list.



Other selections available on the next page

5.7.1 - Conditioning delay

Here the user can set how long the CONDITIONING period will last, espressed in minutes.

CONDITIONING is the status that is needed everytime passing from an OFFLINE status to the ONLINE condition.

This because the new sample entering the analyzer takes time before to replace the pre-existing liquid (standard or cleaning solution) and give the correct result, as the tubings, the lamps and the sample gas line needs to be conditioned. Furthermore coming from the STANDBY or from a ZEROGAS, the UV reactors need time to warm them up and start the oxydation.

During CONDITIONING the airpumps, the liquid pumps and UV lamps are ON but the result shown in the display is the last old value, kept frozen during OFFLINE status.

The same happens to the analog output, frozen value during OFFLINE conditions (CONDITIONING included)

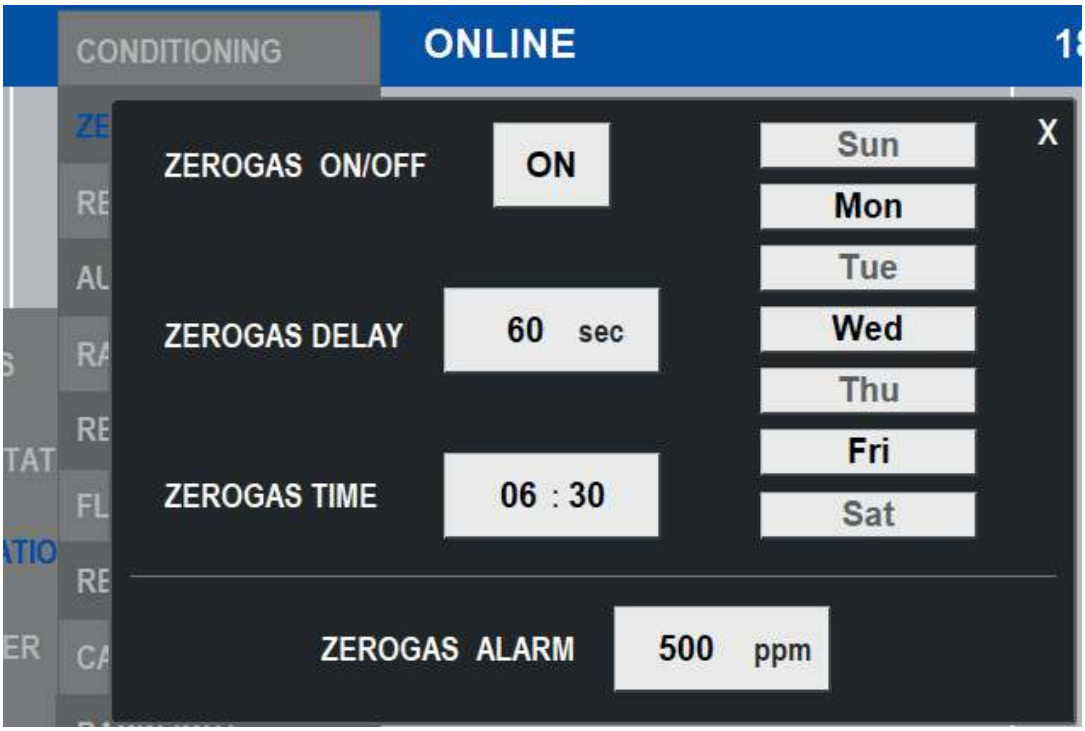
and analytical value during ONLINE.

Normal Conditioning delays are :

12-15 mins for low range (10-20-50 mg/L)

20-25 mins for higher range

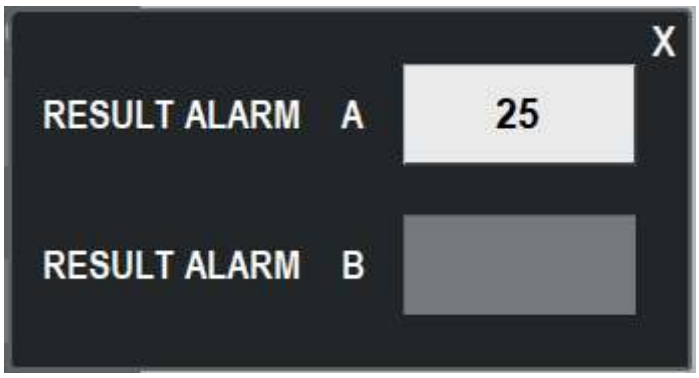
5.7.2 - Zerogas configuration



This page allows the user to set:

ZEROGAS ON/OFF	This command enables or disables the Zerogas function
ZEROGAS DELAY	Time period espressed in seconds for the Zerogas function
ZEROGAS TIME	Activation time (hour and minute) of the function
ZEROGAS DAYS	Activation week days of the function (each day on/off)
ZEROGAS ALARM	High Zerogas threshold espressed in CO_2 ppm

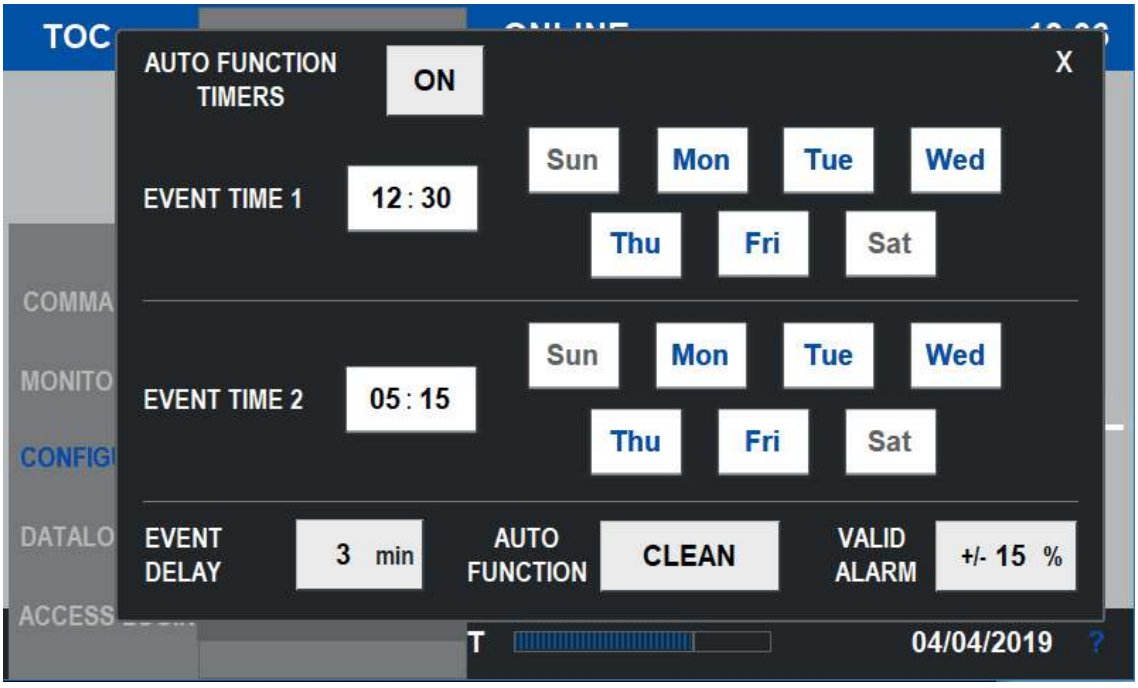
5.7.3 - Result alarm setting



This window will be displayed once RESULT ALARM key is selected from the list and allows the user to set the high Result Value threshold.

Note that Alarm B is only available for Dual Stream option.

5.7.4 - AUTO FUNCTION configuration

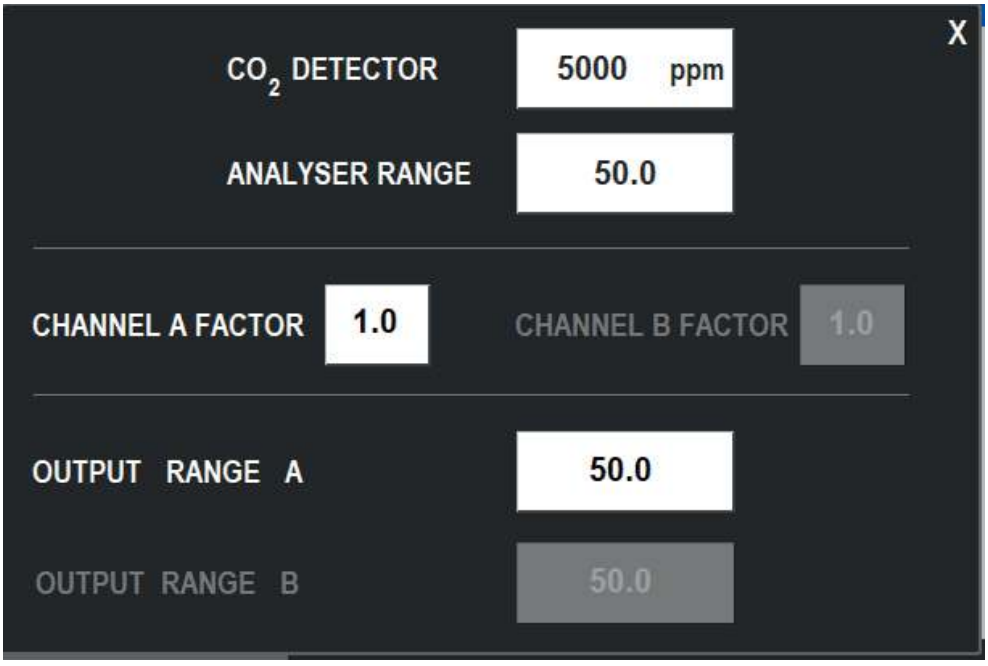


The AUTO function is an offline operation that occurs at a certain predefined time. After it finishes the analyzer come back to the normal online operation. It is possible to have two different event time.

It can be set as an AUTO-CLEAN, an AUTO-CALIBRATION or an AUTO-VALIDATION.

