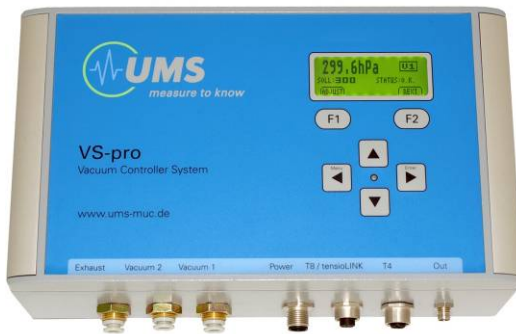


Instruction Manual



VS

Vacuum controller systems VS-single, VS-twin, VS-pro

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1 Introduction

1.1 Safety instructions and warnings

Electrical installations must comply with the safety and EMC requirements of the country in which the system is to be used.

Please note that any damages caused by handling errors are out of our control and therefore are not covered by guarantee.

Vacuum systems are designed to create and control vacuum and should be used for this purpose only. If the vacuum systems are used for other purposes this happens at your own risk and responsibility.

Please pay attention to the following possible causes of risk:

- ⚠ The power supply voltage is 10 to 14.5 VDC unless specified different on the type label. Max. voltage is 18 VDC.
- ⚠ Lightning: Long cables act as antennas and might conduct surge voltage in case of lightning stroke – this might damage sensors and instruments.
- ⚠ Frost: The unit should only be installed in a frost free surrounding. Operation during severe frost might damage the pump.
- ⚠ Vacuum: Only use implosion safe vacuum vessels and sampling bottles. Glass bottles must be plastic coated.
- ⚠ Pressure: Note that vacuum vessels may not be suitable for over-pressure! The exhaust offers a pressure of up to 100 kPa, but in worst case might build up to 300 kPa (3 bar). Only connect pressure vessels with certified pressure load of 3 bar.
- ⚠ Electronic installation: Any electrical installations should only be executed by qualified personnel.
- ⚠ When using a rechargeable battery sufficient ventilation must be ensured as during recharging explosive gases may develop, especially when over-charging.

1.2 Content of delivery

The delivery of a VS-single, VS-twin or VS-pro includes:

- The vacuum unit
- tensioLINK USB-converter Mini
- tensioVIEW software on CD-Rom
- This manual
- 12 V-power supply cable, with female 4-pin plug M12, length 2 m
- Analog output cable, with female 3-pin plug M8
- Vacuum tubes, blue, PUR Øa 6 mm, length 2 m: 1 piece for VS-single, 2 pcs. for VS-twin and VS-pro

For available accessories see chapter “Accessories”.

1.3 Introduction

1.3.1 Foreword

Measuring systems must be reliable and durable and should require a minimum of maintenance to achieve target-oriented results and keep the servicing low. Moreover, the success of any technical system is directly depending on a correct operation.

At the beginning of a measuring task or research project the target, all effective values and the surrounding conditions must be defined. This leads to the demands for the scientific and technical project management which describes all quality related processes and decides on the used methods, the technical and measurement tools, the verification of the results and the modelling.

The continuously optimized correlation of all segments and it's quality assurance are finally decisive for the success of a project. So please do not hesitate to contact us for further support and information. We wish you good success with your projects.

Yours, Georg von Unold

1.3.2 Intended use

The VS vacuum units are designed to evacuate sampling bottles to extract soil water solution from unsaturated zones with pore water samplers, ceramic plates or lysimeters. The VS family replaces the previous UMS systems like the SCS7 or SCS8.

1.3.3 Guarantee

UMS gives a guarantee of 12 months against defects in manufacture or materials used. The guarantee does not cover damage through misuse or inexpert servicing or circumstances beyond our control. The guarantee includes substitution or repair and package but excludes shipping expenses.

Please contact UMS or our representative before returning equipment. Place of fulfilment is Munich, Gmunder Str. 37!

1.3.4 Durability

The nominal lifespan for outdoor usage is 10 years, but protection against UV-radiation and frost as well as proper and careful usage extends the lifespan.

1.3.5 Definitions

Vacuum system

A *vacuum system* mentioned in this manual means a closed circuit consisting of samplers, tubes, bottles etc.

1.4 Short instructions

This chapter is only a summary of following chapters. Please read the complete manual carefully before using the instrument.

1. Connect the black power supply cable to a 12 VDC rechargeable battery or a 12 VDC / 2 A mains power supply unit.
2. Connect the tube to the output of the vacuum unit: "Vacuum1". Insert the other end into a vacuum bottle.
3. Press the key "<" to enter the functions menu. Press the arrow keys to select the function "Volume"
4. Press the function key "F1", wait until the mode "o.k." is shown. This procedure determines the volume of the connected sampling bottle. The bottle resp. vacuum system must be closed.
5. Select the function "Set point/actual value" with the arrow keys.
6. Press the function key "F2" to activate the evacuation -> a vacuum according to the set point is created and maintained.

2 Product description

2.1 VS vacuum station family

The VS vacuum controller systems are designed to extract characteristic soil water samples, either with a constant vacuum, in selected intervals, or controlled by a Tensiometer.

As a system solution the VS units incorporate a vacuum pump, an exhaust valve, sensors and micro-processor controller in the same unit. The vacuum is regulated by the vacuum pump to evacuate the system, or the exhaust valve which vents the system to reduce the vacuum.

Many setting options are offered for control accuracy, mode, repetition, hysteresis etc.

For a tension controlled regulation the UMS Tensiometers type T4, T4e, T5 or T8 are available as an accessory.

The VS units are suitable for laboratory use as well as for battery powered field stations.



Abb. 2.1: Parts of a soil water sampling system

Typical applications

- Long-term monitoring
- Soil water extraction under defined conditions
- Leachate measurements under defined conditions
- Sampling in Lysimeters

Benefits

- Control a vacuum with highest accuracy
- Establish a constant vacuum
- Establish a tension controlled vacuum with optional UMS Tensiometers T4, T5 or T8
- 3-color LED for status check
- Optimised for battery operation
- Multiple setting options
- Internal data logger
- VS-twin and VS-pro can control two vacuum systems
- VS-pro with keypad and display for direct operation

Special benefits of the design

- The high accuracy is achieved as the vacuum is levelled by both control of the pump and a venting valve..
- The pump is fixed on cushioned bearings which considerably extends the lifespan of the vacuum pump.
- Settings are saved in a non-volatile flash memory.
- VS housings are splash-proof (protection class IP67)
- Analog output available for connection to data logger or SPS

2.1.1 VS-single

The VS-single can control one vacuum circuit. It has no display or keypad and is programmed by PC and tensioView software. The VS-single can be used for continuous evacuation, tension controlled evacuation with a Tensiometer or evacuation in intervals.

2.1.2 VS-twin

The VS-twin supplies two independent vacuum circuits. With this you can for example extract soil solution from the root zone and sample leachate water with the same unit.

One pump is integrated, but a switch valve switches between vacuum circuit 1 and 2. Each circuit has a pressure transducer for checking the set point pressure.

Only one Tensiometer can be connected.

The VS-twin has no display or keypad and is programmed only by PC and tensioView software.

2.1.3 VS-pro

As with the VS-twin two independent vacuum circuits can be controlled, but the VS-pro has a keypad and display for general status check, set-up and programming without a PC. Only the main setup is performed by PC and tensioView.

2.2 Extraction methods

The extraction methods are described in the brochure "Soil Water Extraction".

2.3 VS features

See chapter ... for a description of the following options.

2.3.1 Easy setup with tensioVIEW

Setup and data download are performed by using the tensioLINK interface and the graphical Windows software tensioVIEW.

The VS-pro also has a keypad on the front panel for setting the most important functions, and a LC-display for viewing readings and status information.

2.3.2 Take and store readings

The value of the vacuum and, if connected, the Tensiometer signal are continuously measured and stored. Stored readings can be downloaded via the PC interface. Also, these signals are available on the analog output for connection to a data acquisition system.

2.3.3 Power control

Supply a VS with a 12 V mains power device or a 12 V rechargeable battery. The unit will switch off when the voltage of a rechargeable battery drops below 10,5 V or if a voltage of over 15 V (default) is

applied. These limits can be adjusted in the menu "Configuration/Power supply", for example when using a non-stabilized mains power unit which has a too high voltage when not burdened. Please take care when adjusting this function to avoid damage of the VS.

2.3.4 Volume control

The regulation works best if the microprocessor knows the approximate volume of the sampling system. Either enter the volume manually through the function "Volume", or start the function "Measure" to have the volume determined automatically. Do this once after assembling the sampling system. The vacuum system must be closed.

A precise setting of the volume of the vacuum system will shorten the time to establish the vacuum. To measure the current vacuum, the pump has to be inactive. Therefore, during long pumping cycles, the pump will switch off for a short moment.

2.3.5 Protection against water intrusion

The vacuum port of each circuit is equipped with an optical sensor which detects water intrusion. In case, the exhaust valve is opened to exhaust the complete system. This prevents that water enters the pump. At worst condensation water or water drops inside the tube can irritate the detector. In this case (Error message: Water intrusion in vacuum cycle x) the detector can be deactivated in the configuration menu. If you do this, please take further measures to prevent water from entering the vacuum port, for example by the arrangement of your sampling bottles, additional overflow valves SF-protect or an additional buffer bottle (more details in the brochure .

2.3.6 Output signals

Following analog outputs are available on: Vacuum 1, vacuum 2, soil water tension, supply voltage.

Set the output signal range with the tensioVIEW software (0...1 V, 0...2 V or 0...5V).

Male plug 3-pin/M8 for analog output. Offers 2 analog outputs for connection to a data logger.

Configure these outputs with tensioVIEW. Default setting is vacuum 1 and vacuum 2 with 0 to 2 V = -1 to 1bar,

1 V = 0 bar. Output level and source can be selected, for example put the Tensiometer reading on output 2.

2.3.7 Sampling in fixed intervals

Will be included in future.

