

# SUBMATIX

mini Quantum SG

User Manual



## Safety notes

The most important words are:

Danger! Refers to an immediate danger, which can lead to serious injuries as well as to death.



Warning! Refers to a potential danger, which can lead to serious injuries as well as to death.

Attention! Refers to a potential danger, which can lead to small injuries. This term is also used as warning to uncertain use.



The above-mentioned words have to be followed carefully to have fun while diving with the Submatix Quantum rebreather.

### Warning!

The Submatix Quantum rebreather has to be maintained according to the regulations mentioned in this manual. In case of repairs only original Submatix parts must be used. The use of other parts can cause a malfunction of the Quantum rebreather and it can lead to serious injuries or death!

The servicing of the Submatix Quantum rebreather must be carried out regularly and only by authorised Submatix repair facility. The owner and the service department must keep a record of all maintenance work and repairs. The chapters about servicing intervals and works, concluded in this manual, have to be observed carefully.

Only SUBMATIX trained repair technicians are permitted to carry out service and repair on Quantum SG. Use only authentic SUBMATIX parts in the maintenance and repair of the SUBMATIX

### **Liability for function and/or damages**

In any case the owner and/or user will be liable for the function of the unit when the unit is and/or was serviced or overhauled improperly by persons, who do not belong to the Submatix service team or who are not trained in special for the service of the unit.

As far as references to laws, regulations and standards are given the legal system of the German Federal Republic has to take as a basis. Submatix will not be liable for damages which were a result of a non-intended use and also by the use of components not approved by Submatix.

Terms of responsibility and warranty terms of the terms of delivery and sale will not be extended by the above-mentioned notes!

The Submatix Quantum rebreather is a mix gas rebreather for recreational dives and it was not designed for work effort.

This manual serves as guidance for technical understanding of the function of the Quantum rebreather and it does not substitute a detailed training.

The unit must only be used after successful passing of the corresponding training at a training organization, admitted by Submatix.

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## 1.1. Description of the system

The Quantum rebreather is the result of a 10 years experience in the development and production of rebreathers. The Quantum rebreather contains a variety of the developments and innovations. The unit represents the philosophy of Submatix: simplicity/security/dive comfort/kindness for travelling. In the centre of attention is the diver, who uses the unit and not the unit which dives the diver.

The Quantum SG rebreather was developed for sport dives. It must not be used for underwater work!

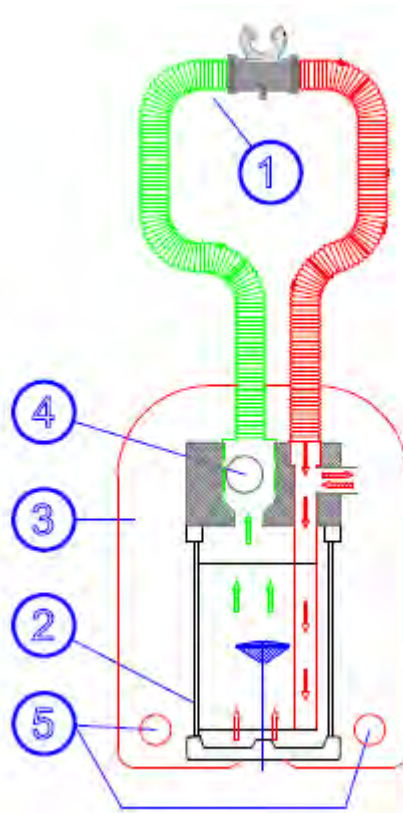
### Limits of use:

Maximum depth	40 meters with Diluent Air 100 meters with diluent tri mix (TMX) 8/80
Temperatures	storage: -30°C to +70°C Water: +4°C to +34°C

## 1.2. Main features

- Super compact and small dimensions (55 cm x 42 cm x 24 cm)
- Weight without cylinders is approx. 25 kg
- Weight with 2 x 2 litres steel cylinders is approx. 32 kg
- Either 2 or 3 litre cylinders can be used.
- Easy handling, quick assembly and fast to use
- ■ A single exhale Counter Lung (CL) lays directly along and at the back of the diver for optimal breathing. This minimises the hydrostatic difference and give good trim. The chest area is left clear and free. CL is constructed of an inner bladder and protective outer cover.
- Transparent scrubber tank (2.5 kg) easy to visually check scrubber material
- Low resistive WOB with short pathway and no T-pieces
- Condensation trap is included in the exhale CL
- All electronic parts are installed in the multi head and seal against humidity
- All cables are sealed, pressure tested and waterproof
- Unit is EMI resistant
- Double redundant power management with 2 x 3.6 V 2100mAh batteries in multi head and 1 x AA Lithium ions batteries in SPX42 (3.6 Volt)
- Head Up Display (HUD)
  - Red LED gives low or high ppO<sub>2</sub> warning for SPX 42
  - Green LED for system OK
  - Blue LED gives low or high ppO<sub>2</sub> warning for Oxyscan (ppo<sub>2</sub> monitor)
- Solenoid requires only low power
- Only 2 connection in the breathing loop
- Input and output of breathing loop
- Patented one-hand usable mouthpiece
- Patented connector system (X-con)

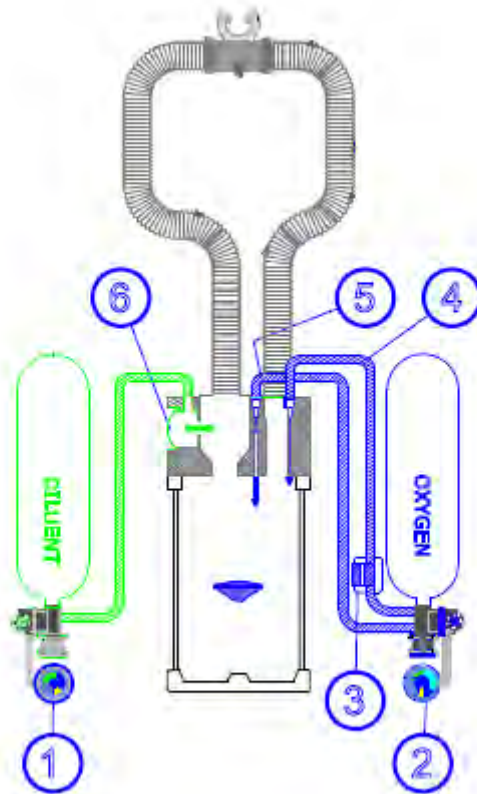
### 1.3. Loop



- 1 breathing hose
- 2 scrubber tank
- 3 exhale counter lung (CL)
- 4 overpressure valve (OPV)
- 5 drain valves in exhale CL

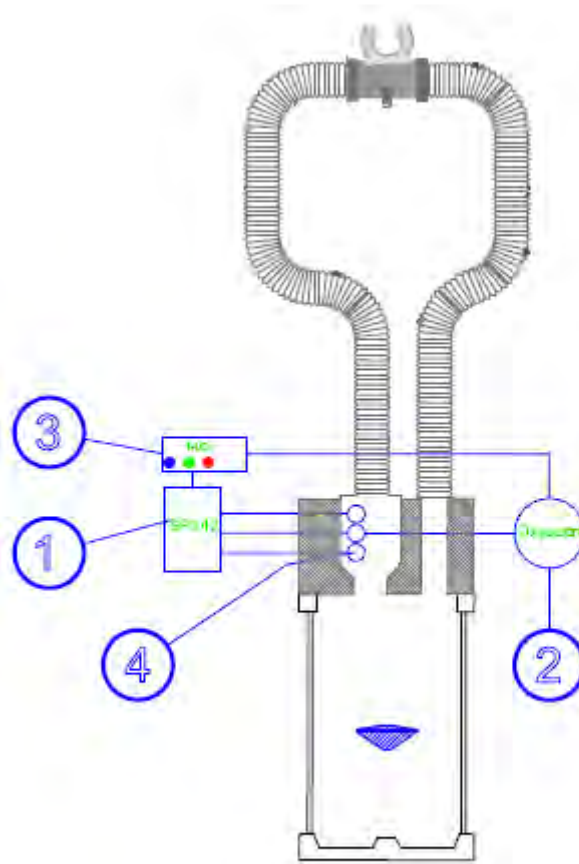


## 1.4. Gas supply



- 1 Diluent cylinder with first stage regulator (1st stage) and submersible pressure gauge (SPG)
- 2 Oxygen cylinder with 1<sup>st</sup> stage and SPG
- 3 Oxygen booster (manual add and needle valve)
- 4 Oxygen supply from the booster
- 5 Oxygen supply to the solenoid
- 6 Diluent supply from Automatic Diluent Valve (ADV)

## 1.5. ppO2 monitoring dive computer and solenoid



- 1 SPX 42 dive computer and set point controller
- 2 Oxyscan ppO2 monitor (redundant system)
- 3 Head Up Display (HUD)
- 4 3 x oxygen sensors for SPX42
- 5 1 x oxygen sensor for Oxyscan

## 2. Component parts

### 2.1. Multi head

The central component of the Quantum rebreather is the multi head with the assembled scrubber tank. All components like oxygen sensors, ADV, OPV, solenoid, electronic parts, and batteries are installed in the multi head. All components are installed in a waterproofed and sealed enclosure.