AUTO FUNCTION TIMERS	This command enables or disables the AUTO function
EVENT TIME 1	Activation time (hour and minute) of the AUTO function event 1 and week days ON/OFF
EVENT TIME 2	Activation time (hour and minute) of the AUTO function event 2 and week days ON/OFF
EVENT DELAY	Time period espressed in minutes for the AUTO function
AUTO FUNCTION	Type of AUTO function CLEAN,CALIBRATION,VALIDATION
VALID ALARM	Tolerance limit % for VALIDATION, that raises the Validation Alarm when the Validation % is out the range Range = (100%-Tol%) to (100%+Tol%)

5.7.5 - Measure range settings



The RANGE selection window allows to set the different ranges

CO_2 DETECTOR	This is the CO_2 measuring range of the IR detector espressed in ppm, models can be of ranges 1000, 5000 or 10000 ppm. Set the value accordingly to the detector mounted in the analyzer.
ANALYZER RANGE	The TOC analyzer range is the oxydation and measuring capability. His value depends on the resample pump size, the reactor carrier flowrate and the detector range. The following example may help to understand: resample pump size = 16 carrier flow = 100 ml/min IR range = 5000 ppm CO_2 In this condition a 50 mg/L TOC solution will develop aorund 4800 ppm CO_2, thus the analyzer range is 50 mg/L TOC. The analyzer range never changes unless an hardware modification has been done.
CHANNEL A FACTOR	In the case of an external dilution or when the TOC is proportionally correlated to a different engineering unit, here it's possible to set the multiplication factor. The following example may help to understand: TOC measured value = 25 mg/L FACTOR = 3.5 (as from empirical COD/TOC ratio) Result displayed = 87.5 mg/L COD
CHANNEL B FACTOR	Same as above, but for channel B, when a second channel option is configurated (dual stream or dual range)

OUTPUT A	Range of the analog output A It is normally considered to be OUTPUT A = ANALYZER Range x FACTOR CHANNEL A
OUTPUT B	Range of the analog output B when present as an option It is normally considered to be OUTPUT B = ANALYZER Range x FACTOR CHANNEL B

5.7.6 - Relays configuration

Only the RELAY A can be configurated, selecting one of the following conditions:

ONLINE (relay activated when analyzer is online)

OFFLINE (relay activated when analyzer is offline)

LOSS OF SMPLE (relay activated in case of loss of sample alarm)

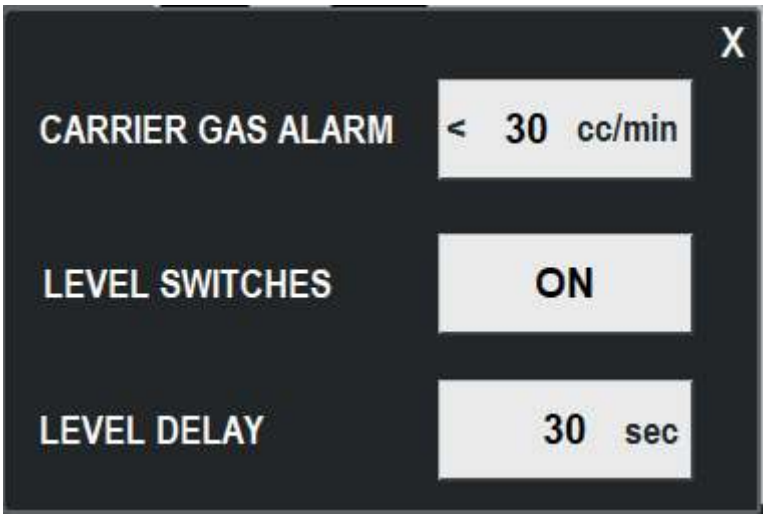
RESULT ALARM (relay activated when the result is higher than the threshold)

VALIDATION ALARM (relay activated in case of validation alarm)

REAGENT ALARM(relay activated in case of reagent's alarm)

CALIBRATION ALARM (relay activated in case of calibration alarm)

5.7.7 - Flow alarm setting



This is the window where the user may define:

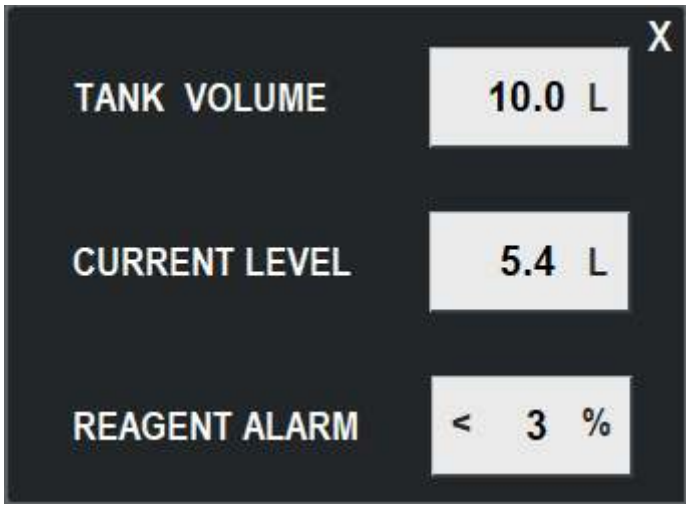
- The low threshold for the carrier flow. For measured flow below the value set the CARRIER FLOW alarm will be activated.
- The external level switches enabled or disabled.
- The delay time for the elevel switch low datection, before to raise the LOSS OF FLOW alarm.

5.7.8 - Reagent configuration window

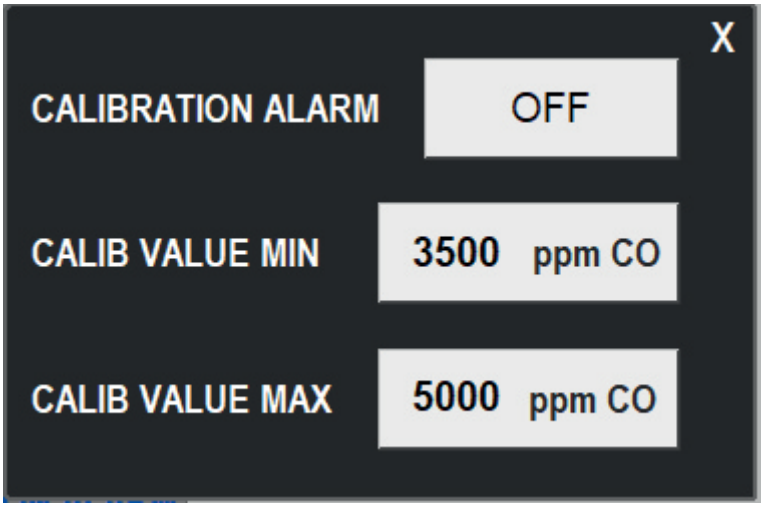
The reagent configuration consists of three parameters, that are used by the analyzer to calculate the reagent level:

- Tank volume, espressed in liters
- The current estimated level (that can be set/correct manually at any time)
- The low reagent threshold %, beyond that the analyzer raises the REAGENT LOW alarm.

Here is the reagent configuration window:



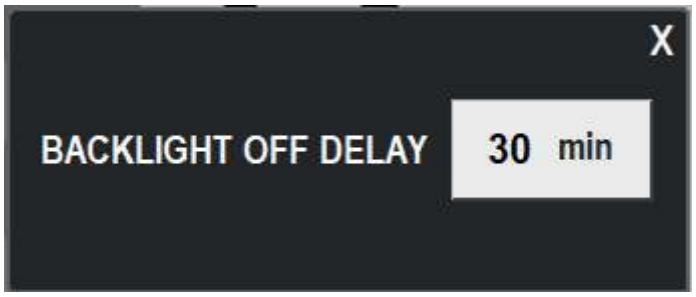
5.7.9 - Calibration alarm setting



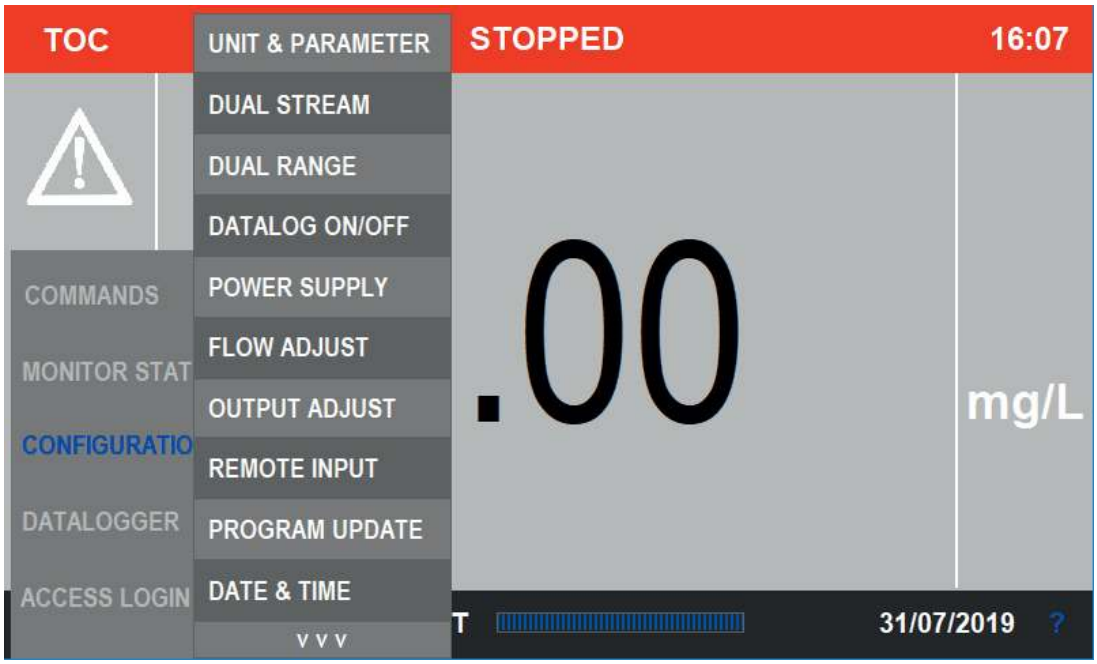
The above window can be used to activate the Calibration alarm and his low and high thresholds.

5.7.9 - Backlight delay setting

The delay time in minutes of display inactivity before switching off the backlight can be set here.

