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bambach tensio-technik

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Overview

For analogue measurements of the suction tension

A tensiometer is used to measure suction tension. The porous cell of the tensiometer uses capillary action to transport water outwards into the drier soil. A negative pressure is then created within the closed pipe. This negative pressure is an indication of the moisture. Suction tension is a force measuring the tension with which the water is held to the soil or its availability. Plant roots must expend this force in order to absorb water. The decisive factors in creating this force are the fine pores and capillaries in the soil.

This soil characteristic which the tensiometer measures is critical for plant growth. One advantage this instrument has over electrical meters is that it does not need to be calibrated. The value of the suction tension increases as long as the substratum is capable of transferring the water and as long as the moisture differential is maintained. If the surroundings become more moist, the the process reverses itself. Close contact with the substrate is needed to get a quick tensiometer reaction and to get a value for certain soil and substratum types.

Tensiometer types:
The available tensiometer base components are classified as small tensiometers or premium tensiometers according to their length and diameter. The tensiometer base components also differ in their connection thread and are classified into the types GL, BL, IT and IT 45.

Display:
The measured value is displayed directly at the measuring point at a manometer that is screwed onto the base of the tensiometer.

Further processing:
Converts the suction tension to an electronic signal when one of the sensors is screwed onto the tensiometer base. Generates a continuous measuring signal using E-sensors or by setting a switching point by means of switching sensors for automatic irrigation.

Overview of products and combinations

Base of tensiometer					+	+ Display		or + Display with further processing	or + Further processing without display		
						Manometer		Manometer with additional output	Switching output		Analogue output
						Analogue *Page 8*	Digital *Page 9*	T-piece 45	M-sensors *Page 10*	Tensio-Switch *Page 11*	E-sensors *Page 12*
Threaded connection											
Usage	**Measuring depth**		**Type**	**Page**		**GL**	**BL**	**IT (45)**	**GL**	**GL**	**GL**
Surface	0 cm	Surface tensiometer	**FV**	*5*		Mx00		IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
	approx. 5 cm		**FO**	*5*		Mx00		IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
Pots > 8 cm	approx. 8 cm	Small tensiometer	**KV02**	*6*		Mx00		IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
Common pot sizes	10 cm to 20 cm	Small, premium tensiometers	**KV2, LM**	*6*		Mx00		IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
Embankment/ gutter crops	15 cm to 25 cm	Small, premium tensiometers	**KV2, LM**	*6*		Mx00		IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
Normal crops	15 cm to 45 cm	Premium tensiometer	**LM**	*7*		Mx00	BD	IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx
Trees	55 cm to 75 cm	Premium tensiometer	**LM**	*7*		Mx00	BD	IT(45)	M-Sx	TSW-400	ES-Ax, ES-(3)Vx

Surface tensiometer

Surface tensiometers can be used for measuring the moisture on irrigation fleeces, on substrate surfaces, within the substrate, as well as on other technical fleeces. Together with a switch sensor as a Tensiostat or E-sensor, they are used for irrigation control in mat irrigation systems – with either drip or flood systems – or in thin-layer crops with drip systems. This type of surface tensiometers is only suitable for short-term use at suction pressures above approx. 300 hPa, since frequent refilling is necessary. In contrast to the open version (FO), the closed version (FV) can also be used directly at surfaces.

Type FO – 501100

Type FV – 501110

TECHNICAL SPECIFICATIONS:

Clay foot:	approx. diameter of 70 mm
Design:	Type FV: top side has stable foil Type FO: top side is open-pored
Threaded connection:	GL14 for analogue manometers IT: one each for GL14 and BL, as integrated T-piece 45° IT45: for two GL14s as integrated T-piece 45°
Total height:	65 mm with GL connection, plus manometer 110 mm with IT(45) connection, plus manometer
Viewing window:	none

Top	Connection for analogue manometer Type / article number	Connection for T-piece for two analogue manometers Type / article number	Connection for Digital manometer
closed	FV-GL / 501110	FV-IT45 / 501110-IT45	On request
open-pored	FO-GL / 501110	FV-IT45 / 501110-IT45	On request

→ *Information about selecting:*
All tensiometers are made up of two components: a tensiometer base and a manometer or sensor.
These components can be combined in many ways and must be selected specifically for each application.

Small tensiometer

Small tensiometers have two different sizes of the porous cell: ø 10 mm for type KV02 for the smallest vessels (pots from approx. 8 cm), also in embankments or gutters;
and ø 15 mm for type KV2 for common pot sizes and also for loose and granulated substrates, as well as medium-sized containers or shallow-rooted bedded plants (LM). For the smaller types, the maximum suction power is limited to max. 200 – 300 hPa, due to their design and the corresponding smaller filling volume. The tensiometers are inserted to depths of 40 – 70 mm or 50 – 80 mm.

Connections for analogue manometers, switching sensors and E-sensors, also with integrated T-piece. The Premium plug-in tensiometers are also available in small sizes with lengths of 16 and 19 cm, with a porous cell diameter of 20 mm and a tube diameter of 25 mm. They have the advantage of a larger filling quantity, but there must be sufficient space at the measurement location for the larger porous cell. Small plug-in tensiometers are often used as tensiostats with switching sensors for irrigation control. They are also often combined with electronic sensors, for controlling or merely for recording moisture profiles. Using T-pieces, it is possible to add manometers (e.g. to monitor the switching points). The water column is usually not calculated using the small tensiometers.