All cables are terminated with waterproof glands and potted to seal against water ingress. The multi head is directly screwed to the frame. Diluent and oxygen cylinders are fixed directly to frame (2 or 3 litres steel cylinders). The back plate is fitted with harness and buoyancy control device (BCD) wing and directly fixed at the frame. Exhale CL is fitted between back plate and BCD. In this position the hydrostatic difference between CL and diver's lungs is minimised. This optimises the Work of Breathing (WOB) in all diving positions. As CL runs along the whole frame, trim is better maintained. The multi head and the scrubber tank are further protected by a sturdy ABS cover.



## 2.2. Frame

The frame is made of 5 mm marine grade and anodised. All components are fitted directly to the frame.



### 2.3. Backplate

The backplate is made of 5 mm marine grade aluminium and permanently connected to the frame. The backplate has 2 pockets for standard 3 kg trim weights or optional two 4 kg weights. The backplate offers the possibility for other cylinders, like bail out gas to be mounted. Note cylinder bag depicted on right side of picture 2.4 (max. 2 litres).



## 2.4. Harness

The harness is adjustable to almost all body sizes and it offers optimal mobility and a clean front.



## 2.5. BCD Wing

Only CE certified and Submatix approved BCD wings must be used.

## 2.6. Multi head

The multi head is the central component part. In the multi head the following parts:

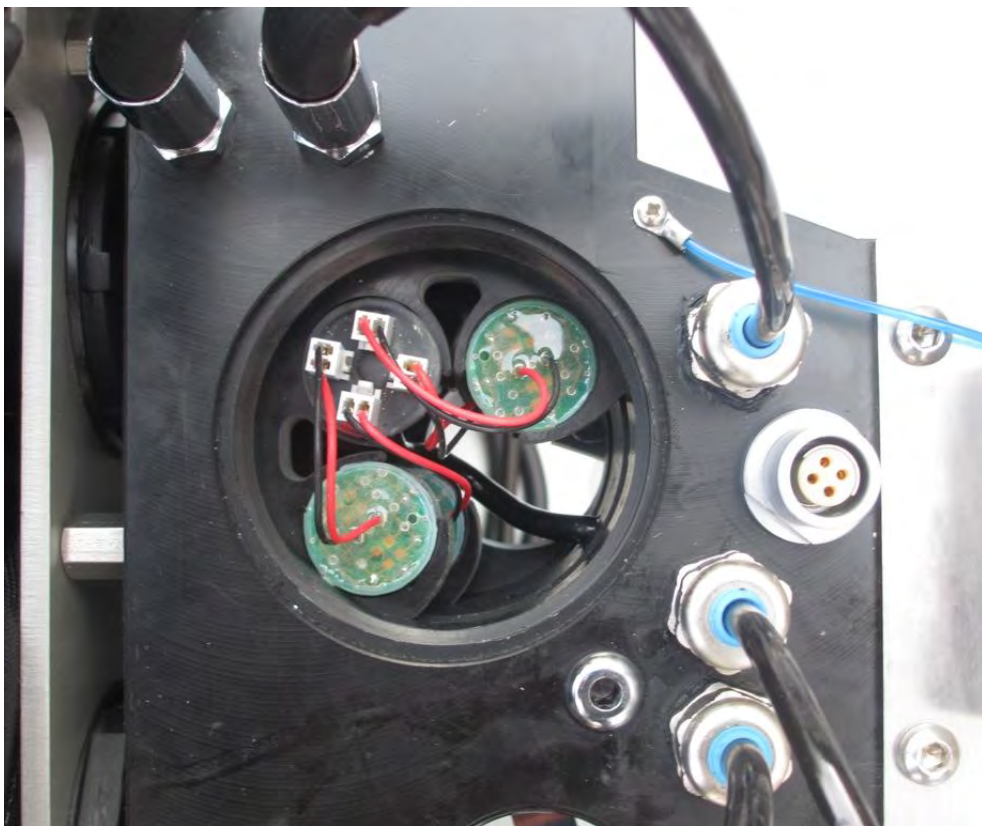
- ADV
- OPV
- Solenoid
- Sensor chamber for 4 Oxygen sensors (for SPX42 and Oxyscan)
- Battery pack (2 x 2100 mAh batteries)
- Solenoid
- Input for O2 to Solenoid from O2 1<sup>st</sup> stage
- Input for ADV and Diluent from diluent 1<sup>st</sup> stage
- Input for O2 and Diluent manual add from O2 and Diluent-Booster
- Cables to HUD,SPX42 dive computer, Oxyscan and charging plug



### 2.6.1. Sensor chamber

In the sensor chamber 3 oxygen sensors for the SPX42 and 1 sensor for Oxyscan 100 are installed. The sensor connectors are 2 pins Molex female. The plugs are moulded and potted therefore sealed against humidity and water.

The sensor chamber is mounted on the inhale side. The top serves to seal sensor chamber and incorporate male inhale connection for the loop. The connection is made with the patented X-con.





## 2.6.2. Electronic box

The electronic box houses the solenoid, batteries, control board and has O<sub>2</sub> supplied to solenoid. It is sealed unit.

The electronic box should only be opened by Submatix authorised personnel!

**Warning** this is NOT a user service item and may void warranty if opened



### 2.6.3. ADV

(Automatic demand valve)

The ADV is supplied by the Diluent 1st stage. When going deeper Diluent is automatically added to the loop through the ADV.



### 2.6.4. Overpressure valve

The overpressure valve is mounted on the back of the multi head. In this position it is located relatively in the centre of the moving breathing volume and therefore it guarantees a constant responding characteristic in all diving positions. This is factory set to 40 mbar.

### 2.6.5. Solenoid

The Solenoid is installed in the multi head and it supplies the Oxygen when required into the loop. To avoid O<sub>2</sub> peaks the flow is limited to 6 l/min.

### 2.6.6. Battery pack of the multi head

In the multi head the power supply for the multi head is installed. It consists of 2 separate 3.7 volt 2,100 mAh lithium batteries. The voltage of the batteries can be read on the SPX display.

### 2.6.7. Manual supply of Diluent

If there is a higher ppO<sub>2</sub>, Diluent can be supplied manually by manual ADV or by inhaling and exhaling through nose.

### 2.6.8. Supply by the O<sub>2</sub> booster

If needed the O<sub>2</sub> booster (blue colour), can manually add O<sub>2</sub> into the loop. The O<sub>2</sub> booster is mounted on the right side (same as cyclinderO<sub>2</sub> cylinder).



### 2.6.9. Connectors of breathing hose

The connectors of the breathing hose are mounted on the multi head (no T-pieces are used which increases hydrostatic resistance and WOD). Submatix use X-con connectors. The connectors only been pushed on and a snap will be hear when correctly connected. X-con connectors are of two different sizes and colour coded to prevent incorrect assembly. These are marked in different colours, red for used gas (exhale) and green for fresh gas (inhale). To remove the connector rings you have to turn them slightly to disengaging the ring and at the same time pull the connectors away.

The exhale side of the multi head has a condensation trap is installed. The trap collects humidity and allowing it to pool in to the bottom of the exhale lung.

Always lightly grease "O" rings before use to allow easy removal and good seal.



#### 2.6.10. Counter Exhale Counter Lung (CL)

By the use of a plug-in connector the exhale CL is fixed to the multi head.

#### 2.7. Exhale Counter Lung

The exhale CL is installed between the backplate and the frame. It is designed double-shelled. The internal bag can be replaced.

The exhale CL is positioned directly along the back of the diver, affording optimal breathing and trim. Condensated water is trap CL and can be drained off removed by two bungs at the bottom of the CL.

#### 2.8. Breathing hose

The breathing hose goes directly over the shoulders of the diver. No T-pieces are used for better WOB.

The fresh inhale gas (green colour) comes over the right shoulder and the used exhale gas (red colour) comes over the left shoulder.

The X-cons cannot be mixed up as there have different size connectors, and different colour coded rings and impossible to interchange.

The Submatix mouthpiece can be operated by only one hand.

The mouthpiece has the two direction valves. The mouthpiece is rotatable and therefore can be rotated to optimise position for diver.



Closed mouthpiece (the lever points down)



Open mouthpiece (the lever shows to the front and forwards)

Attention!



Never uses the breathing hose to carry the unit. Only the fitted handle should be used.

## 2.9. Scrubber tank

The scrubber tank of the Quantum is designed axially. It is made of a transparent Plexiglas pipe. The internal pipe carries the warm exhaled gas to the bottom of the scrubber tank. From the bottom the loop gas flows along through the scrubber tank. CO<sub>2</sub> is removed and then the clean loop gas is supplied to the multi head.

The use of Plexiglas enables a visual inspection of the scrubber material (colour indicated use scrubber and humidity can be checked).

It is essential scrubber tank in be installed correctly into the multi head. It is installed with sticker uppermost as show below. Green on right and red on left (same as breathing loop)

The scrubber tank can be filled with 2.5 kg of scrubber material. Only Intersurgical Spherasorb should be used!





## 2.10. First stage Regulators (pressure reducers) and submersible pressure gauges (SPG)

To avoid the incorrect installation of the cylinders, the Submatix first stages regulators (pressure reducers) have different mounting threads:

Oxygen: EU Nitrox M26

Diluent: DIN

Oxygen first stage is clean in accordance to BAM standards to allow pure Oxygen. At each first stage regulator a SPG connected. The positions of the 1<sup>st</sup>. stages regulators are:

Right side: EU Nitrox M26

Left side: DIN

Line pressure from first stages is set at 10 bar.





Attention!