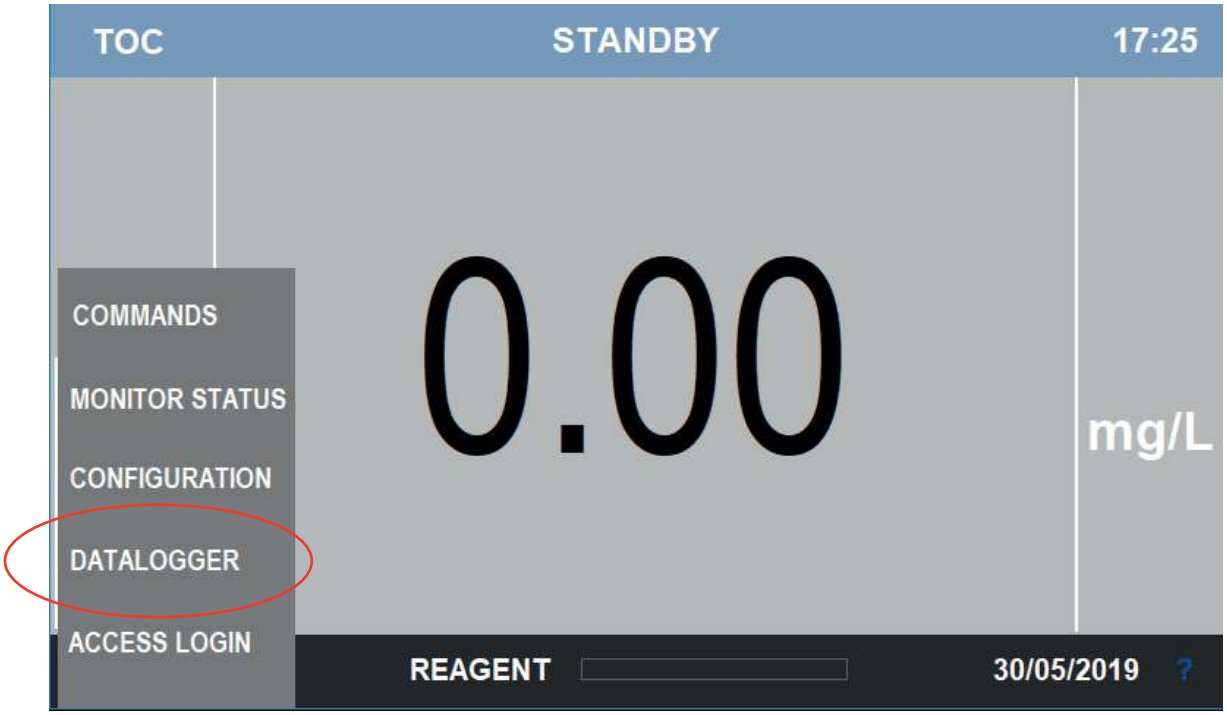


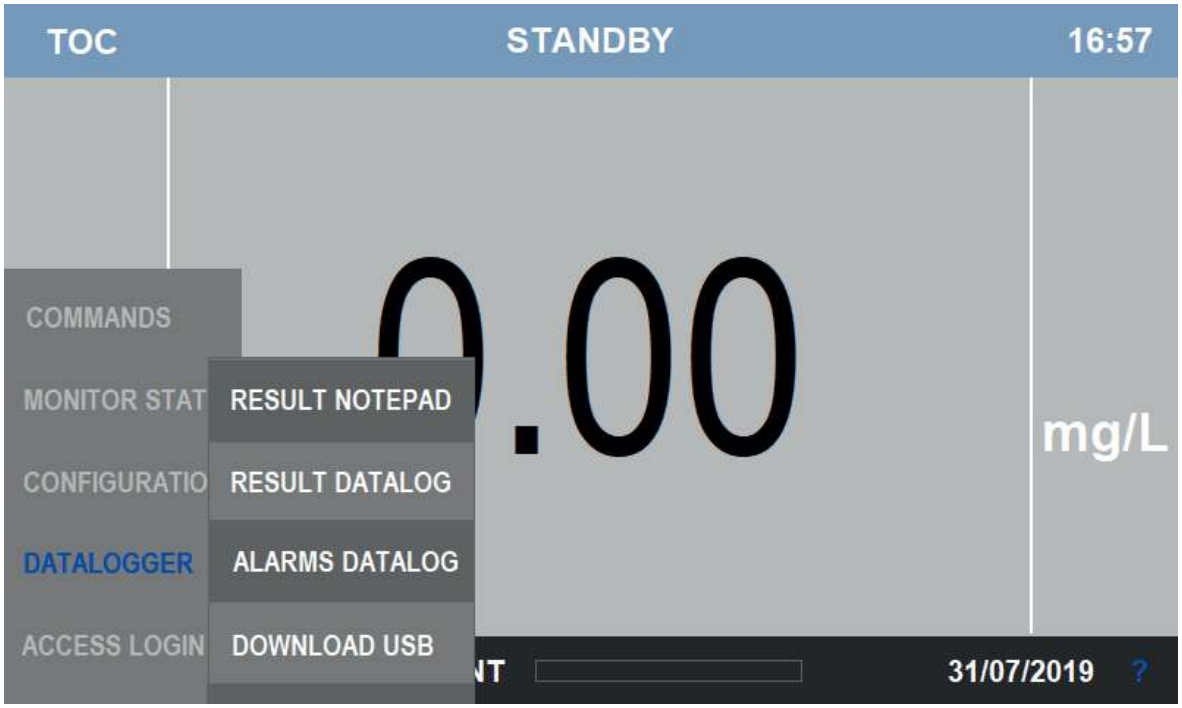
5.7.10 - Factory initial settings



Another list of parameters are present on the additional page. Even if these are basic configurations that do not require to be modified, please contact the 3S ANALYZERS service department in order to receive password and assistance on the displayed parameters..

5.8 - Datalogger pages



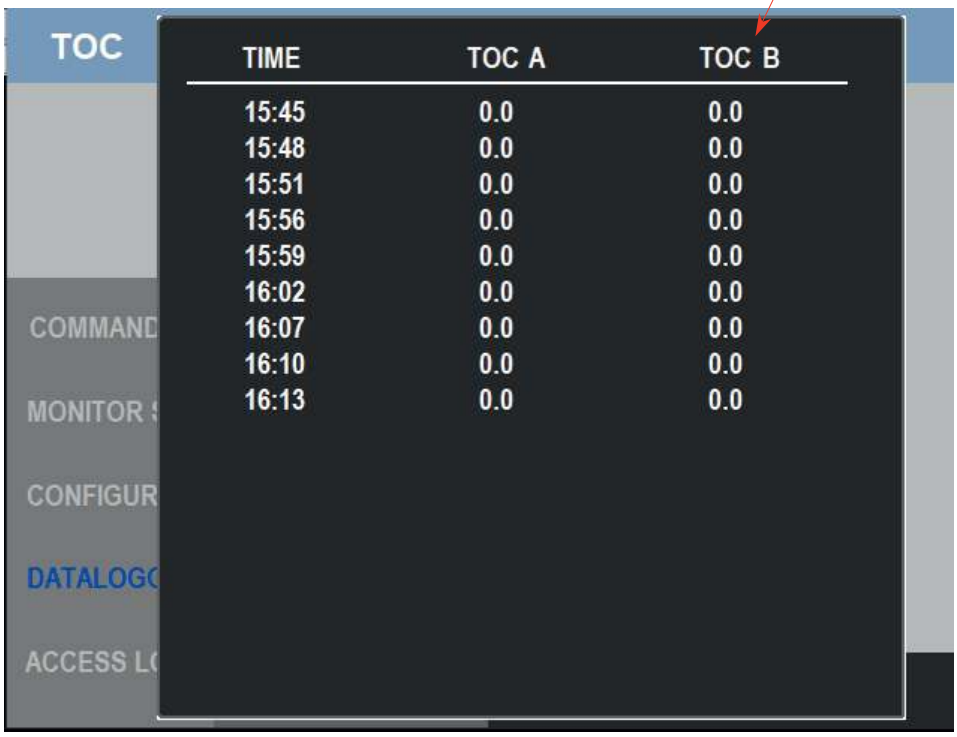


Four different selections are listed in the DATALOGGER menu.

5.8.1 - Result notepad

The Result Notepad is the archive of today's data and is automatically deleted every new day. The data sampling frequency is 3 minutes, thus it may be used for stability test or service purposes.

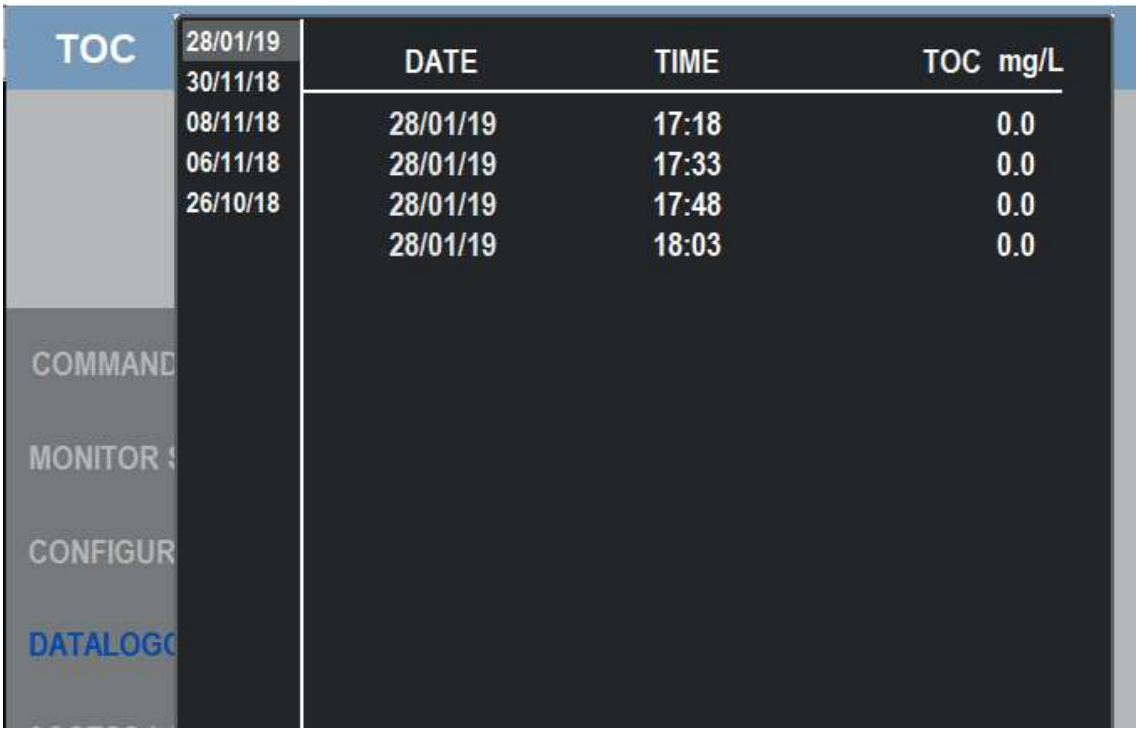
TOC Channel B only present in the case of Dual Stream option



5.8.2 - Result datalogger

The Result Datalog is an historical archive of result data related to the last 30 days, divided by day. The data sampling frequency is 15 minutes.