TECHNICAL SPECIFICATIONS:

Tube diameter:	KV02: ø 15 mm KV2: ø 18 mm LM: ø 25 mm
Porous cell:	Type KV02 approx. ø 10mm x 30mm, cylindrical Type KV2 approx. ø 15mm x 40mm, cylindrical Type LM approx. ø 20mm x 60mm, cylindrical
Threaded connection:	GL14 for analogue manometers IT: one each for GL14 and BL, as integrated T-piece 45° IT45: for two GL14s as integrated T-piece 45°
Overall length:	Type KV02-x 12cm Type KV2-x 15cm Type LM-x 16 or 19cm
Viewing window:	yes, approx. 3 cm

Type KV02

Type KV2

Type LM

→ *Note:*
The smallest tensiometers (KV1/01) with even shorter lengths (of approx. 8.5 cm) are also available on request with a capillary tube extension; the viewing window is then not available.

Porous cell	Overall length	Connection for analogue manometer Type / article no.	T-piece connection for analogue manometer and GL14 Type / article no.
ø 10 mm x 30 mm	12 cm	KV02-GL / 501202	
ø 15 mm x 40 mm	15 cm	KV2-GL / 501206	KV2-IT45 / 501206-IT45
ø 20 mm x 60 mm	16 cm 19 cm	LM-GL / 50123216 LM-GL / 50123219	

Premium plug-in tensiometer

The special features of this type LM-x design are the spacious, stable tube and the strong, long, cylindrical porous cell. In addition to its mechanical stability, a key advantage is the longer service life (and less maintenance) that results from the greater filling volume. The Premium plug-in tensiometers, when used together with analogue or digital manometers as well as electronic sensors, are perfect for all soil measurements involving insertion depths of approx. 10 –15 cm. The tensiometer tube protrudes only approx. 8 –10 cm out of the soil for monitoring purposes. Thus, the maximum insertion depth (measuring depth) is less than the specified total length. (This does not apply to small and very small tensiometers.)

The overall length should be adjusted accordingly to avoid temperature influences resulting from tubes that protrude too far out. Due to the different thread connections, the type LM-x is well suited for switching sensors during irrigation control, and can also be combined with the digital manometer for on-site monitoring.

TECHNICAL SPECIFICATIONS:

Porous cell::	approx. ø 20 mm x 60 mm, cylindrical with tip
Tube:	ø 25 x 3 mm
Threaded connection:	GL14 for analogue manometers BL for digital manometers IT: one each for GL14 and BL, as integrated T-piece 45° IT45: for two GL14s as integrated T-piece 45°
Overall length:	24/34/44/54/64/74 cm, others available on request
Viewing window:	yes, approx. 7 cm when at least 34 cm, smaller and different when less than 34 cm

Threaded connection GL14

Threaded connection BL

50123254

Overall length

	Type LM-GL for - analogue manometer - E-sensors - M-Sensors / TensioSwitch	Type LM-IT with T-piece Threaded connection - one GL - one BL	Type LM- BL for - digital manometer	Type LM-IT45 with T-piece Threaded connection - two GLs
Overall length	**Article number**	**Article number**	**Article number**	**Article number**
24 cm	50123224	50123424	50123024	50123124
34 cm	50123234	50123434	50123034	50123134
44 cm	50123244	50123444	50123044	50123144
54 cm	50123254		50123054	
64 cm	50123264		50123064	
74 cm	50123274		50123074	
84 cm	50123284		50123084	
94 cm	50123294		50123094	

Usage	Overall length	Insertion depth
Vegetable crops, soft fruits, small woody plants, root zone	24 cm to 34 cm	approx. 15 cm to 25 cm
Woody plants, trees, root zone	44 cm to 54 cm	approx. 34 cm to 44 cm
Depth measurements for trees, Monitoring seaping (leakage) water	64 cm to 94 cm	approx. 54 cm to 84 cm

Manometer

Analogue, mechanical manometer (pointer manometer)

The classic tensiometer consists of a tensiometer base component and a manometer. As a pressure measuring instrument, the manometer displays the suction tension of a tensiometer directly and without any preparation. The devices are maintenance-free and very durable, but must be treated as a sensitive measuring device and handled with appropriate care. The measuring element is a capsule spring that can be overloaded up to a pressure of -1 bar (1,000 hPa). The accuracy is generally 1.6 % of the measuring range. The manometers are calibrated individually; the actual deviation is indicated on the test label. The setting is adjustable (zero point adjustment). These special manometers can be used for all tensiometer measurements. Together with switching sensors(+ T-piece), they are used to take control measurements or to assess the set switching point. However, it should be noted that with direct-switching tensiostats, the reaction speed when switching them off is somewhat slower because of the manometer.

50170x

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Digital manometer

The digital manometer consists of a piezo-resistive pressure sensor (comparable to an E-sensor) and display electronics with battery power supply. It must be switched on by pressing a button. In all other respects, the usage is similar to the mechanical manometer; the digital manometer and switching sensors (M-sensor or TSW) can be used together by means of a T-piece. The manometer is maintenance-free and can be used in a range from – 5 to +40 °C. The replaceable lithium battery (CR 2032) has a service life of approx. 10,000 cycles.