Manipulation of the low-pressure (output of 1<sup>st</sup> stages) will lead to defects, damages or malfunctions.

## 2.11. Gas cylinders

2 x 2 litres steel cylinders (valve: Nautech) are used: Oxygen EU Nitrox M26 (certificated Oxygen clean in accordance to BAM standards) and Diluent 230 bar.

By the use of different valve threads cylinders can't be incorrectly fitted to first stages.



### 3. ppO2 monitoring

Attention!



For safety it is necessary to use two redundant ppO2 monitoring systems, which are both properly functioning.

Warnings are set, below ppO2 0.4 and above ppO2 1.6. A warning will be displayed on the Oxyscan, the SPX and the HUD. Slow flash indicates below ppO2 0.4. Fast flash indicates above ppO2 1.6.





### 3.1. SPX42

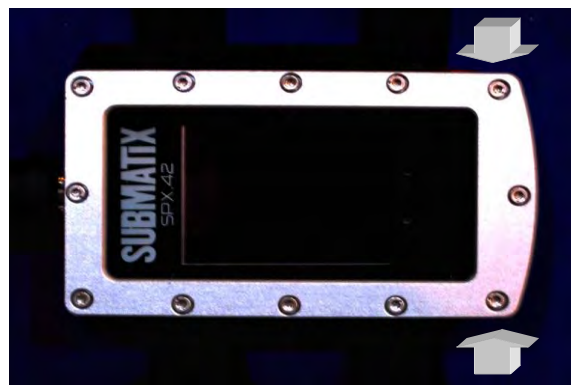
The SPX42 is a dive computer and set point controller.

### 3.2. Operation of the SPX42

The SPX42 is served by two Piezo buttons, which are installed on the left side above and below. Therefore, they can be operated by using one hand while not obscures display.

The fundamental principle of the operation of the buttons is like the following:

#### 1. Simultaneously pressing of both buttons



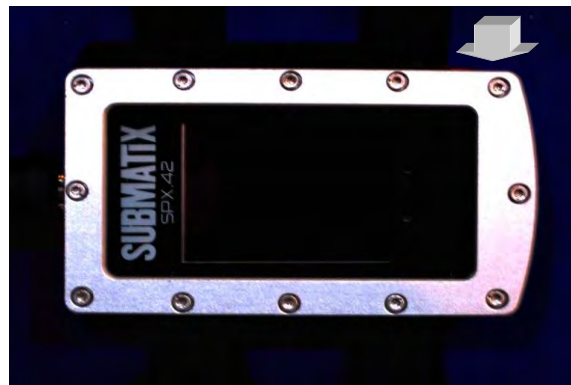
- Activation of a menu
- Confirmation of an action
- Switching on of the SPX42
- In case of non-confirmation termination of action

In setup

- Lower button: selection downwards



- Upper button: selection upwards



- Both buttons at the same time: selection of menu point



### Switching on

By pressing both buttons at the same time the SPX42 will be activated. After the switching on for a short time the Submatix logo and the serial number are displayed.



After some seconds the start screen will be masked out.

### Calibration



The calibration is carried out with ambient air!!!

Attention: The sensors have to be in ambient air. This is done by removing exhale connector and breathing the loop until only ambient air is in the loop. This can be seen when sensor mV readings are stable. Reconnect breathing hose after successful air calibration.



While carrying out calibration with Air the Oxygen tank must be closed!!!

The calibration is carried out automatically with ambient air pressure. The sensor potential has to be between 8 and 15 mV to calibrate in air. Exhausted or defective sensors need to be changed out.

The SPX42 is used with 3 sensors. After the activation the sensor potential is indicated.



When the connected sensors are ok, press both buttons at same time to do air calibration.



If a defective sensor is found, change out for new sensor and repeat calibration.



On the screen will display “3 sensors ok”.



After the simultaneously pressing of both buttons the demand “calibration” will be indicated!



After pressing both buttons simultaneously the actual air pressure is shown.



After pressing both buttons at the same time the term “calibrate Air” is seen.



After simultaneously pressing of both buttons the calibration with Air will be started.





When the calibration with Air was successfully “test with O2” is indicated.



Now open Oxygen cylinder.

After pressing both buttons at the same time the O2 test will start. Now the solenoid will be open and Oxygen will flow into the loop until a ppO2 of 0.9 will be reached.

The mouthpiece should be open to vent ambient air. After successful passing of the O2 test the mouthpiece is closed.

The ppO2 of at least 0.9 has to be reached within 120 seconds.



This test guarantees that the sensors are functioning correctly.

When the test was ok the word “ready” is indicated and the SPX42 switches to the surface screen (blue). If the O2 test will not be carried out within 120 seconds the term “time out” will be displayed. In this case the calibration has to be repeated. Therefore the loop has to be filled with ambient air again. The following steps are to be taken:

1. Removal of exhale side of the breathing hose
2. Breath in and out the open mouth piece
3. Re- read the ppO2 at the calibrated Oxyscan

4. If 0.21 or less are reached and when the value does not decrease further, the loop is rinsed and the calibration can be repeated now.



In the surface screen the breathing loop is filled with O<sub>2</sub> until the partial pressure of 0.4 is reached. This procedure will guarantee that in case of a non-activation of the dive mode an adequate supply with Oxygen is ensured.

Example: Diving in shallow water (maximum 0.5 meters) will not switch on SPX42. Diver needs to manually switch to the dive mode.



The values of the calibration will be filed for 12 hours. If the SPX42 will be switched off in the meantime a new calibration is not completely needed but only provided that the sensors are working.

If the SPX42 is power cycled within 12 hours the request for calibration is indicated with “?”. This means that the sensors are still ok and that the calibration can be skipped (pressing the lower button).

## Surface screen



Upper line:

Left side

Temperature

Height

Time to flight

Gas mix

date and time

right side

CNS

maximum depth

OTU

BAT of SPX

BAT of valve

set point

S 1

S 2

S 3

## Setup

By pushing the upper button you will come to the setup menu. There all settings can be carried out.





By pressing the lower button you will come to the log book.

Setup	1. Gas list	Gas 1 - 8		
		back		
	2. Decompression	Conservatism	very conservative 35/70	
			standard 30/85	
			moderate 25/85	
			aggressive 15/90	
			very aggressive 10/100	
			custom 0 .... 100/0 .... 100	
			deep stops	on/off
			dynamic Gradient	on/off in Bail Out
		last stop	3 m/6 m	
		back		
Set point	auto set point		5m/10m/15m/20m/off	
	high set point		1.0/1.1/1.2/1.3/1.4	
	back			
Individual mode	1. sensor mode		sensor on/off	
	3. sensor warning		1 / 2 / 3	
	4. acoustic warnings		on/off	
	5. back			
5 Settings	1. display settings		1.	
			2. brightness 10 % / 50 % / 100 %	
			3. true up/turn by 180°	
			4. back	
	2. date/time		1. time	
			2. date	
			3. back	
	3. units		1. temperature/Celsius/Fahrenheit	
			2. depth/meter/feet	
			3. salinity/salt water/fresh water	
			4. back	
	4. languages		1. German/English/French	
			2. back	

		1 normox TX 2.Full TX 3.Custom
	5. licences	
	6. factory settings	
	7. software update	
	8. back	
6. Synchronisation	via Bluetooth	
7. Switch off		
8. Back		

1. Gas list
2. Decompression
3. Set point
4. Individual mode
5. Settings
6. Synchronisation
7. Switch off
8. Back

### Gas list



Up to 8 gases can be programmed in. In the Nitrox version 8 Nitrox mixtures are available. In the Normox trimix version 8 Normox trimix mixtures and in the full trimix version 8 full trimix mixtures will be available.

To use trimix mixtures the corresponding key is required. At the moment this key is not available for the Quantum SG version (40 meters permission with Diluent Air).

The programmed gases can be used as DIL 1, DIL 2 and bailout. By marking the corresponding mixture with an "X" it can be used while the dive.



Mixtures which are not marked with an "X" cannot be used while the dive.

To program the composition of the gas you have to follow the following steps:

Choose the gas. By pressing both buttons at the same time the gas can be activated for the programming.

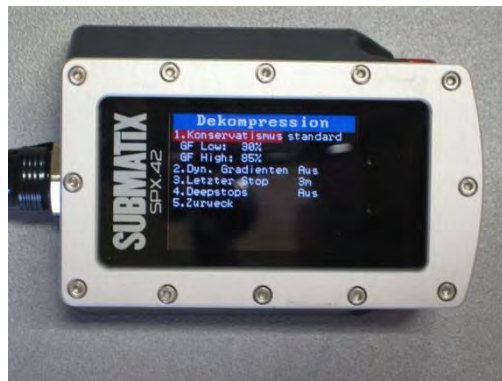


When you have chosen the required gas, scroll to the corresponding gas and change the gas quantity in 1% steps upwards or downwards. By pressing both buttons simultaneously the red coloured gas is high lighted and can be programmed.

Always the MOD and the EAD of the corresponding gas will be indicated. After setting the adjusted gas will be filed by pushing both buttons at the same time. By reselection of the button “back” and pressing both buttons you will come back to the gas list menu.



### *Decompression*



The SPX42 uses Bühlmann 16HLZ model with gradients.



To dive safely with the SPX42 it is essential the diver understand the function of the gradients. This manual does NOT explain the functions of the gradients!!! The comprehension of the gradient theory will be facilitated in the approved training course.