Before to scroll the data list (up and down arrows on the right side) the user can select the desired day from the list on the left side.



5.8.3 - Alarms datalog page

Whenever an alarm occurs, a new line is written, along with the event name (alarm indication) and date and time. When the reason of the alarm returns to normal, then the reset time is added on the right side, as to close the event.

The alarm datalogger will retain a maximum of the last 50 events.

5.8.4 - How to download the result data

After pressing the DOWNLOAD USB key from the DATALOGGER menu, the user has two options:

CLEAR DATALOG	By pressing the button for 2 seconds all stored data will be deleted.
SAVE TO USB	Before to start the Download an USB memory stick is connected to the USB port inside the right cabinet. Wait a few seconds and keep pressed the SAVE TO USB button. The window will close at the end of the operation. The memory stick will be written and a folder named "toc" will contain one .csv file each recorded day .

6 - MAINTENANCE

An adeguate maintenance is the main basis for excellent analyzer's performance.
It's extremely important to establish a scheduled maintenance program to keep the analyser clean and in good general conditions, as follow:

Visual check of FAULT alarms	Daily
Visual check of liquids enclosure for leakages detection	Daily
Visual check of halogens filter	Daily
Sample fast-loop reservoir cleaning	Weekly
Reagents containers refill	Monthly
Scrubber and gas-liquid separator cleaning	Monthly
Sodalime replacement in sodalime filter	Four-monthly
Copper wool replacement in halogens filter	Four-monthly
Pumps tubings replacement	Four-mounthly
UVR check for leakages and tubing connection replacement	Yearly
Diagnostic check of infrared analyzer (for qualified personnel only)	Yearly
Analyzer general inspection (for qualified personnel only)	Yearly

6.1 - Pump tubing replacement

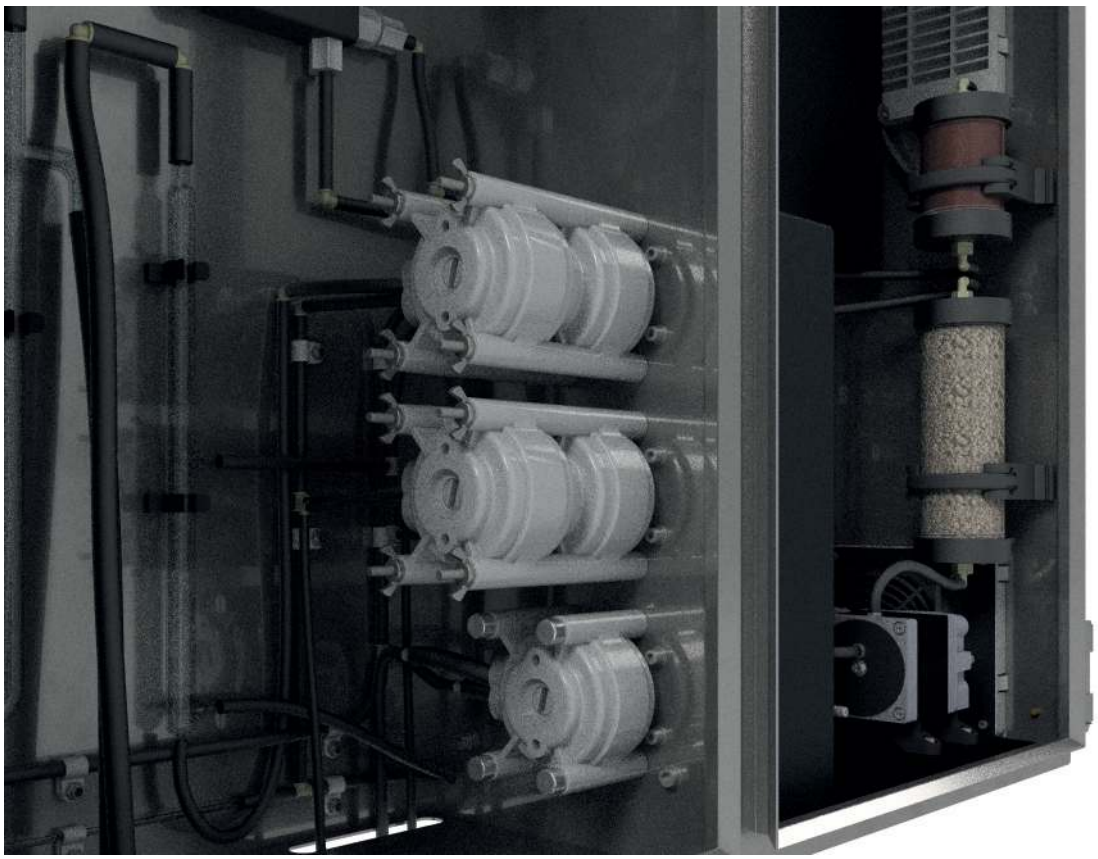
Before proceeding to replace the tubing, please read carefully Section 7 of this manual on hazards and dangers related to the chemicals used. It is recommended to wear appropriate clothing, gloves and eyes protection. Phosphoric acid, sodium persulfate and cleaning solutions should be handled with care. The reducing agent can pose a safety hazard for the operator and contact must be avoided.

The peristaltic pumps are located inside the Liquid Enclosure (left side of the analyzer).
We recommend replacing the tubing regularly to ensure the good operation of the analyzer.
To replace proceed as follows:

A - With the analyzer in normal online operation, disconnect all solution and sample lines from their containers and reconnect them to a distilled water source. Leave the analyzer running in this way for at least an hour.

B - Put the analyzer in Standby. Pumps and UV lamps will be switched off.

C - Using the key, open the Liquids Enclosure.



D - Disconnect each pump tubing from their inlet and outlet fittings, taking care to note which fitting will be needed to reconnect to which pump.

E - Undo the four wings nuts on the mounting screws that supports pump heads.

F - Slide the pump heads to left and remove them from the mounting screws.

G - Carefully separate the two halves, avoiding dropping the rotor and then removing the used tubing.

H - Place the pump half containing the rotor in one hand and move the rollers in the 2, 6 and 10 o' clock positions. Place tubing in the outer port and against the two rollers as shown, keeping your thumb on the tubing to hold it in place. Insert the tubing loading key on the back of the rotor shaft and push the rotor in as far as possible. The tubing should now be positioned deep into the pump head body. With the key firmly pressed against the rotor, turn counter-clockwise, while pushing down until tubing is fully in place around the rotor.

I - With the tubing now on place, remove the key and position the other pump half onto the rotor shaft and snap shut, being careful not to pinch the tubing between the plastic pump halves.

J - Check if the pump turns correctly using the key.

K - Holding the two parts of the pump head tightly together, slide it into the mounting screws moving the rotor block with the key or with a screwdriver until the shaft aligns with the motor drive.

L - Replace the four wing nuts, tightening them to finger tight so to have a firm mounting of the pump head.

M - Repeat the steps from D to L for each additional pump head for which it is necessary to replace the tubing.

N - Reconnect the acid and persulfate intake tubing to their containers, run online the analyzer.

O - The analyzer will start the conditioning cycle, with status indicator flashing with green light, until the
conditioning time will be expired. After the conditioning time of 30 minutes, the analyzer will start regular on line measurements.

6.2 - Copper wool replacement (halogen filter)

The halogens filter is located into the electrical enclosure (please read the hazards and dangers list in section 1). This operation should be made by qualified personnel who have been fully trained and has professional experience to avoid electricity hazards and dangers. Proceed as follows:

A - put the analyzer in stand-by and open the analyzer electrical enclosure

B- disconnect the inlet and outlet tubing of the filter from their fittings

C - remove the filter plastic body from its support clamp

D - unscrew top and bottom caps from filter body

E - with extreme care, using a proper tool, pull out the used wool from ther plastic cylinder

F - replace the used wool with new wool and press it into place to form a compact pod.

G - screw back on the top and bottom caps

H - put the filter in the clamp, connect fittings and turn on line the analyzer

6.3 - Sodalime replacement (CO_2 filter)

The sodalime filter is located inside the electrical enclosure (refer section 1 for hazard warnings).
All handling and manipulations operations on chemicals labelled with symbol should be made by qualified personnel in accordance with national or local regulations.

Qualified Personnel means person who has been fully trained and has professional experience to avoid chemical hazards and dangers.

Warning: Sodalime (granules) is a corrosive and should be handled with extreme care.

Irritating to eyes, respiratory system and skin.

It causes burns.

Avoid contact with skin.

Do not breathe dust.

Wear suitable gloves, face mask, clothes protection and operate in adequate environment.

Before to proceed to sodalime replacement in sodalime filter, read with care the material safety data sheets supplied with this chemical to take all the necessary precautions when handling.

Used sodalime must be disposed according with national or local environmental regulations regarding hazardous and poisonus materials.