2.3.8 Hysteresis modes

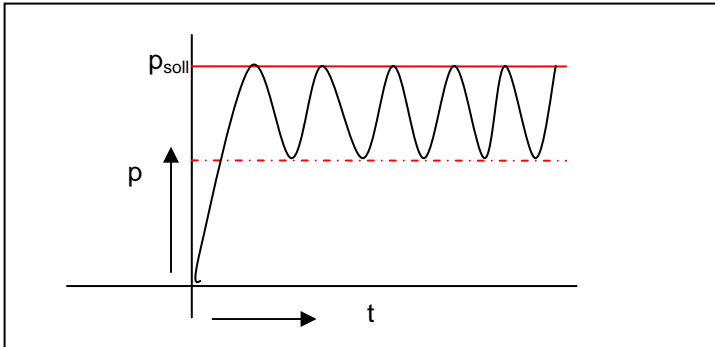
With the hysteresis the operating range of the pump is adjusted. Three optional modes are possible (see figures below). Depending on the selected mode the *Hysteresis* defines the position of the threshold in relation to the set point. In mode 1 the pump is active until the set value is achieved, and remains inactive until the vacuum reaches the threshold. Then, the pump will start again to re-establish the set vacuum. In mode 2 the hysteresis band centres around the set value. Then pump and exhaust valve are alternately activated to keep the vacuum within the upper and lower threshold.

In mode 3 the threshold is above the set value. Pump and valve interact to keep the vacuum between the lower threshold (= set value) and the upper threshold (= set value plus hysteresis).

- ! With a VS-twin or a VS-pro the hysteresis for each circuit can be set individually.
- ! If one of the circuits of a VS-twin or VS-pro is not used it should be deactivated.

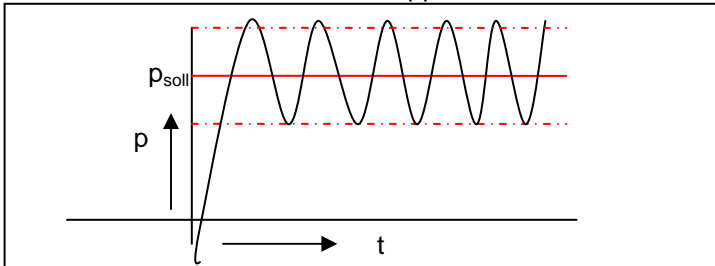
1. P_{sol}

Approaching the set value from below



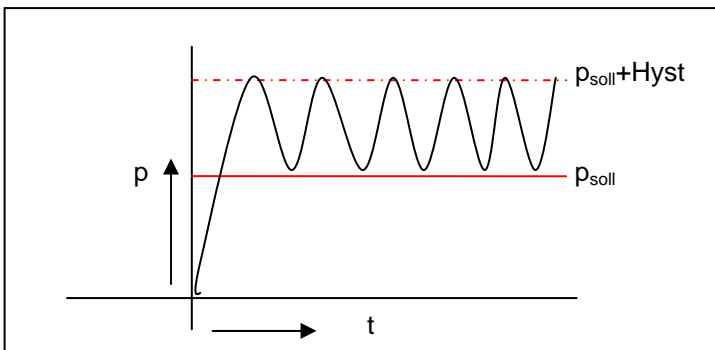
2. $P + \text{Hyst}/2$

The set value is centred between upper and lower threshold



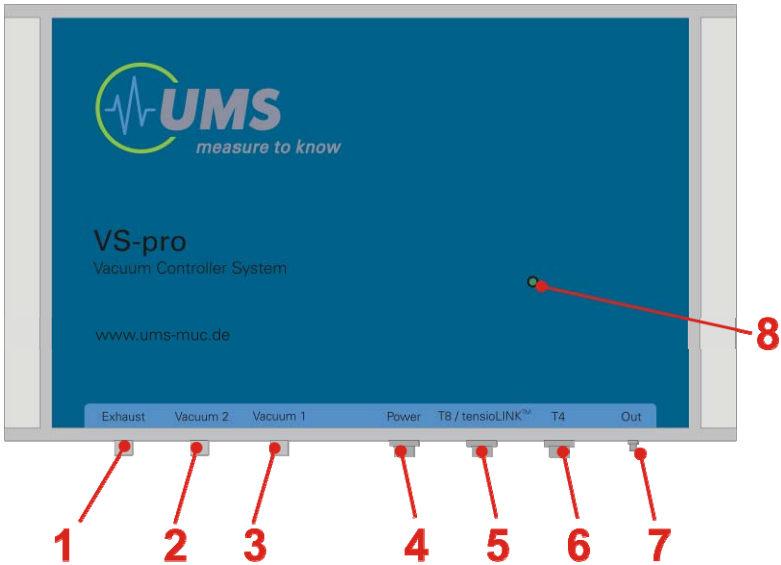
3. $P + \text{Hyst}$

Approaching the set value from above



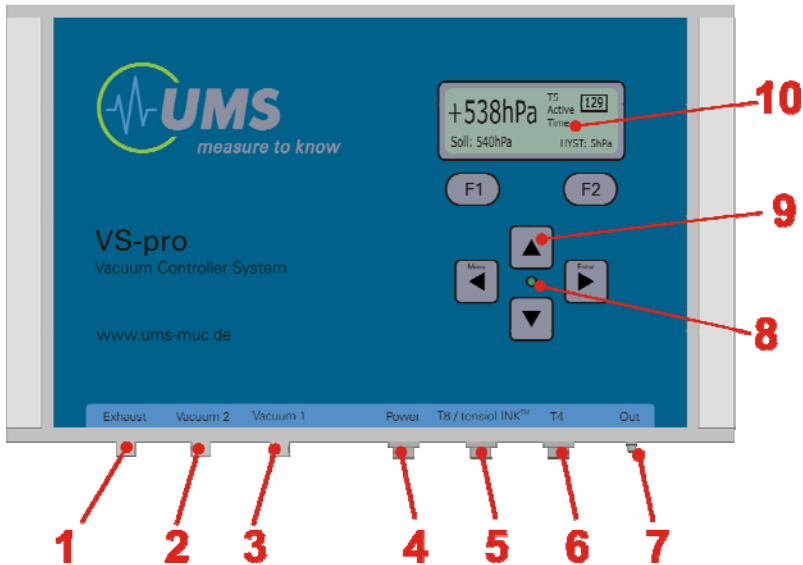
2.4 Description of the VS unit

2.4.1 VS-single and VS-twin



-
- 1 Exhaust**
Pressure output of the pump. This must not be blocked. To reduce noisiness of the pump simply connect a short tube.
 - 2 Vacuum 2 (only VS-twin and VS-pro)**
Port of vacuum circuit 2. Connect to sampling bottle or buffer bottle with supplied blue PUR tube.
 - 3 Vacuum 1**
Port of vacuum circuit 1. Connect to sampling bottle or buffer bottle with supplied blue PUR tube.
 - 4 Power**
4-pin/M12 plug connector for 10...14,5 VDC supply voltage.
 - 5 T8/tensioLINK**
Female plug 8-pin/M12 to connect a T8 controlling Tensiometer or the tensioLINK interface cable .
 - 6 T4**
Female plug 4-pin/M12 to connect a controlling Tensiometer T4, T4e or T5.
 - 7 Out**
Male plug 3-pin/M8 for analog output. Offers 2 analog signals for connection to a data logger.
 - 8 Status LED**
The 2-color LED indicates the current status of the vacuum systems. The LED flashes once or twice every 10 seconds. The first flash belongs to circuit 1, the second to circuit 2.
Green = Status o.k, stable vacuum is established
Yellow = A vacuum regulation is in progress
Red = Error: either low power supply or leaking vacuum system

2.4.2 VS-pro



1 - 8 As above

9 **Operation keypad**

Keypad with 6 keys. Navigate through the menu with the 4 arrow keys. Arrows in the display indicate if an arrow key currently has a function. The top function keys F1 and F2 execute the function which is currently displayed above the key.

10 **Multi-function display**

The display shows readings and functions. Any time a key is pressed the background light is switched on for a few seconds. The bottom rows show the current function of a function key.

2.5 Serial interface

The tensioLINK® serial interface is based on RS-485. The tensioLINK® USB-converter and the Windows software tensioVIEW® are required for connecting the interface to a PC or Laptop. The USB-Mini-PC converter is supplied with each VS as well as a free copy of the software.

2.5.1 tensioLINK®

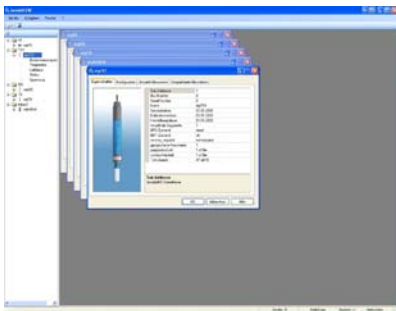
All vacuum devices use the tensioLINK® bus. Via tensioLINK® all functions can be executed, current and stored readings can be uploaded, and the VS can be configured.

Furthermore the RS485 bus allows the assembly of a robust and low-cost sensor network with tensioLINK®-capable sensors like T8, TS1, SIS. Cable lengths of several kilometres are possible. Please contact UMS to receive a description of the data protocol.



2.5.2 tensioVIEW

Devices and sensors are automatically identified by the software when they are connected to the bus network. With the software devices are configured and readings are displayed.



Für Laboranwendungen ist mit tensioLINK® / tensioVIEW® kein weiteres Gerät zur Erfassung der Messdaten notwendig. Die Messdaten der Sensoren werden direkt am Computer dargestellt und gespeichert.

3 Installation

3.1 In-the-field installations

3.1.1 Set-up of a sampling system

The scheme below shows a possible set-up of a soil water sampling system.