TECHNICAL SPECIFICATIONS:

	Analogue manometer
Design:	Capsule spring
Housing:	Stainless steel
Overload protection:	1000 hPa
Accuracy class:	1.6
Diameter:	ø 50 mm
Connection thread:	Screw cap GL14
	Digital manometer
Measurement range:	15 – 800 mbar
Accuracy:	± 2 mbar
Display duration:	10 seconds
Battery:	CR2032
Diameter:	ø 45 mm
Connection thread:	BL

501725

501721

501313

501725

	Type M 400	Type M 600	Type BD (digital)
Article number	**501705**	**501707**	**5017211**
Measurement range	0 to 400 hPa	0 to 600 hPa	15 to 800 hPa
Accuracy	±5 hPa	±5 hPa	±2 hPa
Resolution	5 hPa	10 hPa	10 hPa
Set-point deviation	specified for 3 values	specified for 3 values	not specified
Design	Capsule spring	Capsule spring	Pressure sensor
Zero point	adjustable at front	adjustable at front	Zero point reset
Display	Pointer	Pointer	digital 10 sec. display duration
Protective cap			501725
Further features	robust, precise, maintenance-free	robust, precise, maintenance-free	precise, maintenance-free

Accessories	
Product	**Article number**
Digital manometer Type BD	501721
Adapter GL14 > IT45	501312
Thread adapter GL14 > BL	501313
Protective cap for digital manometer	501725

M-sensors

Switching sensors

"M-sensors" are electromechanical negative pressure monitors that upgrade the tensiometer base to a tensiostat and give it switching capabilities. These negative pressure monitors are membrane switches typically used for low voltage (e.g. 24 V) in a defined, limited switching range. They allow infinitely variable adjustment of the switching point, but with no scaling.

For automatic irrigation, M-sensors are usually connected to an automatic irrigation machine (sensor switches on, machine switches off). Direct switching operations through a 24 V transformer (depending on the solenoid valve voltage) are also possible;
here, the tensiostat switches on and off. The necessary irrigation time must be observed irrespective of the suction tension. The M-sensors must be carefully protected when used in humid areas outdoors (also refer to the new protective housing). Otherwise, their service life could be reduced.

The M-sensor is a mechanical, potential-free membrane switch (passive) for NO (normally open) or NC (normally closed) switching. It features infinitely variable adjustment without scaling.

It is delivered with protective housing and cable gland to prevent corrosion when used outdoors.

TECHNICAL SPECIFICATIONS:

	M-sensors
Max. voltage:	24 V
Switching differential:	approx. 20 % of the final value
Tensiometer connection:	Screw cap GL14
Electrical connections:	Flat plug 6.3 mm
Protection class with protective cap:	IP44

501510xx

	Type M-S10	Type M-S50	Type M-S100
Adjustment range	10 to 50 hPa	50 to 120 hPa	100 to 300 hPa
Article number	50151010	50151050	501510100

TensioSwitch

By taking advantage of the switching output of the TSW, the tensiometer has the full capabilities of an independent tensiostat. Thus, it is an alternative to the M-sensors. The special advantage is the contactless switching, whereby the switching function is electrically designated as "switching to ground" (npn) when the negative pressure rises. The switching status is indicated by a red LED. The switching point is infinitely variable and can be set from approx. 25 to 400 hPa using an adjusting screw.

The special technology utilizes the Hall effect: the suction tension of the tensiometer (negative pressure) is detected using a capsule spring and transmitted to the switching electronics via a magnet. The electrical connection uses a standardized sensor round plug. The brass housing is very robust and splash-proof. It is also covered with a protective cap. The TSW can either switch a solenoid valve (12 or 24 V DC) directly for irrigation (the tensiostat switches on and off) or control a pump via its own relay. A direct connection to automatic irrigation machines (tensiostat switches on, automatic mode switches off) is possible for certain irrigation machines. A small relay (type KR12) is used in the junction box for this.

TSW: Electronic (contactless) switch, as low switch (npn), switching type NO (normally open), switching differential 7 –10 hPa constant, LED to show switching status, power supply 10 – 30 VDC; pressure measurement using capsule spring, brass housing, black

TECHNICAL SPECIFICATIONS:

	TensioSwitch
Switching range:	25 – 400 hPa
Switching differential:	approx. 10 hPa
Power supply:	10 – 30 VDC
Electrical connections:	Plug socket M12x1
Tensiometer connection:	Screw cap GL14

E-sensors

E-sensors are electronic pressure sensors for tensiometers that continually record the negative pressure and, thus, the suction tension of the soil or substrate. The sensors require a power supply and are designed with an analogue current output (4 – 20mA) or analogue voltage output (0.3 – 3.0 VDC), depending on the application.

The pressure sensor is housed in a ventilated plastic enclosure with encapsulated electronics. The sensors are interference-proof according to CE and protected against polarity reversal. The electrical connection is made via an attached cable outlet. The advantage of the E-sensors is their compact form and low weight.

In the application, the E-sensors are connected to digital units such as data loggers, switching gear with analogue unit, PLC (TensioController), or wireless units.

The electronic tensiometers always consist of an E-sensor and the tensiometer base component, which depends on the desired size or insertion depth. The sensor alone only shows the measured value for the zero point without the suction tension. After the E-sensor is screwed onto a prepared tensiometer base and inserted into the soil, the suction tension is then transmitted to a higher-level evaluation system by means of an analogue measuring signal.

The continually acquired measurement data can be used to determine a humidity curve. The humidity curve can then provide information about the water available for the plants. It can be used to optimize and monitor the irrigation settings.

TECHNICAL SPECIFICATIONS:

Power supply:	ES-A:17 to 24 V ES-V: 4 to 15 V ES-3V: 3.3 V
Accuracy:	± 1.5%
Connection:	5 metre attached cable
Cable:	ES-V: 3 x 0.14 mm² ES-A: 2 x 0.14 mm²
Connection Tensio:	Screw cap GL14
Dimensions:	26 x 70 mm
Weight without cable:	20 to 25 g

	Type ES-A	Type ES-V	Type ES-3V
Measurement range			
0 to 500 hPa	501604500	501606500	501608500
0 to 1000 hPa	5016041000	5016061000	5016081000

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Customized solutions

Hand-held measuring device for tensiometers – TensioCheck

Consisting of a manometer and a connectable pressure sensor with a hose connection, this device precisely measures the suction tension or the negative pressure in your tensiometer. The plug-in pressure sensor is equipped with a Luer taper, onto which a disposable cannula can be easily attached with an airtight connection.
A septum is inserted into the lid of the tensiometer base, through which the cannula is pierced at the pressure sensor in order to read the suction tension. The advantage of this hand-held measuring device is that a separate manometer is not required for each tensiometer base component. This enables you to carry out your work while minimizing the usage of sensitive measurement technology. The septum closes by itself after it is pierced with the cannula. One septum lasts for approx. 50 measuring cycles. The customer can easily insert a new septum. Both the tensiometer base, as well as the lid set with septum and spare septa must be ordered separately.