Conservatism: The preselected Gradient Factors (GFs) can be activated through decompression window. Submatix will not be liable for any damages if the diver uses aggressive, very aggressive or custom GF.

GF	GF low	GF high
very conservative	35	70
Standard setting	30	85
moderate	25	85
aggressive	15	90
very aggressive	10	100
custom	xxx	xxx

Dynamic gradients: In the mode dynamic gradients the system switches automatically to the Bühlmann limit in case of hard decompression attempt. That means that the diver has to be brought to the surface within a short period of time.



Submatix will not be liable for damages which are caused by the use of dynamic gradients.

Last stop: For the depth of the last stop you can choose between 3 and 6 meters.

Deep stops: If deep stops are activated (useful for deep dives) the system requires stops in the depth. Thereby the complete rate of the way up can be shortening.





*Set point*



To activate the solenoid several set points can be adjusted. After the calibration the system will be flooded with O<sub>2</sub> to a ppO<sub>2</sub> of 0.4 in the surface mode. In the dive mode the depths and set points can be changed manually.

When the dive is completed the auto set point and ppO<sub>2</sub> level, will be kept

#### Auto set point

Allows the diver to select at what depth the low set point (ppO<sub>2</sub> 0.7), changes to highest set point. Above this depth low set point is use and below this high set point issued..





Adjustable depths:

The depths of 5 meters, 10 meters, 15 meters, 20 meters or deactivated can be set. This will determine at what depth the system will switch from low set point to high set point.

Adjustable set points: In surface mode either the following can be selected 1.0, 1.1, 1.2, 1.3 or 1.4 in surface mode

In dive mode, additionally switch to 1.5/1.6 (O2 deco).

*Individual mode*



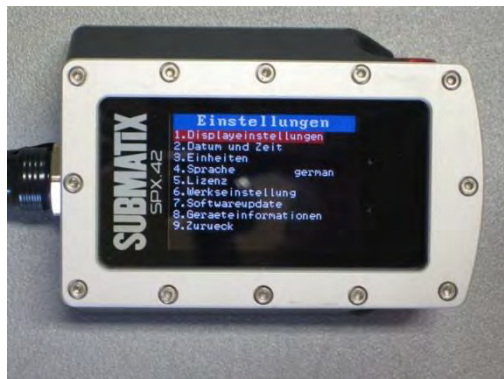


In the individual mode the SPX offers the possibility to adapt the system to other units. Therefore the SPX42 has to be unlocked with a custom code.



By using the Quantum rebreather the factory settings have to be used.

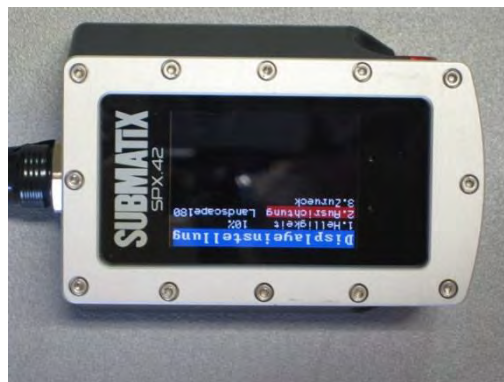
### Settings



## 1. Settings of display

Brightness in 10%/50%/100%

Direction (turn by 180°)



Go back by pressing both buttons at the same time.

## 2. Date/time



Go back by pushing both buttons simultaneously.

### 3. Units



1. Temperature: Celsius/Fahrenheit
2. Depth: meter/feet
3. Salinity: salt water/fresh water
4. Back

### 4. Language: German/English/French



## 5. Licences



To unlock normox TX/full TX/custom key



By the use of trimix mixtures the diver has to be qualified for. After entering the corresponding keys extensions can be activated.

## 6. Factory settings



To reset to factory settings

Attention! By reset to factory settings you will lose the custom key and the TX activation.

## 7. Software update

By pushing both buttons the software update can be carried out.  
Attention, only Submatix approved personnel should do this!

## 8. Unit information



It will be indicated:

Model

Version

Serial number

Memory

Last call

Back

By simultaneously pressing of both buttons you will come back to the setup mode.



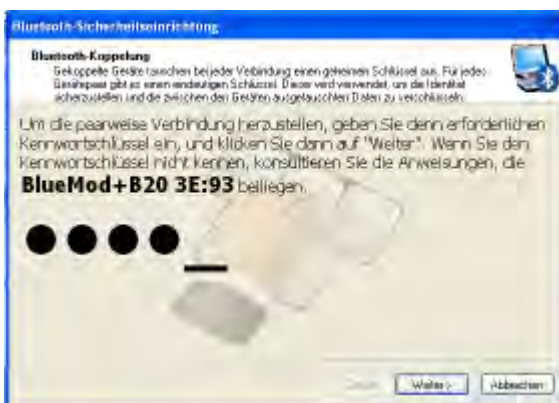
## Synchronisation

To activate the Bluetooth interface.

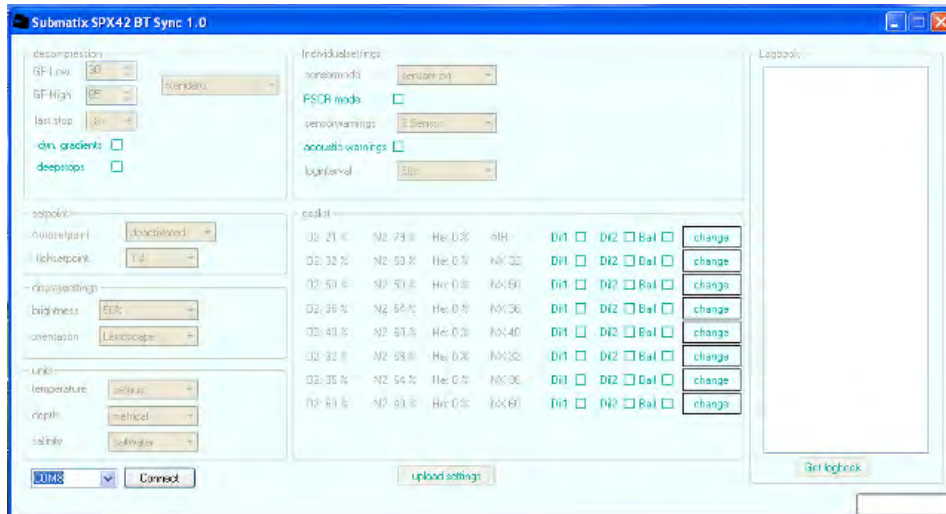
After pressing both buttons at the same time the term „sync“ and a four-digit pin will be indicated. Use this pin to synchronisation at the PC.



On the PC all Bluetooth units in range of the SPX42 are searched. When the PC has identified the SPX you have to insert the pin which was indicated on the SPX display.

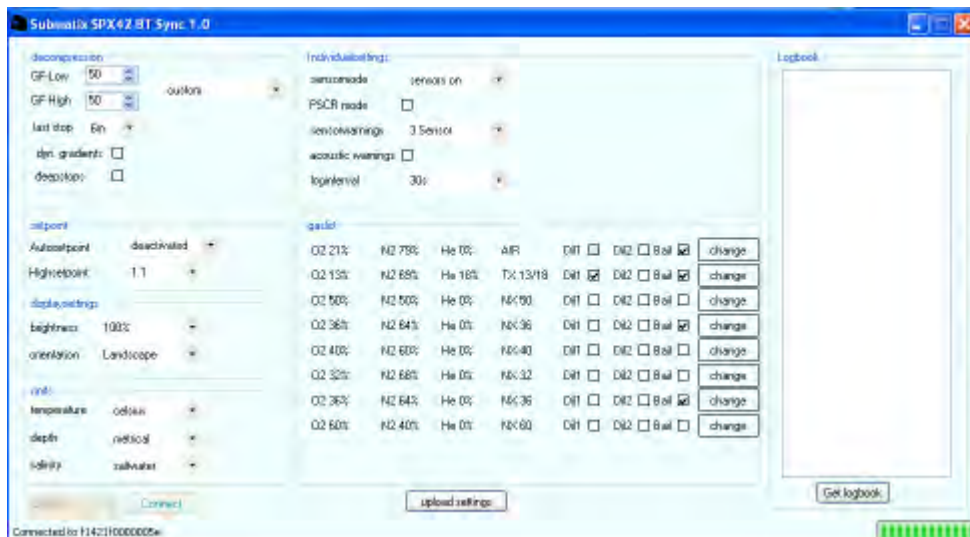


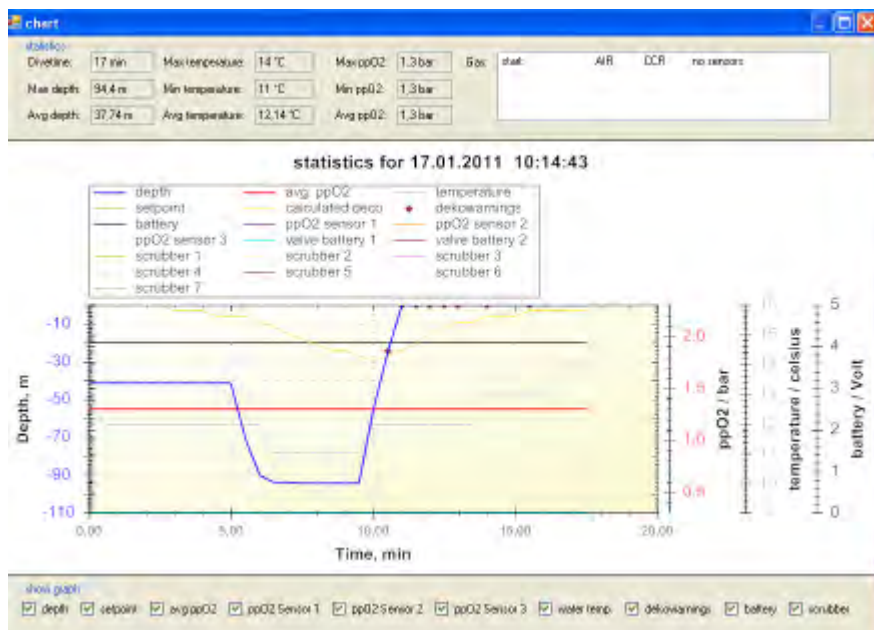
After the insert the PC will make a connection to the SPX42.