A - put the analyzer in stand-by and open the analyzer's electrical enclosure

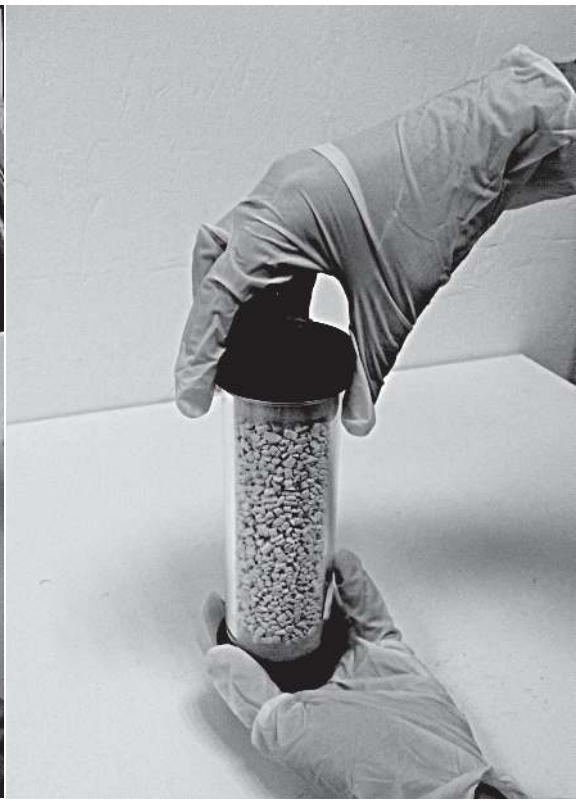
B - disconnect the inlet and outlet tubing of the filter from their fittings

C - remove the filter plastic body from its support clamp

D - unscrew filter upper cap, pull out the wool disc and discharge the used sodalime in a proper container for disposal, taking all precautions its handling

E - fill the plastic body with new sodalime granules, insert the wool disc and screw the upper cap

F - install the filter on its support clamp and reconnect inlet and outlet tubings, put the analyzer on line



6.4 - UV lamp connection's tubing replacement

Warning UV lamps may be hot if recently powered.

Warning: UV lamps may contain corrosive liquid. Handle with suitable gloves. If the analyzer is equipped with the optional reducing agent, extra care must be adopted since the post-lamp scrubber can still contain it.

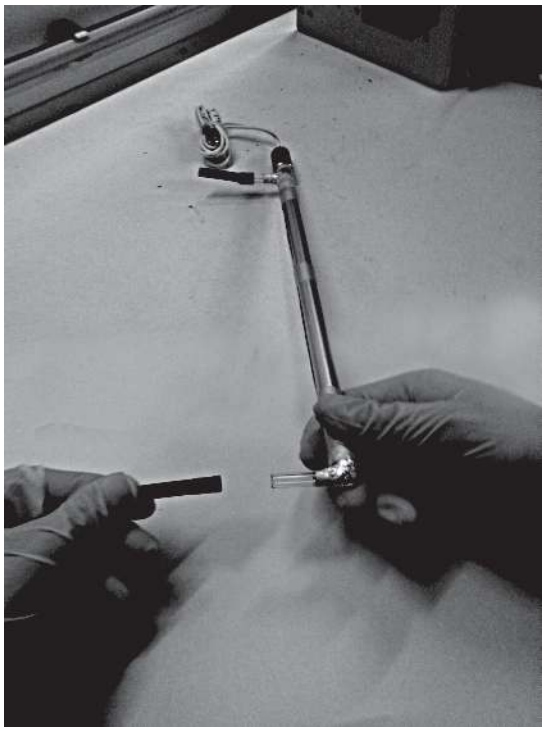
Proceed as follow:

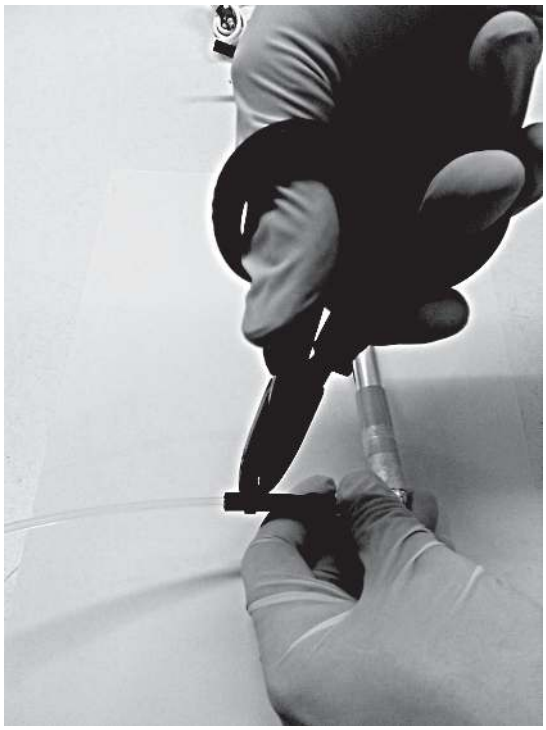
A - Put the analyzer in standby mode

B - Open the analyzer Liquid Enclosure

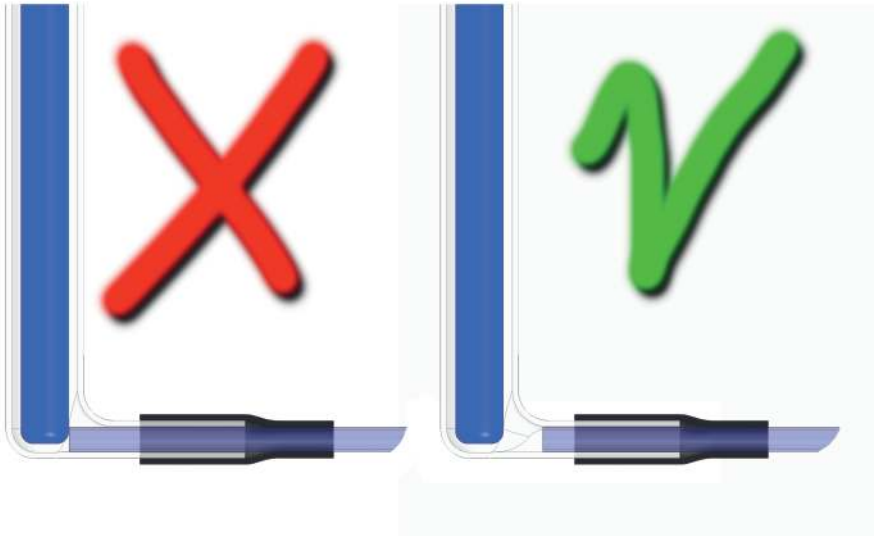
C - Dismount the UV lamps from their supports

D - Cut the plastic clamp and the norprene tubing's connection and replace them with new ones





E - The Teflon tubing should be inserted inside the quartz inlets/outlets of the UV lamps, taking care not to impede the liquid flow.



F - The norprene tubing should cover the Teflon tubing and the arm of the quartz inlets/outlets of the UV lamp

G - Use the black clamps supplied to fix the norprene tubing to the Teflon tubing

H - Check the clamp has been correctly positioned (that there are no leakages) using a syringe with DI water connected at the same point used to drain the lamps.

I - If no leakages are found, then remount the UV lamps on their supports and switch on the analyzer

J - Once the analyzer has been running for two hours check again for leaks at the connection to the UV lamps.

6.5 - UV lamp replacement

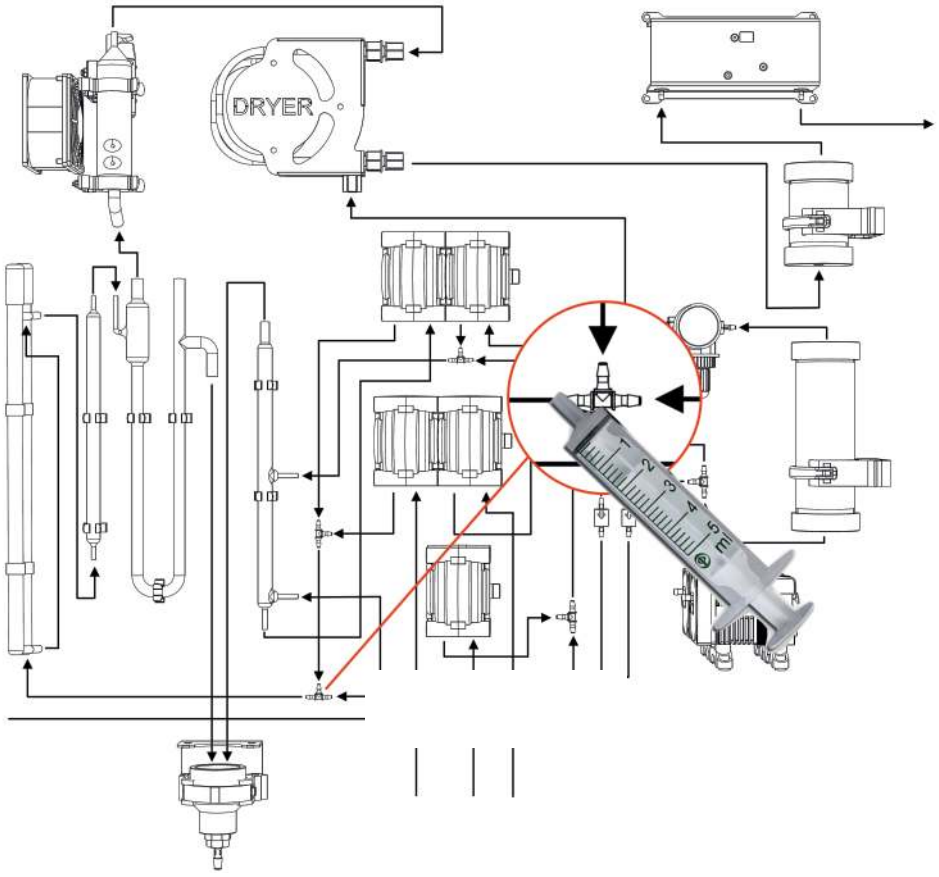
The UV lamps are located in the left enclosure.

WARNING – UV lamps may be hot if recently powered. Handle with suitable gloves.

A - With the analyzer in normal online operation, disconnect all solution and sample lines from their containers and reconnect them to a distilled water source. Leave the analyzer running in this way for at least an hour.

B - Put the analyzer in Standby. Switch off the power.

C - Using the key, open the liquid enlosure. Using a syringe remove the remaining liquid from the UV lamps (see figure). Reconnect the tubing to the 'T' afterwards.



D - Remove the wires from the cable guide in the top of the left enclosure.

E - Disconnect the UV lamp wires from the rear of the UV lamp power supplies, after first cutting the gain protecting the connection.

F - Remove the four screws supporting the lamps using a 3 mm Allen key or driver.

G -Cut the black clamp holding the tubing to the top and bottom of the lamps.

H - Connect the replacement lamps to the UV lamp power supply. First slip the supplied thermo–retractable gain over the end of the UV lamp wire. Reconnect the wires with the UV lamp power supply and position the gains over the connections. Apply heat to contract the gain. The gain is required to protect the connection from humidity.

I - Reinsert the wires into the cable guide.

J - Reconnect the tubing to the top and bottom of the UV lamps following the instructions in Section 5.4.