501303

TECHNICAL SPECIFICATIONS:

	Pressure sensor
Sensor:	piezo-resistive pressure sensor
Measurement range:	-1000 to +2000 mbar
Resolution:	1 mbar
Linearity:	±0.2 % FS
Working temperature:	0 ... +50 °C
	Pressure measuring device
Accuracy:	± 0.1% FS at 25 °C
Pressure units:	mbar, bar, Pa, kPa, PSI, etc.
Sensor connection:	1 sensor socket, 6-pin shielded Mini-DIN socket Automatic sensor detection
Power supply:	9 V battery
Battery life:	approx. 120 hours
Dimensions and weight:	142 x 71 x 26 mm (H x W x D) approx. 150 g

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Capacitive sensors

Volume sensors

Volume sensors measure the water content of the soil or substrate in volume fractions; this is displayed as a percentage based on m^3 of water per m^3 of soil or substrate. This is a measurement of soil moisture without any specification on the availability of water (the suction tension of the soil). This is a direct capacitive measurement. The volume sensor, with its probe or electrodes, forms a capacitor with the soil. Its capacitance changes depending on changes in the dielectric property of the soil due to the changing humidity. It should be noted that the dielectric property of the soil is also determined by its structure. The volume sensors must have clearly established contact. Thus, hollow cavities at the sensor must be avoided at all costs. The salt content of the soil also has a small influence on the measurement (lower for SMT 100 than for SMT 50). Optionally, the sensor can be calibrated to the corresponding soil type.

The total water content is measured; for heavier soils (not substrates) this may only be partially relevant for plants. Another difference with the tensiometer is that moisture differences on the measuring surface are output as an average value. Depending on the type of irrigation, this can be advantageous for monitoring purposes.

Measured values (by default): low values = dryness, high values = humidity. The measuring range of the sensors can be chosen up to 100 %, but the saturation value of soils and substrates is usually only in the middle range. Therefore, a measuring range of 0 to 50 % is usually selected.

TECHNICAL SPECIFICATIONS:

	SMT 50
Output signal:	analogue- 0 – 3 V
Power supply:	3.5 – 30 VDC

	SMT 100 /Aquaflex
Output signal:	digital: T-bus, MODbus (RS485) or SDI-12, analogue: 0 – 3 V, analogue: 0 – 10 V, analogue: 4 – 20 mA (without temperature compensation)
Power supply:	4 to 24 VDC

SMT 50 – 501651

Aquaflex – 501665 /7

SMT 100 – 501660 /1

There are differences in the construction of the volume sensors. The FDR sensors usually have 2 to 3 electrodes and are inexpensive. They have a higher frequency so they are sufficiently salt tolerant, but react more sensitively to soil irregularities because of the smaller measuring volume. With the TDR and TDT sensors, the transit time of the signal is measured on the probe. They achieve high accuracy with a large measuring volume and have good salt tolerance, but are generally more complex (more expensive) (particularly the TDR variant). In contrast, TDT sensors have construction advantages that make them more cost-effective with equally good measurement results. Volume sensors are maintenance-free, very stable and suitable for underground installation.

Usage

Volume sensor SMT50: Measures soil moisture according to the FDR principle (Frequency Domain Reflectory) for simple measurements

Volume sensor SMT100: Precisely measures soil moisture according to the TDT principle (Time Domain Transmissometry) and soil temperature. Factory calibrated for medium mineral soil with a measuring range up to 50 %.

Aquaflex: Measures soil moisture according to the TDT principle (Time Domain Transmissometry) for measurements as an average value over the length. This is well suited for row crops with drip irrigation or for lawn irrigation.

	SMT 50	SMT 100	Aquaflex 100/300	
Measurement technique	FDR	TDT	TDT	
Measurement range	0 to 50 vol.%	0 to 50 vol. % factory default 0 to 100 vol.% possible	0 to 50 vol. % factory default 0 to 100 vol.% possible	
	-20 °C to +85 °C	-40 °C to +80 °C (digital) -40°C to +60 °C (analogue)	-40 °C to +80 °C (digital) -40°C to +60 °C (analogue)	
Measurement precision	± 3% in mineral soils	± 3 vol.% in mineral soils ± 1 vol.% for soil-specific Calibration	± 3 vol.% in mineral soils ± 2 vol.% for soil-specific Calibration	
	± 0.8 °C	± 0.4 °C (digital) ± 0.8 °C (analogue)	± 0.4 °C (digital) ± 0.8 °C (analogue)	
Power supply	3.3 – 30 V	4 – 24 V 12 – 24 V (analogue, 0 – 10 V) Typ. 24 V (current sensor)	4 – 24 V 12 – 24 V (analogue, 0 – 10 V) Typ. 24 V (current sensor)	
Dimensions	approx. 13.5 x 2.15 cm	approx. 18.2 x 3 x 1.2 cm	100 x 2 cm	300 x 2 cm
Cable length	10 m	10 m	10 m	10 m
Output signals				
0 to 3 VDC	501651		On request	On request
0 to 10 VDC		501660	501665	501667
4 to 20 mA		501662		
Digital (SDI-12, T-bus, MOD-bus)		501661	On request	On request

SensorMatic 15

Sensor-controlled switching unit for small irrigation systems

The single-channel Sensormatic 15 controller switches a solenoid valve for irrigation depending on the measured soil moisture. This makes it easy to implement indoor greening systems, garden irrigation, as well as greenhouse or outdoor cultivation. The soil moisture is measured with an SMT50 volume sensor at regular intervals. Optionally, a second volume sensor can increase the reliability of the controller and the measuring point. Depending on the power supply, either impulse valves (battery operated), standard solenoid valves or switching relays (with external mains power supplies) can be switched. The functions are operated and set using buttons, rotary switches and DIP switches.