Therefore the program Submatix Bluetooth sync has to be started. After choosing the correct COM port and pushing the button “connect” the connection will be made.

When the connection is ready for use all settings of the setup menu can be carried out directly at the PC. Furthermore, you can load all log book information.





## Log book

Depth

Set point

ppO2 1/ppO2 2/ppO2 3

Temperature

Decompression warnings

Time/dive profile

Warnings

Battery

Gases

## Switching off

By simultaneously pressing of both buttons the SPX42 will be switched off.

## Back

By simultaneously pushing of both buttons you will come back to the surface mode.

The dive mode will be activated automatically in a depth of 5 meters. By pushing both buttons at the same time the SPX42 can change to the dive mode.

Screen dive mode



Depth  
NDT

Deco stops  
S 1      S 2      S3  
          BAT SPX 42  
          Bat valve

Gas MIX

time  
ppO2

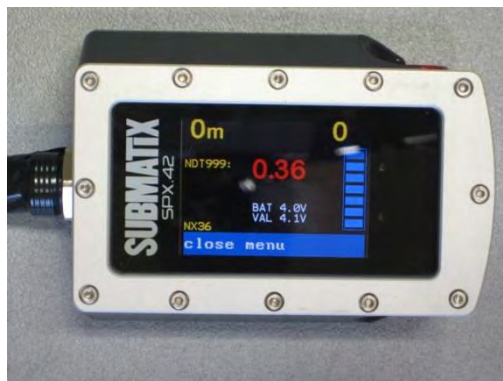
In the dive mode the following adjustments can be carried out: By pressing the lower button you can choose the following settings:

## Switch to bailout



Switch to OC: The SPX recommends the optimal gas from the gas list for the actual depth. But you have also the possibility to use every activated gas from the list. Therefore, you have to push the lower button to scroll through the gas list.

## Close menu



To close the menu you have to push both buttons at the same time.

## Change Diluent



Change of gas to another Diluent: By pressing the lower button you can scroll through all activated gases of the DIL 2 list. By pushing both buttons simultaneously the chosen gas will be activated.

## Change of set point





By pushing both buttons you can select between the following set points:

0.7, 1.0, 1.1, 1.2, 1.3 or 1.4

By pressing both buttons at the same time the chosen set point will be activated.

After entering the water the SPX42 switches back automatically into the surface mode after 2 minutes.

#### *Warnings on the display of the SPX42*

The following warnings can be indicated:

VAL DISC (in red)



The SPX42 is not communication to solenoid printed circuit board or the battery in multi head is empty or may be damaged.

VAL and battery potential red colour: means that the battery in multi head is empty.



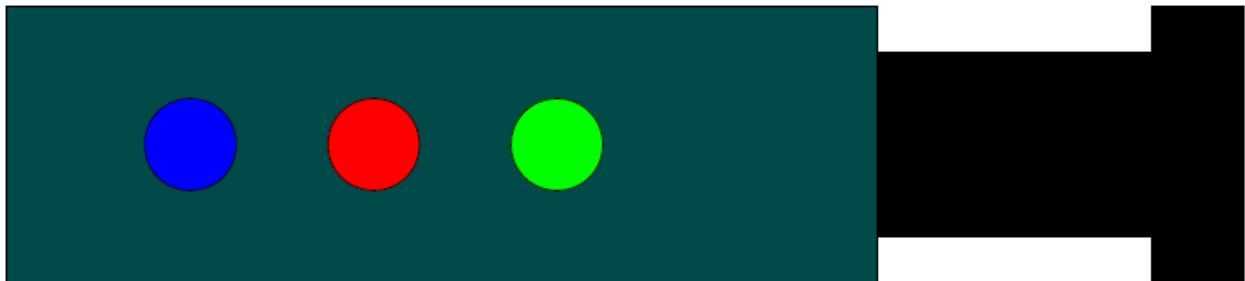
Low or high ppO2 warning is displayed on the SPX42 by ppO2 turning from white to red.

## DECO

If the diver has disregarded a deco stop or he/she has made a too fast ascend, a fat yellow arrow is displayed. The disregarded deco stop is indicated in red colour.

Low battery is indicated by Bat value in red on the SPX42 display.

## Warnings at the HUD



Red LED flashes slowly in case of a low ppO2 (0.4) for SPX42 and in case of a high ppO2 (1.6) a fast sequence.

LED green blinks regularly meaning that the electronics are OK. When the flashing stops, there will be a problem.

Blue LED flashes slowly in case of a low ppO2 (0.4) for Oxyscan and in case of a high ppO2 (1.6) a fast sequence.

### 3.3. Oxyscan 100



The oxyscan 100 is used as a redundant system for monitoring of the ppO<sub>2</sub>. It is connected to a separate oxygen sensor and it does not influence the function of the SPX42 and the solenoid (complete galvanic separation). It is totally redundant system

In case of failure of the SPX42 you can finish the dive safely with the oxyscan and with either a back up dive computer or run time table. Furthermore, you can compare the ppO<sub>2</sub> of the SPX42 for plausibility.

Note calibration should be done in ambient air prior to calibrating SPX-42

- Switching on by a short press of the Piezo switch
- Activation of oxyscan. After 30 second the word “on” is displayed. After a repeated press the oxyscan will be activated.
- Display of battery voltage of oxyscan
- It automatically calibrates in ambient Air for a ppO<sub>2</sub> of 0.21
- After activation and calibration the oxyscan is switched on and it is dive mode.
- Visual low and high warnings (HUD)
- Low warning below 0.4
- High warning above 1.6
- Switch off by 3 times pressing of the Piezo button, afterwards „off“ is displayed. One times pressing of the Piezo button and the unit switches off.

*Diving in mountain lakes*



- The unit is not suitable for diving in mountain lakes!!!

The resulting deviations can be determined in the following table:

Altitude above sea level	Air pressure	ppO2 Air	ppO2 min	ppO2 max	Set Point	Error
m	mbar	bar	bar	bar	bar	%
0	1013	0.21	0.40	1.60	1.10	0.00%
300	976	0.20	0.39	1.54	1.06	3.70%
500	952	0.20	0.38	1.50	1.03	6.00%
700	928	0.19	0.37	1.47	1.01	8.40%
1000	894	0.19	0.35	1.41	0.97	11.70%
1250	866	0.18	0.34	1.37	0.94	14.50%
1500	840	0.17	0.33	1.33	0.91	17.10%
1750	814	0.17	0.32	1.29	0.88	19.60%
2000	789	0.16	0.31	1.25	0.86	22.10%
2250	764	0.16	0.30	1.21	0.83	24.60%
2500	741	0.15	0.29	1.17	0.80	26.90%
2750	718	0.15	0.28	1.13	0.78	29.10%
3000	696	0.14	0.27	1.10	0.76	31.30%
3500	654	0.14	0.26	1.03	0.71	35.40%
4000	614	0.13	0.24	0.97	0.67	39.40%

Functions:

The oxyscan is activated by short press of the Piezo button. 30 seconds after the activation „on“ will be indicated. By a new press of the Piezo button the oxyscan will be switched on. After the activation the battery voltage will be displayed. If the battery voltage is lower than 3 volts the battery must be changed!!!



After the indication of the battery voltage you will see if a sensor is connected: SE/sensor exists. Afterwards the sensor voltage will be displayed in mV.



„SE“ (sensor exists): sensor  
Is connected



display of mVolt of sensor  
(example: 9.8 mV)

The sensor must have a voltage between 6 and 15 mV. When the voltage is within this range the automatically calibration will start.



When no sensor is connected you will see the term "SEr" (sensor error).



Afterwards the system will switch off.

When the sensor voltage is lower than 6 mV „CAL“ and afterwards „SEL“ (sensor low) are displayed. Afterwards the system switches off.

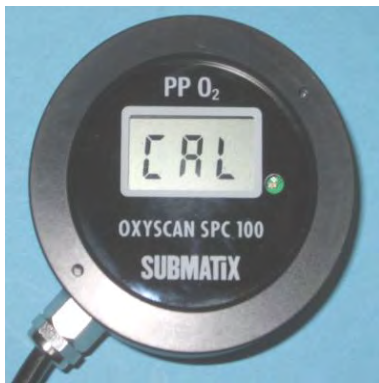


When the sensor voltage is higher than 15 mV “CAL” and afterwards “SEH” (sensor high) are displayed. Afterwards the system switches off.

When the sensor voltage is within the prescribed range the calibration will start.



Attention: The calibration is carried out in Air. Therefore only ambient air should remain in breathing loop before calibration.