6.6 - Fuse replacement

The fuses are located inside the analyzer electrical enclosure (refer to section 1 for hazards and dangers warnings) .

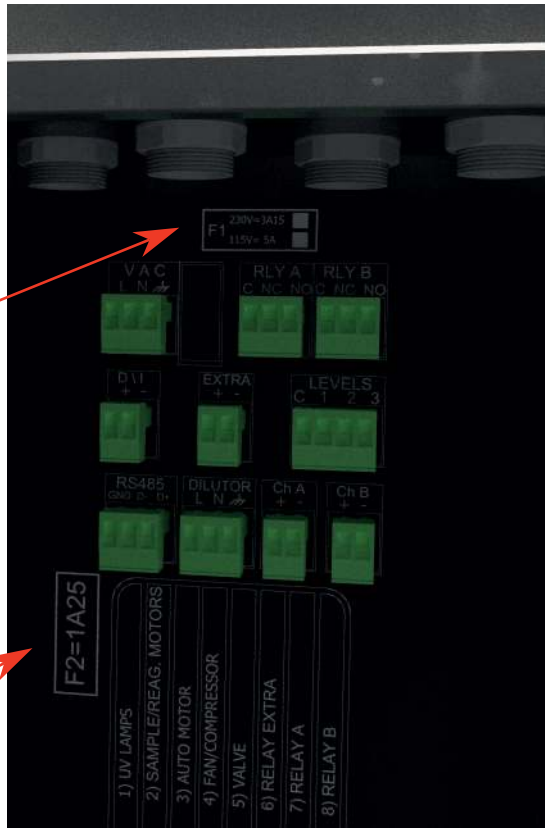
All operations in electrical enclosure should be made by qualified personnel in accordance with national or local codes and regulations.

Qualified Personnel means person who has been fully trained and has professional experience to avoid electricity hazards and dangers.

The analyzer has two fuses located inside the USER CONNECTIONS labelled as F1 and F2. Before to proceed to service operations on the electrical enclosure, read with attention all the information written in this manual regarding this matter.

To avoid any risk, turn off the analyzer main power before servicing the electrical enclosure.

F1
230V = 3.15 A OR 115V = 5 A



F2
1.25 A

A - turn off main power

B - open the electrical enclosure

C - remove the protection cover

D - remove the small protection cover of the fuse assembly

E - remove the fuse

F - check the fuse and if broken replace it with a new one.

7 - CHEMICALS PREPARATION

The chemical solutions used with the 3S-TM analyzer in online standard operation are:

• Phosphoric acid 10 % solution v/v and sodium persulphate 1M, as reagents

• Standard solutions, used in different concentrations depending on the analyzer range to calibrate or validate the analyzer.

• Cleaning solution

• Optional reducing agent solution for applications with high content of chlorides

Before proceeding with the preparation of these solutions, read the material safety datasheets supplied with each chemical and take all the necessary precautions when handling it. Chemicals must be handled by qualified personnel trained on hazards and dangers.

Wear hands and eyes protection and every other PPE required by your company or by the owner of the site.

7.1 - Reagent 1 - phosphoric acid solution 10%

Orthophosphoric acid (H_3PO_4, CAS # 7664-38-2)

H314 - Causes severe skin burns and eye damage.

P260: Do not breathe dust/fume/gas/mist/vapours/spray.
P264: Wash thoroughly after handling.
P280: Wear protective gloves/face protection/protective clothing/protective footwear.
P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower.
P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a poison center/doctor.

Preparation of 10 L of reagent 1 solution:

A - Add 8 liters of distilled water in a 10 liters container that has been previously cleaned and flushed with distilled water.

B - Add slowly 1175 ml of 85% phosphoric acid (H_3PO_4) and dilute to 10 liter volume with distilled water to have a 10% solution.

C - Plug the container and shake with care the solution.

Consumption: 10 L/month for continuous operation

Note: when the amount of TIC (total inorganic carbon) in the sample is high, the phosphoric acid concentration can be increased up to 20%.

7.2 - Reagent 2 - persulphate solution 1 M

Sodium persulfate ($Na_2S_2O_8$, CAS # 7775-27-1)

H272 - May intensify fire, oxidiser.
H302 - Harmful if swallowed.
H315 - Causes skin irritation.
H317 - May cause an allergic skin reaction.
H319 - Causes serious eye irritation.
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H335 - May cause respiratory irritation.

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P280: Wear protective gloves/face protection/protective clothing/respiratory protection/protective footwear.
P302+P352: IF ON SKIN: Wash with plenty of water.
P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P342+P311: If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
P370+P378: In case of fire: Use large quantities of water to extinguish the fire.
P501: Dispose of contents/container in accordance with regulations on hazardous waste or packaging and packaging waste respectively.

Preparation of 10 L of reagent 2 solution:

A - Add 5 liters of distilled water in a 10 liters container that has been previously cleaned and flushed with distilled water.

B - Add 2380 g sodium persulfate ($Na_2S_2O_8$) and dilute to 10 liter volume with distilled water, dissolving the powder by shaking.

C - Plug the container and shake until all the persulfate is dissolved.

D - Wait for at least half an hour or until the solution appears clear.

Consumption: 10 L/month for continuous operation

7.3 - Preparation of TOC standard solution

Use distilled water reagent grade for the preparation of TOC standard solutions and for the calibration of the zero of the analyzer.

Organic compounds usually used as TOC standards are potassium hydrogen phthalate (KHP) reagent grade and ethylene glycol reagent grade.
The table below shows a list of other calibration solution compounds that have been approved for this use.

Organic compound	Amount for 1 L of 1000 mg/L solution
Ethylene glycol	2.33 ml
Potassium hydrogen phthalate (KHP)	2.12 g
Acetic acid	2.50 g
Sucrose	2.38 g

Before proceeding with the preparation of these solutions, read the material safety data sheets supplied with each chemical and take all the necessary precautions when handling it.

For standard solutions preparation, prepare a stock solution 1000 mg/L by adding the quantity shown in the above table (according to chosen compound and concentration in grams or ml) into a 1000 ml class A volumetric flask.
Add demineralized water up to the flask mark.
If other concentrations are required, further dilute the stock solution in the desired ratio.

7.4 - Preparation of COD standard solution

In the case the analyzer is calibrated for a COD measurement, the KHP is the used organic compound.
For 1000 mg/l standard solution preparation, prepare a stock solution by adding 0.85 g of potassium hydrogen phthalate (KHP) into a 1000 ml class A volumetric flask.
Dilute to the final volume with demineralized water. If other concentrations are required, dilute accordingly.

7.5 - Preparation of the cleaning solution

The most suitable cleaning solution depends on the specific analyzer application due to chemical and physical characteristics of the analyzed sample and the chemical compatibility of analyzer materials.
Unless a suitable cleaning solution for the specific application is already known, it is recommended to use a 5% sulphuric acid solution.

Try to establish the best interval and duration of the cleaning cycle to optimize the cleaning in the points where the analyzer becomes more dirty.
If necessary, contact the 3S Analyzers service department to receive help on this matter.

Sulfuric acid (H_2SO_4, CAS # 7664-93-9)

H290 May be corrosive to metals.
H314 Causes severe skin burns and eye damage.

P234 Keep only in original packaging.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
P304 + P340 + P310 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/ doctor.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P363 Wash contaminated clothing before reuse.

Important warning: sulfuric acid reacts exothermically with water and can cause boiling and splashing. The addition should be done slowly and carefully and remember to always pour the acid in the water and never do the opposite.

Preparation of 10 L sulfuric acid cleaning solution:

A - Add 8 liters of distilled water in a 10 liters container that has been previously cleaned and flushed with distilled water.

B - Add slowly and very carefully 500 ml of concentrated sulfuric acid (H_2SO_4) in the tank (**Warning! Read note**)

C - Dilute to 10 liters volume with demineralized water to have a 5% solution.

D - Wait for the solution to be at room temperature before capping the tank.

Consumption: dependent on the analyzer cleaning frequency and duration

7.6 - Preparation of the reducing solution (option 3 reagents)

Preparation of 10 L reducing agent solution:

A - Add 8 liters of distilled water in a 10 liter container that has been previously cleaned and flushed with distilled water.

B - Add 500 g ascorbic acid (CAS 50-81-7) and dilute to 10 liter volume with distilled water.

C - Cap the container and dissolve the powder by agitating the container until the solution appears clear.

Consumption: 10 L/month for continuous operation

7.7 - Preparation of the TC reagent (option TC)

The 3S-TM in the TC configuration requires a single reagent only. The reagent is a mixture of sodium persulfate and phosphoric acid.
Please refer to the safety recommendations in the previous paragraphs before handling such substances.

Preparation of 10 L TC reagent solution:

A - Add 7 liters of distilled water in a 10 liters container that has been previously cleaned and flushed with distilled water.

B - Add very slowly and with extreme care 1175 ml of 85% phosphoric acid and dilute to 10 liter volume with distilled water to have a 10% solution.

C - Plug the container and shake with care to fully mix the acid with the water.

D - Add 2380 g sodium persulfate, dissolving the powder by shaking.

E - Plug the container and shake until all the persulfate is dissolved.

F - Wait for at least half an hour when the solution will appear clear.

Consumption: 10 L/month for continuous operation

8 - SHUTDOWN PROCEDURE

For a shutdown period longer than 2 - 3 days, proceed as follows:

A - Disconnect all solution and sample lines from their containers and reconnect them to a distilled water source, leaving the analyzer running.

B - Run the analyzer for at least 1 hour in these conditions.

C - After 1 hour, put the analyzer on Standby

D - Remove power from the analyzer by disconnecting the plug from the power line.

E - Dispose of remaining reagent solutions and standards according to local regulations.

Note: after following this procedure the analyzer can be safely handled. This is particularly important if the reducing reagent is present since it can pose health hazards.

Additionally, if the analyzer is to be moved or shipped to a new location then all liquid should be removed beforehand.

A - Proceed as above to rinse the analyzer with distilled water.

B - After 1 hour remove the tubing from the distilled water and run the analyzer for a further 30 min.

C - Put the analyzer in Standby. Switch off the power.

D - Remove the remaining liquid from the U-tube by taking off the cap on the right arm and sucking out the liquid with a suitable syringe and tubing.

E - Using a syringe remove the remaining liquid from the UV lamps. Reconnect the tubing to the 'T' afterwards.