Several options are available for both the start and type of irrigation; the start set points can be specified and two sequence programs (for fixed time and cycle program) can be variably configured. The system can also be operated manually by pressing a button using an on/off switch.

Irrigation takes place either when both flow sensors have reached the set starting point and one flow sensor falls below the set point again, or when the first flow sensor reaches the switching point and until both have reached the set point again. The switch point and duration of irrigation for the valve can be selected as one of 15 intervals. There are two sequence programs available. The fixed time program switches off after a specified duration without repetition. The cycled irrigation program waters using up to three cycles until the desired soil moisture is reached. The sensor's measuring range is monitored and a warning is issued if a value exceeds the range. The system can also be operated manually by pressing a button using an on/off switch. Automatic watering mode ends after 30 minutes or when the current watering stops. Various warning functions are available. These are indicated by flashing LEDs or an optional buzzer. A warning is issued when the normal measuring range is exceeded or not reached, when irrigation is too infrequent (> 100 h) and when the battery is low.

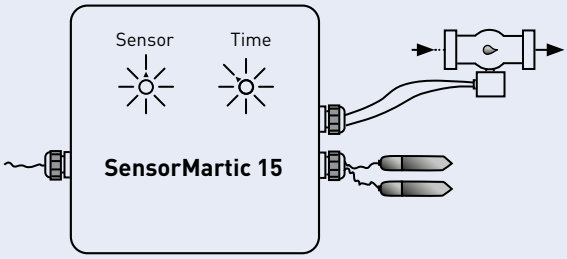
TECHNICAL SPECIFICATIONS:

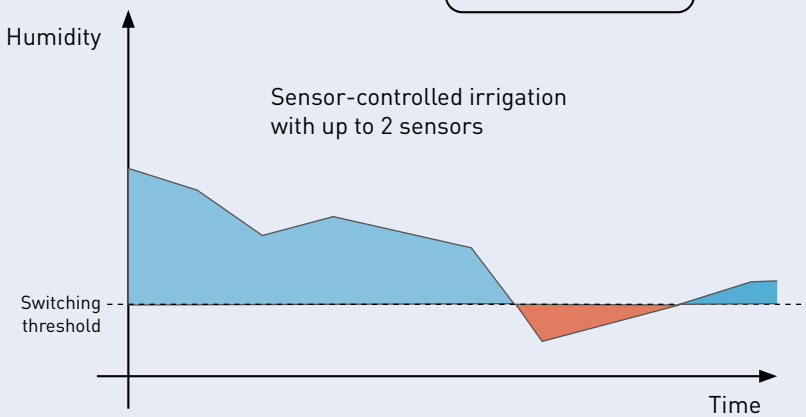
Power supply:	Battery operation: 9 VDC Mains operation: external 24 VDC/230 VAC
Sensor input:	max. 2 Type SMT 50
Switching output:	1
Weight incl. batteries:	approx. 670 g
Dimensions:	Box with cable glands approx. 185 x 145 x 75 mm

501651

Extra features include an additional relay with potential-free switching for AC solenoid valves, an additional release option with thermostat or external float switch, as well as the forwarding of the measured values as analogue signals.

The electronics are mounted in a plastic housing with cable glands for the inputs and outputs. The battery-powered version also includes a battery pack in the lid.
The mains-powered version is supplied with power externally. The electronics are operated with 9 or 24 VDC, which supplies the volume sensors and the solenoid valve.





Product	Article number
Sensormatic 15	501558
Volume sensor SMT 50	501651
Accessories	
Impulse solenoid valve	On request
Solenoid valve	On request
External power supply unit Acoustic alarm	On request

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FFF – Field Humidity Wireless

Using the FFF, measurement data – preferably moisture and temperature in the soil – that is recorded from remote and scattered areas can be transferred directly to your PC or smartphone for monitoring purposes.
This system enables the recording of real-time measurement data and monitoring with the help of a web-based dashboard. Thus, it is ideal for managing both urban facilities and farming operations. The wireless unit itself works with a very long-lasting battery and is waterproof. As such, it can be installed under the floor together with the sensors and is thus protected against vandalism. A special feature is the option to connect several different sensors to one wireless unit. Remote-controlled irrigation can be implemented using further components.

The system set up (installation) is simple. It only consists of connecting the sensors to the wireless unit and inserting the battery.
The dashboard of the Holfuy web service provides a clear user interface for easily viewing the sent measurement data. Measuring intervals can be easily changed, automatic notifications can be set and solenoid valves can be switched at the click of a mouse.

We would be happy to advise you on the best combination of wireless units and sensors for your projects and applications.