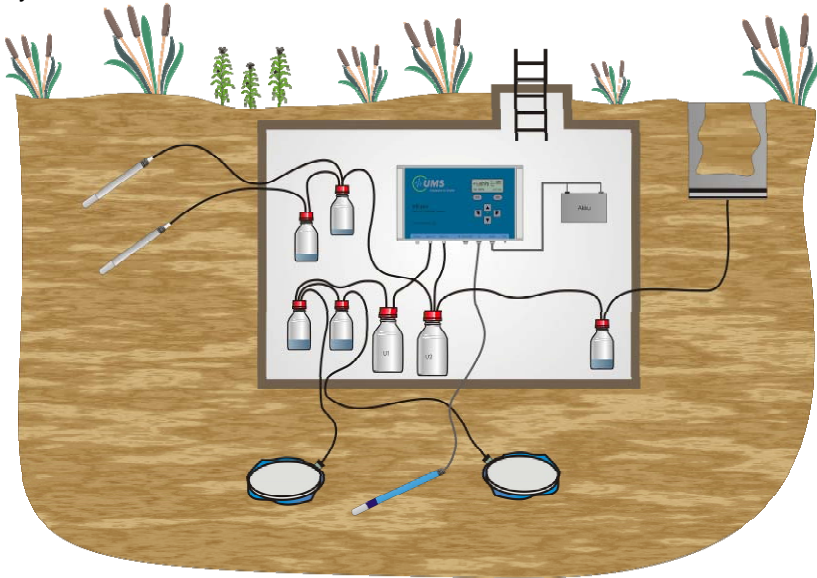


Fig.: Possible plot of a sampling system with a VS-pro

The possible items are: VS vacuum unit with rechargeable battery or 12 V mains power supply, pore water samplers and/or leachate plates, a sampling bottle for each sampler, a vacuum buffer bottle for each vacuum circuit, a controlling Tensiometer with extension cable, and polyethylene suction tubes for the samplers and polyethylene vacuum tubes to connect vacuum port and buffer bottles.

3.1.2 Selecting the site

The installation spot should be representative for the soil horizon! Therefore, in heterogenic soils, classifying drillings should be made before or during installation.

3.1.3 Documentation

For every measuring spot you should:

- Measure out the position where the pressure sensor will be placed. (A must for installations below the ground surface).
- Take documenting photos before, during and after installation.
- Save a soil sample.
- Write down installation depth and angle with the sensor identification (serial number).
- Mark all connecting cables with the corresponding sensor identification, serial number or logger channel on each end. Clip-on number rings are available as an accessory (see chapter 9.2).

3.1.4 General requirements

- ⚠ Please note that VS units, suction tubes to the samplers as well the sampling bottles have to be frost-protected. (unless they are removed in winter or the system is completely emptied before winter)
- ⚠ Use plastic protection tubes or pipes for the suction tubes and cables to prevent rodent bites or sharp bends in tubes which would block the system. and bury these in the soil a frost free depth.
- ⚠ Add a vacuum buffer bottle (for example a 1 or 2 litre sampling bottle) between the sampling bottles and the vacuum unit as a overflow reservoir to avoid that water is drawn up by the pump.
- ⚠ The VS unit must be protected against flooding with water.

For a proper regulation observe the following:

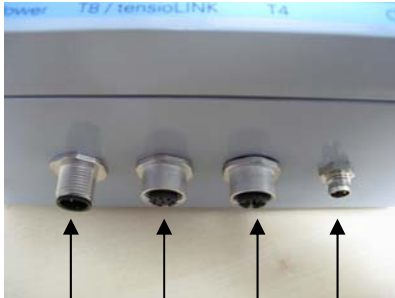
- ⚠ The total volume of the vacuum system (bottles, tubes etc.) must have a volume of min. 1 litres
- ⚠ Tubes and connections have to be installed carefully and tight to avoid leaking.

3.1.5 Install a controlling Tensiometer

Install the controlling Tensiometer in a spot and depth which represents the average situation of your site as good as possible.

The distance to the next suction cup should be at least 100 cm to prevent mutual interference.

3.2 Connections



Power T8/tensio
 LINK
 T4 Analog
 Output

3.2.1 Power supply

Connect a 12 V battery or to a 12 VDC mains power devices (12VDC/2A) to the power port with the supplied power supply cable (4-pin M12).

- ⚠ Max. voltage 15 VDC.
Observe plus and minus.



3.2.2 T8/tensioLINK

T8 and tensioLINK bus connect to the same plug. To use both at the same time insert a 8-pin T-piece connector (see accessories).

3.2.3 Analog output

As an option you can connect the supplied data cable (3-pin /M8 plug) to the analog output plug of the VS. Connect the cable to a data logger or data acquisition system to read two selectable analog signals (vacuum 1, vacuum 2 or Tensiometer).

- ⚠ Never connect a voltage to the analog output.
- ⚠ If not in use always put the supplied protection cap on the plug connector to keep the plug dry and clean.

3.2.4 Vacuum ports

One or both supplied vacuum tubes (outer diameter 6 mm) are inserted into the quick-lock tube connectors.

Insert the tube into the opening until you notice a resistance. Now firmly press in the tube to pass the resistance. The tube should be fixed tightly.



Abb. 3.2: Tube connectors on a VS

To remove the tube push in the outer ring on the tube connector to release the tube.

3.2.5 Exhaust port

To reduce the noisiness of the pump it is recommendable to connect just a short piece of tube to the exhaust port. Insert this tube into a bottle for even better noise reduction.

- ⚠ The exhaust must never be blocked completely as a pressure of 3 bars might develop.

4 Operating a VS

4.1 Status LED

The 3-color LED indicates the current status of a vacuum circuit. The LED flashes once (VS-single) or twice (VS-twin, VS-pro) every 10 seconds. The first flash belongs to vacuum circuit 1, the second to vacuum circuit 2. If only one circuit is existing or activated the LED flashes only once.

The colours have the following meaning:

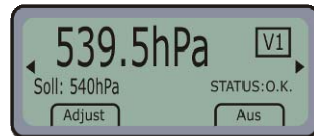
Green	=	Status o. k, system adjusted
Yellow	=	Regulation in progress
Red	=	Error occurred! (e. g. power supply failure, leak in the system)

4.2 Keypad operation (only VS-pro)

4.2.1 Key functions

Function keys F1 and F2

The current function of each key is displayed in the bottom line of the display right above each key.



Function key F1

In most menus the function is “Adjust” to allow the adjustment of a value with the up or down keys and “Apply” to save the setting.

Function key F2

In most menus this key is used for On/Off or for a selection.

Arrow keys up – down:

Adjust a setting or scroll through the menu.

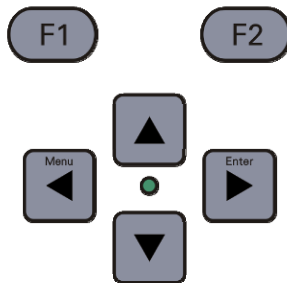
Arrow key left/Menu:

In the status display of V1 the menu list is opened.

In the status display of V2 skip to the status display of V1.

Arrow key right/Enter

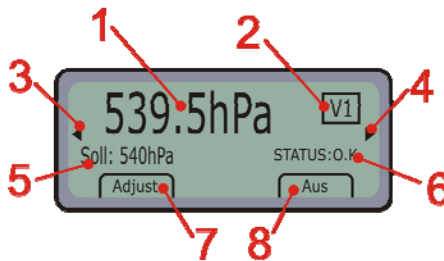
In the status display of V1 skip to the status display of V2.



In the menu list press this key to enter the sub menu of circuit V1. Press the key again to enter the sub menu for V2.

4.2.2 Display

In most menus the the display shows the settings of the selected menu.



- 1** **Current reading**
The current vacuum value of the selected vacuum circuit. The value is updated every 5 to 10 seconds. If a regulation is in progress the value is not updated.
In the Tensiometer menu the soil water tension of a connected Tensiometer is displayed.
- 2** **Vacuum circuit index**
Indicates which vacuum circuit is selected, either V1 or V2.
- 3, 4** **Arrows for navigation**
If visible the arrow key can be used to change the display.
- 5** **Menu and setting**
In most menus the abbreviation indicates in which menu you are. PSET is the Set Point/Measure menu, HYST the hysteresis menu, VOL the volume menu, etc.
The value shows the current setting of a parameter. Press F1 (Adjust) to adjust a value with the up or down keys. This is indicated by a small Up-down-symbol in the display. Then press F1 (Apply) to save the value.
- 6** **Status or mode**
In most menus the selected mode is indicated followed by the status of the mode.
- 7, 8** **Function of keys F1 or F2**
Shows the possible function of the function key beneath and corresponds to the parameter right above.
Field (7) indicates what can be done with field (5) by pressing key F1. Field (8) indicates what can be done with field (6) by pressing key F1.

4.2.3 Select vacuum circuit V1 or V2

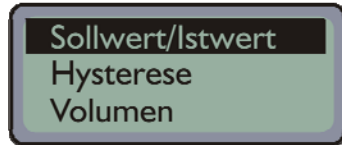
In any set-up menu press the arrow right key to switch from V1 to V2, and the arrow left key to switch from V2 to V1. The adjustment for each circuit is done independently.

! A vacuum circuit which is not used should be deactivated.

4.2.4 Menu list

Press the menu key to show the menu list:

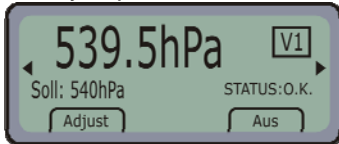
- Set value/current value
- Hystereis
- Volume
- Tensiometer
- Stored data
- Info
- Configuration



Scroll through the menu list with the arrow up or down. To enter the menu press the arrow right key. To return to the menu list press arrow left.

4.2.4.1 Set Point/Measure menu

The menu “Set Point/Measure” is the standard menu for operating the vacuum station. The VS-pro will always return to this menu when no key is pressed for a certain time.



In this menu adjust the set point and the status of each vacuum circuit.