„CAL“: system calibrates



0.21 actual partial pressure of O<sub>2</sub>



After the calibration the sensor has to be measured with pure Oxygen. At least 90% Oxygen must be used.

After the successful calibration the oxyscan switches to the dive mode.

Warnings: low ppO<sub>2</sub> = 0.4 and high ppO<sub>2</sub> = 1.6.

## Warnings under water

The Oxyscan will display a low alarm when ppO<sub>2</sub> is lower than 0.4, and a high alarm when ppO<sub>2</sub> is higher than 1.6.



HUD displays flashing blue LED if ppO<sub>2</sub> alarms are exceeded

On the HUD the high alarm flashes twice as fast than the low alarm rate.

## Reset

To turn off the oxyscan the Piezo button has to be pressed shortly 3 times within 5 seconds. "Off" will be displayed. Afterwards the Piezo button has to be pressed 1 times and the oxyscan switches off.



Attention!



After the reset the system must be activated and calibrated again. The calibration has to be carried out with ambient Air (21% O<sub>2</sub>).

Sensor check with Oxygen.

Attention!



Sensors must not be stored in a closed breathing loop over night or for period longer. The existing humidity in breathing loop leads to malfunctions and failures. Sensors must be stored in a cool and dry place (do not store them in fridge!!!)



#### 4. Filling assembly and starting up

##### 4.1. Filling of cylinders and gas analysis

###### Oxygen



The Oxygen cylinders have to be filled with medical grade Oxygen.

Oxygen cylinder is to be clearly marked.

Oxygen >99.5 Vol%

H<sub>2</sub>O < &/ PPMV

CO<sub>2</sub> < 300 ppmv

CO < % PPMV

Air Liquid M 1001S01R2A001

Do not use industrial grade Oxygen at all.

Only trained personnel are allowed to carry out the filling of the cylinders.

###### Diluent

The Diluent tank is filled with compressed air. The compressed air must correspond to DIN EN 12021 compressed air for breathing units. Diluent cylinder is to be clearly marked.



## 4.2. Filling of scrubber tank

To fill the scrubber tank removed from the multi head. Release catches and undo Velcro tape (if fitted) prior to removing scrubber from multi head and frame. Prior to filling the scrubber tank, unscrew black coloured M8 knob at the bottom, remove black lid and remove sieve. Place Knob over exhale tube (grey) to keep material out. The scrubber tank must be filled to approx. half way. Compress the scrubber material by light lateral knocks all around tank. This will settle the material. Check for any channels and repeat until gone. Add second half to fill line and repeat. Add more as material settles. Add sieve, grease all O-rings, add black lid and screw down hand tight.



Before every dive check for correct filling!





Only the scrubber material Spherasorb by the company Intersurgical must be used!



The unit has only the registration for the use with Spherasorb by company Intersurgical.

#### 4.3. Check for direction of mushroom valves in breathing hose

Before the assembling of the breathing hose the function of the direction valves has to be checked.

**Inhale valve:** breathing in at mouthpiece and check that inhaling is possible

Cover inhales side and check inhaling is not possible

**Exhaling valve:** Breathing out at mouthpiece and check exhaling is possible

Cover exhale side and check exhaling is not be possible

If any problem is found check the direction valves and if needed and replaced as necessary.

Only authorized staff is allowed to replace the direction valves.

#### 4.4. Check voltage and charge of batteries

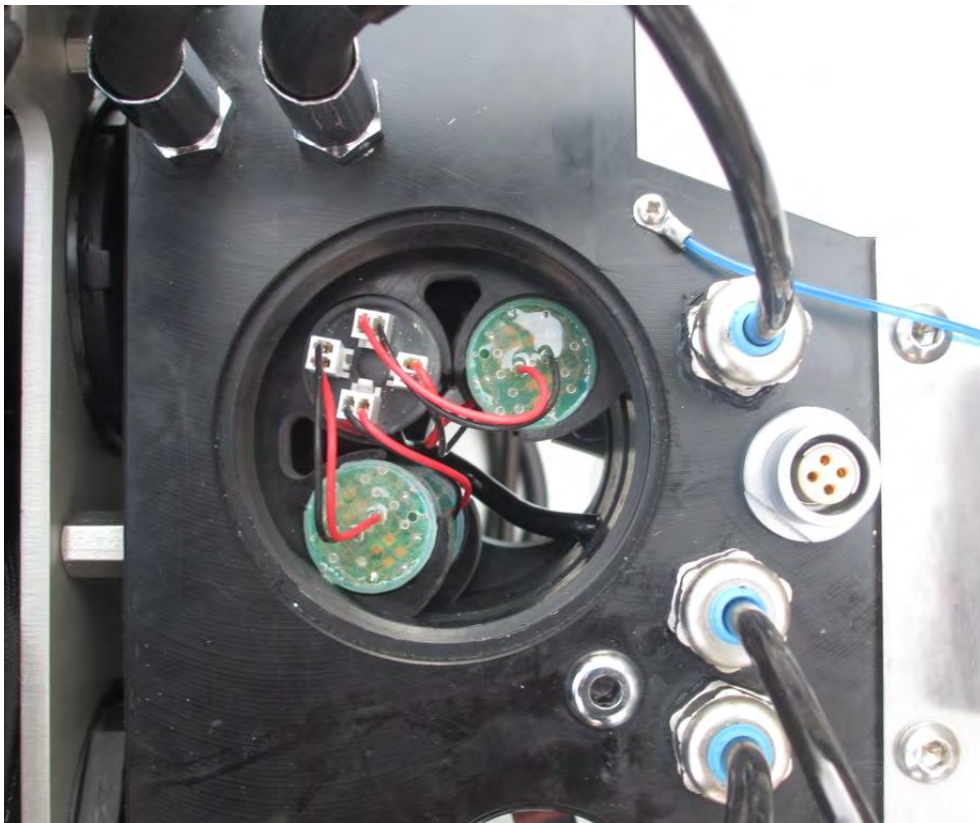
The voltage of batteries is displayed on the SPX42.

„BAT“ means the voltage of the internal storage batteries of the SPX42.

„SOL“ shows the voltage of both batteries in the multi head.



When the voltage is lower than 3.5 V, the batteries have to be recharge by correct battery charger approved by Submatix. Both batteries of the multi head will be charged at the same time by the use of the 4-pin connector at the multi head (shown below). Plug in attached cap prior to diving to turn unit on. Remove cap for storage and transport in aircraft, so unit is turned off (air safety).





#### 4.5. Installation of cylinders



The valves have to be closed.

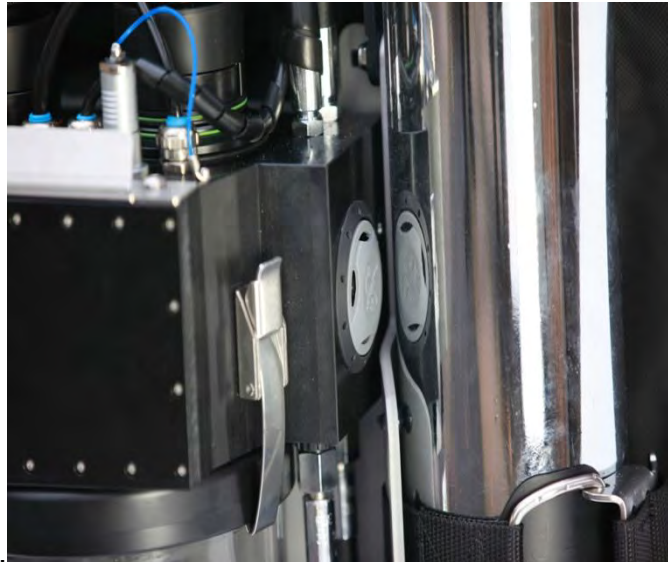
Filled and analysed O<sub>2</sub> and diluent cylinders prior to installing on frame by using tank straps. Connect with corresponding first stages regs.(pressure reducers).

Right side: Oxygen

Left side: Diluent

#### 4.6. Installation of scrubber tank

The filled scrubber tank will be fixed at the multi head and secured by using 2 quick release clips and the Velcro tape.



Attention! Make sure that all O-rings in scrubber are greased with Molykotte 111 (or O2 safe grease).



#### 4.7. Installation of sensors

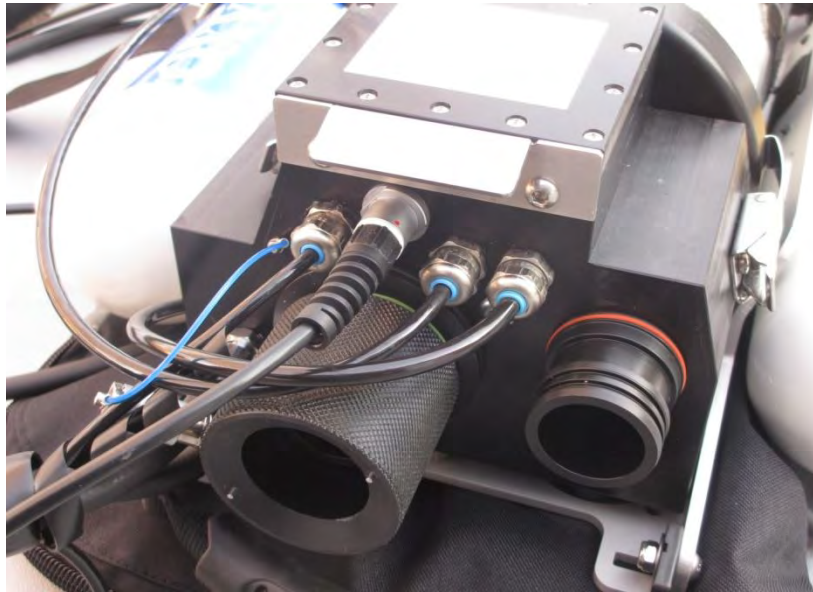
Removal the top of the sensor chamber with supplied tool. Add Oxygen sensors in to the corresponding holding device. The sensor for Oxyscan 100 must be installed at the separate plug marked in red. Take care in removing and replacing sensor plugs hold only white part of sensor plug.