TECHNICAL DATA (wireless unit):

Power supply:	3.6 V lithium battery, type LS33600 with 17 Ah capacity
Power consumption:	< 3.5 µA in sleep mode 80 mA LoRa, 500 mA NB-IoT during transmissions
Battery life:	at measuring interval of 4 hours: > 5 years is possible
Measurement interval:	> 30 min to 4 hours, adjustable
Degree of protection:	IP68
Dimensions:	140 x 97 x 97 mm
Weight:	190 g without battery
Operating temperature:	-40 °C to +80 °C

FFF Field Humidity Wireless
Wireless unit for remote monitoring
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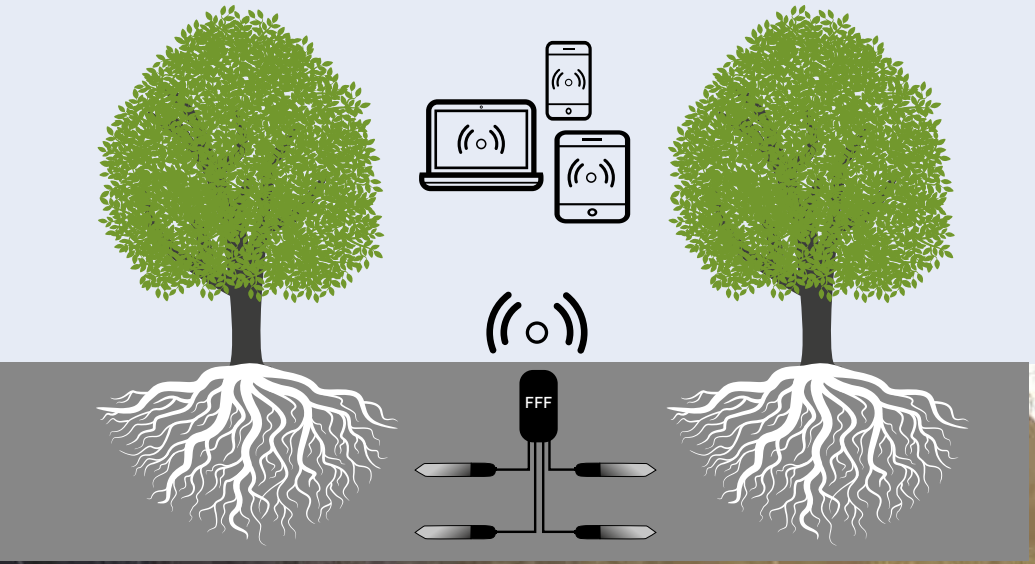


Wireless radio technology	NB-IoT	LoRaWAN
Application range	No need to install your own network. Wireless unit transmits directly via the provider's NB-IoT network	Can be integrated into existing LoRa networks (SmartCity design)
Wireless radio network availability	According to the provider (e.g. Vodafone)	Your own wireless radio network
Range	unlimited	up to 5 km

Connection options

	Measuring soil moisture and temperature	Measuring method
SMT50	low-cost sensor, maintenance-free, under-floor installation	FDR
SMT100	precision sensor, maintenance-free, under-floor installation	TDT
Electronic tensiometers	maintenance-free, above-floor (without temperature measurement)	Suction force
	Flow measurement	
Measuring head for water meter	precise, maintenance-free	inductive
	Controllable units	
Solenoid valve	Bi-stable impulse solenoid valve for connecting to irrigation systems	

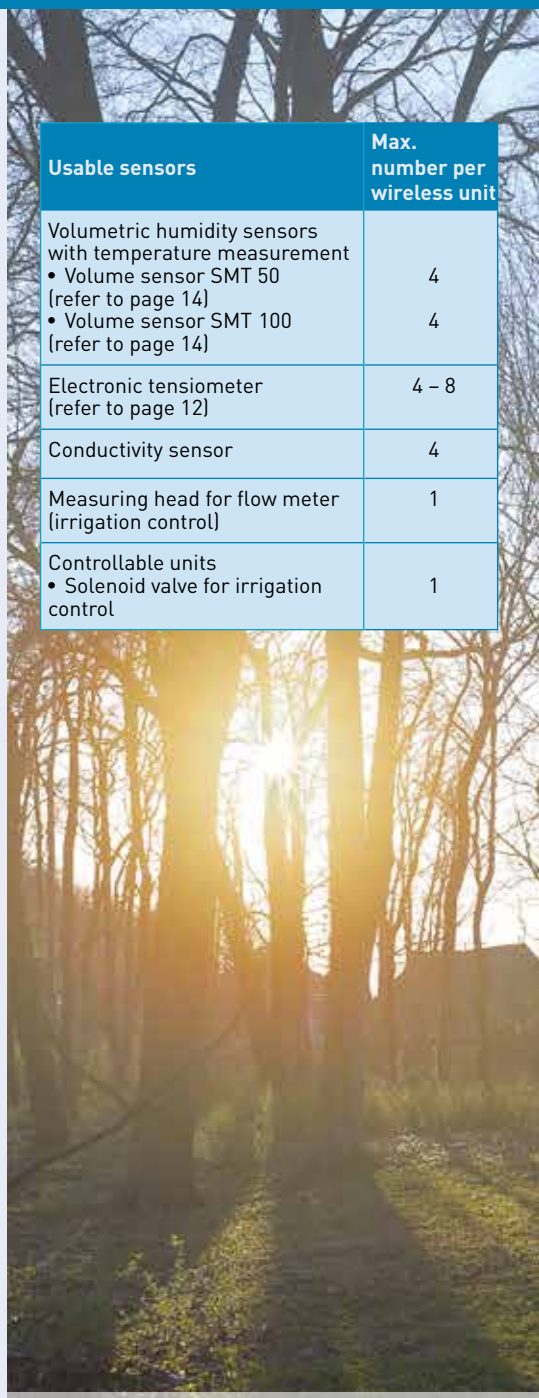
Usable sensors	Max. number per wireless unit
Volumetric humidity sensors with temperature measurement • Volume sensor SMT 50 (refer to page 14) • Volume sensor SMT 100 (refer to page 14)	 4 4
Electronic tensiometer (refer to page 12)	4 – 8
Conductivity sensor	4
Measuring head for flow meter (irrigation control)	1
Controllable units • Solenoid valve for irrigation control	1