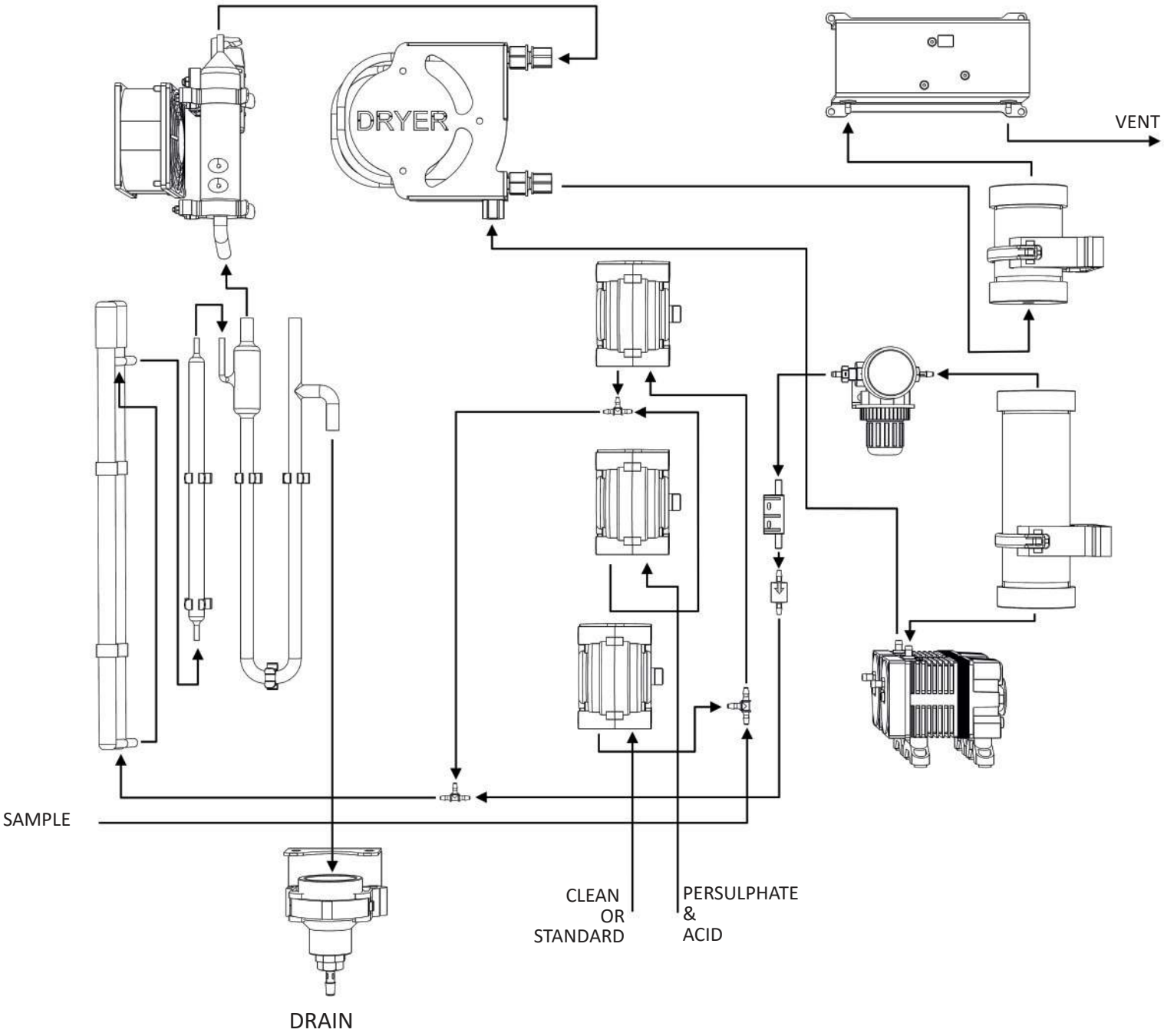
9 - TROUBLESHOOTING

ALARM	CAUSE	CHECKS TO DO	CORRECTIVE ACTION
LOSS OF SAMPLE	The level sensor in the external sample loop reservoir is down	Check sample presence in the fast-loop reservoir. Check the level switch	Restore the proper operation of the level switch
LOW CARRIER FLOW	Carrier flow below the preset threshold set	Check carrier gas flow value in cc/min	Check carrier gas line coming from air compressor until UV reactor outlet tubing looking for blockages and/or possible failures
CALIBRATION ERROR	Last span calibration (manual or autocal) out of the range	Repeat calibration	Check for pump delivery of standard solution and persulfate; prepare a fresh standard solution and make a double check on its correct value; verify that the infrared detector is properly working
ZERO GAS TOO HIGH	Last zero gas calibration failed	Repeat zerogas calibration and check the ppm CO_2 value	Replace sodalime in sodalime filter, check the gas line is free from obstructions from condenser to NDIR. Verify that the IR detector is properly working
REAGENT LOW	Reagents levels are too low (below 3%)	Check reagent tanks level check reagent counter	Add fresh reagents and press the Reag filled up command

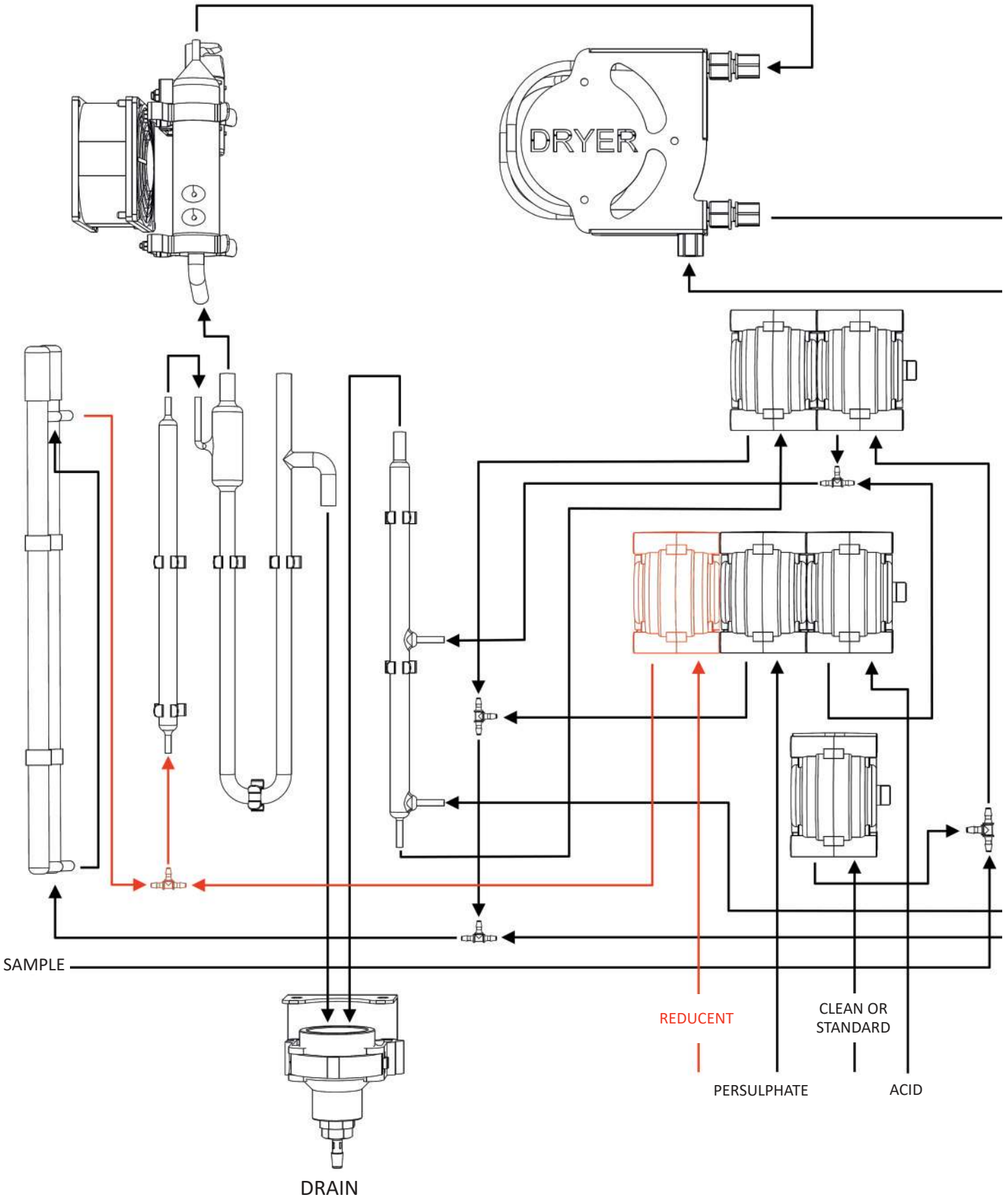
10 - TECHNICAL DATA

Analyte	Total Organic Carbon (TOC), Total Carbon (TC)
Method	For TOC measurements, inorganic carbon is removed by acidification and sparging; this is followed by UV-promoted persulfate oxidation. This process oxidizes the total organic carbon into carbon dioxide which is measured in a nondispersive infrared (NDIR) analyzer. For TC measurements, the sparging step is omitted.
Range	From 0 - 5 mg/L to 20,000 mg/L
Meaasurement type	Continuous
Lower limit of detection	0.2 mg/L (for range 0 - 5 mg/L with nitrogen as carrier gas)
Accuracy	± 2% of full scale nondiluted, ± 4% of full scale diluted ranges
Response time	From 6 minutes, depending on range
Ambient temperature	5 – 40°C / 41 – 104°F
Sample temperature	2 – 70°C / 36 – 158°F
Sample pressure	Pressureless from overflow vessel (Fast Loop Reservoir)
User interface	Color touchscreen
Datalogger	Integrated, data download via USB flash drive (USB stick)
Size	760 × 600 × 210 mm / 29.9 x 23.6 x 8.3 in
Weight	37 kg / 81.57 lbs (approx. depending on range)
Power supply	115 or 230 VAC 50/60 Hz, 350 VA (115 VAC), 250 VA (230 VAC)
Carrier gas	Air purifier integrated, supplied by an internal compressor. N_2 or CO_2 free air supply can be used as an option
Reagents	Phosphoric acid and sodium persulfate (approximately 10 L/month for continuous operation)
Analog outputs	2 × 4–20 mA outputs for measured data
Alarms	2 SPDT contacts. Relay A is programmable – online, offline, loss of sample, result alarm, validation alarm, reagent alarm, calibration alarm. Relay B is for the instrument fault alarm.
Extra relay	Programmable for external operations
Digital input	Remote start/stop
Autofunction	Cleaning, validation and calibration, can be selected using the dedicated peristaltic pump
Dual channel	Dual channel integrated
Dual range	Switches sample to an external dilutor for a higher range once a set-point is passed
Factor	Result multiplication factor, e.g., for converting TOC to equivalent COD value
Protection grade	IP54 - NEMA 3
Conformity	EN 610004-2, EN 610004-4, C 46-022, EN 55022, EN 61326 (electromagnetic compatibility)