Sensor chamber with 4 sensors

- 1 3 sensors for the SPX42
- 2 1 sensor for the Oxyscan (red coloured connection)





Top of sensor chamber and assembly tool

(3 x SPX 42/1 x Oxyscan)

- Calibration of Oxyscan with Air
- Calibration of SPX42
- Calibration with Air until the call „Check O2“

#### 4.8. Assembly of the breathing hose

The breathing hose is fixed at the multi head (colour marking: red to red and green to green). Make sure that the hose is free of twists and turns. The mouthpiece has to be in correct position. The flip lever of the turn valve has to show downwards. The design of breathing hose guarantees the ends can't be mixed up. It is recommended O-ring be greased prior to assembly for better seal and removal.



#### 4.9. Negative pressure test (low pressure test)

After calibration and prior to diving perform a negative pressure test must be carried out. By using the mouthpiece suck the air out of breathing loop until a vacuum is formed. Crimp breathing hose between fingers and close mouthpiece. The vacuum must be maintained for at least 5 minutes.

**When the Negative pressure test is not successful check for leaks.**

#### 4.10. SPX 42 test with O<sub>2</sub>



Open the Oxygen cylinder and start the test. Close the mouthpiece after about 30 seconds.

For the O<sub>2</sub> test the SPX42 opens the solenoid. The systems will feed O<sub>2</sub> until a ppO<sub>2</sub> of 0.9 will be reached.

The test takes maximum 120 seconds. When the ppO<sub>2</sub> of 0.9 will not be reached within 120 seconds the SPX42 stops the test.

#### 4.11. Test with O<sub>2</sub> is OK

When the O<sub>2</sub> test is ok the SPX42 switches to the surface mode.

#### 4.12 Check O<sub>2</sub> booster (manual add O<sub>2</sub>)

Push the booster button (manual add) and check O<sub>2</sub> is added.. Check CL is now full. When the loop is filled with Oxygen, the solenoid will switch off the Oxygen supply.

#### 4.13 Checking the over pressure test

To check for over pressure test put a 2 kg trim weight on the CL. The CL must not be collapse for at least 120 seconds.

When test fails and weight move down.

Check for leaks.

#### 4.14 Open the Diluent tank

Turn on the diluent valve and to check the tank pressure by using the SPG. The Diluent cyclinder has to be filled completely. The pressure gauge has to display at least 200 bar.

#### 4.15 Check of ADV

By pushing the membrane of the ADV will be activated, adds diluent and checks function.

#### 4.16 Fixing of the top cover

The till cover forward and engages stainless still lip on head. Pulled down onto 2 locating pins and secure with electric shock cord.

#### 4.17 Adjustment of the harness

The rebreather will be delivered with an adjustable harness. Before diving adjust harness to suit the individual height of the diver. While the adjusting pay attention that it is at the correct high and flat against their back.

The following adjustments are possible:

1. 2 x adjustable shoulder straps
2. 1 x adjustable abdomen strap
3. 1 x adjustable crotch strap

## 5 Pre-dive Check

### 5.1. Short assembling and check list

Before you will start with the assembly of the unit you have to check all components for completeness and for proper condition by visual control. Damaged parts have to be replaced. Missing parts will lead to termination of further unit preparations. You have to provide spare parts.

If any test fails do not dive units.

Fault find unit, replace or adjusted for any defects until all tests successfully.

- Filling of cylinders and gas analysis
- Filling of scrubber tank and compact
- Check of direction valves of breathing hose
- Check battery voltage at the SPX42 and at the oxyscan. When the voltage is under the limit, charge batteries until full.
- Assembly of tanks/valves keep closed
- Installation of scrubber tank
- Input of sensors (3 x SPX 42 and 1 x Oxyscan)
- Calibration of the oxyscan with Air
- Calibration of SPX42 with Air until the Oxygen test will be required
- Installation of breathing hose
- Negative pressure test
- Start of O<sub>2</sub> test of the SPX 42, open of Oxygen valve and close mouthpiece after at least 120 seconds
- When O<sub>2</sub> test is OK fill the unit completely with O<sub>2</sub>
- Check of O<sub>2</sub> booster (manual add)
- Positive pressure test
- Open Diluent valve
- Check function of Diluent booster and ADV
- Fixing of the top
- Correct operation of BCD

## Kalibrierung und Dichtigkeitstest *Calibration & Tightness test*

Das Gerät ist dazu vollständig montiert. Die Sauerstoff und Diluent Flaschen sind geschlossen! *The unit is complete assembled. Oxygen and Diluent cylinder to close!*



Es ist sicherzustellen, dass sich Luft 21% O<sub>2</sub> im Loop befindetet.  
*You have to ensure that only Air 21% O<sub>2</sub> is in the loop.*

1. Unterdrucktest (Sauerstoff und DILUENT Flaschen sind geschlossen)  
*low-pressure test (Oxygen & Diluent cylinders are closed)*
  2. Kalibrierung Oxyscan mit Luft  
*Calibration of Oxyscan with Air*
  3. Kalibrierung SPX42 mit Luft  
*Calibration of SPX42 with Air*
  4. SPX42 Test O<sub>2</sub> (Sauerstoffflasche öffnen/Mundstück öffnen)  
*SPX42 test Oxygen (Oxygen cylinder open/mouthpiece open)*
  5. Diluentflasche öffnen, Check ADV/Dil Booster  
*Diluent cylinder open, check ADV/DIL Booster*
  6. Loop mit Diluent füllen und Überdrucktest durchführen  
*Fill the loop with Diluent and carry out the over-pressure test*
-

## 6 Diving

The mini Quantum rebreather was developed for skin divers and technical divers. It was not designed for working dives.

Start pre breathing the unit prior to diving. The maximum dive limit is 40 meters with Air as Diluent.

Every dive starts with the planning.

Also: Plan your dive and dive your plan.

### Security notes:

Before going into water all functions have to be checked and have to be ok. Also the gas tanks have to be open. The mouthpiece must be in the mouth of the diver and open.

The diver has to carry with a sufficient supply of buoyancy gas and bailout gas (the tanks have to be open and the automates have to be reachable).



The gas supply of the Quantum rebreather must not be connected with foreign systems like buoyancy, bailout and other.



The diver must carry along a spare dive computer or a run time table.

## 6.1 During the dive

The SPX42 keeps constantly adjusted for correct ppO<sub>2</sub>.

During the dive the following settings can be changed at the SPX42:

- By pushing simultaneously both buttons you will come to the dive setup menu.
- By pushing the lower button you can scroll through the system.
- Change Diluent.
- Switch to Bailout.
- Change set point
- Close menu.

When you have chosen a point of menu you can select and edit it by pushing both buttons at the same time:

- Change Diluent  
You can switch between all gases which are activated by an X (change of gas).
- Switch to bailout  
You can change to the OC mode. By the change the system recommends the optimal gas for the actual depth. But it is also possible to use another gas from the gas list. At any time you can switch back from the OC mode to the CCR mode.
- Change set point  
By simultaneously pushing of both buttons you can activate the menu. By pushing the lower button you can scroll between the set points. The wished set point will be activated by simultaneously pushing of both buttons. While the dive you can adjust the following set points: 0.7, 1.0, 1.1, 1.2, 1.3 or 1.4
- Close menu  
By pushing both buttons at the same time you can leave the menu and the dive screen will be displayed.



## Attention!



When changing gas or going to OC or bailout ensure corresponding gas is correctly selected on SPX42.

## 6.2 Warnings during the dives

The HUD will indicate the following warning to the diver:

- Green LED: flashes once every 20 seconds proves correct operation of SPX42 and solenoid. If the flashes stops there is a problem. Check the problem and if needed change to the OC.
- Red LED : flashes when SPX42 detects a low ppO<sub>2</sub> below 0.4 (slowly sequence) or high ppO<sub>2</sub> above 1.6 (fast sequence).
- Blue LED : flashes for Oxyscan detects a low ppO<sub>2</sub> below 0.4 (slowly sequence) or high ppO<sub>2</sub> above 1.6 (fast sequence).
- Sensor problems: failure of one or more sensors the dive must be turn around and finished. This can be done with oxyscan when it displayed a plausible value.
- Failure of SPX42: finishing of dive with oxyscan or change to OC.

## 6.3 Further possible problems during the dive

- Gas loss Oxygen  
Both red LEDs of the SPX42 and the oxyscan flash. Blue and red on HUD. Check O<sub>2</sub> SPG. Try to feed Oxygen manually. If there is no increase in ppO<sub>2</sub> change to bailout will be necessary.
- Gas loss Diluent  
Symptoms: while descending in a dive the ADV does not response. The result is the CL will collapse and the breathing will not be possible. Change to OC or add diluent.