Flow meter

Solenoid valve

FFF – Customized solutions for remotely monitoring drain water

In fertigation facilities for gutter and container crops, it is important to avoid dangerous salt accumulation due to uncontrolled or too frequent irrigation.
The amount of drainage depends on many factors and changes frequently. The conditions of the facility, the irrigation intensity, leaf mass and rooting, weather conditions and substrate permeability all have an influence. Time-consuming manual measurements can be replaced by more reliable, automatic monitoring.
Depending on the weather, fertigation should always be carried out in a continuous flow with from 5 % (cloudy) to 20% (sunny) drain water. The conductivity value should also be checked daily to avoid concentrations > 2 mS /cm. A customized solution involving the FFF with a conductivity sensor in the drain water measures continuously. It can also transfer the measured values to a PC or mobile phone.



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TensioController

A sensor-guided irrigation controller for any combination of sensors and valves, with pump activation/control, irrigation start according to sensor and timing, irrigation duration according to time and flow rate, alarms issued at limit values, operate via touch screen and/or remote maintenance via PC or smartphone.

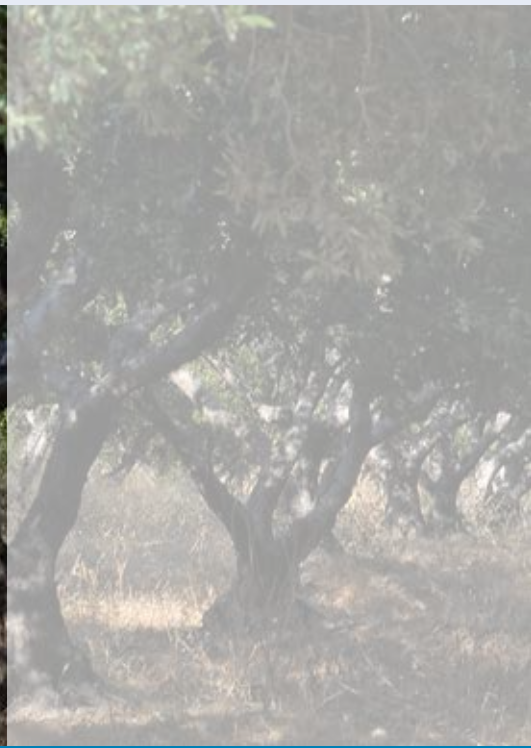
Designs:
Base unit (CPU) + sensor or extension modules in compact housing (small unit) or in corresponding electrical cabinet (various versions) in rail/terminal mounting for cable connections; 24 VDC operations, mains supply.

Configurations:
Multiple combinations, practical small unit: Base unit (CPU) with 8 outputs + 1 module with 6 sensor inputs (partial assignment is also possible). Largest unit: Base unit +14 modules with 120 valve outputs and 48 analogue sensors + additional connections (pump controllers, etc.).

Usage:
Device can be operated using a touch screen, standard size 4.3" (11 cm) or recommended size 7" (18 cm), which is in the housing cover. The easiest remote control method is using a VNC viewer (PC or smartphone) for internet access (VPN) to the router to which the TensioController is connected (Ethernet). The screen contains the display and operating software. The screen server enables it to be shared remotely.

TECHNICAL SPECIFICATIONS:

Screen:	resistive LCD display TFT
Power supply for modules:	Switched-mode power supply 24 VDC
Power supply for sensors:	separate switched-mode power supply 24 or 12 VDC
Output solenoid valves:	potential-free – DC or AC / power supply unit or transformer 24 V max. 24 per module + 16 with extension module
Supply for solenoid valves:	Power supply unit or 24-V transformer
Sensor inputs:	max. 6 per module
Sensor signals:	5 V, 10 V, 4 – 20 mA
Flow measurement:	1 counter input with reed contact
Pump control:	max. 16 pumps via switching output, optionally + relay
Frost monitoring:	1 thermostat input



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Control variables:
Irrigation can be controlled according to the time, soil moisture and irradiation, either individually or in combination, depending on the particular sensor configuration. Analogue tensiometers with E-sensors or volume sensors can be used as the sensors for soil moisture.

Software:
Groups of sensors and valves in 16 sectors, with from 1 to 3 sensors each + max. 8 valves + pump controller, arranged in any configuration. When there are several sensors per sector, the measured value is averaged. Valves and sectors can be operated in serially or in parallel. The irrigation runs according to sensor set-point + time and pause settings. Display with irrigation history, active valve and current measured values. Special task: thermostat-controlled blow-out for pipes during winter irrigation; also suitable for preventing blockages during drip irrigation.

Monitoring:
Limit values for the humidity and pressure for controlling pumps, and for local alarms (individual signal transmitters) or via remote e-mail alarms. Monitoring the irrigation results using measured value monitoring with hysteresis and time settings.
Logging of measured values, irrigation or alarm dates enables extended monitoring functionality; log file can be saved to USB flash drive at the rear of the screen.

Planning specifications for TensioController:

– Number of solenoid valves?
– Power connection?
– IT connection (router)?
– Type of irrigation / water distribution?
– Pump controller for irrigation?
– How should the pumps be switched?
– Type of crop cultivation method?
– Size of the cultivated area, outside or in greenhouse?
– Number of sensors required?