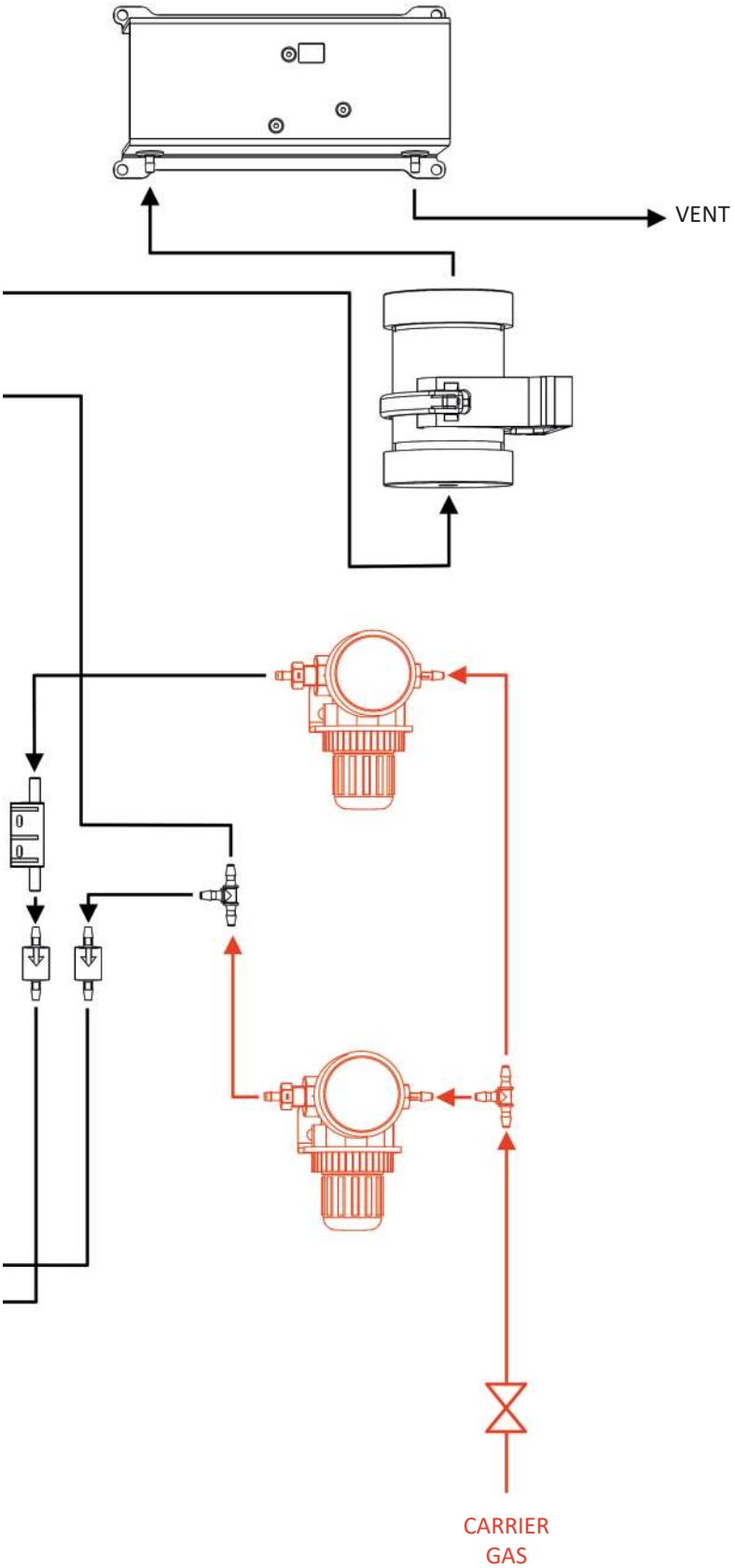
11 - TC CONFIGURATION FLOW DIAGRAM



12 - THREE-REAGENT CONFIGURATION FLOW DIAGRAM (left enclosure)

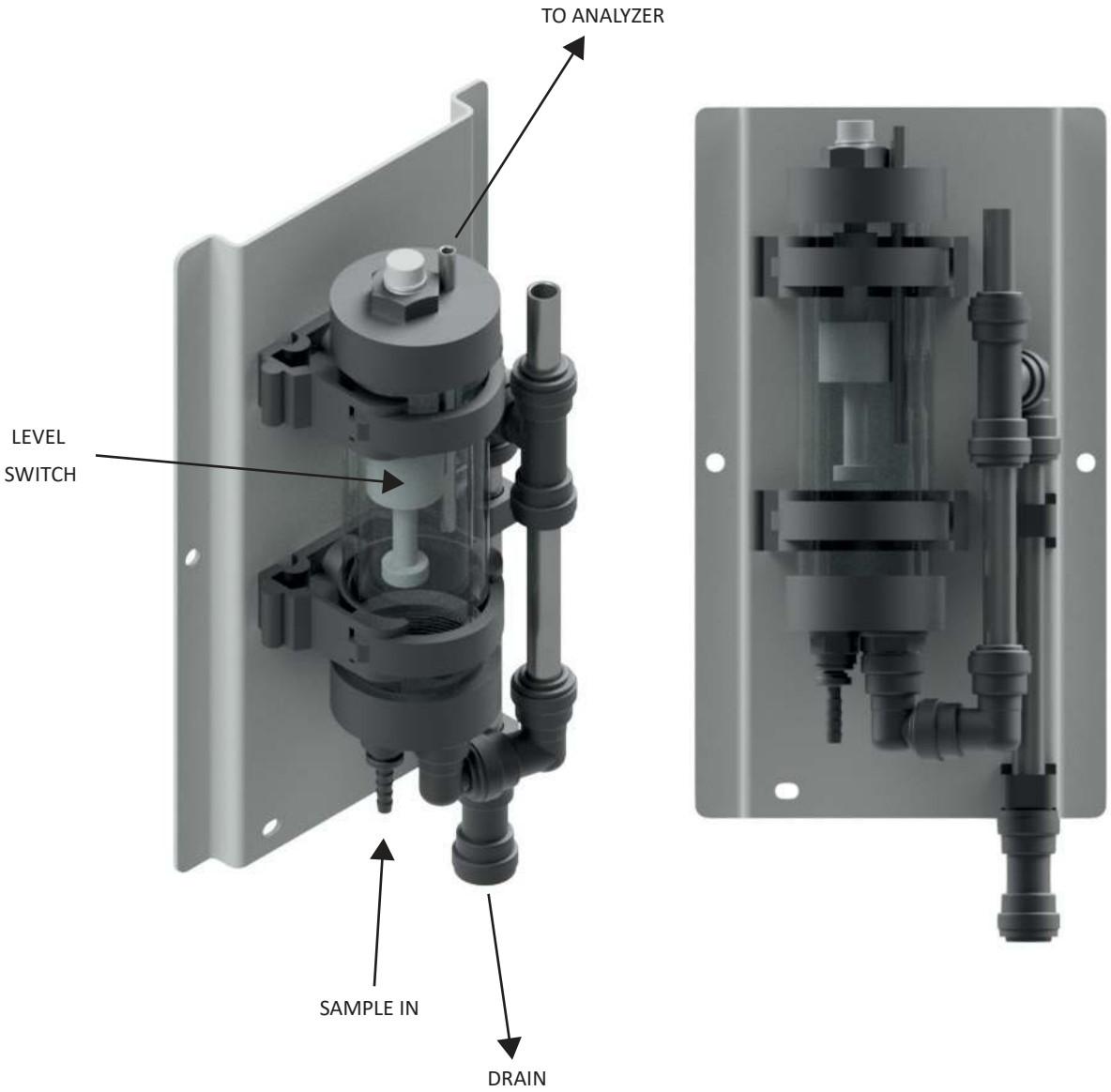


13 - EXTERNAL CARRIER GAS FLOW DIAGRAM (right enclosure)



14 - FAST LOOP RESERVOIR

The external reservoir allows a fast circulation of the sample coming from the sampling point or from the optional filtration unit. Inside the fast loop reservoir the sample is at atmospheric pressure and this allows the sample pump to function with a constant delivery and no over pressure. In addition, the fast loop reservoir is a useful extra quantity of sample to avoid wrong alarms in case of a short loss of sample as well as eliminating air bubbles coming from the sample line or from the cleaning cycle of the optional filtration unit. The stainless steel drain tubing keeps a constant water level inside the container and allows a proper sample circulation to avoid suspended solids accumulation.



The sample flow should be adjusted to have a constant sample overflow through the stainless steel tube. Up to 3 level switches can be connected to the analyzer, e.g. Stream A, Stream B and dilution water. Two of the switches are normally connected to the terminals that are found at the left hand side of the analyzer. For a dual stream analyzer where dilution water is also required for one or both streams, the third level switch is connected to the user connection inside the analyzer (see page 37). For a single stream analyzer, in the event of a missing sample or dilution water stream for a period longer than a preset time (normally set on installation to 30 s), an alarm LOSS OF SAMPLE is triggered and the analyzer switches to Standby. When the missing sample or dilution water stream is reestablished, the analyzer restarts automatically with a conditioning cycle. In the case of a dual stream configuration, if no Stream A is present then the analyzer will continue to work only on Stream B until Stream A is reestablished, and vice versa. If both streams are not present then again the alarm LOSS OF SAMPLE is triggered and the analyzer switches to Standby. If either or both streams are being diluted and the dilution water stream is missing, then jumpers found alongside the internal Level 3 terminal can be used to make the analyzer work only on the undiluted stream or switch to Standby if both streams are diluted, again giving the alarm LOSS OF SAMPLE.