Select the vacuum circuit. The field „Status“ indicates the status of the selected vacuum circuit:

OFF = Regulation (circuit) is not activated

O.K. = Circuit activated and vacuum within the limits

WAIT = Vacuum regulation is in progress

ERROR = Regulation is switched off due to an error

Press key F2 to change the status of the selected circuit. You can select „On“ or „Off“.

The status must be „On“ to change the settings of this circuit.

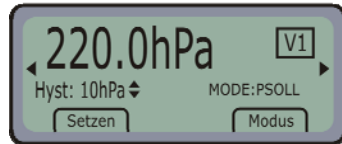
Press key F1 (Adjust), then change the set point with the arrow up or down key. To save the set point press F1 (Apply) again.

The VS-pro will now begin to regulate the vacuum.

4.2.4.2 Hysteresis menu

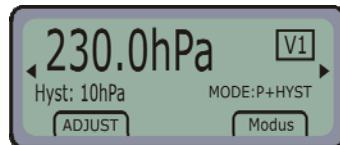
Go to the Hysteresis menu to adjust the hysteresis and regulation mode. Default setting is mode 1.

Please also see the introduction chapter about the three different hysteresis modes.



Press key F1 (Adjust), then change the hysteresis value with the arrow up or down key. To save the hysteresis value press F1 (Apply) again.

Press key F2 (Mode) to change the mode. Press F2 until the requested mode is indicated.



Mode 1: PSOLL

The vacuum is regulated bottom-up towards the set point: the upper threshold is the set point, the lower threshold the set point minus the hysteresis.

Example: PSET = 230 hPa and HYST = 10 hPa

The pump regulates to a vacuum of 230 hPa. The vacuum decent. As soon as a vacuum of 220 hPa is measured, the pump is reactivated to establish the set point vacuum of 230.

Mode 2: P+Hyst/2

The vacuum is regulated between an upper (PSET + ½ HYST) and a lower threshold (PSET - ½ HYST).

The pump establishes a vacuum of set point plus half of the hysteresis. The pump is reactivated as soon as the vacuum reaches the lower threshold, which is the set point less the half of the hysteresis.

Example: PSET = 220 hPa and HYST = 20hPa

The vacuum is regulated to 230 hPa. The pump is reactivated as soon as a vacuum of 210 hPa is measured.

Mode 3: P+Hyst

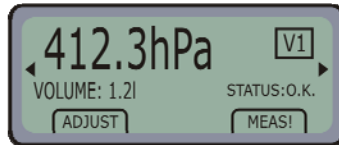
The lower threshold is the set point, the upper threshold is the set point plus the hysteresis. A vacuum of set point plus hysteresis is established. As soon as a vacuum equal to the set point is measured, the pump is reactivated.

Example: PSET = 220 hPa and HYST = 10 hPa

The vacuum is regulated to 230 hPa. The pump is reactivated as soon as a vacuum of 220 hPa is measured.

4.2.4.3 Volume menu

The regulation algorithm is optimized by considering the actual volume of the vacuum system. To get the best performance of regulation, the system volume should be set before the initial operation of a system. Either enter the (estimated) volume manually or perform an automatic detection.



Go to the volume menu.

Press key F2 (MEAS !) for automatic determination of the volume.

For manual set-up, press key F1 (Adjust)). Then change the volume (liters) with the arrow up or down key. Press F1 (Apply) to save the setting.

4.2.4.4 Tensiometer menu

Go to the Tensiometer menu. The current Tensiometer reading is displayed. In this menu you can select the Tensiometer type, the controlling mode and the tension difference.

Only one Tensiometer can be connected, but you have the following options:

- One vacuum circuit (either 1 or 2) is tension controlled, the other circuit works with continuous vacuum.
- Both vacuum circuits can be tension controlled, but a different tension difference and mode can be selected for each circuit.

For each circuit the settings have to be entered individually.

Select the Tensiometer type

Press key F1 (TYPE) to select the type of Tensiometer (T4 or T8)

The selected type is indicated in field [2]. If T8 is selected, the temperature is also indicated below the tension value.

Set-up the tension control parameters

Press key F2 (SCS) to enter the sub menu to set-up the tension control parameters. Select the vacuum circuit.

Press key F2 (MODE) to select either mode TENS or FIXED.

Mode TENS

The Tensiometer reading of the soil water tension now is the control variable.

Press key F1 (Adjust), then change the tension difference DIFF with the arrow up or down key. To save the tension difference DIFF press F1 (Apply) again.

Now the set point is the sum of the tension reading plus the tension difference. The set point will vary depending on the soil water tension. Note that the correlation of set point and upper and lower threshold are defined by the selected hysteresis mode.

Example: the tension difference DIFF is set to 50 hPa, the hysteresis mode is P+Hyst and the hysteresis is 20 hPa.

If the Tensiometer measures a soil water tension of 567 hPa the momentary set point is $567 \text{ hPa} + 50 \text{ hPa} = 617 \text{ hPa}$. Thus, the lower threshold is 617 hPa and the upper threshold is 637 hPa.

Mode FIXED

In the Tensiometer controlled mode instead of a fixed set point the desired tension difference to the current soil water tension, measured by the controlling Tensiometer, is displayed. Tension difference and mode can be selected individually for each vacuum circuit.

4.2.4.5 Configuration menu and sub menus

Configuration/Manual Control

In this menu you find an on and off switch for the pump, the switch valve and the air valve. You can manually start the pump and open or close the valves.

These functions are mainly used as a functional test.

Configuration/Display light

Time after which the display light switches off.

Configuration/Display contrast

Select the display contrast.

Configuration/Power supply

The large digits show the current power supply voltage.

The min and max value for the power supply voltage can be selected. If the voltage supply is out of range, the VS will not turn off, but the pump will not be activated any more. The VS will return to normal operation as soon as the supply is within the range again.

This prevents that a rechargeable battery is deep discharged or the VS unit is damaged by high voltage.

Press F2 (NEXT) to select V-MIN or V-MAX. Press F1 (Adjust) to adjust the settings, and F1 (Apply) to save the settings.

We recommend to use the default settings:

[U-MIN]: 10,5V

Prevent deep discharge of the rechargeable battery. In case a data logger or other devices are connected to the same rechargeable battery it is recommended to set [U-MIN]: 11,5V.

[U-MAX]:

For example, when a non-stabilized mains power supply device is used, it might be necessary to rise the upper limit of 14,5 V to maintain the operation.

Configuration/Error protocol

List of errors occurred during operation, indicated by the status ERROR of one of the vacuum circuits.

Note: set the system time of the VS correctly to track errors including a time stamp.

Configuration/System time

Select "System time" in the menu and press enter to display the system time.

To change the time press the function key F1 (ADJUST) and set the time with the up and down buttons.

Configuration/Calibration/IR water sensor

Each of the two vacuum circuits has an IR-sensor that recognizes water intrusion into the VS, and which will stop the vacuum pump to avoid a damage of the VS.

Under certain conditions the sensor might be disturbed by condensed water or small drops of water inside the tube. If the error list indicates a not existing water intrusion de-activate this sensor, but ensure that no water can intrude the pump.

4.2.5 Reset the device

In case of strange behavior or disrupted display appearances perform a reset. Any stored values or configurations are not lost by this.

Perform a manual reset:

- Press the key "Enter" and keep it pressed.
- Shortly press the key "Menu" until a click is heard.

The display content should be reestablished.

If this does not help, perform a cold boot: disconnect the power supply and wait for 2 minutes.

4.3 VS operation with tensioVIEW®

4.3.1 tensioLINK® Mini USB-Converter

The tensioLINK-USB converter is used to connect sensors and devices with serial *tensioLINK* interface to a PC. These sensors and devices then can be configured, and readings can be uploaded or taken online. The USB port provides the power supply. The interface is controlled with the Windows software *tensioVIEW*.



- ! Software, instructions and driver are available on the supplied CD.
- ! If you connect a T8 Tensiometer, please install a T-piece (see accessories in the appendix and chapter connections)

4.3.2 To work with tensioVIEW®

4.3.2.1 The Menu

tensioVIEW® has a simple menu for mostly self-explaining read-out and configuration of tensioLINK devices.

After starting tensioVIEW the display is more or less blank, most functions are inactivated.

Search Devices



If one or more sensors are connected via the USB-converter they can be searched by pressing the “magnifier” button.


tensioVIEW® offers two options for searching:

Single Device Mode



tensioVIEW® expects that only one device is connected which will be found very quick. This mode is not functional if more than one device is connected!

Multiplex device modes

 tensioVIEW® is able to detect up to 256 devices connected to the bus within 8 seconds, but only if each device is already personalized with an individual bus identification address. If two or more devices have an identical address, none of them will be found.

All devices found will be displayed in the left section as a directory tree. Same types of devices will be grouped in one directory.

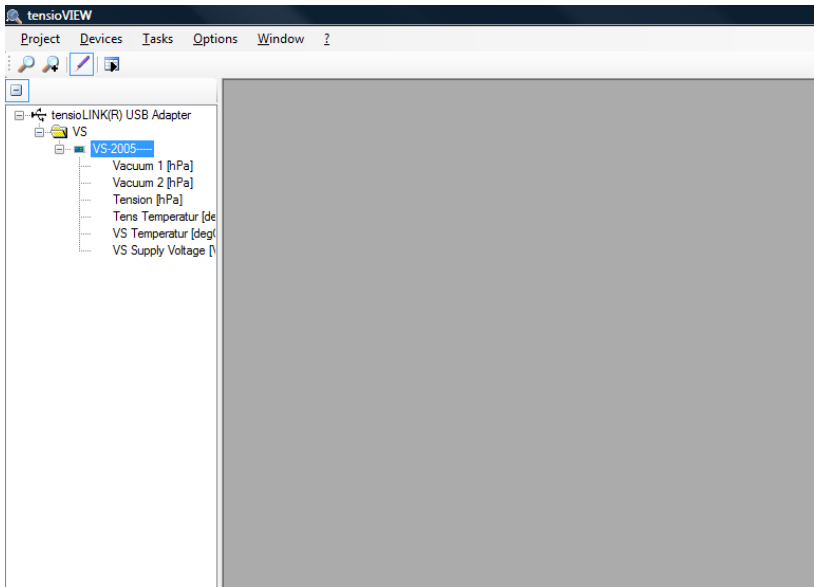


Fig. 4.1: Found devices in tensioVIEW

Detected devices will be displayed with their programmed names. Press the + symbol to see what readings the device can offer. Double-click on the name to open a menu window where all specifications and functions of this device are displayed. Depending on the type different registries are available. The first shows an overview of the current settings and information about address number or error messages.