TensioLogger TRL

Using the TensioLogger, you can easily store and read out the measurement data for your volume sensors and tensiometers.

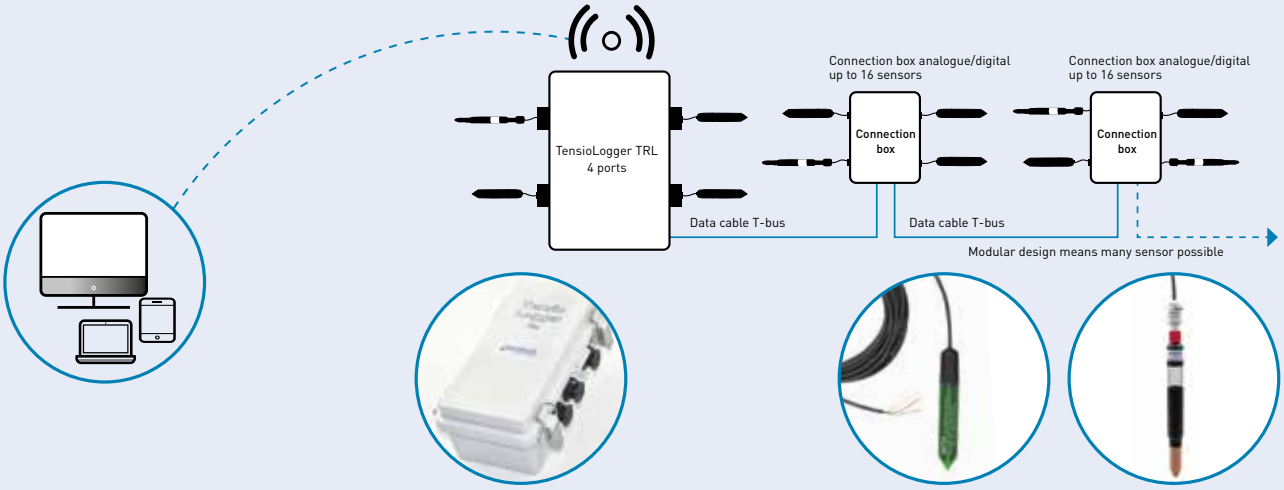
The TensioLogger has 4 digital interfaces. These can either be used to directly connect up to 8 digital sensors or for connecting expansion boxes. Further analogue or digital sensors can then be connected to such expansion boxes. This modular design enables you to simultaneous connect very many sensors to one TensioLogger unit.

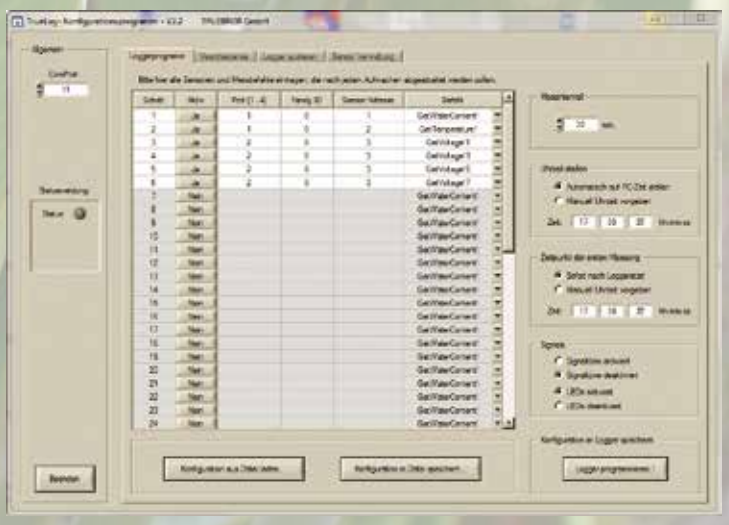
With the digital and the analogue extension boxes, there are two variants available. The digital extension box enables you to connect digital sensors (e.g. SMT100). The analogue version allows you to connect 8 or 16 analogue sensors, such as electronic tensiometers. Suitable software (which is installed on your PC) is provided for changing the TensioLogger settings and exporting the measurement data. The TensioLogger is connected to the PC via the USB cable supplied.

The TensioLogger can be supplied with power via the integrated battery pack; for more stationary use, a mains power connection or a solar module may also be used.

TECHNICAL SPECIFICATIONS:

	TensioLogger TRL
Power supply:	5 – 12 VDC
Power supply:	Battery pack in cover (4x1.5 V mono), optional external 5-VDC power supply or solar panel
Sensor interface:	RS485 (TBUS) up to 50 sensors per logger
Memory capacity:	32 MB for data
Transmission:	2G (4G) modem with SIM card, via FTP protocol
Connections:	1 socket for supply, 2 sockets for sensors, optionally 4 sockets
PC connection:	Adapter cable RS485-USB
Housing:	Plastic (PC), 100x200x70 cm, IP 66





Supplementary products/accessories

Article No.	Product	Article group	Description
501313	Threaded adapter	Extension for tensiometer	from GL14 to BL thread
501312	T-piece	Extension for tensiometer	Connection for two measuring devices
30008068	Replacement battery	Replacement part	for digital manometer
501722	O-ring seal	Replacement part	for digital manometer
501310	O-ring seal	Replacement part	for GL14 screw cap
501303	Lid set for tensiometer	Accessories	One screw cap and septum for TensioCheck
501304	Septum	Replacement part	for TensioCheck

501303

501312

501313

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On Jan. 12022,
PRONOVA Analysentechnik GmbH& Co. KG,
STELZNER®product division, acquired the exclusive products and brand name of the product group "Tensiometer" from Bambach Tensio-Technik GbR.

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