- Water in loop  
Symptoms: gurgling sounds, hard to breath, not response of the ADV. Change to OC.
- Scrubber material does not work  
Symptoms: breathlessness or tunnel vision. Immediately change to OC.

## 7 Post dive, cleaning and storage

### Attention!



After entering the water the gas cylinder have to be closed.

### 7.1 After the dive

- Take off the unit at a suitable place.
- Removal of top cover of the unit.
- Remove scrubber tank from the multi head.
- Visual observation of scrubber material.
- Disposal of used up scrubber material.
- Removing breathing hose for cleaning.
- Use medical grade disinfectant EW80 or equivalent approved by Submatix. Insure both inside and out is soaked for at least 15 minutes. Afterwards rinse in fresh water and dry parts.
- Repeat disinfectant for 15 minutes, rinse with clean water and dry CL with unit standing up right. Drain through bottom CL bungs (water traps). Leave bungs and breathing loop connectors open to dry.

- 

Lay unit down and secure it from a fall. Store the unit dry and with connections open.



Before the next use the open connectors have to be assembled again (check of density).

When the sensors remain in multi head make certain:

- The scrubber tank is not installed.
- The breathing hose is not installed.
- The unit is stored at a shady, dry and cool place.

For oxygen sensors it is important that they are dried off to removing condensation



The unit must be stored in shady, cool and dry place. Do not leave in direct sun!

## 7.2 Short-termed storage

For a short-termed storage (between two dives) the sensors can keep in multi head but the scrubber tank and the top of sensor chamber have to be removed. This will guarantee that the sensors can dry.



You must not store the unit under a temperature of 0 degrees.

### 7.3 Long-termed storage (longer than 2 days)



- All components will be cleaned and disinfected.
- All O-rings of the loop (multi head/breathing hoses) are greased with Molykote 111.
- The sensors have to be removed from the multi head.
- Used up scrubber material must be disposed of safely.  
All components of the loop will be disinfected and dried.
- All components must be stored in disassembled condition.
- The storage has to take place at a shady, cool and dry place (ambient temperature).
- All component parts must not be exposed to direct sun.

## 8 Service



For the proper function of the unit it is necessary to observe all service intervals.

Only by Submatix authorised staff are allowed to carry out the servicing. Submatix will not be liable for damages caused by not carrying out correct service intervals or when others completed the service not authorised by Submatix.

Table service intervals user

Component part	Works	Before the dive	After the dive	Period
Complete unit	Check operation and for leaks	X		
	cleaning		x	
Breathing circulation	Disinfect and clean		X	
X-con connectors	Change of O-rings			Every 12 months
Oxyscan		X		
SPX 42		X		
Sensors	replacement			Every 12 months
Oxygen cylinder	Filling pressure	X		
	Gas analysis	X		
	Association for Technical Inspection			Every 2.5 years
Diluent cylinder	Filling pressure/ gas analysis	X		
	Association for Technical Inspection			Every 2.5 years
Pressure gauges	Pressure control	X		
Scrubber tank	Filling	X		
	O-rings			Every 12 months
BCD	Density and inflator check	X		

Table service intervals producer

Component part	Part	Replacement	Service	Period
Pressure reducers 1st stage reg	Oxygen		x	Every year
	Diluent		x	Every year
Cylinders and valves	Oxygen		x	Every 2.5 years
	Diluent		x	Every 2.5 years
Scrubber tank	O-rings	x		Every year
	Plastic parts	When damaged		Every 10 years
Breathing hose	Direction valves	x		Every year
	Breathing hose	When damaged		Every 5 years
Low-pressure hoses	Diluent	When damaged		Every 5 years
	Oxygen	When damaged		Every 5 years
ADV	Membrane	When damaged		Every year
	O-rings	When damaged		Every year
	Packing seat	When damaged		Every year
Batteries		x		Every 5 years
Sensors		x		Every year
Cable connectors		When damaged		Every 10 years
HUD		When damaged		Every 10 years
Pressure gauges (SPG)	Hoses	When damaged		Every 5 years
	swivel			Every year
	Pressure gauge	When damaged		
SPX 42		When damaged		
Oxyscan		When damaged		
O-rings		x		Every 12 months and at complete revision
Magnetic valve	Valve			Every 10 years
	O-rings			Every year
Multi head		When damaged		Every 10 years

	Sensor connector LP			Every 5 years
--	---------------------	--	--	---------------

A general inspection is needed every 5 years.

The revision must only be carried out by staff, who are authorised by Submatix and only original Submatix parts must be used.

Every carried out works must be written down into a service book.

The Submatix Quantum SG part list serves as basis of the required service works.

## 8.1 Guarantee pass

The first owner has to send back to Submatix the filled in guarantee pass within 14 days.

Every dive has to be planned with the delivered dive planner. The user and its dive partner have to sign it.

Submatix will not be liable for damages, which will happen before Submatix has received the filled in and signed guarantee pass and/or by an improper filling in of the dive planner.

Serial number:

Purchase date:

Name:

Address:

Postal code, place:

Country:

Phone:

Email:

I do accept the terms of use.

Signature:

I do accept that the legal domicile and the place of execution, if not other is written down, is Erfurt/Germany.

Signature:



## 8.2 Important rebreather terms

ADV	Automatic diluent valve
Bail Out	Emergency system
Breathing Loop	Includes breathing hose, scrubber tank, counter lungs, which gas flows around
BCD	Buoyancy control device
CL	Counter Lung
DSV	Dive/surface valve
OC	Open circuit system
ppO <sub>2</sub>	Partial pressure of Oxygen
Pressure reducer	Also know as first stage regulator
OPV	Over pressure valve
Solenoid	Magnetic valve
SPG	Submersible pressure gauge
TCM	Temperature cluster monitor
TG	Dive
Loop	Breathing circulation
Scrubber	Scrubber tank
WOB	Work of breath

### 8.3 Trouble shooting

Problem	Symptoms	Reaction
Closed Oxygen cylinder	Low ppO2 warning	Open O2 cylinder valve
Closed Diluent cylinder	Loop collapses while the dive to the depth No breathing is possible	Open the DIL cylinder valve
Empty Oxygen cylinder	Low ppO2 warning	Change to OC
Empty Diluent cylinder	Loop collapses while the dive to the depth No breathing is possible	Change to OC
Oxygen tank is filled with wrong gas	Low ppO2 warning by the HUD	Change to OC Finishing the dive
Empty batteries in multi head	Warning in Display of SPX42	Finish in manual mode or change to OC
Diluent cylinder is filled with wrong gas	High warning by HUD	Change to OC End of dive
Empty batteries of SPX42	Green LED does not flash You cannot correctly operate the buttons	Finish of dive by use of the oxyscan and the redundant Oxyscan
Empty batteries of oxyscan	Display switches off No warnings at the HUD	Finish of dive with SPX42
Damaged sensors of SPX42	Warnings in display of SPX42	When the oxyscan shows plausible valves you have to finish the dive by use of the oxyscan and the redundant computer, otherwise you have to change to OC
Damaged sensors oxyscan	A non-plausible value is indicated on the Oxyscan display	Finish the dive and use SPX 42
Solenoid does not open	Low ppO2 warning at SPX42 and oxyscan	Manual add O2 or change to OC
Solenoid does not close	High ppO2 warning	Close of O2 valve Change to OC End the dive
ADV does not open	Loop collapses while the dive to the depth No breathing is possible	Manually add DIL finish of dive Change to OC
ADV does not close	Loss of gas/drain sounds Overpressure valve does not response Unit gets buoyancy	Close of valve Change to OC Finish the dive
Too high low-pressure of Oxygen pressure reducer	Solenoid could kept open High ppO2 warning	Close of valve Change to OC End the dive
LP pressure above 10	ADV kept open continuously	Close of valve

bar from Diluent 1 st. stage	Sounds of incoming Diluent	Change to OC End of dive
Leaking of loop	Gurgling sounds Hard breathing work	Change to OC End of dive
Damaged direction valves in mouthpiece	No sounds of valves Increase of CO2 in loop Short-winded Difficulties in breathing	Change to OC
Used-up scrubber material	Increase of CO2 in loop Short-winded Difficulties in breathing	Change to OC
Damaged SPX42	Green LED of HUD does not flashes Display is out	End the dive with redundant monitor (Oxyscan) in manual and or change to OC
Damaged oxyscan	No warnings at HUD	End of dive by use of SPX
Damaged O2 low-pressure hose	Drain sounds Loss of gas	Change to OC Close of valve End of dive
Damaged Diluent low-pressure hose	Drain sounds Loss of gas	Change to OC Close of valve End of dive
Damaged O2 booster → it does not close	High ppO2 warning Sounds	Change to OC Close of valve
Damaged O2 booster → no incoming gas	No increase of ppO2 No sounds	Change to OC End of dive
Damaged Diluent booster → does not close	Drain sounds Existing buoyancy	Change to OC End of dive
Damaged Diluent booster → no incoming gas	No sounds No decrease of ppO2	Change to OC End of dive
Empty or damaged storage batteries in multi head	Warnings by HUD and display of SPX42	Finish of dive in manual control of ppO2/O2 booster
Empty storage battery in SPX42	Warnings by HUD and display of SPX42	Observation of display/end of dive/if needed with oxyscan/spare computer

### Attention!

When changing to OC (emergency system), close the mouthpiece before abandoning the breathing loop. If mouthpiece is left open it may flood the unit and reduce buoyancy and may increase danger of drowning.