4.3.2.2 Properties

The property window shows specifications and info about the device, like bus number, error status etc.

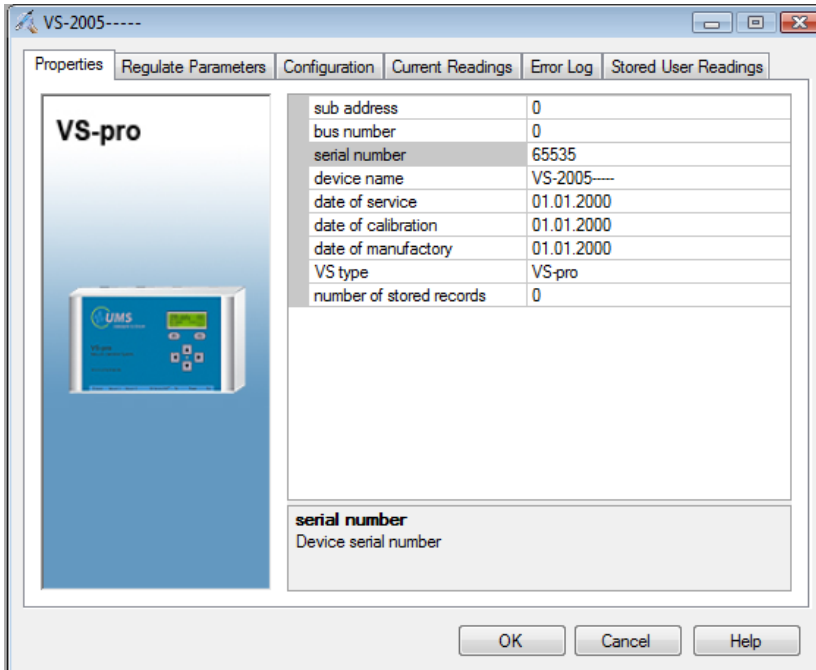


Fig. 4.2: Properties

4.3.2.3 Regulate Parameters

Volume

The regulation algorithm is optimized by considering the actual volume of the vacuum system. Either select the volume manually or press the button „Measure“ for automatic determination of the volume.

Execute this once before the initial operation of a system for each cycle. The system must be closed.

Press “Accept” to transfer the configuration to the VS/VS-pro.

Set Point/ Actual Value Hysteresis

This window shows the current vacuum and the settings and status of one vacuum circuit (VS-single) or both vacuum circuits (VS-twin, VS-pro).

The current vacuum is indicated by the large digits and is up-dated every 5 to 10 seconds.

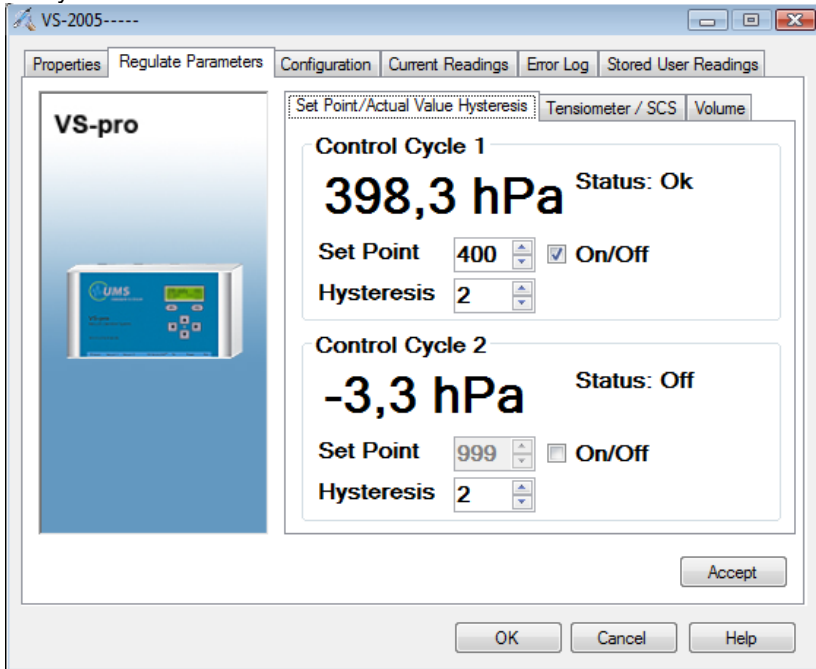


Fig. 4.3: Set Point/Actual Value Hysteresis

Set point and hysteresis are adjusted with the scroll buttons.

If a setting is changed the button „Accept“ is highlighted. Click on the button to send the settings to the VS unit. The VS should response to the changes within 10 seconds.

Tensiometer/SCS

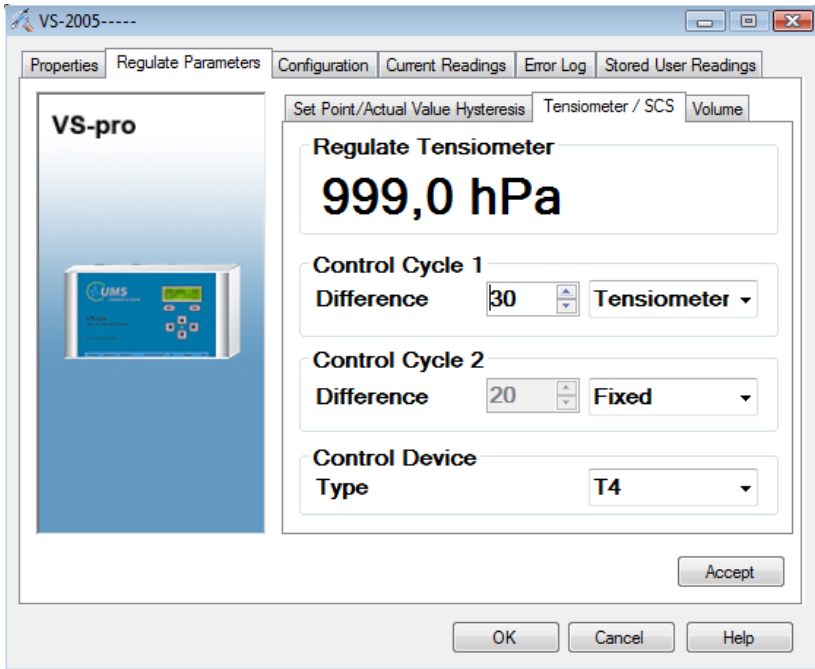


Fig. 4.4 Tensiometer / SCS

In this window the settings for the tension control can be adjusted. Select the Tensiometer type, the tension difference and the control mode. Click on „Apply“ to send the settings to the VS unit.

- ❗ Before a Tensiometer reading is accepted the related control circuit should be activated (in “set point/actual value Hysteresis“). The pre-set value is either the last stored reading or the default value 400 hPa after a new start-up.
- ❗ With older tensioVIEW versions the entered value for “set point/actual value Hysteresis“ must not be 999 as then data is not accepted.

In the Tensiometer/SCS menu observe the following:

- set to Tensiometer (as shown in fig. 4.4 for circuit 1)
- select the controlling Tensiometer
- enter a margin: at this not a fixed set point is given but a margin to the displayed Tensiometer reading.

For example if the Tensiometer reading is 115 hPa and the margin is set as 50 hPa the set point will be 165 hPa (displayed in “set point/actual value Hysteresis”) and the vacuum is re-adjusted accordingly.

The displayed status in the Set Point/Actual value menu (fig. 4.3)

OFF	Regulation is not activated
O.K.	Vacuum within the limits
CONTROL	vacuum regulation is in process
ERROR	The regulation is turned of due to an error
STOP	The regulation is stopped for a defined time schedule (Timeout).

4.4 Expert user functions

With tensioVIEW you can edit the numerous parameters and special functions for an optimised and convenient operation of your VS unit.

! Change of the special functions should only be done by expert users.

4.4.1 Configuration menu

Select the register "Configuration" for viewing and changing the programmed settings of the device.

Depending on the authorization status, only parameters that can be edited are shown. To store it in the device, a changed parameter has to be sent to the device by pressing the "Upload" button. A message notifying about the successful configuration will be displayed.

Configuration changes are effective immediately. The VS will re-start just as if they were connected to power.

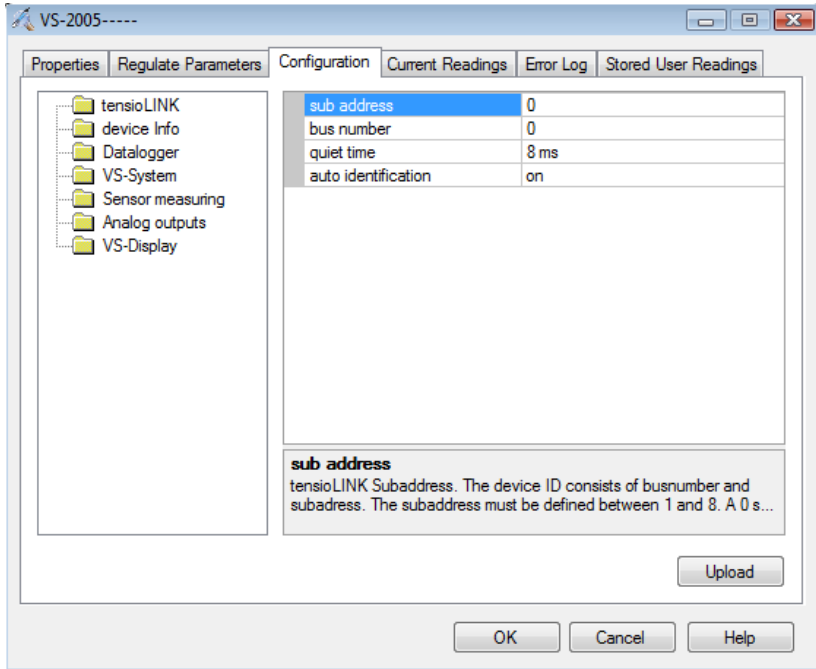


Fig. 4.5 Configuration /tensioLINK



tensioLINK

Busnumber

tensioLINK bus number of the device

Subadresse

tensioLINK sub address of the device

quiet time

Timeout after command in ms

Auto identifikation

Automatic bus identification during plugging the device

Explanation:

tensioLINK uses two types of address for each device, the bus address and the sub address. The reason for this is that there might be sensors installed at the same spot, but with different measuring depths (for example multi-level probes). In this case, the sub address defines the depth starting with 1 for the highest sensor. Furthermore, the sub address could be used to combine groups of sensors, for example of one measuring site.

In general the required identification for a device is always the bus number. If more than 32 devices are connected to the bus the sub address is counted up. The allowed numbers for the bus address are 1 to 32 and for the sub address 1 to 8.

The default value for both bus and sub address is 0. With more than one device connected individual addresses have to be declared.

Device info

Device name

Individually editable name of the Tensiometer in ASCII. Maximum length 12 digits

Data logger

Interval

Logging interval of the internal logger

Values to set: off, 1,10,30 Min, 1h, 6h, 12h, 24h

Overwrite old values

With ring buffer activated the oldest readings are overwritten when the memory space is full.

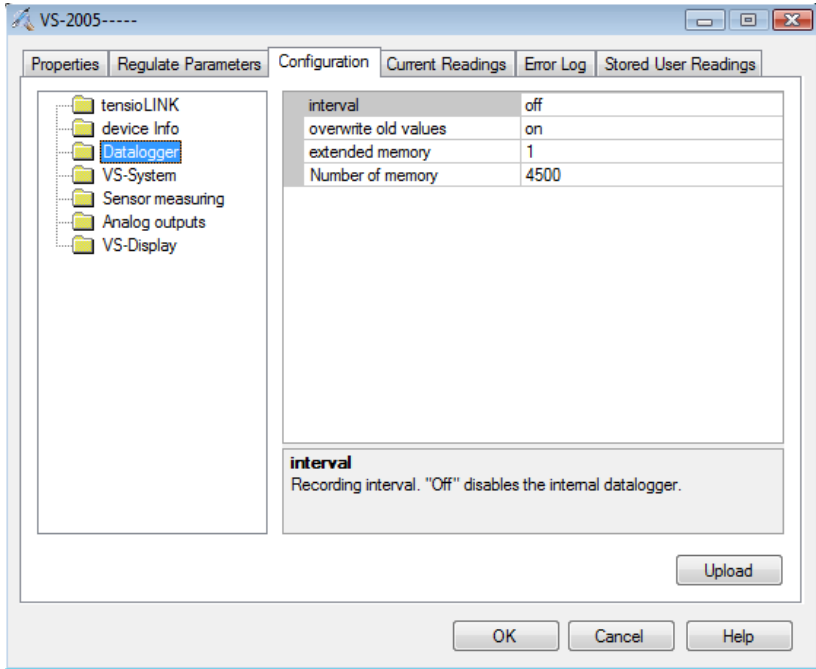


Abb. 4.6: Configuration internal Datalogger

💡 The data is lost, if you disconnect the power unit

VS System

At the register “VS System” you can set the following parameters:

Power save mode

Activates power save mode between the measuring intervals. Analog outputs will be switched off, if the power save mode is activated.

Forced regulation interval

Select an interval for a timed regulation: Off (automatic regulation), 1, 5, 10, 30 sec, 1, 5, 10, 30 min, 1 h.

If a certain interval is selected here the regulation (comparison of set and actual value) is only executed at the pre-set interval. If the interval is set to “Off” the regulation is executed automatically whenever required.

Minimum battery voltage

Lower limit of the supply voltage: if the voltage drops below this value the vacuum regulation is discontinued until the voltage is within the limits again.

Maximum battery voltage

Upper limit of the supply voltage: if the voltage rises beyond this value the vacuum regulation is discontinued until the voltage is within the limits again.

Recovery time after water intrusion

Timeout in seconds after water intrusion to the circuit is detected: after this interval the pump switches on again and ventilates through the exhaust.

Hold time after not establishing vacuum

Timeout after failure of establishing the vacuum. E.g. System is leaky.

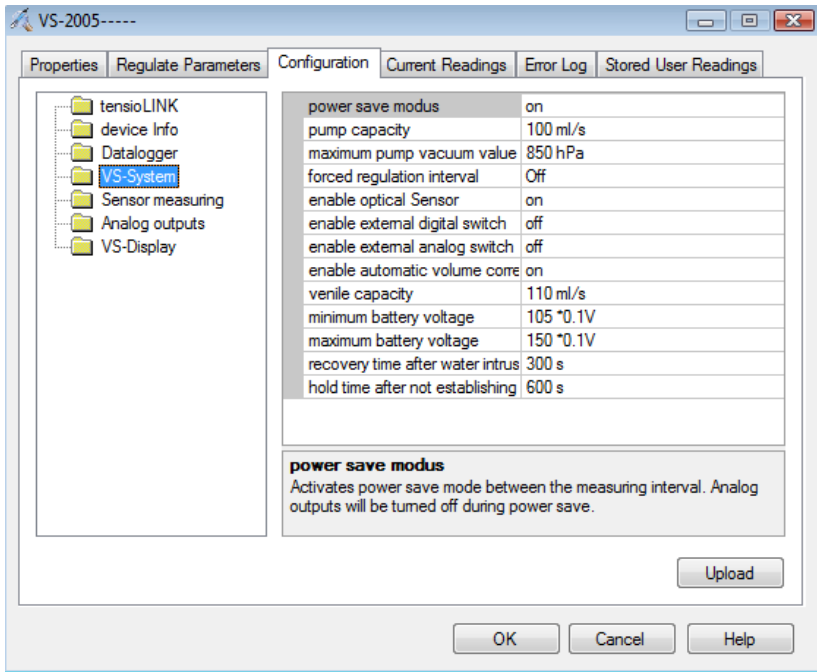


Fig.4.7 Configuration VS-System

Sensor Readings

At the register “VS System” you can set the following parameters:

- Measure interval: actualisation in sec (Off, 1,2,5,10, 20,30,60 sec)
- Enable Tensiometer measuring: on (external Tensiometer is activated); off (external Tensiometer is deactivated)
- External Tensiometer type: choose the type of external Tensiometer (T4, T8/TS1, tensioLINK)

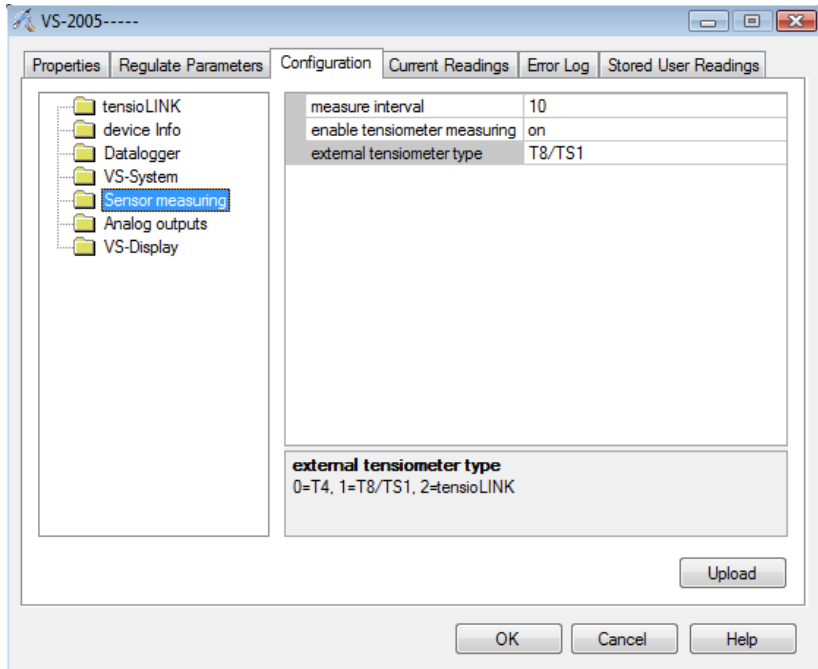


Abb.4.8 Configuration Sensormeasuring

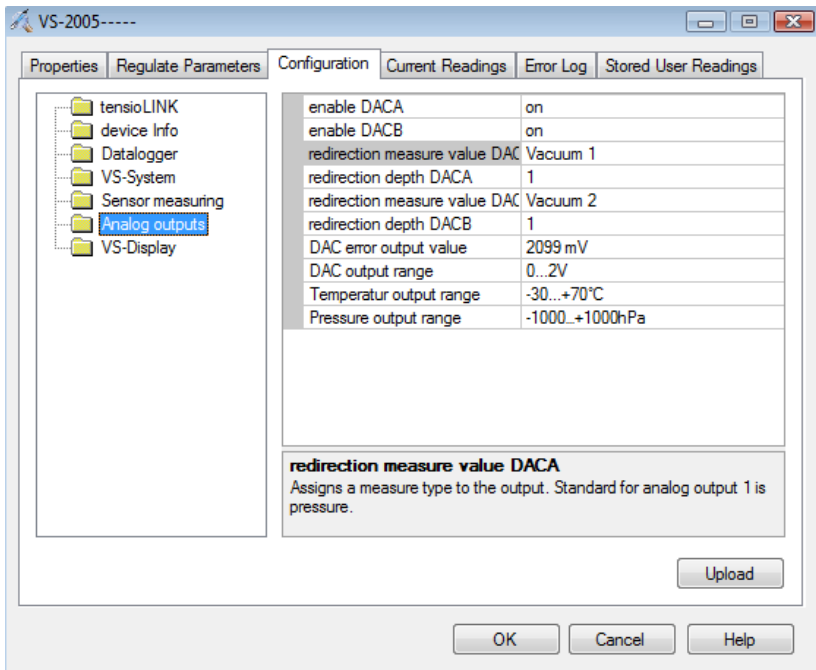
📁 Analog Outputs (DAC)

Enable DACA active

On/off: Turns on/off the analog output 1

Enable DACB active

On/off: Turns on/off the analog output 2



Redirection measure value DACA

A sensor reading can be associated to analog output 1. Standard for analog output 1 is vacuum1.

Redirection measure value DACB

A sensor reading can be associated to analog output 2. Standard for analog output 2 is vacuum2.

Redirection depth DACA

For multilevel probes the DACA reading can be associated to a certain depth. Then, tensioLINK will take readings using the same bus address plus the sub address. For the default value depth = 1 the internal sensor readings are used.

Redirection depth DACB

Associate a depth to reading DACB.

DAC error output value

Error output value for DAC [mV]. If an incorrect reading occurs (e. g. filling status insufficient) this voltage value will be put on the analog output.

DAC output range

Set the output range of the analog reading to 0 to 1 V; 0 to 2 V or 0 to 5 V. A sensor reading will be amplified within this range, for example -100 kPa to +100 kPa can correspond to 0 to 2 V.

Temperature output range

Output range for temperature.

Pressure output range

Output range for pressure.

 **Display**

Changing of the display settings:

language, contrast, active, display light timeout, display mainfunction timer (back to the main menu)

4.4.2 Current readings

Enter the interval in which readings should be taken and click on „Start“. The readings of vacuum 1, vacuum 2 and soil water tension are recorded (but not stored).

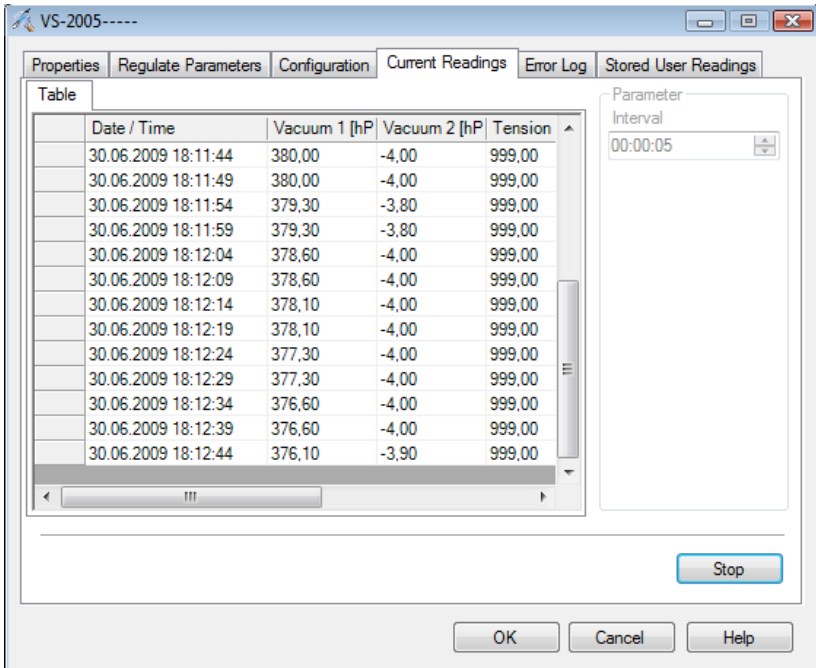


Abb.4.9 Current readings

4.4.3 Error messages window

All errors that have occurred during the operation are listed with error number, date, time and error message.

Click on „Delete“ to delete the list..

4.4.4 Stored readings window

Logged data can be downloaded to a csv-file.

4.4.5 External de-activation

It is possible to externally de-activate or activate the vacuum circuits of the VS units. This can be done for example by certain data loggers. The T8/tensioLINK plug input is used to send the signals to the VS unit.

For information about this topic please ask for the special application note „External de-activation of VS units“.

Note: this is only possible for VS with firmware 1.5 or higher

4.4.6 Up-date the firmware

Please ask your local distributor or UMS

5 Service and maintenance

5.1 Functional test

Manually you can check the functions via keyboard. (Configuration/ Manual Control). In this menu you find an on and off switch for the pump, the switch valve and the air valve. You can manually start the pump and open or close the valves.

6 Protecting the measuring site

6.1 Theft and vandalism

The site should be protected against theft and vandalism as well as against any farming or field work. Therefore, the site should be fenced and signposts could give information about the purpose of the site.

6.2 Cable protection

Cables should be protected against rodents with plastic protection tubes. UMS offers dividable protection tubes as accessory. For long term studies we recommend to dig cables a few centimeters below soil surface inside protection tubes

6.3 Frost

6.3.1 Protection against frost

The Vacuum Unit VS-single...pro can be operated up to – 10 degC.

We normally recommend to stop the

Suction cups, bottles and tubes are filled with water and therefore are endangered by frost!

For all-season operation install suction tubes in a frost-free depth and the sampling bottles in an insulated and buried box.

6.4 Lightning protection and grounding

In-the-field measuring equipment is always susceptible to electrical surge. UMS sensors and stations are protected against over voltage and false polarity as far as this is technically achievable.

But there never can be total lightning protection. Lightning strikes are unpredictable and vary significantly with region, voltage and destructiveness. A proper lightning protection has to be considered whenever a system with several sensors and loggers is installed.

Passive lightning protection measures would comprise one or more grounding rods, preferably with ground water contact, but without (!) an electrical connection to the measuring system.

With an active lightning protection each sensor and the logger are equipped with an individual grounded surge protection module. Unfortunately, these are very expensive.

Please contact UMS or your UMS dealer for assistance about integrating T8 into your measurement system.

General recommendations for lightning protection and grounding for stations with battery power	
First step	Measure the voltage drop between sensor positions, data acquisition etc. to get to know the potential levels
Recommendations for lightning protection on masts	2 or 3 meter masts can be equipped with a lightning rod which is installed on top of the mast, and a grounding rod which is clamped to the foot of the mast. This creates a certain protected space in a 45 degree angle around the tip
Recommendations for lightning protection of enclosures	Surge protection devices are installed in one corner inside the measuring enclosure. All lines to and from the surge protection devices should not run parallel.
System protection of stations with enclosure and mast	Lines to equalize drops in the electrical potential between mast and grounding rod are installed 50 cm below the soil surface.
Lightning protection with grounding rods	According to the standards the ground rod (diam. 25 mm) must be inserted into the ground for a minimum of 2,5 meters below the frost level, i. e. in general 3 meters. Cross shaped rods are less advisable for such low depths, but this depends on soil type, moisture or clay content, and distance between soil surface and ground water level.

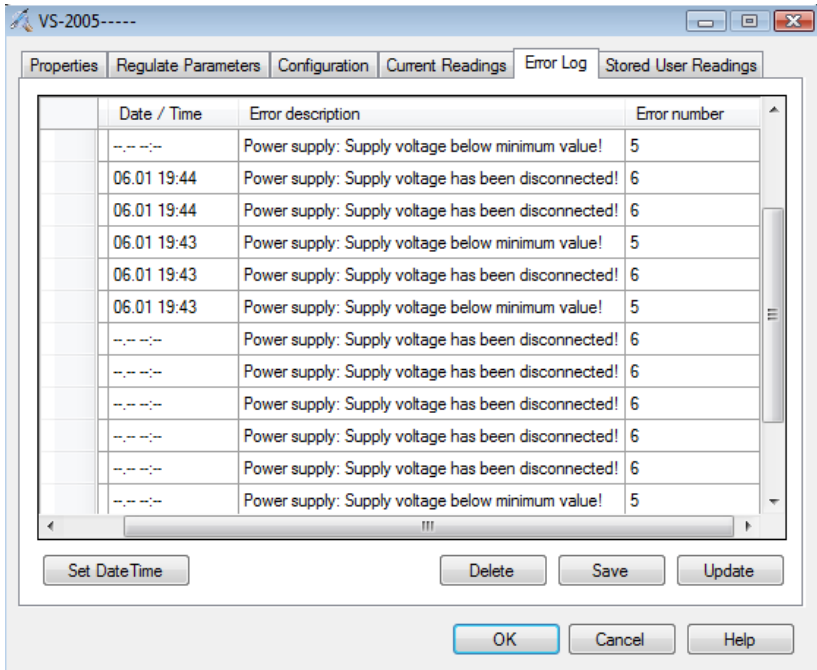
7 Error descriptions

With tensioVIEW it will be shown on the screen

→ Device/Error Log (see figure below)

Errors and description can be displayed via keyboard

→ Configuration/Error Protocol. (only with VS-pro)



Error log no.	Error description	Possible cause	Correction
0	None error occured!		
1	Regulation: Set Point could not be reached!	Water has intruded the vacuum unit through the tube	<ul style="list-style-type: none"> - Check all tubes and connections. - Check for broken cups on samplers - Determine and enter the volume → 1.3.5


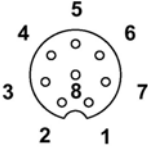


Error log no.	Error description	Possible cause	Correction
2	Regulation: Water intrusion into vacuumsystem 1!	Wasser ist über den Schlauch in die Vakuumstation gelangt	Disconnect the tube on the unit's vacuum port. The VS unit will automatically try to remove the water by repeated pumping.
3	Regulation: Water intrusion into vacuumsystem 2!	Wasser ist über den Schlauch in die Vakuumstation gelangt	Disconnect the tube on the unit's vacuum port. The VS unit will automatically try to remove the water by repeated pumping.
4	Power supply: Supply voltage above maximum value!	The supply voltage is too high. Regulation is not activated to protect the pump.	Assure that the power supply range is between 10.5 ...15 V. In case of high off-load voltage the upper limit can be heightened → 3.2.1
5	Power supply: Supply voltage below minimum value!	Battery discharged or supply voltage not sufficient.	Check the supply voltage (>10.5 V?)
6	Power supply: Supply voltage has been disconnected!	Power supply cable has been disconnected.	Check power supply cable and power supply.
7	System: Condensation in housing!	Housing cover not properly closed, or high variation in temperature	Open the cover and allow the interior to dry. If corrosion is visible send in the unit to UMS.
8	System: vacuum system measured value out of range!	Pressure transducer defective	Unit needs to be send in. Please contact UMS or your dealer.
9	System: Operating temperature out of range!	Enclosure or surrounding is too warm.	Provide appropriate heat-up protection like ventilation or shading.
10	System: Display error!	Display error	Disconnect the power supply for about 2 minutes.
	Display is black	Display heated due to extreme solar irradiation	Disconnect the power supply and allow the unit to cool down.
	Digits on display unreadable	Display error	Disconnect the power supply for about 2 minutes.
	Status message is "STOP" - regulation is not active	Timeout procedure is in progress (after an error has occurred a timeout procedure is executed when the regulation is automatically re-activated). or: Regulation was stopped on purpose through an external source →4.4.5 or: Timer-controlled inactivation of the regulation	Wait until the regulation starts again, or change the set-up.

8 Appendix

8.1 Technical specifications

	VS	VS-pro
Power Supply		
Battery or mains adapter Voltage range (V _{in})	10,5 V-15 V	10,5 V-15 V
Current consumption		
Average value	ca. 15 mA	ca. 16 mA
Standby	ca. 1 mA	ca. 2 mA
Valve and pump operation	50..800 mA	50..800 mA
Connections		
Interface	tensioLINK RS485	tensioLINK RS485
Analog output (adjustable)	2* 0...2 V	2* 0...2 V
Analog input (T4)	yes	yes
Analog input (T8) similar to RS485 interface	yes	yes
Tube connections		
Connector, outer diameter	6mm	6mm
Housing		
Material	Aluminium	Aluminium
Protection	IP66	IP66
Dimension	380*600*215 mm	380*600*215 mm
Vacuum control		
Range	0....-850 hPa	0....-850 hPa
Accuracy	+/- 0,5 hPa	+/- 0,5 hPa
Data storage	4500 Readings	4500 Readings
Operating temperature	-10 °C...40 °C	-10 °C...40 °C

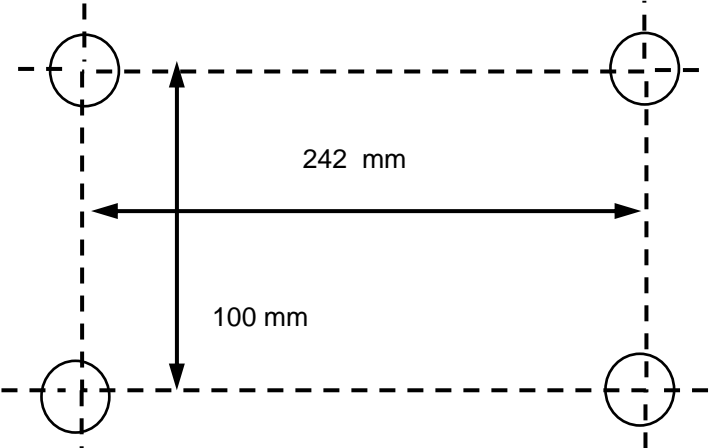
8.2 Connector pin assignment

M12-4pol. male plug (4) Power				
Signal	Color	Pin	Function	
V+	white	1	Vin 10..14.5 V	
V+	brown	2	Vin 10..14.5 V	
V-	black	3	GND	
V-	Blue	4	GND	
M12-8pol. female plug (5) Tensiometer T8/tensiOLINK				
Signal	Color	Pin	Function	
V+	white	1	VDC (Vout)	
GND	brown	2	GND	
A-IN1	green	3	pressure T8 (Signal +)	
S-	yellow	4	Signal-	
dig. IN	grey	5	Status	
A	pink	6	RS485-A	
B	blue	7	RS485-B	
A-IN2	red	8	Stand.:Temp T8	
M12-4pol. female plug (6) Tensiometer T4				
Signal	Color	Pin	Function	
V+	brown	1	VDC (Vin)	
S+	white	2	pressure T4 (Signal +)	
GND	blue	3	GND	
S-	black	4	signal-	
M8-3pol. plug (4) Analog Output Signals				
Signal	Color	Pin	Function	
OUT2+	brown	1	analog outp.2+	
OUT1+	black	2	analog output.1+	
GND	blue	3	signal- (common)	

8.3 Mounting

The VS is designed for wall mounting.

Drilling plan: diameter driller: 6 mm



8.4 Accessories




Please contact UMS for the following accessories!

8.4.1 tensioLINK


Article	Art .No	Description
T-piece	tL-8/T	T-piece junction plug (8pin), 2 bus inputs (female), 1 bus output (male). Recommended to connect a T8-Tensiometer

8.4.2 Tubes


Article	Art .No	Description
tube PE,	SL- PE/6.0	Tube PE, diameter 6,0 / 4,0 mm




Article	Art .No.	Description
	SF-500 SF-1000 SF-2000 SFK	500 ml bottle 1000 ml bottle 2000 ml bottle Sampling bottle 500 ml, implosion protected, with screw cap for up to 3 tubes Spare cap for sampling bottle GL45, blue, for up to 3 tubes
	SF-Clip	Clip for wall mounting of sampling bottles
	SF-protect	Automatic valve for sampling bottles, Overflow protection or free choosable sampling volume, Incl. T-piece

8.4.3 Field-PVC-Box

Article	Art .No.	Description
	SF-FIELDBOX/VS	Field-PVC-box with 6 sampling bottles SF-1000, ea. with SF-protect overflow valve, preassembled tubes and T-connectors, L 400 x B 300 x H 350 mm, incl. 6 lead-throughs PG9 for suction cup tubes and reinforced side walls for subsurface installation

8.4.4 Suction cups



Article	Art .No		Description
SK20 suction cup	SK20-.../....		SK20 simple ceramic cup with removable shaft. For continuous and discontinuous extraction. Suitable for determination of nitrate and common organic and inorganic substances

Article	Art .No		Description
SIC20 suction cup	SIC20- .../....		<p>Pore water sampler SIC20 with removable shaft like the SK20, but with a SiC silicon carbide cup instead of the ceramic cup. SiC is sintered at 2500°C and is less absorbent/desorbent than ceramic or borosilicate. The bubble point 90 kPa. UMS SiC cups are patented.</p>
SKPE suction cup	SKPE25- .../....		<p>The sampled solution is stored inside the shaft and is collected by applying a pressure to the additional tube. With ceramic cup.</p>
SPE20 suction cup	SPE20- .../....		<p>Instead of a ceramic cup the SPE20 pore water sampler has a porous PE-nylon-membrane which is specially suitable for heavy metals and whenever ceramics are inappropriate.</p>

8.4.5 Suction plates

Article	Art .No	Description
Porous glass suction plate	SPG120-1/8"	Porous glass plate, made of Duran glass, porosity 1 ... 1,6 micrometer, bubble point min. 60 kPa, diam. 120 mm, thickness 8 ... 10 mm, tube connector w. outer diam. 1/8", incl. 2 m Teflon tube
Porous glass suction plate with Teflon foil	SPG120-T	Porous glass plate, made of Duran glass, bottom side sealed with Teflon foil, porosity 1 ... 1,6 micrometer, bubble point min. 60 kPa, diam. 120 mm, thickness 8 ... 10 mm, tube connector w. outer diam. 1/8" , incl. 2 m Teflon tube
Porous silicon carbide suction plate	SIC275	Porous silicon carbide plate, 0,1 bar high flow, diam. 285 mm, thickness 5 mm, with rubber foil backing, stainless-steel outflow tube connector w. diam. 5 mm
Porous silicon carbide suction plate	SIC300	Porous silicon carbide plate, 0,1 bar high flow, diam. 310 mm, thickness 1 cm, with rubber foil backing, stainless-steel outflow tube connector diam. 5 mm
Stainless steel lysimeter	KL2-300	Lysimeter made of stainless steel, inner diameter 300 mm, wall 2 mm, height 300 mm, with ceramic bottom plate 0.5 bar high flow, flow rate 2 ltr/hour at 2 kPa (approx. 28 mm/h), with tube connector on bottom side, suitable for monolithic extraction

8.4.6 Tensiometer

Article	Art .No		Description
T4 Tensiometer	T4-... T4e-...		<p>Pressure-Transducer-Tensiometer, cable length 1.5 m from ceramic cup with 4-pin plug M12/IP67. Select the tensiometer length 20 ... 120 cm on your order! (shaft is 11 cm shorter)</p> <p>T4e refillable with syringe</p>
T8 Tensiometer	T8-...		<p>Long term-Monitoring-Pressure-Transducer-Tensiometer, refillable with syringe, temperature sensor, fill level indicator, default signal range 0...2V, (select alternative signal range 0...1V or 0...5V on your order), cable length 1.5 m from ceramic cup with 8-pin plug M12/IP67. Select the tensiometer length 40 ... 120 cm on your order! (shaft is 18 cm shorter)</p>

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Strictly observe rules for disposal of equipment containing electronics.
Within the EU: disposal through municipal waste prohibited - return electronic parts back to UMS.



■
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WEEE-Reg.-Nr. DE 69093488

